Perth Children's Hospital Kids Bridge

EPA Referral Supporting Document

March 2020

EXECUTIVE SUMMARY

Main Roads Western Australia is proposing to construct a new pedestrian link bridge (Kids Bridge) from the northern green space of the Queen Elizabeth II Medical Centre to Kings Park and Botanic Garden, spanning Winthrop Avenue between Monash Avenue and Aberdare Road (the Proposal). The Perth Children's Hospital Foundation are funding the design and construction of the Kids Bridge to improve access to Kings Park and Botanic Garden. Main Roads Western Australia is managing the design and construction of the Proposal on behalf of the Perth Children's Hospital Foundation. The proposed Kids Bridge has been endorsed by government and is a collaboration between Main Roads, PCHF, Child and Adolescent Health Service, Botanic Gardens and Parks Authority, Queen Elizabeth II Medial Centre Trust and the City of Perth. The purpose of the Kids Bridge is to provide direct and safe access to Kings Park and Botanic Garden for all Queen Elizabeth II Medical Centre users whilst also providing them with a nature based experience and improving the recovery experience.

Main Roads Western Australia is referring the Proposal to the Environment Protection Authority for a decision on assessment under Section 38 of the Environmental Protection Act 1986. The purpose of this document is to provide information to support the decision on assessment of the Proposal.

The Proposal being referred includes the construction of a steel bridge, within a Development Envelope area of 1.35 ha. The Proposal footprint has been developed in close consultation with the Botanic Gardens and Parks Authority to ensure the smallest amount of clearing is required. Up to 0.1 ha of native vegetation will be required to be cleared for the Proposal.

Extensive engagement has been undertaken with key stakeholders, with the Proposal being widely supported by all parties consulted.

Whilst it is considered that the Proposal will not have a significant impact on any key preliminary environmental factors, it is recognised that there may be a high level of public interest in this Proposal, given its location. Environmental impact studies undertaken for the Proposal have considered and assessed potential impacts at both local and regional scales. The results of these assessments have informed the impact assessment and development of mitigation measures.

The Proposal's predicted outcomes have been considered in relation to the environmental principles and the Environmental Protection Authority's environmental objectives for each Key Environmental Factor. A summary of potential impacts, proposed mitigation and outcomes for the identified preliminary key environmental factors of the Proposal are provided in the below table.

Key Environmental Factor – Flora And Vegetation	
EPA objective	'To protect flora and vegetation so that biological diversity and ecological integrity are maintained.'
Policy and guidance	The following policy and guidance documents have been used to inform the Flora and Vegetation factor for the Proposal: • Technical Guidance 'Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA 2016c). • 'Protection of Naturally Vegetated Areas through Planning and Development, Environmental Protection Bulletin No. 20' (EPA 2013). • Environmental Protection (Clearing of Native Vegetation) Regulations 2004. • 'Environmental Guidance for Planning and Development - Guidance Statement No. 33' (EPA 2008). • *Biodiversity Conservation Act 2016* (WA). • *Environmental Protection Act 1986* (WA). • *Botanic Gardens and Parks Authority Act 1998* (WA).
Potential impacts	The Proposal may result in the following direct impacts to flora and vegetation: • Clearing of up to 0.1 ha of native vegetation in Very Good condition, comprising the stated listed Priority Ecological Community, "Banksia dominated woodlands of the Swan

	Coastal Plain Interim Biogeographic Region for Australia", which is also listed as the "Banksia Woodlands of the Swan Coastal Plain" Threatened Ecological Community at the Commonwealth level. • Clearing of up to eight *Jacksonia sericea* (Priority 4) individuals, estimated to represent less than 3% of the individuals within KPBG and less than approximately 0.05 % of the known wider population. • Fragmentation of Regional Ecological Linkages (No. 4 and No. 5). • Loss of vegetation in a Nature Reserve (R1720) and Bush Forever Site No. 317. The Proposal may result in the following indirect impacts to flora and vegetation: • Possible introduction and/or spread of weeds and Dieback to adjacent native vegetation.
Mitigation	Avoid • Selection of a design that fulfils safety objectives within the smallest practicable construction footprint. • Optimising use of 'Cleared' areas for the footprint of the Kids Bridge. Using the cleared landscape has been a key consideration in the selection of the Kids Bridge Conceptual Footprint. • The footprint of the bridge has been carefully positioned to avoid impacts to flora and vegetation where possible. Minimise • Minimisation of clearing footprint through the detailed design process in close consultation with Botanic Gardens and Parks Authority. • Restricting, where possible, clearing of vegetation to the footings of the Kids Bridge and surrounding areas required for safety and work requirements. Pruning will be preferred over clearing where possible. • Where possible, vegetation will be pruned and retained under the Kids Bridge to minimise clearing. • Clearing and pruning of native vegetation within KPBG to be undertaken with supervision with staff from Botanic Gardens and Parks Authority. • A Construction Environmental Management Plan will be implemented to minimise direct and indirect impacts during construction to the surrounding environment. Included will be: o Measures to minimise the risk of over-clearing, such as clear demarcation of clearing areas. o Development of a Hygiene Management Plan including standard hygiene measures are implemented to ensure Dieback and weeds are not introduced and/or spread to adjacent vegetation. o Management measures to avoid accidental bushfire to surrounding areas of native vegetation. • KPBG will continue to implement weed management within the vegetation surrounding the Kids Bridge, including management of Declared Pests. Rehabilitate • Rehabilitation and revegetation using suitable native species in disturbed areas where possible following construction.
Outcome	Residual Impact • Permanent loss of up to 0.1 ha of vegetation in Very Good condition. • Permanent loss of up to 0.1 ha of Priority Ecological Community 'Banksia dominated woodlands of the Swan Coastal Plain IBRA Region' (Priority 3) which is listed as a Threatened Ecological Community at the Commonwealth level. • Loss of up to eight *Jacksonia sericea* (Priority 4) individuals. Offset Residual impacts are not considered significant. Offsets are not required for this factor. Summary

	By selecting an alignment for the Proposal that minimises impacts to flora and vegetation, as well as implementing mitigation measures to address potential impacts, it is expected that the EPA's objective to protect flora and vegetation so that biological diversity and ecological integrity are maintained, will be met.
Key Environmental Factor – Terrestrial Fauna	
EPA objective	'To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.'
Policy and guidance	The following policy and guidance documents have been used to inform the Terrestrial Fauna factor for the Proposal: • Environmental Factor Guideline 'Terrestrial Fauna' (EPA 2016d). • Technical Guidance 'Sampling Methods for Terrestrial Vertebrate Fauna' (EPA 2016e). • Technical Guidance 'Terrestrial Fauna Surveys' (EPA 2016f). • Technical Report: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region (EPA 2019). • *Biodiversity Conservation Act 2016* (WA). • *Environmental Protection Act 1986* (WA) • *Botanic Gardens and Parks Authority Act 1998* (WA).
Potential impacts	The Proposal may result in the following direct impacts to fauna: • Clearing of up to 0.1 ha of potential fauna habitat. • Clearing of up to 0.1 ha of Black Cockatoo (Carnaby's Cockatoo - Endangered and Forest Red-tailed Black Cockatoos - Vulnerable) known foraging habitat. No known roosting trees nor breeding trees will be impacted. Impacts to 0.1 ha of suitable foraging vegetation represents approximately 0.01% of available foraging habitat within a 12 km radius. The Proposal may also result in indirect impacts to fauna including: • Habitat fragmentation. • Spread of weeds and Dieback into the surrounding fauna habitat. • Disruption to fauna during construction activities.
Mitigation	Avoid • Selection of a design that fulfils safety objectives within the smallest practicable construction footprint. • Optimising use of 'Cleared' areas for the footprint of the Kids Bridge. Using the cleared landscape has been a key consideration in the selection of the Kids Bridge Conceptual Footprint. • The footprint for the Kids Bridge has been carefully positioned to avoid impacts where possible. This has included the avoidance of large trees and quality Black Cockatoo foraging habitat through the design process. Minimise • Minimisation of clearing footprint through the detailed design process in close consultation with Botanic Gardens and Parks Authority. • Restricting, where possible, clearing of vegetation to the footings of the Kids Bridge and surrounding areas required for safety and work requirements. Pruning will be preferred over clearing where possible. • Clearing and pruning will be undertaken with supervision with staff from Botanic Gardens and Parks Authority. • Development of a Construction Environmental Management Plan to define techniques to minimise risks to native fauna and provide monitoring during construction. • Dust, noise and vibration management measures as outlined in a project specific Construction Environmental Management Plan.
Outcome	Residual Impact Potential impacts to significant fauna is not considered notable or of consequence due to the modest disturbance and small scale of impacts in the context of the surrounding environment. No breeding or roosting trees will be impacted and the amount of foraging habitat loss is not considered significant when assessing impacts in a local and regional context.

	Offset As residual impacts are not considered significant, offsets are not required for this factor. Summary The footprint selected for the Proposal minimises impacts to fauna and, with implementation of proposed mitigation measures, the EPA's objective for fauna will be met.
Key Environmental Factor – Social Surroundings	
EPA objective	'To protect social surroundings from significant harm.'
Policy and guidance	The following policy and guidance documents have been used to inform the social surroundings factor for the Proposal: • Environmental Factor Guideline 'Social Surroundings' (EPA 2016h). • Guidance for the Assessment of Environmental Factors 'Assessment of Aboriginal Heritage No. 41' (EPA 2004). • *Aboriginal Heritage Act 1972* • Environmental Protection (Noise) Regulations 1997
Potential impacts	In the absence of suitable mitigation measures, construction of the Proposal could potentially result in the following impacts to social surrounding: • Aboriginal Heritage Site disturbance during clearing and/or excavation works. • Reduced visual amenity during construction. • Noise impacts to sensitive receptors, from noise emissions generated by construction activity within the Development Envelope (equipment and vehicle operation). No operational impacts from the Proposal are expected.
Mitigation	Avoid • No construction outside normal working hours (7am to 7pm Monday to Saturday) without approval from the City of Perth. Minimise • Any potential risk to sites of Aboriginal heritage significance will be managed through the CEMP and consultation with all relevant groups. • Minimise noise, vibration and dust along with short term impacts to visual amenity through implementation of a Construction Environmental Management Plan.
Outcome	Residual Impact The Development Envelope has been assessed for heritage significance through surveys. No heritage matters of significance will be impacted by the Proposal. Construction of the Proposal is likely to result in minor short-term impacts to visual and noise amenity. Summary Construction and operation of the Proposal is likely to result in minor temporary impacts to visual and noise amenity during the construction phase of the Proposal and no residual social impacts are expected. The Kids Bridge is expected to enhance the visual amenity of the area. It is expected that the EPA objective for Social Surroundings will be met.

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Document Records

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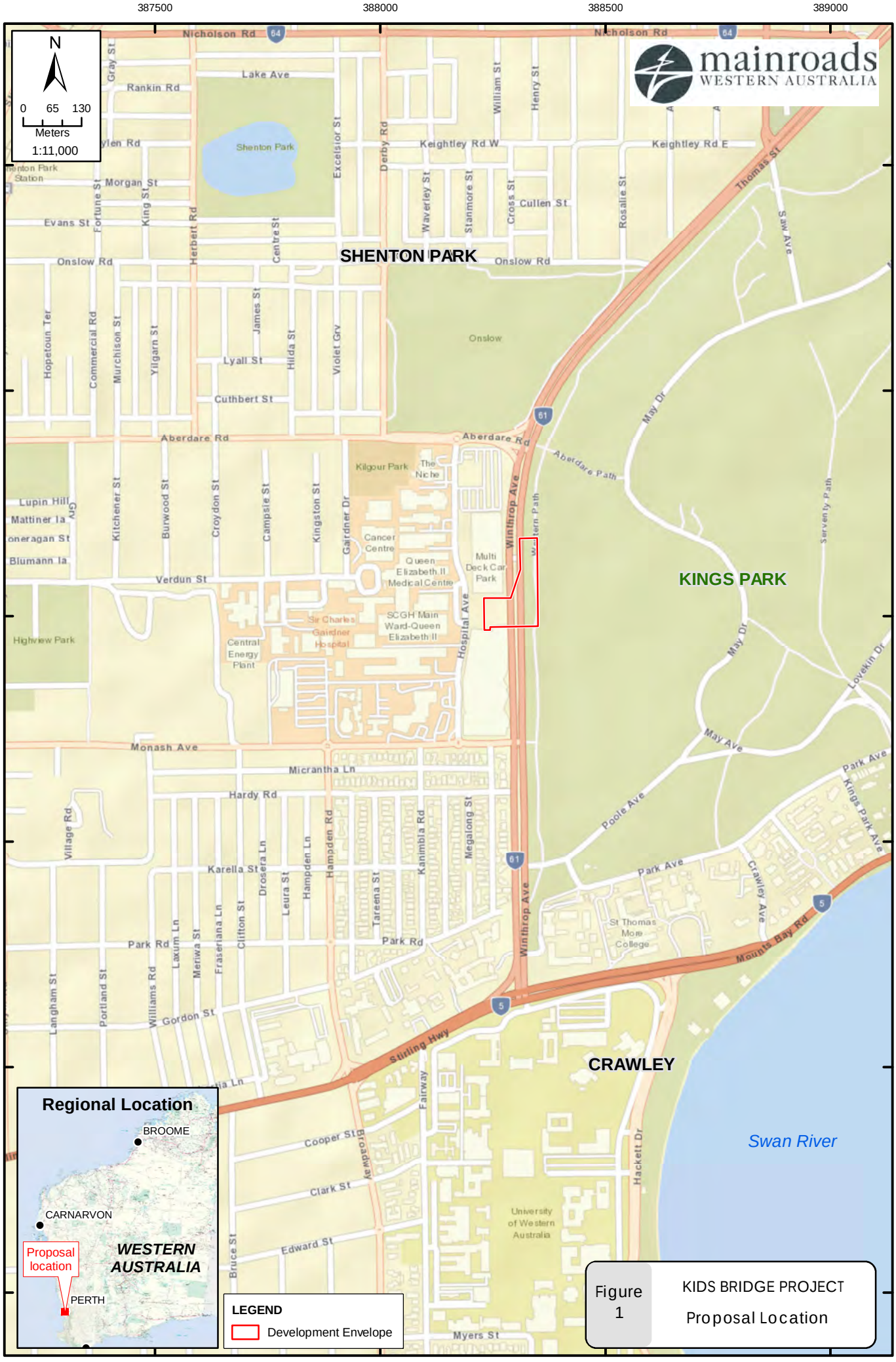
Author:	Amy Dalton Environment Officer, Main Roads Western Australia	Rev 0	27/03/2020

1 INTRODUCTION

Main Roads Western Australia (Main Roads) is proposing to construct a new pedestrian link bridge (Kids Bridge) from the northern green space of the Queen Elizabeth II Medical Centre to Kings Park and Botanic Garden (KPBG) (Proposal). The Kids Bridge was initiated by the Perth Children's Hospital Foundation (PCHF) and will span Winthrop Avenue between Monash Avenue and Aberdare Road. The Kids Bridge has been endorsed by government and is a collaboration between Main Roads, PCHF, Child and Adolescent Health Service (CAHS), Botanic Gardens and Parks Authority (BGPA), Queen Elizabeth II Medial Centre (QEIIMC) Trust and the City of Perth. The purpose of the Kids Bridge is to provide direct and safe access to KPBG for all QEIIMC users whilst also providing a nature based experience and improving the recovery experience.

The Proposal being referred includes the construction of a steel bridge, within an area of up to 1.35 ha (Development Envelope) (Figure 1). The footprint for the Proposal has been developed in close consultation with BGPA and involves the clearing of up to 0.1 ha of native vegetation (Figure 2).

Main Roads is managing the design and construction of the Proposal on behalf of PCHF. Intensive consultation is ongoing with BGPA and PCHF regarding the design and construction methods. On 25 February 2020, the BGPA Board provided in-principle support of the Proposal and the conceptual design. With full BGPA support, Main Roads is planning to commence the construction of the Kids Bridge in late 2020. A formal agreement will be developed between BGPA and Main Roads outlining the roles and responsibilities, and access, construction and rehabilitation requirements relating to the Kids Bridge.



Document Path: Y:\Metropolitan Region\Environment\Project Files\Kings Park - Childrens' Hospital Pedestrian Bridge\GIS and Shapefiles\Mxds\Kings Park Bridge_RegionalLocation_v1.mxd
Source: Aerial image: ESRI Basemap 2010.
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Document Path: Y:\Metropolitan Region\Environment\Project Files\Kings Park - Childrens' Hospital Pedestrian Bridge\GIS and Shapefiles\Mxds\Kings Park Bridge_ConceptDesign_v1.mxd
Source: Aerial image: Skyview 2020. Conceptual Design: x60612387-br-PCHF-PLAN.dwg
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1.1 Purpose of this Document

Main Roads is referring the Kids Bridge Proposal to the Environmental Protection Authority (EPA) for a decision on assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The purpose of this document is to support that referral. This document provides information on the Proposal activities, potential environmental impacts and proposed mitigation measures associated with construction and operation of the Kids Bridge Proposal.

This document has been prepared in accordance with Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a) and Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2018a).

1.2 Project Description

The Proposal is located in the City of Perth within the Metropolitan Region of Western Australia. Main Roads is proposing to construct a new pedestrian bridge spanning over Winthrop Avenue linking the northern green space of the QEIIMC to KPBG (Figure 1).

The area being referred by Main Roads for the construction of the Kids Bridge includes a 1.35 Development Envelope.

The Development Envelope contains a total of 0.63 ha of native vegetation and 0.14 ha of parkland cleared and non-native planted vegetation. The remaining 0.58 ha (43%) of the Development Envelope consists of cleared land).

1.3 The Proponent

Proponent	Commissioner of Main Roads Western Australia PO Box 6202 East Perth WA 6002 ABN/CAN 50 860 676 021
Proposal Key Contact	Martine Scheltema Manager Environment of Main Roads Main Roads Western Australia Don Aitken Centre

1.4 Environmental Impact Assessment Process

1.4.1 Environmental Protection Act 1986, Part IV Environmental Impact Assessment

The Proposal will be referred under Part IV of the EP Act, which is the primary legislation governing environmental protection and impact assessment in Western Australia (WA). Division 1 of Part IV of the EP Act provides for the referral and assessment of significant and strategic proposals.

Although Main Roads does not believe the impacts of this proposal are significant, and the proposal is widely supported by the community, Main Roads has decided to refer the Proposal under Part IV of the EP Act given the commitments made to stakeholders during the planning process.

1.4.2 Environmental Protection and Biodiversity Conservation Act 1999

A proposed action that may have a significant impact on a Matter of National Environmental Significance (MNES) requires approval from the Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Impacts associated with the implementation of this Proposal are not considered significant, therefore Main Roads does not intend to refer the Proposal to the Department of Agriculture, Water and the Environment (DAWE) (formerly known as Department of the Environment and Energy) under the EPBC Act. Further details on potential MNES within the Development Envelope are provided in Sections 4.3, 4.4 and 6.

1.4.3 Other Approvals and Regulation

Following primary environmental approval of the Proposal under Part IV of the EP Act, additional regulatory approvals may be required to develop and operate the Proposal. These are summarised in Table 1.

Table 1: Summary of Other Regulatory Approvals Required

Proposed Activities	Type of Approval	Regulatory Agency	Legalisation Regulating the Activity
Sourcing of construction water	Licence to take^	DWER	*Rights in Water and Irrigation Act 1914 (RIWI Act)*
Development Application	Application for works within a Bush Forever site	Western Australian Planning Commission	*State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region*
Clearing of Native Vegetation (if not assessed under Part IV of EP Act)	Application for a permit to approve clearing of native vegetation*	DWER	*Part V of the Environmental Protection Act 1986 (EP Act)*

* Required if not assessed by EPA
^ Only required if agreement to access and use landowner water sources not reached.

1.4.3.1 Planning approvals

A Development Application for the Bush Forever site will be submitted to the Western Australian Planning Commission (WAPC) after review by the City of Perth. Prior to submission of a Development Application, consent will be sought from QEIIMC Trust and the BGPA board.

1.4.4 Decision Making Authorities

The authorities listed in Table 2 have been identified as decision making authorities (DMAs) for the Proposal.

Table 2: Decision Making Authorities for the Proposal

Decision Making Authority	Relevant Legislation
Minister for Planning	*Planning and Development Act 2005*
Western Australian Planning Commission	*Planning and Development Act 2005*
Botanical Gardens and Parks Authority	*Botanical Gardens and Parks Authority Act 1998*

2 THE PROPOSAL

2.1 Proposal Benefits

Accessing KPBG from the Perth Children's Hospital site is currently not easy. There are two main pedestrian crossings from the QEIIMC campus to KPBG. The first crossing is at the far northeast corner of the eastern car park and requires pedestrians to cross nine lanes of traffic in order to access parklands. The second crossing is at the far southeast corner of the eastern car park and requires pedestrians to cross eight lanes of traffic in order to access KPBG.

The Kids Bridge will connect to existing KPBG dual-use paths, running parallel to Winthrop Avenue and will provide access through to the May Avenue Parkland. On the QEIIMC campus, the Kids Bridge will connect into the elevated section of the Northern Green Space between the Perth Children's Hospital and the multi-deck car park.

During planning stages for the new Perth Children's Hospital, the Children's Advisory Committee identified access to KPBG via a bridge as a key facility for consideration. The importance of the respite opportunity was cited along with the benefit of a sense of normality that a trip to KPBG via a journey on an iconic bridge would give children, particularly those who are frequent or long-term patients. Children and their families currently have limited opportunities to escape the rigours of medical treatment and the clinical environment to enjoy much needed respite and distraction when at the Perth Children's Hospital site. The construction of a pedestrian bridge that connects the Northern Greenspace directly adjacent to the Perth Children's Hospital site to KPBG will provide direct and safe access for patients and their families with respite from the hospital and assist in maintaining the psychological wellbeing of families dealing with childhood health issues.

QEIIMC campus staff, many of whom work in highly demanding and stressful jobs, would also benefit from the wellbeing and fitness activities as the Kids Bridge would provide them with a greater opportunity to escape their work environment.

The proposed Kids Bridge highlights the value of KPBG to the community and the health benefits the KPBG delivers. KPBG hosts a diverse range of events and activities, with May Avenue Parkland having a variety of attractions for children situated just 600 m from the hospital boundary on Winthrop Avenue, which would provide patients with not only entertainment but a sense of normality and much needed connection with the wider community. The Kids Bridge is aligned with the values, service function and vision of KPBG, and is referred to in the KPBG Management Plan (BGPA 2014).

Other benefits for the patients, their families and supporters, and the QEIIMC staff include:

- Clinical opportunities could be realised to use inclines of the bridge in Gait Therapy, Physiotherapy and Occupational Therapy (e.g. learning to use crutches / wheelchairs on different terrain and inclines).
- KPBG could be utilised in an educative manner for the patients at the Perth Children's Hospital including raising environmental awareness.
- Easy use of KPBG will provide patients on campus with ample space and opportunity to visit with their pet, where allowed. This was nominated as a high priority by the Perth Children's Hospital Youth Advisory Committee in place at the time the new hospital was being designed.
- Health benefits will be realised for campus staff through increased cycling and pedestrian travel to work, and the ability to use the park for fitness, lifestyle and work break activities.

2.2 Key Proposal Characteristics

The Development Envelope incorporates an area of up to 1.35 ha, of which 43% is comprised of cleared land. The remaining 47% of the Development Envelope consists of native intact vegetation (within KPBG) and 10% Parkland Cleared and planted areas (within the median strip of Winthrop Avenue).
The PCHF have committed to funding the proposed Kids Bridge in partnership with Main Roads, who will deliver the detailed design, construction and ongoing maintenance of the bridge. The Proposal involves a predominately steel structure featuring a single span over Winthrop Avenue connecting Hospital Avenue on the QEIIMC campus with the May Avenue Parkland located in KPBG. The Kids Bridge footprint within KPBG has been designed to have the least possible impact on native vegetation. The Kids Bridge is predominately a steel structure with a concrete deck and abutments.

In addition to the Kids Bridge, at the request of BGPA, the Proposal also includes the construction of a raised walkway located approximately 50 north of the bridge site. This raised walkway will be constructed to link the Western Path to the shared path on Winthrop Avenue between the bridge landing and to the QEIIMC carpark intersection. A raised walkway has been requested by BGPA to minimise impacts to vegetation. The exact location of the walkway is yet to be finalised with consultation continuing with BGPA to ensure the alignment avoids significant trees and has the least impact to groundcover.

The Development Envelope will accommodate the construction works area and the Kids Bridge and walkway infrastructure. The actual amount of disturbance required to complete the construction of the Proposal will be substantially less than the area currently depicted as the Development Envelope as a 1 m buffer has been applied to the design, depicted by the Conceptual Footprint in Figure 2. The final disturbance footprint will be defined (and reduced wherever possible) during the detailed design stage.

Key Proposal characteristics are presented in Table 3.

Table 3: Key Proposal Characteristics

Proposal Title	Perth Children's Hospital Kids Bridge	
Proponent Name	Commissioner of Main Roads Western Australia	
Short Description	The Proposal is to construct a new pedestrian link steel bridge from the northern green space of the Queen Elizabeth II Medical Centre to Kings Park and Botanic Garden.	
Element	**Location**	**Proposed Extent**
Physical elements		
Kids Bridge construction and associated infrastructure	Figure 1, Figure 2	Clearing or disturbance within a 1.35 ha Development Envelopment of: • Up to 0.1 ha native vegetation.
Operational elements		
Constructed Kids Bridge		Operate the Proposal using standard management and maintenance practices.

2.3 Proposal Stages

2.3.1 Design

The concept design provides for the construction of a new steel pedestrian bridge across Winthrop Avenue.

The Proposal will include, but is not limited to, the following key design components:

- Steel piers and concrete footings
- Abutments
- Concrete deck

- Walkway surface
- Feature uprights
- Lighting – functional and decorative
- Handrail details
- Drainage

The general alignment of the proposed bridge has already undergone several iterations based on advice from BGPA to minimise the impact to vegetation. The footprint of the 15% design was pegged on site and walked through with representatives from BGPA, Main Roads and the design team. Specific changes were made to the landing to be tied in further north and additional minor adjustments to avoid impacts to Marri and Jarrah tree roots. On 25 February 2020, the BGPA Board provided in-principle support of the Proposal and 15% design.

2.3.2 Construction

Construction is planned to commence in late 2020 and is expected to take approximately 6 months to complete. The construction methods for the structure will depend on the form of the final design.

It is anticipated that the Kids Bridge will be fully fabricated offsite and transported in manageable lengths. The fabricated sections would include both girders connected with the steel plate and transverse cross beams that support the concrete deck, the barrier rails and the steel uprights. The concrete deck would be cast in-situ in one pour after the bridge is fully continuous along the full length of the deck. Construction methodology will be discussed with BGPA upon completion of the design phase.

Any fill required for the bridge abutments will be certified clean fill. Requirements for fill used in KPBG will be determined in consultation with BGPA.

Any required lay down areas for material storage and site compounds will be established by the contractor in consultation with Main Roads, BGPA, QEIIMC Trust and the City of Perth. Where possible, existing cleared areas will be utilised.

The construction of the Kids Bridge will be managed by a Construction Environmental Management Plan (CEMP) that will be developed in close consultation with BGPA to minimise the risk of any adverse impacts to KPBG and the surrounding environment. The CEMP will stipulate contractual compliance requirements and operational controls for aspects such as clearing methods, fauna management, induction requirements, incident response and auditing. The CEMP will be approved by BGPA representatives prior to the commencement of works.

2.3.3 Operation

The Kids Bridge will provide direct and safe access for pedestrians to and from KPBG. The Kids Bridge will be subject to routine maintenance after construction to preserve the condition of the bridge. Formal agreements will be finalised with QEIIMC Trust and BGPA that outline access requirements for maintenance and ongoing operation of the bridge. Main Roads will retain ownership of the bridge and will be responsible for all future funding, inspection and maintenance. Maintenance operations will be confined to the bridge structure and may include drainage cleaning, pruning of vegetation and debris clearing.

2.4 Alternative Options Considered

A number of options have been considered as part of planning considerations for the Kids Bridge. The Kids Bridge design and alignment has been selected in order to minimise impacts on vegetation within the Proposal footprint, including any clearing required to facilitate construction activities. This has resulted in the selection of an alignment that provides the lowest environmental impact.

Options considered as part of planning considerations for the Kids Bridge are detailed below.

2.4.1 Level Crossing

A level crossing was not considered a suitable alternative for the Proposal. Access would still require pedestrians, including children who may be unwell, to have an interface with a busy road network. A bridge was selected as the preferred option by the PCHF, prior to handover of the Proposal to Main Roads, as it would provide an enjoyable, safe and accessible experience for those visiting KPBG.

2.4.2 Pedestrian Bridge Attached to the QEIIMC Building

A potential option for the Proposal was a bridge that was connected to the QEIIMC building. This option was rejected by PCHF as it caused safety and security control issues from people being able to enter QEIIMC directly, with 24 hour access. It was also not possible to gain permissions to construct and deliver within the timeframe of delivery for the QEIIMC (see Section 2.4.4).

2.4.3 Pedestrian Bridge Aligned with Existing Cleared Track Designated for Rehabilitation

An alternative alignment for the Kids Bridge was considered during the early design stage. Directly opposite from the QEIIMC northern green space within KPBG, is a cleared access track that has been closed by BGPA for rehabilitation. It was proposed to BGPA that the bridge be designed within the already cleared area. BGPA did not support this Proposal as rehabilitation of the track to reconnect habitat within KPBG was considered a priority.

2.4.4 Planning History

The Kids Bridge was initially proposed to be delivered by the Department of Health (DoH) in conjunction with the construction of the Perth Children's Hospital (PCH). A full architectural design was developed for the bridge in 2014. However, due to the delays with PCH construction, the bridge was postponed so that the focus could be placed on opening PCH.

When DoH recommenced planning activities for the bridge, a few key issues were faced, including available funds and bridge ownership. The available funds were not sufficient to deliver the 2014 design and the stakeholders involved were not comfortable taking on the ownership of the bridge including ongoing maintenance.

In late 2019, Main Roads agreed to take over responsibility of the bridge from DoH including the design, construction and ongoing bridge ownership. Main Roads commissioned a revised concept design based on the initial architectural DoH design featuring simplified sections and scaled back features. This concept provided a more affordable and constructible design which was used as an example for tender submissions for the detailed design. AECOM, a design consultant, have now been engaged to complete the detailed design phase of the Proposal.

The bridge design and alignment has been selected in order to minimise impacts on vegetation within the bridge footprint, including any clearing required to facilitate construction activities. This has resulted in the selection of an alignment that results in the lowest environmental impacts.

3 STAKEHOLDER ENGAGEMENT

Stakeholder engagement has been undertaken in association with concept designs and planning work from 2014. Discussions were primiarly limited to government agencies and the PCHF given the infancy of the project. Stakeholder engagement was reinitiated in 2019 when Main Roads took over management of the project. A Steering Committee and Working Group was formed for the Proposal to ensure that the goals and priorities of key stakeholders were considered.

3.1 Steering Committee

A Steering Committee was formed to provide overarching guidance and support in the development of the Kids Bridge. The committee provides input and decision making at a strategic level in line with the goals and priorities of key stakeholders.

The responsibilities of the Steering Committee are to:

- Provide strategic advice and direction for the development of the Proposal through the delivery stage.
- Consider recommendations on all relevant Proposal matters including the design gate stage and significant variations in scope, cost or time.
- Ensure that the development of the Proposal meets key performance outcomes including community and key stakeholder requirements.
- Ensure that appropriate communication, engagement and collaboration with key stakeholders is undertaken.
- Ensure options are exlored to minimise the financial costs while maximising the net benefit to the community.
- Consider other matters raised by the committee members of key stakeholders.

The members of the Steering Committee for the Proposal are presented inTable 4.

Table 4: Steering Committee Members

Organisation	Title
Main Roads Western Australia	Managing Director
	Executive Director Metropolitan and Southern Regions
Perth Children's Hospital Foundation	Chief Executive Officer (CEO)
Queen Elizabeth II Medical Centre Trust	Director
Botanic Gardens and Parks Authority	Executive Director
Department of Treasury	Principal Policy Advisor
Department of Health	Executive Director Infrastructure and Major Capital Projects
Office of the Government Architect	Western Australian Government Architect
Perth Children's Hospital	Executive Director Child and Adolescent Health Service

3.2 Working Group

The purpose of the Working Group has been to provide direction and support in the development of the Kids Bridge. The Working Group provides input and recommendations to the Steering Committee to ensure that the goals and priorities of key stakeholders are realised.

The Working Group will provide oversight of the implementation of the Proposal by a Project Team established within Main Roads.

The responsibilities of the Working Group are to:

- Provide support from the member organisations in order to achieve the level of corporation and collaboration required for successful delivery of the Proposal.
- Review key aspects of the design at design gate stages.
- Monitor the financial status of the Proposal.

- Provide recommendations to the Steering Committee regarding Proposal decisions involving scope, cost and time implications.
- Report to the Steering Committee on key Proposal milestones.
- Endorse the terms of an agreement for operational and maintenance purposes.

The members of the Working Group for the Proposal are presented in Table 5.

Table 5: Working Group Members

Organisation	Title
Main Roads Western Australia	Director Metropolitan Operations
	Project Director
	Project Manager
	Asset Manager
	Manager Environment
Perth Children's Hospital Foundation	Head of Corporate Services
Department of Health	Project Manager
Kings Park and Botanic Garden	Director of Horticulture and Conservation
Child Adolescent Health Service	Project Manager Infrastructure
Chris Watts	Manager Transport
Office of the Government Architect	Senior Architecture Officer
Main Roads Western Australia	Project Manager

3.3 Recent Stakeholder Engagement

Stakeholder and community engagement is continuing within the local community, local government authorities and State Government agencies. Recent stakeholder engagement is provided in Table 6.

Table 6: Summary of Stakeholder Engagement

Stakeholder	Date	Consultation type/topics discussed	Outcome
PCHF	30/08/2019	Main Roads managing the project.	Project named Kids Bridge.
Working Group	20/09/2019	Terms of reference, concept design, design brief items.	Changes required to draft design brief.
EPA	11/10/2019	Referral of the Proposal to the EPA.	Decision made to refer Proposal to EPA in 2020.
Working Group	29/10/2019	Operation responsibilities, outline of design process.	Proceed with design tender.
Working Group	22/11/2019	Submissions from design tender.	Preferred designer to be recommended to Steering Committee.
Steering Committee	26/11/2019	Project governance, project status, design submissions.	Recommended designer endorsed.
PCHF, QEIIMC Trust, Child and Adolescent Health Services (CAHS)	13/12/2019	Footprint in green space area, design specifics.	Minor changes to footprint prior to 15% design submission.
BGPA	17/12/2019	Impact on vegetation, preferred alignment.	Alignment iterations produced in an attempt to reduce environmental impacts.
PCHF	14/01/2020	Funding agreement discussion.	Draft agreement to be amended.
Working Group	28/01/2020	Additional stakeholders, comms, design items.	15% design reviews.
Whadjuk People Native Title Claim Group	24/02/2020	Aboriginal heritage survey and discussion undertaken.	Further Involvement of Traditional Owners in design process.
BGPA Board	25/02/2020	BGPA Board meeting and site visit. Key design features, steps taken to minimise	Endorsement of the Kids Bridge received from BGPA board on 05/03/2020.

Stakeholder	Date	Consultation type/topics discussed	Outcome
		disturbance to significant vegetation and bridge ownership discussed.	
Urban Bushland Council	05/02/2020	Initial phone and email correspondence.	Consultation meeting arranged.
Urban Bushland Council	20/03/2020	Briefing on key project features.	Key design features and steps taken to minimise environmental impacts discussed.

3.3.1 Perth Children's Hospital Foundation

The PCHF raises funds for the hospital to assist it in accessing new technologies, treatments, facilities and expertise. The PCHF are funding the design and construction of the bridge to provide a safe linkage to KPBG.

A meeting with PCHF was held on 13 December 2019 with representatives from Main Roads, QEIIMC Trust, Child and Adolescent Health Service and the project designers.

The primary interest of PCHF is ensure the bridge provides a safe linkage to KPBG, that is also aesthetically pleasing. PCHF have been involved at all stages of the design and are part of the Working Group that was formed for the project.

3.3.2 Queen Elizabeth II Medical Centre Trust

The QEIIMC Trust is responsible for the development, management and control of the land that the Perth Children's Hospital and Green Space Area, where part of the Kids bridge will be built on.

3.3.3 Child and Adolescent Health Service

CAHS provides a comprehensive service supporting health, wellbeing and development of young Western Australians. In the context of this project, CAHS oversee the safety requirements and operation of the Perth Children's Hospital where many of the bridge users are expected to travel from and to.

3.3.4 City of Perth

City of Perth is the Local Government Authority associated with this project and will review and recommend the project Development Application to WAPC. Particular areas of interest for City of Perth are the landscaping/verge assets, vegetation removal/pruning, pedestrian facilities and cycleways.

3.3.5 Botanic Gardens and Parks Authority

The BGPA are responsible for the management of KPBG under the *Botanic Gardens and Parks Authority Act 1998*.

BGPA's primary interest lies in minimising the impact of the native vegetation within the Development Envelope. This requires the selection of an alignment which will result in the lowest impact to native vegetation and fauna habitat.

3.3.6 Office of the Government Architect

The Office of Government Architect (OGA) provides strategic advice to government agencies to improve the design of public spaces and enhance the quality of the built environment. OGA has been involved in reviewing the bridge design to assist in ensuring positive outcomes for the wider community. The OGA are part of the Working Group and Steering Committee formed for the Proposal.

3.3.7 Whadjuk People Native Title Claim Group

An Aboriginal heritage survey was undertaken with the Whadjuk People Native Title Claim Group and Archae-aus. The survey included both archaeological and ethnographical components. No

new archaeological Aboriginal Sites or isolated cultural material were identified during the course of the survey. The Whadjuk People Native Title Claim Group will be involved in the detailed design process for the Kids Bridge.

3.3.8 Urban Bushland Council

Engagement was initiated with the Urban Bushland Council in February 2020. A response meeting was undertaken on 20 March 2020, resulting in a discussion on key design features and steps taken to minimise environmental impacts.

4 ENVIRONMENTAL PRINCIPLES AND FACTORS

4.1 Principles

Section 4A of the *Environmental Protection Act 1986* (EP Act) establishes the objectives and principles of the EP Act. In accordance with the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b), this section describes how each of the five principles of the EP Act has been applied to the Proposal (Table 7).

Table 7: *Environmental Protection Act 1986* Principles

No.	Principle	Consideration of Principle in the Proposal
1	The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In the application of the precautionary principle, decision should be guided by:* *careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and an assessment of the risk-weighted consequences of various options.*	Comprehensive desktop and field studies have been undertaken within and adjacent to the Development Envelope within KPBG. Studies includes: • Flora and vegetation. • Terrestrial fauna. • Heritage (Aboriginal). • Dieback. Potential impacts have been identified and described under each key environmental factor. Information gathered during these studies has reduced the uncertainty surrounding prediction of impacts for the assessment. Mitigation and management measures have been proposed to ensure potential impacts to the environment are significantly reduced. Main Roads has ensured that the Proposal's design (where possible) avoids serious or irreversible damage to the environment.
2	The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*	The Proposal will ensure the health, diversity and productivity of the environment is maintained through retaining as much habitat as possible.
3	The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	Main Roads has sought to preserve as much of the remnant biodiversity as possible by avoiding areas of native vegetation where practicable.
4	Principles relating to improved valuation, pricing and incentive mechanisms *Environmental factors should be included in the valuation of assets and services* *The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement* *The users of goods and services should pay prices based on the full life cycle costs of providing goods and services including the use of natural resources and assets and the ultimate disposal of any wastes* *Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems*	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors have determined the location and design of the Kids Bridge within the Development Envelope, with a strong focus on reducing the direct and indirect clearing footprint. Potential impacts on flora, vegetation and terrestrial fauna have been assessed and mitigation and management measures proposed. Main Roads accepts that the cost of the Proposal must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Proposal costs.
5	The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	Management strategies will be implemented to ensure that generation of waste during the construction phase is minimised. All activities shall be carried out with the principles of cleaner production and waste minimisation.

4.2 Identification of Preliminary Key Environmental Factors

Environmental factors are those parts of the environment that may be impacted by an aspect of a proposal. The EPA has 13 environmental factors, organised into five themes: Sea, Land, Water, Air and People.

The preliminary Key Environmental factors and EPA objectives are provided in Table 8**.** The relevance of each factor to the Proposal has been summarised and the significant environmental factors that require further consideration identified.

Table 8: Environmental Factors Relevant to the Proposal

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
Sea	Benthic Communities and Habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	No impacts to benthic habitats.	No significant impacts.
	Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	No impacts to coastal processes.	No significant impacts.
	Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	No impacts to marine environmental quality.	No significant impacts.
	Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	No impacts to marine fauna.	No significant impacts.
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Construction requires vegetation clearing.	No significant impacts. Refer to Section 4.3.
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	Distinctive landforms are not present.	No significant impacts.
	Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	No conservation significant subterranean fauna given the location of the Development Envelope (South West Australia).	No significant impacts.
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Construction may result in some minor, short-term impacts to Terrestrial Environmental Quality.	No significant impacts.
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction will result in some habitat clearing.	No significant impacts. Refer to section 4.4.
Water	Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	No wetlands or rivers are located within the Development Envelope.	No significant impacts.
Air	Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	No impacts to air quality expected.	No significant impacts.
People	Social Surroundings	To protect social surroundings from significant harm.	Development Envelope is within a populated area with potential Aboriginal heritage disturbance and noise and amenity issues.	No significant impacts. Refer to section 4.5.
	Human Health	To protect human health from significant harm.	No human health impacts expected. No radiation emissions.	No significant impacts.

4.3 Preliminary Key Environmental Factor – Flora and Vegetation

4.3.1 EPA Objective

The EPA's objective for flora and vegetation is '*to protect flora and vegetation so that biological diversity and ecological integrity are maintained'* (EPA, 2018b).

4.3.2 Policy and Guidance

The following policy and guidance documents have been used to inform the Flora and Vegetation factor for the Proposal:

- Environmental Factor Guideline 'Flora and Vegetation' (EPA 2016b).
- Technical Guidance 'Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA 2016c).
- 'Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20' (EPA 2013).
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations).
- 'Environmental Guidance for Planning and Development - Guidance Statement No. 33' (EPA 2008).
- *Biodiversity Conservation Act 2016* (WA).
- *Environmental Protection Act 1986* (WA).
- *Botanic Gardens and Parks Authority Act 1998* (WA).

4.3.3 Receiving Environment

Flora and Vegetation Studies

The flora and vegetation values for the Proposal have been primarily derived from the flora and vegetation survey completed by Biota Environmental Sciences (Biota) in 2020 (Appendix A). The survey was completed by biologists from Biota, in collaboration with staff from BGPA within and adjacent to the Development Envelope (Figure 3). The entire survey area was systematically searched for significant flora with a more intensive targeted search conducted in a targeted search area (Figure 3) for significant flora, including species significant to KPBG.

The flora and vegetation assessment completed by Biota (2020) included the following key components:

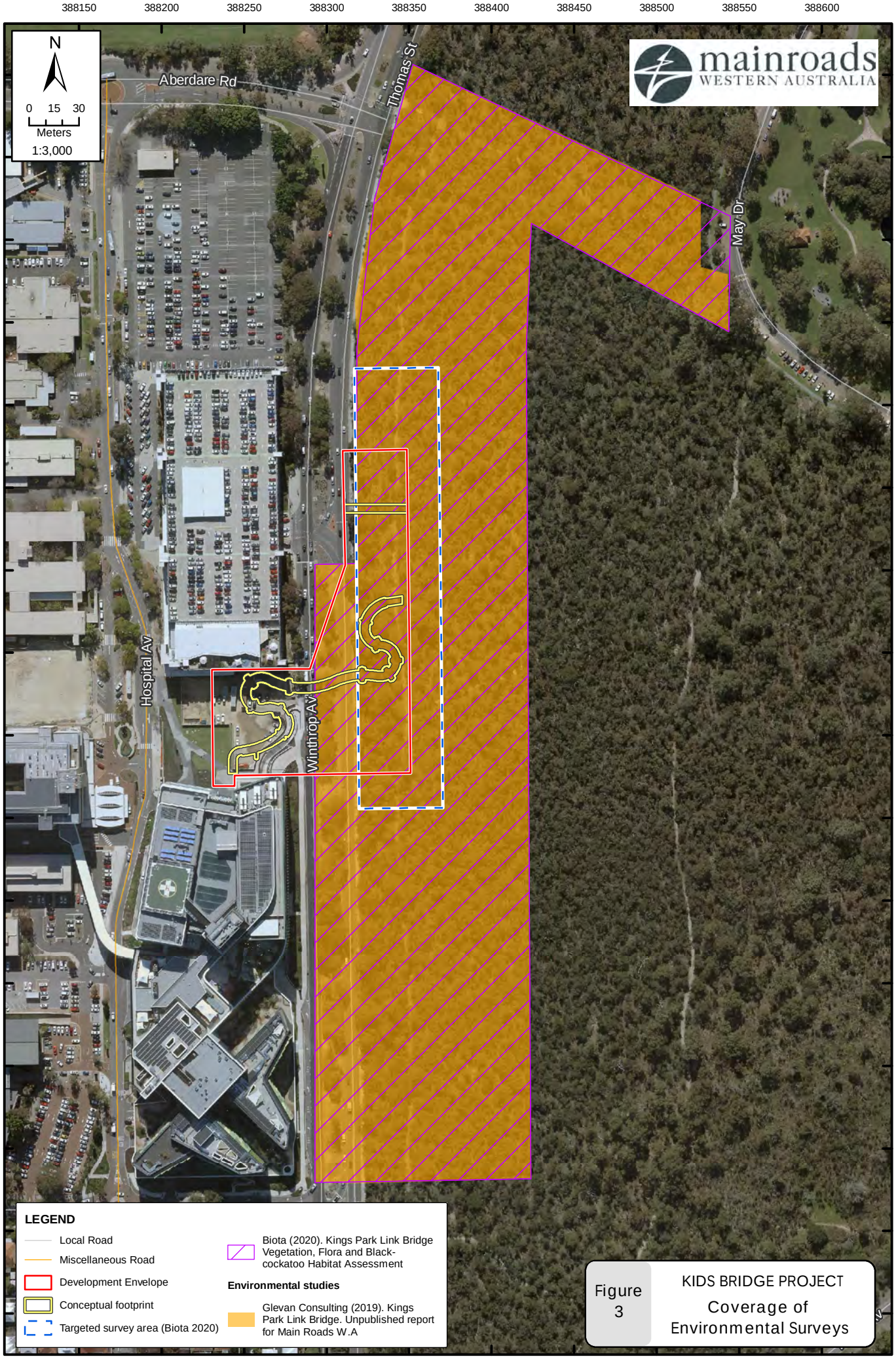
- A desktop review to identify flora and vegetation features of significance that are known from the broader area (within a 5km radial buffer), and an assessment of the likelihood of occurrence for significant vegetation and flora.
- A detailed field survey to characterise vegetation and vegetation condition within the Development Envelope including the identification of any Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs).
- A targeted field survey to search for significant flora species. The targeted flora survey was undertaken with assistance from two staff members from BGPA.
- Identification and mapping of weed species listed as Declared pests under the Western Australian *Biosecurity and Agriculture Management Act 2007* (the BAM Act), or Weeds of National Significance (WoNS).

Additional tree surveys have also been undertaken by Arbor Centre (2014) and Biota (2019). These assessments measured and located all individuals of tree and shrub species with a trunk diameter of >100 mm to help inform the development of the infrastructure design and reduce impacts on native vegetation by avoiding individual tree and shrubs where possible.

All of the investigations that have informed the flora and vegetation values for the Proposal are described in Table 9.

Table 9: Summary of Flora and Vegetation Surveys Undertaken for the Proposal

Survey/Report Author	Survey/Report	Survey Effort and Area	Relevance to Development Envelope
Biota Environmental Sciences (2020)	Perth Children's Hospital Pedestrian Kids Bridge Vegetation, Flora and Black-Cockatoo Assessment.	A biological survey was undertaken by three suitably qualified botanists, with field assistance from BGPA in September and October 2019 over a 8.59 ha survey area. Quadrat sampling was conducted on 12th September and 8th October. Systematic targeted flora searches were completed through a targeted flora survey area (within the survey area) on 8th October 2019.	Provides a basis for current information on vegetation types, condition, species composition along with the presence of significant flora and vegetation.
Botanic Gardens and Parks Authority (2019)	Floristic sampling site data.	BGPA supplied data from floristic sampling sites, located within KPBG in the vicinity of the Development Envelope. Sites distributed in regular intervals across KPBG are regularly monitored for flora (and evidence of Quenda), most recently from Spring 2018. At each of these sites, all understorey species within a 5 m radius around the central point are recorded, together with all overstorey tree species within a 20 m radius.	Flora species from 18 BGPA (2019) sampling sites located in the Biota (2020) survey area were used to inform the species list for the Proposal. Significant flora and records of weeds were also compiled for the desktop assessment for the Proposal.
Glevan Consulting (2020)	Dieback Occurrence Assessment.	Glevan Consulting undertook an assessment of an 8.59 ha survey area to assess for the presence of Phytophthora Dieback within the Development Envelope. This included a soil and tissue sample, which was tested for the presence of Phytophthora Dieback.	Provides information on the Phytophthorra Dieback status of the vegetation within and adjacent to the Development Envelope prior to the commencement of construction activities.
McChesney (2017)	A Description of the Plant Communities of KPBG Bushland and Associated Vegetation Mapping.	Vegetation was sampled and vegetation types were mapped in KPBG. Plant communities were derived from multivariate analysis of native plant cover data sampled on a 100 m grid throughout the plateau of KPBG bushland.	The vegetation types identified in this survey were used to inform the vegetation associations mapped by Biota (2020).



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Source: Aerial image: Skyview 2020. Survey areas: Biota (2020), Glevan (2019).
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Regional Biogeography

The Development Envelope is located within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) region and the Perth (SWA02) subregion (DSEWPaC 2012a). The Perth (SWA02) subregion is described by Mitchell et al. (2003) as a low lying coastal plain, mainly covered with woodlands. It is dominated by *Banksia* spp. or *Eucalyptus gomphocephala* (Tuart) on sandy soils, *Casuarina obesa* on outwash plains and *Melaleuca* spp. in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by *Eucalyptus marginata* (Jarrah) woodland. The climate is warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa* and *Corymbia calophylla* (Marri) woodlands and *Melaleuca* spp. shrublands, are extensively only in the south.

Broadscale (1:1,000,000) pre-European vegetation mapping (Beard 1981) indicates the Development Envelope lies within a broad extent of one vegetation system association,
Spearwood 6: Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) – Wandoo (*E. wandoo*) woodland. This system association has 24.4% remaining on the Swan Coastal Plain

The vegetation complexes of the Swan Coastal Plain have been mapped by Heddle et al. (1980) at a scale of 1:250,000. An extension of the vegetation complex mapping of Heddle et al. (1980) was conducted by Webb et al. (2016). The Development Envelope lies within a single vegetation complex, the Karrakatta Complex – Central and South: Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) – *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) – *Banksia* species. *Agonis flexuosa* (Peppermint) is co-dominant south of Capel River. This vegetation complex has 23.49% remaining on the Swan Coastal Plain

Vegetation Communities within the Development Envelope

Biota (2020) described the native intact vegetation within the Development Envelope as being comprised of two vegetation associations, consisting of *Allocasuarina fraseriana, Eucalyptus marginata* subsp. *marginata* mid-height woodland over *Banksia attenuata* and *B. menziesii* low woodland (DBm) and *Allocasuarina fraseriana* mid-height woodland over *B. attenuata* and *B. menziesii* low woodland (DBg). The dominant vegetation in the Development Envelope is 'DBm', with 81% of this vegetation association comprising the vegetation in the Development Envelope. Two other mapping units comprised of Parkland Cleared areas and Cleared areas were also mapped within the Development Envelope (Table 10, Figure 4).

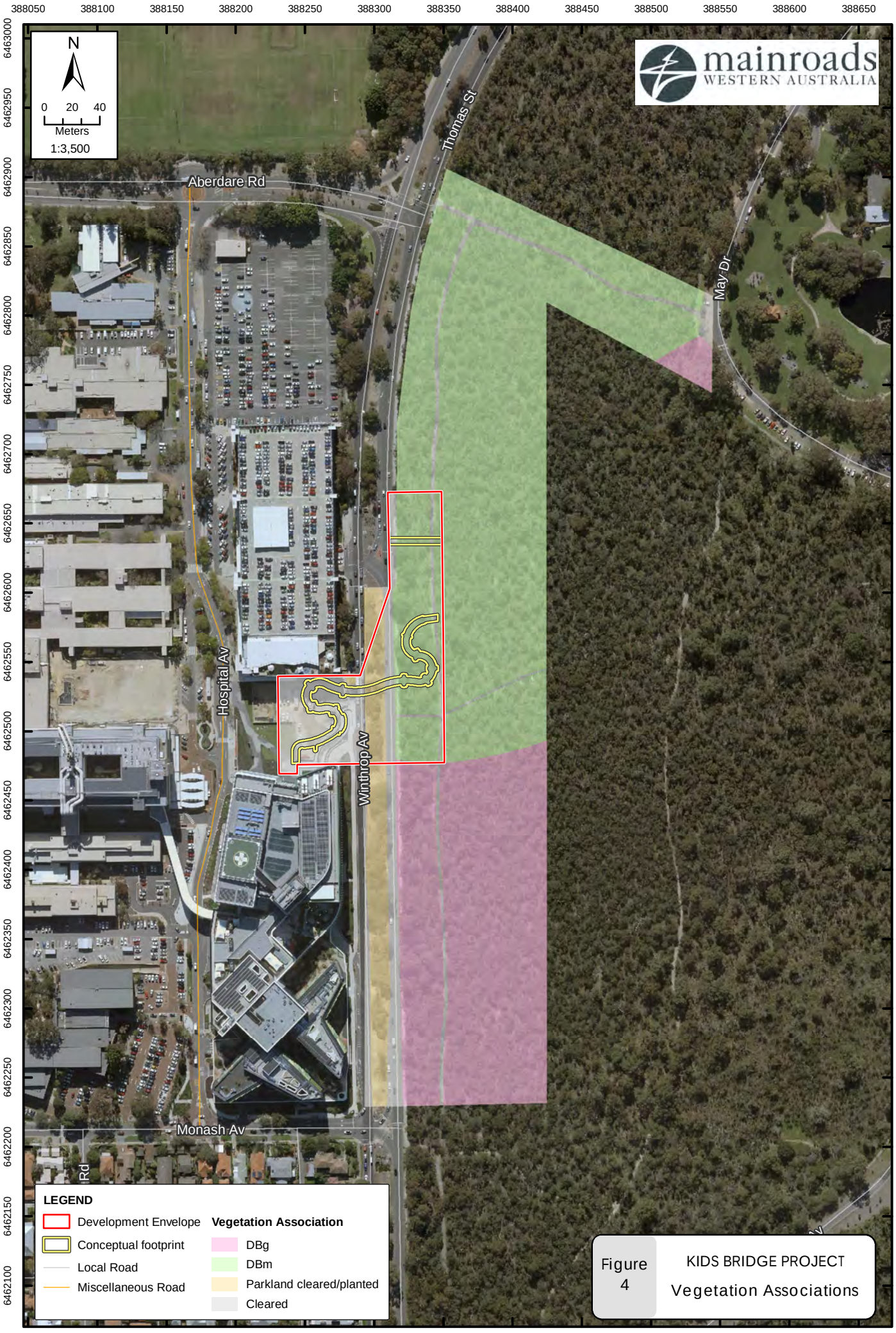
The two vegetation associations ('DBm' and 'DBg') have been originally mapped in the Development Envelope and surrounds (within KPBG) by BGPA (McChesney 2017). The data gathered during the Biota (2020) survey did not identify any need to change the mapping boundary between these units, however the descriptions were refined to more closely reflect the dominant species in KPBG within the Development Envelope.

Biota (2020) undertook Floristic Community Type (FCT) analysis of the vegetation within the Development Envelope. The floristic analysis completed for all quadrats sampled, clearly identified that both vegetation associations ('DBm' and 'DBg') mapped in the Development Envelope are representative of FCT 28 from Gibson et al. (1994): the 'Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands' from Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes.

Table 10: Vegetation sub-associations and other mapping units identified for the Development Envelope.[1]

Mapping Code	Vegetation Type	FCT from Gibson et al. (1994)	Extent in the Development Envelope (ha)
DBm	*Allocasuarina fraseriana, Eucalyptus marginata* subsp. *marginata* mid height woodland over *Banksia attenuata, B. menziesii* low woodland over *Acacia saligna, Banksia sessilis* var. *cygnorum* isolated tall shrubs over *Xanthorrhoea preissii, X. brunonis* subsp. *brunonis* sparse shrubland over *Hibbertia hypericoides* subsp. *hypericoides* sparse low shrubland over *Tetraria octandra, Mesomelaena pseudostygia* sparse low sedgeland to open low sedgeland.	FCT 28	0.63
DBg	*Allocasuarina fraseriana mid-height woodland over Banksia attenuata, B. menziesii low woodland over Acacia saligna, Banksia sessilis var. cygnorum* sparse tall shrubland over *Xanthorrhoea preissii* sparse shrubland over Tetraria *octandra, Mesomelaena pseudostygia* sparse low sedgeland.	FCT 28	<0.01
PC	Parkland cleared areas, including some planted trees, in the median strip of Winthrop Avenue.	NA	0.14
C	Cleared areas, comprising roads, dual-use paths and a fire-break.	NA	0.58
Total			**1.35**

[1] Note: The entire Development Envelope was not mapped by Biota (2020). Based on a review of the aerial imagery and site photos, the balance of the Development Envelope outside of the Biota (2020) survey has been considered by Main Roads to be Cleared and Parkland Cleared



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Source: Aerial image: Skyview 2020. Vegetation Association: Biota (2019)
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Vegetation condition within the Development Envelope

The vegetation condition within the Development Envelope was mapped by Biota (2020). The condition assessments were based on the ranking scale of Keighery (1994) as presented in EPA (2016a). The rankings considered the degree of invasion by introduced flora (weeds), impacts from historical and ongoing human activity, and the structural integrity of the vegetation.

The condition of the vegetation mapped within the Development Envelope varied from Very Good to Degraded (Table 11, Figure 5). A small section of the vegetation in the Development Envelope was Parkland Cleared, consisting of scattered native remnant trees and planted vegetation, which was assigned a condition ranking of Degraded. The remainder of the vegetation in the Development Envelope, which comprised intact woodland vegetation, was in Very Good condition mapped around existing disturbance corridors. The spread of introduced flora taxa, particularly of grasses and low-growing herbs, was the main contributor to habitat deterioration and degradation. The remaining area was mapped as Cleared.

Numerous weed species, from multiple locations were recorded within the Development Envelope. Dense patches of herbaceous weed species occurred through the entirety of the Development Envelope along the edges of roads, tracks and dual-use paths.

A summary of vegetation condition within the Development Envelope is provided in Table 11 and shown in Figure 5.

Table 11: Extent of Vegetation Condition Ratings Mapped within the Development Envelope[2]

Vegetation Condition	Extent in the Development Envelope (ha)
Very Good	0.63
Degraded	0.14
Cleared	0.58
Total	**1.35**

[2] Note: The entire Development Envelope was not mapped by Biota (2020). Based on a review of the aerial imagery and site photos, the balance of the Development Envelope outside of the Biota (2020) survey has been considered by Main Roads to be Cleared and Parkland Cleared

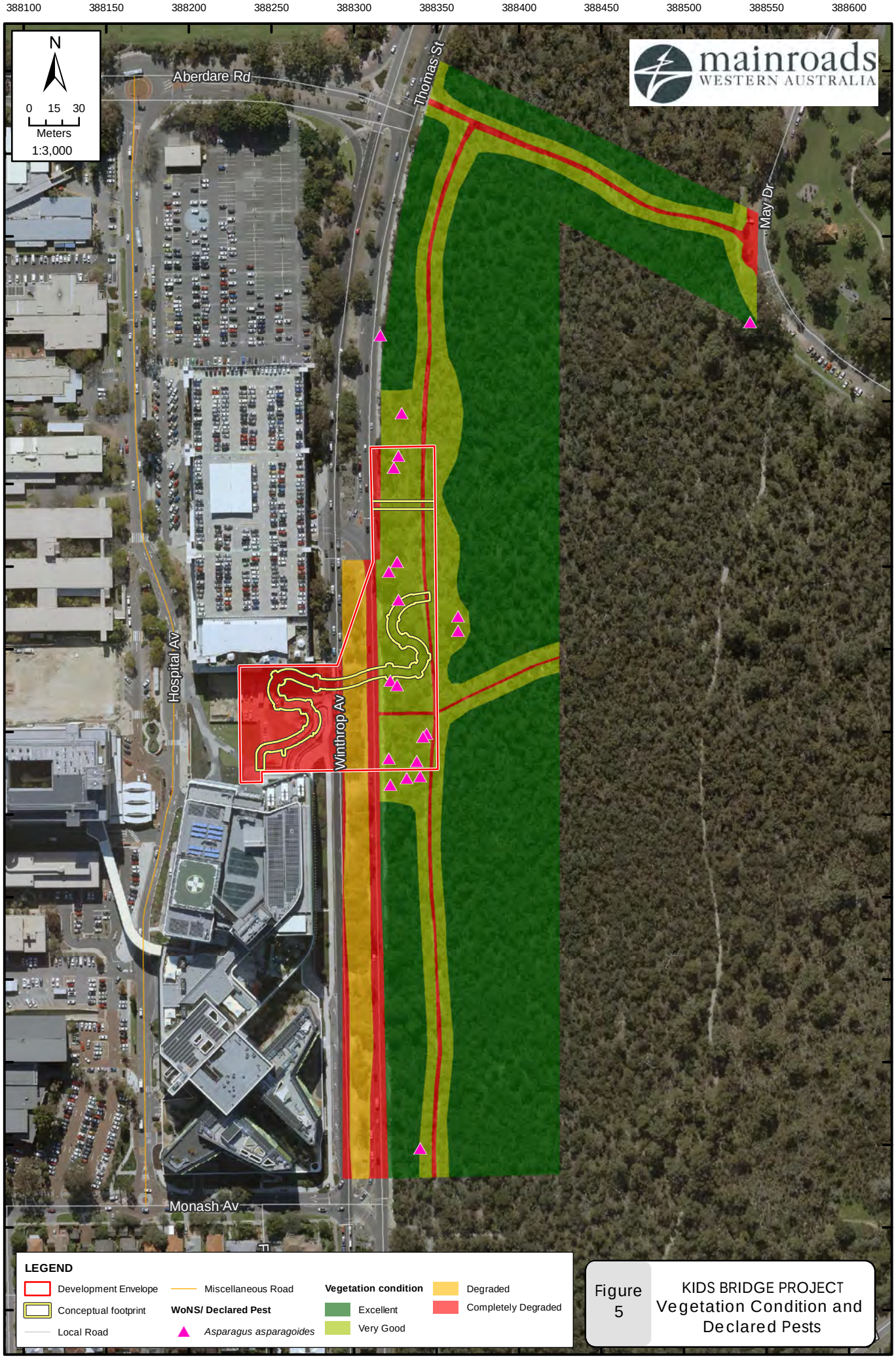

Figure 5

KIDS BRIDGE PROJECT
Vegetation Condition and Declared Pests

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Source: Aerial image: Skyview 2020. Vegetation Condition: Biota (2019)
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Threatened and Priority Ecological Communities

Based on the Biota (2020) desktop assessment, one state-listed TEC and four state listed PECs occur within 5 km of the Development Envelope (Table 12). Of the communities identified in the desktop assessment, only one of these were recorded in the Development Envelope, the Priority 3 listed 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA region' PEC (Banksia Woodland PEC).

The two vegetation associations mapped in the Development Envelope ('DBm' and 'DBg') were confirmed as belonging to FCT 28 (Biota 2020), which represents the Banksia Woodland PEC. As such, 0.63 ha of vegetation mapped as 'DBm' and 'DBg' within the Development Envelope comprises this PEC (Figure 6).

This state listed Banksia Woodland PEC is also a Commonwealth listed TEC "Banksia Woodlands of the Swan Coastal Plain" (BWSCP TEC), listed under the EPBC Act. Biota (2020) undertook an assessment of the vegetation associations 'DBm' and 'DBg' against the diagnostic criteria and condition thresholds for this TEC from the approved conservation advice (TSSC 2016). The assessment determined that vegetation associations 'DBm' and 'DBg' also comprise the BWSC TEC listed under the EPBC Act.

The remaining TECs and PECs identified in the desktop assessment were considered to not occur due to a lack of suitable habitat in the Development Envelope (Table 12).

Table 12: TECs and PECs that occur within 5 km of the Development Envelope (adapted from Biota [2020])

Community Name	Conservation Status		Likelihood of Occurrence in the Development Envelope
	State	Federal	
SCP25: Southern Swan Coastal Plain *Eucalyptus gomphocephala* – *Agonis flexuosa* woodlands.	Priority 3	Threatened (Critically Endangered)	**Does not occur:** Occurs 3.6 km west of the Development Envelope. No suitable habitat is present within the Development Envelope.
Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	Priority 3	Threatened (Endangered)	**Occurs:** The Development Envelope occurs within an area mapped as this PEC/TEC, and the dominant species in the mapped vegetation associations DBg and DBm are characteristic of the PEC/TEC.
Coastal Saltmarsh: Subtropical and Temperate Coastal Saltmarsh	Priority 3	Threatened (Vulnerable)	**Does not occur:** Occurs 1.5 km south of the Development Envelope. No suitable habitat within the Development Envelope.
SCP30a: *Callitris preissii* (or *Melaleuca lanceolata*) Forests and Woodlands, Swan Coastal Plain	Threatened (Vulnerable)	-	**Does not occur:** Occurs 4.6 km southeast of the Development Envelope. No suitable habitat is present within the Development Envelope.
Northern Spearwood Shrublands and Woodlands	Priority 3	-	**Does not occur:** Occurs 4 km east of the survey area. No suitable habitat is present within the Development Envelope.
Acacia Shrublands on Taller Dunes	Priority 3	-	**Does not occur:** Occurs 4.4 km east of the Development Envelope. No suitable habitat is present within the Development Envelope.

Flora Diversity

A total of 124 native flora taxa from 75 genera belonging to 35 families were recorded in the Development Envelope by Biota (2020) based on the 2019 sampling by Biota and BGPA, the 2018 monitoring survey by BGPA and the earlier survey by Arbor Centre (2014).The plant families with the highest species richness were Orchidaceae (19 taxa), Fabaceae (13 taxa), Asparagaceae (12 taxa), Proteaceae (11 taxa) and Cyperaceae (9 taxa). These are typical dominant family groups in vegetation within the locality (Biota 2020).

Significant Flora

The flora desktop assessment undertaken by Biota (2020) included searches of the EPBC Act Protected Matters Search Tool (EPBC PMST) database and the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database, DBCA Threatened Flora Database and BGPA supplied data within 5 km of the Development Envelope.

No Threatened flora species listed under the *Biodiversity Conservation Act 2016* (BC Act) or the EPBC Act have been recorded in the Development Envelope to date and none are expected to occur (Biota 2020).

One Priority 4 (P4) shrub species, *Jacksonia sericea,* was recorded at numerous locations throughout the Biota (2020) survey area, with 47 individuals from 32 records recorded in the Development Envelope. This species was also recorded from numerous locations in vegetation adjacent to the Development Envelope. A total of 219 individuals of *Jacksonia sericea* have been recorded from 127 locations within the Biota (2020) survey area from all sampling to date (Figure 7).

The Biota (2020) desktop assessment considered that the following DBCA Priority listed species have some potential to occur in the Biota (2020) survey area, despite not being recorded from the area to date:

- *Poranthera moorakatta* (Priority 2) (P2): This species has previously been recorded from a location 800 m east of the Biota (2020) survey area, in vegetation sub-association 'DBm' and may potentially occur in the Development Envelope.
- *Amanita wadjukiorum, A. fibrillopes* and *A. preissii* (all Priority 3) (P3): These fungi species have been recorded within 1 km of the Development Envelope. The nearby locations of *A. wadjukiorum* and *A. fibrillopes* were visited by a Botanist from Biota during the field survey but no sign of either species was found. These species would generally only be found under optimal conditions (during winter months and following good rainfall). Given the close proximity of records of *A. wadjukiorum* and *A. fibrillopes*, these species are considered likely to occur in the Development Envelope, while *A. preissii* may potentially occur.

However, given the size of the survey area and its location on the edge of KPBG, significant flora species considered potentially occurring within the Biota (2020) survey area are considered unlikely to occur within the small area of the Conceptual Footprint.

Conservation Reserves

The eastern portion of the Development Envelope (0.59 ha) lies within the Kings Park Class A Nature Reserve (R 1720), which is listed as a Bush Forever site 317 (Figure 8). Bush Forever site No. 317 is situated on the Spearwood Dunes and covers approximately 320 ha of bushland, including river-limestone cliffs and vegetated uplands (WAPC 2000). The Development Envelope is also mapped as an Environmentally Sensitive Area (ESA), associated with the reserve and Bush Forever site (Figure 8). Bush Forever sites are protected as ESAs pursuant to the EP Act.

Ecological Linkages

Regional Ecological Linkages act as corridors for flora and fauna to move between regionally and locally significant areas (WALGA 2004). Two regional ecological linkages mapped in the Regional Ecological Linkages for the Perth Metropolitan Region (PMR) dataset are mapped over the Development Envelope. Link No. 4 links Bush Forever sites No. 317 to 315 (including Bush Forever Site No. 228), maintaining connectivity to the coast. Link No. 5 occurs in the eastern portion of the Development Envelope and links Bush Forever sites No. 317 through to 281 (including Bush Forever sites No. 218, 119, 312) (Figure 8).

Introduced and Invasive Species

A total of 33 introduced species from 30 genera and 14 families have been recorded from the Development Envelope based on all sampling to date (Biota 2020). These species include weeds from outside of Australia, along with species that are native to Western Australia or Australia but have been introduced to KPBG.

One species recorded from the Development Envelope, **Asparagus asparagoides* (Bridal Creeper) is both a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (the BAM Act) and a Weed of National Significance (WoNs) species. A total 28 plants from 11 records were recorded in the Development Envelope. This species was identified in areas adjacent to the Development Envelope by Biota (2020). This species is already subject to weed control in KPBG.

Locations of **Asparagus asparagoides* within and adjacent to the Development Envelope are shown in Figure 5.

Dieback

Glevan (2020) completed a Dieback assessment for the Development Envelope (Figure 3) (Appendix B). The assessment identified no *Phytophthora* spp. (Dieback) infestations or evidence of disease presence within the Development Envelope and surrounding area.

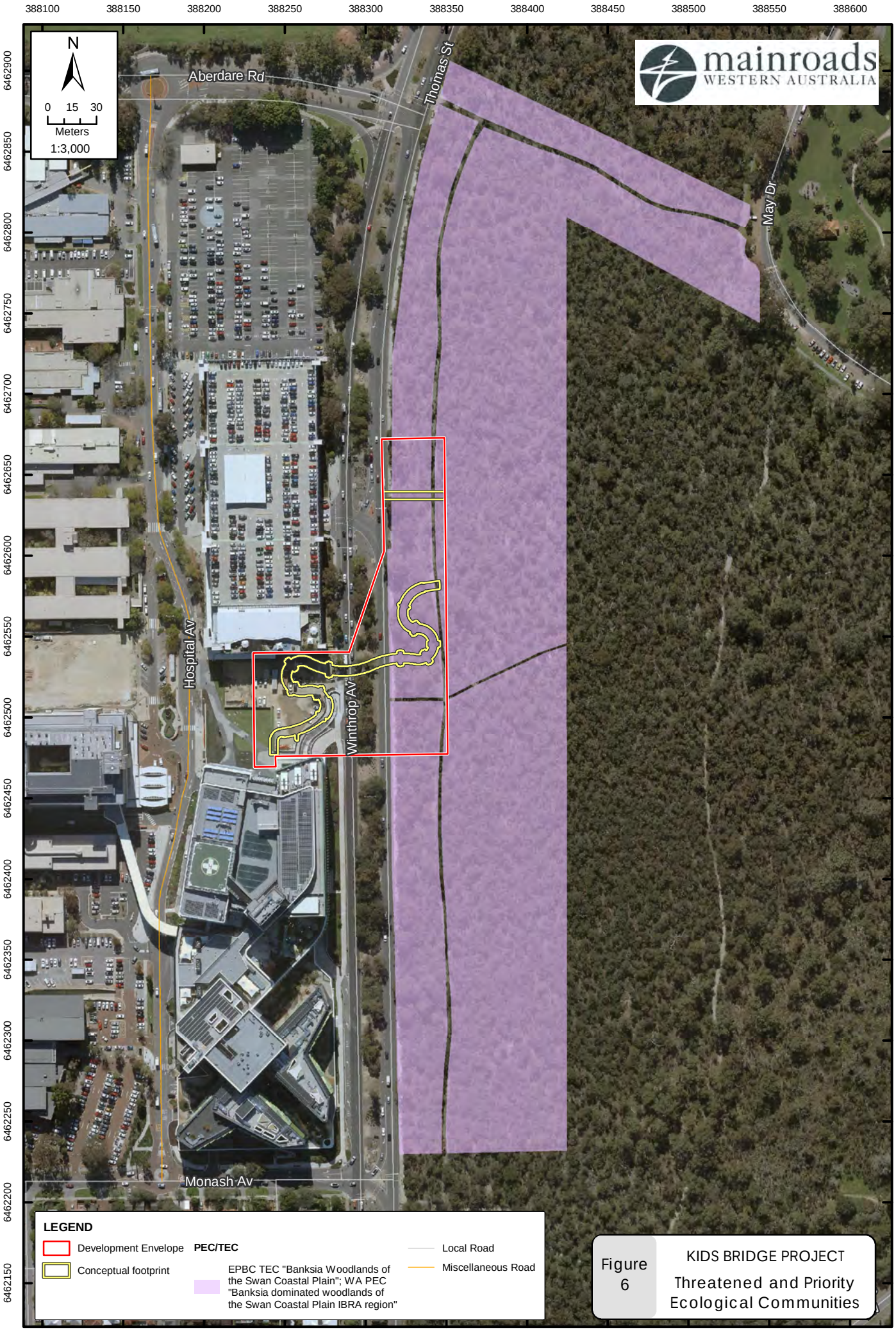

Figure 6

KIDS BRIDGE PROJECT

Threatened and Priority Ecological Communities

Document Path: Y:\Metropolitan Region\Environment\Project Files\Kings Park - Childrens' Hospital Pedestrian Bridge\GIS and Shapefiles\Mxds\Kings Park Bridge_TEC_PEC_v1.mxd
Source: Aerial image: Skyview 2020. TEC/PEC: Biota (2019)
Created by: DWhite

March 2020

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enquiries@mainroads.wa.gov.au

Document Path: Y:\Metropolitan Region\Environment\Project Files\Kids Bridge - Perth Children's Hospital and Kings Park\GIS and Shapefiles\Mxds\Kings Park Bridge_ConsSigFlora_v1.mxd
Source: Aerial image: Skyview 2020. Conceptual Design: x60612387-br-PCHF-PLAN.dwg; Conservation Significant Flora: Biota (2019)
Created by: DWhite

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Document Path: Y:\Metropolitan Region\Environment\Project Files\Kings Park - Childrens' Hospital Pedestrian Bridge\GIS and Shapefiles\Mxds\Kings Park Bridge_Reserves_EcoLinkages_v1.mxd
Source: Aerial image: Skyview 2020. Bush Forever: DPLH 2020; Linkages: WALGA 2017
Created by: DWhite

March 2020
mainroads.wa.gov.au
enquiries@mainroads.wa.gov.au

4.3.4 Potential Impacts

Direct Impacts

The Proposal will result in the direct loss of vegetation and flora due to the clearing of up to 0.1 ha of native vegetation. The vegetation to be cleared in the Development Envelope ranges from Very Good to Degraded condition.

Areas of Very Good condition vegetation in the Development Envelope are represented by:

- 0.63 ha of vegetation in in 'DBm'.
- <0.01 ha of vegetation in 'DBg'.

Areas in Degraded condition comprised 0.14 ha of parkland cleared and planted vegetation in 'PC'.

Within the Development Envelope, the maximum direct impacts the Proposal will have on native vegetation and flora include:

- The removal of up to 0.1 ha of native vegetation in Very Good condition forming part of the 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA region' Priority 3 listed PEC (also listed as the Commonwealth BWSCP TEC).
- The removal of up to eight *Jacksonia sericea* (P4) individuals, which is estimated to impact up to approximately less than 3% of the individuals within KPBG and less than approximately 0.05% of the known wider population.

Other potential direct impacts include:

- Fragmentation of Regional Ecological Linkages (No. 4 and No. 5).
- Permanent loss of up to 0.1 ha of native vegetation within a Class A Nature Reserve (R 1720) and Bush Forever Site No. 317.

Indirect Impacts

The potential indirect impacts to flora and vegetation from the Proposal include:

- Introduction and spread of Declared Pests and other introduced weeds within the Development Envelope and/or into vegetation adjacent to the Development Envelope.
- Introduction and spread of Dieback into vegetation adjacent to the Development Envelope during construction.

4.3.5 Assessment of Impacts

4.3.5.1 Direct Impacts

Broad Scale pre-European (Beard) Vegetation associations

The EPA's guidance statement No. 33 has set a threshold for the retention of 10% of the pre-existing extent of native vegetation within constrained areas (EPA 2008). The Development Envelope is considered to be constrained as it is within the Perth Metropolitan area. The vegetation association 'Spearwood 6' has an extent greater than the 10% threshold on the Swan Coastal Plain and within the City of Perth (Table 13). After the implementation of the Proposal, the current extent on the Swan Coastal Plain will remain at this level, while a loss of 0.01% of this vegetation association will occur within the City of Perth. However, within the City of Perth, this vegetation association is well represented in DBCA managed reserves (96.34%) (Table 13).

Based on the remaining extent of vegetation associations by the Proposal and their representation in areas managed for conservation, removal of up to 0.1 ha of native vegetation in the Development Envelope is not considered to represent a significant impact to the retention of native vegetation at the regional or local scale.

Table 13: Extent of Vegetation Associations Mapped within the Development Envelope (Government of Western Australia 2019b)

Pre-European Vegetation Association	Scale:	Pre–European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Managed Lands	Extent Remaining After Clearing	
						Area (ha)	% of Pre-European Extent
Spearwood 6	*Statewide*	56,343.01	13,362.25	23.72	39.83	13,362.15	23.72
	IBRA Bio region *Swan Coastal Plain*	56,343.01	13,362.25	23.72	39.83	13,362.15	23.72
	IBRA Sub-region *SWA2*	56,343.01	13,362.25	23.72	39.83	13,362.15	23.72
	Local Government Authority *City of Perth*	1,377.03	332.35	24.14	96.34	322.25	24.13

Regional Vegetation Complexes

The Karrakatta Complex – Central and South has less than 30% remaining on the Swan Coastal Plain, with 23.49% of this vegetation complex remaining. The removal of up to 0.1 ha of this vegetation within the Development Envelope would result in less than a 0.01% loss of this vegetation complex within the City of Perth, while current extent of the Swan Coastal Plain will remain at 23.49% (Table 14).

Based on less than a 0.01% reduction of this vegetation complex, the potential loss of up to 0.1 ha in the Development Envelope is not likely to represent a significant residual loss in proportion to the remaining vegetation given the small amount of clearing required for the Proposal. As such, the clearing required for the Proposal is not considered to represent a significant impact to the retention of native vegetation at the regional or local scale.

Table 14: Extent of Vegetation Complexes Mapped within the Development Envelope (Government of Western Australia (2019b)

Pre-European Vegetation Association	Scale	Pre–European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves	Extent Remaining After Clearing	
						Area (ha)	% of Pre-European Extent
Karrakatta Complex – Central and South	*IBRA Bio region* *Swan Coastal Plain*	53,080.99	12,467.20	23.49	8.07	12,467.10	23.49
	Local Government Authority *City of Perth*	849.19	315.42	37.14	-	315.32	37.13

Threatened and Priority Ecological Communities

The Development Envelope comprises two vegetation associations 'DBm' and 'DBg', both of which are representative of FCT28 from Gibson et al. (1994) forming part of the Priority 3 Banksia Woodland PEC and Commonwealth listed BWSC TEC. The Proposal will require the removal of up to 0.1 ha of this state listed PEC and Commonwealth listed TEC. Given the small amount of clearing required (0.1 ha), the removal of native vegetation in the Development Envelope is not expected to be a significant impact on the PEC or TEC at the local scale, given that there is approximately 122.5 ha of 'DBm' and 14.4 ha of 'DBg' within KPBG that is likely to comprise this PEC and TEC (McChesney 2017). The vegetation to be cleared is on the western boundary of KPBG, which covers approximately 320 ha and is part of a large tract of native vegetation. The clearing for the Proposal is unlikely to fragment this PEC and TEC as it involves the removal of a small area and connections to the adjacent PEC and TEC in KPBG will remain north, south and east of the Proposal. Given the extent of this patch within the adjoining vegetation in similar or better condition vegetation, removal of approximately 0.07% of this PEC and TEC within KPBG is expected to be minor.

The vegetation to be cleared comprises less than 0.001% of the estimated extent of this PEC and TEC on the Swan Coastal Plain, with additional DBCA managed reserves within 10 km of the Proposal, including Bold Park Reserve (R45409). The vegetation to be cleared is associated with the edge of the PEC and TEC patch, in an area adjacent to cleared areas and is not considered to be in an important position between (or linking) other patches in the landscape. The Proposal is unlikely to result in the substantial reduction in the quality or integrity of the broader PEC and TEC patch and is unlikely to cause a substantial change in the species composition of the PEC and TEC. The vegetation to be cleared is approximately 0.07% of the estimated PEC and TEC patch size within KPBG and comprises less than 0.001% of the estimated extent of the PEC and TEC on the Swan Coastal Plain.

Given the nature and scale of the clearing of vegetation, the impacts to this PEC and TEC are likely to be minor. The Proposal is not expected to significantly impact the state listed PEC and Commonwealth listed TEC.

Threatened Flora

Based on available information, investigations and surveys undertaken to date, no Threatened flora have been identified as occurring within the Development Envelope. The likelihood of occurrence assessment for Threatened and Priority flora conducted by Biota (2020) for the Proposal, did not identify that any Threatened flora species had the potential to occur. Therefore, impacts to Threatened flora are not expected.

Priority Flora

One Priority flora species, *Jacksonia sericea* (P4) has been recorded within the Development Envelope by Biota (2020). Potential impacts to *Jacksonia sericea* (P4) species within the Development Envelope have been estimated by accessing records of the species using BGPA monitoring data, DBCA records and datasets. It is noted that these records often provide count (frequency) in descriptors such as common, abundant, frequent, occasional and scattered without providing an actual number of individuals.

A total of 219 individuals have been recorded from 127 locations within the Biota (2020) survey area from all sampling to date (Figure 7). *Jacksonia sericea* (P4) was recorded from 75 additional locations distributed throughout KPBG during the monitoring by BGPA in 2018; the number of individuals was not recorded at each of these locations, so no comparison of population size within KPBG is possible, but it is assumed a minimum of one individual was present. However, the eight individuals within the Conceptual Footprint represent approximately 3% of the total 294 locations within KPBG, based on Biota (2020) sampling and monitoring undertaken by BGPA staff in 2018. It is likely that *Jacksonia sericea* (P4) would be present at numerous locations between the regular grid of monitoring sites undertaken by BGPA, so this proportion of the local population occurring in the Development Envelope is an overestimate. This species is clearly widespread and not uncommon within the intact bushland in KPBG.

With respect to the broader distribution of *Jacksonia sericea* (P4), the Western Australian Herbarium Records (DBCA 2020) indicate that this species has been recorded from approximately 88 records with over 11,000 individuals, extending from Neerabup to Mandurah. Given that the distribution of this species extends over approximately 100 km on the Swan Coastal Plain, the individuals within the Conceptual Footprint would make up only a small proportion (less than 0.05%) of the total population.

Given the population estimates used are likely to be under estimates and that the species are relatively widespread on the Swan Coastal Plain and within KPBG bushland, the potential impacts associated with the removal of up to six individuals are not expected to be significant for the priority flora species *Jacksonia sericea* (P4).

Conservation Reserves and Environmentally Sensitive Areas (ESAs)

The Proposal will require the clearing of up to 0.1 ha of vegetation within the Kings Park Class A Reserve (R 1720), which is also a Bush Forever site (No. 317) and listed as an ESA (Figure 8). This reserve contains approximately 320 ha of bushland and the removal of 0.1 ha will result in the loss of up to 0.03% of native vegetation within the reserve. Construction of operation of a pedestrian footbridge linking the Kings Park reserve and Perth Children’s Hospital is included in the KPBG Management Plan (BGPA 2014).

The vegetation to be cleared within the reserve and Bush Forever site (No. 317) is adjacent to existing tracks and pedestrian pathways, resulting in some minor fragmentation in this area of the reserve. The clearing for the Proposal will occur on the western boundary of the reserve and is unlikely to contribute to the existing fragmentation of the site as it involves the removal of a small area on the edge of the reserve. Connections to the remainder of the reserve will remain north, south and east of the Proposal.

Given the minor amount of clearing required, along the edge of the reserve, the loss of 0.1 ha (up to 0.03%) of vegetation within Kings Park Reserve (R 1720) and Bush Forever Site No. 317 is not expected to be significant.

Ecological Linkages

Two Regional Ecological Linkages mapped in the Regional Ecological Linkages for the PMR dataset are mapped over the Development Envelope. Link No. 4 links Bush Forever sites No. 317 to 315 (including Bush Forever Site No. 228), maintaining connectivity to the coast (Figure 8). Link No. 5 occurs in the eastern portion of the Development Envelope and links Bush Forever sites No. 317 through to 281 (including Bush Forever sites No. 218, 119, 312) (Figure 8).

For the purposes of this assessment, the extent of the local ecological linkage to be impacted by the Proposal includes the Bush Forever Site No. 317 associated with KPBG. The Proposal will require the clearing of up to 0.1 ha of native vegetation in the Regional Ecological Linkages 4 and 5.

Given the small amount of clearing within Bush Forever Site No. 317, along the edge of the reserve in an area adjacent to cleared areas, the Development Envelope is not considered to be in an important position between other patches in the landscape. Given the extent of this patch within the adjoining vegetation in similar of better condition vegetation, the removal of up to 0.1 ha of vegetation within the Regional Ecological Linkages 4 and 5, is not expected to significantly impact on Regional Ecological Linkages 4 and 5.

4.3.5.2 Indirect Impacts

Introduced and Invasive Species

The construction and operation phase of the Proposal has the potential to result in the introduction and spread of existing introduced weeds into the Development Envelope and adjacent vegetation. Native vegetation within the Development Envelope (within KPBG) is currently subject to weed control by BGPA.

Without management in place, weeds can become widespread and/or new weeds species could become established in and around the Development Envelope. This could result in impacts that, while not significant, would be detrimental to the condition of remnant vegetation. Due to the hygiene measures to be implemented by the Proposal and ongoing weed control by BGPA, it is not anticipated that the Proposal will have a significant residual impact on the surrounding vegetation due to weeds.

Dieback

Dieback is caused the plant pathogen *Phytopthorra* spp., which kills susceptible plants by attacking their root systems. More than 40% of plant species in south-west Western Australia are known to be susceptible, particularly plants belonging to the Proteaceae, Ericaceae and Xanthorrhoeaceae families. The Dieback assessment for the Proposal undertaken by Glevan (2020) did not identify any Dieback infestations or evidence of disease presence within the Development Envelope or surrounding area.

Without adequate management in place, it is possible that Dieback could lead to the death of susceptible species in affected areas. However, given the very low likelihood of the disease being present in the Development Envelope and surrounding areas and the hygiene measures to be implemented by the Proposal, it is not anticipated that the Proposal will have a significant residual impact on the surrounding native vegetation due to Dieback.

4.3.6 Mitigation

The EPA's mitigation hierarchy has been applied during the Proposal design and in the development of appropriate mitigation and management strategies to address the key potential impacts to flora and vegetation. Where impacts cannot be avoided during the Proposal detailed

design phase, they will be minimised. The avoidance and mitigation measures for impacts to flora and vegetation are detailed below.

Avoid

- Selection of a design that fulfils safety objectives within the smallest practicable construction footprint.
- Optimising use of 'Cleared' areas for the footprint of the Kids Bridge. Using the cleared landscape has been a key consideration in the selection of the Kids Bridge Conceptual Footprint and hence identification of the Development Envelope.
- The footprint of the bridge has been carefully positioned to avoid impacts where possible. Including avoidance of 'Excellent' condition vegetation (to the south of the Development Envelope) and *Jacksonia sericea* (P4) individuals where possible.

Minimise

- Minimisation of clearing footprint through the detailed design process in close consultation with BGPA.
- Restricting, where possible, clearing of vegetation to the footings of the Kids Bridge and surrounding areas required for safety and work requirements. Pruning will be preferred over clearing where possible.
- Where possible, vegetation will be pruned and retained under the Kids Bridge to minimise clearing.
- Clearing and pruning of native vegetation within KPBG to be undertaken with supervision with staff from BGPA.
- A CEMP will be developed to define techniques to minimise direct and indirect impacts during construction to the surrounding environment. Included will be:
    - Measures to minimise the risk of over-clearing, such as clear demarcation of clearing areas.
    - Development of a Hygiene Management Plan including standard hygiene measures are implemented to ensure Dieback and weeds are not introduced and/or spread to adjacent vegetation.
- BGPA will continue to implement weed management within the vegetation surrounding the Kids Bridge, including management of Declared Pest,**Asparagus asparagoides* (Bridal Creeper).

Rehabilitation

- Rehabilitation and revegetation using suitable native species in any selected areas disturbed during construction to be in consultation with BGPA.

4.3.7 Predicted Outcome

The Proposal will result in the removal of up to 0.1 ha of remnant native vegetation that forms part of the Banksia Woodland PEC/TEC. The Proposal will also require the removal of up to eight *Jacksonia sericea* (P4) individuals.

By selecting a footprint for the Proposal that minimises impacts to flora and vegetation, as well as implementing mitigation measures to address potential impacts, it is expected that the EPA's objective (for the factor Flora and Vegetation) to protect flora and vegetation so that biological diversity and ecological integrity are maintained, will be met. It is expected that the Proposal will be managed so that the only residual potential impacts are those summarised in Table 15. As outlined previously, the extent of clearing associated with the Proposal will be refined through detailed design and the actual amount of clearing will be less than current estimates.

Table 15: Predicted Residual Impact to Flora and Vegetation

Scale	Summary of Residual Impacts
Vegetation	Clearing of up to 0.1 ha of native vegetation in Very Good condition vegetation and up to 0.01 ha of Degraded condition parkland cleared and planted vegetation.
Priority Ecological Communities	Clearing of up to 0.1 ha of 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region' PEC (also listed as the Commonwealth BWSCP TEC).
Priority Flora	Clearing of up to eight *Jacksonia sericea* (P4) individuals estimated to represent less than 0.05 % of the known population.

4.4 Preliminary Key Environmental Factor – Terrestrial Fauna

4.4.1 EPA Objective

The EPA's objective for terrestrial fauna is 'to protect terrestrial fauna so that biological diversity and ecological integrity are maintained' (EPA 2018b).

4.4.2 Policy and Guidance

- Environmental Factor Guideline 'Terrestrial Fauna' (EPA 2016d).
- Technical Guidance 'Sampling Methods for Terrestrial Vertebrate Fauna' (EPA 2016e).
- Technical Guidance 'Terrestrial Fauna Surveys' (EPA 2016f).
- Technical Report: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region (EPA 2019).
- *Biodiversity Conservation Act 2016* (WA).
- *Environmental Protection Act 1986* (WA).
- *Botanic Gardens and Parks Authority Act 1998* (WA).

4.4.3 Receiving environment

Fauna Studies

A fauna survey was undertaken as part of the Kids Bridge Vegetation, Flora and Black Cockatoo Habitat Assessment by Biota (2020) (Figure 3).

The Biota (2020) assessment included a desktop review to identify and assess the likelihood of occurrence of significant fauna species that may occur in the Development Envelope. The field survey focused on assessing Black Cockatoo habitat to identify foraging, roosting and breeding habitat for Black Cockatoos.

To ensure a systematic approach was applied by Biota (2020), a Zoologist traversed 20 m transect lines within the survey area and recorded the location of all trees with the potential to form hollows (e.g. Jarrah, Marri and Tuart) with a Diameter at Breast Height (DBH) greater than or equal to 500 mm (herein referred to as Suitable DBH Trees) were recorded. For any tree supporting hollows considered to have any potential for breeding by Black Cockatoos, details of the hollows were recorded. The potential of the habitat to support foraging was also assessed, and any evidence was recorded, along with sightings of Black Cockatoo individuals.

Details of the fauna surveys undertaken in the Development Envelope are provided in Table 16.

Table 16: Fauna Investigations Undertaken for the Purpose of This Proposal

Survey/Report Name	Survey/Report	Survey Effort and Area	Relevance to Development Envelope
Biota Environmental Sciences (2020)	KPBG Link Kids Bridge Vegetation, Flora and Black Cockatoo Habitat Assessment	A Black Cockatoo Habitat Assessment was undertaken by a qualified zoologist on 8th October over a 8.59 survey area to identify foraging, roosting and breeding habitat for Black Cockatoos.To ensure that all potential breeding habitat trees were recorded, a systematic approach was applied, whereby 20 m transect lines were traversed and potential Black Cockatoo breeding trees with a diameter at breast height of >500 mm were recorded. This method was applied until the entire survey area had been traversed.	Provides information on the Black Cockatoo habitat within the Development Envelope, along with evidence of other significant fauna species.
BGPA (2020)	Floristic sampling site data	KPBG supplied data from floristic sampling sites, located within KPBG in the vicinity of the Development Envelope. Sites distributed in regular	Quenda records in KPBG were used to inform the Biota (2020) assessment and the likelihood

Survey/Report Name	Survey/Report	Survey Effort and Area	Relevance to Development Envelope
		intervals across KPBG are regularly monitored for flora and evidence of Quenda, most recently from Spring 2018.	of Quenda occurring in the Development Envelope.

Fauna Habitat Value

The native intact vegetation and Parkland Cleared areas within the Development Envelope provides potential habitat for fauna. Based on the Biota (2020) survey, the Development Envelope is estimated to contain approximately 0.1 ha of potential fauna habitat within vegetation associations 'DBm', 'DBg' and 'PC' (Figure 4).

The dominant tree and shrub species within the remnant native vegetation in the Development Envelope includes Jarrah, Banksia and *Allocasuarina fraseriana* (Sheoak) (within 'DBg' and 'DBm'), which all represent foraging plant species for Black Cockatoos. Two small Norfolk Island Pines were also noted within the median strip (within 'PC'), which may represent a foraging plant for Carnaby's Cockatoo, despite being in poor condition. A total of 38 Suitable DBH Trees for Black Cockatoos were recorded in the Biota (2020) survey area. Two hollows with potential suitability for Black Cockatoo breeding ('Trees with a Suitable Nest Hollow') were recorded in the Biota (2020) survey area, however these are located outside of the Development Envelope.

The native remnant vegetation within the Development Envelope may also provide fauna habitat for other significant species such as the Quenda (*Isoodon fusciventer*) (Priority 4), Black-striped Snake (*Neelaps calonotos*) (Priority 3) and Peregrine Falcon (*Falco peregrinus*) (Other Specially Protect Fauna) and Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*).

Fauna Diversity

The desktop assessment undertaken by Biota (2020) included searches of the EPBC PMST Database, DBCA NatureMap Database and DBCA Threatened Fauna Database within 5 km of the Development Envelope, along with BGPA supplied data of Quenda records within KPBG bushland that were known to be a reintroduction into KPBG approximately seven years ago.

The desktop assessment identified 254 fauna species previously recorded within 5 km of the Development Envelope. This comprised 32 mammals (19 native), 159 birds (153 native), 53 reptiles and 10 amphibians. When consideration of habitat is applied and those species reliant on aquatic habitats for breeding and feeding are removed, the total potential vertebrate assemblage is reduced to 30 mammals (18 native), 112 (106 native), 52 native reptiles and three native amphibians. This also excludes one species (European Cattle) that is unlikely to be a resident within KPBG, which was only returned from the EBPC PMST.

Significant Fauna

Searches of the EPBC PMST, NatureMap and DBCA records identified the potential occurrence of significant fauna species within 5 km of the Development Envelope. The desktop assessment undertaken by Biota (2020) identified:

- Nine species listed under the EPBC Act and/or the BC Act.
- Three migratory bird species protected under international agreements.
- 12 DBCA Priority listed species.

The Biota (2020) survey confirmed that habitats within the Development Envelope are currently being utilised by the following significant fauna species:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Threatened/Endangered).
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Threatened/Vulnerable).

In addition to the above species, four significant fauna species were classed as ‘may potentially occur’ within the Biota (2020) survey area, despite not being recorded in the Biota (2020) survey:

- Quenda (*Isoodon fusciventer*).
- Peregrine Falcon (*Falco peregrinus*).
- Black-striped Snake (*Neelaps calonotos*).
- Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*).

However, given the size of the survey area and its location on the edge of KPBG, significant species considered potentially occurring within the survey area are considered unlikely within the small area of the Conceptual Footprint. The results of the likelihood of occurrence assessment adapted from the Biota (2020) assessment are presented in Table 17.

Table 17: Significant Fauna Known Likelihood of Occurrence Assessment within the Biota (2020) survey area (adapted from Biota [2020]).

Species	Status*		Habitat	Regional Records	Likelihood of Occurrence in the Development Envelope and Conceptual Footprint
	EPBC Act	WA			
Mammals					
Western Ringtail Possum (*Pseudocheirus occidentalis*)	CR	CR	On the Swan Coastal Plain, particularly Peppermint (*Agonis flexuosa*) forests and woodlands, Tuart (*Eucalyptus gomphocephala*) woodlands with Peppermint mid-story and Jarrah (*E. marginata*) and Marri (*C. calophylla*) woodland.	Two individuals recorded at Tree Top Walk in KPBG in 2018, but these are considered to have been released in the park rather than representing an existing population.	**Unlikely to Occur:** recent record from KPBG, which is considered to involve unauthorised release of animals. No other recent records, and nearest known natural population is over 100 km to the south at Yalgorup National Park.
Numbat (*Myrmecobius fasciatus*)	EN	EN	Eucalypt woodland with hollow logs and branches for shelter and termites for food. Formerly occurred in a wider range of habitats.	Recorded just north of KPBG in 1927, but no recent records from the region and generally accepted to be extinct on the coastal plain near north Perth.	**Would not Occur:** Species is restricted to several remnant and re-introduced populations, and is not considered to be extant in the vicinity of the Development Envelope.
Western Quoll, Chuditch (*Dasyurus geoffroii*)	VU	VU	Now primarily restricted to Jarrah forest and woodlands, with smaller numbers in other eucalypt woodland and Mallee.	Several records from the vicinity of the Development Envelope, however the most recent is from 1969; most date from the 1920s and 1930s.	**Unlikely to Occur:** Habitat within the Development Envelope could be marginal, and there are no recent records from the vicinity; this species is generally considered to be very scarce in the Perth area.
Brush-tailed Phascogale, Common wambenger (*Phascogale tapoatafa wambenger*)	CD	-	Use a range of habitats from mallee to rainforest, but prefers open forest with sparse groundcover.	One recent record (2017); a dead individual found on a road in the Perth CBD, ~3 km northeast of the survey area, however the origin of the carcass uncertain. One other record from 2016 from ~11 km southwest, however the location description does not match the coordinates, so this location is uncertain.	**Unlikely to Occur:** Habitat within the Development Envelope may be suitable, however there are only two records from the coastal plain in the Perth suburbs; one of uncertain provenance and the location of the second is uncertain.
Quenda (*Isoodon fusciventer*)	P4	-	Variety of forest, woodland, shrubland and heath communities, but prefer areas of denser vegetation, including wetland fringes and heathland.	Recently (re-)established in KPBG and several recent records within 1 – 2 km of the Development Envelope.	**May Potentially Occur:** The species occurs within KPBG and there are recent records nearby, but habitat within the Development Envelope is not optimal (lacking sufficient ground cover). No sightings or secondary evidence recorded during the current survey, or from the sites monitored by KPBG in 2018. Unlikely to occur in the Conceptual footprint due to the small footprint area within KPBG.
Water-rat, Rakali (*Hydromys chrysogaster*)	P4	-	Variety of permanent fresh water bodies, ranging from subalpine streams to lakes, creeks and farm dams. Also on sheltered coastal beaches, mangroves and offshore islands.	Several records within 5 km of the Development Envelope from the margins of the Swan River, however most are not recent records.	**Would not Occur:** No suitable habitat within the Development Envelope.

Species	Status*		Habitat	Regional Records	Likelihood of Occurrence in the Development Envelope and Conceptual Footprint
	EPBC Act	WA			
Birds					
Carnaby's Cockatoo	EN	EN	Forages in proteaceous heath and shrubland, eucalypt woodlands and introduced pine plantations. Nests in hollows and large eucalypts.	Numerous records (>2000) from KPBG and surrounding areas.	**Known to Occur:** Suitable foraging habitat within the Development Envelope and foraging evidence recorded; this species occurs regularly in KPBG.
Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)	EN	EN	Primarily eucalypt forests of Jarrah, Marri and Karri (*E. diversicolor*). Nests in hollows in large eucalypts.	A few scattered records on the coastal plain, including one from KPBG, but caution advised due to identification difficulties of *C. latirostris.* Records listed by KPBG from Recher, WA Museum and others appear to be referrable to *C. latirostris* and a result of taxonomic confusion. Generally restricted to the Darling Range in the Perth area.	**Unlikely to Occur:** Largely restricted to the Darling Scarp in the Perth area, and few records from the coastal plain, especially compared to *C. latirostris.* May visit the survey area on very rare occasions but overall is considered unlikely to occur.
Australasian Bittern (*Botaurus poiciloptilus*)	EN	EN	Freshwater wetlands with dense reed beds of *Baumea* or *Typha* for breeding and roosting, and more open sedgelands and grassed areas for foraging.	Old records (early 1900s) from several wetlands witin 10 km; most recent records from the mid -2000s at Herdsman Lake, ~5 km to the northwest.	**Would not Occur:** Is now a rare visitor to the Perth area, and no suitable habitat in the Development Envelope.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	VU	VU	Eucalypt forests of Jarrah, Marri and Karri, with recent movement into the Perth suburbs.	Numerous records from KPBG and surrounding areas.	**Known to Occur:** Red-tailed Black Cockatoos were observed on three occasions during the Biota (2020) survey and one observation of three birds perched in a *Eucalyptus megacarpa* just outside the Biota (2020) survey area.
Fork-tailed Swift (*Apus pacificus*)	Mi	Mi	Aerial over most habitat types.	Sparse records throughout the Perth Metropolitan area; nearest is 3 km southwest of the Development Envelope.	**Unlikely to Occur:** This species is highly mobile and known to occur occasionally in the region, but is a scarce visitor and would only overfly the survey area.
Glossy Ibis (*Plegadis falcinellus*)	Mi	Mi	Shallow margins of freshwater wetlands and adjacent flats, river pools, flooded samphire and sewage ponds.	Recorded from several nearby wetlands; most records from Herdsman Lake, approximately 5 km to the north west.	**Would not Occur:** No suitable habitat within the Development Envelope. The species occurs along the nearby Swan Estuary
Eastern Osprey (*Pandion cristatus*)	Mi	Mi	Coasts, estuaries, larger near coastal wetlands and rivers, offshore islands.	Numerous records from the Swan River, and few records from KPBG (probably mostly overflying birds).	**Would not Occur:** No suitable habitat within the Development Envelope. The species occurs along the nearby Swan Estuary and may overfly the area on occasion, but would not use the habitat in the Development Envelope.
Peregrine Falcon (*Falco peregrinus*)	OS	-	A wide range of habitats, including forests, woodland, wetland and coastal areas and open country.	Numerous records in the Perth area, including several from KPBG within 2 km of the Development Envelope.	**May Potentially Occur:** This species may occur in the Development Envelope as a foraging visitor, but unlikely to breed as there is no suitable breeding habitat. While this species may occur as a foraging visitor in the Development Envelope, it is unlikely to occur in the Conceptual Footprint due to the small footprint area in KPBG, along the edge of the reserve.

Species	Status*		Habitat	Regional Records	Likelihood of Occurrence in the Development Envelope and Conceptual Footprint
	EPBC Act	WA			
Black Bittern (*Ixobrychus flavicollis*)	P2	-	In the South-west region of Western Australia, primarily vegetated rivers and streams.	Records within 5 km of the Development Envelope are only "historical" (undated, prior 1976); no recent records from the region.	**Would not Occur:** No suitable habitat with the Development Envelope and the species is now extremely scarce (or possibly extinct) in the Perth area.
Masked Owl (*Tyto novaehollandiae*)	P3	-	Tall eucalypt and woodland, usually with open area, perhaps for hunting.	Three relatively recent (2000 onwards) records from within 10 km of the Development Envelope but few records overall on the Swan Coastal Plain.	**Unlikely to Occur:** No suitable habitat within the Development Envelope and the species is now extremely scarce (possibly extinct) in the Perth area.
Blue-billed Duck (*Oxyura australis*)	P4	-	Primarily deeper freshwater wetlands and swamps, often with less dense vegetation. Less commonly other wetlands such as salt lakes, sewage ponds and estuaries.	Nearest record approximately 1 km to the west at Shenton Park Lake, recorded from most wetlands in the region.	**Would not Occur:** No suitable habitat in the Development Envelope.
Australian Little Bittern (*Ixobrychus dubius*)	P4	-	Dense reed beds in freshwater wetlands.	Nearest records from Lake Monger and Herdsman Lake. Approximately 5 km northwest of the Development Envelope.	**Would not Occur:** No suitable habitat in the Development Envelope.
Reptiles					
Jewelled South-west Ctenotus (*Ctenotus gemmula*)	P3	-	Banksia woodlands with low vegetation.	No recent records (later than 1970s) from the region.	**Unlikely to Occur:** Suitable habitat but no recent records from the region.
Lerista lineata	P3	-	Coastal dunes, Banksia/Eucalypt woodlands and suburban gardens.	Several records within 10 km of the Development Envelope, but none north of the Swan River.	**Unlikely to Occur:** Not known to occur north of the Swan River.
Black Striped Snake (*Neelaps calonotus*)	P3	-	Coastal dunes and Banksia/Eucalypt woodlands.	Nearest record is a historical record from the northern edge of KPBG, approximately 2 km from the Development Envelope. This species still occurs at Bold Park, approximately 5 km west of the Development Envelope.	**May Potentially Occur:** Habitat within the Development Envelope is potentially suitable, although there are no recent records from KPBG. Unlikely to occur in the Conceptual Footprint due to the small footprint area within KPBG.
Invertebrates					
Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*)	P3	-	Banksia woodland and heathland on sandy soils.	Previous records from KPBG.	**May Potentially Occur:** While this species may potentially occur in the Development Envelope due to suitable habitat and the species has been recorded previously from KPBG, it is unlikely to occur in the Conceptual Footprint due to the small footprint area within KPBG.
Inornate Trapdoor Spider (*Euoplos inornatus*)	P3	-	Poorly known; woodlands, including creek banks.	One sighting from 1998 from KPBG; most other records are from further east.	**Unlikely to Occur:** Only one record within KPBG.

Species	Status*		Habitat	Regional Records	Likelihood of Occurrence in the Development Envelope and Conceptual Footprint
	EPBC Act	WA			
Graceful Sunmoth (*Synemon gratiosa*)	P4	-	Breeding is specifically associated with *Lomandra maritima* and *L. hermaphrodita.*	Historical records (1930s) from KPBG; recorded in Shenton Bushland in 2010.	**Unlikely to Occur:** No records from KPBG since the 1930s. Very limited occurrence of the host species *Lomandra hermaphrodita.*

* CR = Critically Endangered; EN = Endangered; VU = Vulnerable; CD = Conservation Dependent; Mi = Migratory; OS = Other specially protected species; P = Priority species.

Black Cockatoos

The Development Envelope falls within known (and predicted) distributions of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, as described in the Department of Sustainability, Water, Environment, Populations and Communities (DSEWPaC) 2012 referral guidelines (DSEWPaC 2012b) and DotEE (2017) draft referral guidelines. The Carnaby's Cockatoo is the predominant species on the Swan Coastal Plain (EPA 2019) and is a common visitor to the Perth area, particularly during the non-breeding season. There are over 2,000 records from KPBG and its immediate surrounds (Biota 2020). Both BGPA data and DBCA data indicate recent records of observations of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo within KPBG. There are no known breeding locations of Carnaby's Cockatoos within Perth's inner suburbs (Biota 2020).

Marri nuts with chew marks indicative of Carnaby's Cockatoo were found within the Biota (2020) survey area (Figure 9). The Forest Red-tailed Black Cockatoo was recorded from the Biota (2020) survey area on two occasions during the assessment. The third sighting by Biota (2020) involved three individuals perched in a *Eucalyptus megacarpa* tree outside the Development Envelope (Figure 9).

The breeding distribution of Carnaby's Cockatoo on the Swan Coastal Plain includes coastal areas such as Yanchep, Baldivis and Lake Clifton near Bunbury. While programmes using artificial nest boxes around Perth have had some success, no wild breeding has been reported in Perth's inner urban areas (Biota 2020). Forest Red-tailed Black Cockatoos nest in hollows in Jarrah, Marri and *Eucalyptus diversicolour* (Karri) trees, with eggs laid in October and November. They feed primarily on seeds of Eucalypts and other species such as *Allocasuarina* spp. (Johnstone and Storr 1998). More recently, the species has begun foraging on Cape Lilac (**Melia azedarach*) on the Swan Coastal Plain.

The Swan Coastal Plain is generally more important to Black Cockatoos as a feeding ground and only small areas support breeding to the north of Perth (DotEE 2017, EPA 2019). Foraging habitat is defined as areas including plants of species known to support foraging within the range of each Black Cockatoo species. While a broader range of species utilised for foraging (including introduced species such as **Pinus* spp.), Marri and Jarrah woodlands are particularly important to the Forest Red-tailed Black Cockatoo, while Banksia woodlands and proteaceous heath (i.e. shrublands dominated by *Banksia* spp. and *Hakea* spp. and Grevillea spp.) are also utilised by Carnaby's Cockatoo (DSEWPaC 2012b, EPA 2019).

Black Cockatoo Breeding Habitat

During the targeted Black Cockatoo Habitat Assessment completed by Biota (2020), a total 38 Suitable DBH Trees were identified in the survey area. These comprised 28 *Eucalyptus marginata* (Jarrah), four *Corymbia calophylla* (Marri), three dead stags of indeterminate species (likely Jarrah), one *Eucalyptus gomphocephala* (Tuart) and two *Eucalyptus* sp. of unknown species that are likely introduced (recorded from the Winthrop Avenue Median strip). Two 'Trees with a Suitable Nest Hollow' were recorded within survey area, however these are located outside of the Development Envelope (Biota 2020).

Of the 38 Suitable DBH Trees a total of five trees comprising two Marri, two Jarrah and one introduced *Eucalyptus* sp. are located within the Development Envelope.

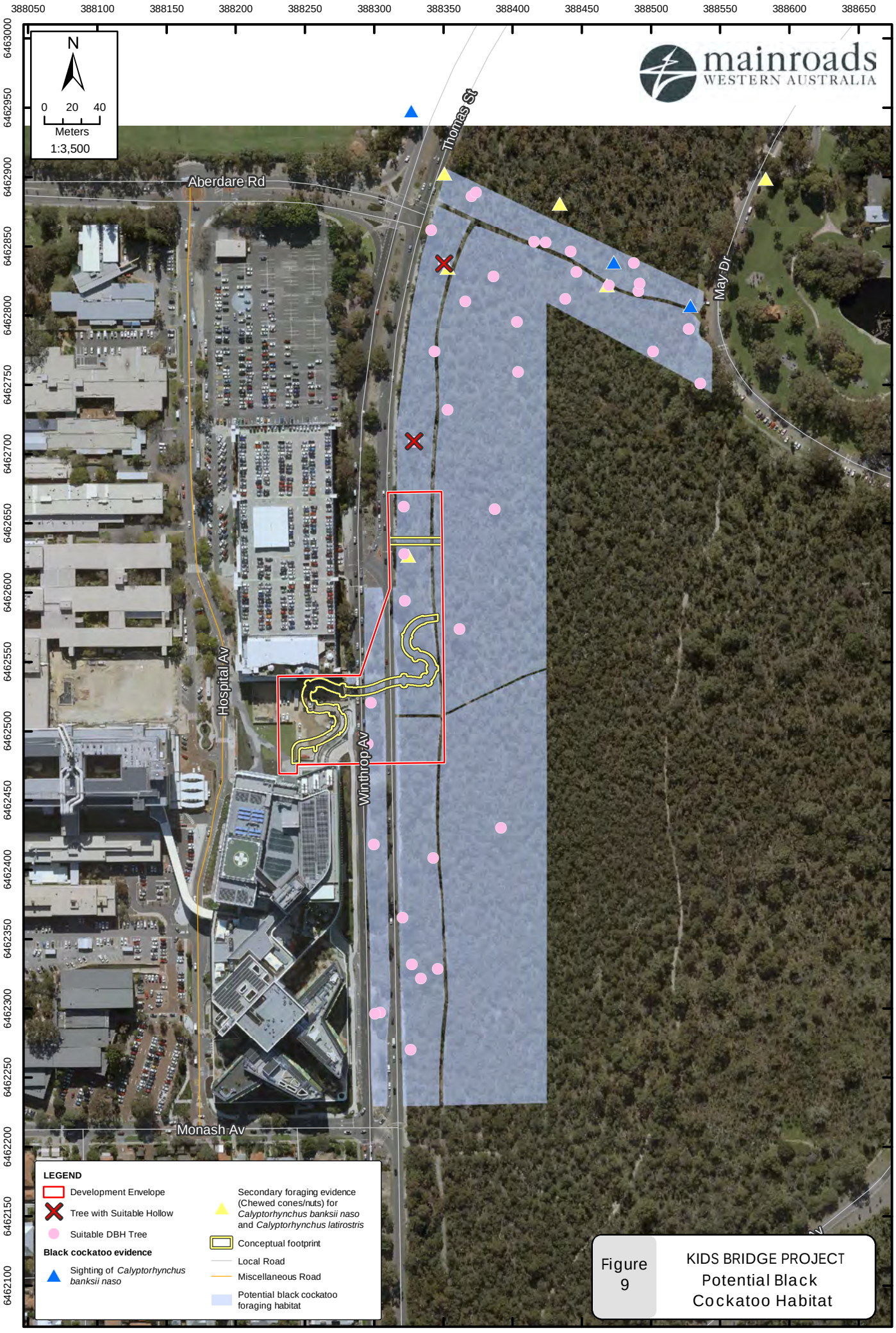
Black Cockatoo Foraging and Roosting Habitat

The Development Envelope contains quality foraging habitat for Black Cockatoos. The dominant tree and shrub species within the Development Envelope (Jarrah, Banksia and Sheoak) all represent foraging species for Black Cockatoos and evidence of foraging on these species was recorded during the survey (within vegetation associations 'DBm' and 'DBg'). Marri nuts with chew marks

indicative of Carnaby's Cockatoo were found. Two small Norfolk Island Pines were also noted within the median strip (within 'PC' vegetation), which may represent a foraging plant for Carnaby's Cockatoo, despite being in poor condition.

KPBG including the majority of the Development Envelope provides quality foraging habitat for Black Cockatoos. Vegetation associations 'DBm' and 'DBg' were assessed as being quality foraging habitat for Black Cockatoos, while areas mapped as 'PC' were considered poor quality foraging habitat. The Development Envelope provides a combined total of up to 0.77 ha of suitable foraging habitat for Black Cockatoos. There is a total of 0.63 ha of quality foraging habitat and 0.14 ha of poor quality foraging habitat for Black Cockatoos within the Development Envelope.

There are no known roosting sites within the Development Envelope. A known roosting site within Kings Park ('KINPERR001', located 1.5 km north east of the Development Envelope) was recorded in the Great Cockatoo count of 2017 (Figure 10). However, no Black Cockatoos were recorded at the same site in 2018, nor during any of the counts at the site in the five years prior (Peck et al. 2019).



Document Path: Y:\Metropolitan Region\Environment\Project Files\Kings Park - Childrens' Hospital Pedestrian Bridge\GIS and Shapefiles\Mxds\Kings Park Bridge_BCHabitat_v1.mxd
Source: Aerial image: Skyview 2020. Black Cockatoo Trees/Habitat: Biota (2019)
Created by: DWhite

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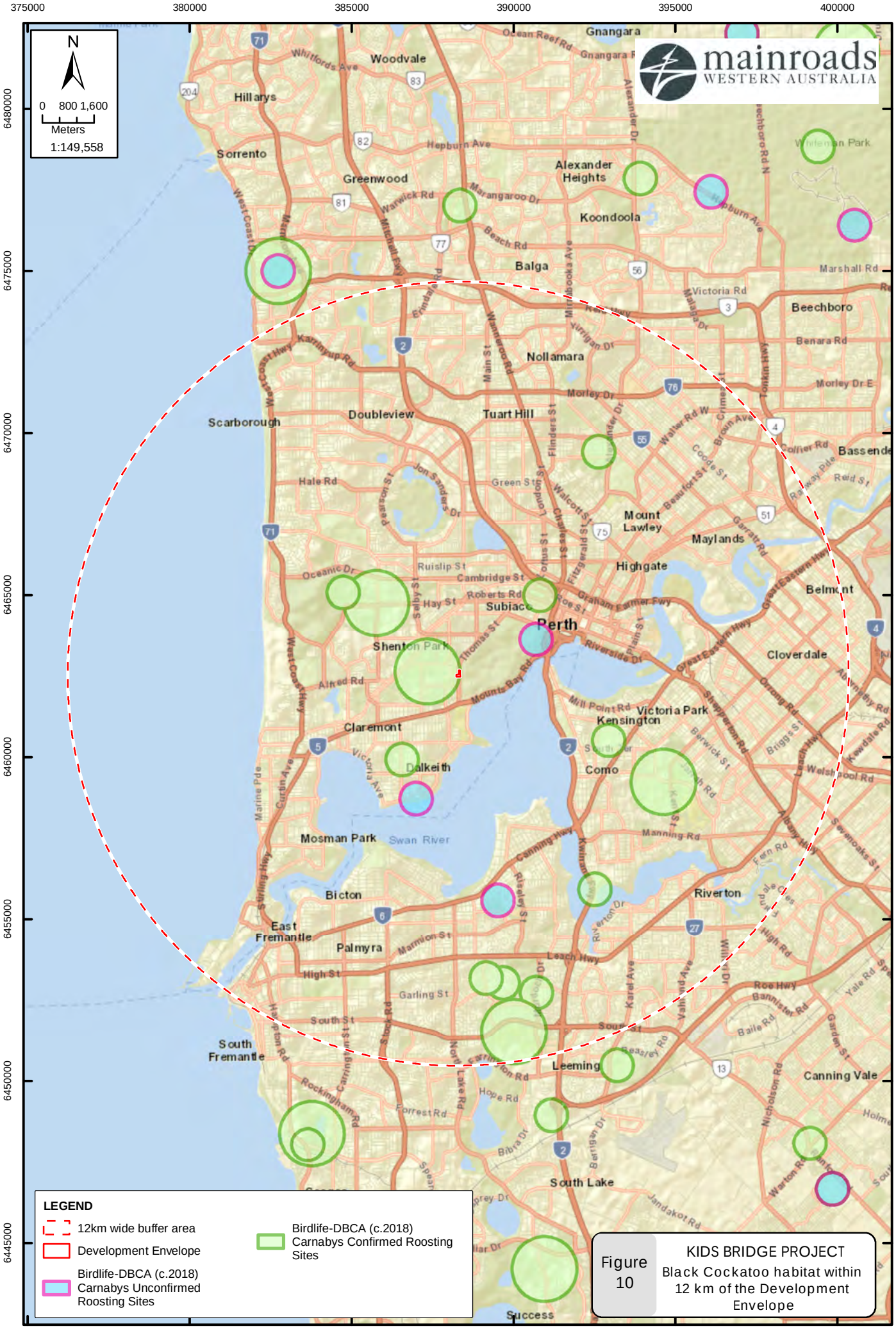

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Source: Aerial image: Skyview 2020. Black Cockatoo Trees/Habitat: Biota (2019)
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Quenda, Southwestern Brown Bandicoot (*Isoodon fusciventer*)

Quenda (*Isoodon fusciventer*) occurs in patches through the South-west of Western Australia, from just north of Perth through to Esperance. It occurs in a variety of habitat types, including forest, woodland, shrubland and heathland, but prefers areas with dense undergrowth for shelter. It also favours sandy substrates to allow for digging up food, and often occurs in association with wetland areas (Van Dyck and Strahan 2008).

Quenda have recently (approximately seven years ago) been re-introduced to some parts of KPBG, by uncertain means and have since become established. However, they reportedly do not yet occur in the vicinity of the Development Envelope and no observations of individuals or secondary evidence were made during Biota (2020) biological survey or by BPGA personnel during their routine surveys. In addition, the habitat within the Development Envelope lacks the dense ground cover preferred by Quenda, although it is noted that they do currently occur in areas elsewhere in KPBG bushland with a similar density of ground cover (C. McChesney, BGPA, pers. comm. 2019). This species may potentially occur in the Development Envelope, although the habitat is not optimal. While this species may potentially occur in the Development Envelope, it is considered unlikely to occur in the Conceptual Footprint due to the small footprint area within KPBG, along the edge of the reserve.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is a BC Act Other Specially Protected Fauna species, occurring throughout Australia, except perhaps for some desert areas and the Nullabor Plain (Johnstone and Storr 1998). It occupies a wide range of habitats including woodlands, wetlands, open country and built up areas. This species breeds primarily on ledges in cliffs, granite outcrops, quarries and tall buildings, but will also use hollow trees and old nests of raptors or corvids (Johnstone and Storr 1998).

Peregrine Falcons are seen regularly in central Perth and breed on tall buildings in the Central Business District. There are several records from KPBG. This species is highly mobile and vagrant. This species may occur in the Development Envelope as a foraging visitor, but unlikely to breed as there is no suitable breeding habitat. While this species may occur as a foraging visitor within KPBG, it is unlikely to occur in the Conceptual Footprint due to the small footprint area in KPBG, along the edge of the reserve.

Black-striped Snake (*Neelaps calonotos*)

The Black-Striped Snake is a DBCA Priority 3 listed species, restricted to the sandy coastal strip of the Swan Coastal Plain between Mandurah and Lancelin, with some records inland at Gingin, Bullsbrook and Caversham. This species primarily occurs on dunes and sandplains vegetated with heaths and Eucalypt or Banksia woodlands. There is suitable habitat for this species within the Development Envelope and the primary prey species, *Lerista praepedita,* occurs in KPBG. Although there are no recent local records of the species, this species is still considered to potentially occur due to the presence of suitable habitat. Habitat in the Development Envelope is potentially suitable, however this species is considered unlikely to occur in the Conceptual Footprint due to the small footprint area within KPBG, along the edge of the reserve.

Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*)

The Swan Coastal Plain Shield-backed Trapdoor Spider is a DBCA Priority 3 listed species, with a widespread distribution throughout the Swan Coastal Plain from Dallyellup north to at least Ledge Point (including Rottnest Island and Garden Island). The species is known to persist in the remnant bushland of KPBG, Bold Park and Shenton Park (Rix et al. 2018). While this species may potentially occur in the Development Envelope, it is considered unlikely to occur in the Conceptual Footprint due to the small footprint area within KPBG, along the edge of the reserve.

4.4.4 Potential Impacts

Direct Impacts

The Development Envelope (1.35 ha) comprises approximately 0.58 ha of cleared areas that provides limited value as habitat to fauna. The Proposal has the potential to directly and indirectly impact fauna and fauna habitat in the remaining 0.64 ha of remnant vegetation, as well as potentially impacting fauna in some areas of parkland cleared and planted vegetation (0.14 ha) during the construction phase.

Potential direct impacts to fauna species known or potentially occurring within the Development Envelope include:

- Clearing of up to 0.1 ha of potential fauna habitat (total amount of all area of potential fauna habitat)
- Clearing of up 0.1 ha of Black Cockatoo (Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo) known foraging habitat. No known roosting, Trees with a Suitable Nest Hollow or Suitable DBH Trees will be impacted by the Proposal as the bridge will avoid clearing all Suitable DBH Trees within the Development Envelope.

Indirect Impacts

The Proposal may also result in indirect impacts to fauna including:

- Habitat fragmentation.
- Spread of weeds and Dieback into the surrounding fauna habitat.
- Disruption or disturbance to fauna as a result of noise, vibration, light and dust emissions from construction activities.

4.4.5 Assessment of Impacts

4.4.5.1 Direct Impacts

Clearing and Loss of Habitat

The Proposal will result in the clearing of up to 0.1 ha of fauna habitat within the 1.35 ha Development Envelope. This is considered to be a conservative disturbance figure as actual clearing is expected to be less than this amount. Pruning within the Conceptual Footprint will be the preferred method over clearing where possible and no Suitable DBH Trees will be cleared within the Development Envelope.

Further discussion on potential impacts to significant fauna is provided below.

Impact to Significant Fauna

Clearing of the Proposal has the potential to impact on significant fauna including:

- Loss of potential foraging habitat for Black Cockatoos (approximately 0.1 ha of potential habitat), including Carnaby's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable).

Black Cockatoos

No Suitable DBH Trees will be impacted by the Proposal (Figure 9). The eastern portion of the footprint is located in KPBG, which contains large areas of foraging, and potential breeding habitat in similar condition (approximately 320 ha). The foraging habitat within the clearing footprint is approximately 0.03% of a larger patch of similar quality foraging habitat within KPBG (Biota 2020).

Biota (2020) has estimated that at least 725 ha of foraging habitat exists within 12 km of the Development Envelope. The 0.1 ha of potential Black Cockatoo habitat to be cleared represents less than 0.1% of the foraging habitat (and potential areas of suitable breeding and roosting) available within a 12 km radius of the Development Envelope in conservation reserves (Biota 2020).

The EPA (2019) identifies the importance of retaining foraging habitat in proximity to identified roosting and nesting habitat, noting individuals of Carnaby's Cockatoo may forage in areas up to 12 km of the identified roosting and nesting habitats and with such foraging habitat assisting with habitat connectivity and movement of individuals across the landscape (Le Roux and Shah 2006 in EPA 2019). The Great Cockatoo Count of 2017 recorded eight white-tailed Black Cockatoos (most likely Carnaby's Cockatoo) at a known roosting site within KPBG (Site KINPERR001, approximately 1.5 km east-north-east of the Development Envelope) (Peck et al. 2017). The removal of 0.1 ha of foraging habitat is unlikely to cause a long-term decrease in the population of Black Cockatoos given the extent available high quality foraging habitat within 12 km of this roost site.

Given the lack of breeding habitat present within the Development Envelope and the highly mobile nature of Black Cockatoo species (e.g. birds that can fly), the Proposal is not expected to affect any Black Cockatoo individuals which could result in a long-term decrease on the population of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo.

The clearing of 0.1 ha of quality foraging habitat is not expected to have a significant impact on Black Cockatoos.

4.4.5.2 Indirect impacts

Habitat Fragmentation

Clearing of native vegetation will occur on the edge of KPBG along Winthrop Avenue. This is not expected to cause permanent fragmentation or edge effects to fauna habitat within KPBG, due to the small amount of clearing (0.1 ha) required. The footprint for the Proposal has been selected to avoid vegetation in 'Excellent' condition. The footprint has instead been designed to overlap 'Cleared' areas and vegetation in 'Degraded' and 'Very Good' condition. The potential fragmentation resulting from implementation of the Proposal is expected to be highly localised and no significant residual impacts are anticipated.

Construction Activities

Temporary secondary impacts on fauna may also occur through noise, vibration, light and dust during construction. Increased noise, vibration and dust may result in native fauna avoiding the area however, is not expected to have any permanent implications on fauna, given the small size of disturbance of habitat within the Development Envelope (0.1 ha).

4.4.6 Mitigation

Mitigation and management measures for the Proposal have been developed using the EPA's mitigation hierarchy. Mitigation measures will continue to be developed and refined through the detailed design process to avoid and minimise impacts to fauna. Where impacts cannot be avoided during the detailed design phase, they will be minimised. The avoidance and mitigation measures for impacts to fauna are detailed below.

Avoid

- Selection of a design that fulfils safety objectives within the smallest practicable construction footprint.
- Optimising use of 'Cleared' areas for the footprint of the Kids Bridge. Using the cleared landscape has been a key consideration in the selection of the Kids Bridge Conceptual Footprint and hence delineation of the Development Envelope.

- The footprint for the Kids Bridge has been carefully positioned to avoid impacts where possible. This has included the avoidance of Black Cockatoo Suitable DBH Trees and where possible, quality Black Cockatoo foraging habitat through the design process.

Minimise

- Minimisation of clearing footprint through the detailed design process in close consultation with BGPA.
- Restricting, where possible, clearing of vegetation to the footings of the Kids Bridge and surrounding areas required for safety and work requirements. Pruning will be preferred over clearing where possible.
- Clearing and pruning will be undertaken with supervision by staff from BGPA.
- Development of a CEMP to define techniques to minimise risks to native fauna and provide monitoring during construction.
- Wherever practical, clearing will be undertaken on one front only, to provide an opportunity for fauna to move out of the Development Envelope into adjacent vegetated areas.
- If native fauna is disturbed during clearing, it shall be allowed to make its own way to adjacent vegetated areas within KPBG.
- Native mammals or birds injured as a result of the Proposal construction or operation shall be taken to a designated veterinary clinic or a wildlife carer.
- Dust, noise and vibration management measures as outlined in a project specific CEMP.

4.4.7 Predicted Outcome

The Proposal will result in the removal of up to 0.1 ha of fauna habitat, consisting of quality foraging habitat for Black Cockatoos. By selecting a footprint for the Proposal that minimises impacts to fauna, as well as implementing mitigation measures to address potential impacts, it is expected that the EPA's objective for Terrestrial Fauna will be met. It is expected that the Proposal will be managed so that the only residual potential impacts are those summarised in Table 18. As outlined previously, the extent of clearing associated with the Proposal will be refined through detailed design and the actual amount of clearing will be less than current estimates.

Table 18: Predicted Residual Impact to Fauna

Scale	Summary of Residual Impacts
Fauna Habitat	Loss of up to 0.1 ha of fauna habitat.
Black Cockatoos	Loss of up to 0.1 ha of quality Black Cockatoo foraging habitat.

4.5 Preliminary Key Environmental Factor – Social Surroundings

The EPA's objective for social surroundings is '*to protect social surroundings from significant harm'* (EPA 2018b).

4.5.1 Policy and Guidance

- Environmental Factor Guideline 'Social Surroundings' (EPA 2016g).
- Guidance for the Assessment of Environmental Factors 'Assessment of Aboriginal Heritage No. 41' (EPA 2004).
- *Aboriginal Heritage Act 1972*
- Environmental Protection (Noise) Regulations 1997.

4.5.2 Receiving Environment

Cultural Heritage

No Registered European heritage sites occur within the Development Envelope. A desktop search was undertaken of the State Heritage Register and the closest European heritage site is 'Park Avenue Building' (Place ID 814) located approximately 500 m to the southeast of the Development Envelope. One Municipal Heritage Place 'Queen Elizabeth II Medical Centre' occurs in the western portion of the Development Envelope.

Aboriginal Heritage

The Development Envelope occurs within the Whadjuk Indigenous Land Use Agreement (ILUA) area. A search of the Aboriginal Heritage Inquiry System (AHIS) did not identify any Registered Aboriginal Heritage sites within the vicinity of the Development Envelope. One 'Other Heritage Place' titled 'KPBG' (Place ID 18936) is mapped over the eastern portion of the Development Envelope within KPBG, however this is listed as 'not a site' (DPLH 2020).

Aboriginal heritage surveys for the Proposal were conducted in February 2020 by Archae-aus and . The survey included both archaeological and ethnographic components. No archaeological Aboriginal sites or isolated cultural material were identified during the course of the survey.

Land Use

The Development Envelope intersects three land parcels which are comprised of Crown, Reserve and the road Lot 'Winthrop Avenue'.

A portion of land within the eastern section of the Development Envelope is located within KPBG, which is Crown land and a 'Class A' Nature Reserve (Figure 1). This land is currently managed by BGPA. A formal agreement will be entered between Main Roads and BGPA to outline roles and responsibilities for the Kids Bridge, along with access, construction and rehabilitation requirements.

The remaining portion of land is the Queen Elizabeth II Medical Centre Reserve (Figure 1). This is Crown Land and a Class A reserve with the Primary Interest Holder being the QEIIMC Trust. A Management Order (vesting) has been given to the QEIIMC Trust. A formal agreement will be entered with the QEIIMC trust outlining the roles and responsibilities relating to the Kids Bridge.

Visual Amenity

Changes to amenity are potentially the greatest in areas with a high perceived scenic amenity value which are visible from public locations, such as roads, walk trails and lookouts.

The design process has undergone significant stakeholder involvement in all stages of the design, including from the OGA, to ensure that the Kids Bridge provides a safe and high value aesthetic

experience. The final design will align with the requirements of PCHF, QEIIMC, CAHS, OGA, City of Perth and BGPA to ensure that visual amenity is enhanced.

Noise and Vibration

The existing noise environment within the vicinity of the Development Envelope is anticipated to be dominated by the following local noise sources:

- Traffic noise associated with Winthrop Drive.
- Natural (leaves rustling, wind in trees and bird and insect calls).

Noise from the construction of the Proposal will be temporary and localised.

4.5.3 Potential Impacts

Direct Impacts

In the absence of suitable mitigation measures, construction of the Proposal could potentially result in the following impacts to social surroundings:

- Aboriginal Heritage Site disturbance during clearing and/ or excavation works.
- Reduced visual amenity during construction.
- Noise impacts to sensitive receptors, from noise emissions generated by construction activity within the Development Envelope (equipment and vehicle operation).

Indirect Impacts

Construction of the Proposal may potentially affect the amenity of residents and users of KPBG for recreational purposes during the construction phase. The nearest residence is approximately 300 m to the southwest of the Development Envelope.

4.5.4 Assessment of Impacts

4.5.4.1 Direct Impacts

Heritage Site Disturbance During Clearing and/or Excavation Works

No Registered Heritage sites occur within the Development Envelope. One ‘Stored Data’ site titled ‘KPBG’ (ID 18936) is mapped over the eastern portion of the Development Envelope within KPBG. This site has been previously assessed and deemed not to be a site (DPLH 2020). No Aboriginal heritage sites were identified within the Development Envelope during the completed ethnographic and archaeological survey. As such, no impacts to Aboriginal heritage will occur as a result of implementation of the Proposal.

The Municipal Heritage Place ‘Queen Elizabeth II Medical Centre’ mapped over the western portion of the Development Envelope. Proposal activities are not expected to impact this Municipal Heritage Place.

Noise and Vibration Impacts from Construction

Noise and vibration impacts are expected to result only from the construction phase, however these impacts are expected to be short in duration and not expected to be significant.

Reduced Visual Amenity

Reduced visual amenity impacts are expected to only occur during the construction phase. These impacts are expected to be short and not expected to be significant.

The Kids Bridge has been designed to be visually appealing and is expected to enhance the visual amenity for the area. No residual impacts to visual amenity are expected for the Proposal.

4.5.4.2 Indirect Impacts

Construction of the Proposal may potentially affect the amenity of residents and users of KPBG for recreational purposes during the construction phase only. These impacts are expected to be minor and short term. Indirect impacts from the Proposal on social surroundings are anticipated to be limited or negligible.

4.5.5 Mitigation

Impacts to social surroundings are considered minor, however any impacts will be minimised through the detailed design phase and during construction through the following mitigation and management as detailed below.

Avoid

- Limit construction activity to normal hours (between 7am to 7 pm Monday to Saturday) and liaise with the City of Perth if construction activities are required outside of these hours.

Minimise

- Any potential risk to sites of Aboriginal heritage significance will be managed through the CEMP and consultation with all relevant groups. Works for the Proposal will be undertaken in accordance with the *Aboriginal Heritage Act 1972* (AH Act).
- Potential impacts from construction noise will be mitigated through measures outlined in the CEMP which will include:
    - Ensure compliance with the requirements of the Environmental Protection (Noise) Regulations.
    - Communicate the need to undertake out of hours project activities to the community, where necessary.
    - Adopt construction techniques that will minimise noise vibration impacts within nearby sensitive receptors, particularly for compaction operations.
    - Undertake compaction operations during normal business hours and maximise separation distances between vibration inducing activities and nearby sensitive receptors.
    - A complaints register to be maintained by the Contractor.
- Impacts to visual amenity will be addressed through the detailed design of the Proposal and will be minimised and suitably managed through the implementation of a CEMP. The Proposal is expected to contribute to the enhancement of visual amenity for the area.

4.5.6 Predicted Outcome

Construction and operation of the Proposal is likely to result in minor impacts to visual and noise amenity during the construction phase of the Proposal and residual social impacts are not expected.

It is expected that the EPA objective for Social Surroundings will be met.

5 OFFSETS

5.1 Background

Environmental offsets are conservation actions that provide environmental benefits intended to counter balance the significant residual environmental impacts associated with a proposal (Government of Western Australia 2014).

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design, development and implementation of the CEMP and finally, an offset proposal. Application of the management hierarchy has been documented throughout this document.

5.2 Significant Residual Impact

The Proposal is not expected to have a significant residual impact, given the minor scale and nature of the proposed impacts, the revegetation and the management measures to be applied.

5.3 Offset Strategy

Main Roads proposes to develop an offset strategy for this Proposal in accordance with the Western Australian Offset Guidelines (Government of Western Australia 2014). Development of the strategy will include liaison with relevant agencies and other stakeholders to identify suitable offsets.

Main Roads has successfully delivered environmental offsets for projects through the state. This delivery includes working closely with relevant agencies and other stakeholders to identify suitable offsets, acquire offsets and implement the strategy.

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

6.1 Controlled Action Provisions

6.2 Policy and Guidelines

MNES are listed and protected under the following legislation and guidelines:

- *Environment Protection and Biodiversity Conservation Act 1999* Act.
- Environment Protection and Biodiversity Conservation Regulations 2000.
- Significant Impact Guidelines (No.1.1): Matters of National Environmental Significance (DotE 2013).

6.3 Summary of Existing Environmental Values and Potential Impacts on MNES

A number of desktop and targeted field surveys have been undertaken for the Proposal in order to assess the presence of MNES which trigger the requirement for referral (Sections 4.3 and 4.4) and have been summarised in Table 19.

The EPBC Act protects and manages MNES, which includes nationally and internationally Threatened species and TECs. The Biota (2020) assessment identified three MNES that have the potential to be impacted through the Proposal. These include:

- *Banksia Woodlands of the Swan Coastal Plain* (BWSCP) TEC listed as Endangered.
- *Calyptorhynchus latirostris* (Carnaby's Cockatoo) listed as Endangered.
- *Calyptorhynchus banksia naso* (Forest Red-tailed Black Cockatoo) listed as Vulnerable.

The MNES identified in the Development Envelope and the potential impacts from the Proposal are summarised in Table 19.

Table 19: Matters of National Environmental Significance within the Development Envelope

MNES	Impact of Proposal
Listed Threatened Ecological Communities	Direct loss of up to 0.1 ha of BWSCP TEC (see Section 4.3).
Listed Threatened Flora	No EPBC Act listed flora were identified during detailed and targeted field surveys within the Development Envelope (see Section 4.3) and none are expected to be impacted by the Proposal.
Listed Threatened Fauna	Direct loss of up to 0.1 ha of habitat for the following EPBC Act listed fauna species known to occur within the Development Envelope (see Section 4.4); Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Vulnerable), including approximately: • 0.1 ha of very quality foraging habitat. The foraging habitat contains dominant tree species including Jarrah (*Euclayptus marginata*) and Sheoak (*Allocasuarina fraseriana*) as well as other proteaceous plant species such as *Banksia, Hakea* and *Grevillea* spp. No Suitable DBH trees will be cleared for Proposal.

6.4 Mitigation Measures

Mitigation measures to address potential impacts on MNES are outlined in relevant sections for each preliminary key environmental factor in this document and will also be detailed in the project CEMP, to reduce potential impacts on MNES.

6.5 Summary of Assessment of Level of Significance of Impact on MNES

In determining the significance of clearing up to 0.1 ha of the BWSCP TEC for the Proposal, consideration was given to the significance impact criteria, as described in Section 2.2.4 of DotEE's *Approved Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain Ecological Community* (TSSC 2016) (Table 20). The significance of clearing was also assessed against the impact criteria for Critically Endangered and Endangered Ecological Communities outlined in DotEE's *Significant Impact Guidelines 1.1 Matters of National Environmental Significance* (DotEE 2013) (Table 21). Given the nature and scale of this Proposal, clearing of up to 0.1 ha of BWSCP TEC for this Proposal is not considered significant.

In determining the significance of clearing of up to 0.1 ha of quality foraging habitat, an assessment against the impact criteria for Endangered species outlined in DAWE's *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DotEE 2013) (Table 22) was completed. A review of the 2012 Referral Guideline for Black Cockatoos was also undertaken, which did not indicate that referral to the DotEE was necessary for the Proposal. Given the nature and scale of the Proposal, it is considered that the clearing of up to 0.1 ha quality foraging habitat for this Proposal is not significant.

The Threat Abatement Plan for disease in natural ecosystems caused by *Phytopthorra cinnamomii* was also used to assess the potential impacts on MNES within the Development Envelope, presented in Table 23.

Table 20: Application of Significance Impact Criteria in DotEE's Conservation Advice for Banksia Woodlands of the Swan Coastal Plain TEC to the Proposal (TSSC 2016)

Criteria	Description of proposed action in relation to significant impact criteria	Assessment
Large size and/or a large area to boundary ratio – larger area/boundary ratios are less exposed and more resilient to edge effect disturbances such as weed invasion and human impacts.	Vegetation to be cleared is associated with the edge of a BWSC TEC patch and areas adjacent/near to cleared areas (e.g. existing paths). The Proposal will have negligible impacts to area/boundary ratios and edge effect pressures.	Not significant.
Evidence of recruitment of key native plant species following disturbance (including through successful assisted regeneration).	Vegetation to be cleared has been subject to minimal disturbance. Recruitment of key native plant species unknown. Given the nature and scale of the clearing (i.e. less than 0.07% of the estimated TEC patch occurs within the Conceptual Footprint), the vegetation impacts are likely to be negligible.	Not significant.
Faunal habitat as indicated by patches that meet a diversity of habitat requirements and that contribute to movement corridors.	Vegetation to be cleared is part of a large tract of native vegetation that provides fauna habitat. Given the extent of the TEC patch and adjoining native vegetation, the Conceptual Footprint is not considered to be part of critical movement corridors.	Not significant.
High species richness, most evident from the variety of native plant species but may also be shown by a high number of native fauna species.	Vegetation to be cleared is in Very Good condition, but has been subject to weed invasion, particularly grasses and low-growing herbs. The Conceptual Footprint is continuous with adjacent areas of native vegetation in similar or better condition.	Not significant.
Presence of listed threatened species or key functional species such as key pollinator and dispersal animals.	Vegetation to be cleared provides habitat for listed Black Cockatoo species, however, is not considered critical habitat. The Conceptual Footprint is unlikely to contain critical habitat for key functional species such as key pollinator and dispersal animals.	Not significant.
Scarcity of weeds and feral animals or opportunities to manage them efficiently.	Vegetation to be cleared has been subject to weed invasion. Particularly grasses and low-growing herbs. However, the vegetation is located within KPBG, which has opportunities to manage weeds and feral animals. The area will be subject to intensive management by BGPA. Given the nature and scale of the clearing (i.e. less than 0.07% of the estimated TEC patch occurs within the Conceptual Footprint), the vegetation impacts are likely to be negligible.	Not significant.
Absence or limited symptoms of Dieback.	A recent Dieback occurrence assessment (Glevan 2020) identified no Dieback infestations or evidence of disease presence within the Development Envelope and surrounding area. The potential for the introduction and/or spread of Dieback can be appropriately managed through standard hygiene procedures during land clearing to ensure plant pathogens are not introduced or spread. The implementation of standard hygiene procedures will assist in ensuring the Proposal will not introduce an/or spread disease to an extent which may impact surrounding vegetation.	Not significant.
Connectivity to other native vegetation remnants or restoration works (e.g. native plantings). In particular, a patch in an important position between (or linking) other patches in the landscape.	Vegetation to be cleared is part of a large tract of native vegetation located within KPBG. Vegetation to be cleared is associated with the edge of a BWSCP TEC patch and is not considered in an important position between (or linking) other patches in the landscape.	Not significant.
Acts as important links to larger patches of nearby vegetation.	Vegetation to be cleared is part of a large tract of native vegetation located within KPBG. Vegetation to be cleared is associated with the edge of a BWSCP TEC patch and is not considered in an important position between (or linking) other patches in the landscape.	Not significant.
Occurs within an area where the ecological community has been most heavily cleared and degraded, so is locally or regionally at risk.	Vegetation to be cleared is associated with the edge of a BWSCP TEC patch and areas adjacent/near to cleared areas (e.g. existing paths). There has been a substantial decline in the geographic extent of the BWSCP TEC across the SCP (TSSC 2016). The vegetation to be cleared comprises less than 0.001% of the estimated extent of the BWSCP TEC on the Swan Coastal Plain. Given the nature and scale of the clearing, the vegetation impacts are likely to be negligible.	Not significant.

Criteria	Description of proposed action in relation to significant impact criteria	Assessment
Vegetation that is of a 'sub-community'/ floristic community type that is recognised as a TEC or Priority Ecological Community (PEC) by the Western Australian Government.	Vegetation to be cleared is considered representative of FCT 28, Spearwood *Banksia attenuata* or *Banksia attenuata* – Eucalyptus woodlands. FCT 28 is not recognised as a TEC in Western Australia.	Not significant.
Edge of the range of the ecological community.	The vegetation to be cleared is not at the edge of the range of the BWSCP TEC.	Not significant.

Table 21: Application of Significant Impact Guidelines 1.1 – Matters of National Environmental Significance for the Proposal for BWSCP TEC (DotEE 2013)

Criteria	Description of proposed action in relation to significant impact criteria	Assessment
Reduce the extent of an ecological community.	The action will result in the clearing of up to 0.1 ha of the BWSC TEC. The clearing is associated with the edge of a BWSCP TEC patch and areas adjacent/near to cleared areas (e.g. existing paths). The vegetation to be cleared is less than 0.07% of the estimated TEC patch (Biota 2020) and comprises less than 0.001% of the estimated extent of the BWSCP TEC on the SCP. The vegetation to be cleared is located on the western boundary of KPBG, which covers approximately 320 ha. Additional DBCA managed reserves occur within 10 km of the Proposal including Bold Park Reserve (R 45409).	Not significant.
Fragment or increase fragmentation of an ecological community.	The action will not fragment a TEC as it involves the removal of a small area associated with the edge of a BWSCP TEC patch and areas adjacent/near to cleared areas (e.g. existing paths). Connections to the adjacent TEC will remain north, south and east of the Proposal.	Not significant.
Adversely affect habitat critical to the survival of an ecological community	The action will not adversely affect habitat critical to the survival of the TEC.	Not significant.
Modify or destroy abiotic factors necessary for an ecological community's survival.	The action will not modify or destroy abiotic factors necessary for the TEC's survival. No changes to hydrological regime or nutrient inputs to soil are proposed as part of the Proposal.	Not significant.
Cause a substantial change in the species composition of an ecological community.	The action will not cause a substantial change in the species composition of the TEC.	Not significant.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community.	The action will result in the clearing of up to 0.1 ha associated with the edge of a BWSCP TEC patch and areas adjacent/near to cleared areas (e.g. existing paths). This action is not considered to be substantial as the clearing is less than 0.07% of the estimated TEC patch (Biota 2020). The action is unlikely to result in a substantial reduction in the quality or integrity of the broader TEC patch.	Not significant.
Interfere with the recovery of an ecological community.	The action will not interfere with the recovery of the TEC.	Not significant.

Table 22: Application of Significant Impact Guidelines 1.1 – Matters of National Environmental Significance to the Proposal for Black Cockatoos

Criteria	Description of proposed action in relation to significant impact criteria	Assessment
Lead to a long-term decrease in the size of a population.	The action will result in the clearing of up to 0.1 ha of quality foraging habitat and no potential breeding trees. The Proposal is located in KPBG (approximately 320 ha in size), which contains large areas of foraging, and potential breeding habitat in similar condition. The foraging habitat present within the Conceptual Footprint is less than 0.1% of a larger patch of similar quality foraging habitat within KPBG and is approximately 0.01% of the available foraging habitat within 12 km of the Proposal (Government of Western Australia 2019a). Clearing of Black Cockatoo foraging habitat is not expected to result in the loss of foraging or potential breeding habitat that could have a long-term decrease on the population of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. The EPA (2019) identifies the importance of retaining foraging habitat in proximity to identified roosting and nesting habitat, noting individuals of Carnaby's Cockatoo may forage in areas up to 12km of identified roosting and nesting habitats and with such foraging habitat assisting with habitat connectivity and movement of individuals across the landscape (Le Roux 2017 and Shah 2006 in EPA 2019). The Great Cockatoo Count of 2017 recorded eight white-tailed black-cockatoos (most likely Carnaby's Cockatoo) at a known roosting site (KINPERR001) (Peck et al. 2017), however no Black Cockatoos were recorded at the same site in 2018 (see Peck et al. 2019). Clearing by the Proposal of up to 0.1 ha of Black Cockatoo foraging habitat within a 12 km radius of the KINPERR001 roosting site is unlikely to cause a long-term decrease in the population of Black Cockatoos given the extent of available quality foraging habitat within 12 km of this roost site (approximately 725 ha) (Biota 2020). The Proposal will not clear any potential future breeding trees or trees containing hollows (suitable or otherwise) for Black Cockatoo breeding. Given the lack of breeding habitat present within the Conceptual Footprint and the highly mobile nature of Black Cockatoo species (e.g. birds that can fly), the Proposal is not expected to affect any Black Cockatoo individuals which could result in a long-term decrease on the population of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo.	Not significant.
Reduce the area of occupancy of the species.	As outlined by IUCN (2017), the 'area of occupancy' can be defined as "a scaled metric that represents the area of suitable habitat currently occupied by the taxon'. The Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo have estimated areas of occupancy of around 20 000 km² and 10,000 km² across south-western Australia respectively (DotEE 2019a, DotEE 2019b). The foraging habitat present within the Conceptual Footprint is less than 0.1% of a larger patch of similar quality foraging habitat within KPBG and is approximately 0.01% of the available foraging habitat within 12 km of the Proposal(Government of Western Australia 2019a). Accordingly, the Proposal is not expected to significantly reduce the total area of occupancy of the Forest Red-tailed Black Cockatoo or Carnaby's Cockatoo.	Not significant.
Fragment an existing population into two or more populations.	The Proposal will not fragment an existing population as it involves the removal of a small area of foraging habitat adjacent/near to the edge of a large patch of foraging habitat in similar condition. Connections to the adjacent foraging and breeding habitat will remain north, south and east of the Proposal. The scale and nature of the Proposal is not sufficient to sever connections between nearby areas of black cockatoo habitat, nor sever connections between two or more populations that occur within known distributions.	Not significant.
Adversely affect habitat critical to the survival of a species.	The Proposal will require the clearing of up to 0.1 ha of quality foraging habitat. The foraging habitat present within the Conceptual Footprint is less than 0.1% of a larger patch of similar quality foraging habitat within KPBG and is approximately 0.01% of the available foraging habitat within 12 km of the Project (GoWA 2019a). The effect of the clearing of Black Cockatoo foraging habitat by the Proposal is not expected to result in an adverse effect that the survival of the taxon or its habitat.	Not significant.

Criteria	Description of proposed action in relation to significant impact criteria	Assessment
Disrupt the breeding cycle of a population.	The Proposal will not remove any potential future breeding trees (>500 mm DBH) or any trees containing hollows (of suitable size or not) for nesting of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. Accordingly, the Proposal is not expected to disrupt the breeding cycle of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo.	Not significant.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	The Proposal will require the clearing of up to 0.1 ha of quality foraging habitat, which is less than 0.1% of a larger patch of similar quality foraging habitat within KPBG and is approximately 0.01% of the available foraging habitat within 12 km of the Proposal (Government of Western Australia 2019a). Considering the distributions of both Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, the extent of foraging habitat available in the local area and broader Swan Coastal Plain, the effect of clearing of 0.1 ha of foraging habitat for the Proposal is not expected to result in a loss of foraging habitat that could cause a decline in the population of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo.	Not significant.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	The scale and nature of the Proposal is not sufficient to sever connections between nearby areas of Black Cockatoo habitat, nor sever connections between two or more populations that occur within known distributions.	Not significant.
Introduce disease that may cause the species to decline.	The DEC (2008), DPaW (2013) and EPA (2019) identify the potential threats to the survival of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo as including declining vegetation health and other diseases. Dieback and Marri Canker (*Quambalaria coyrecup*) can infect species used by Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo for foraging, nesting and roosting. A recent Dieback occurrence assessment (Glevan 2020) identified no Dieback infestations or evidence of disease presence within the Development Envelope and surrounding area. The potential for the introduction and/or spread of Dieback (and Marri Canker, if present) can be appropriately managed through standard hygiene procedures during land clearing and construction to ensure plant pathogens are not introduced or spread. The implementation of standard hygiene procedures will ensure the Proposal will not introduce an/or spread disease to an extent which may cause a reduction in the quality of the black cockatoo foraging habitat present, which could in turn cause Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo to decline. The disease status of Black Cockatoos in the wild remains unknown, although infectious diseases such as beak and feather disease, avian polyomavirus and chlamydophilosis may pose a threat, as they are significant in other captive and free-living psittacine species. The Proposal not involve any actions which could potentially introduce infectious diseases within Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo populations which could cause the taxon to decline.	Not significant.
Interfere with the recovery of the species.	The Proposal will result in the clearing of up to 0.1 ha of quality foraging habitat. No potential breeding habitat will be removed as a result of the Proposal. The removal of foraging habitat is not expected to interfere with any natural or Government-led recovery of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo.	Not significant.

Table 23: Relevant Commonwealth threat abatement plan/objectives for potential impacts on MNES within the Development Envelope

Impact	Plan/Conservation Advice and Threats		Response
	DotEE (2018) 'Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*'		
	1	Identify and prioritise for protection of biodiversity assets that are, or may be, impacted by *Phytophthora cinnamomi*	The Proposal is considered to be consistent with this objective. Dieback mapping has been completed as part of the Proposal planning. No Dieback infestation was identified in or adjacent to the Development Envelope. A Hygiene Management Plan will be implemented for construction of the Proposal to minimise risk of any introduction or spread of this disease.
	2	Reduce the spread and mitigate the impacts of Phytophthora to protect priority biodiversity assets and susceptible landscapes	
	3	Inform and engage the community by promoting information about Phytophthora, its impacts on biodiversity and actions to mitigate these impacts	The Proposal is considered to be consistent with this objective. Extensive community and stakeholder consultation has been undertaken regarding environmental investigations and potential impacts (see Section 3).

6.6 Predicted Outcome

The predicted outcomes for MNES proposed to be impacted by the Proposal are:

- Direct loss of up to 0.1 ha of BWSCP TEC in Very Good condition.
- Direct loss of up to 0.1 ha of potential foraging habitat for Black Cockatoo Species (Carnaby's Cockatoo – Endangered and Forest Red-tailed Black Cockatoo - Vulnerable).

Based on the low level of impact to Threatened species and ecological communities listed under the EPBC Act from implementation of the Proposal and in consideration of significant impact guidelines, Main Roads considers that referral of the Proposal to DAWE is not warranted. Main Roads undertakes significant and regular consultation with DAWE to ensure both parties have a sound understanding of assessment thresholds and regulatory trends.

7 HOLISTIC IMPACT ASSESSMENT

In order to achieve a holistic view of how impacts may impact the wider receiving environment or specific species, the Environmental Impact Assessment process needs to consider the connections and interactions between ecosystems, communities, populations and the wider environment. This requires consideration of the impacts of the Proposal in a regional context as well as at the local scale.

The Kids Bridge project has been initiated by the Perth's Children's Hospital Foundation and the works have been identified in the KPBG Management Plan (BGPA 2014) as a major initiative and is aligned with the specific functions of KPBG including recreation and tourism.

There is currently no easy or safe access to KPBG from the Perth Children's Hospital and QEIIMC. The primary purpose of the Kids Bridge is to provide safe access for users, in particular children, from the Perth Children's hospital and QEIIMC, to the KPBG bushland and the included play areas within the KPBG reserve. Significant social benefits are expected to occur once the Kids Bridge is in operation, providing safe access for users whilst also providing a high value aesthetic and nature based experience. Significant social benefits are expected to occur once the Kids Bridge is completed.

The preliminary environmental and social impact studies undertaken for the Proposal have considered and assessed potential impacts at both local and regional scales and the results have informed the impact assessment and development of mitigation measures. Biological survey work has been undertaken with assistance from BGPA to inform the environmental values in the Development Envelope and potential impacts of the Proposal. This information has assisted in reducing the Conceptual Footprint to avoid impacts to flora, vegetation and fauna.

While it is considered that the Proposal will not have significant adverse impacts on environmental or social factors, it is recognised that there may be a high level of public interest in this proposal.

The Proposal's predicted outcomes have been considered in relation to the environmental principles (see Section 4.1) and the EPA's environmental objectives for each Preliminary Key Environmental Factor.

Main Roads considers that the significant measures undertaken to date to reduce the Proposal's impacts and the efforts made to design the Kids Bridge to avoid or minimise impacts on environmental values, and the commitment to develop and implement a CEMP, will ensure that the EPA's objectives for each key environmental factor will be met.

8 REFERENCES

Arbor Centre (2014). KPBG Link Kids Bridge Stage 1 Preliminary Arboricultural Assessment. Arbor Centre, Wattle Grove, WA.

Beard, J. S. (1981). Vegetation Survey of Western Australia 1:1,000,000 Vegetation Series. Map Sheet 7 - Swan. University of Western Australia Press, Western Australia.

Biota Environmental Sciences [Biota]. (2019). Additional Tree Survey. Unpublished report prepared for Main Roads Western Australia.

Biota Environmental Sciences [Biota]. (2020). KPBG Link Kids Bridge Vegetation, Flora and Black-cockatoo Habitat Assessment, Unpublished report prepared for Main Roads Western Australia.

Bishop, C. A., M. Williams, D. Mitchell, A. Williams, J. Fissioli, and T. Gamblin. (2010). Conservation of the Graceful Sun-moth (Synemon gratiosa): Findings from the 2010 Graceful Sun-moth surveys and habitat assessments across the Swan, South West and southern Midwest Regions. Department of Environment and Conservation, Kensington, Western Australia.

Botanic Gardens and Parks Authority [BGPA]. (2014). King Park and Botanic Garden Management Plan 2014 - 2019. List of bird sightings, 23/06/1996, Botanic Gardens and Parks Authority.

Botanic Gardens and Parks Authority BGPA. (2019). KPBG Floristic Sampling Site Data. Botanic Garden and Parks Authority.

DBCA (2020). Western Australian Herbarium Rare Flora Records, from Department of Biodiversity, Conservation and Attractions.

Department of Environment and Conservation [DEC]. (2008). Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus baudinii) and Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) Recovery Plan, DEC, Perth, Western Australia.

Department of the Environment and Energy [DotEE]. (2013). Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia.

Department of the Environment and Energy [DotEE]. (2017). Revised draft referral guideline for three threatened Black Cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus banksii naso. Available from: https://www.environment.gov.au/system/files/consultations/1a21997c-5542-4cd6-ace9-561865bbff29/files/draft-revised-referral-guideline-black-cockatoos.pdf

Department of the Environment and Energy [DotEE]. (2018). Threat Abatement Plan for Disease in Natural Ecosystems caused by *Phytopthorra cinnamomi.* Retrieved January 2020, from the Department of the Environment and Energy: http://www.environment.gov.au/system/files/resources/ee1f3b9f-6e2e-4a01-86f3-6abb167fb443/files/tap-phytophthora-cinnamomi-2018.pdf

Department of the Environment and Energy [DotEE]. (2019a). *Calyptorhynchus latirostris* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat.

Department of the Environment and Energy [DotEE]. (2019b). *Calyptorhynchus banksii naso* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat.

Department of Parks and Wildlife [DPaW]. (2013). Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia.

Department of Planning, Lands and Heritage [DPLH]. (2020). Aboriginal Heritage Inquiry System. Retrieved January 2020, from https://www.dplh.wa.gov.au/information-and-services/online-services/aboriginal-heritage-inquiry-system

Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC]. (2012a). Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Subregions) - States and Territories. Department of Sustainability, Environment, Water, Population and Communities, Canberra. Retrieved January 2020 from http://www.environment.gov.au/topics/land/national-reserve-system/science-mapsand-data/australias-bioregions-ibra.

Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC]. (2012b). EPBC Act referral guidelines for three threatened Black Cockatoo species: Carnaby's Cockatoo (endangered), *Calyptorhynchus latirostris*; Baudin's Cockatoo (vulnerable), *Calyptorhynchus baudinii*; Forest Red-tailed Black Cockatoo (vulnerable), *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia.

Environmental Protection Authority [EPA]. (2004). *Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41.* Perth, Western Australia: EPA.

Environmental Protection Authority [EPA]. (2008). Environmental Guidance for Planning and Development – Guidance Statement No. 33. Environmental Protection Authority.

Environmental Protection Authority [EPA]. (2019). EPA Technical Report: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region, EPA, Perth.

Environmental Protection Authority [EPA]. (2013). *Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20.* Perth: Environmental Protection Authority.

Environmental Protection Authority [EPA]. (2016a). *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures.* Perth, Western Australia: EPA.

Environmental Protection Authority [EPA]. (2016b). *Environmental Factor Guideline: Flora and Vegetation.* Prepared for the Government of Western Australia. Retrieved January 2020, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-flora-and-vegetation

Environmental Protection Authority [EPA]. (2016c). *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment.* Retrieved January 2020, from http://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment

Environmental Protection Authority [EPA]. (2016d). *Environmental Factor Guideline: Terrestrial Fauna.* Retrieved January 2020, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-terrestrial-fauna

Environmental Protection Authority [EPA]. (2016e). *Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna.* Retrieved January 2020, from http://www.epa.wa.gov.au/policies-guidance/technical-guidance-sampling-methods-terrestrial-vertebrate-fauna

Environmental Protection Authority [EPA]. (2016f). *Technical Guidance Terrestrial Fauna Surveys.* Retrieved January 2020, from http://www.epa.wa.gov.au/policies-guidance/technical-guidance-terrestrial-fauna-surveys

Environmental Protection Authority [EPA]. (2016g). *Environmental Factor Guideline: Social Surroundings.* Prepared for the Government of Western Australia. Retrieved January 2020, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-social-surroundings

Environmental Protection Authority [EPA]. (2018a). *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual.* Perth, Western Australia: EPA.

Environmental Protection Authority [EPA]. (2018b). *Statement of Environmental Principles, Factors and Objectives.* Prepared for the Government of Western Australia. Retrieved January 2020, from http://www.epa.wa.gov.au/statement-environmental-principles-factors-and-objectives

Environmental Protection Authority [EPA]. (2019). EPA Technical Report: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region, EPA, Perth.

Gibson, N., B. Keighery, G. Keighery, A. Burbidge, and M. Lyons (1994). A floristic survey of the southern Swan Coastal Plain. Department of Conservation and Land Management, Western Australia.

Glevan Consulting. (2020). KPBG Link Kids Bridge, Phytophthora Dieback occurrence assessment, unpublished report prepared for Main Roads.

Government of Western Australia. (2014). Western Australian Offset Guideline. Retrieved January 2020, from http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WA%20Environmental%20Offsets%20Guideline%20August%202014.pdf

Government of Western Australia. (2019a). 2018 South West Vegetation Complex Statistics. Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca

Government of Western Australia. (2019b). 2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth. https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Heddle, E. M., O. W. Loneragan, and J. J. Havel. (1980). Vegetation complexes of the Darling System, Western Australia. Pages 37–74 Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Perth, Western Australia.

International Union for Conservation of Nature [IUCN] (2017). Guidelines for Using the IUCN Red List Categories and Criteria, Version 13. Available online: http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf

Johnstone, R. E., and G. M. Storr. (1998). Handbook of Western Australian Birds Volume I - Non-Passerines (Emu to Dollarbird). Western Australian Museum, Perth.

Keighery, B. J. (1994). Bushland Plant Survey - A Guide to Plant Community Survey for the Community. Wildflower Society of Western Australia (Inc), Nedlands, Western Australia.

McChesney, C. (2017). The Plant Communities of KPBG Bushland, Perth, Western Australia. Botanic Gardens and Parks Authority, KPBG, WA.

Mitchell, D., K. Williams, and A. Desmond (2003). Swan Coastal Plain 2 (SWA2 - Swan Coastal Plain subregion). Pages 606–623 in J. E. May and N. L. McKenzie, editors. A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions. Department of Conservation and Land Management, Western Australia.

Peck, A., Barrett, G. and Williams, M. (2017). The 2017 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso). BirdLife Australia, Floreat, Western Australia.

Peck, A., Barrett, G. and Williams, M. (2019). The 2019 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso). BirdLife Australia, Floreat, Western Australia.

Rix, M. G., J. A. Huey, S. J. B. Cooper, A. D. Austin, and M. S. Harvey. (2018). Conservation systematics of the shield-backed trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, Idiosoma): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. ZooKeys 756:1–121.

Threatened Species Scientific Committee [TSSC]. (2016). Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community. Available from: http://environment.gov.au/biodiversity/threatened/communities/pubs/131-conservation-advice.pdf.

Van Dyck, S., and R. Strahan (Eds.). (2008). The Mammals of Australia, 3rd edition. Reed New Holland, Sydney

Webb, A., J. Kinloch, G. Keighery, and G. Pitt. (2016). The extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia. Department of Parks and Wildlife, Bunbury, Western Australia.

Western Australian Local Government Association [WALGA]. (2004). Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region. Western Australian Local Government Association and Perth Biodiversity Project, West Perth, WA

Western Australian Planning Commission [WAPC]. (2000). KPBG - Bush Forever Site No. 317. Pages 347–348 Bush Forever Volume 2: Directory of Bush Forever Sites. Department of Environmental Protection, Perth.

9 APPENDICES

Appendix A: Kings Park Link Bridge Biological Survey

Appendix B: Dieback Assessment