Department of Energy, Mines, Industry Regulation and Safety

GOVERNMENT OF WESTERN AUSTRALIA

Clearing Permit Decision Report

1. Application details and outcomes

1.1. Permit application details

Permit number:	10368/1
Permit type:	Purpose Permit
Applicant name:	Enmic Pty Ltd
Application received:	5 October 2023
Application area:	3 hectares
Purpose of clearing:	Sand Mining
Method of clearing:	Mechanical Removal
Tenure:	Mining Lease 70/1302
Location (LGA area/s):	Shire of Augusta-Margaret River
Colloquial name:	Boranup Limesand Project

1.2. Description of clearing activities

Enmic Pty Ltd proposes to clear up to 3 hectares of native vegetation within a boundary of approximately 12.5 hectares, for the purpose of limesand mining. The project is located approximately 2.5 kilometres northwest of Karridale, within the Shire of Augusta-Margaret River.

The application is to allow for continued limesand mining at the quarry.

1.3. Decision on application and key considerations

Decision:	Grant
Decision date:	19 December 2024
Decision area:	3 hectares of native vegetation

1.4. Reasons for decision

This clearing permit application was made in accordance with section 51E and 51O of the *Environmental Protection Act 1986* (EP Act) and was received by the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) on 31 October 2023. DEMIRS advertised the application for a public comment for a period of 21 days, and one submission was received.

In making this decision, the Delegated Officer had regard for the site characteristics (Appendix B), relevant datasets (Appendix F), supporting information provided by the applicant including the results of a flora and vegetation survey (Appendix E), the clearing principles set out in Schedule 5 of the EP Act (Appendix D), proposed avoidance and minimisation measures (Section 3.1), relevant planning instruments and any other matters considered relevant to the assessment (Section 3.3).

The assessment identified that the proposed clearing may result in:

- the potential introduction and spread of weeds into adjacent vegetation, which could impact on the quality of the adjacent vegetation and its habitat values;
- the potential direct impacts to fauna of the local area;
- potential land degradation in the form of wind erosion.

After consideration of the available information, as well as the applicant's minimisation and mitigation measures (see Section 3.1), the Delegated Officer determined the proposed clearing can be minimised and managed to be unlikely to lead to an unacceptable risk to environmental values.

The Delegated Officer decided to grant a clearing permit subject to conditions to:

- avoid, minimise to reduce the impacts and extent of clearing;
- take hygiene steps to minimise the risk of the introduction and spread of weeds;
- undertake slow, progressive one-directional clearing to allow terrestrial fauna to move into adjacent habitat

ahead of the clearing activity; and
- commence sand mining no later than three months after undertaking clearing to reduce the risk of erosion.

1.5. Site map

A site map of proposed clearing is provided in Figure 1 below.

Figure 1. Map of the application area. The blue area indicates the initial footprint when the application was submitted in which the proposed clearing was of 25.62 hectares of native vegetation. The yellow area indicated the reduced footprint within which the proposed clearing of 3 hectares of native vegetation is approved.

2. Legislative context

The clearing of native vegetation in Western Australia is regulated under the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations).

In addition to the matters considered in accordance with section 51O of the EP Act (see Section 1.4), the Delegated Officer has also had regard to the objects and principles under section 4A of the EP Act, particularly:
- the precautionary principle
- the principle of intergenerational equity
- the principle of the conservation of biological diversity and ecological integrity.

Other legislation of relevance for this assessment include:
- *Biodiversity Conservation Act 2016* (WA) (BC Act)
- *Conservation and Land Management Act 1984* (WA) (CALM Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Mining Act 1978* (WA)

The key guidance documents which inform this assessment are:
- *A guide to the assessment of applications to clear native vegetation* (DER, December 2014)
- *Procedure: Native vegetation clearing permits* (DWER, October 2021)
- Technical guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016)

3. Detailed assessment of application

3.1. Avoidance and mitigation measures

In order to avoid impacts to a local flora population of Priority 4 *Banksia sessilis* var. *cordata* the Permit Holder reduced the initial clearing permit application to clear 25.62 hectares of native vegetation within a clearing permit footprint of the same area to request the approval for clearing 3 hectares of native vegetation within a clearing permit footprint of 12.46 hectares.

The thickest limesand resource is chosen by the application as this provides a greater total of limesand per area cleared, rather than clearing larger areas where the limesand is shallower to achieve the same volume of resource. That minimizes the clearing footprint. The least significant and weakest areas of vegetation have been selected for mining and therefore clearing with only the apple anticipated to be required within 10 plus years applied for. The current application area incorporates the cleared area

of CPS 5804/1. Progressive closure and revegetation are to follow mining; as new land is opened, excavated land will be closed (Enmic, 2024).

The Delegated Officer was satisfied that the applicant has made a reasonable effort to avoid and minimise potential impacts of the proposed clearing on environmental values.

3.2. Assessment of impacts on environmental values

In assessing the application, the Delegated Officer has had regard for the site characteristics (see Appendix B) and the extent to which the impacts of the proposed clearing present a risk to biological, conservation, or land and water resource values.

It was determined that the application area is unlikely to represent significant habitat for fauna of the region. The application area is dominated by *Agonis flexuosa* which is one of the foraging resources for the Critically Endangered Western ringtail possum (DPaW, 2017). However, the canopy density in the application area is sparse (<20% cover) and is unlikely to represent critical habitat for the Western ringtail possum. Additionally, most of the vegetation in the application area is in Completely Degraded condition as it has been utilized as a limesand mine (see map in Appendix 1.5). Similarly, habitat suitability for all three species of black cockatoos was assessed and it was determined no nesting, roosting, or foraging vegetation is present in the application area. The application area forms part of a linkage between areas of the Naturaliste National Park however, the vegetation being cleared will not significantly impact on this linkage as the vegetation being cleared is sparse and more significant areas to the west are being retained.

Advice received from the Department of Primary Industries and Regional Development (2024) identified that soils in the area proposed for clearing are primarily deep calcareous sands with horizons of organic matter. There is a risk of wind erosion on site however careful management during the clearing period including staging the clearing process and areas no longer used are quickly rehabilitated with ground cover would reduce the likelihood of wind erosion (DPIRD, 2024). Activities undertaken during mining operations which are not related to clearing are managed under the *Mining Act 1978*. The tenement has a condition on them requiring the holder to take all reasonable and practicable measures to prevent or minimise the generation of dust from mining operations. There is also a condition on the tenement requiring that the development and operation of the project are carried out to create the minimum practicable disturbance to the existing vegetation and natural landforms. Provided steps are implemented to minimise the risk of erosion, the proposed clearing can be considered acceptable.

The assessment against the clearing principles (see Appendix C) identified the impacts of the proposed clearing are limited and able to be managed to be environmentally acceptable with standard avoid and minimize, hygiene and staged clearing conditions for erosion management, as well as a directional clearing condition to minimize potential direct impacts to local fauna.

3.3. Relevant planning instruments and other matters

The clearing permit application was advertised on 31 October 2023 by the Department of Energy, Mines, Industry Regulation and Safety inviting submissions from the public. One submission was received in relation to this application.

The permit area is within the South West Native Title Settlement area (DPLH, 2024). This settlement resolves Native Title rights and interests over an area of approximately 200,000 square kilometres within the south west of Western Australia. The mining tenure has been granted in accordance with the future act regime of the *Native Title Act 1993* and the nature of the act (i.e. the proposed clearing activity) has been provided for in that process, therefore the granting of a clearing permit is not a future act under the *Native Title Act 1993*.

There are no registered Aboriginal Sites of Significance within the application area (DPLH, 2024). It is the proponent's responsibility to comply with the *Aboriginal Heritage Act 1972* and ensure that no Aboriginal Sites of Significance are damaged through the clearing process.

Other relevant authorisations required for the proposed land use include:

- A Mining Proposal / Mine Closure Plan approved under the *Mining Act 1978*.

It is the proponent's responsibility to liaise with the Department of Water and Environmental Regulation and the Department of Biodiversity, Conservation and Attractions, to determine whether a Works Approval, Water Licence, Bed and Banks Permit, or any other licences or approvals are required for the proposed works.

End

Appendix A. Details of public submissions

Summary of comments	Consideration of comment
The Shire of Augusta-Margaret River objected to the proposed clearing based on a number of grounds. The Shire has an "environment first" approach. The proposal is to clear an additional 15 hectares over the next decade. This type of development is contrary to the objectives set out in key Shire planning documents, specifically the Local Planning Scheme No.2, Local Planning Strategy, Environmental Strategy and Overarching Sustainability Policy.	Compatibility with local planning schemes was considered during the grant of Mining Lease 70/1302.
The Shire is opposed to large-scale clearing of native vegetation. The Shire recently won a SAT case (DR 7/2023) opposing clearing of 97 peppermint trees. In making its decision, SAT highlighted the importance of peppermint trees and their habitat for the critically endangered Western Ringtail Possum.	The applicant reduced the proposed clearing to 3 hectares of native vegetation to minimise impacts to Western ringtail possum and its habitat. The least significant and weakest areas of vegetation have been selected for mining (Enmic, 2024).
The majority of the clearing footprint is identified as "peppermint woodland", likely to be habitat to Western Ringtail Possum (WRP). Internal environmental mapping identifies three (3) WRP directly north of the clearing footprint and one Chuditch. The Western Ringtail Possum is listed as 'critically endangered' under the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Biodiversity Conservation Act 2018* (WA). It is also listed as critically endangered on the International Union for Conservation's Red List of Threatened Species.	The applicant reduced the proposed clearing to 3 hectares of native vegetation to minimise impacts to Western ringtail possum and its habitat. The least significant and weakest areas of vegetation have been selected for mining (Enmic, 2024).
The site is zoned Principal Ridge Protection Area in *SPP6.1: Leeuwin-Naturaliste Ridge Policy.* Proposed clearing goes against the following policy statements of SPP6.1 for this zone as follows: 1. LUS 3.1 In Principal Ridge Protection Areas, protection of conservation and landscape values will be paramount. Only land uses compatible with these values will be permitted. 2. LUS 3.5 There is a general presumption against the clearing of remnant vegetation in the Principal Ridge Protection Area other than for approved building envelopes, access and services.	Compatibility with the Leeuwin-Naturaliste Ridge Policy was considered during the grant of Mining Lease 70/1302.
It also goes against the 'Statement of Intent' set out in SPP6.1 as follows: The nature conservation values will be conserved through: 1. reinforcing the functions of the Leeuwin-Naturaliste National Park; 2. fostering strategic environmental corridors and preserving biological diversity; 3. protecting and maintaining remnant vegetation; 4. protecting water quality and quantities required to maintain ecosystem functions; 5. supporting the establishment of a marine reserve; and 6. establishing land use controls to conserve land and marine environments.	The application area has been reduced to exclude areas of greater environmental value. The proposed clearing is not likely to impact on the functions of Leewin-Natuaraliste National Park and will not severe any environmental corridors in the local area.
Potential impacts on karst systems: Has a detailed and recent geotechnical investigation been undertaken of karst systems in the area proposed for clearing?	The proposed clearing is not likely to impact on any karst systems.
The Flora Survey provided with the Clearing Permit documents outlines a section on fauna, however, it is limited	The application area has been reduced to remove the area of *Banksia sessilis* var *cordata* which is suitable foraging habitat

Summary of comments	Consideration of comment
to a desktop overview. It is strongly recommended that a detailed fauna survey be prepared prior to issue of a clearing permit. There is likely to be fauna within the subject area that requires federal referral- such as State and Commonwealth conservation three listed Black Cockatoo species. The flora assessment recorded plant species such including *Banksia* sessilis var *cordata* and *Hakea oleifolia* that would provide foraging habitat for Black Cockatoos. The loss of equal to or greater than 1 hectare of high-quality foraging habitat is likely to require a referral (as determined using the foraging quality scoring tool) (Commonwealth of Australia, 2022). There is potentially other conservation listed fauna within the site including Chudich, Westen Ringtail Possum as well as impacts and loss of habitat including ecological linkages to all fauna including Quenda.	for black cockatoos. Areas of significant western ringtail possum habitat have also been removed from the application area.
The detailed survey for the Flora and Vegetation Assessment did not include covering the majority of the native vegetation area on foot and no tracking of the consultants' traversing footprint has been included in the report. There are potentially Priority listed flora species, such as *Caladenia abbreviata, Stylidium lowrieanum, Eucalyptus marginata* x *megacarpa* not found during the survey. A Priority 4 species- *Banksia sessilis* var. *cordata* was recorded on the site. The extent of the *Banksia sessilis* var *cordata/Agonis flexuosa* Low Woodland vegetation type may be of a greater extent than the mapping indicates due to the limitation of the survey access to the site.	The vegetation containing *Banksia sessilis* var *cordata* has been removed from the application area which now only includes vegetation adjacent to the existing quarry face.
Aboriginal Heritage Sites are located directly north and west (directly adjacent) of the subject area. Has an archaeological aboriginal survey been undertaken of the subject area, and approvals in place?	There are no registered sites within the application area. It is the applicant's responsibility to comply with the *Aboriginal Heritage Act 1972* and ensure that no Aboriginal Sites of Significance are damaged through the clearing process.
The subject area is predominantly identified as "Excellent" condition native vegetation. EPA Guidance Statement No.33 "Section B2.3 Considering Native Vegetation and Flora During Planning" and checklist is a relevant consideration that aims to retain natural areas which regionally and locally support a high diversity of native flora, fauna and/or range of ecological communities. It is recommended that EPA No.33 and its key objectives are fully considered.	The application area has been reduced to remove areas of vegetation which have the potential to support higher diversity of flora and fauna.
Surrounding National Park land is identified as Environmentally Sensitive Areas (ESA). It is highly likely that R30656 is also an ESA but is not listed. It is recommended that the ESA listing over R30656 is further investigated.	The areas surrounding Mining Lease 70/1302 are an Environmentally Sensitive Area due to them being within the Leeuwin - Naturaliste Ridge Area which is listed on the Register of National Estate. The Register of National Estate has been frozen since 2007 meaning that no places can be added or removed.
Visual impacts – The current clearing footprint is approximately 9 hectares. Proposed clearing of an additional 15 hectares will further exacerbate adverse visual impacts from large sections of Bussell and Caves Road and surrounding roads and settlements	The application area has been reduced to 3 hectares of clearing surrounding the existing quarry face which will limit the amount of visual impacts.
The proposed clearing footprint is located on a steep hillside. Due to the steep gradient across the site, and the sandy soil type, there is potential for "blow-outs and further erosion outside of the proposed clearing footprint. This should be factored into any decision making. It is recommended that a geotechnical report is prepared.	There is potential for wind erosion following clearing activities. Conditions have been placed on the clearing permit and mining lease in order to minimise the risk of erosion during clearing and operation of the mine.
If the clearing permit is supported, it is recommended that the proponent enter an off-setting arrangement for revegetation of an area equivalent to the area that has been cleared. Details of this arrangement are to be agreed upon to the satisfaction of the local government, DWER and DBCA.	Following the reduction in the application area, the assessment of clearing did not consider that the clearing would result in significant residual impacts which require an offset.

Appendix B. Site characteristics

B.1. Site characteristics

Characteristic	Details
Local context	The area proposed to be cleared is part of an expansive tract of native vegetation in the intensive land use zone of Western Australia. It is adjacent to Leeuwin-Naturaliste National Park and Caves Road runs along the eastern border of the application area. There are also extensive areas of agricultural land to the east of the application area. Spatial data indicates the local area (10 kilometre radius from the centre of the area proposed to be cleared) retains approximately 52 per cent of the original native vegetation cover.
Ecological linkage	The application area is within a patch of vegetation that is intersected by an ecological linkage as mapped in the South West Regional Ecological Linkages technical report (Molloy et al., 2009).
Conservation areas	The application area is not located within any conservation areas (GIS Database). The Leeuwin-Naturaliste National Park is located approximately 20 metres north of the application area at its closest point. The National Park also envelopes the application area to the west and south but at a greater distance (1-1.5 kilometres) (GIS Database).
Vegetation description	The vegetation of the application area is broadly mapped as the following Beard vegetation associations (GIS Database): 1: Tall forest; karri (*Eucalyptus diversicolor*); 129: Bare areas; dune sands; 1108: Medium open woodland; marri; and 1109: Medium open woodland; marri & river gum. A flora and vegetation survey was conducted over the application area by PGV Environmental during October 2021. The following vegetation associations were recorded within the application area (PGV Environmental, 2022): AfSg1: *Agonis flexuosa* Low Open Woodland over *Spyridium globulosum* Shrubland over *Acrotriche cordata* Open Low Heath AfSg2: *Agonis flexuosa* Low Open Woodland over *Spyridium globulosum* Shrubland over *Acrotriche cordata/Leucopogon parviflorus* Open Low Heath
Vegetation condition	The vegetation survey (PGV Environmental, 2022) indicated the vegetation within the proposed clearing area is in Excellent (Keighery, 1994) condition, with very few weeds species present. The full Keighery (1994) condition rating scale is provided in Appendix D.
Climate and landform	The application area is mapped within elevations of 65-170 metres AHD (GIS Database). The average annual rainfall (Cape Leeuwin) is 952.1 millimetres (BoM, 2023).
Soil description	The soil is mapped as the following soil landscape units (DPIRD, 2024): 216GrKPf: Steep dunes, (gradients usually in excess of 20%) not exposed to prevailing winds. Deep pale calcareous sands with brown topsoil; and 216GrKPm: Steep bare dunes of mobile pale calcareous sand, not exposed to prevailing winds.
Land degradation risk	The application area has been mapped as being in an area with a high potential for wind and water erosion (DPIRD, 2024). The application area does not have a high risk of flooding or waterlogging (DPIRD, 2024).
Waterbodies	The desktop assessment and aerial imagery indicated that there are no watercourses within the application area (GIS Database).
Hydrogeography	The application area is not located within any Public Drinking Water Source Areas (PDWSA) (GIS Database). The mapped groundwater salinity is 1,000-3,000 milligrams per litre total dissolved solids which is described as brackish (GIS Database).
Flora	There are records of the priority flora species *Banksia sessilis* less than one kilometre away but not within the application area. Other conservation significant flora species have been recorded within 10 kilometres of the application area (see Appendix B.3).
Ecological communities	There are no Threatened or Priority Ecological Communities recorded within the local area (GIS Database).
Fauna	There are records of the Critically Endangered Western ringtail possum less than one kilometre away but not within the application area. Other conservation significant fauna species have been recorded within 10 kilometres of the application area (see Appendix B.4).

B.2. Vegetation extent

	Pre-European area (ha)	Current extent (ha)	Extent Remaining %	Current extent in all DBCA managed land (ha)	Current proportion (%) of pre-European extent in all DBCA Managed Lands

IBRA Bioregion - Warren	833,986	659,432	79	588.485	67
IBRA Subregion - Warren	833,986	659,432	79	588.485	67
Local Government – Shire of Augusta-Margaret River	211,681	131,715	62	99,070	47
Beard vegetation associations - State					
1	72,410	56,328	78	47,060	65
129	95,286	82,850	87	42,870	45
1108	4,592	1,138	25	0	0
1109	18,226	3,004	16	107	1
Beard vegetation associations - Bioregion					
1	69,118	53,852	78	45,958	65
129	12,605	12,063	96	10,719	85
1108	8,769	8,024	92	5,750	66
1109	33,365	32,174	96	26,094	78
Beard vegetation associations - subregion					
1	69,118	53,852	78	45,958	65
129	12,605	12,063	96	10,719	85
1108	8,769	8,024	92	5,750	66
1109	33,365	32,174	96	26,094	78

Government of Western Australia (2019)

B.3. Flora analysis table

With consideration for the site characteristics set out above, relevant datasets (see Appendix F.1), and biological survey information, impacts to the following conservation significant flora required further consideration.

Species name	Conservation status	Suitable habitat features? [Y/N]	Suitable vegetation type? [Y/N]	Suitable soil type? [Y/N]	Distance of closest record to application area (km)	Number of known records (WA Herbarium)	Are surveys adequate to identify? [Y, N, N/A]
Acacia inops	Priority 3	N	N	N	<7	16	Y
Actinotus repens	Priority 3	N	N	N	<7	36	Y
Aotus carinata	Priority 4	N	N	N	<8	23	Y
Austrostipa mundula	Priority 3	N	N	N	<7	16	Y
Banksia sessilis var. *cordata*	Priority 4	Y	Y	Y	<1	58	Y
Caladenia abbreviata	Priority 3	Y	Y	Y	<6	12	Y
Caladenia ambusta	Priority 2	Y	Y	N	<5	2	Y
Dampiera heteroptera	Priority 3	N	Y	Y	<2	18	Y
Drakaea micrantha	Threatened	N	N	N	<9	50	Y
Eucalyptus calcicola subsp. *calcicola*	Priority 4	Y	Y	N	<4	24	Y
Lambertia orbifolia subsp. *vespera*	Threatened	N	N	N	<5	24	Y

Species name	Conservation status	Suitable habitat features? [Y/N]	Suitable vegetation type? [Y/N]	Suitable soil type? [Y/N]	Distance of closest record to application area (km)	Number of known records (WA Herbarium)	Are surveys adequate to identify? [Y, N, N/A]
Lepyrodia extensa	Priority 2	N	N	N	<2	12	Y
Machaerina ascendens	Priority 2	N	N	N	<5	17	Y
Pultenaea pinifolia	Priority 3	N	N	N	<7	44	Y
Reedia spathacea	Threatened	N	N	N	<7	26	Y
Stylidium gloeophyllum	Priority 4	N	N	N	<4	23	Y
Stylidium lowrieanum	Priority 3	Y	Y	Y	<2	24	Y

T: threatened, CR: critically endangered, EN: endangered, VU: vulnerable, P: priority

B.4. Fauna analysis table

With consideration for the site characteristics set out above, relevant datasets (see Appendix F.1), and biological survey information, impacts to the following conservation significant fauna required further consideration. Marine species and migratory birds were not included in the table below are there is no suitable habitat for those species in the application area.

Species name	Conservation status	Suitable habitat features ? [Y/N]	Suitable vegetation type? [Y/N]	Distance of closest record to application area (km)	Number of known records (total)	Are surveys adequate to identify? [Y, N, N/A]
Atrichornis clamosus (Noisy Scrub-bird)	Endangered	Y	Y	<5	1,112	N/A
Bettongia penicillata ogilbyi (Woylie)	Critically Endangered and Endangered	Y	Y	<3	16,540	N/A
Calyptorhynchus banksii naso (Forest Red-tailed Black Cockatoo)	Vulnerable	N	N	<2	3,287	N/A
Calyptorhynchus baudinii (Baudin's Cockatoo)	Endangered	N	N	<2	3,918	N/A
Calyptorhynchus latirostris (Carnaby's Cockatoo)	Endangered	N	N	<1	20,601	N/A
Dasyurus geoffroii (Chuditch)	Vulnerable	Y	Y	<1	5,274	N/A
Elapognathus minor (Short-nosed Snake)	Priority 2	N	N	<7	27	N/A
Falco peregrinus (Peregrine Falcon)	Other Specially Protected	Y	Y	<7	1,756	N/A
Falsistrellus mackenziei (Western False Pipistrelle)	Priority 4	N	N	<4	468	N/A
Isoodon fusciventer (Quenda)	Priority 4	N	N	<3	9,126	N/A
Leipoa ocellata (Malleefowl)	Vulnerable	N	N	<10	29,461	N/A
Macroderma gigas (Ghost bat)	Vulnerable	N	N	<4	823	N/A
Notamarcropus eugenii derbianus (Tammar Wallaby)	Priority 4	Y	Y	<3	2,408	N/A
Notamacropus irma (Western Brush Wallaby)	Priority 4	Y	Y	<3	5,244	N/A
Perameles bougainville (Shark Bay Bandicoot)	Vulnerable and Endangered	Y	Y	<6	247	N/A
Petrogale lateralis lateralis (Black-footed Rock-wallaby)	Endangered	Y	N	<3	2,000	N/A
Pezoporus flaviventris (Western ground parrot)	Critically Endangered	N	N	<5	331	N/A
Phascogale tapoatafa wambenger (Brush-tailed Phascogale)	Conservation Dependent	Y	Y	<3	1,448	N/A
Potorous gilbertii (Gilbert's Potoroo)	Critically Endangered	N	N	<3	571	N/A
Pseudocheirus occidentalis (Western Ringtail Possum)	Critically Endangered	N	Y	<1	14,669	N/A

Species name	Conservation status	Suitable habitat features ? [Y/N]	Suitable vegetation type? [Y/N]	Distance of closest record to application area (km)	Number of known records (total)	Are surveys adequate to identify? [Y, N, N/A]
Pseudomys fieldi (Shark Bay Mouse)	Vulnerable	N	N	<4	171	N/A
Pseudomys shortridgei (Heath Mouse)	Vulnerable and Endangered	N	N	<4	474	N/A
Setonix brachyurus (Quokka)	Vulnerable	Y	Y	<3	6,122	N/A
Tyto novaehollandiae novaehollandiae (Masked Owl)	Priority 3	Y	Y	<6	66	N/A

T: threatened, CR: critically endangered, EN: endangered, VU: vulnerable, P: priority

B.5. Land degradation risk table

Risk categories	*Land Unit 1*
Wind erosion	H2: >70% of the map unit has a high to extreme wind erosion risk
Water erosion	M1: 10-30% of the map unit has a high to extreme water erosion risk
Salinity	L1: <3% of the map unit has a moderate or high salinity risk or is presently saline
Subsurface Acidification	L1: <3% of the map unit has a high subsurface acidification risk or is presently acid
Flood risk	L1: <3% of the map unit has a moderate to very high risk
Water logging	L1: <3% of the map unit has a moderate to very high to risk
Phosphorus export risk	M2: 30-50% of the map unit has a high to extreme phosphorus export risk

(DPIRD, 2024)

Appendix C. Assessment against the clearing principles

Assessment against the clearing principles	Variance level	Is further consideration required?
Environmental value: biological values		
Principle (a): *"Native vegetation should not be cleared if it comprises a high level of biodiversity."* Assessment: The were no conservation significant flora species recorded within the application area (PGV Environmental, 2022; GIS Database). A population of over 50 *Banksia sessilis* var. *cordata* individuals was recorded by the detailed flora and vegetation survey conducted by PGV Environmental (2022). This population was initially located inside the application area; however, the Permit Holder has reduced the clearing permit footprint to avoid impacts to this Priority species. Other Priority flora species were recorded within 10 kilometres from the application area (see Appendix B.3). It is unlikely that the proposed clearing of 3 hectares will significantly impact Priority flora of the region.	Not likely to be at variance	No
Principle (b): *"Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna."* Assessment: The area proposed to be cleared is dominated by Peppermint trees (*Agonis flexuosa*) low open woodland (PGV Environmental, 2022). Given the low height and sparseness of the vegetation it is unlikely the application area contains significant habitat for conservation significant fauna. Various fauna species of conservation significance have been recorded within 10 kilometres of the application area. Impacts to fauna moving through the area can be mitigated by placing a directional clearing condition on the permit.	May be at variance	No
Principle (c): *"Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora."* Assessment: There are no records of any Threatened flora species within the application area (PGV Environmental, 2022: GIS Database). The area proposed to be cleared is unlikely to contain habitat for flora species listed under the BC Act.	Not likely to be at variance	No

Assessment against the clearing principles	Variance level	Is further consideration required?
Principle (d): *"Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community."* Assessment: There are no records of any Threatened Ecological Communities (TECs) within the application area (GIS Database). The flora survey over the application area did not identify any vegetation communities which area which are considered to be a TEC (PGV Environmental, 2022).	Not likely to be at variance	No
Environmental value: significant remnant vegetation and conservation areas		
Principle (e): *"Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared."* Assessment: The extent of native vegetation in the Warren bioregion and subregion, local government area, and state is presented in Appendix B.2. The vegetation extent for vegetation association 1108 and 1109 at state level is inconsistent with the national objectives and targets for biodiversity conservation in Australia (Commonwealth of Australia, 2001). Although the vegetation proposed to be cleared is considered to be part of a formal ecological linkage in the local area, the application area is adjacent to the existing Boranup Limesand Project and the proposed clearing is unlikely to significantly impact any known or mapped ecological linkages.	Not likely to be at variance	No
Principle (h): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area."* Assessment: Given the distance to the nearest conservation area (20 metres), the proposed clearing may have an impact on the environmental values of nearby conservation areas. Impacts can be minimised by placing a staged clearing condition on the clearing permit to prevent erosion in conservation areas adjacent to the application area.	May be at variance	No
Environmental value: land and water resources		
Principle (f): *"Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland."* Assessment: There are no watercourses or wetlands within the application area and none of the vegetation has been identified as being riparian vegetation (PGV Environmental, 2022; GIS Database).	Not likely to be at variance	No
Principle (g): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation."* Assessment: The mapped soils are highly susceptible to wind erosion. Noting the location of the application area, the proposed clearing is likely to cause appreciable land degradation.	May be at variance	No
Principle (i): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water."* Assessment: There are no permanent watercourses or wetlands within the application areas (GIS Database). The proposed clearing is unlikely to result in significant changes to surface water flows. The area of the proposed additional clearing is unlikely to cause deterioration in the quality of underground water.	Not likely to be at variance	No
Principle (j): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding."* Assessment:	Not likely to be at variance	No

Assessment against the clearing principles	Variance level	Is further consideration required?
There are no water courses or waterbodies within or in close proximity to the application area (GIS Database). The application area is on sandy soils and water from rain events is likely to quickly infiltrate or runoff, with flooding considered unlikely.		

Appendix D. Vegetation condition rating scale

Vegetation condition is a rating given to a defined area of vegetation to categorise and rank disturbance related to human activities. The rating refers to the degree of change in the vegetation structure, density and species present in relation to undisturbed vegetation of the same type. The degree of disturbance impacts upon the vegetation's ability to regenerate. Disturbance at a site can be a cumulative effect from a number of interacting disturbance types.

Considering its location, the scale below was used to measure the condition of the vegetation proposed to be cleared. This scale has been extracted from Keighery, B.J. (1994) *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc). Nedlands, Western Australia.

Measuring vegetation condition for the South West and Interzone Botanical Province (Keighery, 1994)

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, with disturbance affecting individual species; weeds are non-aggressive species.
Very good	Vegetation structure altered, with obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and/or grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and/or grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and/or grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Appendix E. Photographs of the vegetation

AfSg1: *Agonis flexuosa* Low Open Woodland over *Spyridium globulosum* Shrubland over *Acrotriche cordata* Open Low Heath (PGV Environmental, 2022).

AfSg2: *Agonis flexuosa* Low Open Woodland over *Spyridium globulosum* Shrubland over *Acrotriche cordata/Leucopogon parviflorus* Open Low Heath (PGV Environmental, 2022).

Appendix F. Sources of information

F.1. GIS databases

Publicly available GIS Databases used (sourced from www.data.wa.gov.au):

- Aboriginal Heritage Places (DPLH-001)
- Clearing Regulations – Schedule One Areas (DWER-057)
- DBCA – Lands of Interest (DBCA-012)
- DBCA Legislated Lands and Waters (DBCA-011)
- Environmentally Sensitive Areas (DWER-046)
- Groundwater Salinity Statewide (DWER-026)
- Hydrographic Catchments – Catchments (DWER-028)
- Hydrography – Inland Waters – Waterlines
- Hydrography, Linear (DWER-031)
- IBRA Vegetation Statistics
- Native Title (ILUA) (LGATE-067)
- Pre-European Vegetation Statistics
- Remnant Vegetation, All Areas
- RIWI Act, Groundwater Areas (DWER-034)
- RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)
- Soil Landscape Land Quality – Flood Risk (DPIRD-007)
- Soil Landscape Land Quality – Phosphorus Export Risk (DPIRD-010)
- Soil Landscape Land Quality – Subsurface Acidification Risk (DPIRD-011)
- Soil Landscape Land Quality – Water Erosion Risk (DPIRD-013)
- Soil Landscape Land Quality – Waterlogging Risk (DPIRD-015)
- Soil Landscape Land Quality – Wind Erosion Risk (DPIRD-016)
- Soil Landscape Mapping – Best Available (DPIRD-027)
- Soil Landscape Mapping – Rangelands (DPIRD-064)
- WA Now Aerial Imagery

Restricted GIS Databases used:

- Black Cockatoo WTBC Breeding
- Black Cockatoo FRTBC Breeding
- Black Cockatoo BC Roosts
- Black Cockatoo BC Feeding SCP
- Black Cockatoo Feeding JF
- Black Cockatoo Feeding Areas Buffered
- Black Cockatoo Baudins Distribution
- Black Cockatoo Forest Red Tail Distribution
- Black Cockatoo Carnabys Distribution
- Threatened Flora (TPFL)
- Threatened Flora (WAHerb)
- Threatened Fauna
- Threatened Ecological Communities and Priority Ecological Communities
- Threatened Ecological Communities and Priority Ecological Communities (Buffers)
- Western Ringtail Possum Habitat Suitability (DBCA-049)

F.2. References

Bureau of Meteorology (BoM) (2024) Bureau of Meteorology Website – Climate Data Online, Cape Leeuwin. Bureau of Meteorology. http://www.bom.gov.au/climate/data/ (Accessed 1 November 2024).

Commonwealth of Australia (2001) *National Objectives and Targets for Biodiversity Conservation 2001-2005*, Canberra.

Department of Environment Regulation (DER) (2014) *A guide to the assessment of applications to clear native vegetation*. Perth. Available from: https://www.der.wa.gov.au/images/documents/your-environment/native-vegetation/Guidelines/Guide2_assessment_native_veg.pdf

Department of Parks and Wildlife (2017). Western Ringtail Possum (*Pseudocheirus occidentalis*) Recovery Plan. Wildlife Management Program No. 58. Department of Parks and Wildlife, Perth, WA.

Department of Planning, Lands and Heritage (DPLH) (2024) Aboriginal Heritage Inquiry System. Department of Planning, Lands and Heritage. https://espatial.dplh.wa.gov.au/AHIS/index.html?viewer=AHIS (Accessed 28 November 2024).

Department of Primary Industries and Regional Development (DPIRD) (2024) NRInfo Digital Mapping. Department of Primary Industries and Regional Development. Government of Western Australia. URL: https://dpird.maps.arcgis.com/apps/webappviewer/index.html?id=662e8cbf2def492381fc915aaf3c6a0f (Accessed 28 November 2024).

Department of Primary Industries and Regional Development (DPIRD) (2024) Advice received in relation to Clearing Permit Application CPS 10368/1. Office of the Commissioner of Soil and Land Conservation, Department of Primary Industries and Regional Development, Western Australia, May 2024.

Department of Water and Environmental Regulation (DWER) (2021) Procedure: Native vegetation clearing permits. Joondalup. Available from: https://dwer.wa.gov.au/sites/default/files/Procedure_Native_vegetation_clearing_permits_v1.pdf

Enmic Pty Ltd (Enmic) (2024) Clearing permit application form, CPS 10368/1, received 5 October 2023.

Environmental Protection Authority (EPA) (2016) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment. Available from: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/EPA%20Technical%20Guidance%20-%20Flora%20and%20Vegetation%20survey_Dec13.pdf

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

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

Molloy, S., Wood, J., Hall, S., Wallrodt, S. and Whisson, G. (2009) South West Regional Ecological Linkages Technical Report, Western Australian Local Government Association and Department of Environment and Conservation, Perth.

Northcote, K. H. with Beckmann G G, Bettenay E., Churchward H. M., van Dijk D. C., Dimmock G. M., Hubble G. D., Isbell R. F., McArthur W. M., Murtha G. G., Nicolls K. D., Paton T. R., Thompson C. H., Webb A. A. and Wright M. J. (1960-68) Atlas of Australian Soils, Sheets 1 to 10, with explanatory data. CSIRO and Melbourne University Press: Melbourne.

PGV Environmental (2022) Detailed Flora and Vegetation Survey. Report prepared for Lime Industries, April 2022.

Western Australian Herbarium (1998-) FloraBase - the Western Australian Flora. Department of Biodiversity, Conservation and Attractions, Western Australia. https://florabase.dpaw.wa.gov.au/ (Accessed 28 November 2024).

4. Glossary

Acronyms:

BC Act	*Biodiversity Conservation Act 2016,* Western Australia
BoM	Bureau of Meteorology, Australian Government
DAA	Department of Aboriginal Affairs, Western Australia (now DPLH)
DAFWA	Department of Agriculture and Food, Western Australia (now DPIRD)
DCCEEW	Department of Climate Change, Energy, the Environment and Water, Australian Government
DBCA	Department of Biodiversity, Conservation and Attractions, Western Australia
DER	Department of Environment Regulation, Western Australia (now DWER)
DMIRS	Department of Mines, Industry Regulation and Safety, Western Australia
DMP	Department of Mines and Petroleum, Western Australia (now DMIRS)
DoEE	Department of the Environment and Energy (now DCCEEW)
DoW	Department of Water, Western Australia (now DWER)
DPaW	Department of Parks and Wildlife, Western Australia (now DBCA)
DPIRD	Department of Primary Industries and Regional Development, Western Australia
DPLH	Department of Planning, Lands and Heritage, Western Australia
DRF	Declared Rare Flora (now known as Threatened Flora)
DWER	Department of Water and Environmental Regulation, Western Australia
EP Act	*Environmental Protection Act 1986*, Western Australia
EPA	Environmental Protection Authority, Western Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Federal Act)
GIS	Geographical Information System
ha	Hectare (10,000 square metres)
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union
PEC	Priority Ecological Community, Western Australia
RIWI Act	*Rights in Water and Irrigation Act 1914*, Western Australia
TEC	Threatened Ecological Community

Definitions:

{DBCA (2019) Conservation Codes for Western Australian Flora and Fauna. Department of Biodiversity, Conservation and Attractions, Western Australia}:-

T **Threatened species:**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**
Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**
Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**
Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct Species:

EX **Extinct species**
Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW **Extinct in the wild species**
Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species:

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI **Migratory species**
Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD **Species of special conservation interest (conservation dependent fauna)**
Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS **Other specially protected species**
Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P **Priority species:**

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

P1 **Priority One - Poorly-known species**
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 **Priority Two - Poorly-known species**
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 **Priority Three - Poorly-known species**
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 **Priority Four - Rare, Near Threatened and other species in need of monitoring**
(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Principles for clearing native vegetation:

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna.

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

(j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.