

Vegetation Behaviour and Management at Bremer Bay and Point Henry

A guide for vegetation conservation and hazard management



Shire of Jerramungup

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Bremer Bay/Point Henry Vegetation Mapping and Management Project

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For the Shire of Jerramungup

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Front cover image: Point Henry Peninsula and its housing developments south from
Torreburup Hill, with the foreground slashed for asset protection. N McQuoid.

Foreword

Jerramungup Shire President and/or CEO

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Introduction

The information in this guide is to help landowners and managers in the Bremer Bay and Point Henry area conserve and manage the area's vegetation and its many values.

It relates directly to Reserve 511 – the area from the Wind Tower Hill to the Fishery Beach Harbour; Reserve 51949 – the strip of bush between John St and Sea Dragon Drive in Bremer Bay townsite; and the Point Henry Peninsula south of Wellstead Rd.

The guide is designed to explain the vegetation community patterns, ecological behaviour and values, and to provide recommended management actions. The reduction of bushfire hazard and the conservation of vegetation community integrity are the primary focus of the management recommended.

The information presented is a result of the Shire of Jerramungup's Bremer Bay / Point Henry Vegetation Mapping and Management Project. An objective of the project is to provide information to landholders and managers about the vegetation and its sustainable management, in particular reduced bushfire hazard.

The Vegetation Mapping and Management Project used an objective, evidence-based approach to investigating the vegetation communities through the use of 115 sites across Reserves 511 and 51949, and Point Henry peninsula. This identified and mapped 29 vegetation communities, recorded their composition and structure, and assessed their typical bushfire hazard ratings.

It was designed as a way to see the forest and the trees, and based on a long-term view of natural cycles and ecological influences in order to reflect on how we can sustainably live within the place's means. It considers history, and addresses the present realities.

The study found that some of the prominent vegetation communities have been altered by historic disturbance from burning and grazing, which is a somewhat unique situation. This relatively recent regime, and to some extent its cessation, appears to have brought about instability and increased densities in some circumstances, and this phenomenon is explored and explained.

This guide, as a result of the projects findings, interprets the vegetation community patterns, ecological behaviour and sensitivities, and develops recommended responses as management regimes and techniques to support the conservation of the values within.

The values include the flora and vegetation itself and its amenity, character, cover, form, diversity, habitat, cooling and shading, soil and moisture conservation, and ground protection. Notwithstanding, the vegetation can also present bushfire hazards in warm and windy conditions, which can - to some extent by skilled intervention - be reduced, and this is also a value to attain and conserve.

The vegetation mapping and management project has the two Aspirations

- *Vegetation communities conserved for amenity, nature and heritage values and reduced bushfire hazard.*
- *Continued improvement by the community in the understanding of vegetation behaviour to enable the conservation of amenity, nature and heritage, and reduced bushfire hazard.*

To help realise the aspirations, the information developed and outlined by this guide provides management and conservation objectives, priorities and recommendations.

The management and conservation recommendations take into account:

- Protecting life and property is the number 1 priority;
- Resourcing and practicality;
- Time taken to achieve this response;
- The likely capabilities of the responsible party; and
- Conservation of amenity, biodiversity and cover

In addressing the aspirations and objectives, the management recommendations are designed to focus on maintaining vegetation community health and integrity, and lowest possible densities and hazard ratings, and specifically to achieve stated desires for the vegetation, which are:

- More open woodland stands with less and larger peppermints and mallees;
- Open woodlands that are 'grassy' underneath - more like the Noongars had it once - and more manageable;
- Open peppermint woodlands in original locations in gullies, swales and side-slopes with intact and protective ground cover and mulch layers;
- Retained patches of mid and understorey thickets;
- Peppermint, coast wattle and weeds removed from heath and kwongkan communities, where they were once absent from, to restore their integrity;
- Intact and healthy kwongkan communities, which are listed as threatened;
- Weeds eradicated;
- Quality habitat, particularly for Carnaby's cockatoo;
- Reduced bushfire hazard; and,
- Ease of maintenance.

How to use this guide

The information in this guide has been designed and presented to provide a context as background, history, descriptions and values for the vegetation communities, and then how best to manage and sustain those values.

The first order underpinning successful management is a well, developed understanding of the recognition, behaviour, patterns and sensitivities of the different vegetation communities and the dominant plants. This guide provides information to complement existing knowledge and abilities, and help develop new awareness and skills.

The information begins with a list of the terms used throughout, as the basis for supporting the further understanding of vegetation and its management.

The next part introduces and backgrounds the Bremer Bay and Point Henry landforms and vegetation to set the scene and situation. It outlines the history of the area and its profound influence on the vegetation communities, and discusses disturbance ecology in some detail, which is the driving natural force that shapes the vegetation.

After these introductions the description of the vegetation becomes the focus as identified by the mapping and management project. The bushfire hazard assessment process is outlined, the 29 vegetation communities are shown as maps - and thereafter described in detail as structure, composition, locations, hazard, behaviour and sensitivities.

The vegetation community maps form a visual guide, and they show reference sites to help identify and show the vegetation community types. The best way to use this is to identify the location of your property or area of interest on the maps and read the descriptions of those communities for their explanations, visiting the reference sites will help to identify and compare the different communities.

The natural, amenity and heritage values found in the vegetation communities are outlined next. Placed here to develop the cultural and social context in which we have, see and live with those values.

Bringing the context together with what we need to do to sustain the vegetation and our connection with it, the final part describes and recommends vegetation management and conservation actions. This part includes a matrix approach with a central table (Table 2) showing the 29 vegetation communities, with their behaviour types, sensitivities, conservation ratings, typical bushfire hazard ratings, reference sites and management actions recommended.

The final parts of the guide provide references from which some of the information and its development has been drawn and influenced by, and further reading for those wishing to know more.

Nomenclature and terms used

AS 3959: *The Australian Standard for the Construction of buildings in bushfire-prone areas; as the document produced by Standards Australia (Standards Australia 2009).*

Allelopathy, Allelopathic: Suppression of growth of plants by a chemical toxin produced and released from a nearby plant of the same or another species or genus. Plants that have this ability. Victoria tea tree is known to be allelopathic, which increases its ability to invade bushland.

Behaviour (vegetation): The ecological and biological responses of vegetation communities and the plants within to disturbance and over different timescales - immediate to very long-term. It's a term introduced by this project to help improve the understanding of vegetation and plants, and to develop the concept that plants and vegetation respond in various ways to environmental factors, including in ways that impact amenity, conservation and fire hazard.

Plants/vegetation are not just benign passengers on the landscape, they respond to different stimuli and opportunities. Their behaviour is described as: how plants and individuals and groups as vegetation regenerate, the different strategies they use, what stimulates them to do so, and functional traits for regeneration: precocious, robust, vulnerable. Behaviour also relates to the long-term relationship between vegetation and the different soils, situations and habitats different vegetation communities and have evolved to occupy, and the dynamics of those sites of occupation and their role as a selection pressure or opportunity gradient for vegetation to sort into communities by.

Precocious behaviour: Plants that readily seed or resprout or both, produce large amounts of seed and strong long-lived soil seed banks (geosporous), respond strongly by regenerating to a range and high frequency of disturbances, readily disperse seed to enable the occupation of new sites, and tolerant of plant diseases. Introduced weeds have all these behavioural traits, as well as limited natural suppressant agents as aliens.

Robust behaviour: Plants that readily seed or resprout or both, produce strong seed-sets and banks, often have long-lived soil seed banks (geosporous), respond strongly by regenerating to a limited type and frequency of disturbances, do not readily disperse seed to occupy new sites, and not readily susceptible to plant diseases.

Vulnerable behaviour: Plants that do not readily seed or resprout, seed produced is usually limited and held in the branches or canopy (brady-sporous) and is not long-lived, have intricate relationships with pollinators, with respond by regenerating to a limited type of very infrequent disturbance, often occupy very diverse vegetation communities, do not usually disperse, and susceptible to plant diseases.

Bradyspory, brady-sporous: The gradual release of seed from a plant's cone or fruit over a long period of time. Plants that hold their seed in the canopy, which is gradually released over time as the seed matures. As opposed to 'tachyspory', which the more-or-less immediate release of seed as soon as they have matured. When seed release is triggered by an environmental event such as fire, flood, drought, heat, hailstorm etc, it is termed 'serotiny'.

Climax community: A biological community of (in this case) plants as vegetation, through the process of ecological succession the development of vegetation in an area over time, had reached a steady or stable state (Clements 1920). Also known as 'old growth' community.

Conservation rating: *Animal or plant species, and ecological communities (often vegetation communities) that are rare, threatened, vulnerable, conservation dependant or conservation priority, as listed by Commonwealth or State Government legislation.*

Dispersal: *The movement of biological (in this case plant) propagules as seed and vegetative means from the parent plant. The varied ability of different plants and their strategies evolved to move propagules. Many plants endemic to the south west of Australia have reduced abilities to disperse propagules as an evolutionary response to optimise survival old stable landscapes (See OCBIL Theory). Plants that are proficient at dispersal are those precocious species as weeds, and plants from more dynamic sites including peppermint, coast wattle, net bush and swamp yate, which are the issue of this project.*

Disturbance: *Ecological disturbance, an event or force, of non-biological or biological origin, that usually brings about mortality to organisms and changes in their spatial patterning in the ecosystems they inhabit. Disturbance plays a significant role in shaping the structure of individual populations and the character of whole ecosystems. (Paine 2012). Ecological disturbances include erosion, fire, flood, drought, soil movement, wind, salt spray, vegetation removal, and nutrient application.*

Disturbance opportunist: *A plant that has evolved to respond strongly to frequent land disturbance, weeds and peppermint and coast wattle are examples. Or, as a short or relatively short-lived plant that appears after disturbance, often in large numbers, examples are Kennedia creepers and shark-tooth wattle.*

Dormant: *A geosporous plant that is predominantly present over time as seed in the soil rather than as a manifest plant. Wattle and Kennedia feature this presence profile, notably A. leioderma in mallee communities, which responds powerfully after fire from geosporous seed to dominate shrub strata for several years following, after which is slowly dies out to once again exist as a geosporous seed bank.*

Edge effect: *The increased growth of plants along the edges against cleared land as tracks, paddocks etc. The increased growth compared to the remainder of the population or community attained due to the availability of additional light, nutrients and water by the plants along the edge. Can also occur when vegetation stands are thinned and the remaining plants have reduced competition for light, nutrients and water.*

Fire frequency: *The time between fire as a disturbance event at a site or in a vegetation community. The time between events determines the composition and structure of the vegetation community, depending on the ability and strategies plants use to replace themselves and how long they live.*

Forest: *Vegetation communities predominantly composed of trees of 10-30 m high, sometimes taller, with a relatively dense 30-70% pfc (Beard et al 2013).*

Genus: *The collective term for a group of plants above the level of species and within a family. Plural is genera.*

Geosporous, geospory: *Plants that store their seed in the ground, the storage or placement of plant seeds in the ground. The seeds are usually hard coated and resistant to damage. Legumes such as Acacia, Daviesia and Pultenaea, and some Grevillea and Adenanthos species in the Proteaceae family also use this strategy.*

Hazard: *Vegetation biomass mostly fine fuel material as leaves, buds, fruits, twigs, small branches, bark, and ground litter, which is the material that contributes most to a fire's rate of spread and flame height (Hines et al 2010).*

Heath: *A type of low, mostly dense shrubland, generally less than 1m tall (Beard et al 2013). Included in Kwongkan (above) (Hopper 2014), and often an understorey component of some shrublands.*

Kwongkan: *A Noongar Aboriginal term, now widely used and accepted to mean the sandplain in semi-arid country of the south west of Australia, and its characteristically low shrubby vegetation interspersed with a mosaic of woodlands and mallee. (Hopper 2014)*

Mallee: *Multi-stemmed shrubs of the Eucalyptus genus, with an underground lignotuber or mallee root, from which the plants are able to resprout after damage, usually from fire.*

OCBIL Theory: *OCBIL theory aims to develop an integrated series of hypotheses explaining the evolution and ecology of, and best conservation practices for, biota on very old, climatically buffered, infertile landscapes (OCBIL's). Conventional theory for ecology and evolutionary and conservation biology has developed primarily from data on species and communities from young, often disturbed, fertile landscapes (YODFELs), mainly in the Northern Hemisphere. OCBIL's are rare, but are prominent in the Southwest Australian Floristic Region, South Africa's Greater Cape, and Venezuela's Pantepui Highlands. (Hopper 2009).*

Resprouting: *Resprouting is a common plant response to injury from a variety of insults, including fire damage, drought, frost, heat wave, waterlogging, herbivory, storm damage, lightning strikes and excessive salt levels. Bradshaw et al 2011.*

Risk. *The chance that an event will occur. The possibility of something bad happening at some time in the future; a situation that could be dangerous or have a bad result (OED 2017).*

Sensitivity: *The fragility and/or susceptibility of a plant or vegetation community to alteration, damage, destruction or disease, by disturbance or disease.*

Serotiny, serotinous: *An ecological adaptation by plants where they release their seed in response to an environmental trigger such as fire, flood etc, rather than spontaneously at seed maturation (tachyspory). The term serotiny is sometimes also referred more broadly to plants that release their seeds over a long period of time, irrespective of the trigger or whether release is spontaneous. In this sense, the term is synonymous with the more accurate 'bradyspory' above.*

Shrubland: *A collection of shrubby vegetation communities as: mallee heath – emergent mallee over (kwongkan) heath; scrub-heath – scattered tall shrubs over (kwongkan) heath; heath (or kwongkan) – dense low shrubs to 1 m; and dwarf scrub – open shrubby scrub to around 1 m. (Beard et al 2013)*

Species: *The basic unit of classification (below the rank of genus), which usually refers to one or several groups of plants or other living organisms that interbreed and maintain their distinct identity through successive generations (Brooker and Kleinig 2001).*

Stability: *Relates to the state of development or succession of vegetation communities as the presence and dominance arrangement of plants with pioneer or long-lived roles. Unstable*

vegetation communities are in a state of repair as evidenced by the dominance or co-dominance and density of legume and other shorter-lived species. Stable communities are dominated by longer-lived plants and are usually old (since disturbance) and more open because pioneer plants have died out. Climax or old growth communities are stable in this regard.

Subspecies: A form of a species having a distinctive identity and occupying a particular habitat or region (Brooker and Kleinig 2001).

Susceptible: Relates to the vulnerability and relative fragility of vegetation communities to impacts by disturbance and disease, which can lead to their significant alteration or even removal.

Thicket: A vegetation community consisting primarily of shrubs greater than 1m tall, with a 30-70% or greater projected foliage cover (pfc) (Beard et al 2013).

Woodland: Vegetation composed of trees 10 – 30 m in height with an open canopy of 10-30% projected foliage cover (pfc). Low woodland is vegetation dominated by trees less than 10 m in height with a cover of usually 10 – 30 pfc (Beard et al 2013).

Shire of Jerramungup planning instruments

The Shire of Jerramungup has a number of planning processes to guide and support the governance of development, community and conservation, which relate to Bremer Bay and Point Henry. They include:

- The Community Plan 2016 – 2026 (Shire of Jerramungup 2016) is designed to support compliance with the Local Government Act in addressing the State Government’s Strategic Community Planning requirement. It is a strategy and planning document that reflects the longer-term (10+ year) community and local government aspirations and priorities. Its vision is a *Progressive, Prosperous and Premium Place to Live and Visit*, and has strategic directions for Environment, Community and Economy with objectives, actions and key projects designed to realise the vision.
- The Corporate Business Plan 2014/15-2017/18 (Shire of Jerramungup 2014) relates to the Community Plan, it details the services, operations and projects the Shire will deliver over the defined period, the processes for delivering these and the associated cost. It contains team, operational, technical delivery and financial plans, and informs the annual budget.
- The Local Planning Strategy No. 2 (Shire of Jerramungup 2012) as endorsed by the WA Planning Commission (WAPC) sets the broad strategic planning direction for the Shire for the next 20 years. Its underlying objective is to provide for existing and anticipated land uses, to enable new land requirements to be appropriately accommodated as they arise, and to ensure that natural resources are protected and managed for the present and future needs of the community.
- Local Planning Scheme No. 2 (Department of Planning 2014) as delegated to the Shire of Jerramungup by the WAPC, relates to the delivery of The Local Planning Strategy No 2. It has a number of purposes and aims. The purposes set out planning aims, reserves, zoning, land use control, assessment procedures, and administration. The aims include assisting implementation, protection of land for sustainable agriculture, encouraging economic growth, sustainable settlements, rural lifestyle and residential development that protects and enhances rural landscapes and environmental values, protecting the natural environment while realising appropriate development, and to promote the sustainable use of natural resources. The latter three aims relate directly to the Bremer Bay / Point Henry Vegetation Mapping and Management Project and this guide.
- Local Planning Policies (LPP’s) are developed in respect of matters that relate to planning and development in the Scheme area, and often include responses to State Planning Policies as they occur. LPP’s are usually released for public comment in draft form for consideration before adjustment and finalisation. The information in this guide can support the design and implementation of LPP’s for building development and bushfire hazard in relation to achieving vegetation protection, under development at the time of the preparation of this guide.
- The Point Henry Rural Limited Strategy (Shire of Jerramungup 1991) laid out the case and defined areas for the development of a special rural (now rural residential) zoned precinct on the Point Henry peninsula. The Strategy report concluded that development of differing densities could occur dependant on environmental capability, subject to strict environmental and visual protection criteria and controls, and a fire management plan is developed and implemented. The strategy was adopted and implemented largely as recommended.

The Bremer Bay/Point Henry vegetation mapping and management project and this management guide were developed to help support sustainable development with the Shire of Jerramungup and WA State planning processes. The information in this guide can directly assist landowners and the Shire of Jerramungup with the implementation of planning policies.

Bremer Bay landforms and vegetation

The Bremer Peninsulas comprise Hood Point and the Doubtful Islands to the east, Points Henry and Gordon in the centre and Cape Knob to the west. They form a central expression of the Albany Fraser gneiss orogen – the same geological formation as the dramatic coastal headlands at Albany and Esperance.

The landforms have been influenced by the rise and fall of the sea level over millions of years. The highest and lowest levels can be seen in the structures and material composition of the areas land and sea forms. The Eocene ocean rise between 38 and 80 million years ago saw the shoreline north near Jerramungup, and the formation of the spongolite marine plain as a sea floor. During this time the peaks of the Barrens were islands, and these older formations were extensively eroded to form broad sandy plains that exist around them today. The lowest sea level was only around 12,000 years ago during the latter stages of the Pleistocene, when the sea levels were some 90 metres less than today, and the Bremer and Gairdner Rivers flowed out and formed the present-day Bremer Canyons offshore along the continental edge.

The granite headlands of the Bremer peninsulas feature dramatic sea cliffs and rising rock domes, remote windswept wilderness and endemic flora including Bremer grevillea (*Grevillea nivea*) and hood point mallee (*Eucalyptus retusa*).

Sandy plains, old dunes and swales support stands of Peppermint (*Agonis flexuosa*), which occurs here at its eastern limit forming extensive tall woodlands in the most sheltered sites and dense shrublands elsewhere.

Coast yate or yandil (*Eucalyptus cornuta*) occurs at its eastern mainland limit as a tall tree here in isolated small patches in deeper wetter swales and alongside estuaries.

The clay and loamy sand soils of the hills and headlands of the Bremer Bay and Point Henry area have extensive patches of banksia (*Banksia media*, *B. nervosa*, *B. dryandroides*) and other Proteaceae (*Adenanthos cuneatus*, *Hakea nivea*, *H. marginata*, *H. trifurcata*, *H. varia*, *H. corymbosa*, *Isopogon formosus*, *Synaphea* sp.) dominated kwongkan shrublands, thickets of melaleuca (*Melaleuca densa*, *M. pentagona*), and wattle (*Acacia heteroclita*).

On yellow sands and down-slope with more clay and loam content, open woodland of candle banksia (*Banksia attenuata*) over rich proteaceous kwongkan and stands of mallee (*Eucalyptus decipiens* subsp. *chalara*) occur close to town.

The open sandy flats south of Bremer Bay townsite are occupied by shrublands of low spreading shrublands dominated by rigid wattle (*Acacia cochlearis*).

A marine plain fragment with clay soils over spongolite has open often mixed mallee of mostly tallerack (*Eucalyptus pleurocarpa*), spongolite clay mallee (*Eucalyptus* aff. *angulosa*) and hook-leaved mallee (*E. uncinata*) over relatively species rich lower shrubs and kwongkan.

Limestone ridges and associated sandy slopes of the centre of Pt Henry Peninsula are occupied by proteaceous kwongkan dominated by parrot bush (*Banksia sessilis*), *Pomaderris myrtilloides* yellow honeymyrtle (*Melaleuca thymoides*), grass tree (*Xanthorrhoea platyphylla*) and other genera, and patches of coastal ridge-fruited mallee (*Eucalyptus angulosa*).

History of Bremer Bay and Point Henry area, its influence on the vegetation

The vegetation communities of the area, particularly the areas south of Bremer Bay townsite and the Point Henry peninsula show significant signs of a history of disturbance as the dominance and density of disturbance opportunist plant species in several vegetation communities. These include peppermint (*Agonis flexuosa*), coast wattle (*Acacia cyclops*), net bush (*Spyridium globulosum*), the introduced weed Victorian tea tree (*Leptospermum laevigatum*) and coastal ridge-fruited mallee. Less widespread, although indicative of long-term disturbance are patches of granite thicket wattle (*A. heteroclita*), and summer scented wattle (*A. rostellifera*), below granite rises. This disturbance history is almost certainly the result of grazing and burning from when the area was under management for sheep grazing.

The vegetation communities and their densities, regeneration abilities, sensitivities and bushfire hazard are the subject of this study and its management recommendations. Much can be learnt and adopted as management methodologies from an understanding the ecological influence of past land management practices of Noongar and European people, the roles and habits of now extinct native animals, and the responses of the plants and vegetation to different disturbance types, events and regimes.

The Noongar Aboriginal people of the area included the Koreng people from Bremer Bay/Gordon Inlet west, and the Wudjari people to the east (Tindale 1974). The Bremer Bay area was and remains a vitally important place for Noongar people for hunting and other food gathering, water provision, men's and women's business, and ceremonial and spiritual dimensions, as evidenced by a number of significant sites and stories that relate to the Bremer Bay Tribe (Hassell 1975; E Eades, M Wellstead pers. comm.). Sites of significance include Short Beach, Torreburrup Hill, Wellstead Estuary, Gnornbup Swamp, and Little Boat Harbour. The Noongar camp on Whitetrail Rd, and continued visitation to the area exemplifies the close attachment by the Noongar community.

Max Wellstead perspective: Peppermint Grove homestead and farm site was selected in 1845 and occupied in 1848 by John Wellstead, Max's Great Grandfather. First few sheep as a starting flock were brought to area in 1855, as part of grazing the lands from the Stirlings to the Fitzgerald River. The Peppermint Grove location at Bremer Bay was selected for its pasture and water, and for proximity to shipping for transport of wool. By 1860 the flock grew to a shepherding operation, in 1872 shepherd had charge of groups of around 400 sheep, and in 1882 10,000 sheep were shorn in the sheds at Peppermint Grazing Co at Bremer Bay.

The pastures of Point Henry and the Bremer Bay area now in Reserve 511 were preferred because of the open nature of the peppermint woodland and the feed provided by johnny grass (curly grass) (*Desmocladus flexuosus*) and wattles (*Acacia spp.*), and the lack of native poison (*Gastrolobium spp.*) The native johnny grass and wattle pasture was later supplemented with introduced trefoil clover (*Lotus spp.*), Bokhara clover (*Melilotus albus*, *M. indicus*), kikuyu (*Pennisetum clandestinum*) and buffalo grass (*Stenotaphrum secundatum*). Buffalo grass remains prominent around Peppermint Homestead.

A rabbit proof fence was built in 1934 to fence off Point Henry Peninsula. The fence utilised local yawl or salt paperbark (*Melaleuca cuticularis*) posts and rabbit netting to run from the rocks in eastern corner of Dillon Bay to the rocky headland above the Back Beach Bombie in Bremer Bay, with rock walls going into the ocean at either end. The fence kept rabbits out for several years, although when rabbits got through, they were poisoned with Grim and pollard around their warrens, which also killed brush wallabies. Dead rabbits and wallabies were collected by Max's father, skinned and pegged as processing for sale.

Max remembers boodies (*Bettongia lesueur graii*) and their warrens, and ringtail possums (*Pseudocheirus occidentalis*) being around when he was a child, this included catching by mistake ringtail possums in rabbit traps, which displeased his father. The mainland subspecies of the boodie (*B. lesueur graii*) is extinct, and the western ringtail possum is believed to be locally extinct in the Bremer Bay area having not been seen for many decades; it still exists to the west from Mt Many Peaks around to south of Mandurah. The boodie lived in burrows and dug and scratched the ground extensively, as such it is believed to have served an important ecological regulation function in the grassland and understorey vegetation ecosystems by spreading seeds and fungi, and browsing to check wattle and other under shrub regrowth. This influence is likely to have increased soil water absorption and reduced combustible material under trees, which would have helped maintain the balance of trees, shrubs and groundcovers including woody weedy species (Sarre 1999; Martin 2003). These influences may well have been the case in the Bremer Bay vegetation communities as it was largely open country when settled (M. Wellstead pers. comm.). It is thought that predation by the red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) caused the extinction of the boodie and locally the ringtail possum (DEC 2012).

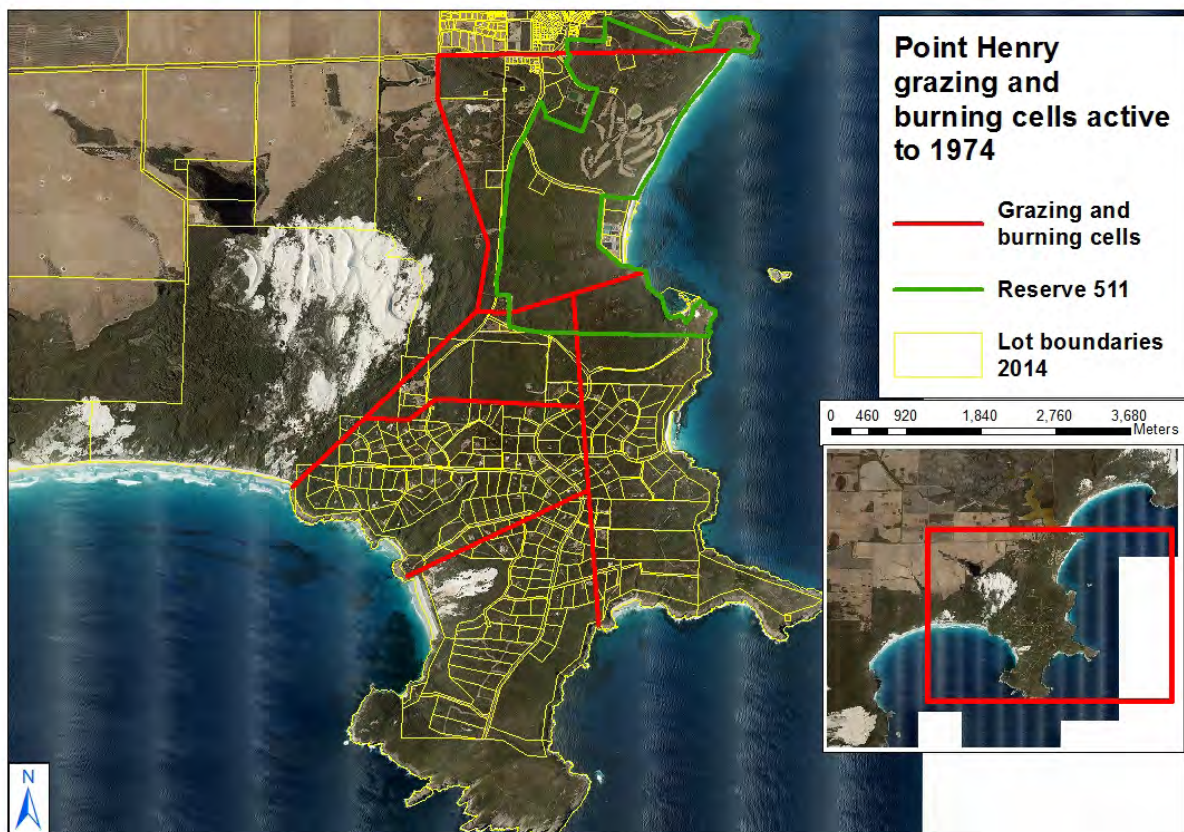
The granite country of the Bremer Bay and Point Henry area was dominated by grass tree (*Xanthorrhoea platyphylla*) and open pasture country. In 1965 broadcast Veldt Grass (*Ehrharta calycinus*) and clover (*Trifolium spp.*) with superphosphate, which went well. The sheep camped in peppermint patches, which were scattered across the gullies on the peninsula, and as open woodland areas on the flats and low rises from west of the peppermint Homestead north along either side of what is now Wellstead Rd. The sheep grazing helped keep the country open. The area from the homestead up to Torreburrup Hill was preferred sheep grazing country because of the pasture under peppermint trees and on the open granite country. The area off the end of Horse Hill Rd, so named because of the preference by the horses for these low hills, was also preferential grazing country, where grassy valleys sat between limestone ridges (M Wellstead pers. comm.).

Water was abundant in creeks in a number of short gullies across the peninsula at Short Beach, Native Dog Beach, south of Blossoms Beach, Little Boat Harbour, and Polly's Gully on the eastern flank of Point Henry south of Banky Beach. The creek at Fishery Beach used to run out of a cave of around 20 metres deep, which was collapsed and the creek flow ceased by the 1968 Meckering earthquake. The other creeks now flow less often, if at all, compared to the period up to the 1970's. These creek flows provided water for sheep on the peninsula (M Wellstead pers. comm.).

Fire and grazing occurred extensively across the Point Henry Peninsula from the late 1800's/early 1900's up to the early 1970's. The Peninsula was split into four management cells, with another cell over most of what is now Reserve 511 (Map 2).

The cells were burnt in wind-driven burns regularly (every 3-4 years) on a rotational basis for pasture promotion to maximise sheep grazing and carrying capacity and to maintain a mixture of recently burnt and older vegetation. The burning program included patch (mosaic) burning a part of the system to provide unburnt patches to provide somewhere for the native animals to go (M Wellstead pers. comm.).

The Local Authority curtailed the burning program in 1972, as the fires were considered to be dangerous. The last sheep were agisted up until 1974 following the 1969 drought further inland. The area now covered by Reserve 511 was last grazed under lease by the Wellsteads in 1958 (M Wellstead pers. comm.).



Wellstead grazing and burning cells active to 1974 (as grazing)

Since 1972, the fire history is sporadic, with fires occurring in relatively small patches in 1993, 1996, 2002 and 2015. The largest fire was in 2002 started by a lightning strike near Black Rocks Rd, which burnt approximately 2,300 ha in an area south west to Horse Hill Rd and then north to the Golf Course in Reserve 511.

The Point Henry Peninsula has been subject to subdivision and further private property developments since the early 1990's, where the Wellstead holding has been broken up and progressively sold. 194 blocks have been created, ranging in size from approximately 3 to around 40 hectares, with most around 4 hectares. The Shire of Jerramungup planning scheme No. 2 provides for the majority of the properties to be zoned 'special rural', with a few mostly larger lots remaining 'rural' (Dept. Planning 2007).

The development of Point Henry Peninsula as predominantly special rural/rural residential in differing densities was considered suitable if aligned with land use capabilities of different parts of the peninsula. This capability includes the consideration of strict environmental and visual protection criteria, the location of building envelopes roads and other access, and fire management (Shire of Jerramungup 1991). The information provided here is from the *Bremer Bay/Point Henry Vegetation Mapping and Management Project*, which was designed to support the sustainable development of Point Henry and the protection of its unique environment.

Disturbance ecology

Disturbance ecology is the most significant natural process driving the composition (the comprising species) and structure (density, shape and size of plants comprising) of the vegetation communities of the study area. This is particularly significant on the Point Henry Peninsula where a previous use of the area as a grazing property applied considerable disturbance on the vegetation, and for which the effects continue to play out.

'Disturbance' in the vegetation ecology sense is the natural forces on the landscape that affect plants by destroying or damaging them, as well as promoting and in a few cases limiting their regeneration. This disturbance is the physical impact on the ground surface and the plants that occupy it, which in the case of the study area includes historic grazing, fire, soil movement, vegetation removal and nutrient application. (See also Nomenclature and terms used, page 10).

In response to disturbance, vegetation communities change in structure and composition, as the ebb and flow of the various plants that comprise the community over time. Some plants are short-lived opportunists that live and die relatively quickly, and others are long-lived that eventually dominate the mature community.

Disturbance drives the development and stability of vegetation communities long-term, with stability a key factor in determining the density of the vegetation. In this way, late stage mature composition and structure eventually forms an old growth community, or a climax community (Clements 1920; Roughgarden et al 1989).

In the case of the common vegetation communities in the study area, unstable communities are recovering from disturbance and usually have denser structures dominated by shorter-lived disturbance opportunists or pioneer plants. The old growth or climax stages of these communities have fewer and larger of the long-lived plants, which remain after the pioneer plants have died out, to stand over scant midstoreys and dense protective groundcover blankets.

Vegetation communities can exist for very long periods as old growth communities, it isn't like old age; rather it's the result of an enduring sorting process, which eventually leaves the fittest and sometimes luckiest standing to live very long lives, and the seed and vegetative propagules of the pioneer plants (wattle (*Acacia spp.*), coral vine (*Kennedia spp.*), lignum (*Muehlenbeckia adpressa*), net bush (*Spyridium globulosum*) etc) in the ground ready to activate and perform their restorative roles if and when disturbance occurs. Seeds of other pioneer plants dispersed from adjacent stands also take advantage of disturbance, able to germinate and grow among the damaged and suppressed groundcover stratum.

The common peppermint (*Agonis flexuosa*) and mallee (*Eucalyptus angulosa*) dominated vegetation communities of the area can be this old growth type when old enough, when older woodlands and shrublands are very open, with scant shrub midstorey components, and luxuriant complex and resilient groundcovers; and with lower bushfire hazard ratings.

Ground disturbance

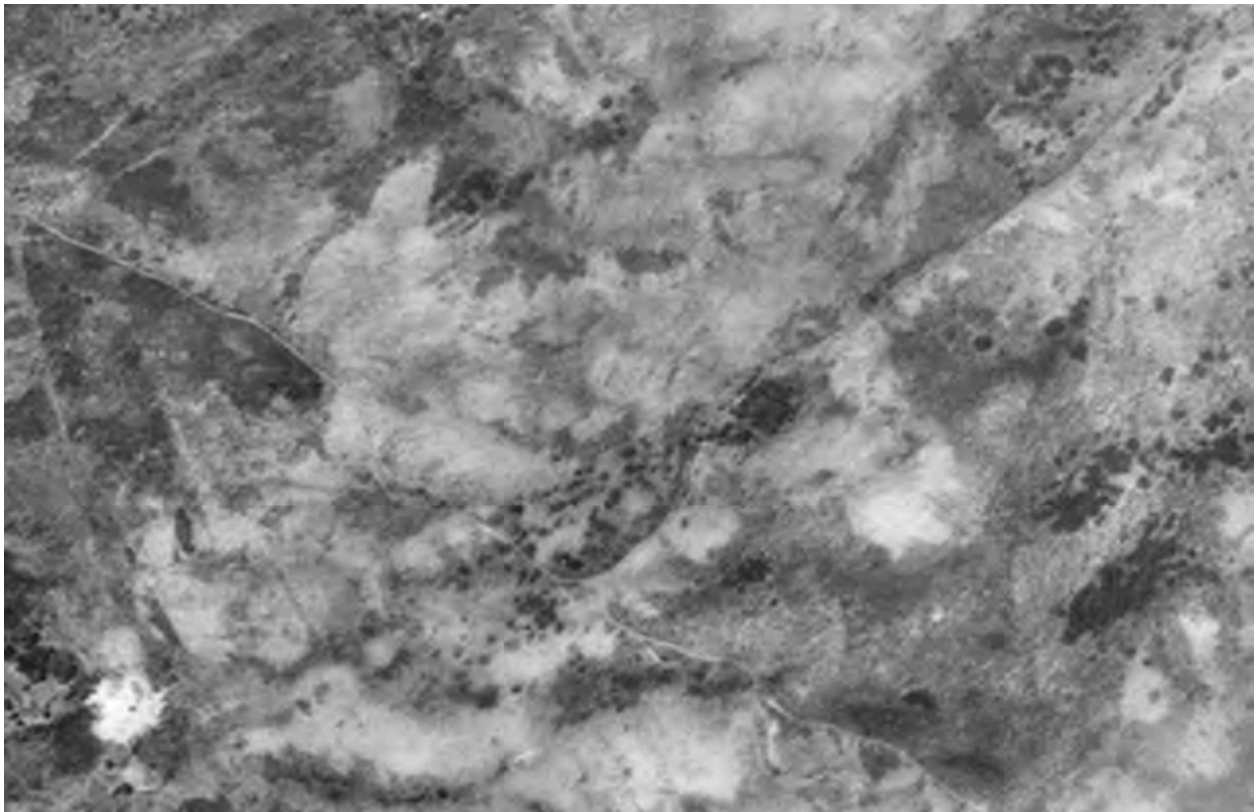
Ground disturbance is the physical interference and movement of the soil surface; such interference includes wind and water erosion, the actions of livestock as hooves and camps, mechanical earthworks, vegetation clearing, machinery and vehicle movement on soil, and fertiliser application.

Ground disturbance is a powerful stimulant of pioneer and weed plants, particularly legumes including wattle and kennedia that store their seeds in the ground (geospory), which can respond strongly to the scarification from soil movement. It also provides competition and light - filled voids upon which seeds from plants that hold their seeds in the canopy (bradyspory, serotiny) fall and regenerate.

Wattle and other native legume seed can lie in the ground and remain viable for very long periods of time due to the tough nature of the hard seed and the protection afforded by surrounding soil. Ants are known to harvest and store native legume seed seeking the fatty aril attached as food. Very old native legume seed banks have been known to activate when disturbed or exposed, an example is the growth of rare *Acacia* and *Daviesia* species in the floor of gravel pits developed in long cleared paddocks (100 + years) near Doodlakine in the central wheatbelt.

Long-term frequent and even relatively intermittent ground disturbance can lead to the development of altered vegetation communities, dominated by plants that have developed very large geosporous seed banks, or in some cases bradysporous plants with the superior ability to disperse seeds broadly – e.g. the weed Victorian tea tree (*Leptospermum laevigatum*), and the local peppermint. This situation causes instability in the community due to the artificial predominance of pioneer plants, including introduced weeds, at the expense of longer-lived old growth or climax community plants. Prime examples of these communities exist on Point Henry Peninsula as the AcySgS and LIS communities (see Table 2), which likely occur due to the frequent disturbance from historic preferential grazing and camping by stock and horses in some sites near water availability.

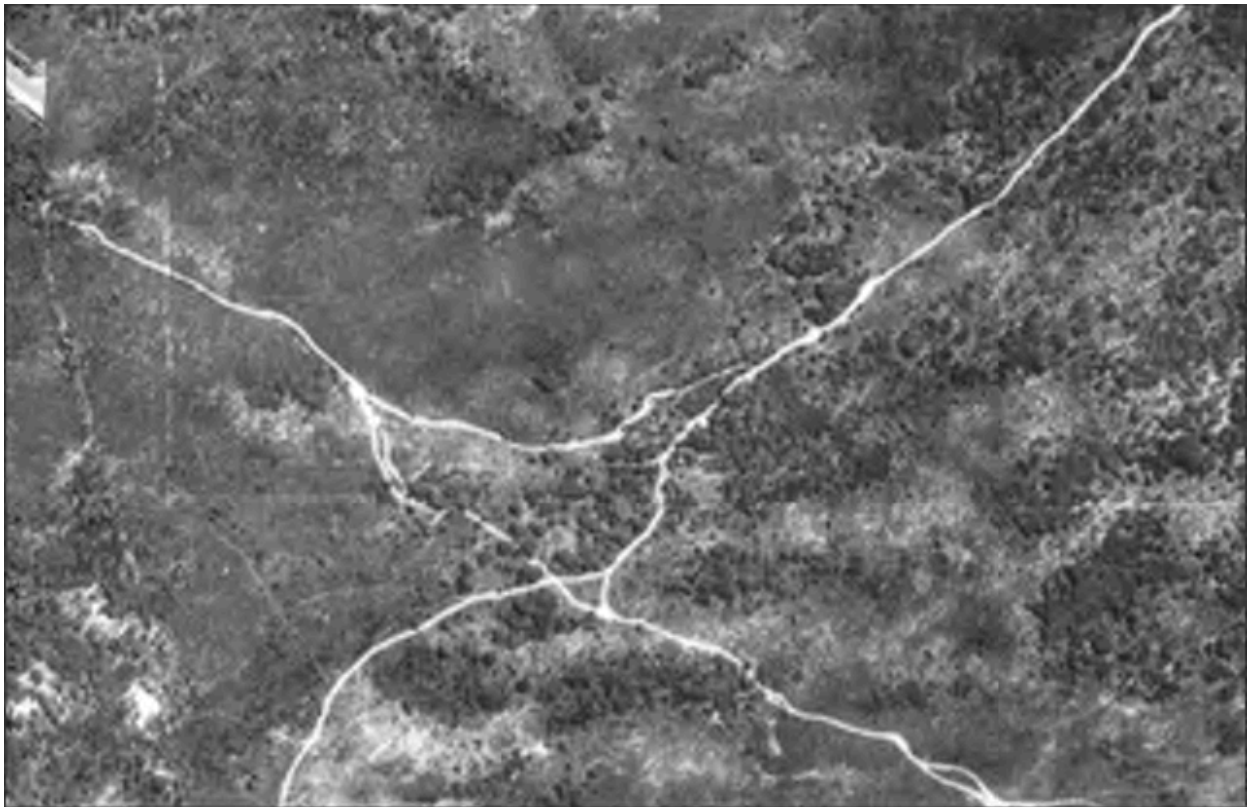
Peppermint is a peculiar example of a native pioneer plant; it is dominant in the Bremer Bay and Point Henry area, where it is close to its eastern distribution limit at Gordon Inlet. Peppermint has moved onto ridges from its natural preference for valleys and swales during the last several decades, which can be seen on the sequence of aerial images dating back to the 1950's (I Weir pers. comm.) following. It is a very strong disperser of seed, and it has likely invaded the ridges due to the suppression of their vegetation communities by frequent fire during the area's grazing regime.



Lot 104 Pt Henry Rd 1958. Image: Ian Weir. Note the peppermint stands and extent



Lot 104 Pt Henry Rd 1976. Image: Ian Weir. The peppermint stands and extent increases



Lot 104 Pt Henry Rd 1983. Image: Ian Weir. Further expansion of peppermint community



Lot 104 Pt Henry Rd 1993. Image: Ian Weir. Continued peppermint expansion



Lot 104 Pt Henry Rd 1993. Image: Ian Weir. Peppermint expansion, and increasing density



Lot 104 Pt Henry Rd 2013. Image: Ian Weir. Continued expansion and increased density

Fire disturbance

Fire is both a destructive medium that kills and consumes vegetation, and as a disturbance, is a powerful plant regeneration agent. Native plants and the vegetation communities they form have varying capacities to cope with fire, having a range of developed abilities to resprout or regenerate from seed following damage by fire, as well as sensitivities that see some adversely affected by fire.

Some plants, as pioneers or disturbance opportunists, are able to respond positively to the disturbance of fire, while others more sensitive are killed and must have long periods without fire to reach maturity and achieve sufficient seed set for successful regeneration.

Frequent fire can alter vegetation communities and reset their development trajectories, causing systemic instability. It does this by encouraging the predominance of pioneer geosporous and less sensitive resprouter species, and removing sensitive serotinous and bradysporous species.

'Frequent', as a concept in the context of the predominantly sensitive south west Australian vegetation, is intervals of generally less than around 30 years for regeneration maturity as sufficient seed bank development, or the order of 100 - 150 or more years for stable, open and low-hazard climax community development.

There are very few old climax communities remaining, although a few exist on private land in the district, and in a few pockets in reserves where fire and other disturbances have been excluded for a long time. These are particularly instructive, showing the existence of open, sparse, low-hazard communities with (depending on the community) few large shrubs and trees, almost non-existent under-shrub layers and luxuriant diverse and thick ground covers of dryland sedges and rushes. An example of one of these is the ancient tallerack or blue mallee (*Eucalyptus pleurocarpa*) community (EpOR) in Reserve 51949 alongside John St.

Fire is often used to remove vegetation to reduce bushfire hazard, and allow access in the short term. However, the use of fire for the removal of vegetation has consequences to consider and overcome; while it effectively eliminates vegetation in an immediate sense, it also promotes regeneration. It can encourage the invasion of more precocious plants, often into vulnerable sensitive vegetation communities, and destabilise robust communities. When frequent, it will apply a long-term selection pressure that favours pyrogenic disturbance opportunist plants, which increases hazard and alters shelter, cover and habitat.

An example of the density of recently burnt vegetation is alongside Bremer Bay to Boxwood Hill Rd 23 km west of town, where the mallee communities (EpEd and EpK) were burnt in 2015, which are now recovering as a dense wattle-dominated thicket, within which the mallees are resprouting and other plants regenerating. This two-year old community is the same community as the tallerack/blue mallee EpK/EpOR community in Reserve 51949. However, it is in recovery following fire and as a result is a much denser legume - dominated community while it recovers to eventually become an open, low hazard, climax community, if not disturbed again for many years.

Landscape history

Ground disturbance and frequent fire are new common phenomena in an old landscape. The South west of Australia is known to be a very old landscape, some 40 times older than the rest of the continent, which is to say that it is one of the oldest places on Earth since soil building has occurred through volcanic or glacial action. The resultant subdued landscapes and impoverished soils have a co-evolved legacy of richness and vulnerability in the vegetation communities, which are largely prone to severe alteration from frequent disturbance. This situation and process is part of the new science of understanding the evolution and sensitivities of vegetation and plants in old landscapes, known as OCBIL Theory (Hopper 2009). This work develops and advocates the rethinking needed to sustainably manage the southwest Australian vegetation.

The area covered by the majority of Reserve 511 and the Point Henry Peninsula was subject to grazing, predominantly by large numbers of sheep, from around 1880 to 1958 in the case of Reserve 511 and 1973 on Point Henry Peninsula. The grazing was accompanied by a rotational burning program to encourage grasses and new growth as native pasture, and the development and use of water points in gullies.

The grazing and burning regime for the order of 70 – 90 years brought a unique and significant destabilising ground and fire disturbance regime, by which the area was profoundly influenced, and is still recovering from. This disturbance regime encouraged and resulted in altered vegetation communities, where the changes in composition, structure and ecological instability described above, has brought about increased densities and fire hazard in some dominant vegetation communities.

The mixture of burning and grazing modified the vegetation by promoting and then removing by grazing the significant regrowth of favoured resprouting groundcovers, as well as the disturbance opportunist peppermint and wattles, the latter which were also preferentially grazed. The disturbance regime altered the composition and structure, and therefore the ecological developmental trajectory of the vegetation communities.

It appears likely that the greatest pressure from grazing and burning was on the peppermint shrubland and woodland communities. This is where the johnny or curly grass (*Desmocladus flexuosus*) and coast wattle (*Acacia cyclops*) predominate, which were the pasture components preferentially encouraged by burning and sought by stock. The relative good health of other communities suggests that they were not so much preferred by the grazing stock.

Similar peppermint dominated vegetation communities the Peppermint Beach area of the Doubtful Island Peninsula, although with a history of infrequent disturbance, appear to be older and more open than the Reserve 511 and Point Henry communities. This history may be the reason that they have not developed the same composition and structural alteration, densities and fire hazards of related communities in Reserve 511 and on the Point Henry Peninsula.

Notably, peppermint occurs further west along the coast to around the Pallinup Estuary (Beaufort Inlet) and beyond, although in these areas it is often a relatively sporadic member of the vegetation communities, rather than the dominant it is in

the Bremer Bay area. This may be due to the greater community stability from a less frequent recent disturbance regime.

Kwongkan and other vegetation communities

Not all vegetation communities have dense and open stages like the common peppermint dominated, mallee and eucalypt woodland communities described. Some predominantly occur as thicket communities, and others as diverse kwongkan shrubland and heath communities dominated by banksia and other proteaceous plants.

Soil differences account for the existence of these communities, with a range of yellow sand, limestone sand, clay and shallow granite sandy loam types, compared to the relatively uniform deep grey sands under the shrubland and woodland communities.

The thicket communities can be wattle dominated, in fact almost pure stands in the case of what are likely relatively long-lived dominant granite wattle (*Acacia heteroclita*) in the AhT community, and in other places it mixes with Pt Henry honeymyrtle, which is a long-lived shrub.

Proteaceous kwongkan communities have exceptionally diverse groundcover and shrub strata. In most cases the groundcovers are very long-lived resprouter sedges and rushes, and the shrub strata comprising mostly long-lived serotinous species. These communities have fewer wattles and other legume pioneer species, and are easily damaged and modified by frequent disturbance.

Limestone ridge communities are different again, with a predominance of long-lived shrub strata, which includes some legumes. These communities have some quite short-lived pioneer species, including a couple of wattles and kennedia creepers. Their disturbance response behaviour fits somewhere between the precocious peppermint and mallee and robust clay plain mallee communities, and the vulnerable proteaceous communities. The biggest threat to these communities by frequent disturbance is the loss of sensitive species, and the composition and structural modification and hazard increase that can come from invading peppermint, wattle, Victorian tea tree and even mallee from adjacent precocious communities.

Composition, structure and hazard development

Frequent ground disturbance and fire applies a selection pressure on the vegetation that favours those pioneer and precocious plants. Their evolutionary role is to provide rapid cover, nutrients and repair as a foundation for the development of the long-lived plants into a stable old growth stand.

Frequent disturbance develops instability in plant communities by promoting a cycle of constant recovery, with the absence of attrition over time, at the expense of more open and less fire-hazardous old growth or climax communities. Its direct impacts are an inherent density from composition and structure alteration, the dispersal and introduction of precocious pioneer plants and introduced weeds, and the alteration of more sensitive and diverse communities adjacent.

In terms of the succession and structural development and its bushfire fuel loads as hazard for the common vegetation communities of the study area, 'frequent' is periods less than at least the order of 50 years, which is generally the time taken for a vegetation community to be able to replace its composition and reach a degree of old growth structure. However the ideal timescale varies depending on the type of vegetation community, its location and its disturbance history. The vegetation communities of the Point Henry Peninsula were burnt every three to four years during its 90 or so years as a grazing property, which was possible and done because the bush was able to grow back sufficiently to carry fire, and it encouraged edible regeneration. However, this very frequent disturbance preferentially 'selected' a predominance of pioneer species, which ultimately altered the communities. In this way the cycle was not an ideal disturbance frequency for any purpose other than grazing.

The recovery process post disturbance is a healing cycle that the plant components in a vegetation community contribute to depending on their abilities and roles. Pioneer plants have a recovery role to quickly protect and provision the site, so that the long-lived plants can prosper and endure. Think of the pioneer plants as the scab tissue, and the long-lived plants as the skin.

Another effect or process of disturbance or the removal of competition in plants is the 'edge effect'. This phenomenon occurs when plants of the same age as their surrounding cohort grow larger, often a great deal larger - because they have better access to light, nutrient and water resources, and less competition. Access to these resources and the edge effect phenomena is often found at the edge of stands such as on roadsides, at the edge of paddocks and other cleared areas, and in open gaps in vegetation caused by the death of some individuals.

The edge effect is a powerful growth stimulus that can be used to manipulate some vegetation communities by thinning to produce larger shrubs and trees more quickly. Old growth communities exhibit the edge effect in their fewer larger plants remaining to benefit from the eventual attrition and decay of the majority of their departed kith and kin.

The management of the vegetation communities of the study area must take into account the disturbance history and its processes, and the legacy it has left in altered vegetation communities. The regenerating vegetation results need to be managed to manoeuvre the trajectories and development of composition and structure, towards mature lower hazard old growth/climax communities, lest the vegetation become dense due to preponderance of regeneration. This can be achieved by limiting or eliminating disturbance and promoting the edge effect, by the careful removal of pioneer plants by non-stimulating/low or no disturbance methods such as slashing, mowing, cutting and mulching. Old growth could also be achieved by leaving the vegetation undisturbed for many decades or more, although we can achieve similar results quickly, by using knowledge and mechanical agents of attrition that time otherwise provides.

Vegetation of Bremer Bay and Point Henry

The *Bremer Bay/Point Henry Vegetation Mapping and Management Project* identified 29 vegetation communities in its study area. The vegetation communities were selected for their differences according to the four criteria:

1. Species composition and dominants.
2. Structure patterns as size and community strata: groundcover, understorey, shrubs, mallee and trees.
3. Difference in substrate occupied as landforms, underlying geology, soil type and aspect.
4. Behaviour patterns, responses to disturbance by dominant species.

Communities were scored using the industry standard Perth Bushland Survey (Keighery 1994) methodology, which records site, substrate, situation, community strata, species composition as presence and dominance, and structure.

The vegetation community composition and structure assessments are the basis for informing the vegetation mapping, as an objective community and site based method. This follows the methodology developed for the Vegetation of Ravensthorpe Range Mapping project (Craig et al 2008).

Vegetation community classifications generally follow The Vegetation of Western Australia at the 1:3,000,00 scale (Beard et al 2013). However, the actual community types recorded in the study area did not necessarily fit with the strict definitions, and were described according to dominant genera and generalised structure recorded.

Vegetation biomass bushfire fuel hazard was also assessed and recorded for each site using the comprehensive Victorian Department of Sustainability and Environment's Overall Fuel Hazard Assessment Guide (Hines et al 2010).

The vegetation communities outlined in *Australian Standard 3959 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009) AS 3959, are an attempt to apply generalised structure and composition types found across Australia for supporting the determination of Bushfire Attack Levels (BAL). However, the vegetation communities of southern Western Australia are among the most complex in Australia and indeed the world, including the vegetation communities in the Bremer Bay/Point Henry area, and do not easily or often fit the generalised AS 3959 types. Notwithstanding, some AS 3959 types are relevant as similar or somewhat similar and these have been identified in the community descriptions below.

Sites were selected for vegetation community and hazard assessments in typical vegetation communities, which were identified by field searches following the investigations of patterns identified on aerial imagery supplied by the Shire of Jerramungup.

Disturbance sensitive and otherwise vulnerable vegetation communities and their ecological behaviours were identified in following the methodology and recommendations in Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management Region (Barrett et al 2009).

Vegetation hazard

Vegetation fuel hazard is the density and arrangement of the live and dead vegetation in vegetation communities as biomass. The biomass is the leaves, buds and fruits, twigs, sticks, branches and bark in the standing vegetation and on the ground as litter. It is the fuel that burns in a fire event, and as such is the hazard.

The vegetation biomass hazard was assessed at each of the 115 vegetation community assessment sites using the Victorian Department of Sustainability and Environment method (Hines et al 2010). This methodology allows an objective fire hazard assessment across variable vegetation community types.

Biomass hazard in vegetation communities in the Bremer Bay/Point Henry study area is varied according to the type of vegetation community, the dominant species and their structures, and age and disturbance history.

Vegetation biomass develops as vegetation communities grow. The development trajectory and densities are closely related to disturbance ecology as the composition and structure of the vegetation community changes over time.

The typical hazard ratings of each vegetation community are provided in Table 2. Typical hazard refers to the hazard recorded at the assessment site, chosen as a typical example of that community.

Vegetation maps

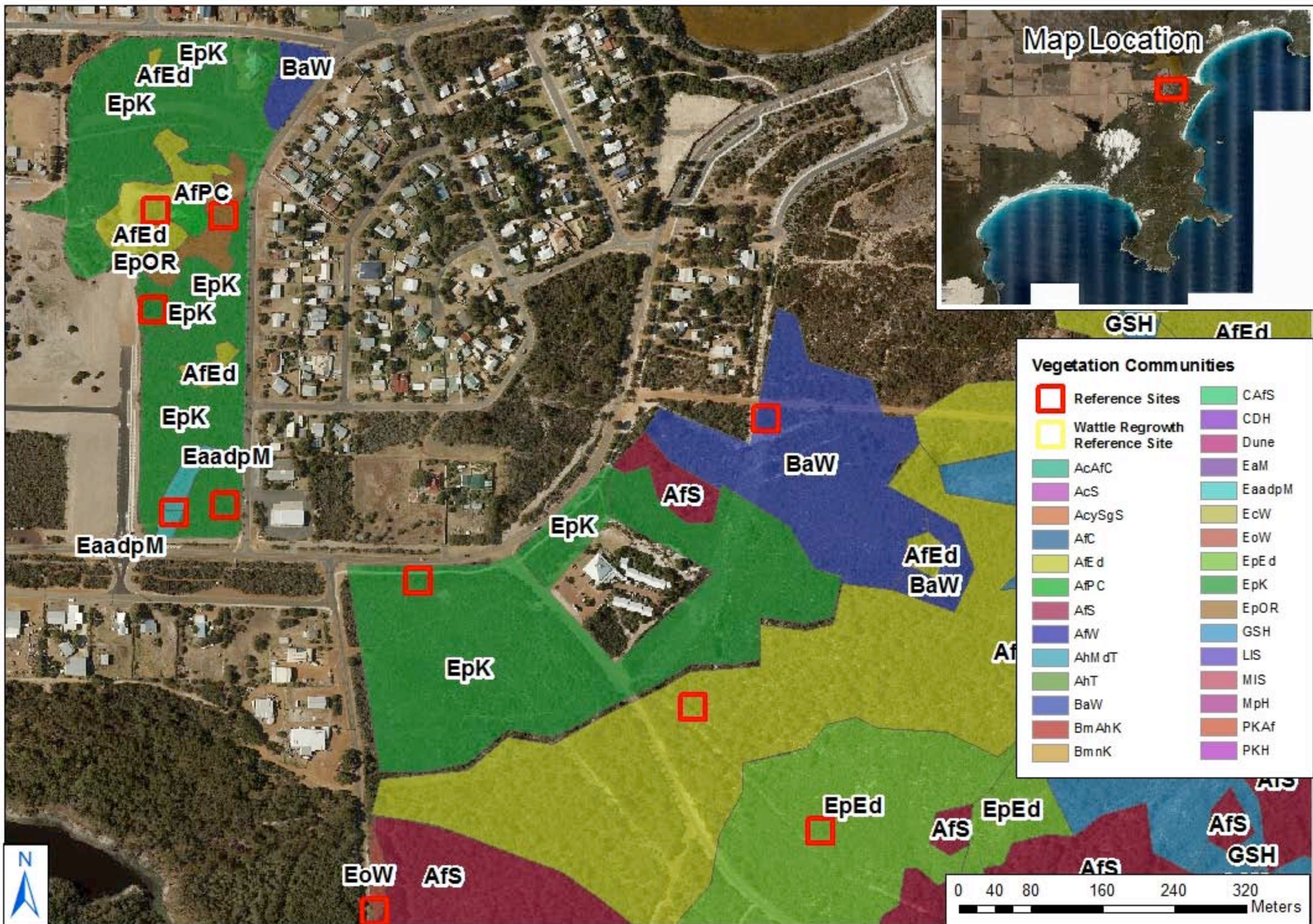
The vegetation mapping and management project identified 29 vegetation community types across Shire of Jerramungup Reserves 511 and 50949, and the Point Henry Peninsula. The vegetation maps were derived by using aerial photography to identify the communities, and from the vegetation community assessments to confirm and describe their different compositions and structures, bushfire hazard ratings and conservation status. Further, the ecological behaviour and sensitivities of the different communities were identified, and reference sites assigned.

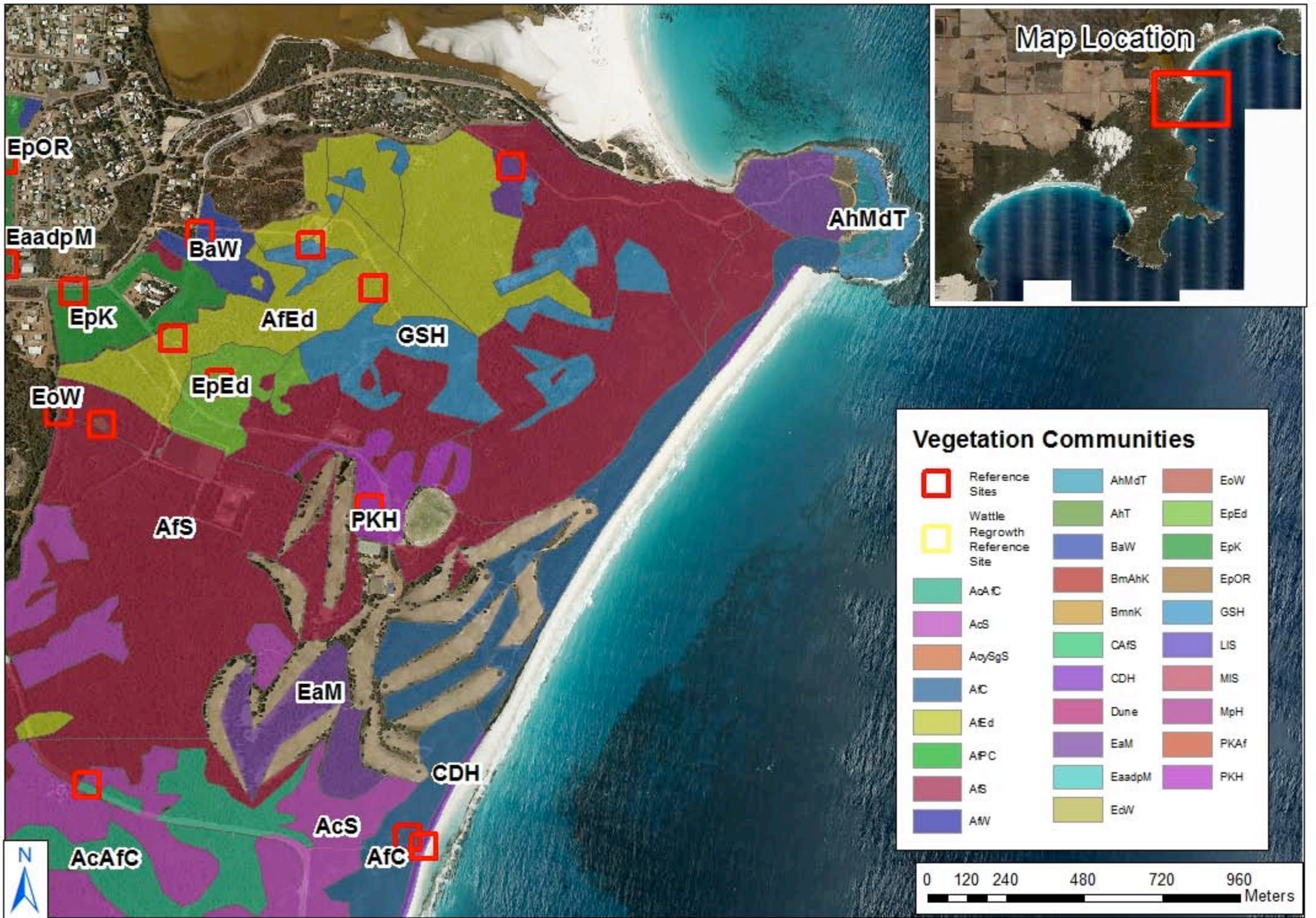
The maps show the 29 vegetation communities with reference sites, their ecological behaviour, hazard ratings, and conservation ratings (maps following pages 31 to 62).

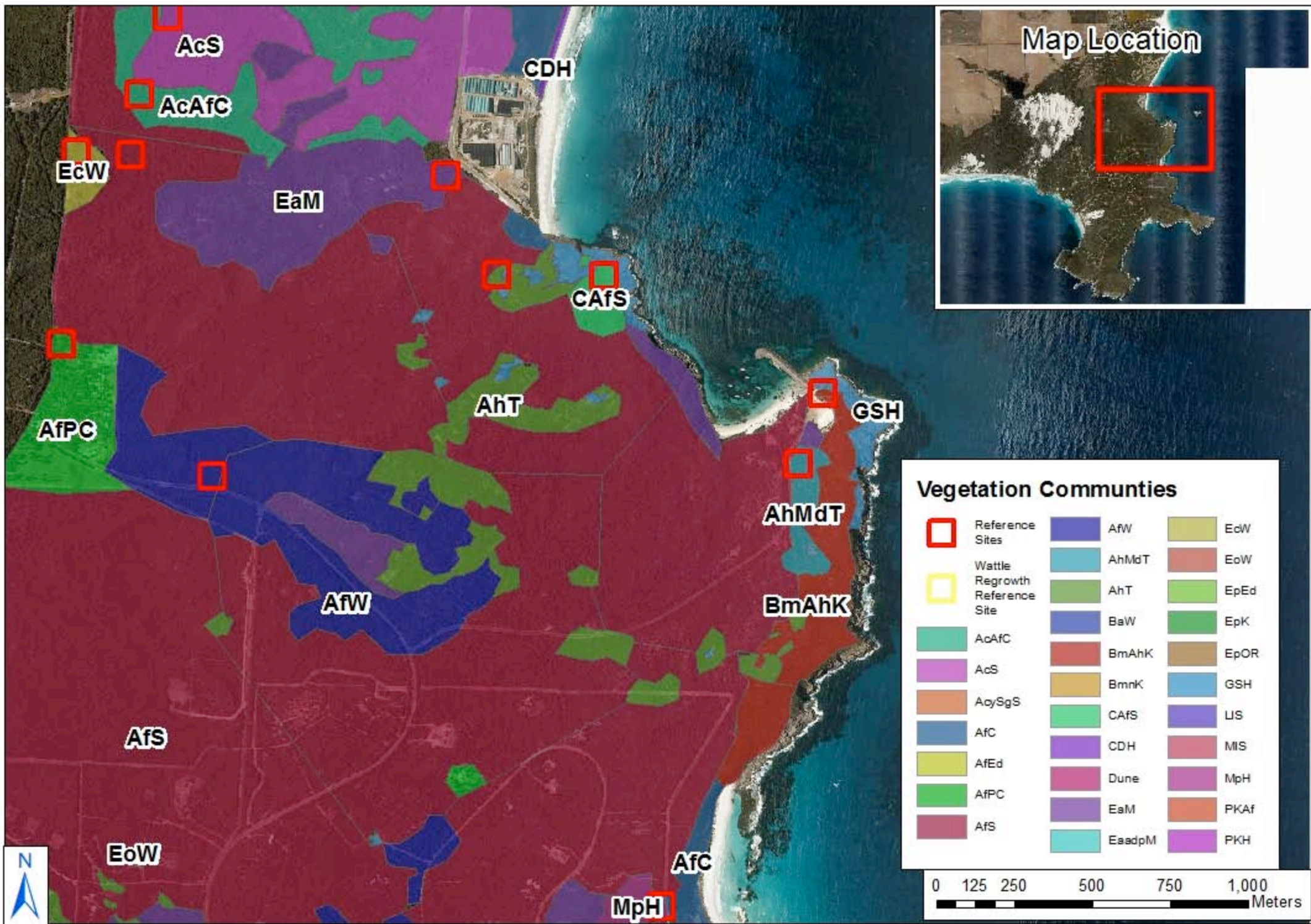
Vegetation mapping is the common method of identifying and interpreting the different assemblages of plants (vegetation communities) and their patterns of occurrence of underlying geology and soil systems, as well as disturbance history by the types of communities and their patterns of occurrence.

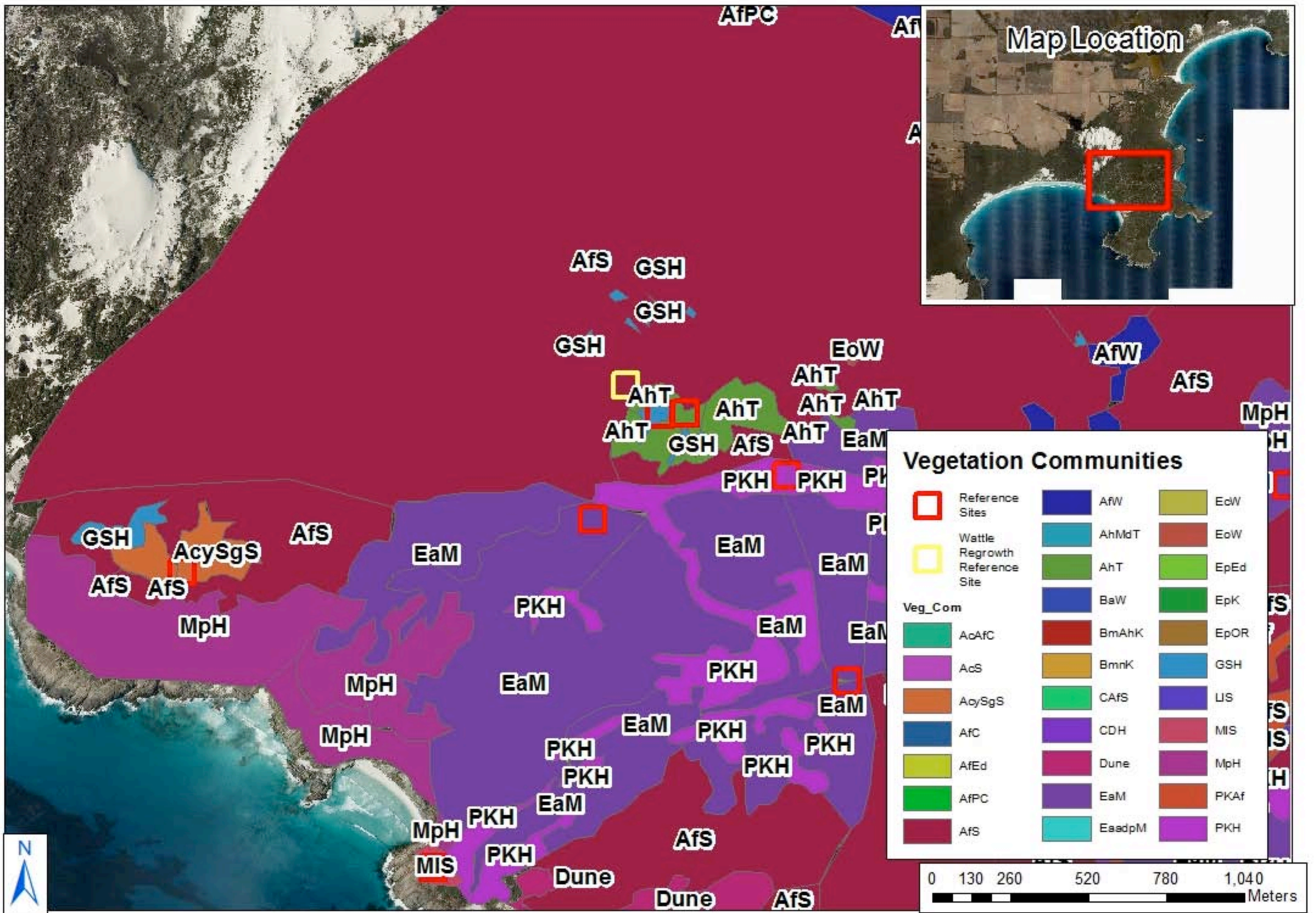
Vegetation mapping has been used as a foundation to better understand, manage and sustain the plants and vegetation of the south coast of WA in a number of groundbreaking studies (Newbey 1979; Craig et al 2008; EPA 2011; Beard et al 2013).

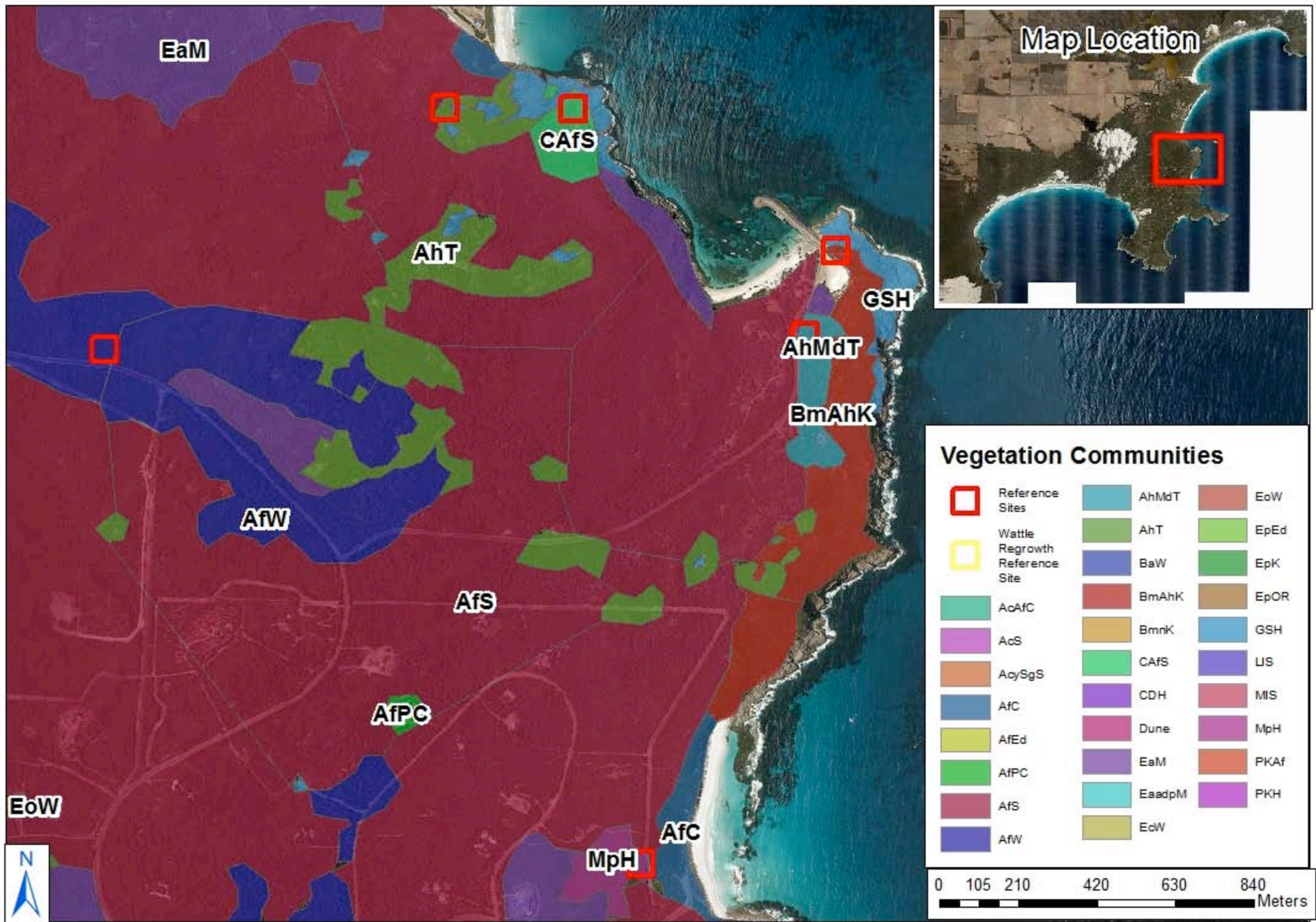
The vegetation mapping took account of the composition and structure of vegetation communities in line with the methods outlined above. However, it also differed in that it considered and recorded the ecological behaviour and sensitivities of the communities, and assessed their fuel hazard ratings as a related matter. These additional measures are to help improve our understanding of the vegetation's response to disturbance, stability and sensitivity profiles, biomass development trajectories and its implications for sustainable management. The management recommendations of Table 2 are informed by these important additional factors.











EaM

CAfS

AhT

GSH

AhMdT

BmAHK

AfW

AfS

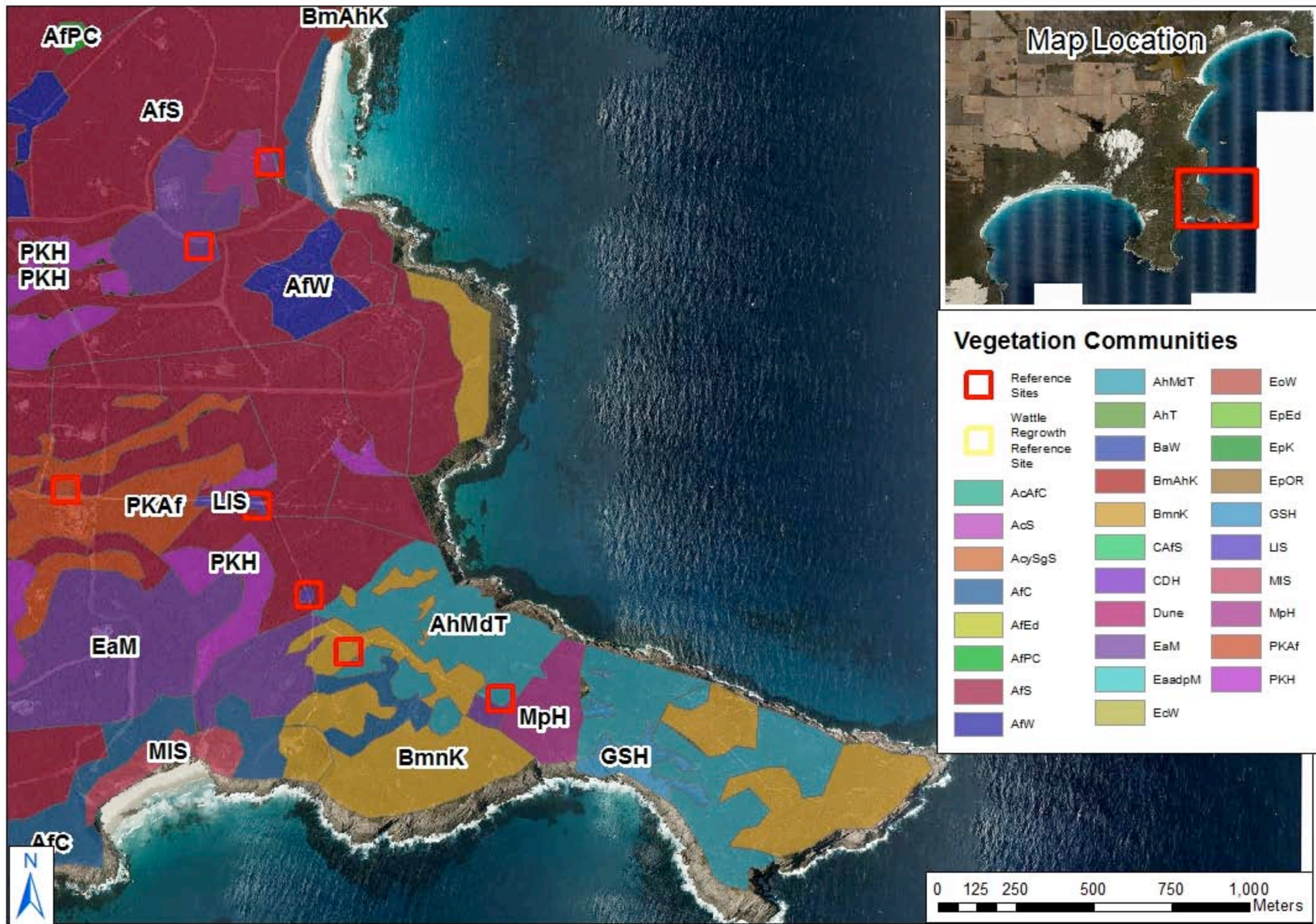
AfPC

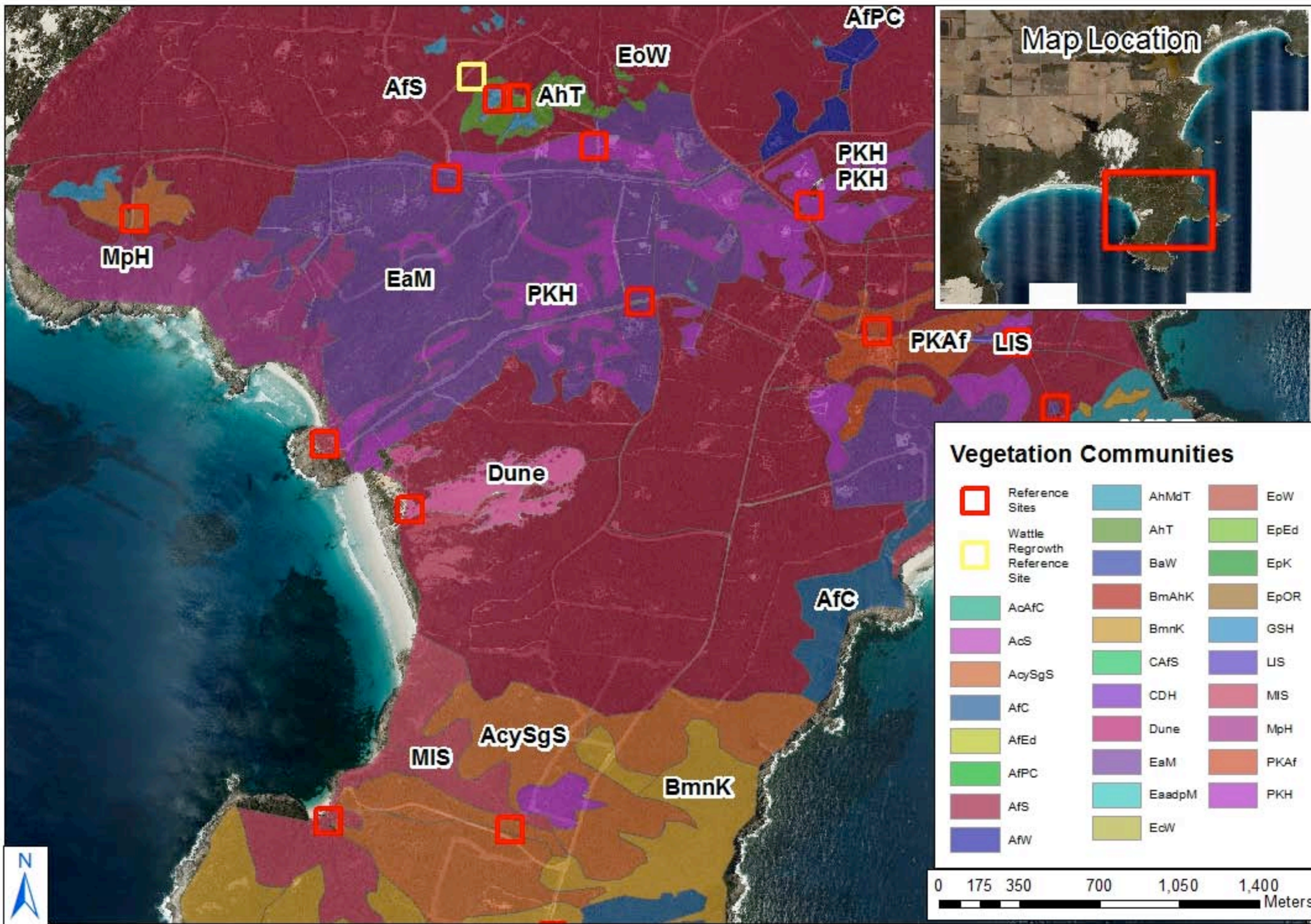
EoW

AfC

MpH







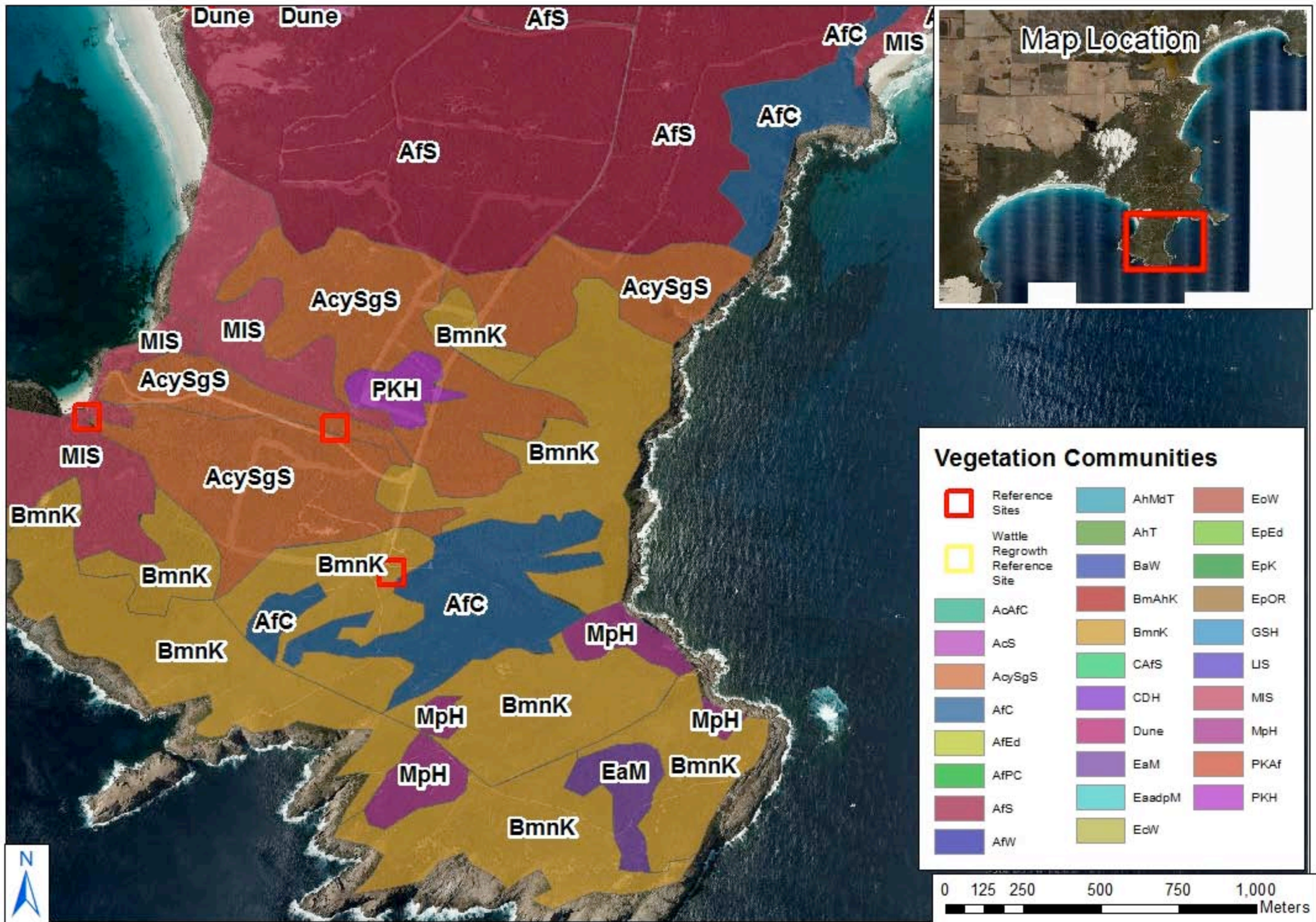
Map Location

Vegetation Communities

	Reference Sites		AhMdT		EoW
	Wattle Regrowth Reference Site		AhT		EpEd
	AcAFC		BaW		EpK
	AcS		BmAHC		EpOR
	AcySgS		BmnK		GSH
	AFC		CAFS		LIS
	AfEd		CDH		MIS
	AfPC		Dune		MpH
	AfS		EaM		PKAf
	AfW		EaadpM		PKH
			EdW		

0 175 350 700 1,050 1,400 Meters

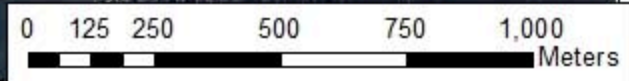


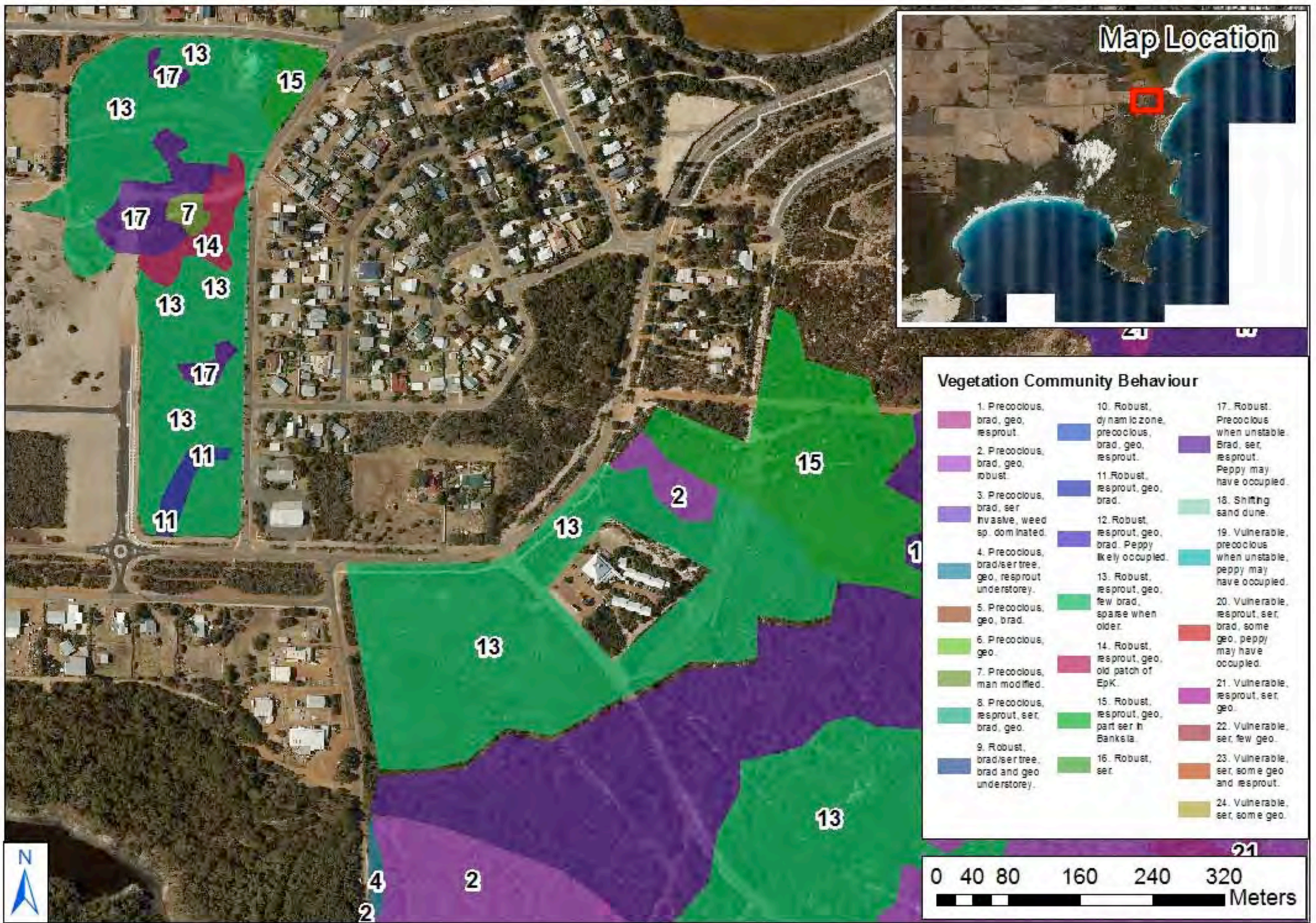


Map Location

Vegetation Communities

	Reference Sites		AhMdT		EoW
	Wattle Regrowth Reference Site		AhT		EpEd
	AcAFC		BaW		EpK
	AcS		BmAHC		EpOR
	AcySgS		BmnK		GSH
	AfC		CAfS		LUS
	AfEd		CDH		MIS
	AfPC		Dune		MpH
	AfS		EaM		PKAf
	AfW		EaadpM		PKH
			EcW		

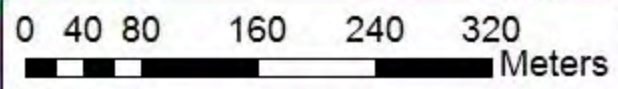


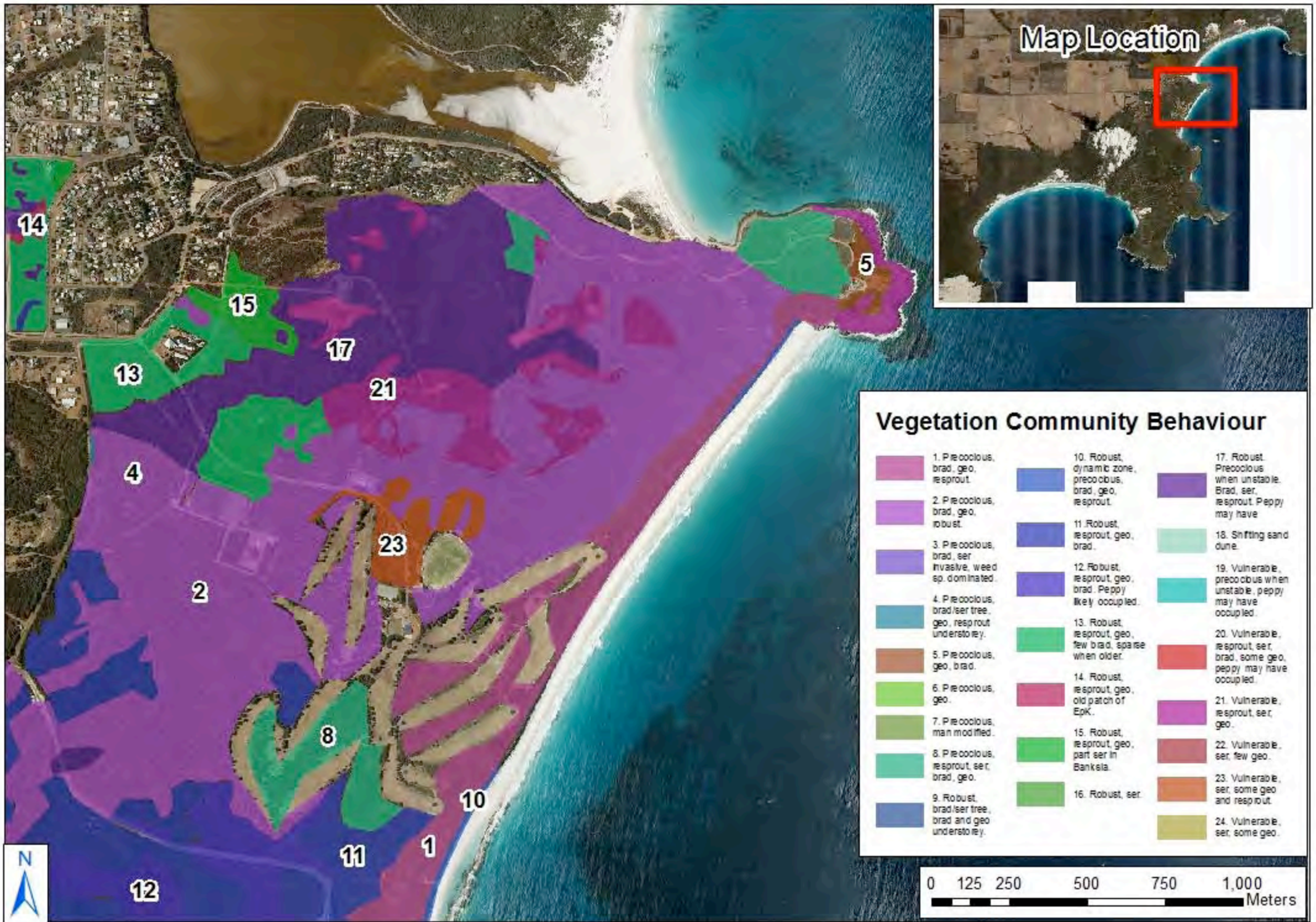


Map Location

Vegetation Community Behaviour

1. Precocious, brad, geo, resprout.	10. Robust, dynamo zone, precocious, brad, geo, resprout.	17. Robust, Precocious when unstable. Brad, ser, resprout. Peppy may have occupied.
2. Precocious, brad, geo, robust.	11. Robust, resprout, geo, brad.	18. Shifting sand dune.
3. Precocious, brad, ser Invasive, weed sp. dominated.	12. Robust, resprout, geo, brad. Peppy likely occupied.	19. Vulnerable, precocious when unstable, peppy may have occupied.
4. Precocious, brad/ser tree, geo, resprout understorey.	13. Robust, resprout, geo, few brad, sparse when older.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
5. Precocious, geo, brad.	14. Robust, resprout, geo, old patch of EpK.	21. Vulnerable, resprout, ser, geo.
6. Precocious, geo.	15. Robust, resprout, geo, part ser in Banksia.	22. Vulnerable, ser, few geo.
7. Precocious, man modified.	16. Robust, ser.	23. Vulnerable, ser, some geo and resprout.
8. Precocious, resprout, ser, brad, geo.		24. Vulnerable, ser, some geo.
9. Robust, brad/ser tree, brad and geo understorey.		



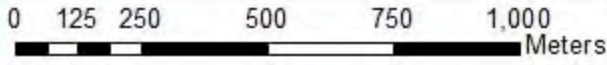


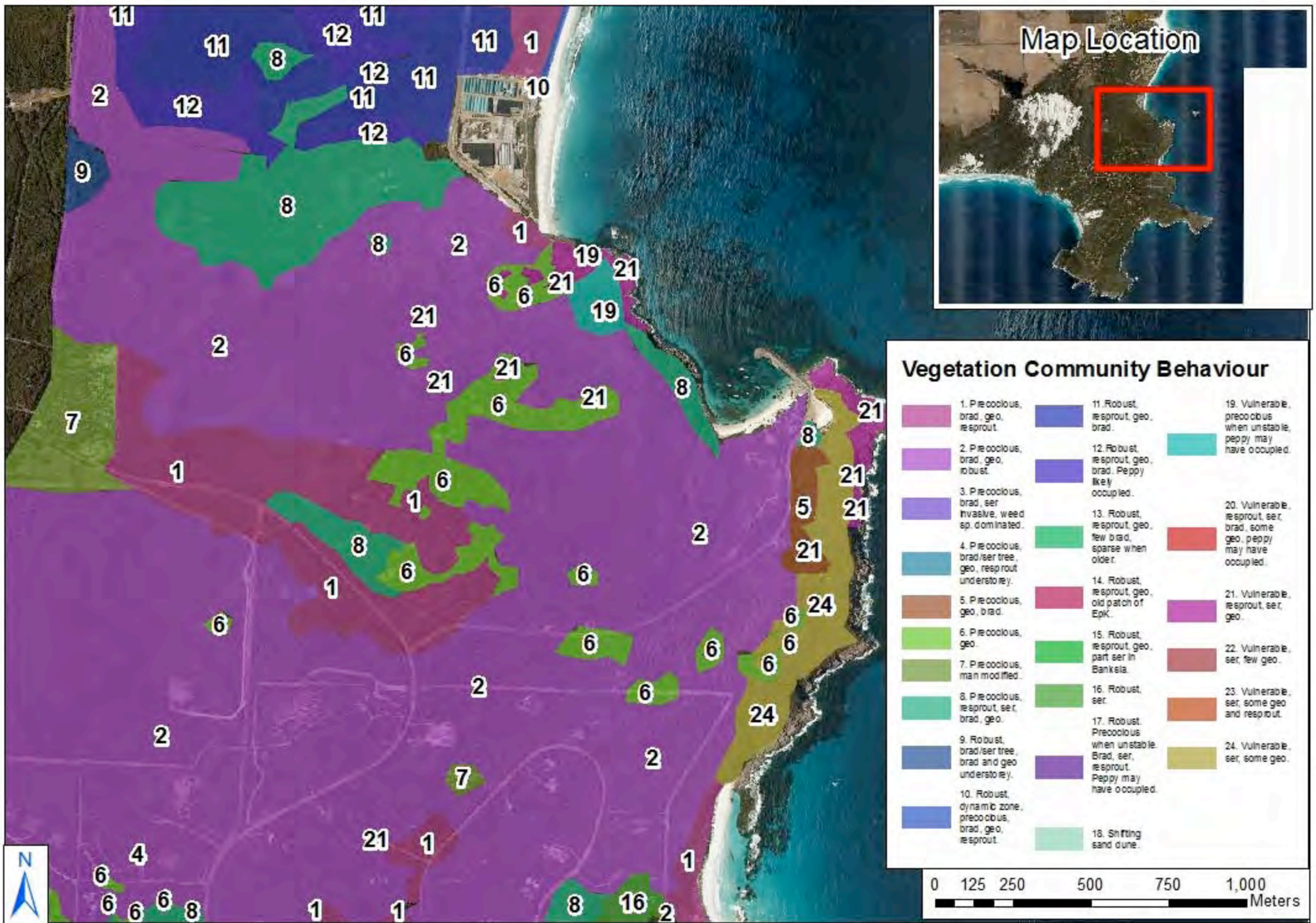
Map Location



Vegetation Community Behaviour

1. Precocious, brad, geo, resprout.	10. Robust, dynamic zone, precocious, brad, geo, resprout.	17. Robust. Precocious when unstable. Brad, ser, resprout. Peppy may have
2. Precocious, brad, geo, robust.	11. Robust, resprout, geo, brad.	18. Shifting sand dune.
3. Precocious, brad, ser, invasive, weed sp. dominated.	12. Robust, resprout, geo, brad. Peppy likely occupied.	19. Vulnerable, precocious when unstable, peppy may have occupied.
4. Precocious, brad/ser tree, geo, resprout understorey.	13. Robust, resprout, geo, few brad, sparse when older.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
5. Precocious, geo, brad.	14. Robust, resprout, geo, old patch of Epk.	21. Vulnerable, resprout, ser, geo.
6. Precocious, geo.	15. Robust, resprout, geo, part ser in Banksia.	22. Vulnerable, ser, few geo.
7. Precocious, man modified.	16. Robust, ser.	23. Vulnerable, ser, some geo and resprout.
8. Precocious, resprout, ser, brad, geo.		24. Vulnerable, ser, some geo.
9. Robust, brad/ser tree, brad and geo understorey.		



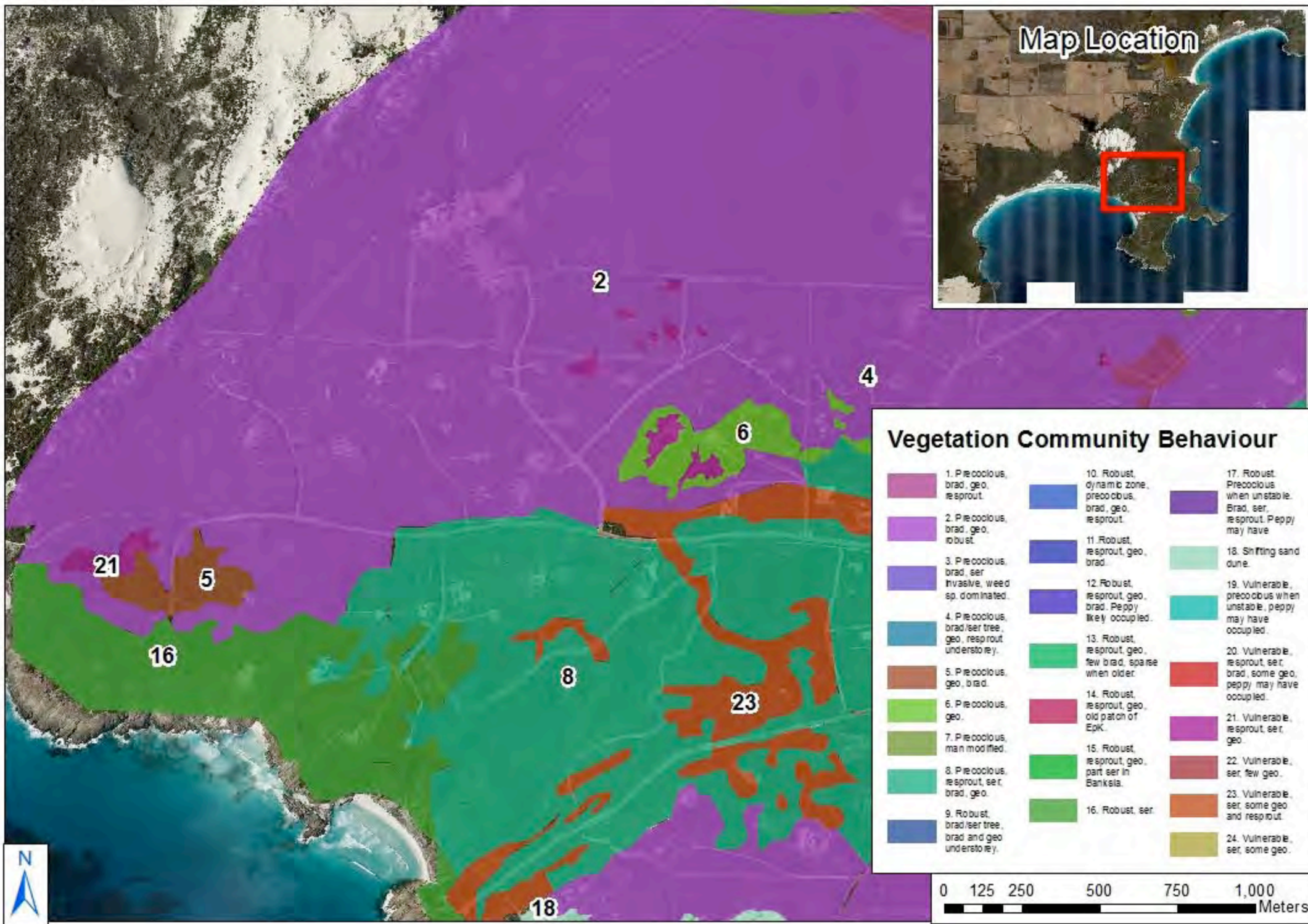


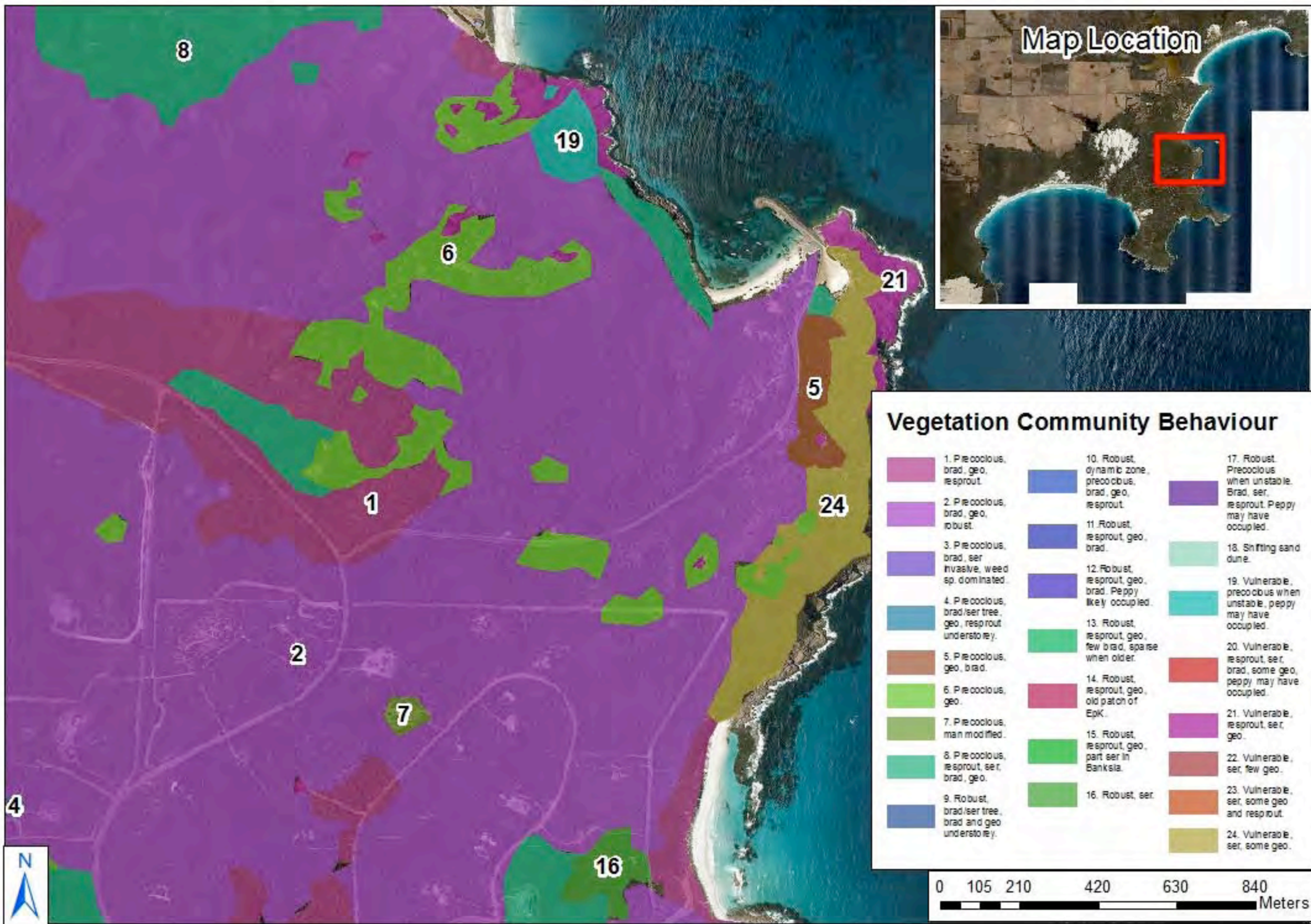
Map Location

Vegetation Community Behaviour

1. Piceoculous, brad, geo, resprout.	11. Robust, resprout, geo, brad.	19. Vulnerable, piceoculous when unstable, peppy may have occupied.
2. Piceoculous, brad, geo, robust.	12. Robust, resprout, geo, brad. Peppy likely occupied.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
3. Piceoculous, brad, ser, invasive, weed sp. dominated.	13. Robust, resprout, geo, few brad, sparse when older.	21. Vulnerable, resprout, ser, geo.
4. Piceoculous, brad/ser tree, geo, resprout understorey.	14. Robust, resprout, geo, old patch of Epk.	22. Vulnerable, ser, few geo.
5. Piceoculous, geo, brad.	15. Robust, resprout, geo, part ser in Banksia.	23. Vulnerable, ser, some geo and resprout.
6. Piceoculous, geo.	16. Robust, ser.	24. Vulnerable, ser, some geo.
7. Piceoculous, man modified.	17. Robust, Piceoculous when unstable. Brad, ser, resprout. Peppy may have occupied.	
8. Piceoculous, resprout, ser, brad, geo.	18. Shifting sand dune.	
9. Robust, brad/ser tree, brad and geo understorey.		
10. Robust, dynamic zone, piceoculous, brad, geo, resprout.		

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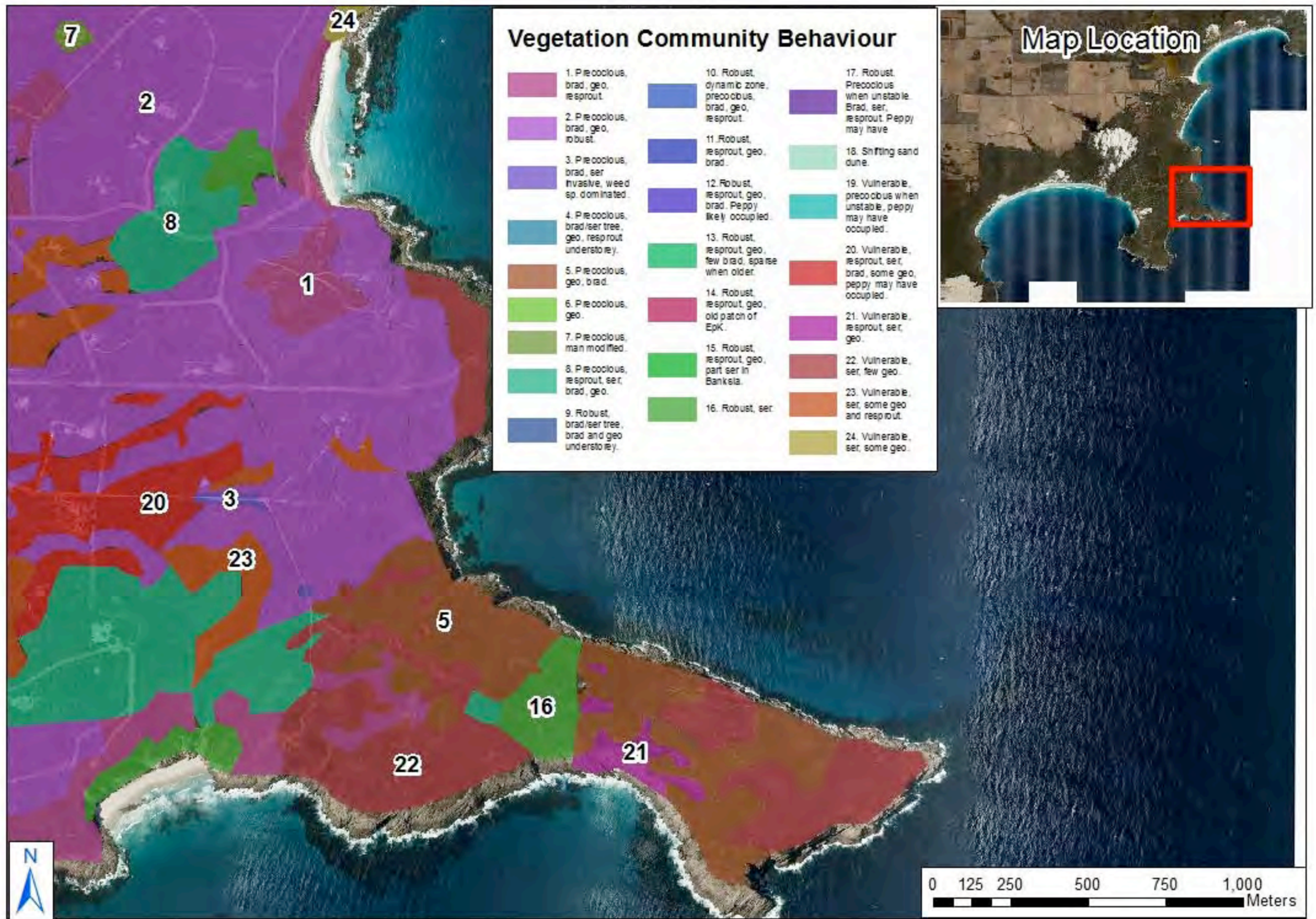


Map Location

Vegetation Community Behaviour

1. Precocious, brad, geo, resprout.	10. Robust, dynamic zone, precocious, brad, geo, resprout.	17. Robust, Precocious when unstable, Brad, ser, resprout. Peppy may have occupied.
2. Precocious, brad, geo, robust.	11. Robust, resprout, geo, brad.	18. Shifting sand dune.
3. Precocious, brad, ser, invasive, weed sp. dominated.	12. Robust, resprout, geo, brad, Peppy likely occupied.	19. Vulnerable, precocious when unstable, peppy may have occupied.
4. Precocious, brad/ser tree, geo, resprout understorey.	13. Robust, resprout, geo, few brad, sparse when older.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
5. Precocious, geo, brad.	14. Robust, resprout, geo, old patch of EpK.	21. Vulnerable, resprout, ser, geo.
6. Precocious, geo.	15. Robust, resprout, geo, part ser in Banksia.	22. Vulnerable, ser, few geo.
7. Precocious, man modified.	16. Robust, ser.	23. Vulnerable, ser, some geo and resprout.
8. Precocious, resprout, ser, brad, geo.		24. Vulnerable, ser, some geo.
9. Robust, brad/ser tree, brad and geo understorey.		

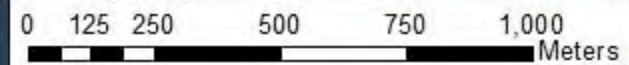
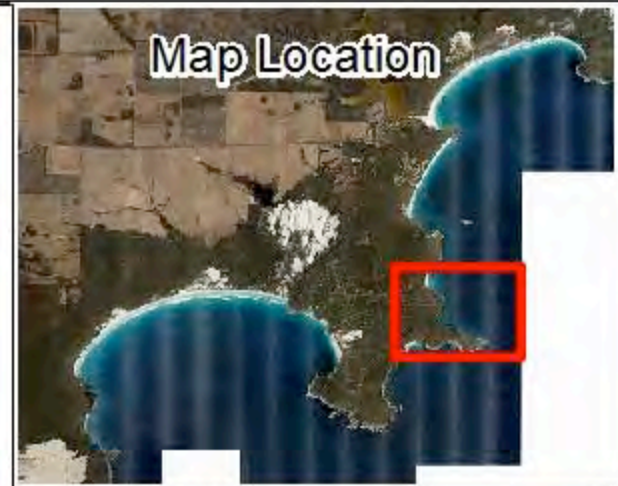
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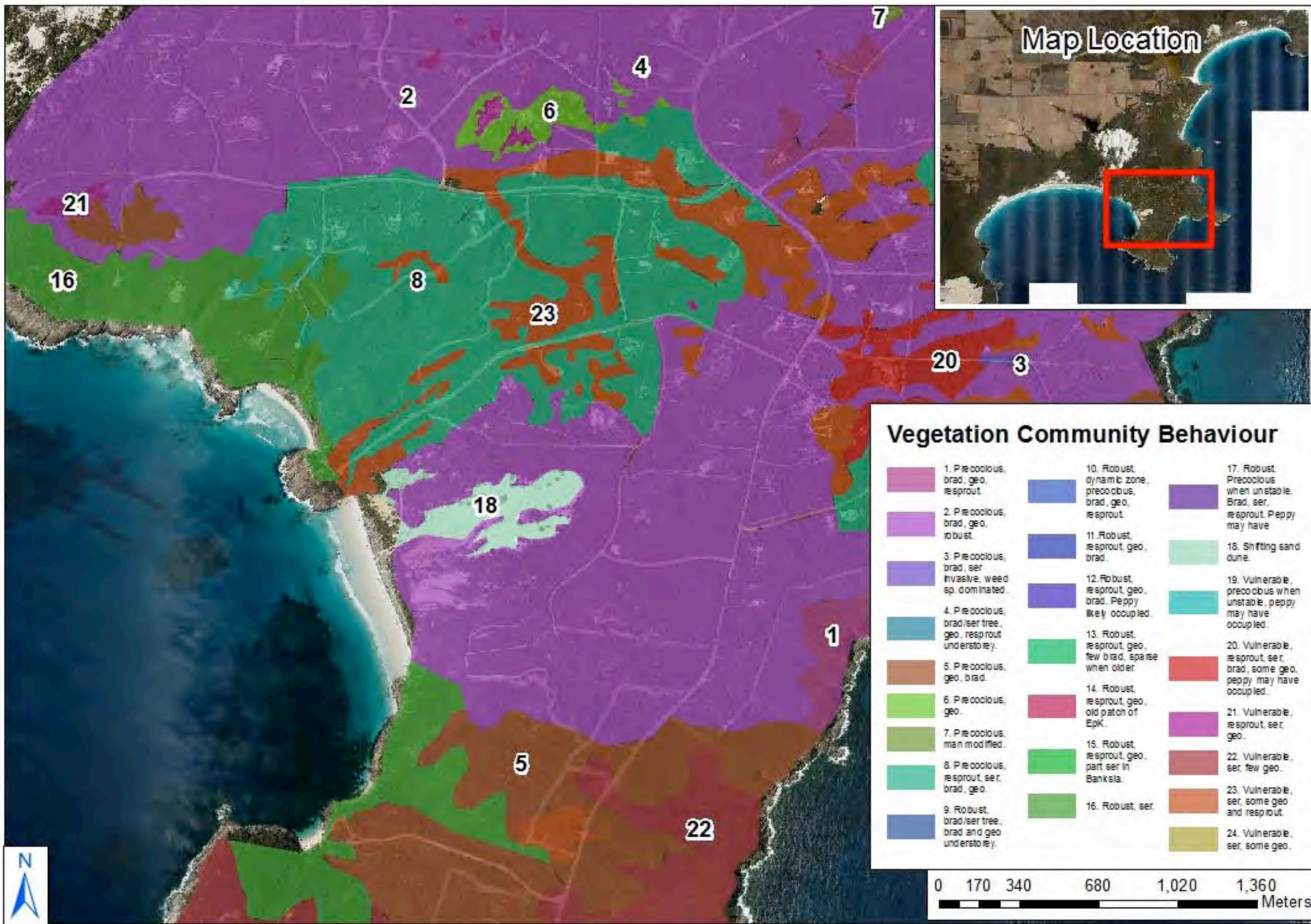


Vegetation Community Behaviour

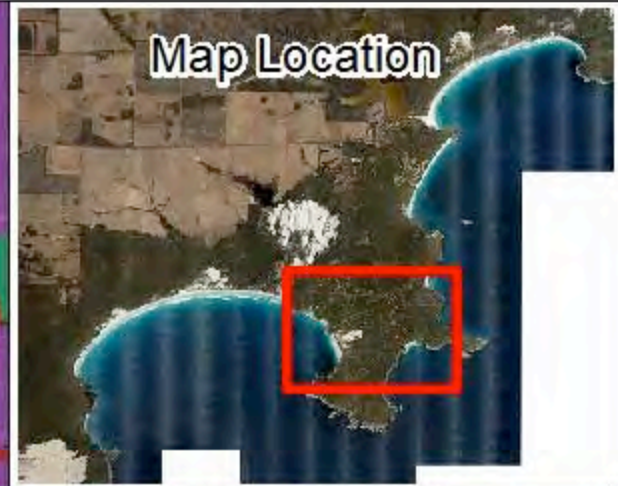
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2. Precocious, brad, geo, robust.	11. Robust, resprout, geo, brad.	18. Shifting sand dune.
3. Precocious, brad, ser, invasive, weed sp. dominated.	12. Robust, resprout, geo, brad, Peppy likely occupied.	19. Vulnerable, precocious when unstable, peppy may have occupied.
4. Precocious, brad/ser tree, geo, resprout understorey.	13. Robust, resprout, geo, few brad, sparse when older.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
5. Precocious, geo, brad.	14. Robust, resprout, geo, old patch of Epk.	21. Vulnerable, resprout, ser, geo.
6. Precocious, geo.	15. Robust, resprout, geo, part ser in Banksia.	22. Vulnerable, ser, few geo.
7. Precocious, man modified.	16. Robust, ser.	23. Vulnerable, ser, some geo and resprout.
8. Precocious, resprout, ser, brad, geo.		24. Vulnerable, ser, some geo.
9. Robust, brad/ser tree, brad and geo understorey.		

Map Location



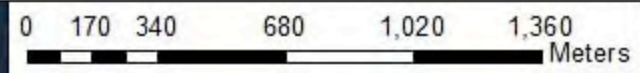


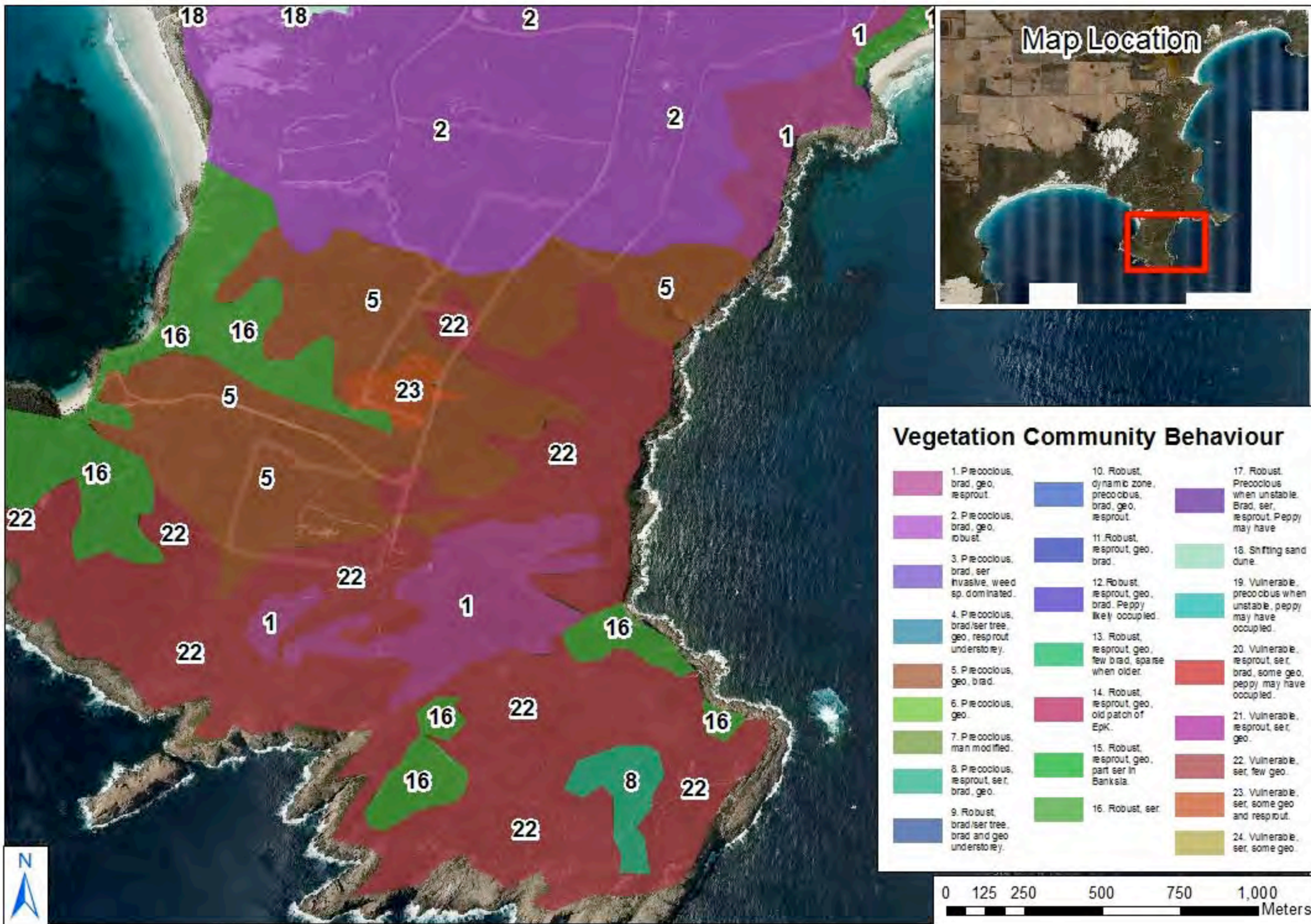
Map Location



Vegetation Community Behaviour

1. Precocious, brad, geo, resprout.	10. Robust, dynamic zone, precocious, brad, geo, resprout.	17. Robust. Precocious when unstable. Brad, ser, resprout. Peppy may have
2. Precocious, brad, geo, robust.	11. Robust, resprout, geo, brad.	18. Shifting sand dune.
3. Precocious, brad, ser, invasive, weed sp. dominated.	12. Robust, resprout, geo, brad, Peppy likely occupied.	19. Vulnerable, precocious when unstable, peppy may have occupied.
4. Precocious, brad/ser tree, geo, resprout understorey.	13. Robust, resprout, geo, few brad, sparse when older.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
5. Precocious, geo, brad.	14. Robust, resprout, geo, old patch of Epk.	21. Vulnerable, resprout, ser, geo.
6. Precocious, geo.	15. Robust, resprout, geo, part ser in Banksia.	22. Vulnerable, ser, few geo.
7. Precocious, man modified.	16. Robust, ser.	23. Vulnerable, ser, some geo and resprout.
8. Precocious, resprout, ser, brad, geo.		24. Vulnerable, ser, some geo.
9. Robust, brad/ser tree, brad and geo understorey.		



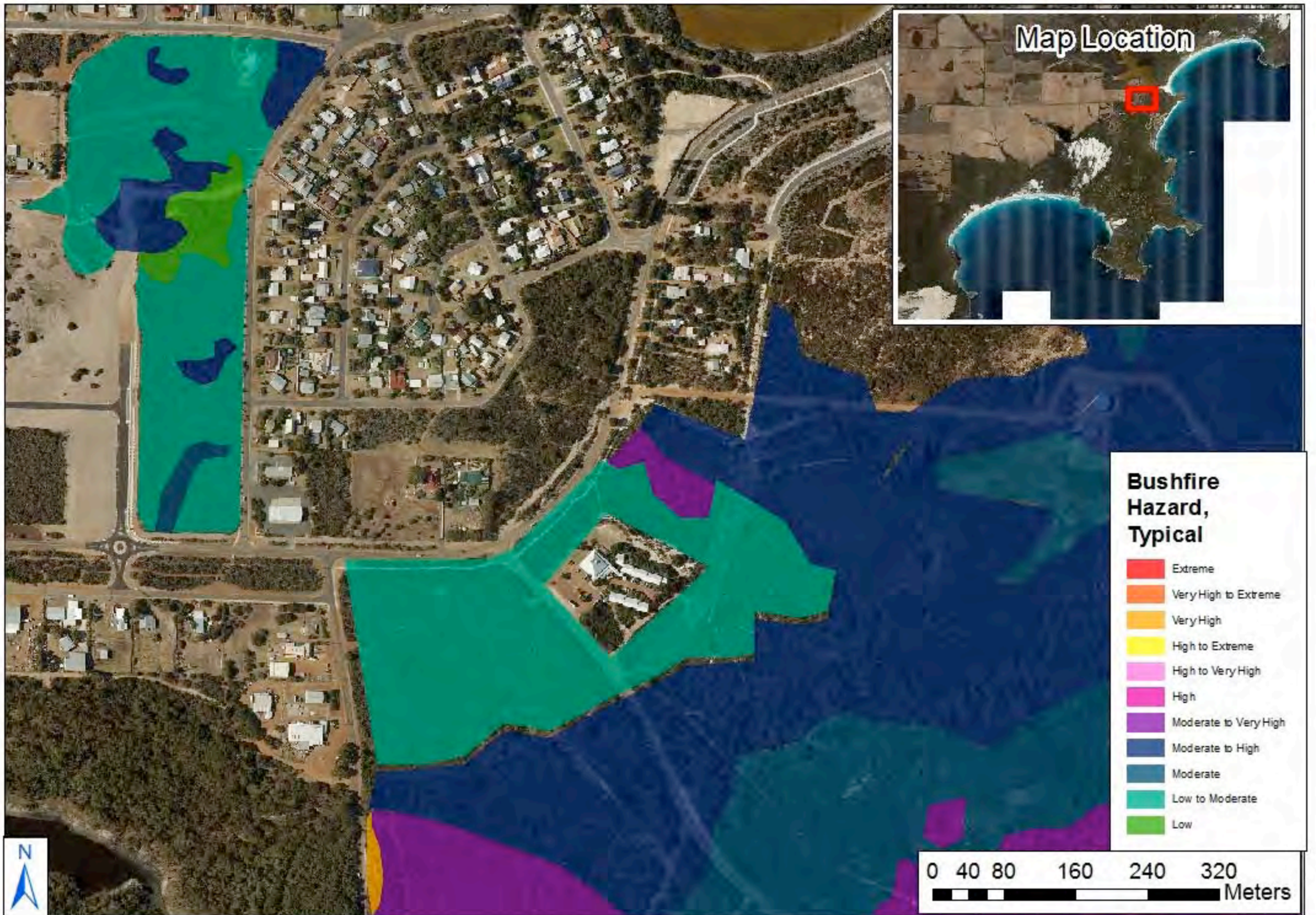


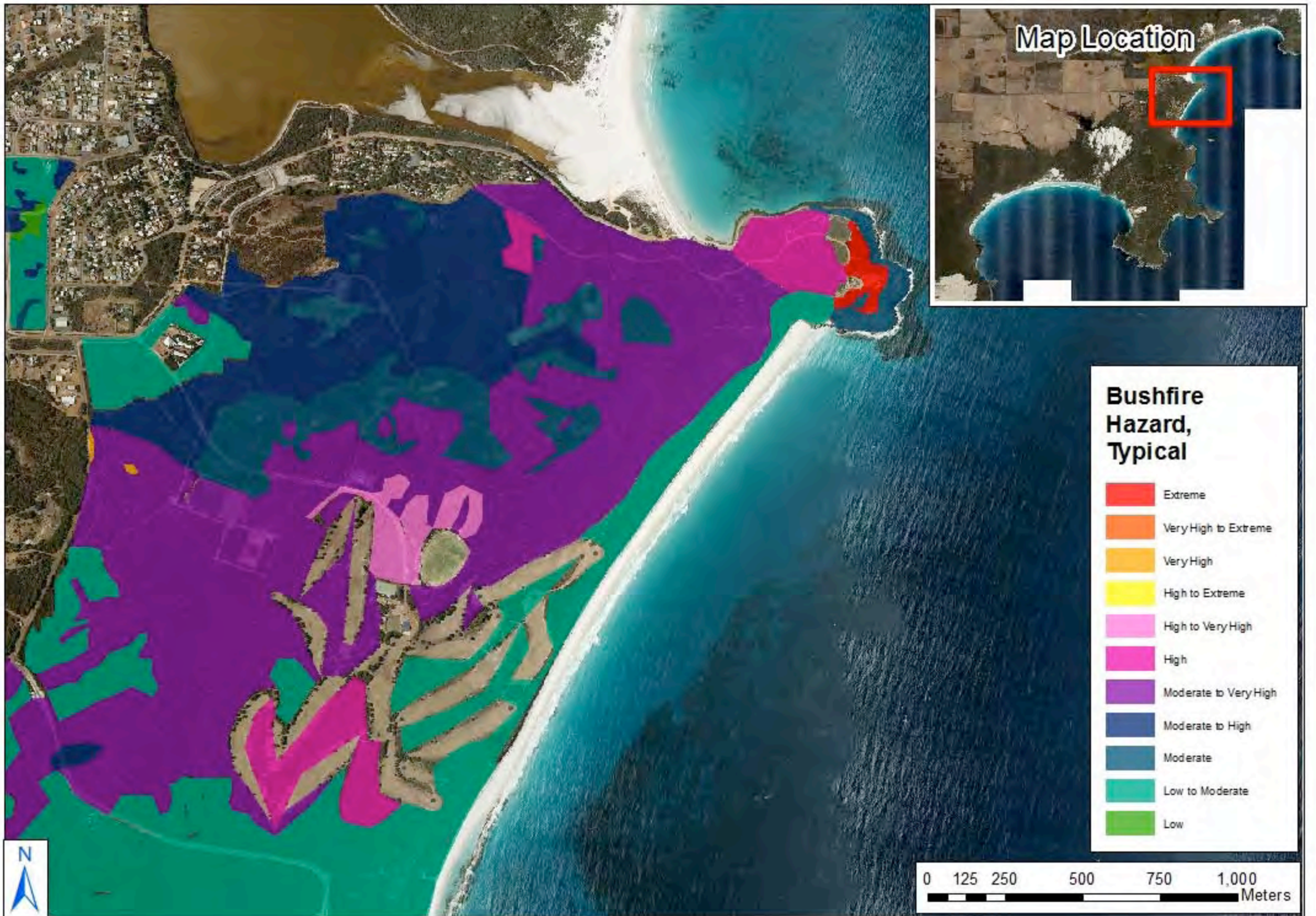
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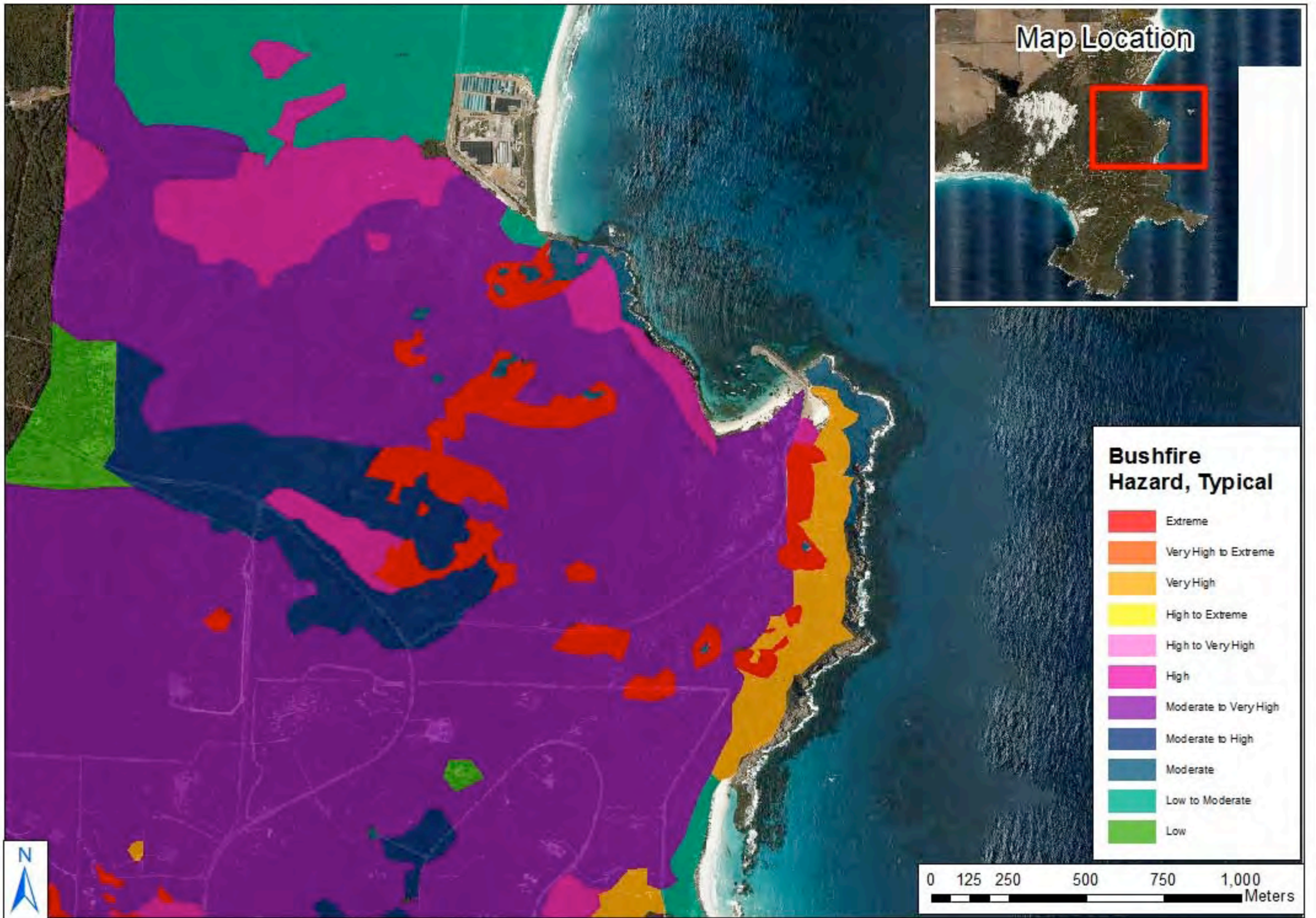
Vegetation Community Behaviour

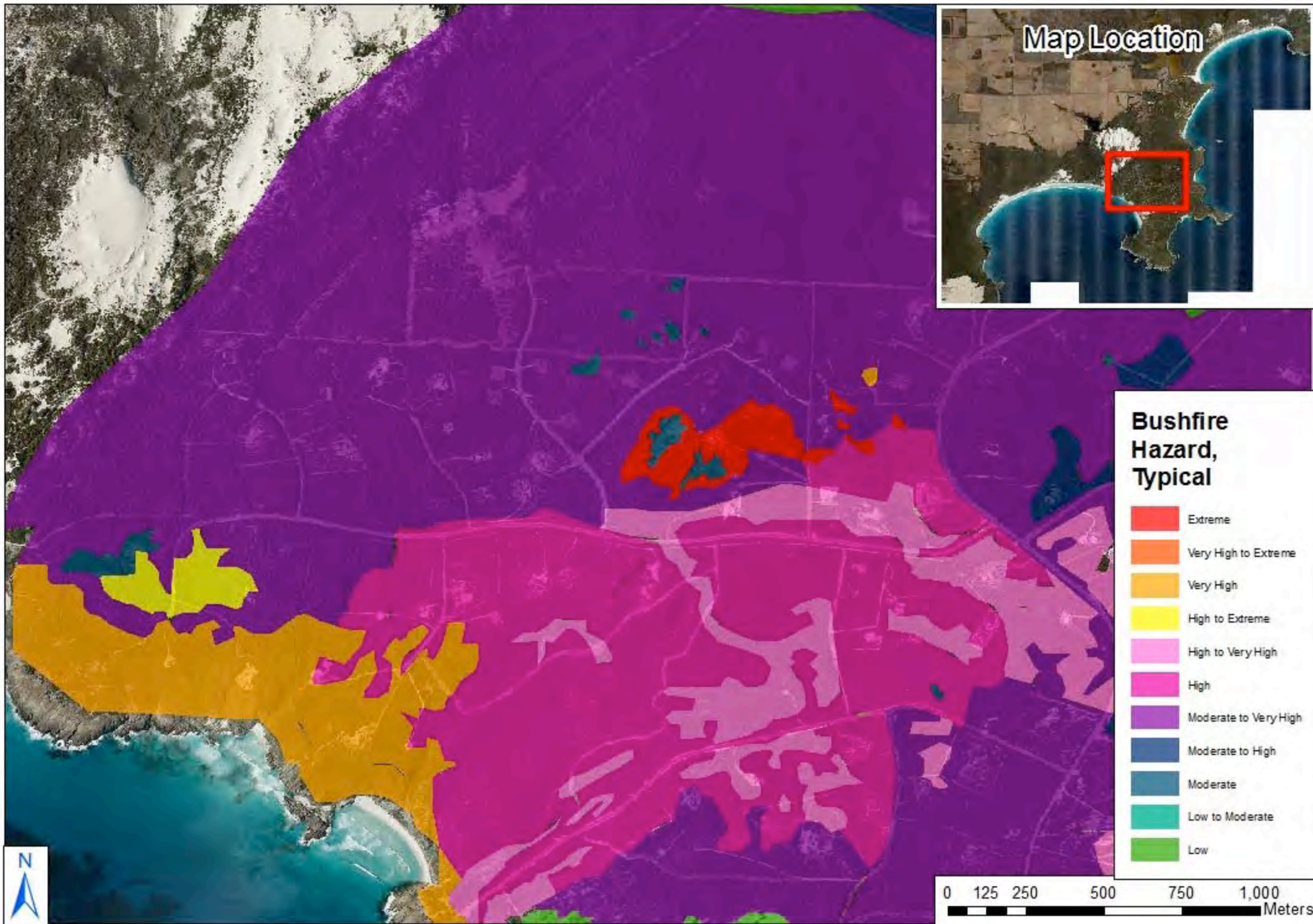
1. Precocious, brad, geo, resprout.	10. Robust, dynamic zone, precocious, brad, geo, resprout.	17. Robust. Precocious when unstable. Brad, ser, resprout. Peppy may have
2. Precocious, brad, geo, robust.	11. Robust, resprout, geo, brad.	18. Shifting sand dune.
3. Precocious, brad, ser invasive, weed sp. dominated.	12. Robust, resprout, geo, brad. Peppy likely occupied.	19. Vulnerable, precocious when unstable, peppy may have occupied.
4. Precocious, brad/ser tree, geo, resprout understorey.	13. Robust, resprout, geo, few brad, sparse when older.	20. Vulnerable, resprout, ser, brad, some geo, peppy may have occupied.
5. Precocious, geo, brad.	14. Robust, resprout, geo, old patch of Epk.	21. Vulnerable, resprout, ser, geo.
6. Precocious, geo.	15. Robust, resprout, geo, part ser in Banksia.	22. Vulnerable, ser, few geo.
7. Precocious, man modified.	16. Robust, ser.	23. Vulnerable, ser, some geo and resprout.
8. Precocious, resprout, ser, brad, geo.		24. Vulnerable, ser, some geo.
9. Robust, brad/ser tree, brad and geo understorey.		

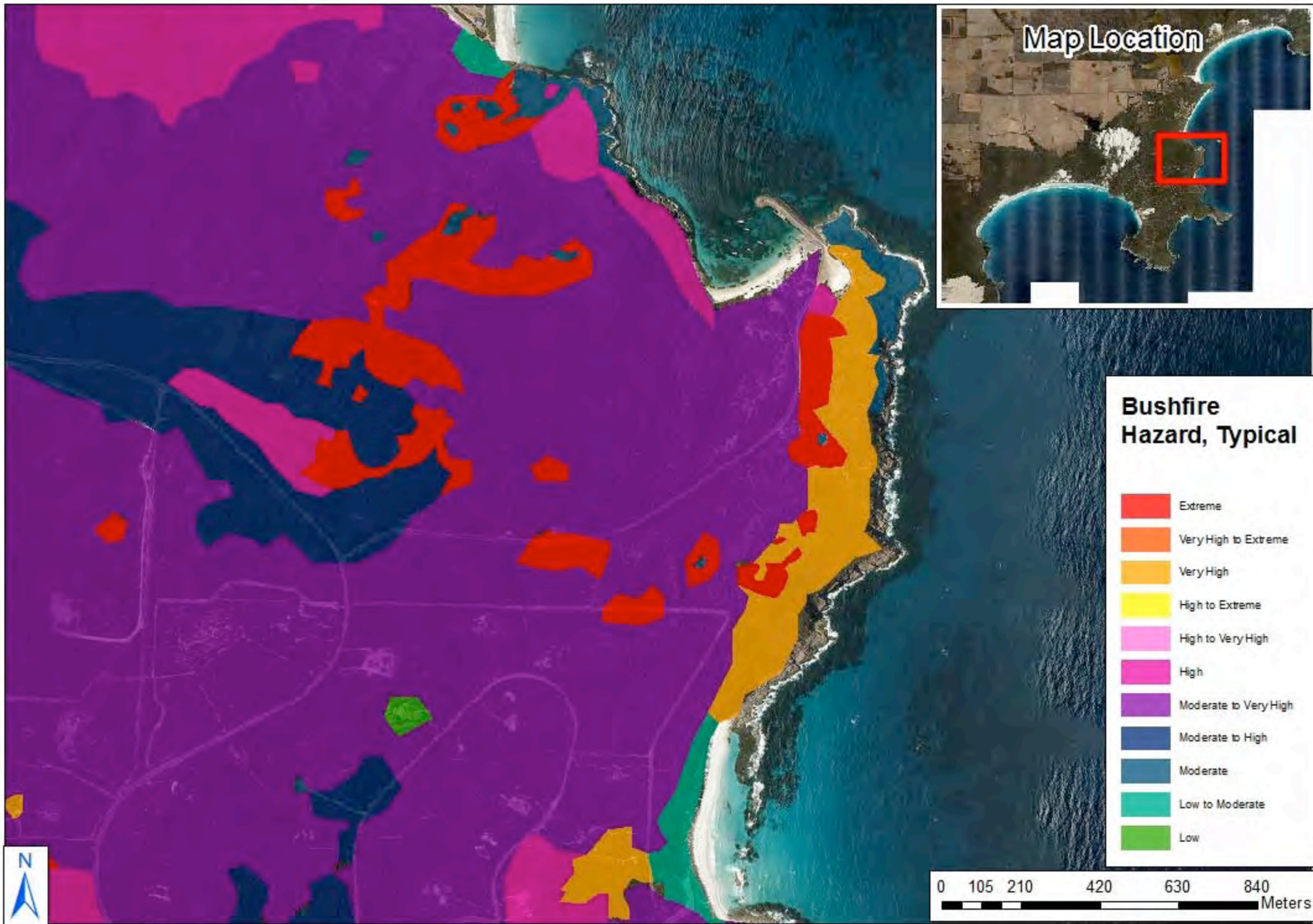
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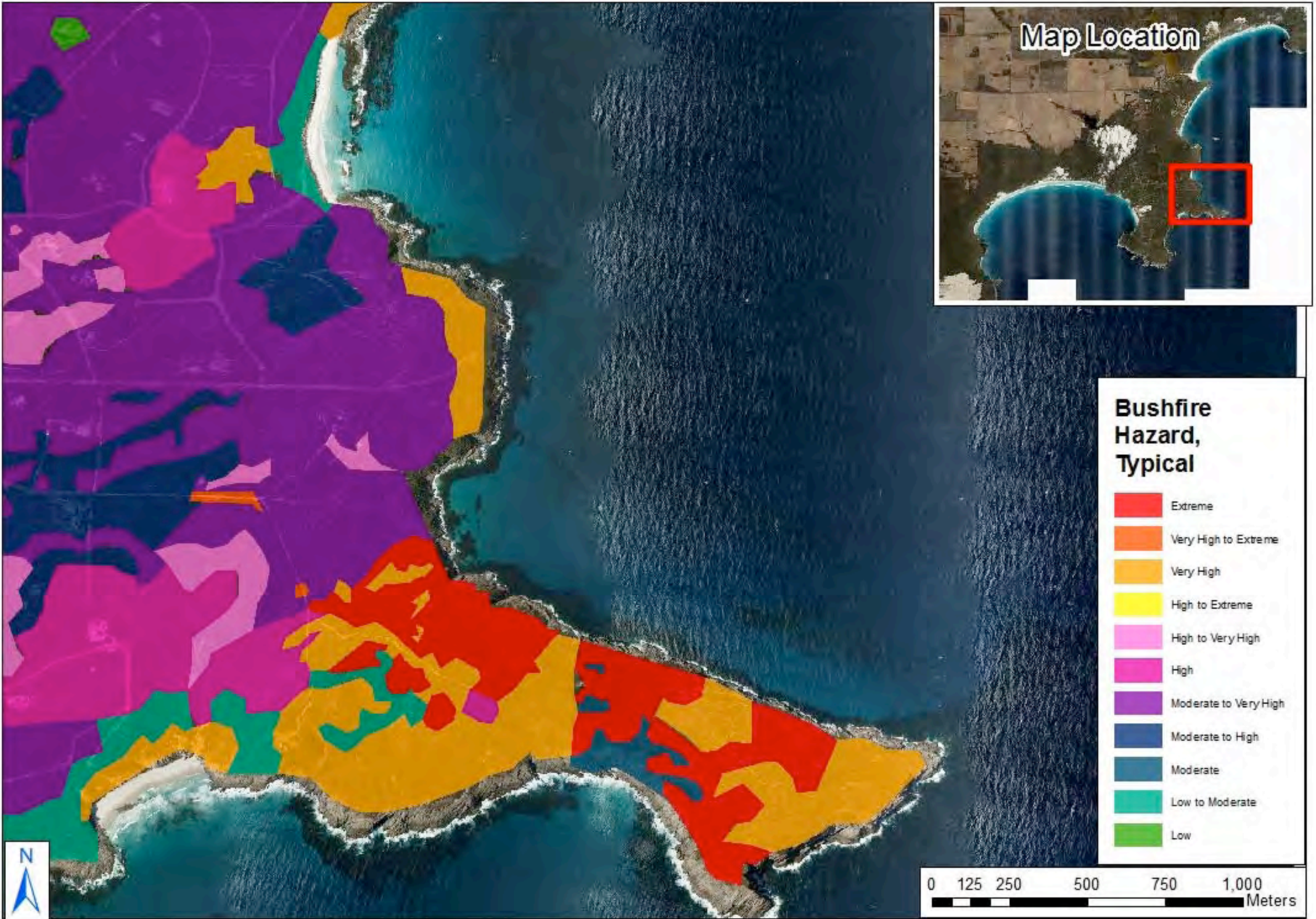


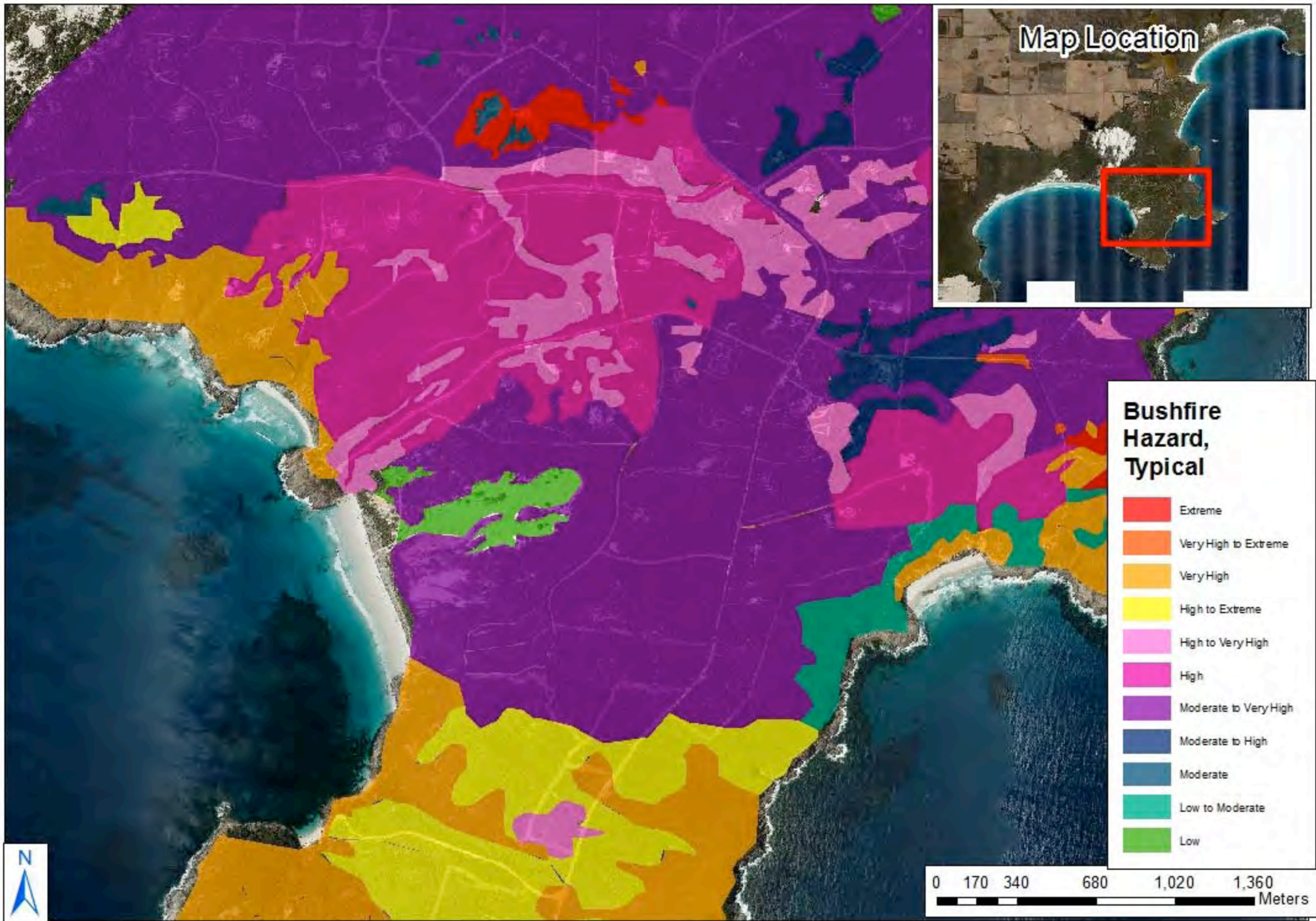


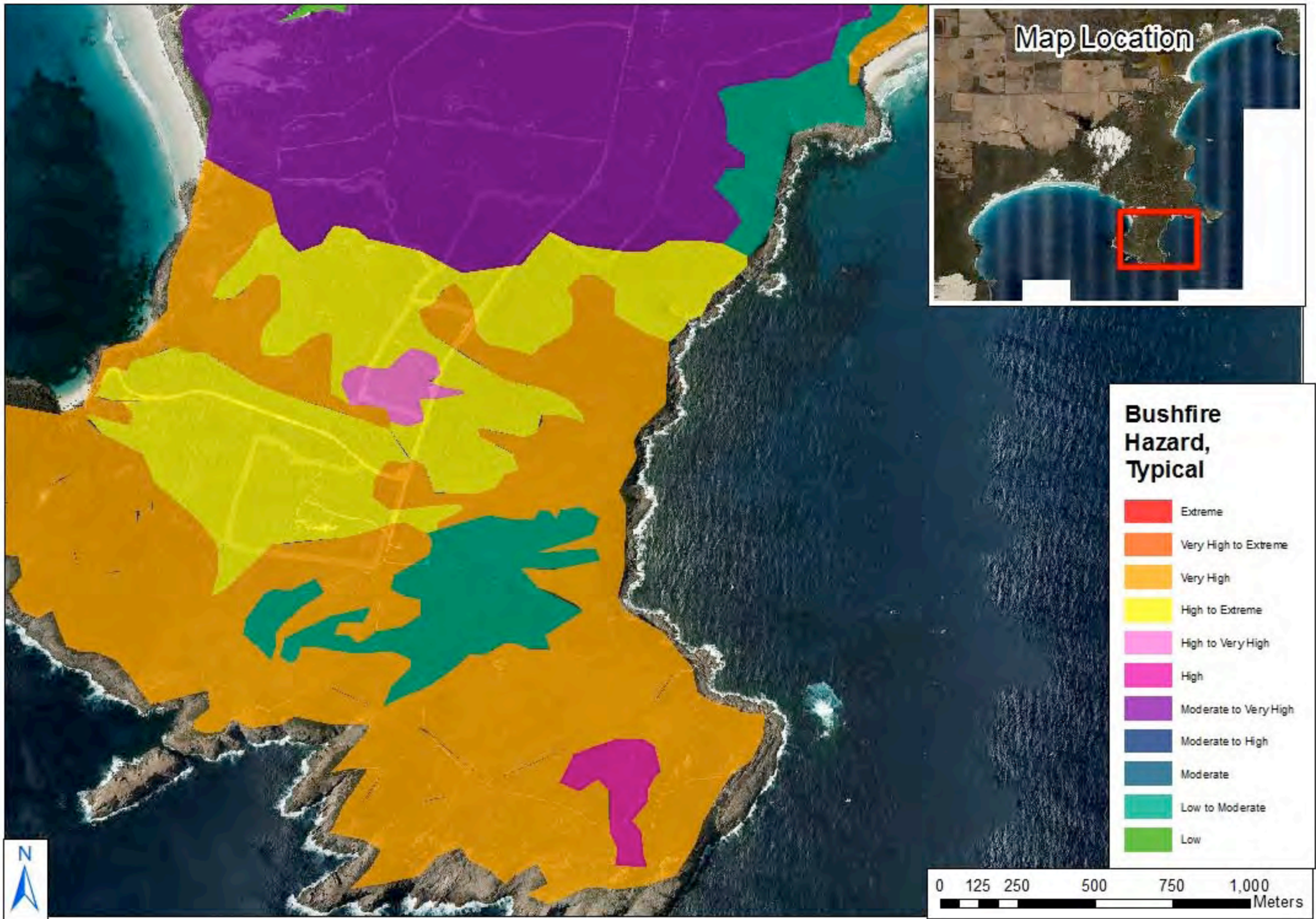




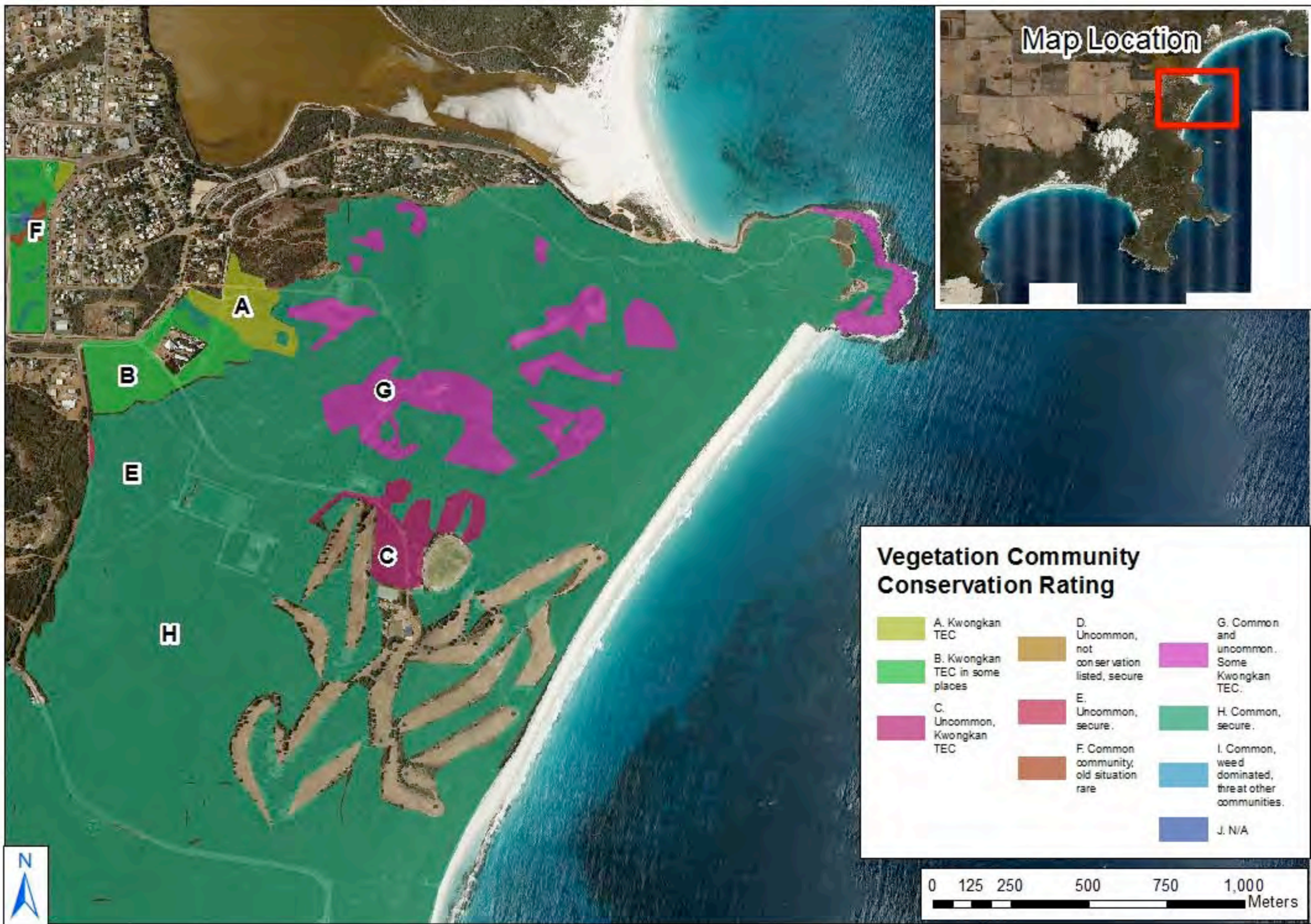




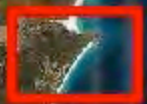







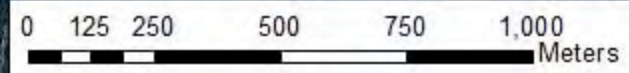


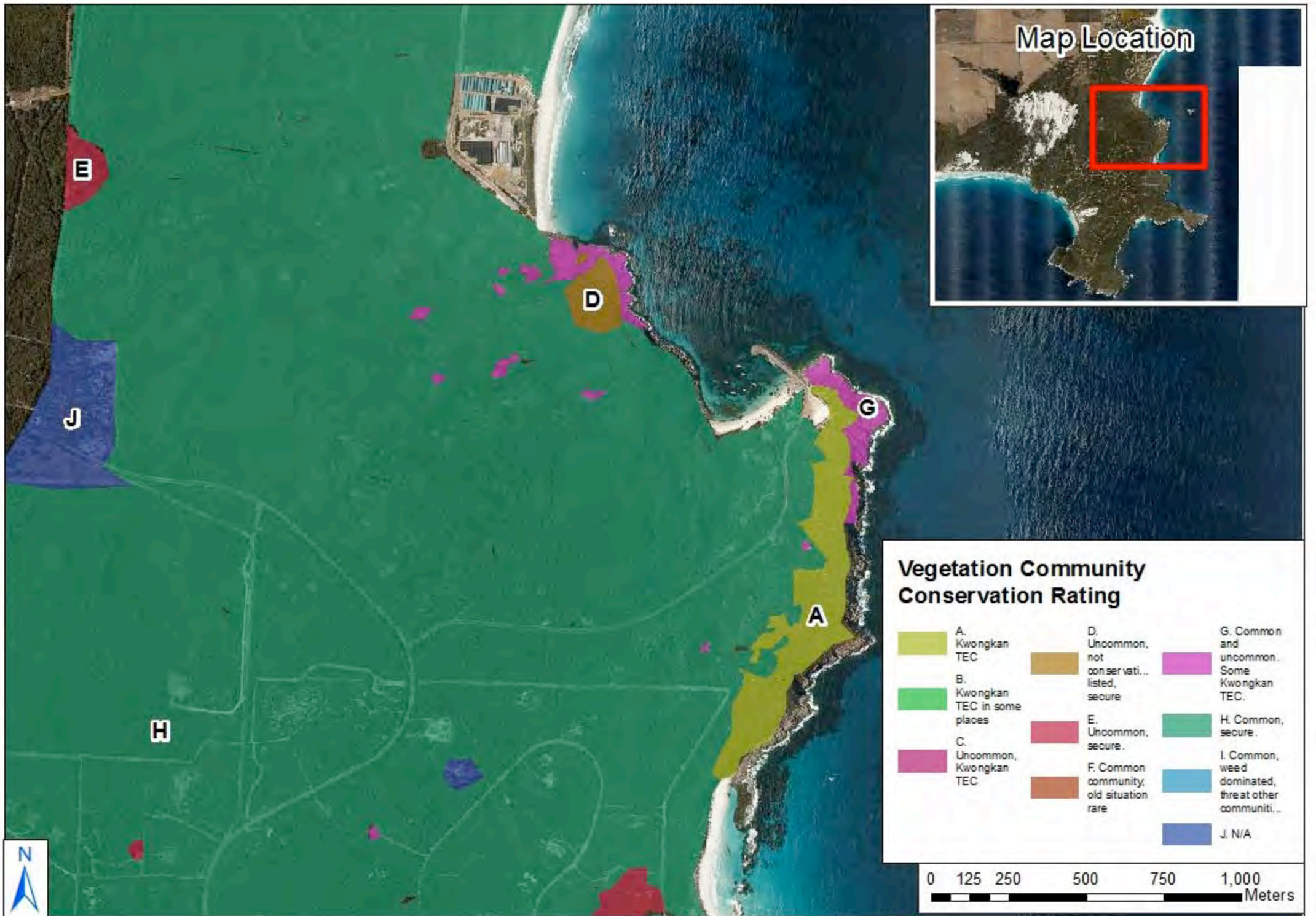
Map Location

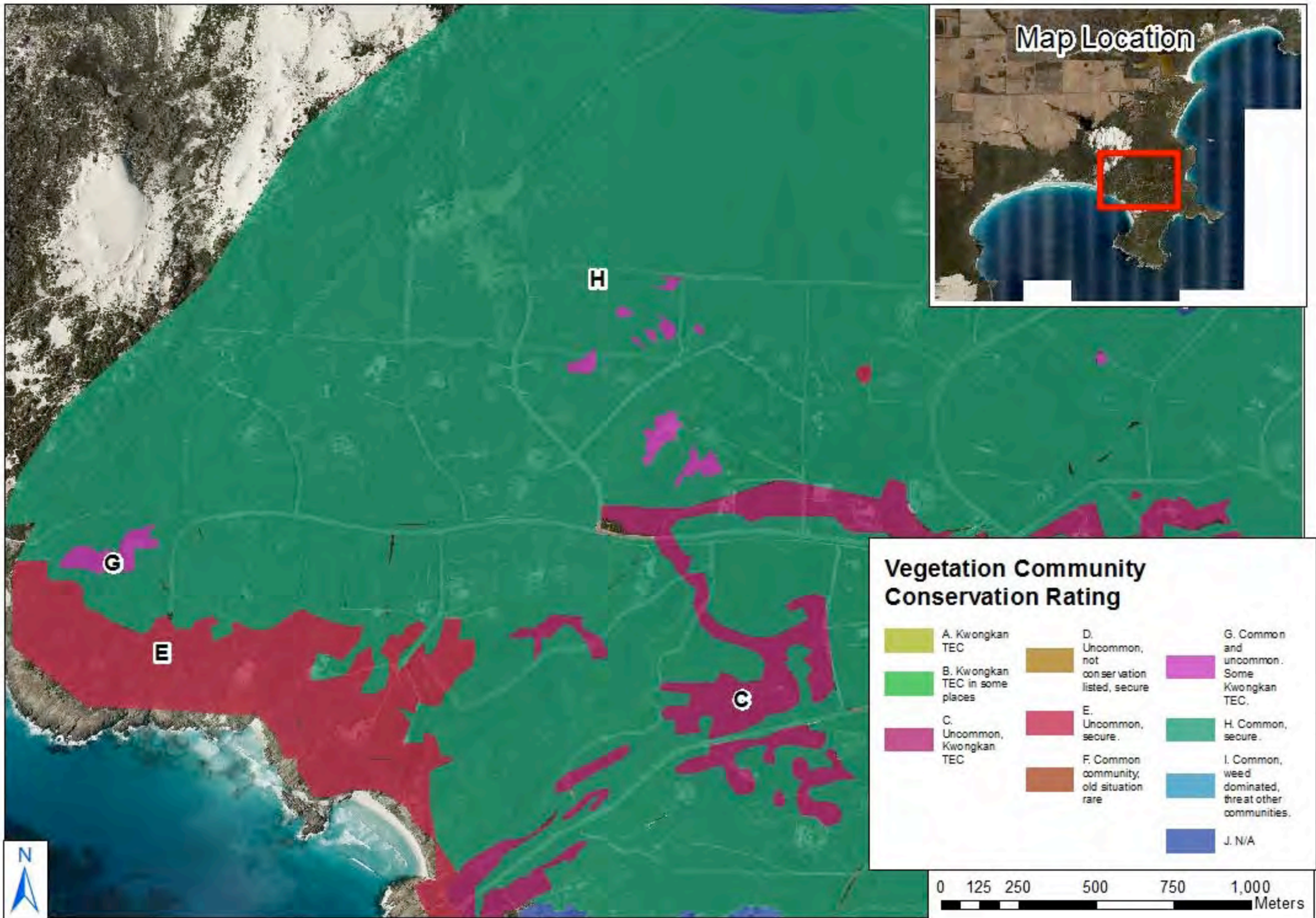


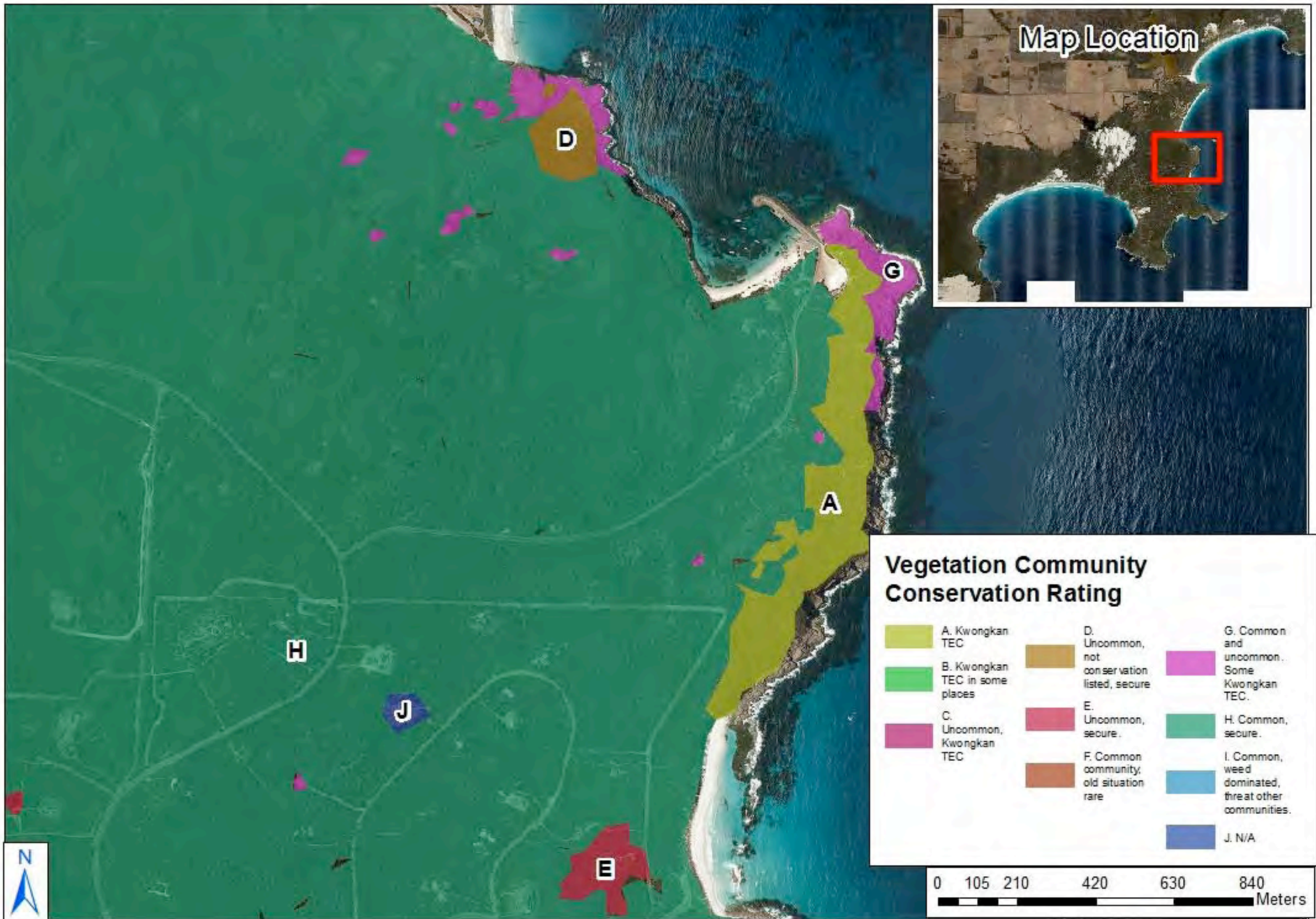
Vegetation Community Conservation Rating

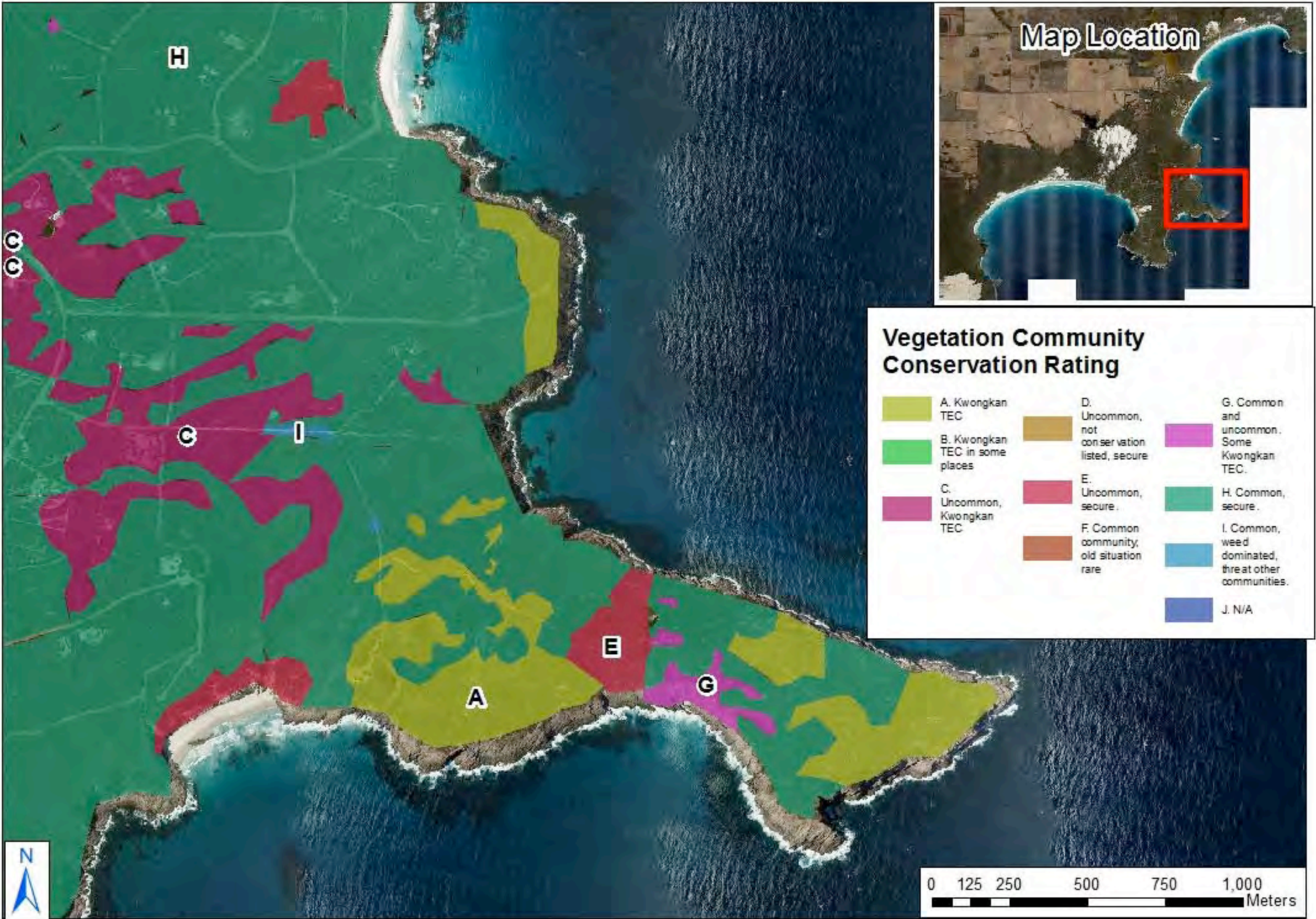
	A. Kwongkan TEC		D. Uncommon, not conservation listed, secure		G. Common and uncommon... Some Kwongkan TEC.
	B. Kwongkan TEC in some places		E. Uncommon, secure.		H. Common, secure.
	C. Uncommon, Kwongkan TEC		F. Common community, old situation rare		I. Common, weed dominated, threat other communities.
					J. N/A



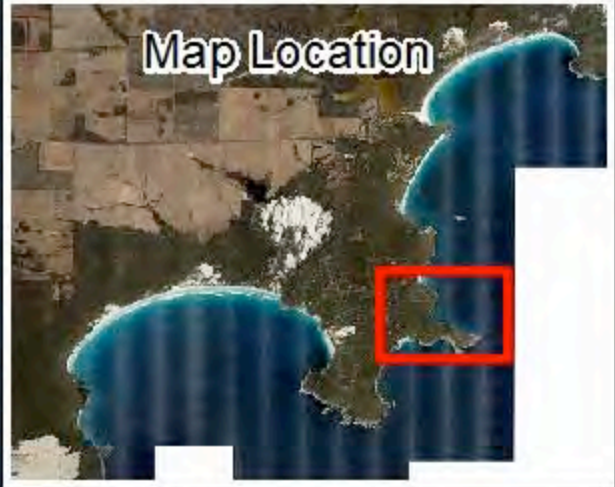







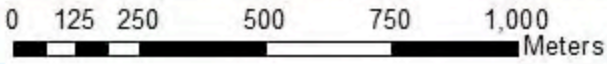


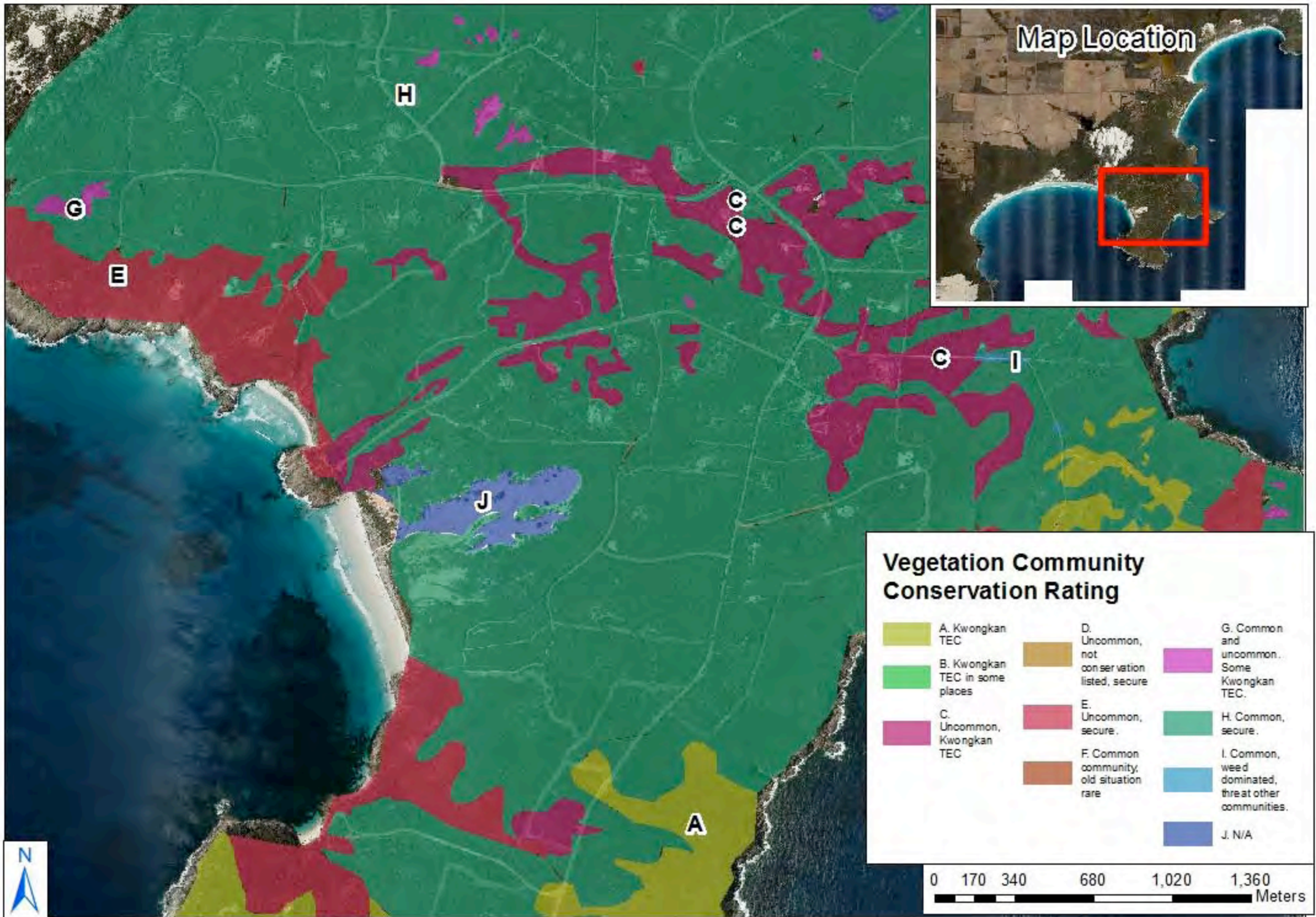
Map Location

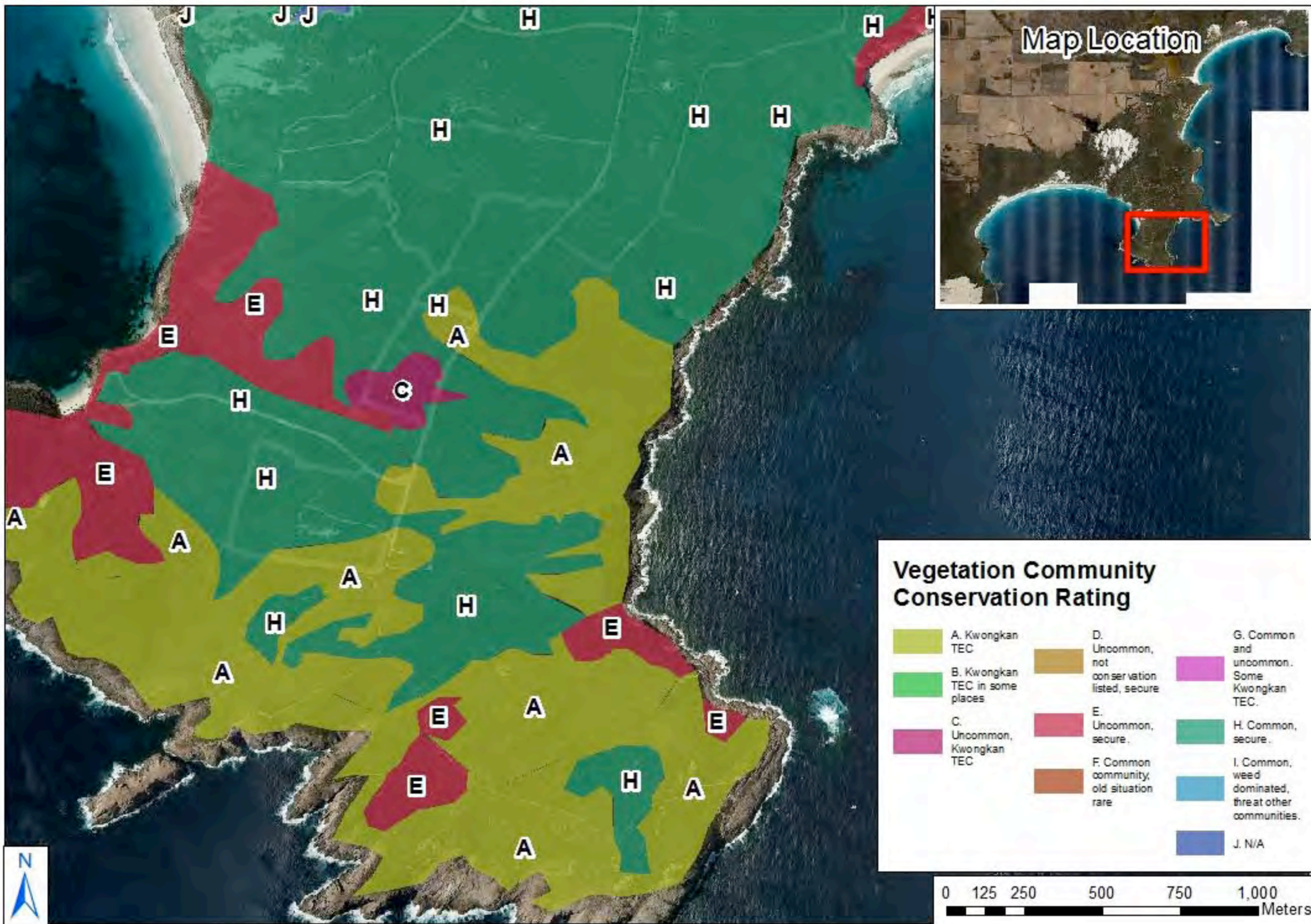


Vegetation Community Conservation Rating

 A. Kwongkan TEC	 D. Uncommon, not conservation listed, secure	 G. Common and uncommon. Some Kwongkan TEC.
 B. Kwongkan TEC in some places	 E. Uncommon, secure.	 H. Common, secure.
 C. Uncommon, Kwongkan TEC	 F. Common community; old situation rare	 I. Common, weed dominated, rare at other communities.
		 J. N/A













Map Location

Vegetation Community Conservation Rating

 A. Kwongkan TEC	 D. Uncommon, not conservation listed, secure	 G. Common and uncommon. Some Kwongkan TEC.
 B. Kwongkan TEC in some places	 E. Uncommon, secure.	 H. Common, secure.
 C. Uncommon, Kwongkan TEC	 F. Common community, old situation rare	 I. Common, weed dominated, threat other communities.
		 J. N/A

0 125 250 500 750 1,000 Meters



Vegetation communities

The 29 vegetation communities identified and mapped have a range of different compositions, structures, hazard ratings, occurrence patterns and sensitivities. They have been assigned code titles, which are a combination of abbreviated names of the dominant species as composition and the vegetation structural type. Code titles are designed to aid identification and discussion, they also appear on the map figures above.

The following list identifies the vegetation communities in alphabetical order, and outlines their primary attributes. The outlines are provided as an introduction to the communities and as a foundation for their conservation and management in later sections.

AcAfC: Acacia cochlearis open shrubland, with Agonis flexuosa emergent clumps

Low shrubland to around 1.5 metres, with emergent peppermint shrubs to 3 metres. Dominant shrubs are rigid wattle (*Acacia cochlearis*), grey stinkwood (*Jacksonia furcellata*), dune sheoak (*Allocasuarina lehmanniana*), coast daisy bush (*Olearia axillaris*), creeping hakea (*Hakea prostrata*), and cauliflower hakea (*H. corymbosa*).

Emergent taller shrubs are coast hakea peppermint (*Agonis flexuosa*) and olive-leaved hakea (*Hakea oleifolia*).

Groundcover dominants are sedges (*Schoenus grandiflorus*, *S. sp.*, *Anarthria gracilis*, *Lepidosperma sp.*) and pig face (*Carpobrotus virescens*).

Bushfire hazard low to moderate; high where more peppermint as emergent shrubs, and clumps of shrubs, are present.

AS3959 equivalent is Open heath C-11.

The community is common in the northern central parts of Reserve 511 either side of White Trail Rd, where it forms patches on the edges of sand valley floors between the broader Ac community and old consolidated dunes with peppermint shrublands. It is a relatively low diversity community. The dominant shrubs – *Acacia cochlearis*, *Jacksonia furceolata*, *Allocasuarina lehmanniana* and *Hakea prostrata* – are strong resprouting species.

AcS: *Acacia cochlearis* open shrubland

Very similar to AcAfC, differs in that it has no to few emergent peppermint shrubs as clumps. Structure is mostly a relatively even spread of 1 - 2 metre tall dominant shrubs as mostly joined clumps. Composition of the shrubland is the same as AcAfC, without the emergent peppermint, although with few very scattered emergent coast hakea (*Hakea oleifolia*), coast wattle (*Acacia cyclops*) and net bush (*Spyridium globulosum*). Peppermint does occur in low numbers, although it appears to be unable to compete or thrive, with several shrubby individuals dead or dying, along with net bush, coast hakea and coast wattle.

Bushfire hazard is low to moderate due to the low vegetation biomass, structure and ground litter accumulation. Notwithstanding, the community would carry fire quickly in warm windy conditions. White Trail Rd and the shared use trail intersect the community, providing good access for fire suppression. In addition, a planned slashed firebreak linking Wellstead Rd and White Trail Rd near the Abalone farm will increase accessibility to this community for fire suppression.

The community is being invaded by Victorian tea tree in its northernmost occurrence southwest of the sewage ponds. This is altering its structure and increasing its fire hazard rating, and control measures are warranted.

To maintain the low to moderate hazard rating, it should be left out of prescribed burning programs due to the potential for the influx of more hazardous disturbance opportunists - peppermint, net bush and the weed Victorian tea tree. This would alter the composition and structure and increase the hazard rating.

Closest AS3959 equivalent is Open Heath C-11. Although the emergent peppermint component makes it significantly different and no direct AS3959 equivalent applies.

The community is common in the northern central parts of Reserve 511 either side of White Trail Rd, where it forms large patches in the sand valley floors fringed by the AcAfC community and old consolidated dunes with peppermint shrublands. It is a relatively low diversity community. The dominant shrubs – *Acacia cochlearis*, *Jacksonia furceolata*, *Allocasuarina lehmanniana* and *Hakea prostrata* – are strong resprouting species.

AcySgS: Acacia cyclops, Spyridium globulosum shrubland

Medium to tall shrubland to around 5 metres, mostly dense. Dominant shrubs are coast wattle (*Acacia cyclops*) and net bush (*Spyridium globulosum*), in places peppermint (*Agonis flexuosa*), and to some extent coast hakea (*Hakea oleifolia*). Undershubs are beard heaths (*Leucopogon flexuosus* and *L. parviflorus*), buttercup (*Hibbertia cuneiformis*) and false boronia (*Phyllanthus calycinus*). Groundcovers are sedges (*Lepidosperma gladiatum*, *L. sp.* *Schoenus grandiflorus*, *S. sp.*) and coastal native grass (*Poa porphyroclados*). Creepers are often relatively dense and include old mans beard (*Clematis pubescens*), bluebell (*Billardiera heterophylla*), dodder (*Cassytha sp.*) and lignum (*Muehlenbeckia adpressa*). Peppermint (*Agonis flexuosa*) occurs sporadically and in some patches in this community, suggesting that ground disturbance conditions present are more preferential to the soil stored seed (geosporous) obligate seeding dominant coast wattle and net bush. The community also has the present in the understorey. In the western expressions of this community at the end of Black Rocks Rd, several weed species are present and at times dominant including boxthorn (*Lycium ferocissimum*) in the overstorey, and capeweed (*Arctotheca calendula*), pimpernel (*Lysimachia arvensis*), soursob (*Oxalis pes-caprae*), and annual veldt grass (*Ehrharta longifolia*) as groundcover. The presence of these weeds shows the community and its locations have had a history of significant ground / soil disturbance to promote the introduced weeds, which also accounts for the development of the precocious native plants that comprise the community.

Bushfire hazard is high to extreme due to the very dense nature of the community, particularly the 1-2m and over 2m strata, and the mostly thick ground litter.

The closest AS3959 equivalent is somewhere between Closed Scrub D-13 and Open Scrub D-14. However as the community is dominated by both large shrubs and an under-shrub layer it does not fit either well.

The community occurs in gully sides and on headland slopes towards the end of Point Henry Peninsula, where the disturbance that underpins its persistence is likely to be wind driven soil movement up gullies east and west off the ocean and onto adjacent slopes. Its underlying soil is also slightly better granitic sand being nearby to granite rocks of gully sides and adjacent slopes.

AfS: *Agonis flexuosa* tall shrubland and low open forest

The most common vegetation community in the study area, it is a medium to tall shrubland to around 7 metres, mostly dense to more open when older. In some cases the tall shrubs are almost trees, however as they have biomass as branches and leaves relatively close to the ground, they classify as tall shrubs. Where the community occurs in dune swales closer to the shore, the structure is closer to 'low open forest' or 'closed scrub', although the composition, lower stature and limited occurrence keeps it within this broader shrubland classification. It is possible that the low open forest expressions are old growth stands of the peppermint shrubland, and this warrants further investigation. Peppermint 'woodland' has been classified and mapped as a separate community (AfW) due to its structural difference and potentially lower hazard rating.

Dominant tall shrubs are peppermint (*Agonis flexuosa*), coast wattle (*Acacia cyclops*), and net bush (*Spyridium globulosum*). Undershubs are beard heaths (*Leucopogon flexuosus* and *L. parviflorus*), buttercup (*Hibbertia cuneiformis*), false boronia (*Phyllanthus calycinus*), soft saltbush (*Rhagodia preissii*) and hispid stinkweed (*Opercularia hispidula*), as well as smaller peppermint and coast wattle plants. Groundcovers are curly grass (*Desmocladius flexuosus*) and sedges (*Ficinia nodosa*, *Lepidosperma gladiatum*, *L. sp.*, *Schoenus grandiflorus*, *S. sp.*). Creepers are old mans beard (*Clematis pubescens*) and bluebell (*Billardiera heterophylla*).

Bushfire hazard is moderate to very high, depending on the density of the vegetation layers, and the depth of the ground litter. The highest hazard ratings are in those with the most dense overstorey and thickest ground litter under dense upper and mid strata. The densest overstorey of peppermint appears across the majority of the community's occurrence, where it is in recovery since disturbance from fire, which triggered vigorous regeneration.

The closest AS3959 equivalents are Tall Shrubland E-15 for the shrubland expression and Closed Scrub D-13 or Low Open Forest A-04 for the low forest expression. The tall shrubland is dissimilar as the real community has a more complex and dense understorey, and the forest is dissimilar in its height.

Some patches of the community are older (longer time since fire), the order of thirty plus years and probably longer. These patches have lower hazard ratings due to the lessened density from plant attrition with age in relatively short-lived coast wattle and net bush, which is a valuable ecological situation to identify and promote.

The community occurs across Reserve 511 and the Point Henry Peninsula on deep grey sand plains and lower slopes. It is widespread on the Point Henry Peninsula, with many of the building assets built among it.

It is robust and able to respond vigorously to disturbance, and has the propensity to invade other adjacent vegetation communities following disturbance. It has the ability to become a taller community with sparse understorey if left undisturbed for long periods, or through manipulation to remove plants without regeneration triggering disturbance.

AfC: *Agonis flexuosa* coastal clumping or emergent with coastal spp understory
Very similar to the AFS community, differing in the composition of the understory and structure, and is a relatively low diversity community. Peppermint (*Agonis flexuosa*) is dominant as emergent clumps, with the majority of the community in the 1-2m strata as net bush (*Spyridium globulosum*), coastal daisy bush (*Olearia axillaris*) and coast hakea (*Hakea oleifolia*). Under 1m, rigid wattle (*Acacia cochlearis*), red rice flower (*Pimelea rosea*) and coastal olax (*Olox benthamiana*). Ground covers are curly grass (*Desmocladius flexuosus*), sedges (*Schoenus grandiflorus*, *S. sp.* *Lepidosperma sp.*), coastal pigface (*Carpobrotus virescens*) and milkweed (*Euphorbia sp.*). Creeper is bluebell (*Billardiera heterophylla*).

Bushfire hazard is low to moderate due to the low vegetation biomass, structure and ground litter accumulation. Notwithstanding, the community would carry fire quickly in warm windy conditions. Although given its narrow linear near-shore dune swale occurrence, its fire hazard is relatively insignificant.

There is no AS3959 equivalent. It would be a combination of Open Heath C-11 and Tall Shrubland E-15 to take account of the structures of the dominant strata.

As a low to moderate hazard community, it should be left out of prescribed burning programs, due to its limited occurrence and the potential for the influx of more hazardous disturbance opportunists peppermint, net bush and the weed Victorian tea tree (*Leptospermum laevigatum*) that occur alongside. This would alter the composition and structure and increase the hazard rating.

The community is found against the coast in dune swales and sides in central parts of Reserve 511 between the Rock Cairn and Back Beach corner near the abalone farm. It forms linear patches fringed by the AF community on the inland side, and the CH community on dune tops and old consolidated dunes.

AfEd: *Agonis flexuosa* and *Eucalyptus decipiens* shrubland

A medium to tall shrubland to around 7 metres, mostly open when older and where peppermint component is less. Dominant tall shrubs are mallee (*Eucalyptus decipiens* subsp. *chalara*), net bush (*Spyridium globulosum*), peppermint (*Agonis flexuosa*), and coast wattle (*Acacia cyclops*). Undershrubs are beard heath (*Leucopogon flavidus*), rigid wattle (*Acacia cochlearis*), cockies tongues (*Templetonia retusa*), and hispid stinkweed (*Opercularia hispidula*), and smaller mallee and coast wattle plants. Groundcovers are curly grass (*Desmocladus flexuosus*) and sedges (*Lepidosperma* sp., *Lyginea barbata*, *Schoenus grandiflorus*, *S. sp.*).

Bushfire hazard is moderate to high, depending on the density of the vegetation layers, and the depth of the ground litter. The highest hazard ratings are in those areas of the community with peppermint as a large part of the overstorey, and where a denser 1-2m shrub stratum of mostly net bush and coast wattle occurs.

The closest AS3959 equivalent is Tall Shrubland E-15. However AfEd differs in a more complex understorey composition and denser structure, and taller over shrub height.

Some patches of the community are older (longer time since fire), the order of thirty plus years and probably longer, similar to some patches of the Af community. These patches have lower hazard ratings due to the lessened density from plant attrition with age in relatively short-lived coast wattle and net bush.

The community occurs in the north western section of Reserve 511 in a band north and west of the wind turbine hill, and as two smaller patches in Reserve 51949. It occupies deep pale grey and yellow sand plain and lower slopes.

It is relatively robust and able to respond to disturbance. It has the ability to become a taller community with sparse understorey if left undisturbed for long periods, or through manipulation to remove net bush, coast wattle and peppermint without regeneration triggering disturbance.

AfPK: Agonis flexuosa parkland cleared

This community occurs as mostly small patches of the Af community that have been modified to open sparse woodland by property owners to reduce biomass hazard for asset protection. The inclusion of this modified community is to measure and record its structure, composition and fire hazard rating; to develop a baseline on which to monitor its ecological and biomass development; and as an example of the modification of the AfS and AfW communities in which several building assets occur.

Fire hazard is low due to mostly absent shrub and ground cover understorey strata.

AS3959 equivalent is Low Open Woodland B-08.

This altered AfS and AfW community is included, as its structure has been modified to create a low hazard and simplified community with some instructive value for hazard management.

The community occurs in a few places on the Point Henry Peninsula among the broader AfS and AfW communities, notably at Bremer Bay Beaches Caravan Park grounds under the peppermint woodland.

AfW: *Agonis flexuosa* woodland

A medium woodland community with trees to around 18 metres; mostly open when older. Almost identical in species composition and diversity to the Af community, this community differs in its taller and more open structure, lower bushfire hazard rating and preference for more protected parts of valleys and lower slopes.

Dominant trees are tall peppermint (*Agonis flexuosa*), under these shrubs of coast wattle (*Acacia cyclops*), net bush (*Spyridium globulosum*), coast hakea (*Hakea oleifolia*), and peppermint. Undershubs are beard heaths (*Leucopogon flexuosus* and *L. parviflorus*), buttercup (*Hibbertia cuneiformis*), rigid wattle (*Acacia cochlearis*), false boronia (*Phyllanthus calycinus*), and the sprawling soft saltbush (*Rhagodia baccata*), as well as smaller peppermint, net bush and coast wattle plants. Groundcovers are a dense cover of curly grass (*Desmocladius flexuosus*) and sedges (*Anarthria gracilis*, *Ficinia nodosa*, *Lepidosperma gladiatum*, *L. sp.*, *Schoenus grandiflorus*), and scattered native grasses (*Poa porphyroclados*, *Tetrarrhena laevis*). This community also has a significant herb flora including hispid stinkweed (*Opercularia hispidula*), native gerbera (*Trichocline spathulata*) and native oxalis (*Oxalis perennans*). Creepers are old mans beard (*Clematis pubescens*), running postman (*Kennedia prostrata*) and the sprawling soft saltbush climbing shrubs.

Bushfire hazard is moderate to high, depending on the extent and the depth of the ground litter, which varies patch to patch, and the density of the midstorey shrub strata. This community is in recovery after fire in November 2002 that affected the majority of its large southern occurrence, which triggered vigorous regeneration. The old tall peppermint trees have not been killed, showing strong resprouting from their bases, which 14 years on have attained just over half the height of the pre-fire trees. However the structure is tall shrubland like for the moment, while the regrowth attains the original height and the community the original structure and density, which will likely occur in the coming decades if fire and other stimulating disturbance can be eliminated.

Closest AS3959 equivalent is Woodland B-05. Difference is that some trees in AfW can be lower than 10m tall.

The regenerating community is relatively open, albeit with significant mid strata of net bush and coast wattle, which probably reflects what was a very open woodland community pre fire. The original tall open woodland would have had a lower hazard rating due to the sparse wide-spaced trees and lessened density from the absence or reduced presence of relatively short-lived coast wattle and net bush, which is a valuable ecological situation to promote for lower hazard conditions.

Like the similar Af shrubland community, it is robust and able to respond vigorously to disturbance. However, disturbance can interfere with its woodland structure, modifying it towards a more dense shrubland community if burnt too often. The recovery to open tall woodland of this community is important to conserve its open structure and simple composition as a low fire hazard community. Monitoring the recovery and structural change is an important and recommended measure to better understand its ecology and natural trajectory.

Early settlers and pioneers report that the peppermint communities of the Bremer Bay area were open, grassy and low bushfire hazard when they arrived and in the

early days of settlement. It also had a notable mammal fauna including brush tail and ring tail possums, which are now in very low numbers or locally extinct. This suggests that the open woodland peppermint community is the preferential peppermint dominant community to have for amenity, conservation and low bushfire hazard.

The community occurs in two places in Reserve 511: as a small patch at the Noongar Camp and across White rail Rd in a gully, and from the Bremer Bay Beaches Caravan Park south. It continues from the caravan park across Point Henry Rd to the southwest, and also occurs in the Ridgeview Rd area of the Short beach precinct.

AhMdT: *Acacia heteroclita*, *Melaleuca densa* thicket

A very dense low shrubland and thicket, dominated almost exclusively by granite thicket wattle (*Acacia heteroclita*) and Point Henry honeymyrtle (*Melaleuca densa*). Very similar to community AhT, differing in composition by the presence of the co-dominant Point Henry honeymyrtle. The dominance of Point Henry honeymyrtle varies, in some places it occurs in pure patches.

The community's dense thicket structure is predominantly in the 1-2 and 0-1m strata, with some taller shrubs of the two dominant species emergent to around 3m in some parts. Its lower strata of undershrubs comprises cockies tongues (*Templetonia retusa*), *Eutaxia obovatus*, beard heath (*Leucopogon flavescens*), net bush (*Spyridium globulosum*), turpentine bush (*Beyeria latifolia*), rock thryptomene (*Thryptomene saxicola*), and smaller plants of granite thicket wattle and Point Henry honeymyrtle. Ground covers are sedge (*Lepidosperma sp.*), curly grass (*Desmocladius flexuosus*), and mats of mosquito orchids (*Cyrtostylis sp.*); the dominant creeper is dodder (*Cassytha sp.*). It is a low diversity community.

Bushfire hazard is extreme due to the dense structure and thick ground litter accumulation. However, due to its relatively small patch size and limited occurrence, it is of limited hazard concern to infrastructure.

The AS3959 equivalent is Closed Scrub D-13.

It is a relatively sensitive community, as its dominant and Point Henry honeymyrtle regenerates from canopy-stored seed Point Henry honeymyrtle, and it's associated, although far less dominant shrub - granite thicket wattle - regenerates from soil-stored seed. Both shrubs are killed by fire and slashing, and will return post-fire disturbance if the intervals are long enough to ensure seed supply, although the wattle is more resilient due to its soil stored seed bank and would dominate if fire frequency was greater than the order of 20 -30 years. The honeymyrtle will return strongly following disturbance if the original stand was old enough to have enough seed to dominate the regeneration cohort and the follow up rains are sufficient.

This community occurs as distinct patches on shallow loamy soils in Reserve 511 at the headland near the Rock Cairn, and on Point Henry Peninsula on the headland south of Fishery Boat Harbour, and on the Point Gordon and Point Henry headlands.

AhT: Acacia heteroclita thicket

A very dense low shrubland thicket dominated almost exclusively by granite thicket wattle (*Acacia heteroclita*). Very similar to community AhMdT above, which differs in composition by the presence of the co-dominant Point Henry honeymyrtle.

This community's dense thicket structure is predominantly in the 1-2m strata, with some taller shrubs of the two dominant species emergent to around 3m in some parts. Its lower strata of undershrubs comprise only a few species, as turpentine bush (*Beyeria latifolia*) and rock thryptomene (*Thryptomene saxicola*). Ground covers are few with scattered patches of sedge (*Lepidosperma sp.*), mosquito orchid (*Cyrtostylis sp.*), and rock fern (*Chelianthes austrotenuifolia*). The creeper recorded at Torreburrup Hill is the introduced bridal creeper (*Asparagus asparagoides*). It is a very low diversity community.

Bushfire hazard is extreme due to the dense structure and thick ground litter accumulation. However, due to its relatively small patch sizes and limited and relatively remote occurrences, it is of limited hazard concern to infrastructure, except on Torreburrup Hill where it is managed by slashing.

The AS3959 equivalent is Closed Scrub D-13.

The community is resilient to fire impact, responding strongly by regenerating from soil stored (geosporous) seed when the parent trees are killed by fire very sensitive Slashing is an effective management method around infrastructure, as it removes the adult plants without stimulating the seed bank to bring about regeneration. Notwithstanding, if the return of the community to the places from which it was slashed were required, scarifying the ground or burning the litter would stimulate the seed bank and promote regeneration.

This community is common on granite rises and slopes in the southern sections of Reserve 511 from the headland and slopes above the Back Beach Bombie, south west to Torreburrup Hill, and on the Point Gordon Peninsula. On the granite slopes of the Wind Tower Hill and on the end of Point Henry, granite thicket wattle also occurs as a shrub among other communities.

BaW: Banksia attenuata woodland

A low to medium woodland to around 8 metres, mostly open to sparse when older, with a dense and diverse low shrub and ground cover strata. It is classified as woodland due to the dominant large shrub-like banksia trees. The dominant tree is slender banksia (*Banksia attenuata*); in the pure community no other trees or large shrubs occur, except for some peppermint (*Agonis flexuosa*) at its edges where it meets the Af community. Undershubs are a kwongkan community dominated by Proteaceae family plants, including white smokebush (*Conospermum teretifolium*), cauliflower hakea (*Hakea corymbosa*), summer honeymyrtle (*Melaleuca striata*), dogwood (*Jacksonia* sp.), wedge-leaved woollybush (*Adenanthos cuneatus*), one-sided bottlebrush (*Calothamnus gracilis*), *Taxandria spathulata*, *Darwinia diosmioides*, coneflower (*Petrophile squamata*), and lanolin bush (*Franklandia fucifolia*). Groundcovers are dryland rushes (*Anarthria prolifera*, *A. scabra*, and *Lyginea barbata*), sedge (*Lepidosperma* sp.), and grey curly grass (*Desmocladus cinerea*). Herbs or small shrubs are *Dampiera* sp. and *Philotheca nudiflora*.

The diversity of Proteaceae family plants sees this community consistent with the nationally listed Threatened Ecological Community (TEC) *Proteaceae dominated Kwongkan of the Southeast Coastal Botanical Province*.

Bushfire hazard is moderate to high, depending on the density of the vegetation layers, and the depth of the ground litter. The highest hazard ratings are in those areas of the community with peppermint as a large part of the overstorey, and where a denser 1-2m shrub stratum of mostly net bush and coast wattle occurs.

The closest AS3959 equivalent is generally Low Woodland B-07, and in places Low Open Woodland B-08. However the BaW understorey of low shrubs is dense and very diverse, making it significantly different.

The community is relatively old with a quite open tree strata as a result. The lower strata (0-1m) shrubs are long-lived and dense, and it has a relatively dense sedge and rush groundcover layer. The relative density of the two lower strata provides a very high bushfire hazard rating.

The community occurs in the north-western section of Reserve 511 in a patch north of the wind turbine hill, on both sides of Progress Drive near its Junction with the Bremer Bay – Boxwood Rd, extending from here north through the townsite to the eastern end of Reserve 51949. It occupies deep pale yellow sand plain. The iron content making the sand yellow, and likely accounting for the starkly different and diverse Proteaceae dominated community.

The community is very sensitive to disturbance by fire or soil movement, and particularly sensitive to Phytophthora dieback. It is very attractive and with summer flowering trees and understorey plants, and as such a characterising and valuable community. A firebreak between Frantom Way and Progress Drive dissects the community, and good access is available to suppress fire should it occur. Its values and conservation listing underscore the imperative to protect it from fire and phytophthora dieback.

BmAhK: Banksia media, Acacia heteroclita Kwongkan shrubland

A dense low to medium shrubland to 2 metres, with diverse shrub and ground cover strata. The dominant and largest shrubs are granite thicket wattle (*Acacia heteroclita*) and southern plains banksia (*Banksia media*). Some scattered and emergent mallee (*Eucalyptus angulosa*) occurs. Other lower shrubs in the kwongkan community include Point Henry honeymyrtle (*Melaleuca densa*), violet honeymyrtle (*Melaleuca violaceae*), turpentine bush (*Beyeria latifolia*), sharp hakea (*Hakea marginata*), coneflower (*Petrophile* sp.), coastal olax (*Olax benthamiana*), *Andersonia simplex*, beard heaths (*Leucopogon flavescens*, *L. gibbosus*), and pink rice flower (*Pimelea ferruginea*). Groundcovers are sedges (*Gahnia trifida*, *Lepidosperma* sp., and *Schoenus* sp.). Herbs or small shrubs are hispid stinkweed (*Opercularia hispidula*), and enamel orchid (*Thelymitra* sp.). The parasitic creeper (*Cassytha* sp.) is common on the community's shrubs.

The diversity of Proteaceae family plants sees this community consistent with the nationally listed Threatened Ecological Community (TEC) *Proteaceae dominated Kwongkan of the Southeast Coastal Botanical Province*.

Bushfire hazard is very high, due to the density of the elevated fuel layer of the 0-1m and 1-2m shrub strata. However, due to the limited extent and coastal location of this community away from infrastructure, its hazard is not a significant management issue. The community is relatively old although dense, comprised of predominantly long lived dominant species.

The closest AS3959 equivalent is Closed Heath C-10, with some patches closer to Open Heath C-11. It would be impractical to map these differences in the community.

The community occurs in the north-western section of the Point Henry Peninsula, in a linear patch on the granite headland south of the Fishery Beach harbour. It occupies sandy loam among granite rocks in an exposed site.

The community is very sensitive to disturbance by fire or soil movement, and particularly sensitive to Phytophthora dieback. It is very attractive with a number of plants with large and colourful flowers, and as habitat and food source for Honey Possum and Carnaby's Cockatoo, and as such a characterising and valuable community. Its values and conservation listing underscore the imperative to protect it from fire and phytophthora dieback.

BmnK: Banksia media and B. nervosa Kwongkan shrubland

A dense low to medium shrubland to 2 metres, with diverse shrub and ground cover strata. The 1-2m stratum is dominated by southern plains banksia (*Banksia media*), with other components being the wattles (*Acacia myrtifolia*, *A. cyclops* and *A. heteroclita*). The 0-1m stratum is the most dense and diverse stratum with violet honeymyrtle (*Melaleuca violaceae*), fishbone dryandra (*Banksia nervosa*), dryandra-leaved banksia (*Banksia dryandroides*), leafless bossiaea (*Bossiaea praetermissa*), beard heath (*Leucopogon flavescens*), dwarf sheoak (*Allocasuarina humilis*), yellow honeymyrtle (*Melaleuca thymoides*) and *Kunzea sp.* Groundcovers are the sedges *Lepidosperma sp.*, and *Schoenus sp.*. The parasitic creeper (*Cassytha sp.*) is scattered.

The diversity and dominance of Proteaceae family plants sees this community consistent with the nationally listed Threatened Ecological Community (TEC) *Proteaceae dominated Kwongkan of the Southeast Coastal Botanical Province*.

Bushfire hazard is very high, due to the density of the elevated fuel layer of the 0-1m and 1-2m shrub strata. However, due to the limited extent and coastal location of this community away from infrastructure, its hazard is not a significant management issue. The community is relatively old although dense, comprised of predominantly long lived dominant species.

The AS3959 equivalent is Open Heath C-11.

The community occurs in the southern section of the Point Henry Peninsula, on the windswept granite headlands of the end sections of Points Gordon and Henry. It occupies sandy clay loam among granite rocks.

The community is very sensitive to disturbance by fire or soil movement, and particularly sensitive to Phytophthora dieback. It is very attractive with a number of plants with large and colourful flowers, and as habitat and food source for Honey Possum and Carnaby's Cockatoo, and as such a characterising and valuable community. Its values and conservation listing underscore the imperative to protect it from fire and phytophthora dieback. Tracks to the points traverse this community, and have several boggy holes in the soft clay rich soils; this presents a Phytophthora dieback hazard and an access difficulty, which requires repair.

CAfS: Callitris and Agonis flexuosa shrubland

An open low to medium shrubland to 2 metres, with relatively diverse shrub and ground cover strata. The community will increase in height over time, and it was burnt in 2002 and is dominated by slow growing native cypress (*Callitris roei*). Other larger shrubs in the community are those found on sandy soils around the granite outcrops against the coast in the area, including Point Henry honeymyrtle (*Melaleuca densa*), beard heath (*Leucopogon flavescens*), peppermint (*Agonis flexuosa*) and turpentine bush (*Beyeria latifolia*). Lower shrubs include rigid wattle (*Acacia cochlearis*), *Lasiopetalum quinquenervium*, coastal olax (*Olax benthamiana*), coastal fan-flower (*Scaevola crassifolia*), broom Ballarat (*Exocarpus sparteus*) and pink rice flower (*Pimelea ferruginea*). Groundcovers are curly grass (*Desmocladius flexuosus*), mat rush (*Lomandra sp.*), the fine sedge (*Schoenus sp.*) and purple grass (*Rytidosperma sp.*). Herbs or small shrubs are hispid stinkweed (*Opercularia hispidula*) and pig face (*Carpobrotus virescens*). Creepers are soft saltbush (*Rhagodia baccata*), coral vine (*Kennedia sp.*), and lignum (*Muehlenbeckia adpressa*).

Bushfire hazard is high, due to the density of the elevated fuel layer of the 0-1m and 1-2m shrub strata. However, due to the limited extent and coastal location of this community away from infrastructure, its hazard is not a significant management issue. The community is relatively old although dense, comprised of predominantly long lived dominant species.

There is no AS3959 equivalent. It would be a combination of Open Heath C-11 and Tall Shrubland E-15 to take account of the structures of the dominant strata. As a recovering community post 2002 fire, its structure and classification will change; if able to become old it will likely attain Tall Shrubland E-15.

The community occurs in the central southern section of the Reserve 511 as a small linear patch on the granite headland north of the Fishery Beach harbour. It occupies sand among granite rocks in an exposed site.

The community is very sensitive to disturbance by fire, particularly at frequencies less than the order of 30 + years to maintain the slow growing and brady-sporous obligate seeding native cypress pine component. It is a small yet a characterising and valuable community, which will eventually become a low patchy native cypress pine forest. Its local rarity and value underscore the imperative to protect it from fire.

CDH: Coastal dune low heath

A relatively diverse low shrubland or heath community to 2 metres, of the consolidated foredunes along the shoreline. The 1-2m stratum is dominated by net bush (*Spyridium globulosum*), sail wattle (*Acacia littorea*), peppermint (*Agonis flexuosa*), coastal daisy bush (*Olearia axillaris*), with coast hakea (*Hakea oleifolia*) scattered in hollows. The under 1m stratum comprises net bush (*Spyridium globulosum*), sail wattle (*Acacia littorea*), peppermint (*Agonis flexuosa*), coastal daisy bush (*Olearia axillaris*), rigid wattle (*Acacia cochlearis*), red rice flower (*Pimelea rosea*), coastal berry bush (*Acrotriche cordata*), beard heath (*Leucopogon flavescens*), tapeworm bush (*Platysace compressa*), coastal fan-flower (*Scaevola crassifolia*), coastal olax (*Olax benthamiana*) and false boronia (*Phyllanthus calycinus*). Ground covers are curly grass (*Desmocladus flexuosus*), sedges (*Lepidosperma gladiatum*, *Schoenus grandiflorus*) and coastal pigface (*Carpobrotus virescens*). The parasitic creeper dodder (*Cassytha sp*) is relatively common.

Similar to the AfC community, it differs in the greater diversity of the composition, and the lower shrub and heath structure.

Bushfire hazard is high due to the relatively dense shrub strata and structure. Although given its narrow linear near-shore dune swale occurrence, its fire hazard is relatively insignificant.

The closest AS3959 equivalent would be a combination of Closed Heath C-11 and Low Shrubland C-12 depending on the aspect and position in dune dips or on slopes.

As a low to moderate hazard community, it should be left out of prescribed burning programs, due to its limited occurrence and the potential for the increased dominance of more hazardous disturbance opportunists peppermint, net bush and potentially the weed Victorian tea tree (*Leptospermum laevigatum*).

The community is found as a narrow strip against the coast in central parts of Reserve 511 between along Back Beach, and in small patches behind Short Beach and Blossoms Beach. It forms linear strips fringed by the AfC community on the inland side and the sparsely vegetated beach.

Dune: sand dune

Signifies the sand dunes prominent on and adjacent to the Point Henry Peninsula. The vegetation cover on dunes is non-existent to very sparse. Some small clumps of peppermint (*Agonis flexuosa*) exist surrounded by mobile sand, and patches of sedges (*Ficinia nodosa*, *Lepidosperma gladiatum*) on less mobile damp sites in swales.

Closest AS3959 equivalent is Sparse Open Tussock G-24. Although Dune communities are no vegetation - to very sparse indeed.

EaadpM: Eucalyptus aff. angulosa E. decipiens, E. pleurocarpa mallee shrubland

A medium, relatively dense mallee shrubland to around 6 metres. Dominant mallees are spongolite mallee (*E. aff angulosa*), *E. decipiens* subsp. *chalara*, tallerack or blue (*Eucalyptus pleurocarpa*), and hook –leaved mallee (*E. uncinata*). Larger shrubs over 2m are coast wattle (*Acacia cyclops*) two-leaf hakea (*Hakea trifurcata*).

Undershrubs in the 0-1 and 1-2m strata are sparse although relatively diverse, and include purple regelia (*Regelia inops*), coast wattle, violet honeymyrtle (*Melaleuca violaceae*), beard heaths (*Leucopogon flavidus*, *L. parviflorus*), cauliflower hakea (*Hakea corymbosa*), *Acacia leioderma*, cockies tongues (*Templetonia retusa*), spiked Andersonia (*Andersonia simplex*), *Hovea trisperma*, *Hakea marginata*, and one-sided bottlebrush, (*Calothamnus gracilis*). Groundcovers are relatively dense, and include course curly grass (*Desmocladius latifolius*), sedges (*Anarthria laevis*, *Lepidosperma sp. Mesomelaena stygia*, *Tetraria sp.*), dianella (*Dianella revoluta*) and hispid stinkweed (*Opercularia hispidula*). Creeper is bluebell or cummuck (*Billardiera heterophylla*).

Bushfire hazard is moderate, due to the low density of the shrub strata and sparse thin ground litter.

The closest AS3959 equivalent is Tall Shrubland E-15. However, the difference is in the relatively dense shrub strata of the local community.

This community is very old (longer time since fire), the order of thirty plus years and probably longer with no evidence of fire apparent. This community is part of a larger mallee community with lower hazard ratings due to the reduced density resulting from shrub plant attrition with age in the shrub layer.

It is relatively sensitive, although able to respond to disturbance if it is infrequent. If burnt it will recover as a wattle dominated dense community, before eventually (after many decades) settling to the old open and complex community it is present as now. Evidence of this can be seen in this and the related EpEd and EpK communities where it occurs along the Bremer Boxwood Rd around 23 km west of town,

The community occurs in the western sector of Reserve 51949 on skeletal sand over spongolite clay. It does have some proteaceous plants presenting its understorey. However, due to their low diversity and limited occurrence, it is not consistent with the Commonwealth listed Proteaceous Kwongkan Shrublands of the Southeastern Botanical Province Threatened Ecological Community (TEC), as is the case in the similar EpK and EpEd communities.

EaM: Eucalyptus angulosa mallee shrubland

A medium to tall shrubland to around 7 metres, mostly relatively dense. Dominant tall shrub is coastal ridge-fruited mallee (*Eucalyptus angulosa*), with varying patchy and scattered peppermint (*Agonis flexuosa*), net bush (*Spyridium globulosum*), coast wattle (*Acacia cyclops*) and sail wattle (*Acacia littorea*). Undershubs in the strata less than 2m vary in density being sparse on sand plain occurrences to relatively dense on limestone ridges; they include net bush, coast wattle, *Melaleuca pentagona*, beard heaths (*Leucopogon flavidus*, *L. gibbosus*, *L. obovatus*), *Rhadinothamnus rudis*, *Pomaderris myrtilloides*, curry flower (*Lysinema pentapetalum*), dogwood (*Jacksonia furceolata*), creeping hakea (*Hakea prostrata*), variable-leaved hakea (*H. varia*), buttercups (*Hibbertia amplexicaulis*), yellow honeymyrtle (*Melaleuca thymoides*), tapeworm bush (*Platysace compressa*), *Pultenaea heterochila*, coastal berry bush (*Acrotriche cordata*), cockies tongues (*Templetonia retusa*), and leafless bossiaea (*Bossiaea praetermissa*). Groundcovers are curly grass (*Desmocladius flexuosus*), sedge (*Lepidosperma sp.*), dryland rush (*Anarthria prolifera*), and triggerplant (*Stylidium sp.*). The common creeper is old mans beard (*Clematis pubescens*).

Bushfire hazard is in one case moderate, and mostly high to very high due to the relative density of the mallee and other shrub strata and the depth of the ground litter. The patches on the limestone ridges of Point Henry are generally a higher hazard rating due to the greater density and diversity of their under-shrub strata, particularly where *Melaleuca pentagona* is an under-shrub to emergent clumping mallee in the Short Beach area.

The closest AS3959 equivalents are Open Scrub D-14 and Tall Shrubland E-15. However, the difference is in the relatively dense shrub strata of the local community, which can approach Open Heath C-11 or Low Shrubland C-12 in dimensions.

The majority of patches of the community recorded across the centre of the Point Henry Peninsula were burnt in late 2002, showing strong growth since and evidence of the mallee having spread by the fire disturbance opportunity to adjacent communities including AfS and AfW. The patch on private property off Gneiss Hill Rd, and the patches on the Point Gordon and Point Henry headlands did not have evidence of recent fire. Patches in northern Reserve 511 were not recorded to have had recent fire, although charcoal from older fires is evident in patches west of the Abalone Farm.

The community occurs in patches throughout eastern central and southern sections of Reserve 511 and across Point Henry Peninsula. It occupies deep grey sand plains, sand ridges and swales, and predominantly on the north facing slopes of limestone ridges on Point Henry Peninsula where its understorey is and more dense and diverse. It also occurs in patches on the extremities of Point Henry and Point Gordon on sand among granite, and similarly in Reserve 511 near John Cove and the Rock Cairn.

It is robust and able to respond strongly to disturbance. It has the ability to become a taller community with sparse understorey if left undisturbed for long periods, or through manipulation to remove net bush, coast wattle and peppermint without regeneration triggering disturbance.

EcW: Eucalyptus cornuta tall woodland

A relatively tall woodland/open forest community with trees to around 30 metres, mostly open when older.

The dominant tall tree is yandil or coast yate (*Eucalyptus cornuta*), and the relatively dense tall shrub understorey strata is mostly net bush (*Spyridium globulosum*) and coast wattle (*Acacia cyclops*), and a few mallees of the hybrid coastal ridge fruited mallee x yandil (*E. angulosa x cornuta*), as well as some peppermint (*Agonis flexuosa*) at the edges. Undershubs are sparse and comprise beard heath (*Leucopogon parviflorus*), cut-leaf buttercup (*Hibbertia cuneiformis*), and the sprawling soft saltbush (*Rhagodia baccata*). Groundcovers are a dense cover of curly grass (*Desmocladius flexuosus*) and sedges (*Lepidosperma* sp.). This community also has a significant herb flora including kidney dichondra (*Dichondra repens*), native sorrel (*Oxalis perennans*), native geranium (*Pelargonium australe*), and the introduced weeds pimpernel (*Lysimachia arvensis*) and annual veldt grass (*Ehrharta longifolia*). Creepers are old mans beard (*Clematis pubescens*), the introduced bridal creeper (*Asparagus asparagoides*) and sprawling soft saltbush. The shrub and ground cover composition is very similar to the Af and AfW communities. Some history of disturbance is evident in the yandil forest community by the presence of introduced weeds.

Bushfire hazard is high, due to the depth and extent of the ground litter and the density of the midstorey shrub strata. This community does not appear to have been burnt for many years, likely the order of 40 +, with some evidence as old charcoal on some tree trunks. The tall undershrubs are relatively dense although they are on a thinning trajectory due to age and will continue to thin over time as older plants die.

The AS3959 equivalent is Woodland B-05.

The community occurs as a relatively small patch dissected by Wellstead Rd, on the Reserve 511 (east) side the shrub strata is intact, and on the private property (west) side the shrub strata has been mostly removed during winter 2016 by slashing for fire hazard reduction.

Like the similar AfS and AfW communities, the tall shrub strata of the yandil forest are robust and able to respond vigorously to disturbance. However, disturbance can interfere with the forest/ woodland's tall shrub structure, modifying it towards a denser and more hazardous shrubland community if burnt too often. The recovery to an open forest or tall woodland of this community is important to conserve its open structure and simple composition as a low fire hazard community. Monitoring the recovery and structural change across its different management regimes either side of Wellstead Rd is an important and recommended measure to better understand the development, ecology and natural trajectory of the yandil community.

The community occurs as one patch straddling Wellstead Rd, in Reserve 511 and on adjacent private property. It also occurs as a modified smaller patch in the Bremer Bay Caravan Park near Wellstead Estuary.

EoW: Eucalyptus occidentalis woodland

A medium to tall woodland community with tallest trees to around 20 metres, mostly open when older.

The dominant tall tree is mor or swamp yate (*Eucalyptus occidentalis*), and the relatively sparse tall and medium shrub strata are net bush (*Spyridium globulosum*), coast wattle (*Acacia cyclops*), peppermint (*Agonis flexuosa*), and mallee (*Eucalyptus decipiens* subsp. *chalara*). Shrubs in the 0-1m strata are sparse and comprise cockies tongues (*Templetonia retusa*), beard heaths (*Leucopogon flavescens*, *L. parviflorus*), soft saltbush (*Rhagodia baccata*) and small plants of peppermint, net bush and coast wattle. Groundcovers are dominated by a dense cover of curly grass (*Desmodcladus flexuosus*) and sedges (*Ficinia nodosa*, *Lepidosperma* sp.). This community also has herb and annual components to the ground cover including native sorrel (*Oxalis perennans*) and the introduced weeds freesia (*Freesia leichtlinii*) and annual veldt grass (*Ehrharta longifolia*). Creepers are old mans beard (*Clematis pubescens*), the introduced bridal creeper (*Asparagus asparagoides*) and sprawling plants of soft saltbush. The presence of some introduced weeds suggest a degree of dynamism in the community, which is likely due to its damp base and proximity to the weed infested old tip a little to the west.

Bushfire hazard is very high, due to the depth and extent of the ground litter and the density of the midstorey shrub strata and bark hazard of the yate trees. The community location in eastern Reserve 511 does not appear to have been burnt for many years, likely the order of 40 +, with some evidence as old charcoal visible. The tall undershrubs are on at thinning trajectory due to age and will continue to thin over time as older plants die. The Point Henry Peninsula patch was burnt in November 2002 and is recovering as a relatively thick shrubland, which will recover to a medium to tall open woodland in time.

The community occurs as a few small patches, in Reserve 511 alongside Wellstead Rd, and in one location on Point Henry Peninsula on private property east of Torreburrup Hill.

The AS3959 equivalent is Woodland B-15, with some stands and parts of stands Open Woodland B-06.

Like the similar Af, AfW and EcW communities, the swamp yate woodland community is robust and able to respond vigorously to disturbance. However, disturbance can interfere with the woodland's shrub structure, modifying it towards a denser and more hazardous shrubland community if burnt too often. The recovery to open tall woodland of this community is important to conserve its open structure and simple composition as a low fire hazard community. Monitoring the recovery and structural change is an important and recommended measure to better understand the development, ecology and natural trajectory of the mor woodland community.

EpEd: Eucalyptus pleurocarpa Eucalyptus decipiens mallee shrubland

A medium to tall open shrubland to around 7 metres. Dominant mallees are tallerack or blue mallee (*Eucalyptus pleurocarpa*) and mallee (*E. decipiens* subsp. *chalara*) from which it is named. Larger shrubs over 2m are sparse and scattered net bush (*Spyridium globulosum*), peppermint or wonil (*Agonis flexuosa*), coast wattle (*Acacia cyclops*), and in a few places Victorian tea tree (*Leptospermum laevigatum*). Shrubs in the 0-1 and 1-2m strata are relatively diverse, and include dwarf sheoak (*Allocasuarina humilis*), cauliflower hakea (*Hakea corymbosa*), two-leaf hakea (*H. trifurcata*), *H. marginata*, beard heaths (*Leucopogon gibbosus*, *L. flavescens*), *Daviesia benthamii*, corky honeymyrtle (*Melaleuca suberea*), *Labichea lanceolata*, curry flower (*Lysinema pentapetalum*), *Acacia leioderma*, *Petrophile squamata*, pom-pom Darwinia (*Darwinia diosmioides*) and grass tree or balga (*Xanthorrhoea platyphylla*). Groundcovers are often relatively dense, and include curly grass (*Desmocladius latifolius*), sedges (*Lepidosperma* sp., *Lyginea barbata*, *Mesomelaena stygia*, *M tetragona*, *Schoenus* sp.), and the herbs *Backhousia* sp., *Isotropis* sp., and *Daucus* sp. Creeper is bluebell or cummuck (*Billardiera heterophylla*).

Bushfire hazard is moderate, due to the relatively low density of the shrub strata and the minimal ground litter.

The closest AS3959 equivalent is Tall Shrubland E-15. Differs in taller over shrubs/mallees and more complex diversity of understorey shrubs.

Most of this community is very old (longer time since fire), the order of thirty plus years and probably longer with no evidence of fire evident. The community is very similar to EpK and EpOR in composition and structure, albeit less complex than EpK and less sparse than EpOR.

The community is relatively sensitive, although able to respond to disturbance if it is infrequent. If burnt it will recover as a wattle and possibly net bush dominated dense community, before eventually (after many decades) settling to the open and complex community it is present as now. As stated for the similar EpK and EpOR communities following, evidence of this disturbance and settling cycle can be seen where the EpEd and EpK communities occur along the Bremer Boxwood Rd around 23 km west of town; here it was burnt in 2015 and is recovering dominated in the short to medium term by a heavy density of wattles as the 1-2 and soon to include the over 2m strata.

The community occurs in eastern section of Reserve 511 west of the wind turbine hill, adjacent to the shared use rail from the hotel to the Sports Club. Its diversity of Proteaceous shrubs and ground covers in places sees it often consistent with the Commonwealth listed Proteaceous Kwongkan Shrublands of the Southeastern Botanical Province Threatened Ecological Community (TEC).

EpK: Eucalyptus pleurocarpa mallee shrubland over kwongkan

A medium to tall open shrubland to around 7 metres, sparse when older and where peppermint component is less. Dominant mallee is tallerack or blue (*Eucalyptus pleurocarpa*), with varied occurrence of other mallees (*E. decipiens* subsp. *chalara*), purple mallee (*E. pluricaulis*), sickle mallee (*E. falcata*), spongolite mallee (*E. aff. angulosa*), and hook-leaved mallee (*E. uncinata*). Larger shrubs are Christmas tree or munji (*Nuytsia floribunda*), net bush (*Spyridium globulosum*), peppermint (*Agonis flexuosa*), coast wattle (*Acacia cyclops*) and Victorian tea tree (*Leptospermum laevigatum*). Undershubs are very diverse, and include grey honeymyrtle (*Phymatocarpus maxwellii*), beard heath (*Leucopogon flavidus*), cauliflower hakea (*Hakea corymbosa*), two-leaf hakea (*H. trifurcata*) red hakea (*H. ferruginea*), *Hakea marginata*, rigid wattle (*Acacia cochlearis*), myrtle wattle (*A. myrtifolia*), one-sided bottlebrush, (*Calothamnus gracilis*), *Taxandria spathulata*, *Isopogon buxifolius*, *I. trilobus*, *Acacia leioderma*, dwarf sheoaks (*Allocasuarina humilis*, *A. microstachya*), summer honeymyrtle (*Melaleuca striata*), yellow honeymyrtle (*M. thymoides*), *M. scabra*, *M. violaceae*, *Conothamnus aureus*, purple regelia (*Regelia inops*), creeping banksia (*Banksia repens*), *Banksia tenuifolia*, fishbone dryandra (*B. nervosa*, *B. pteridifolia*) and grass tree or balga (*Xanthorrhoea platyphylla*). Groundcovers are often relatively dense, and include curly grass (*Desmocladius cinerea*, *D. fasciculatus*, *D. flexuosus*, *D. latifolius*), sedges (*Anarthria laevis*, *A. prolifera*, *Lepidosperma* sp., *Lyginea barbata*, *Mesomelaena stygia*, *M. tetragona*, *Schoenus* sp.), purple flags (*Patersonia occidentalis*), Dianella (*Dianella revoluta*) spear grass (*Austrostipa heteropogon*) and Veldt grass (*Ehrharta calycinus*). Creeper is bluebell or cummuck (*Billardiera heterophylla*).

Bushfire hazard is mostly low and in places moderate, depending on the density of the shrub strata.

Does not have an AS3959 equivalent. Notwithstanding, the closest equivalent would be the combination of Tall Shrubland E-15 and an understorey of Open Heath C-11. Complex South West Australian Mallee communities have no equivalents in eastern Australia.

Most of this community is very old (longer time since fire), the order of thirty plus years and probably longer with no evidence of fire apparent. These patches have lower hazard ratings due to the lessened density from plant attrition with age in relatively short-lived coast wattle and net bush.

It is relatively sensitive, although able to respond to disturbance if it is infrequent. If burnt it will recover as a wattle dominated dense community, before eventually (after many decades) settling to the old open and complex community it is present as now. Evidence of this can be seen in this and the related EpEd community where they occur along the Bremer Boxwood Rd around 23 km west of town,

The community occurs in Reserve 51949 and in the eastern section of Reserve 511 west of the wind turbine hill on skeletal sand over spongolite and granitic clays. Its diversity of Proteaceous shrubs and ground covers in many places sees it consistent with the Commonwealth listed Proteaceous Kwongkan Shrublands of the Southeastern Botanical Province Threatened Ecological Community (TEC).

EpOR: Eucalyptus pleurocarpa very open mallee over dryland rush ground cover

A sparse open mallee shrubland to around 7 metres. The dominant mallee is tallerack or blue mallee (*Eucalyptus pleurocarpa*), with very occasional mallee (*E. decipiens* subsp. *chalara*, hook-leaved mallee (*E. uncinata*) and spongolite mallee (*E. aff. angulosa*) at the edges where it joins adjacent mallee shrubland communities. Larger shrubs are a few very scattered coast wattle (*Acacia cyclops*) and Victorian tea tree (*Leptospermum laevigatum*). Undershubs in the 0-1 and 1-2m strata are diverse although few and sparse, including grey honeymyrtle (*Phymatocarpus maxwellii*), *Isopogon buxifolius*, dwarf sheoaks (*Allocasuarina humilis*, *A. microstachya*), net bush (*Spyridium globulosum*) one-sided bottlebrush, (*Calothamnus gracilis*), rigid wattle (*Acacia cochlearis*), beard heath (*Leucopogon* sp.), *Daviesia incrassata*, buttercups (*Hibbertia* sp.) and honeymyrtle (*Melaleuca scabra*). Groundcovers are a dense luxuriant cover of curly grass (*Desmocladius latifolius*) and the sedges (*Anarthria laevis*, *Schoenus* sp., *Lepidosperma* sp., *Mesomelaena stygia*, *M. tetragona*, wallaby grass (*Rytidosperma caespitosa*) and fox-tailed mulga grass (*Neurachne alopecuroidea*).

Bushfire hazard is low due to the very sparse structure of the mallee and shrub strata.

The closest AS3959 equivalent is Open Shrubland B-09, and closer to Tall Shrubland E-15 in some places. Main difference is the structurally sparse and species rich ground cover with few to no grasses of EpOR.

This community is very old indeed (longer time since fire), the order of 50 plus years and probably longer with no evidence of fire apparent. It is very similar to the adjacent EpK and EpEd communities, although is likely older and with a lower bushfire hazard.

It is sensitive in this old open and diverse state, vulnerable to fire and to some extent dieback. It is able to respond to disturbance, however, if burnt it will recover as a wattle dominated dense community, before eventually (after many decades) settling to the old sparse and complex community it is present as now. Like the EpK and EpEd communities, evidence of this can be seen in this community where it occurs along the Bremer Boxwood Rd around 23 km west of town.

The community occurs as a band through the centre east of Reserve 51949, on skeletal sand over spongolite clay. It is very instructive as to how old, stable and sparse a mallee community can be if disturbance is limited for long periods of time, leading to diverse attractive vegetation with low bushfire hazard ratings. As such, it is an ideal candidate for monitoring to measure the factors and comparable differences to the related EpK and EpEd communities leading to its current state.

GSH: Granite rock: proteaceous shrublands, herb fields and low heath

A range of communities associated with shallow soils on and adjacent to granite rocks: medium shrubland to around 4 metres in relatively small patches - mostly to around 2 metres, as well as low kwongkan to around 1 metre and herbfields.

Dominant taller shrubs are Bremer grevillea (*Grevillea nivea*) (Conservation Priority 2), granite thicket wattle (*Acacia heteroclita*), with some net bush (*Spyridium globulosum*) and peppermint (*Agonis flexuosa*), as well as some tallerack or blue (*Eucalyptus pleurocarpa*) mallee near the edges where it joins adjacent communities. Shrubs in the 0-1 and 1-2m strata are relatively diverse, and include rock thryptomene (*Thryptomene saxicola*), *Acacia leioderma*, beard heath (*Leucopogon flavescens*), tapeworm bush (*Platysace compressa*), curry flower (*Lysinema pentapatalum*), granite thicket wattle, peppermint, two-leaf *Hakea trifurcata*, creeping hakea (*Hakea prostrata*), one-sided bottlebrush (*Calothamnus quadrifidus*), dwarf sheoaks (*Allocasuarina humilis*, *A. microstachya*), rigid wattle (*Acacia cochlearis*), yellow honey-myrtle (*Melaleuca thymoides*), *Petrophile squamata*, couch honey-pot (*Banksia nivea*), fishbone dryandra (*B. nervosa*), parrot bush (*B. sessilis*), *Synaphea* sp. false boronia (*Phyllanthus calycinus*), *Chorizema* sp. and grass tree or balga (*Xanthorrhoea platyphylla*). Groundcovers are often relatively dense, and include curly grass (*Desmocladus flexuosus*), sedges (*Lepidosperma* sp. several species, *Mesomelaena stygia*, *Schoenus curvifolius*, *S. sp.*), purple flags (*Paterosonia occidentalis*), snail orchid (*Pterostylis* sp.), *Backhousia* sp., wallaby grass (*Rytidosperma* sp.) and seedlings of *Acacia leioderma* and couch honey-pot. Creepers are dodder (*Cassytha* sp.) and bluebell or cummuck (*Billardiera heterophylla*).

Bushfire hazard is mostly moderate, due to the mostly low density of the shrub strata and patchy to non-existent ground litter. This community also occurs mostly away from infrastructure assets, and where it is nearby adjacent to the Sports Club/tennis courts it is a low sparse community, reducing its hazard consequence.

There is no direct AS3959 equivalent. Rather it is a mixture of Low Shrubland C-12, Open Scrub D-14, and Open Herbfield G-27. The reason for the mixture is that they all occupy shallow to very shallow soils associated with granite rocks.

Most of this community is old (longer time since fire), the order of thirty plus years and probably longer with no evidence of fire apparent.

The community is varied and sensitive, susceptible to *Phytophthora* dieback and fire. Notwithstanding, its forms are able to respond to infrequent disturbance.

The community occurs as several patches in the northern and southern sections of Reserve 511, east and northeast of the Sports Club and oval, west of the wind turbine hill and near the back Beach Bombie and Fishery Beach harbour, on and around Torreburrup Hill, as well as on the extremities of Point Gordon and Point Henry. However, the conservation priority listed Bremer grevillea is only found around in the Wind Turbine hill area, on skeletal loamy sand among and on granitic outcrops.

In some patches, its diversity of Proteaceous shrubs and ground covers sees it consistent with the Commonwealth listed Proteaceous Kwongkan Shrublands of the Southeastern Botanical Province Threatened Ecological Community (TEC), particularly around the Wind Tower Hill area and adjacent to the Sports Club/tennis courts.

LIS: *Leptospermum laevigatum* shrubland and thicket

A weed dominated community that has infested and replaced the Af community in places. It is a medium to tall shrubland to around 7 metres, which becomes a dense long-lived thicket.

The dominant tall shrub is Victorian tea tree (*Leptospermum laevigatum*). A few scattered peppermint (*Agonis flexuosa*), coast wattle (*Acacia cyclops*), net bush (*Spyridium globulosum*) and coast hakea (*Hakea oleifolia*) occur as minor components of this and the 1-2m component. The few sparse undershrubs in the 0-1m strata are beard heath (*Leucopogon flexuosus*), stinkwood (*Jacksonia furcellata*), *Pultenaea praetermissa*, sail wattle (*Acacia littorea*), as well as some smaller peppermint and coast wattle plants. Groundcovers are sedges (*Lepidosperma* sp., *Lyginea barbata*, *Ficinia nodosa*), pigface (*Carpobrotus virescens*) and native carrot (*Daucus* sp.), as well as an even moss layer. Creepers were not recorded.

Bushfire hazard is very high to extreme, due to the density and structure of the dominant shrubland thicket, and to a degree the cover of the ground litter. However, due to its very limited extent, and that it is relatively robust and can be managed to reduce shrub hazard, it is not a significant hazard problem.

The AS3959 equivalent is mostly Closed Scrub D-13, with some sparser stands Open Scrub D-14.

The community exists because the dominant weed is a rampant regenerator from extensive seed production ability, and the absence of natural limiting agents. The community is able to respond vigorously to disturbance, and has the propensity to invade other adjacent vegetation communities following disturbance. Some patches of the community are relatively old (longer time since fire), the order of thirty plus years and probably longer. Despite this age, the invasive nature of the tea tree sees it develop dense thickets over time, which shows little sign of thinning in the stands observed, in fact they are likely increasing in extent and density. On-going monitoring of the development of the community may help better understand this trend. However, the tea tree is a very significant fire hazard and invasive weed and should be systematically removed from the area. Monitoring the behaviour and patterns of the remaining native vegetation post-removal is important to understand responses to improve management.

The community occurs in patches of varying size across Reserve 511 and the Point Henry Peninsula, predominantly on deep grey sand plains and lower slopes. It is in thickest patches on Horse Hill Rd, Point Gordon track, Black Rocks Rd, and in a few patches near the end of Point Henry Peninsula.

The dense patches on Horse Hill Rd and Pt Gordon Track are likely present as extensive infestations due to the long-term (from the late 1800's to 1973) disturbance history of the location by grazing sheep and horses, the latter giving rise to the name of the location and road. The disturbed ground and subsequent removal of grazing pressure would likely have lead to the extent and density of the infestation as it stands today.

This community is weed-dominated and should be strategically removed.

MIS: Melaleuca lanceolata tall shrubland

A medium to tall shrubland to around 7 metres, often relatively dense. Dominant tall shrub is Rottnest Island tea tree (*Melaleuca lanceolata*), with associated tall shrubs being scattered peppermint (*Agonis flexuosa*), coastal ridge-fruited mallee (*Eucalyptus angulosa*), net bush (*Spyridium globulosum*) and coast wattle (*Acacia cyclops*).

Undershrubs in the strata less than 2m are mostly sparse and include *Melaleuca pentagona*, cockies tongues (*Templetonia retusa*), parrot bush (*Banksia sessilis*), *Rhadinothamnus rudis*, *Pultenaea heterochila*, *Scaevola crassifolia*, *Lasiopetalum quinquenervium* and small plants of Rottnest Island tea tree, net bush and coast wattle. Groundcovers are sedge (*Lepidosperma* sp.), coastal native grass (*Poa porphyroclados*) and pigface (*Carpobrotus virescens*). The creeper is old mans beard (*Clematis pubescens*).

Bushfire hazard is very high due to the relative density of the tall shrub strata and the depth of the ground litter. However due to its limited occurrence in patches against the coast, it is of limited hazard significance.

The closest AS3959 equivalent is Open Scrub D-14. However, the MIS community is often taller.

All patches of the community observed were long unburnt. As the majority of the species comprising the community are obligate seeders, it is of limited extent, and the dominant Rottnest Island tea tree takes many years to reach maturity and full size, it is considered to be a sensitive community.

The community occurs in patches along the coastal edges of southern Reserve 511 and the Point Henry Peninsula central. It occupies deep yellow pale grey sand dunes in protected sites, sand ridges and swales right against the coast. Notable locations are around Native Dog Beach and Little Boat Harbour parking and facility site.

MpH: Melaleuca pentagona heath

A heath or low shrubland and often thicket community to around 2 metres, mostly very dense. Dominant shrub is *Melaleuca pentagona*, associated shrubs in the 1-2 and 0-1m strata include yellow honeymyrtle (*Melaleuca thymoides*), sail wattle (*Acacia littorea*), *Rhadinothamnus rudis*, peppermint (*Agonis flexuosa*), parrot bush (*Banksia sessilis*), pink rice flower (*Pimelea ferruginea*) beard heath (*Leucopogon flavidus*) and false boronia (*Phyllanthus calycinus*). Groundcovers are curly grass (*Desmocladus flexuosus*), sedge (*Lepidosperma* sp.) and speargrass (*Austrostipa* sp.). The common creeper is bluebell (*Billardiera heterophylla*). On the edges scattered emergent plants of coastal ridge-fruited mallee (*Eucalyptus angulosa*) occur associated with the adjacent mallee community.

Bushfire hazard is extreme due to the dense thickets of the 1-2m elevated fuel strata. The patches on the coastal sand slopes below limestone ridges are also an additional hazard due to the slope and prevailing summer (south-easterly) wind direction.

The AS3959 equivalent is Closed Heath C-10.

The community occurs in patches close to the coast on the Point Henry Peninsula. It occupies deep grey limey sands down slope from limestone ridges and in swales between. It is most easily observed behind Short Beach up behind the carpark and slashed firebreak, and behind Native Dog Beach, extending up towards the ridges along the lower end of Native Dog Rd.

It is robust and able to respond strongly to infrequent disturbance. The majority of the species it comprises are obligate seeders with canopy-stored seed, with a few wattles that have soil-stored seed. However frequent fire (less than the order of 30 year intervals) would likely favour peppermint, coast wattle (*Acacia cyclops*) and net bush (*Spyridium globulosum*) altering its composition and structure, although not its hazard rating. The community appears to remain as a dense thicket structure into old age and not thinning over time as other communities do, it appears to remain mostly less than 3 metres due to the resilient long-lived *Melaleuca pentagona* and the exposed sites it occupies. Slashing the community results in a loss of the melaleuca, and the promotion of groundcover sedges and low shrubs.

PKAf: Proteaceous kwongkan with *Agonis flexuosa*

A low to medium heath and shrubland, predominantly to 2 metres, with taller surrounding and emergent patches of peppermint (*Agonis flexuosa*). It is similar to the often-adjacent PKH community, differing by the common presence of peppermint, coast wattle (*Acacia cyclops*) and net bush (*Spyridium globulosum*).

The community has a very diverse lower shrub and ground cover strata. The open 1-2m strata includes peppermint, coast wattle, parrot bush (*Banksia sessilis*), net bush, candle hakea (*Hakea rusCIFolia*), variable – leaved hakea (*Hakea varia*), stinkwood (*Jacksonia furcellata*), southern balga (*Xanthorrhoea platyphylla*), cockies tongues (*Templetonia retusa*), coastal olax (*Olox benthamiana*), and rigid wattle (*Acacia cochlearis*). The 0-1m strata is the most dense and diverse layer with yellow honeymyrtle (*Melaleuca thymoides*), beard heath (*Leucopogon sp.*), dwarf sheoak (*Allocasuarina humilis*), creeping hakea (*Hakea prostrata*), cauliflower hakea (*H. corymbosa*), curry flower (*Lysinema pentapatalum*) buttercups (*Hibbertia amplexicaulis*), tapeworm bush (*Platysace compressa*), couch honey-pot (*Banksia nivea*), nodding banksia (*B. nutans*), candle hakea, leafless bossiaea (*Bossiaea praetermissa*), false boronia (*Phyllanthus calycinus*), coastal berry bush (*Acrotriche cordata*) and buttercup (*Hibbertia racemosa*). Groundcovers are curly grass (*Desmodcladus flexuosus*), sedges (*Anarthria gracilis*, *A. prolifera*, *Lepidosperma sp. x 2*, *Schoenus sp. x 2*), yellow dune daisy (*Senecio sp.*), native carrot (*Daucus glochidiatus*), tube lechenaultia (*Lechenaultia tubiflora*), enamel orchid (*Thelymitra sp.*), speargrass (*Austrostipa heteropogon*) and coastal native grass (*Poa porphyroclados*). A few scattered plants of the creeper (*Cassytha sp.*).

The diversity and dominance of Proteaceae family plants sees some parts of this community consistent with the nationally listed Threatened Ecological Community (TEC) *Proteaceae dominated Kwongkan of the Southeast Coastal Botanical Province*.

Bushfire hazard is moderate to high, depending on the density of the elevated fuel layer of the 0-1m and 1-2m shrub strata. Its proximity to building assets on the Point Henry Peninsula presents it as a community for which hazard management will be a requirement, particularly as it often occurs on slopes associated with limestone ridges.

There is no direct AS3959 equivalent. PKAf is a mixture of Open Heath C-11 with some patches of Tall Shrubland E-15.

The community occurs on the slopes alongside and near Horse Hill Rd. These slopes are associated with the band of limestone ridges that span Point Henry Peninsula, from Torreburrup Hill and Black Rocks Rd southwards to approximately a line from the southern end of Blossoms beach across to Banky Beach, on which the related PKH community occurs. The difference being the predominance of peppermint in what is likely to be an ingression over time of the more precocious shrub, it is present in other parts of the PKH community, although not to the same extent as in this separately mapped community.

The community is sensitive to disturbance by frequent fire, soil movement, slashing, and particularly sensitive to Phytophthora dieback. The presence of peppermint, coast wattle and net bush suggests that the community being altered by the incursion of these precocious native plants from adjacent patches of the Af

community, which is also increasing the bushfire hazard rating. This incursion is likely related to relatively frequent fires destabilising the low shrubland community, stimulating the adjacent peppermint, coast wattle and net bush to regenerate and disperse to invade the vulnerable low shrubland/heath, which in its stable state is most like the also often adjacent PKH community. Management of the community to maintain its species composition values and reduce its bushfire hazard would focus on preventing disturbance and the careful physical removal of peppermint, coast wattle and net bush.

The community is attractive with a number of plants with large and colourful flowers, and as habitat and food source for Honey Possum and the endangered Carnaby's Cockatoo, which is often seen foraging among its proteaceous plants, and as such a characterising and valuable community. Its values and conservation listing underscore the imperative to protect it from fire and phytophthora dieback.

PKH: Proteaceous kwongkan heath.

A low to medium dense heath and shrubland, predominantly to 1.5 metres, with a few sparse taller surrounding and emergent shrubs of peppermint (*Agonis flexuosa*) and coastal ridge-fruited mallee (*Eucalyptus angulosa*). It is similar to the often-adjacent PKH community, differing by the dominance of *Pomaderris myrtilloides* and parrot bush (*Banksia sessilis*), fewer peppermint, coast wattle and net bush, and limestone ridge substrate.

Like the PKAf, this community has a very diverse lower shrub and ground cover strata. The 1-2m stratum includes *Pomaderris myrtilloides*, parrot bush, sail wattle (*Acacia littorea*), peppermint, coast wattle, net bush, variable – leaved hakea (*Hakea varia*), yellow honeymyrtle (*Melaleuca thymoides*), candle hakea (*Hakea ruscifolia*), *Rhadinothamnus rudis*, and the introduced Victorian tea tree (*Leptospermum laevigatum*). The 0-1m strata is the most dense and diverse layer with yellow honeymyrtle (*Melaleuca thymoides*), cauliflower hakea (*H. corymbosa*), dwarf sheoak (*Allocasuarina humilis*), curry flower (*Lysinema pentapetalum*), creeping hakea (*Hakea prostrata*), parrot bush, leafless bossiaea (*Bossiaea praetermissa*), buttercup (*Hibbertia racemosa*), beard heath (*Leucopogon flavescens*, *L. gibbosus*, *L. obovatus*), stinkwood (*Jacksonia furcellata*), coastal berry bush (*Acrotriche cordata*), sail wattle (*Acacia littorea*), rose cone flower (*Isopogon formosus*), pink rice flower (*Pimelea ferruginea*), frog hakea (*Hakea nitida*), buttercups (*Hibbertia amplexicaulis*), tapeworm bush (*Platysace compressa*), couch honey-pot (*Banksia nivea*), nodding banksia (*B. nutans*), candle hakea, southern balga (*Xanthorrhoea platyphylla*), cockies tongues (*Templetonia retusa*), coastal olax (*Olox benthamiana*), *Pultenaea heterochila*, fishbone dryandra (*Banksia nervosa*), and rigid wattle (*Acacia cochlearis*). Groundcovers are curly grass (*Desmocladus flexuosus*), sedges (*Anarthria gracilis*, *A. prolifera*, *Lepidosperma* sp. limestone, *L. sp.*, *Schoenus* sp. x 2), *Logania* sp., and coastal native grass (*Poa porphyroclados*). And the creepers climbing lignum (*Muehlenbeckia adpressa*), old man's beard (*Clematis pubescens*), and dodder (*Cassytha* sp.).

The diversity and dominance of Proteaceae family plants sees much of this community consistent with the nationally listed Threatened Ecological Community (TEC) *Proteaceae dominated Kwongkan of the Southeast Coastal Botanical Province*.

Bushfire hazard is high to mostly very high, depending on the density of the elevated fuel layer of the 0-1m and 1-2m shrub strata, which is mostly dense. Its proximity to building assets presents it as a community for which hazard management will be a requirement, particularly as it often occurs on limestone ridges and their slopes across the central band of the Point Henry Peninsula almost exclusively on private property.

The AS3959 equivalent is predominantly Closed Heath C-10, and to a lesser extent Open Heath C-11 in some more open areas.

The community occurs across the central section of the Point Henry Peninsula, as the band of limestone ridges that span the peninsula from Torreburrup Hill and Black Rocks Rd southwards to approximately a line from the southern end of Blossoms beach across to Banky Beach. It is closely associated with the PKAf community, which occurs on the sandy slopes adjacent to the ridges.

The community is sensitive to disturbance by frequent fire, soil movement, slashing, and particularly sensitive to Phytophthora dieback. Very infrequent fire will maintain the community, and slashing will remove some of the most dominant shrubs, notably the autumn flowering *Pomaderris myrtilloides*, which is often the densest component, altering the composition and structure irreversibly. The community is also prone to compositional and structural alteration by the incursion of peppermint, coast wattle, net bush and Victorian tea tree by the incursion of these precocious native plants from adjacent patches of the Af community, which would also increase the bushfire hazard rating. Like the PKAf community This incursion is likely related to relatively frequent fires destabilising the low shrubland community, stimulating the adjacent peppermint, coast wattle, net bush and Victorian tea tree to regenerate and disperse to invade the vulnerable low shrubland/heath. Management of the community to maintain its species composition values and moderate bushfire hazard would focus on preventing disturbance and the careful physical removal of any peppermint, coast wattle, net bush and Victorian tea tree.

The community is attractive with a number of plants with large and colourful flowers, and as habitat and food source for Honey Possum and the endangered Carnaby's Cockatoo, which is often seen foraging among its proteaceous plants, and as such a characterising and valuable community. Its values and conservation listing underscore the imperative to protect it from fire, ground disturbance and phytophthora dieback.

The values of the Bremer Bay and Point Henry vegetation

Bremer Bay and Point Henry have very significant and popular natural and cultural values. These are the reason and foundation for the place's desirability and status as a home, recreation destination, conservation area, and enterprise base.

The values are encapsulated in many ways by the vegetation communities, as amenity, flora, fauna habitat, character, and in its stewardship as a measure of our relationship with the landscape. This comes together as a well-developed sense of place.

This section outlines the range of values, their dimensions and elements related to the vegetation communities, their place in legislated protection, and the relationships we have as stewards. The vegetation management section later outlines the vegetation communities, their sensitivities, and management recommendations to support their conservation.

Natural

The natural and nature conservation values are:

- The landscape, seascapes, landforms, geology and soils;
- the vegetation communities, and the flora within,
- the habitats formed by the landscape, vegetation and flora for native fauna;
- the native fauna;
- the food resources provided by the vegetation, flora and fauna;
- the integrity of the above as the ecology; and
- the provision of wild resources for people as a relationship with nature.

Stewardship of the natural environment is an imperative to maintain the values listed, and to maintain the integrity of the natural values - with the focus on vegetation communities as the most immediate and variable natural feature – and the subject of this guide. This stewardship includes legislated protection by Government, protection from damaging agents such as disease / frequent disturbance / weeds / feral pests, skilful management, and sharing an intact nature with the broader community.

The integrity of the vegetation communities influences the range of other values under, down-slope and within; as soils and landforms that they sit upon and protect, further on as catchment and waterway health, and within as cover and food for the fauna. Vivally, it has a relationship with people, where it provides services and value, as well as presenting potential hazards, which make it the focus of attention here.

The Bremer Bay and Point Henry landforms are dominated by the imposing peninsulas of the Albany Fraser orogen gneiss that jut south into the southern ocean, including the central Point Henry Peninsula, enveloping the embayments and beaches that characterise the place. To the north of the peninsulas, a marine plain lies under the surface soils, comprised of the marine sedimentary spongolite rock, most evident as the cliffs along the shores of the Wellstead estuary.

Clay, sand and limestone soils overlie the gneiss geology of the peninsula, most heavily patterned towards the end of Point Henry, with a plate of limestone evident as a series of ridges running east - west across the centre of the peninsula. A mosaic

of clay, thin sandy clay, and patches of deeper yellow sands soils overlie the marine plain. The flora strongly reflects the differences in soil types, with the clay, deep yellow sand, and limestone ridge-sides having the richest and often sparsest floras, and the deep grey sands, particularly in swales and lower protected slopes having the least diverse although often dense plant assemblages forming shrublands and woodlands.

The clay and sandy clay soils with their poor draining characteristics, and their rich often proteaceous dominated flora, present challenges to keeping phytophthora dieback introduction at bay. Phytophthora introduction would seriously damage and weaken these character communities, which are prime habitat for a number of animals – including some threatened species. It is these community's sensitivities and the threat of phytophthora dieback, and their role as primary threatened animal habitat that make them a threatened ecological community (TEC) in their own right.

The Bremer Bay/Point Henry area sits within the ESP 01 Fitzgerald subregion of the Esperance Plain Bioregion of the Interim Biogeographic Regionalisation of Australia (IBRA) (Australian Government 2012), and within the Southeast Coastal Botanical Province (Hopper and Gioia 2004). The biological richness of the area, in the context of its place within the subregion and province above, gives the area special recognition as a place of biological significance.

The 29 vegetation communities include a rich diversity of plants as flora, from tall trees to tiny annual herbs. From charismatic banksias and orchids, to modest stolid shrubs and groundcovers. The flora includes one area endemic- the Bremer grevillea (*Grevillea nivea*), which is known from granite rocks near Bremer Bay townsite and the Doubtful Island peninsula, and a few near the limits of their range including peppermint (*Agonis flexuosa*) and Point Henry honeymyrtle (*Melaleuca densa*) near their easternmost. Otherwise the flora is present as a number of assemblages of common plants, in a number of compositions and structures, including some that have been altered by a recent history of frequent ecological disturbance.

A range of native fauna inhabits the vegetation communities of the Bremer Bay/Point Henry area. From native land snails (*Bothriembryon sp.*) of the wattle and peppermint shrublands, to wedge-tailed and white-breasted sea eagles (*Aquila audax* and *Haliaeetus leucogaster*) that nest in the yandil woodland. The largest mammals are western grey kangaroos (*Macropus fuliginosus*) and the smallest the noolbenger or honey possum (*Tarsipes rostratus*); probably the most common is the bush rat (*Rattus fuscipes*), who's runs and burrow mounds are everywhere under peppermint stands.

The bird diversity of the study area is relatively rich, as shown by a list of 42 species compiled for bird presence on private property on Short Beach Rd Point Henry. The list developed over a few years of observations includes mostly bushland birds, with a few flyover sea birds and seasonal visitors.

Conservation listed vegetation communities, flora and fauna

All vegetation communities, flora and native fauna are protected under State and Commonwealth Acts of Parliament. Some are specially protected because they are rare or threatened (Wildlife Conservation Act 1950; EP Act 1986; EPBC Act 1999), which in the Bremer Bay/Point Henry area, includes one ecological community, five animals and one plant (Table 1).

Table 1. Conservation listed communities and species

Community or species	Conservation listing	Vegetation community known occurrence
Kwongkan TEC	Commonwealth EPBC Act Endangered ¹ WA State Priority 3 ²	BaW, BmAhK, BmnK, EpK, GSH, PKH, PKAf
Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>)	Commonwealth EPBC Act Endangered ¹ WA State Endangered ³	BaW, BmAhK, BmnK, PKH, PKAf
Malleefowl (<i>Leipoa ocellata</i>)	Commonwealth EPBC Act Vulnerable ¹	AfS, AfW
Mallee Western Whipbird (<i>Psophodes nigrogularis leucogaster</i>)	Commonwealth EPBC Act Vulnerable ¹ WA State Endangered ³	BmnK, BmAhK
Chuditch (<i>Dasyurus geoffroii</i>)	Commonwealth EPBC Act Vulnerable ¹ WA State Vulnerable ³	AfS, AfC, CDH
Western ringtail possum (<i>Pseudocheirus occidentalis</i>)	Commonwealth EPBC Act Vulnerable ¹ WA State Endangered ³	Presumed locally extinct. AfS, AfW, EcW
Bremer grevillea (<i>Grevillea nivea</i>)	WA State Priority 2 ⁴	GSH

¹ Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 2016

² WA Department of Parks and Wildlife Priority Ecological Communities for Western Australia, Version 26. 30 November 2016

³ WA Wildlife Conservation Act 1950, Wildlife Conservation (Specially Protected) Fauna Notice 2015. WA Government Gazette, 3 November 2015

⁴ WA Department of Parks and Wildlife Florabase Priority Flora

Amenity

The plants and vegetation of Bremer Bay and Point Henry provide valuable and compelling amenity for people. The vegetation and its variety in landform matchings provide a broad-form setting, and with the plants within as structural features, they combine to invoke a particular sense of the place.

Amenity is a variety of provisions as form and colour, shade and shelter, ground protection, structure and visual appeal, protection from wind and weather hostility, local flavour and feel, agreeable smell and sound, and as habitat shared with appealing plants and animals.

It is often the vegetation amenity that attracts people to a particular a place or property, and is an agent that must be conserved to maintain appeal, performance and value. On the other hand, certain vegetation situations can form detractor from some people's ideal or agreeable amenity, where it may be considered a hazard or threat, or to be harsh and perhaps uninviting.

Amenity is a vital value to maintain in order to support peoples agreeable interactions with the place and its nature. The conservation of amenity is therefore a management priority. A particular instance of this priority is the peppermint woodlands and shrublands that have great amenity value, however they can also suffer detractor as a higher bushfire hazard when dense. Considered management can strategically manipulate these communities to maintain agreeable amenity and

reduce hazard, more like the open communities that first attracted people to the area.

Heritage

Within and among the vegetation cultural heritage as sites and structures exists, which represents the area's Noongar and European history.

Noongar people have used the area for many thousands of years, visiting, camping, hunting and living under the protection of the vegetation communities. Historic sites include water points in gullies behind beaches, and campsites close to the coast in sheltered shady groves. Evidence of occupation includes stone and shell fragments from tool making and stone lizard traps, with registered sites known in parts of Reserve 511 (DAA 2017). The prime contemporary camping site is the camp on Whitetrail Rd, from where Noongar people continue their relationship with the land and sea.

It is understood that Noongar land management practices over tens of thousands of years formed and maintained a vegetation community template that suited their resource and cultural requirements (Gammage 2011). This was achieved by first possessing a complete knowledge and a primary relationship with the landscape, landforms, soils, waterways, vegetation, plants and animals - and their various functions and ecological interactions. With this wherewithal, they were able to manipulate the vegetation for benefit using ability, skill, fire, time, hand tools, hand grubbing, weather, the family group, and actions of fostered game (Hallam 2014). This likely developed the common woodlands in the Bremer Bay / Point Henry area as templates, which were open, game rich and inviting to early European settlers.

European heritage is most prominent as built structures, including notably the fence remnants that divided the Point Henry Peninsula into four. The fences were to contain stock, and in earlier times to keep rabbits off the peninsula, the fences ended with rock walls into the ocean in three places, above the western end of Back Beach, at the western end of Banky Beach and the rocks at the eastern end of Dillon Bay. Fence remnants still stand along the sand trail from Back beach to the Bremer Bay Beaches Caravan Park, and behind the Wellstead peppermint Grove Property. Other European heritage is present as the sites of boiling pits behind Fishery Beach used by 19th century sealers and whalers (M Wellstead pers. comm.).

Recognition and conservation of this heritage, and the amenity and other values bestowed by people living and visiting here throughout history, is imperative.

Character

The Bremer Bay and Point Henry area's mix of landscape, seascape, vegetation, flora, fauna, amenity and heritage provides a unique character. The character is an economic as well as cultural, natural and historic value, and is added to by the contemporary community of people in a variety of responses.

The quality of the management of the vegetation can help shape and maintain the valuable character. The vegetation management recommended by this guide is designed to conserve and enhance the character of the place.

Vegetation management and conservation

Aspirations, objectives, priorities and recommendations

The Vegetation mapping that informs this management section identified the 29 vegetation communities in Reserves 511 and 51949, and the Point Henry Peninsula, and their distribution, extent, sensitivities and typical hazard ratings. The mapping forms the basis for developing the management and conservation objectives, priorities and recommendations of this section.

The management and conservation objectives, priorities and recommendations are designed to attain the aspirations:

- *Vegetation communities conserved for amenity, nature and heritage values and reduced bushfire hazard.*
- *Continued improvement by the community in the understanding of vegetation behaviour to enable the conservation of amenity, nature and heritage, and reduced bushfire hazard.*

Values and character

The values of the vegetation communities of Bremer Bay and Point Henry are their integrity, flora, fauna, amenity and heritage. The conservation of these values will be supported by reduced bushfire hazards, and as result, the extent and impact of bushfires.

The common denominator holding and influencing the values is the vegetation cover and its health and stability, which together with an approach as a community to better understand the vegetation and its behaviour, and develop management skills, can support the protection and maintenance (conservation) of the values and aspirations.

The improved understanding, the management activities and their results in conserving and sustainably managing the area's values and character, can help better invoke a shared sense of place.

Management objectives and priorities

Vegetation management objectives reflect the values of the vegetation communities, and guide the development and implementation of the management recommendations. They are:

- A shared understanding of the types, behaviour and sensitivities of the vegetation communities
- Conservation of sensitive vegetation communities, habitats, flora and fauna
- Conservation of amenity and heritage
- Conservation of vegetation community integrity
- Lowest possible bushfire hazard
- Ease and practicality of implementation

Priority vegetation communities for management are also identified to support management and conservation. Priority for management relates to vegetation communities that have:

1. High or above bushfire hazard assessments/ratings;
2. Significant extent or coverage;
3. Proximity to community and private assets,

4. Conservation listing or known sensitivities; and
5. Been altered by disturbance to increase density and bushfire hazard;

Management and conservation recommendations

The management and conservation recommendations are based on a vegetation trait based approach to understanding vegetation regeneration, regeneration stimuli, structural development, and therefore hazard and conservation. *It is a more nuanced appreciation of the relative sensitivity of responses of biodiversity (vegetation in this case) to disturbance types and events, (including fire and fire regimes) at within and between community scales. Fluxes in a few species (and communities) may be large, and have large effects on other species (and communities), in some communities but not others.* Bradstock Williams and Gill Eds of Flammable Australia 2012.

Management and conservation recommendations are provided here in a matrix model. Table 1 shows the relevant attributes necessary for sustainable management of the 29 vegetation communities as: behaviour, sensitivity, conservation rating, fire hazard rating, reference sites and recommended management actions.

The reference sites are included to identify locations where the communities and their composition, structure and behaviour can be observed and considered. The sites are selected for their ease of access and occurrence on public lands.

The matrix model organises and presents (Table 2) the variables in vegetation communities and values, and supports management actions regardless of tenure. The management actions suit Reserves 50949 and 511, as well as private property.

Notwithstanding, Table 2 presents recommended management actions for all vegetation communities to assist landowners and managers who may have their own property-specific needs as priorities.

The vegetation management and conservation recommendations take into account:

- ***Protecting life and property is the number 1 priority;***
- ***Resourcing and practicality;***
- ***Time taken to achieve this response;***
- ***The likely capabilities of the responsible party; and***
- ***Conservation of amenity, biodiversity and cover***

The second part of this management section presents some further detail on methods and techniques to sustainably manage and conserve the values of the vegetation communities, including the priority of reduced bushfire hazard. Further, the second part draws a focus on a group of seven priority plants for attention, identified for their contribution to vegetation community density, instability and increased hazard.

To use this management section landowners and managers should study the vegetation maps to identify the vegetation communities on their holdings as the first management action. Then consult Table 1 to ascertain the attributes of their vegetation communities and identify management recommendations. Thereafter, take in the further information on the specifics of managing their vegetation communities to conserve their values and achieve property management desires.

In addressing the aspirations and objectives, the management recommendations are designed to focus on maintaining health and lowest possible densities and hazard ratings, and specifically to achieve stated desires for the vegetation, which are:

- more open stands with less and larger peppermints and mallees;
- open woodlands that are grassy underneath - more like the Noongars had it once - and more manageable (Hallam 2014);
- open peppermint woodlands in original locations in gullies, swales and side-slopes with intact and protective ground cover and mulch layers;
- retained patches of understorey thickets here and there;
- peppermint, coast wattle and weeds removed from heath and kwongkan communities where they were once absent from;
- intact healthy kwongkan;
- weeds eradicated;
- quality habitat, particularly for Carnaby's cockatoo
- lowest hazard; and,
- ease of maintenance.

Reference sites

The reference sites support the management priority of understanding vegetation communities. Table 1 lists the locations of the reference sites, and the vegetation community maps further back show where the sites are.

The reference sites are included to identify locations where the communities and their composition structures and behaviours can be viewed and studied. The sites are selected for their ease of access and occurrence on public lands.

Trials program

A trials program is being developed to support and test vegetation management methods and techniques, in line with the subject matter and information in this guide. Priority vegetation communities for trials are those that have:

1. High or above bushfire hazard assessments;
2. Significant extent or coverage;
3. Proximity to community and private assets,
4. Conservation listing or known sensitivities; and
5. Been altered by disturbance to increase density and bushfire hazard;

The trial program aims to understand the nuances and patterns of vegetation behaviour in response to disturbance, and how it can best and most practicably be manipulated to achieve lower densities and hazard ratings. The results will support the conservation of lower hazards, amenity, sensitive and threatened flora and vegetation communities, and fauna.

The program will investigate, evaluate and refine vegetation and land management methods and techniques as recommended in the guide to management of vegetation in the Bremer Bay / Point Henry area. Specifically, this will be vegetation manipulation treatments to reduce density, conserve amenity and nature, manoeuvre vegetation communities towards a settled old growth or climax state, and test plant removal methods that don't disturb the ground and cause the density cycle to restart.

Trials seek to will match hazard mitigation methods and their effectiveness in the different vegetation communities. They will try and test efficacy, practicality, safety and cost effectiveness of management and mitigation methods.

The trials will include assessment/reference sites in priority vegetation communities for ongoing monitoring of biomass accumulation, fire and treatment age, disturbance pressure selection trajectories, treatment effectiveness and comparison, and amenity and conservation values.

Training program

A knowledge (education) and training development program is being developed to help further support landowners and managers with the management and conservation of amenity, nature and low bushfire hazard. Participation in knowledge and training can help implement the information and recommendations in this guide, and to gain, share and hone skills.

The program will focus primarily on vegetation management to develop an improved relationship with vegetation as the valuable, dynamic, and flammable medium.

The purpose of the program is to develop the knowledge, skills, confidence and network for Bremer Bay and Point Henry private property owners, land managers and practitioners to sustainably manage their vegetation communities and natural landscapes. The program objectives are:

1. Develop an understanding of the composition, structure and hazard profiles of the vegetation communities of Bremer Bay and Point Henry.
2. Develop a working knowledge of the landscape relationships, disturbance ecology, ecological sensitivities and values of the vegetation communities.
3. Use the understanding and experience of vegetation ecology gained, to develop skills in sustainable vegetation management to enhance and maintain amenity, protect natural values, and attain and conserve lowest bushfire hazard levels.

Table 2. Vegetation communities, behaviour, sensitivity, conservation, hazard, reference sites and management methods.
Priority communities highlighted green

Vegetation Community	Behaviour	Sensitivity	Conservation rating	Bushfire hazard	Reference sites	Management actions
AcAfC	Robust. Geosporous, resprouter, bradysporous. Peppermint likely occupied recently	Stable, although invaded by peppermint.	Common, secure	Low to Moderate	White Trail Rd, both sides south of cemetery, Shared-use Trail south of Whitetrail Rd	<ul style="list-style-type: none"> • Limit disturbance, • Thin coast wattle and peppermint and remove regrowth. • Cut wattle, cut and spray peppermint. • Leave groundcover intact. • Monitor ingress of peppermint and coast wattle disturbance opportunists
AcS	Robust. Resprouter and geosporous dominated, some bradysporous	Stable, tolerant of infrequent disturbance, peppermint invades with disturbance	Common, secure	Low to Moderate	Shared-use Trail, south of Whitetrail Rd	<ul style="list-style-type: none"> • Limit disturbance • Remove tea tree and peppermint invaders • Maintain as low hazard buffer.
AcySgS Acacia cyclops, Spyridium globulosum shrubland	Precocious. Geosporous and bradysporous dominated. Some resprouting groundcovers	Unstable, transitional, disturbance driven	Common, secure	High to Extreme	North side of Little Boat Harbour Rd, 100m west of Point Henry Rd. 200m short of end of Black Rocks Rd	<ul style="list-style-type: none"> • Prevent disturbance to promote stability and decrease hazard. • Thin wattle, net bush and peppermint where present; remove peppermint regrowth. • Cut wattle and net bush, cut and herbicide treat peppermint. • Cut coast wattle and net bush will not resprout, branches will rot and form mulch. • Remove boxthorn where present. • Leave groundcover intact, mow to maintain low cover.
AfC	Precocious. Bradysporous and resprouting dominant and groundcovers. Geosporous shrubs	Unstable, relatively fire sensitive	Common, secure	Low to Moderate	Behind Back Beach, north end off beach access track and north of lagoon access track off	<ul style="list-style-type: none"> • Limit disturbance, as this community occurs along the coastal strip, it is not necessary or feasible to do more.

					Whitetrail Rd	
AfEd Agonis flexuosa, Eucalyptus decipiens shrubland	Precocious when unstable. Bradysporous, resprouter dominants, some geosporous. Peppermint may have occupied	Fire and disturbance sensitive for structure change, Coast wattle, net bush and peppermint dominate when unstable	Common, secure	Moderate to High	Around lookout on Progress Dve. Shared-use Trail: South east of hotel	<ul style="list-style-type: none"> • Limit/prevent disturbance • Thin coast wattle and peppermint. • Coast wattle can be cut and will not resprout, and branches left to rot and form mulch. • Herbicide treat thinned peppermint bases to prevent regrowth. • Leave groundcover intact.
AfPC Agonis flexuosa parkland cleared	Robust, man-modified, removed lower strata. Bradysporous and resprouter dominant. Geosporous wattles can appear. Can convert to AfS and AfW if not maintained	Relatively stable when maintained, can be weedy, disturbed by physical slashing	N/A	Low, can increase without maintenance	Bremer Bay Beaches Caravan Park grounds	<ul style="list-style-type: none"> • Remove midstorey and some peppermint selectively within building protection zones. • Thin peppermint and patches of understorey selectively in remaining areas. • Cut and herbicide treat peppermint bases to prevent resprouting. • Leave groundcover intact and mow to around 200 mm high to maintain stability and competition. • Pull/grub wattle and peppermint seedlings as they appear ongoing
AfS Agonis flexuosa tall shrubland and low forest	Precocious. Bradysporous and resprouting dominant peppermint. Geosporous co-dominant coast wattle	Mostly unstable, oldest most stable, very fire and disturbance sensitive to structure and density change. Stability can lead to AfW community	Common, secure	Moderate to Very High	Shared-use Trail, north of Bremer Bay Beaches Caravan Park. Newbey Rd Torreburrup Hill roadside disturbance wattle profusion.	<ul style="list-style-type: none"> • Limit/prevent disturbance. • Thin coast wattle and peppermint and remove regrowth. • Coast wattle can be cut and left to rot and form mulch, larger sections removed for firewood. • Cut wattle bases, cut and herbicide treat peppermint bases. • Pull/grub wattle, net bush and peppermint seedlings as an ongoing technique. • Maintain groundcover intact, mow to

						around 200 mm maintain robust low cover.
AFW Agonis flexuosa woodland	Precocious. Bradysporous and resprouter dominant, geosporous shrubs, resprouter groundcovers	Oldest most stable, secure, fire sensitive	Common, secure	Moderate to High	Point Henry Rd, just southeast of Bremer Bay Beaches Caravan Park	<ul style="list-style-type: none"> • Limit disturbance. • Thin coast wattle and peppermint and prevent regrowth to promote open tall woodland. • Cut wattle and net bush and leave to rot or mulch. • Cut and herbicide treat selected peppermints at base to prevent regrowth. • Leave groundcover intact; mow to around 200 mm to maintain low cover and competition. • Pull/grub wattle, net bush and peppermint seedlings as an ongoing programme.
AhMdT	Precocious. Geosporous wattle, bradysporous melaleuca.	Frequent fire sensitive, broad scale slashing can remove the community leaving it weed prone	Common, secure	Extreme	South of Fishery Boat Harbour off Fishery Beach Rd. Point Gordon track, southeast off end of sand track	<ul style="list-style-type: none"> • Limit disturbance. • Slashing will remove dominant wattle, and burning will promote its density. • Best left alone to maintain intact to protect its fertile loamy soils, and as most of this community occurs on headlands away from infrastructure assets, so does not require management intervention.
AhT	Precocious. Geosporous wattle dominant. Longevity of dominant unknown.	Slashing sensitive, fire non-sensitive	Common, secure	Extreme	Torreburrup Hill, sandy walking track above Back Beach south end.	<ul style="list-style-type: none"> • Limit disturbance. • Slashing will remove and burning will promote density. • Best left mostly alone to maintain intact to protect its fertile loamy soils. • Most patches of this community occur on headlands and hills away from infrastructure assets, where it does not

						<p>require management.</p> <ul style="list-style-type: none"> • Maintain slashed areas around assets on Torreburrup Hill to maintain low fuel zones. • Trial thinning by selective cutting of some patches on Torreburrup Hill to assess sustainable hazard reduction. • Cut wattles will not resprout.
BaW	Robust. Resprouting and serotinous banksia dominant, resprouting and serotinous understorey	Susceptible. Robust if undisturbed, frequent fire sensitive, dieback sensitive	Kwongkan TEC Prime forage habitat of threatened Carnaby's cockatoo	Moderate to High	Lower (west) end of Progress Dve both sides, north east corner Reserve 51949 on John St	<ul style="list-style-type: none"> • Prevent disturbance to retain stability and lowest hazard, disturbance will promote density and ingress of wattle and peppermint. • Constitutes the Kwongkan TEC so has special protection afforded. • Maintain by mowing the existing break through behind hotel at around 200 mm high, to leave groundcover intact and stable to limit ingress of precocious plants.
BmAHK	Vulnerable. Serotinous banksia dominants, geosporous wattle co-dominant	Susceptible, stable if undisturbed or very infrequently disturbed by fire, compromised by ground disturbance, dieback sensitive. Wattle could dominate if disturbed too often	Kwongkan TEC. Forage habitat for Carnaby's cockatoo	Very high	Headland south of Fishery Boat Harbour, behind/above quarry	<ul style="list-style-type: none"> • Prevent disturbance to prevent dominance of wattle. • Limited to rocky country of the headlands. • Some patches constitutes the Kwongkan TEC so has special protection afforded. • Repair coastal tracks, fill in bog holes to prevent phytophthora dieback, conserve banksia components, and maintain stability. • Damage will promote the ingress of tea tree.
BmnK	Vulnerable. Dominant banksias all serotinous, some geosporous	Susceptible, stable if undisturbed or very infrequently disturbed by fire,	Kwongkan TEC. Prime forage habitat of threatened	Very high	Point Henry track. South of Point Henry Rd end; Point	<ul style="list-style-type: none"> • Prevent disturbance to maintain composition. • Limited to rocky country of the

	understorey	compromised by ground disturbance, dieback sensitive	Carnaby's cockatoo		Gordon Track, south of sand track junction	<p>headlands.</p> <ul style="list-style-type: none"> • Constitutes the Kwongkan TEC so has special protection afforded. Repair coastal tracks and fill in bog holes to prevent phytophthora dieback, conserve composition, and maintain stability. • Damage will promote modification by the ingress of tea tree, wattle and peppermint.
CAfS	Vulnerable, precocious when unstable. Peppermint may have occupied with disturbance	Susceptible, unstable, frequent fire destabilises, removes Callitris promotes Agonis and wattle	Uncommon, not conservation listed, secure	High	South of and above Back Beach Bombie on headland	<ul style="list-style-type: none"> • Limited occurrence. • Prevent disturbance to promote native cypress and prevent dominance of peppermint. • Future shared use trail will access the patch and support protective management, and interpretation.
CDH	Robust Ecologically dynamic zone, dominated by tough bradysporous, geosporous and resprouting low shrubs and groundcovers	Stable, copes with frequent disturbance due to composition of pioneer sand dune plants.	Common, secure	Low to Moderate	On dunes along rear (west) of Back Beach, off end of either side of Lagoon Track	<ul style="list-style-type: none"> • Limit disturbance, as this community occurs along the coastal strip, it is not necessary or feasible to do more.
Dune	Shifting sand dune	Unstable sand	N/A	Low	Behind (east of) Blossoms Beach, east of track	<ul style="list-style-type: none"> • Limit vehicle damage to adjacent communities. • Monitor shape and movement of dune systems.
EaadpM	Robust. Eucalypt dominants resprout, and bradysporous to a lesser degree, geosporous, and bradysporous undershrubs, resprouter groundcovers	Stable if undisturbed by fire, dense following fire with wattle disturbance opportunists	Common, secure	Moderate	South end Reserve 51949, west side	<ul style="list-style-type: none"> • Limited occurrence, one small patch. • Prevent disturbance to maintain stability and moderate hazard.

EaM Eucalyptus angulosa mallee shrubland	Precocious. Eucalypt dominant resprouter, bradysporous and serotinous. Geosporous, and bradysporous undershrubs, resprouter groundcovers	Unstable when disturbed, expands flowing fire by bradyspory - and original mallees resprout	Common, secure	High	Black Rocks Rd opposite end of Wellstead Rd; Short Beach Rd corner of Magpie Rise	<ul style="list-style-type: none"> • Prevent disturbance to promote stability and limit regeneration and increase in community extent. • Thin mallee, coast wattle and peppermint and remove regrowth. • Cut wattle, cut and herbicide treat mallee and peppermint trunk bases to prevent resprouting. • Pull/grub wattle, mallee, net bush and peppermint seedlings as an ongoing program. • Leave groundcover intact; mow to around 200 mm maintain stability and cover. • Maintain (as above) clumps around assets to promote taller mallee as and towards open woodland patches, thin and maintain open mallee to promote taller protective community on broader property area.
EcW	Robust. Dominant tree bradysporous and serotinous. Responsive bradysporous and geosporous understorey	Unstable when disturbed, frequent fire sensitive	Uncommon, secure	High	Wellstead Rd Yandil forest	<ul style="list-style-type: none"> • Very limited occurrence. • Prevent disturbance to maintain stability and density reduction trajectory, and to conserve eagle, hawk and owl nesting habitat. • Same community extends opposite on PP on west side of Wellstead Rd has had understorey removed, which is a useful comparative response monitoring opportunity.
EoW	Precocious. Dominant tree bradysporous, serotinous and resprouter.	Unstable when disturbed	Uncommon, secure	Very high	Shared-use Trail, opposite Yate Pl, near here on Wellstead Rd	<ul style="list-style-type: none"> • Limited occurrence. • Limit/prevent disturbance to maintain stability and lowest hazard, and prevent flush of yate seedlings.

	Bradysporous and geosporous understorey					<ul style="list-style-type: none"> Undershrubs can be thinned or removed in patches to promote sedges and other groundcovers to reduce hazard and prevent shrub regrowth. Pull/grub wattle, yate, net bush and peppermint seedlings as an ongoing technique.
EpEd	Robust. Resprouter dominant mallees. Some bradysporous, geosporous and resprouter shrubs. Becomes sparser when older	Stable, unstable when disturbed, can shift to Af dominated	Common, secure	Moderate	Shared- use Trail south east of Hotel	<ul style="list-style-type: none"> Prevent disturbance to maintain and promote moderate hazard and amenity. Thin/remove peppermint and coast wattle and prevent regrowth if and where necessary.
EpK Eucalyptus pleurocarpa mallee shrubland over kwongkan	Robust. Resprouter mallee dominants, dormant geosporous wattle understory, few brad, very sparse when old	Stable, unstable when disturbed. Fire and ground disturbance would trigger dormant wattle response	Kwongkan TEC in some places	Low to moderate	Reserve 50949 alongside John St, behind (east) of Hotel. Bremer Bay Boxwood Rd, north of Hotel alongside trail	<ul style="list-style-type: none"> Prevent disturbance to maintain and promote low to moderate hazard and amenity. Thin/remove Victorian tea tree, peppermint, coast wattle and net bush and prevent regrowth if and where necessary. Thin patches of grey honeymyrtle by cutting and removing or mulching on site.
EpOR Eucalyptus pleurocarpa very open mallee over dryland rush ground cover	Robust. Very old patch of EpK. Resprouter mallee dominants. Bradysporous and resprouter understorey and groundcovers, geosporous dormant wattle	Stable, unstable when disturbed, compromised by disturbance - made dense again by dormant wattle response	Common community, old situation, very rare	Low	Reserve 50949, off John St adjacent to slashed north south firebreak	<ul style="list-style-type: none"> Prevent disturbance to maintain and promote low hazard, amenity and example of old low hazard bushland. Thin/remove any occurrence of Victorian tea tree, peppermint, coast wattle and net bush and prevent regrowth.
GSH	Vulnerable. Resprouter, serotinous, and	Susceptible, stable if undisturbed or very infrequently	Common and uncommon. Kwongkan TEC	Low to Moderate	Torreburrrup Hill, west side of summit, patches	<ul style="list-style-type: none"> Prevent disturbance to maintain composition. Limited to rocky country of the granite

	geosporous shrubs.	disturbed by fire. Serotinous proteaceous plants sensitive to fire and dieback	at Windy Hill. <i>Grevillea nivea</i> a conservation priority species		either side of Progress Dve near water tank	hills. <ul style="list-style-type: none"> • Some patches Kwongkan TEC and priority flora so has special protection afforded. • Damage as disturbance will promote the ingress of tea tree, wattle and peppermint.
LIS Leptospermum laevigatum shrubland and thicket	Precocious. Bradysporous, and serotinous invasive weed species dominated	Unstable, expands with and without disturbance, modifies other communities	Common, weed dominated, a threat to other communities	Very high to extreme	Horse hill Rd, and Pt Gordon sand track	<ul style="list-style-type: none"> • Prevent disturbance. • Remove stands starting from headland extremities. • Ensure seed is not spread and is destroyed by mulching in piles. • Follow up control and monitoring of treatment sites. • Removal will reduce hazard.
MIS	Robust. Serotinous dominant melaleuca	Susceptible, stable if undisturbed or very infrequently disturbed. Frequent fire will remove	Uncommon, secure	Very high	Little Boat Harbour, Native Dog Beach	<ul style="list-style-type: none"> • Prevent disturbance to maintain and promote hazard reduction and important amenity and erosion control at coastal recreation sites. • Limited shoreline occurrence and important amenity and protective value reduce hazard concern. • Can be thinned to promote larger trees and more open understorey.
MpH Melaleuca pentagona heath	Robust. Serotinous melaleuca dominant	Stable if undisturbed or infrequently burnt	Uncommon, secure	Extreme	Short Beach, behind (west) of carpark on rise along slashed break. Point Henry Rd, east side near south end.	<ul style="list-style-type: none"> • Limit disturbance to maintain valuable thicket cover on windswept sites. • Maintain accessible slashed firebreaks between assets and this community, leaving groundcovers intact to maintain cover stability. • Community will be permanently removed by slashing.
PKAf Proteaceous	Vulnerable. Resprouter,	Susceptible, intolerant, occupied	Uncommon, Kwongkan TEC	Moderate to high	Limestone ridge sides and adjacent	<ul style="list-style-type: none"> • Prevent disturbance to limit peppermint dominance and ingress of tea tree.

kwongkan with <i>Agonis flexuosa</i>	serotinous, bradysporous proteaceous and peppermint dominants. Some geosporous mid-storey shrubs. Peppermint may have occupied	by Peppermint, damaged/ modified by ground disturbance and frequent fire			valleys. Horse Hill Rd north side, near Point Henry Rd	<ul style="list-style-type: none"> • Some patches constitute the Kwongkan TEC so has special protection afforded. • Remove peppermint and Victorian tea tree and coast wattle to reduce hazard and maintain integrity.
PKH Proteaceous kwongkan heath	Vulnerable. Serotinous dominant proteaceous shrubs. Some geosporous and resprouter associated shrubs	Susceptible, intolerant, damaged by ground disturbance, frequent fire and dieback	Uncommon, Kwongkan TEC	High to very high	Limestone ridges and sides. Torreburrup Rd north of Black Rocks Rd junction, Point Henry Rd, south of Short beach Rd junction.	<ul style="list-style-type: none"> • Prevent disturbance to limit ingress of precocious species. Many patches constitute the Kwongkan TEC so has special protection afforded. • Remove peppermint, Victorian tea tree, and coast wattle to reduce hazard and maintain integrity. • Cut peppermint and tea tree and herbicide treat bases to prevent regrowth. • Slashing permanently alters and will remove the community. • Slashed breaks around buildings will be easily maintained as an altered community, ensure groundcovers are maintained by mowing to around 200 mm/ not less than 100 mm, leaving mulch behind encourage full cover.

Management methods and techniques

This part 2 of the management and conservation section describes the main recommended methods and techniques, by which to understand and sustainably manage the values of the vegetation communities and landscape. It should be read and used in conjunction with Table 2 on the previous pages.

The predominant value that requires management is hazard reduction, the actions and results of which can also support the conservation of other values outlined in Part 1. In this way, maintaining nature, heritage and low hazard, is all part of a conservation philosophy.

Specifically, the methods and techniques are about implementing vegetation manipulation treatments to reduce biomass, conserve amenity and nature, manoeuvre vegetation communities towards a settled old growth or climax state, and test density reduction methods that don't disturb the ground and cause the density cycle to restart.

The desired result to return the common and widespread peppermint and mallee dominated vegetation communities, as the priority common and altered high-hazard communities, to a more stable state by low disturbance manipulation techniques, and in testing and measuring the success or otherwise of techniques developed and used.

The methods and techniques are designed to enable the encouraging the development of open, low-hazard, high amenity, old growth shrubland and woodland vegetation communities, by strategic thinning, mulching and encouraging the 'edge effect'.

Older is not necessarily bigger in plants, in fact it usually isn't age by itself that determines size, it's about competition. Older, more open woodland and mallee communities have the edge effect in equilibrium happening, which sustains the structure and maintains lowest hazard.

Maintenance of groundcover health and stability is important in open woodland and shrubland communities, to conserve soil and moisture and limit the ingress of precocious plants that can alter the structure and cause increased hazard.

Lower density in open woodland and tall shrubland can be had from peppermint and eucalypt communities. However thinning cannot easily be done in heath, kwongkan, banksia open woodland and thicket communities. These communities are best left alone, save for the removal of precocious peppermint, coast wattle and Victorian tea tree, and the thinning of mallee in limestone ridge kwongkan, to maintain their integrity. This is because they're largely single-storey structures cannot cope with slashing to remove plants without severe alteration and long-term damage.

The complex understoreys of banksia open woodland and proteaceous kwongkan are very susceptible to damage including significant irreversible removal of key species by slashing. However, in the development of protection zones around buildings, the slashing and mowing maintenance of kwongkan communities has shown to be successful in promoting some lower growing species components as dominant and stable groundcovers.

The structural and ecological effects and hazard reduction effectiveness of selectively thinning melaleuca and wattle thickets are not known. Although the development and maintenance of the strategic firebreak program on Point Henry Peninsula shows that these communities are altered and can become weed infested in some cases (Wattle thickets on Torreburrup Hill), and select and sustain pruned shrubs and groundcovers in others (melaleuca thickets behind Short Beach). Manipulation methods in these communities are recommended as part of a trials program to test sustainability and effectiveness of different treatments.

Management methods and techniques can be developed and improved by the rollout and involvement by landowners and managers in the planned trials and knowledge and training programs.

Conservation and reduced hazard results can be achieved, through an ongoing knowledge-based and skilled commitment and effort by landowners and managers on private and public lands.

It will be harder at first to tackle weed and precocious plant infestations as strategic removal and treatment. However, follow up will be an easier and getting easier task, requiring diligence and maintenance - rather than machinery and muscle.

Equipment, tools, methods and techniques

The principle use of equipment and tools is for removing and controlling vegetation, as slashing, mowing, cutting, herbicide application and mulching.

It is imperative to use suitable personal safety equipment when undertaking these tasks, and to tell someone when you have started and finished, or to work with another person for added safety. Safety equipment includes strong boots, eye protection, hearing protection, gloves fit for purpose, hats and other sun protection, close fitting clothes for machinery operation, and chainsaw chaps.

Appropriate training and proficiency is vital when using equipment and machines, when and for undertaking safe and effective vegetation management operations. If in doubt, or as a potentially more efficient alternative to doing it yourself, the use of competent contractors should be considered.

Slashing large areas and as preliminary removal of mid storeys is best done with a tractor or skid steer-based slashing machine. Landscaping contractors have these machines and they can be contracted to undertake vegetation removal and thinning.

Slashing using tractors and skid steer machines can be problematic as they can cause significant ground disturbance, which will promote the regeneration of density inducing plants. However, machine slashing is very useful in bringing large areas and large and dense shrubs under control, so that access and follow up control and groundcover management is more easily achieved.

A garden and gardening approach is useful in tackling some vegetation management tasks, including pruning, cutting herbicide use for spot spraying regrowth, mulching and weed control. This common approach can be expanded for efficient use in managing vegetation, particularly around building assets, as well as more broadly as relatively efficient and low disturbance plant control methods.

Garden equipment as mowers, whipper snippers, brush cutters, mulchers, pole saws, chainsaws and sprayers lend themselves for low impact/low disturbance methods of plant, vegetation and ground management. These tools are readily available and commonly and safely used in otherwise everyday situations.

Chain saws and pole saws are excellent for pruning trees and large shrubs to create canopy cover and limit dense low growth that may increase hazard. They are also efficient tools for cutting shrubs off at the base for thinning operations, particularly pole saws, which allow the operator to be at a safe distance from the chain and reach the bases of shrubs through branches and without unsafe stooping.

Larger trees should not be cut down unless operators are trained in tree felling. Tree felling is potentially very dangerous and significant skill is needed to successfully and safely fall trees. It is best to hire trained contractors for felling and lopping larger trees.

Pole saws also allow the branches of shrubs to efficiently be cut up for mulch or firewood, again without bending. Using these methods is the only way to sustainably remove coast wattle, net bush, smaller peppermints and Victorian tea tree from sensitive kwongan communities. The bases of the freshly cut peppermint and smaller tea tree must be treated with herbicide, otherwise they will grow back.

Strong, powerful and relatively light battery powered chain and pole saws are available and are price competitive; they can easily perform the cutting tasks required. Traditional petrol-powered models are also excellent performers, although they are mostly heavier.

Spot spraying of herbicides using hand held or backpack pressure sprayers are the most efficient and minimal disturbance way of achieving the effective control of peppermint, Victorian tea tree and other unwanted plants.

Spot spraying herbicide application on selected plant regrowth will require more effort up-front compared to blanket spraying that is traditionally used in some situations such as roadside vegetation management. Notwithstanding, blanket spraying should never be used, particularly on roadsides, where its indiscriminate killing will leave an ecological vacuum as an unstable groundcover community, which will be filled with precocious natives and weeds such as love grass and Victorian tea tree. Spot spraying of target peppermint and tea tree re-growth, and dense wattle seedling patches, will instead achieve the most effective results. Herbicide types, mixes and rates are provided in the next parts on *precocious native plants* and *weeds*.

Mowing with robust yard mowers is a useful way of managing ground-cover vegetation, and even removing and mulching low dense midstorey vegetation. Mowing should be done with the mower set to its highest position to avoid unnecessary vegetation damage. Robust ride-on mowers, ideally with soft tyres to minimise ground and soil disturbance, are useful for maintaining large areas of groundcover under open woodlands. Catchers should be left off all mowers to allow the mulched material to fall back down and contribute to the protective groundcover blanket and nutrient cycle that encourages the groundcovers to fill in gaps.

Mulching machines have a use in reducing potentially hazardous tree and shrub branches and leaves to a finer mass, which can be directly applied to the ground where it will quickly break down and protect the ground. Away from buildings and in more remote parts of properties and in reserves, branches cut down can be left to break down, as they will not add significantly to the hazard, and will relatively quickly break down, and contribute to the ground biota.

Protection of the ground and ground cover vegetation is critical in healthy vegetation communities. Maintaining dense healthy ground cover is necessary to hold moisture, prevent erosion, and for preventing the establishment of invasive plants. This can be achieved by leaving ground covers and leaf and stick litter intact by preventing disturbance, and by mulching and leaving cut material spread on site post density reduction treatments, and by the mowing method mentioned above.

Fire can be used as tool for vegetation control. However, great care must be exercised, and follow up is critical to ensure the regeneration of unwanted precocious plants stimulated by the disturbance are removed by grubbing or sport spraying, or mowing in some cases. Fire can be good for an immediate reduction effect, although bad for long-term selection pressure and destabilisation of communities: the bush can tolerate fire, although will be changed by frequent fire. It is better and safer in most vegetation management circumstances to instead use non-stimulating methods outlined above.

Follow up after all treatments is imperative, and is likely how the Noongars managed to form open woodland communities, by pulling the seedlings as they grew following their firing of the undergrowth, as well the grazing pressure of their game animals would have removed seedlings. Follow up is easy, it's about recognising the precocious plants as seedlings to remove, grub them out as they appear.

Table 3. Vegetation management tasks, equipment/tools and methods/techniques

Task	Equipment/tool	Method/technique
Slashing of broad areas of mid and understorey	<ul style="list-style-type: none"> • Personal safety equipment • Tractor or skid steer mounted slasher or mulcher 	<ul style="list-style-type: none"> • Contractor hired to undertake program. • Careful strategic removal of midstorey patches and bands from peppermint shrublands and woodlands. • Care taken not to churn up soil as disturbance. • Soft tyres, air reduced if possible to minimise soil impact
Slashing maintenance of firebreaks and under woodland canopies	<ul style="list-style-type: none"> • Personal safety equipment • Tractor or skid steer mounted slasher or mulcher 	<ul style="list-style-type: none"> • Contractor hired to undertake program, or own machines. • Careful slashing or mowing maintenance of previously slashed firebreaks and under woodland tree cover • Care taken not to churn up soil as disturbance. • Soft tyres, air reduced to minimise soil impact
Mowing maintenance of firebreaks and parkland	<ul style="list-style-type: none"> • Personal safety equipment 	<ul style="list-style-type: none"> • Careful mowing maintenance of previously slashed firebreaks and under

woodland and shrubland	<ul style="list-style-type: none"> • Ride-on mower • Self-propelled mower • Yard mower • Brush cutter 	<p>woodland tree cover.</p> <ul style="list-style-type: none"> • Care taken not to churn up soil as disturbance. • Soft tyres, air reduced to minimise soil impact
Ground cover maintenance	<ul style="list-style-type: none"> • Personal safety equipment • Ride-on mower • Self-propelled mower • Yard mower • Brush cutter 	<ul style="list-style-type: none"> • Mow elevated groundcovers to leave a minimum of 100-150 mm growth • Select highest cutting depth on machine • Soft tyres, air reduced to minimise soil impact.
Thinning of peppermint, coast wattle from large areas	<ul style="list-style-type: none"> • Personal safety equipment • Chainsaw • Power pole saw 	<ul style="list-style-type: none"> • Careful selective cutting down of shrubs and small trees to thin stands. • Leave largest and strongest plants, remove smallest and weakest. • Use contractors for large trees or large areas. • Remove branches from protection zones or mulch • Leave to rot on ground in bushland
Removal of peppermint from kwongkan	<ul style="list-style-type: none"> • Personal safety equipment • Chainsaw • Power pole saw • Paint brush and herbicide pot • Spot sprayer 	<ul style="list-style-type: none"> • Cut off peppermint at base • Paint or spray freshly cut bases with herbicide (see later section also) • Minimise disturbance • Leave cut branches on site or remove and burn in piles or mulch
Removal of coast wattle and net bush	<ul style="list-style-type: none"> • Personal safety equipment • Chainsaw • Power pole saw 	<ul style="list-style-type: none"> • Cut off shrubs at their bases • No need for herbicide, they will not grow back • Minimise disturbance • Remove from protection zones or mulch • Leave cut branches on site in bushland or remove and burn in piles or mulch
Tree and shrub branch pruning	<ul style="list-style-type: none"> • Personal safety equipment • Chainsaw • Power pole saw • Branch loppers/ pruners 	<ul style="list-style-type: none"> • Carefully trim and cut lower branches of trees and shrubs to at least 2 metres • Remove or mulch branches in asset protection areas, otherwise leave to rot on ground
Brush mulching for revegetation	<ul style="list-style-type: none"> • Personal safety equipment • Chainsaw • Power pole saw • Branch loppers/ pruners 	<ul style="list-style-type: none"> • Select sites for revegetation • Ideal following weed control to develop competition and replace vegetation cover in what is likely an ecological vacuum • Select branches with unopened seed capsules of melaleuca, eucalyptus, regelia, peppermint, banksia, and other desirable plants with canopy stored seed • Cut and place branches on bare soil

		<p>surface as a covering seed laden branch / mulch</p> <ul style="list-style-type: none"> • Monitor seedling recruitment annually
Herbicide control of woody weeds and precocious native plants, cut bases	<ul style="list-style-type: none"> • Personal safety equipment • Paint brush and herbicide pot • Spot sprayer 	<ul style="list-style-type: none"> • Paint or spray freshly cut bases with herbicide (see later sections for detail)
Herbicide control of woody weeds and precocious native plants, regrowth	<ul style="list-style-type: none"> • Personal safety equipment • Spot sprayer • Tractor, ute or cart mounted sprayer 	<ul style="list-style-type: none"> • Treat regrowth canopies with herbicide as described in later sections • Read and learn further on herbicide treatments • Consider the use of contractors for larger areas • Monitor and retreat if necessary
Grubbing / pulling coast wattle, net bush peppermint, Vic. tea tree	<ul style="list-style-type: none"> • Personal safety equipment • Hoe or mattock 	<ul style="list-style-type: none"> • Hand pull seedlings as they appear or reach manageable size (around 20 cm) • Use hoe or mattock to grub out and remove roots of stronger seedlings • Leave removed seedlings as mulch
Cooking cut branches with seed on, and mulch piles, mainly Vic tea tree	<ul style="list-style-type: none"> • Personal safety equipment • Thick black plastic • Weed matting 	<ul style="list-style-type: none"> • Pile cut or mulched branches in easy to get at places, in piles that suit the size of the plastic sheets • Cover with black plastic or weed matting and hold down with rocks, pegs or sand piles • Remove plastic after several months, or check periodically for composting • Monitor areas for seedling recruitment for at least two years and pull any that appear.
Dieback hygiene	<ul style="list-style-type: none"> • Knowledge of dieback • Dieback hygiene information • Spray bottles to administer bleach solutions • Bleach (sodium hypochlorite) solution • Methylated spirits • Pressure washer • Washdown facilities 	<ul style="list-style-type: none"> • Take dieback seriously, it is a very serious threat to our natural heritage • Maintain clean vehicles, machines, equipment and tools • Treat small tools and footwear with sprayed neat methylated spirits or 1:10 sodium hypochlorite bleach in clean water • Do not permit dirty machines or vehicles onto your property • Wash down dirty machines and vehicles at washdown facilities, or at the beach where infected soil can cause no harm • Close tracks and boggy sites when they are wet
Veld grass control	<ul style="list-style-type: none"> • Personal safety equipment • Spray equipment to suit the size of the task 	<ul style="list-style-type: none"> • Investigate information on veld grass control, or use a competent contractor • See later weeds section on perennial veldt grass control • Application of herbicide to infestations

	<ul style="list-style-type: none"> • Grass selective herbicide 	<ul style="list-style-type: none"> • before seed set, usually in June – July • Monitor treated areas for regrowth • Brush mulch or plant out treated areas to encourage native plant competition
Burning cut heaps of woody weeds and other tress and shrubs	<ul style="list-style-type: none"> • Knowledge of fire behaviour and danger • Wet windless weather within allowed burning season • Water and reliable delivery mechanism • Personal safety equipment 	<ul style="list-style-type: none"> • Use as last resort, plant material is far better used as mulch, habitat, or rotted nutrients • Ensure weather and season are suitable • Never undertake in windy conditions regardless of season • Ensure water is available and reliable and tested as such • Undertake in cool, still or light wind, and ideally wet conditions • Burn small piles, not huge bonfires • Consider your neighbours for smoke and ash • Consider your and neighbours rainwater supply with ash fall
Repairing tracks and mud holes	<ul style="list-style-type: none"> • Personal safety equipment • Appropriate machinery or tools for size of job • Clean dieback free machinery or tools 	<ul style="list-style-type: none"> • Measure extent of dips and holes when wet to plan repair • Close tracks when they are wet • Repair in dry soil conditions only • Dieback free material only • Fill with solid material, limestone is ideal in most situations • Ensure good runoff drainage on tracks and over repairs • Educate people about dieback hazard
Monitoring plant and vegetation growth	<ul style="list-style-type: none"> • Digital camera • Steel droppers, wooden posts or star pickets • Scoring sheets (Keighery 1994) 	<ul style="list-style-type: none"> • Identify strategic photo-monitoring points • Mark points with dropper/post/pegs • Take images at least annually from marked spots looking the same way • Compare images over time with site • Fill out scoring sheets at same time annually (spring is ideal) to identify vegetation composition, structure and site changes.

Planting suitable additional trees and large shrubs can help in establishing and maintaining open woodland and shrubland as low hazard, protective and appealing plantings. Other than the local peppermint and coastal ridge-fruited mallee, less common trees and large shrubs found nearby that best suit the private property situations and the sandy lime soils of Point Henry Peninsula are:

- Showy honey-myrtle (*Melaleuca nesophila*). A large closed shrub to 6 metres, can get larger in sheltered well watered sites. Mauve pompom flowers in spring. Responds well to pruning and hedging, and is a natural replacement for Victorian

tea tree, which it resembles. Native to the relatively small area of coast between Starvation Bay and Boat Harbour, centred on Bremer Bay. It is widely grown in gardens across Australia

- Rottnest Island tea tree (*Melaleuca lanceolata*). A tall open dark green shrub to 8 metres, white flowers in clusters in spring, can be slow growing, likes sheltered sites. Can be seen in the wild at Little Boat Harbour and Native Dog Beach carpark.
- Coastal moort (*Eucalyptus utilis*). A medium spreading fast growing tree, with smooth green bark to 12 metres, sometimes more in sheltered sites. Can be pruned to achieve an agreeable acropetal (salmon gum shaped) low hazard form, provides excellent shade and shelter.
- Cape Knob mallee (*Eucalyptus calcicola* subspecies *unita*). A tall spreading mallee to 10 metres with smooth cinnamon bark. Favours sandy limestone soils, can be pruned to an open umbrella canopy form. Native to the coast from Cape Knob to Green Range.
- Bald Island marlock (*Eucalyptus conferruminata*). A small to medium acropetal tree to 8 metres with smooth copper bronze bark and large mace like fruits. Common in garden plantings to form shade and shelter. Prefers sandy coastal soils, and is native to a few isolated patches from Albany to Middle Island in the Recherche Archipelago. Can regenerate thickly and vigorously from seed following fire.
- Mor or swamp yate (*Eucalyptus occidentalis*). A medium tree to 20 metres, commonly to 15, with a spreading acropetal crown and a stocking of rough black bark. Occurs in sandy damp soils in the Bremer Bay area, and swamps, creeks and fertile granite loams across the south coast. Ideal for creating larger shade patches in sheltered sites.
- Yandil (*Eucalyptus cornuta*). A relatively tall tree to 30 metres in sheltered sites, with a stocking of rough dark grey bark; grows shorter with a more spreading form in exposed sites Would make an ideal tall shade tree for large parkland situations, that can be pruned to encourage a high spreading canopy.

Peppermint (*Agonis flexuosa*). A variable tree or shrub, depending on site and soil conditions, in sheltered sites with more organic moisture holding sands it will grow to over 15 metres as a broad shady tree. On exposed sites with dry soils it will grow as a spreading or even spindly shrub to around 2 metres. Other sections of this guide describe the precocious disposition of peppermint. Notwithstanding, it can be an outstanding and very tough amenity tree or shrub, responding well to pruning and fast growth with added water and nutrients. Indeed, natural stands can be pruned to encourage tall open shady growth, and planted trees can grow relatively quickly to form shade and shelter.

Coastal ridge fruited mallee (*Eucalyptus angulosa*). A spreading mallee that can attain heights of 7 or more metres in sheltered sites with access to moisture. Like peppermint it is precocious in disposition, although it can provide excellent shade and shelter when pruned to promote taller plants with shading crowns.

Dieback management

Phytophthora dieback is a very significant threat to the vegetation communities and the animals they support in the Bremer Bay/Point Henry area.

Phytophthora dieback is a soil borne pathogen that causes dieback in a range of susceptible native plants, including members of the Proteaceae family that characterise some of the vegetation communities in the broader Bremer Bay area.

A number of species of the Phytophthora genus cause the dieback by root rot, which starves and prevents water uptake in infected plants. The most serious species is the introduced *Phytophthora cinnamomi*, which is present as a few relatively small infestations in the Bremer Bay townsite.

While the disease and its impacts are very serious, management is relatively simple, consisting of careful hygiene measures to prevent soil movement and keeping tools and equipment clean. Specific measures include:

- Maintain tracks so that they don't allow water to puddle and mud to form.
- Avoiding driving off road in wet conditions, particularly through mud or muddy puddles.
- Washing down vehicles and machines thoroughly after off road access, and before entering clean sites.
- Keeping footwear clean and mud free, and not to allow soil and mud transfer between sites.
- Using washdown stations in public reserves.
- Vigilance in checking for deaths of susceptible plants, and in identifying causes with the help of experts.
- Keeping tools, footwear and equipment clean, and using bleach solutions to clean and sterilise.
- Learning about Phytophthora dieback, what it looks like, where it is, its impacts, hygiene and other management from South Coast NRM and the Department of Parks and Wildlife.

Fauna and threatened ecological community management

The conservation and management of the fauna of the area is achieved through the maintenance of their habitats as intact healthy vegetation communities, as described and recommended by this guide. Specifically this is by the conservation of the range of vegetation communities and a mosaic of densities found in the area.

For landowners, getting to know the animals that share their properties is an important step. Birds can be better known through observation and identifying calls, which can be achieved via any of the excellent bird identification guide-books and birdcall and image apps available.

Learn to recognise the ground marks and scats of the mammals of the area, the most common native mammal, the bush rat, is very rarely seen, although its runs and burrows in the bush are unmistakable, and it's easy to tell from the feral black rat – which has a tail longer than its body. Get to know the invertebrates too, as they perform invaluable roles in the ecosystem.

The management recommendations for the range of vegetation communities outlined in this guide, take into account the habitat needs of the range of animals as mammals/marsupials, birds, reptiles, frogs, and invertebrates.

The management recommendations include some vegetation community alteration as thinning and density/hazard reduction. However, these measures are recommended to be strategic, near to built assets, predominantly in vegetation communities that have been altered by frequent disturbance, and not everywhere - so that significant parts of altered peppermint and mallee communities remain 'unmanaged' by intervention. This latter measure will benefit mallee fowl, which prefers denser peppermint stand in which to build its nesting mounds.

Endangered Carnaby's cockatoo will be best conserved by the conservation of its critical habitat in the proteaceous kwongan vegetation communities. The management recommendations provide for interventions to remove weeds and density altering peppermint and coast wattle from these communities, and to protect them from *Phytophthora dieback*. Implementing these measures will benefit the conservation of the community for Carnaby's cockatoos, western whipbird and all its dependant animals.

Hazard management

Achieving and maintaining lowest practicable bushfire hazard is a management priority. When implemented with knowledge, skill and care, it can support the maintenance of other vegetation community conservation and amenity values.

Principle hazard forming and integrity threatening plants

The six (four native and two introduced) plants that dominate most of the priority vegetation communities with extreme, very high and high bushfire hazard ratings. The plants that are most common, widespread and precocious in their behaviour are, in order of dominance:

1. Peppermint (*Agonis flexuosa*)
2. Coast wattle (*Acacia cyclops*)
3. Net bush (*Spyridium globulosum*)
4. Coastal ridge fruited mallee (*Eucalyptus angulosa*)
5. Victorian tee tree (*Leptospermum laevigatum*). Introduced weed
6. Boxthorn (*Lycium ferocissimum*). Introduced weed, weed of national significance.

These plants are ecologically precocious, as they:

- respond vigorously to disturbance stimulus by regenerating from seed and resprouting;
- can disperse readily to occupy other adjacent communities;
- are associated with or adjacent to private and community assets;
- are very common, not rare or threatened;
- likely represent ecosystem instability by their presence in large numbers.

These plants are those that can and should be strategically thinned and removed by non - disturbing techniques to reduce the hazard by developing more open and stable vegetation communities, and conserve the vegetation community values.

Notwithstanding, these plants are not dominant components of some vegetation communities with extreme, very high and high bushfire hazard ratings. The sustainable management of these communities is addressed in part in table 1, and is the subject of a trials program to investigate hazard reduction methods that will maintain community and habitat integrity where possible.

Victorian tea tree and boxthorn are invasive introduced weeds, which impact native vegetation, and should be systematically eradicated from the area.

The six principle hazard forming plants appear to be more prevalent due to the 130 + years of disturbance history of grazing and burning across Point Henry peninsula and the area now covered by Reserve 511, since its cessation in the 1970's, which has brought about ecosystem imbalance. This is an unintended consequence, where the regrowth promoted by frequent fire was consumed by grazing stock and in earlier times what was likely large numbers of grazing boodies, wallabies and kangaroos. The legacy of this disturbance regime and its abrupt end is the issue that now requires management through a developed understanding and a range of actions to reduce vegetation biomass hazard.

Strategic manipulation of the common, precocious and robust vegetation communities across the area will assist in reducing hazard and restoring integrity

and stability to the vegetation communities. Manipulation measures include removal and thinning of stands in proximity to assets, or thinning in selected strategic places and patches for hazard reduction and amenity conservation, as outlined in Table 1. This would emulate the grazing pressure supplied by sheep and native herbivores that followed the burning practiced (that promoted regeneration of edible forage), to counter the development of vegetation density in the absence of herbivore control.

The thinning and mulching process will also help maintain groundcover health and stability, to conserve soil and moisture, and limit the ingress of precocious plants and hazard development.

Not all stands of these precocious plants should be removed, just those where strategic hazard reduction is required. This is because the dense stands supply particular habitat as cover and nesting sites for some native animals, it is not cost effective to manipulate all the dense priority vegetation community stands, can be an important contrast and learning opportunity, and it is important to leave some stands unmanaged to their own natural trajectories. The latter despite that they have been altered by unnatural frequent disturbance regimes.

1. Peppermint is very long-lived (200 + years) reaching over 20 metres as a tree in sheltered well-watered sites, and as a low tree or broad shrub often in dense stands to around 7 metres in more open sites.

Peppermint regenerates very strongly by resprouting after damage, and from continuous production and release of canopy-stored seed (bradyspory) that germinates readily and often densely on disturbed ground.

It does not germinate and regenerate readily where disturbance is not apparent and vegetation communities are stable and competitive, particularly ground cover strata.

Peppermint plants respond strongly by resprouting from trunks and roots; they are not killed by damage, cutting or fire.

Small seedlings to around 1 metre can easily be pulled up and will not resprout. Larger plants must be cut and the cuts poisoned with an immediate wet spray 30% Glyphosate and ideally a wetting agent, although this is not usually necessary. Regrowth can be controlled with 11: 1 Glyphosate, and Pulse® wetting agent at label recommendations, sprayed onto strongly growing resprouting foliage.

2. Coast wattle is relatively short lived (20-40 years), growing to a spreading small tree to around 6 metres in sheltered sites, and lower (often much lower) shrub in more open sites.

Coast wattle favours sandy soils and regenerates exclusively from hard long-lived seed dropped to and stored in the ground (geospory), the seed is dispersed short distances by ants and to some extent birds. Seed germination is stimulated most vigorously by soil disturbance, and to a lesser although still significant extent by fire.

The predominance of coast wattle in vegetation communities indicates instability, and a disturbance history and regime preventing stability.

Very few coast wattle plants are present in old, open, low hazard woodland and tall shrubland vegetation communities on sands (commonly peppermint communities). In these situations they have mostly died out, although the seed bank remains unstimulated in the soil awaiting the opportunity to perform its role as an infrequent pioneer plant.

Coast wattle plants are killed by fire and damage, cutting them off low will kill the adult plant.

Seedlings can be pulled by hand easily when under around 0.8 m tall.

Coast wattle is excellent firewood, dense and slow burning and leaves only some ash.

3. Net bush is a relatively short-lived (20-30 years) shrub or small tree to around 4 metres in sheltered sites and lower in more open sites.

It forms a significant part of the understorey structure in peppermint and eucalypt woodland and mallee throughout the area, and dominates the near shore dune and swale communities.

Net bush regenerates strongly from soil-stored (geospory) and possibly canopy released seed, although the level and of patterns of release and soil longevity are not known. It regenerates strongly on disturbed ground and after fire.

It does not resprout and is killed by fire and other damage. It can be cut down and left to rot, which it does relatively quickly.

Seedlings can be pulled easily, even when larger they will come out due to their weak root structure.

Net bush's precocious abilities are suited to the coastal dunes and swales where it predominates, these naturally dynamic and exposed sites are riven by frequent disturbance from wind and soil movement, which drives and determines the composition of the occupying vegetation community.

4. Coastal ridge-fruited mallee is a long-lived mallee (200 years +) due to its mallee lignotuber from which it resprouts after fire. It can grow to around 9 metres in sheltered places when long unburnt, where it will form open tall mallee woodlands. In most cases around Reserve 511 and the Point Henry Peninsula, it is around 5 metres tall in dense patches due to recent fire. It is almost exclusively the only mallee present on Point Henry Peninsula.

Like peppermint, coastal ridge-fruited mallee regenerates strongly by resprouting and from seed fall onto disturbed ground, although its seed germinating ability is not as rampant as peppermint.

Its seed is dispersed short distances by wind and further (to 50m or so) and down hill by water movement over bare burnt ground following fire.

It can be thinned by cutting and treating the cut trunk base with 30% Glyphosate, seedlings can be easily pulled by hand when small before they develop a lignotuber.

5. Victorian tea tree is a serious invasive weed, which grows in dense stands and thickets to around 5 metres tall.

It regenerates from canopy-shed seed, of which it produces vast quantities. It sheds its seed over time (bradyspory) as well as in pulses following fire and other disturbance that kills or stresses parent plants (serotiny). The fine seed is dispersed by wind, often up to several hundred metres from parent stands (N. McQuoid pers. obs.).

It invades disturbed sites powerfully and thickly, and will occupy peppermint, wattle, mallee, and other less stable vegetation communities by stealth, aided by its allelopathic abilities to suppress adjacent native plants. It is less able to occupy stable or complex vegetation communities including kwongan on limestone ridges and nearby sands, and old mallee communities on clay.

It can be controlled using a variety of methods, which are outlined in the *Weeds* section following.

It was apparently introduced to Point Henry by seed that had fallen onto vehicles driven out on tracks that had been parked under tea tree hedges in town, whereupon the seed dislodged and grew on the disturbed track soils.

The areas where it is particularly dense off the end of Horse Hill Rd have a history of preferential grazing and camping by sheep and horses when the area was a grazing holding (M Wellstead pers. comm.). This significant and long term disturbance, and its subsequent cessation would have provided the ideal opportunity for Victorian tea tree to occupy the ideal unstable ground conditions. In other places it is responding strongly to disturbed sites and unstable vegetation communities, establishing a significant vegetation component and bushfire hazard.

Its strategic removal from the area is necessary as a hazard management measure, from private properties and roadsides and other public lands working from outliers and extremities inwards. A removal strategy is required to eradicate the hazard threat posed, which includes mapping and community input, training, shared responsibility, control effort, and monitoring to facilitate its efficient eradication over time. Without removal the hazard threat will increase.

6. African Boxthorn is an open spreading thorny shrub to around 4 metres. It occurs in disturbed sites often around old stockyards, shepherds camps and homesteads.

It is included here because it is a very serious weed that can modify vegetation communities, and responds vigorously to disturbance, although it is less of a bushfire hazard concern than the other plants in this group.

Its seed is relatively short lived (up to six years) in the soil (geosporous), and is dispersed by foxes and birds that eat the red berries. It also suckers from lateral roots, and will grow from damaged root fragments, which can survive many months and then resprout (HerbiGuide 2014). See the *Weeds* section following for more information and control measures.

Weeds

Priority weeds are those that are introduced, invasive, impact natural and amenity values, and are bushfire hazard forming. Four priority weeds occur in the Bremer Bay/Point Henry area:

1. Victorian tea tree (*Leptospermum laevigatum*)
2. African boxthorn (*Lycium ferocissimum*)
3. Sydney golden wattle (*Acacia longifolia*)
4. Veldt grass (*Ehrharta calycina*)

These weeds are a threat to the range of cultural, natural and safety values that make the Bremer Bay/Point Henry area attractive. The weeds respond strongly to disturbance, and they can be controlled and eradicated with some knowledge, effort and skill applied. The Albany-based HerbiGuide weed management resource (www.herbiguide.com.au) is an excellent source of background and control information, and information from this source has been used here to outline weed characteristics and recommend control measures.

1. Victorian, or coastal tea tree occurs in large infestations on Horse Hill Rd and Gordon Inlet track, as well as in smaller patches on Black Rocks Rd, Point Henry Rd, Native Dog Rd and towards the end of Point Henry Peninsula. It occurs as smaller infestations throughout the Point Henry Peninsula and in Reserves 511 and 51949. As well, it occurs in clumps and thickets along roadsides further afield in the Bremer Bay and Gairdner districts.

Victorian tea tree is a large spreading shrub to 5m tall, with distinctive small grey-green oval leaves to around 30mm long, and profusions of small cup-like fruits to around 8mm across. It produces and disperses copious fine seed, which allows it to easily invade nearby disturbed sites - and establish smaller numbers of plants in healthy bushland. It can also regenerate by suckering from roots and from branches touching the ground. Younger plants (less than 25 mm trunk diameter) tend to resprout (coppice), and older plants (more than 50 mm trunk diameter) usually die when cut down. It is allelopathic, which prevents the establishment of potentially competitive native plants.

It can be controlled with some sustained effort. Strategic control is most effective by working from the edges of infestations inwards.

HerbiGuide recommends:

- *Slash, fell, or mulch thickets, then burn (in piles) when dry. Spray regrowth until just wet with a mixture of 100 mL of Grazon® plus 25 mL Pulse® in 10 L of water. This treatment has residual action, which tends to control seedlings in the following year.*
- *Individual plants can be controlled by applying a mixture of 200 mL of Access® in 10 L of diesel to the lower 50 cm of each trunk in the spring (Summer applications have not been very effective).*
- *Overall spraying with 100 mL glyphosate(450g/L) plus 25 mL Pulse® in 10 L of water is also effective but many seedlings usually appear the following season.*
- *Seedlings can be manually removed in the first year or two. Older seedlings tend to break off and regrow.*
- *Large plant can be controlled by cutting and painting the stump with glyphosate, picloram gel or Access®.*

- *Plant (native) shrubs and trees 2 years after the last spray to increase the levels of shade.*

Otherwise, local successful methods include: large older plants cut off at the base and painted with 30% Glyphosate, grubbing / pulling smaller plants, and stack or mulch into piles to compost, cover with black plastic to cook / kill seeds in summer. Maintain vigilance to pull seedlings as they appear. Seedlings can be manually removed in the first year or two, after that they will not come out.

2. African boxthorn occurs near the end of Black Rocks Rd on private property and in the coastal reserve. It is an open spreading and very thorny shrub to 4 metres x 3 metres.

It is a very serious weed and therefore listed as a Weed of National Significance (Hussey et al 2007)

African boxthorn has small berry fruits, which may number in the thousands on each bush, and hold very large numbers of seeds. Berries are eaten by birds and foxes, which can disperse ingested seed broadly.

It also grows readily by root and branch fragments, and regenerates rapidly after fire. Care must be taken when undertaking control so as not to spread plant material that may regenerate.

HerbiGuide recommends:

- *Chemical control tends to be less effective when the plants are dormant. Best results usually occur when the plant is actively growing and in full leaf. This can be tested by shaking the tree and if all the leaves remain attached it is not entering dormancy.*
- *Manual removal is difficult because it is so thorny and juveniles tend to break off and regrow from the roots, Seedlings can be hand pulled. Mature plants generally can be pulled successfully with a tractor and chain, but require burning (to destroy plant material) to prevent re establishment.*
- *Physical removal and burning is the most common control method. Broken roots and stumps should be painted with 200 mL Access® in 10 L of diesel to control regrowth.*
- *Individual bushes and a 5 m buffer area can be sprayed with a mix of 100 mL Grazon® plus 25 mL Pulse® in 10 L water in late spring when the plants are actively growing in late spring or when there is good foliage cover. This will control most existing plants and seedlings for about a year. Overall spraying with 100 mL glyphosate(450g/L) plus 25 mL Pulse® in 10 L water when the plants are actively growing is also effective but has no residual action.*
- *Chemical control tends to be less effective when the plants are dormant. Best results usually occur when the plant is actively growing and in full leaf. This can be tested by shaking the tree and if all the leaves remain attached it is not entering dormancy.*
- *Re-treat regrowth and seedlings annually. Replant tall growing, perennial native species 2 years after the last spray.*
- *Monitor sites at least every 2 years to ensure control can be applied before new plants are old enough to set seed.*
- *In some areas Boxthorn provides habitat for native animals and provision of alternative habitat or relocation may be required.*

3. Sydney golden wattle is only known from a few plants on Progress Drive in Reserve 511, a few plants and stands in Bremer Bay townsite, along the extension of Mary St towards the airfield, and at the Bremer Bay Golf Course.

It is a large spreading shrub or tree to 8 metres tall, mostly to around 5 metres, which flowers in winter and spring. It is very invasive on WA south coast and has the ability to form large dense hazardous thickets, which increase in extent following fire from soil stored (geosporous) seed.

It must be eradicated from Bremer Bay area while infestations are still small.

HerbiGuide recommends:

- *In large dense stands a hot fire may be used to kill old trees and encourage seed to germinate so that it may be controlled by herbicides and reduce the soil seed bank.*
- *Apply herbicides in spring.*
- *For mature or juvenile trees, apply a mixture of 1 L of Access® in 60 L of diesel to the lower 500 mm of the trunk or inject the stems with 1 mL Tordon® Timber Control herbicide per 1.5 metres of height.*
- *For seedlings, apply 4 L/ha of glyphosate (450 g/L) or spray until just wet with a mixture of 100 mL of glyphosate (450 g/L) per 10 L of water.*
- *For juvenile trees, spray a mixture of 100 mL of glyphosate (450 g/L) plus 25 mL Pulse® Penetrant per 10 L of water onto the foliage until just wet.*
- *Avoid further burning or denuding the area as this will encourage seedling establishment.*
- *Repeat treatment every second year to ensure that no trees reach an age where they can set seed. Larger trees with trunks greater than 100 mm diameter can be cut with a chain saw close to the ground and these usually don't re shoot. However, there are some varieties that regularly reshoot after cutting. Smaller trees tend to reshoot unless they are severed below ground level or the cut stump is painted immediately with glyphosate or triclopyr.*

4. Perennial veldt grass occurs sporadically in the Bremer Bay / Point Henry area mostly in very disturbed sandy sites. It is an erect perennial grass to around 0.8 metre tall.

It produces large amounts of reddish brown seeds held in seed heads above leaves. Reproduction is by seed and rhizome roots; seed does not live long in the soil, usually up to only 3 years.

Perennial veldt grass can effectively outcompete native plants and prevent their recruitment, and dense stands are a significant fire hazard.

It invades disturbed sites, and increases in density and extent when stimulated by fire. To combat regeneration and spread, burning should be avoided.

HerbiGuide recommends:

- *Spray with 800 mL/ha Verdict®520 plus 1% oil at any time from autumn to spring and repeat annually or as required. In areas with native Geraniaceae, 6 L/ha Fusilade® Forte is preferred.*
- *Regrowth of mature plants has been reported when grass selective herbicides are applied after seed formation.*

Amenity

Managing amenity involves conserving the vegetation communities and their features of aesthetics as form, diversity, look, sound and feel; and performance as cover, habitat, health, stability and shelter. Amenity is also primarily about how we respond to the landscape and vegetation in our siting and forms of buildings, roads, driveways, and other infrastructure, private and public, and in the performance of those assets.

Interventions to manage amenity are held within the recommendations for vegetation management and conservation above. However, amenity is also in the patterns and results of the interventions, where it is enhanced by quality processes and method implementation, and undone by poor implementation and management.

Well-sited buildings that fit the landscape, with grounds that are pleasing to the eye having well designed and landform-matched access, gardens/natural bushland surrounds, and attractive and sheltering low hazard protection zones, have quality amenity. Poor quality amenity is where vegetation is damaged, dieback and or weed infested, with poorly designed and badly performing access, infrastructure that doesn't fit the landforms, and a requirement for excessive and destabilising ongoing maintenance.

Achieving and conserving quality amenity is an ideal that this guide has sought to deliver through its recommendations. Amenity will be had and enhanced by being mindful of the value of good amenity, and by using the methods and techniques recommended, as well as getting good advice and support for design and intervention, to carefully manage and conserve the landscape and vegetation.

Heritage

The best way to protect Noongar and European heritage is to know more about it, how to recognise it and where it is, particularly as it relates to our private properties. For public lands, the protection of heritage is an important land management imperative, and in many instances, heritage is protected by legislation.

Noongar heritage is evident as stone chips in sheltered sandy sites, often behind sand dunes and behind beaches and around swamps. Protection of these sites and fragments is not onerous, its best achieved by knowing they exist, and forbidding any removal of material. The material is protected by the WA Aboriginal Heritage Act 1972, further it is considered poor form and bad karma or 'warra' to interfere with or remove material. It is good karma to recognise these artefacts and celebrate the people who put them there.

The map on page 18 shows the old fence lines that crisscrossed the Point Henry Peninsula and parts of Reserve 511. These old fence lines, and the remaining pieces of these structures can be conserved by knowing where they are, particularly on private properties, and ensuring they are not damaged or burnt. The most prominent fence remnants are between the Beaches Caravan Park and Back Beach; and between Peppermint Grove Homestead and Black Rocks. These too represent pioneers and their efforts and the stories and forms the remnants make are important to conserve. These artefacts can best be conserved by protecting them from damage, including fire, and by sharing their existence and the stories they tell.

Protecting assets and buildings

There is a wealth of detailed scientific research on bush fire behaviour under a range of locations, weather, vegetation and slope conditions that have demonstrated the significance of increased distance from bushfire hazards and reduced fire fuel loads in limiting bushfire threats to houses and other assets. In new developments, separation distances based on vegetation and slope are incorporated into the design, building and approval process. However, in existing developments, some of these elements are not included or retrospective.

There are 5 key Bushfire Protection Measures that can assist in the protection of buildings and other assets:

- The provision of a clear separation of buildings from bushfire hazards, in the form of a fuel-reduced area surrounding a building;
- The use of construction standards and designs of houses to increase the protection of residents in houses in a bushfire event;
- Adequate water supply, pressure, and independent delivery ability;
- Appropriate access for residents, fire fighters, emergency service workers and those involved in evacuations; and
- Suitable landscaping around a structure to limit the fire spreading into a building.

An Asset Protection Zone (APZ) is a buffer area between a bushfire hazard (for example, vegetation) and buildings and is one of the major protection measures landowners can implement. This area is managed to minimise the fuel loads and reduce potential radiant heat levels, flames, embers and smoke attack. The appropriate distance is based on the vegetation type, slope and the level/standard of construction.

Many local governments require a minimum of 20 m of APZ around a house. This can include low fuel areas such as driveways, vegetable patches, lawns or reticulated lawns or gardens. New guidelines for planning in bushfire prone areas were released in February 2017 (WAPC 2017), these state that the APZ needs to be sufficient to ensure that the potential radiant head impact of a fire will not exceed a particular level (29 kW/m²). This is site-specific based on vegetation, slope and house construction and design standards. The previous 20 m limit provides a good rule of thumb however, as it not only allows a low fuel zone around a building, but provides a “defendable space” around a house, which is a workable area in which residents or fire fighters can undertake protection or suppression activities as needed.

It should be noted that the defendable space should clearly mark the location of leach drains and septic tanks if they occur within. These hidden infrastructure elements are the common sewage treatment facilities on Point Henry Peninsula, and are often located in defendable zones. They should be marked on-ground and in fire plans to ensure that they are not traversed, lest they entrap fire-fighting appliances.

New houses in bushfire prone areas are required to be constructed to a particular standard based on their potential Bushfire Attack Level (BAL). While these standards are not retrospective for existing houses, simple measures such as installing metal flyscreens and removing flammable objects from porches or

verandas (such as doormats, pot plants, timber outdoor furniture etc.) in a bushfire event can significantly reduce the impact of the fire on the house.

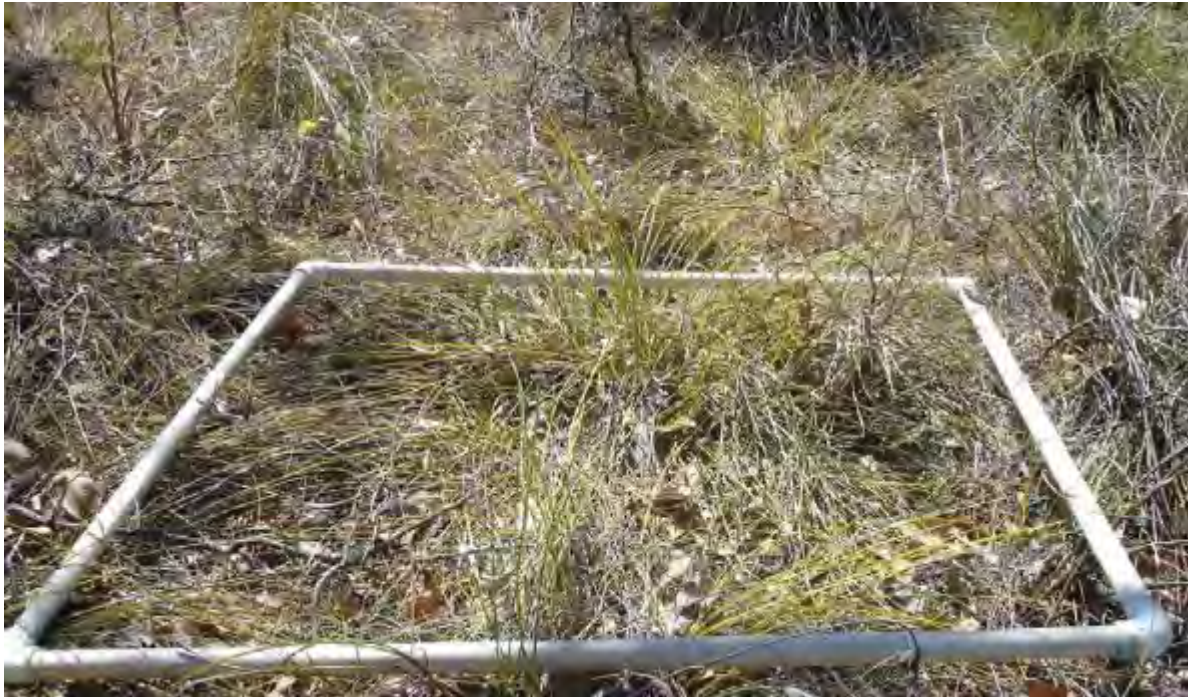
Similarly, designing your garden/landscaping to minimise the possible impacts of fire can assist. Embers (small burning or smouldering bits of bark/leaves etc.) pose a major threat in bushfires and research has shown them to be a significant source of building damage. These 'fire brands' can be carried in the wind in front of a fire, sometimes up to kilometres ahead of the fire front. They can lodge in doorways, under houses, in gutters, or in garden beds. With the right conditions, these can evolve into flames. So positioning your garden beds away from your house, or more importantly away from any glazed areas, can prevent any embers and subsequent flames, causing glass to break and allow flames and/or embers into the house itself. Metal fly screens with gaps less than 2 mm can prevent embers entering a house even if the glass breaks. This type of black coloured stainless mesh is commonly available, and can be retro fitted to many types of windows, and being black is visually unobtrusive.

Having an adequate water supply, in addition to your household requirement, will give you and/or fire-fighters, the best chances of protection your house in a fire event. A separate tank and pump to provide pressure should you lose power is recommended. The tank can also be equipped with fittings suitable for your fire brigade appliances so they can draw water if needed. In a fire event, you will have to assume you will lose power and water (if you are on reticulated water, fire services drawing water are likely to impact on your domestic supply) and as such you should try to be self-sufficient were possible. If you are able, it also helps to position your water tank, or install a 50 mm delivery pipe and male cam-lock coupling, so that a fire truck may be able to access water easily.

The provision of your APZ will also allow residents reasonable low radiant heat areas to evacuate if needed, and allow fire fighters and their appliances ready access to fight any fire and protect your house. It should be noted, that fire fighters are not obliged to protect a house or asset, if they think that the separation distance between the vegetation and the dwelling is unsafe.

New standards for Asset Protection Zones were released in February 2017. These are summarised as:

- Fences: within an APZ should be constructed of non-combustible material (eg. iron, brick, limestone, metal post and wire). It is recommended that solid or slated non-combustible perimeter fences are used.
- Objects within 10m of a building – combustible objects must not be located close to the vulnerable parts of a building, eg. Doors and windows.
- Within the APZ, fine fuels (dead vegetation matter less than 6 mm in thickness) should be reduced and maintained to an average fuel load of 2 tonnes per hectare (see picture below as a guide note this is for a vegetation type on the west coast, but shows 1.8 tonnes per hectare fuel load for comparison).



1.8 tonne per hectare of native grasses and sedge from FESA Visual Fuel Load Guide Swan Coastal Plain (2012).

- Trees (> 5 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.
- Shrubs (0.5 metres to 5 metres in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m² in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- Ground covers (<0.5 metres in height): can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 mm in height. Ground covers greater than 0.5 m in height are to be treated as shrubs.
- Grass: should be managed to maintain a height of 100 millimetres or less.

If you require further information on your legal requirements, check your annual Fire Breaks/Bushfire Notice, or call your ranger services at the Shire of Jerramungup. Additional resources, such as checklists, survival guides and information can be downloaded from the Department of Fire and Emergency Service Website (www.dfes.wa.gov.au).

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He lives on the Point Henry Peninsula at Bremer Bay, and works as a consulting landscape ecologist and conservation planner.

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He has a Master's Degree in Ecology and a Post Graduate Diploma in Bushfire Planning. He is a Certified Environmental Professional and a Level 3 Bushfire Consultant with the Fire Protection Association Australia.

Gary is also an active member of the Dunsborough Volunteer Fire and Rescue Service

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