Appendix D Individual Hotspot Summaries

Appendix D Disclaimer

Information contained in the hotspot summaries was prepared by Seashore Engineering as part of *Assessment of Coastal Erosion Hotspots in Western Australia* completed in March 2018, and should be understood in the context of the main report. This assessment articulates views based on the knowledge available to Seashore Engineering at the time of preparation, including some information obtained from local coastal managers. Opinions contained within each hotspot summary do not necessarily represent the views of the State Government or any of its Departments.

Fifty-five individual summaries were prepared between May 2016 and September 2017 following a brief assessment of the hotspot. Consequently, information contained in each summary may not fully represent present conditions, and there may be simplification of or inconsistency with detailed evaluations. Management and adaptation options presented are a guide only, and do not replace the need for dedicated comprehensive Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) preparation on locations subject to coastal hazards.

Information is provided for three timeframes, being Imminent (0–5 years), Expected (5–25 years) and Projected (25+ years). For some assets protected by existing erosion mitigation structures in the timeframe of interest, an asterisk (*) is marked next to the assets susceptible to erosion hazard text. Approximate costs applied to each management and adaptation option for this hotspot for the Imminent and Expected timeframes are presented as 50k, L, M and H within each summary. Corresponding costs are $50,000 for preparation of plans for retreat in the next timeframe or reviewing lease agreements, <$0.5M for low cost, $0.5M–$2M for moderate cost and $2M–$30M for high cost. Further information on the methodology and terms used can be found within the main report.

Appendix D.1. China Town, Broome

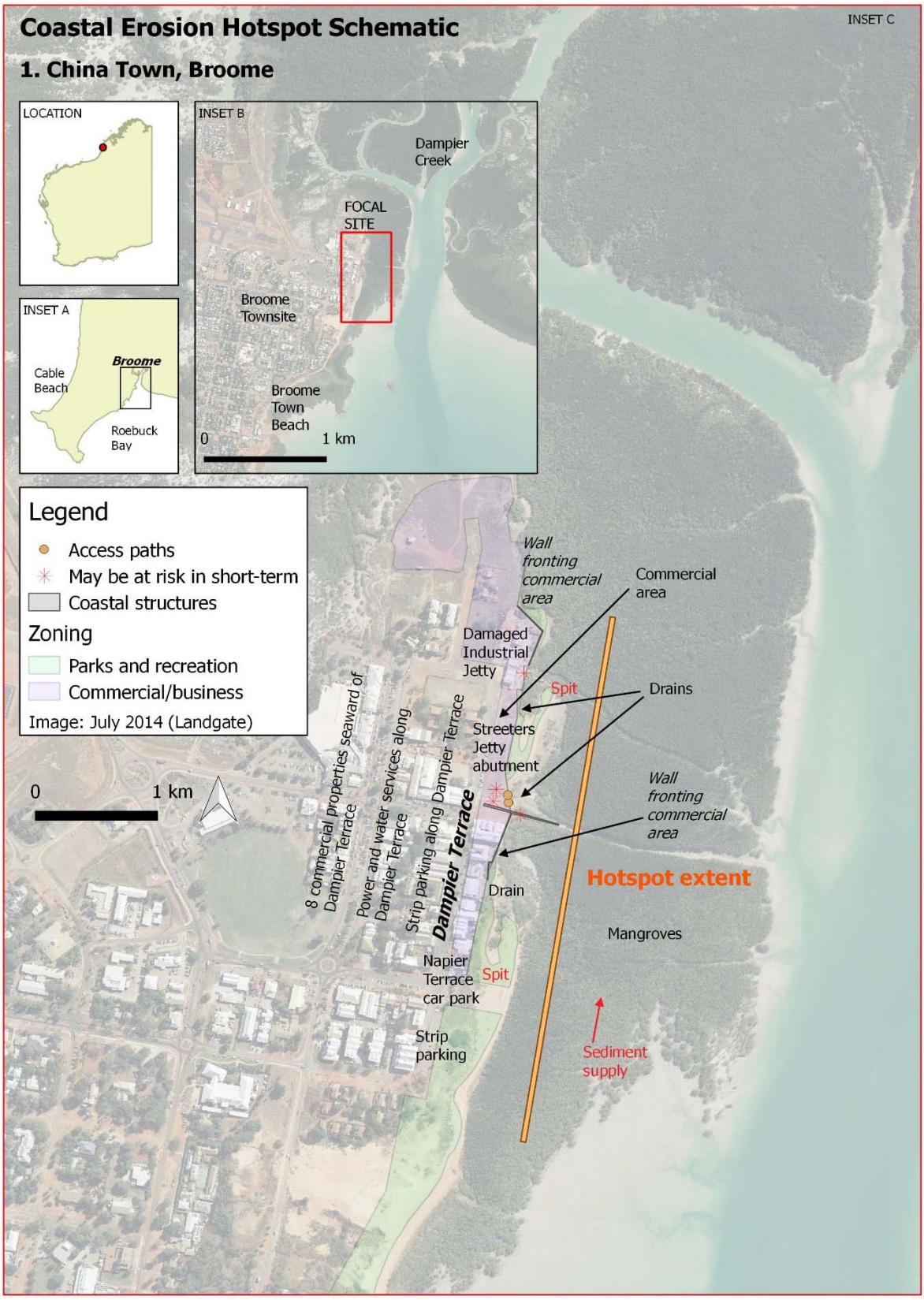

Figure D-1: China Town, Broome schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-1: China Town summary information

Hotspot No.	1
Hotspot Name	China Town
Local Coastal Manager	Shire of Broome
Hotspot issue	China Town in Broome, is a shore of spits on tidal flats supporting mangroves at the mouth of Dampier Creek, and significant modification of the natural land area has been undertaken to develop the commercial precinct. The spits indicate some northerly sediment transport, possibly due to incoming tidal currents along the shore. It is noted that mangroves exist at the edges of the peninsula which reduces wave energy at the shore, attenuates storm surge and improves coastal stability. Erosion is episodic, mainly due to rare tropical cyclone activity. Erosion is locally exacerbated by stormwater drainage, mangrove clearing for access to Streeter's jetty (constructed late 1800s) and transfer of erosion stress from walling fronting the private properties. Existing management has included armouring drains and installing walling along the shoreline fronting Dampier Terrace. Private property may be at risk due to early planning in Broome allowing freeholding of land close to high water mark, with recent developments subsequently allowed on this land. Thirteen publicly owned assets may be at risk of erosion damage in the area (see attached figure) with two unprotected assets at risk of damage in the short-term. These are the abutment to Streeters Jetty and the concrete access paths near Streeters Jetty. Eight private properties on Dampier Terrace may be at risk in the medium-term, with risk partly dependent on the integrity and maintenance of the existing walling. This is not a high recreational use foreshore, with walking and birdwatching the main uses. Increased use of the jetty is anticipated with the new Jetty to Jetty walk. Non-governmental stakeholders that are likely to have an active interest in how this foreshore is managed include individual property owners, the local historical group, the Yawuru prescribed body corporate, Environs Kimberley, and the Broome Chamber of Commerce.
Extent of erosion problem and hotspot characteristics	Along Dampier Terrace between Frederick Street and Chapple Street. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Apparent costs of likely forms of erosion mitigation are high. • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Complete **Hazard Assessment:** Cardno (2014) - Immediate risk of erosion identified (existing buffer <S1)). **Management & Adaptation Options:** Broome Town Centre/Broome Central: Protect with a coastal protection structure to provide storm surge immunity and coastal erosion protection. **Additional Comments:** Further studies required to determine type, alignment and timing of structure/construction. **Reports:** Cardno (2014) Broome Coastal Vulnerability Study. Prepared for Shire of Broome. Rev. A, 12-Sep-2014 Baird Australia. (2017) Broome Townsite Coastal Hazard Risk Management and Adaptation Plan. Prepared for Shire of Broome. 12518.101.R2.RevC, 17 March 2017.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly geotechnical, littoral transport and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	2 public assets susceptible to erosion hazard. Land connection to Streeters jetty (Dampier Creek), damaged concrete access paths. Private Property: 1 seaward of Dampier Terrace.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	7 public assets susceptible to erosion hazard. Land connection to Streeters jetty (Dampier Creek), damaged concrete access paths, park area, old industrial area north of Dampier Terrace, three drains Private Properties: 8 seaward of Dampier Terrace

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	13 public assets susceptible to erosion hazard. Dampier Terrace, Dampier terrace car park strip, car park at end of Napier Terrace, Napier Terrace strip parking, Land connection to Streeters jetty (Dampier Creek), damaged concrete access paths, park area, and an old industrial area north of Dampier Terrace. Services: 100P-12 and 100AC water pipelines, HV power cables with power pillars along Dampier Terrace, and three drains. Private Properties: 8 seaward of Dampier Terrace
Existing management	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Shore control structures have been provided for nearshore assets (mainly private))
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Threats from episodic flooding and local instability (inconsistent walling). Greatest pressure at drains. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Minor works anticipated for connectivity between adjacent structures and post event repairs. Review existing walling and develop local minimum walling standards which ensure compatibility between adjacent structures. Ensure space/access for future protection works)
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: Broad scale lowering of sediment affecting more than 25% of structures or storm damage to more than 25% of structures. **Monitoring**: Visual assessment (photographs & engineer's inspection) **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Net erosion and focus at drains likely to cause irregular pressure along sections of walling. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Strengthen protection to meet the minimum walling standard (see 0-5yr option). Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Protect - H Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: (i) Exposure of wall at mean high water spring tide; (ii) Failure of any section of walling affecting buildings; (iii) Private protections not compatible between adjacent properties. **Monitoring**: Height of beach monitoring (note, this may require evaluation of change to MHWS from the tide gauge record); Photographic record; Structural inspection. **Alternate option:** Accommodate (property level protection, flood proofing, piled foundations).
Management and adaptation options for Projected timeframe (25+ years).	Shire to build single structure capable of withstanding regular exposure to tides, deeply embedded. Avoid (N), Retreat (Y - partial, consider cost-effectiveness at the time of design & construction), Accommodate (N), Protect (Y - Protection will need to integrate with drainage and mangroves to get a slightly lower cost – needs a holistic approach)
Works to avoid to achieve long-term plans	No extension of infrastructure (including coastal protection structures) seaward of agreed line of protection.

Appendix D.2. Broome Town Beach

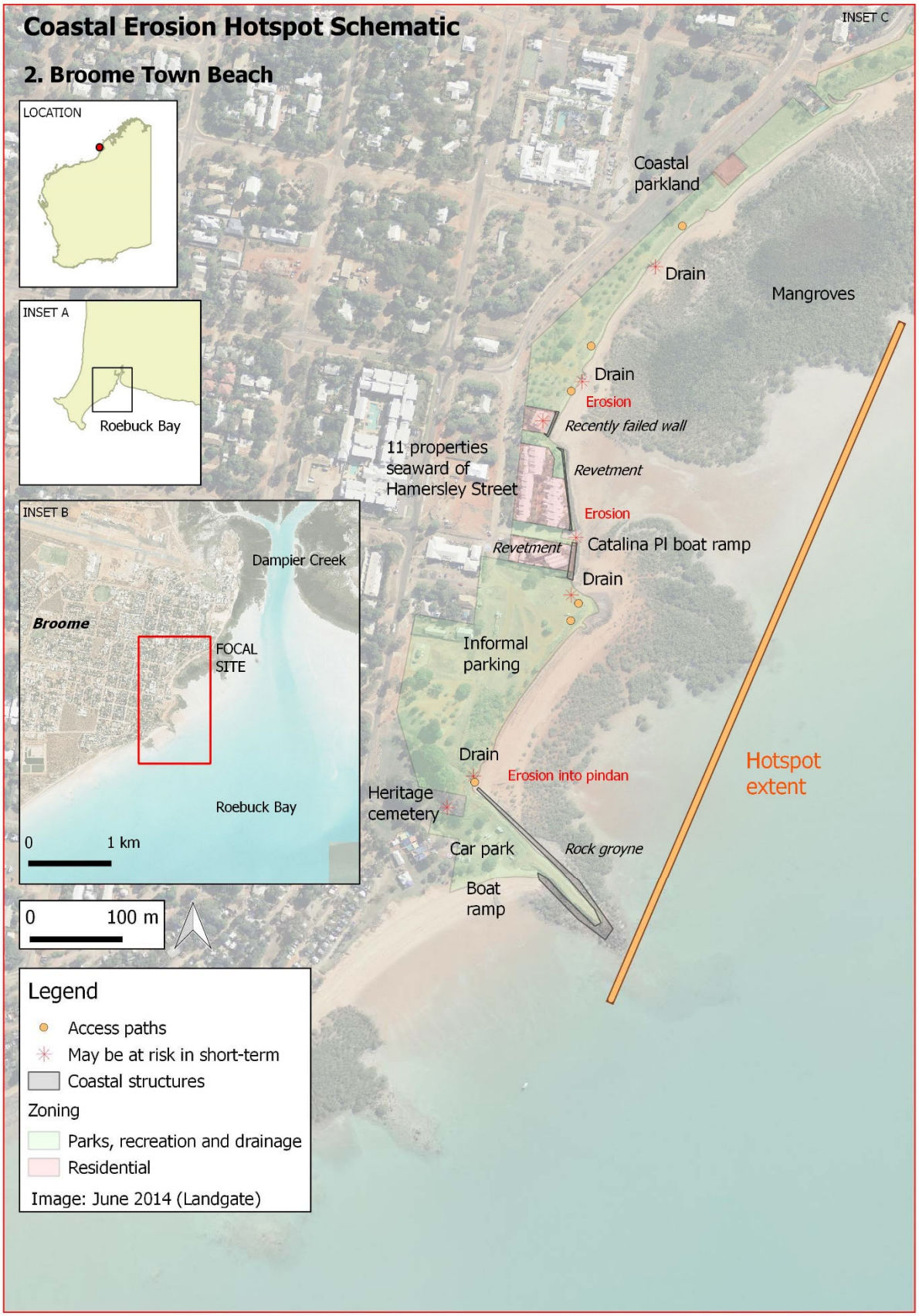

Figure D-2: Broome Town Beach schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-2: Broome Town Beach summary information

Hotspot No.	2
Hotspot Name	Broome Town Beach
Local Coastal Manager	Shire of Broome
Hotspot issue	Broome Town Beach has experienced natural recession of a vulnerable sandy and pindan coast subject to tropical cyclone activity. Erosion is progressive, locally exacerbated by stormwater drainage, mangrove clearing for boat access and revetments. Existing management has included armouring drains, extending the revetment along the car park and private property owners constructing revetments to protect their individual properties. Ten publicly owned assets may be at risk of erosion damage in the area (see attached figure), with seven assets at risk of damage in the short-term, including the heritage cemetery, three stormwater drains, Catalina Place vehicle and boat access to beach, and the coastal parkland. One private property on Hamersley Street is at risk of erosion damage in the short term, with the seawall recently failing and requiring reconstruction. In the longer term, 11 private properties may be impacted and five stormwater drains. This is a high use foreshore, particularly during peak tourist seasons and damage to Catalina Place beach access likely to be of concern. The local historical group have concerns regarding the erosion threat to the pioneer cemetery.
Extent of erosion problem and hotspot characteristics	Broome Town Beach N of the groyne to N of 33 Hammersley St Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Apparent costs of likely forms of erosion mitigation are high. • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Complete **Hazard Assessment:** Cardno (2014) - Immediate risk of erosion identified (existing buffer <S1)). **Management & Adaptation Options:** Town Beach: Protect through construction of a coastal revetment, planned for 2018-2019. **Additional Comments:** Further studies on construction of the Town Beach Revetment (engineering, environmental and local stakeholder issues); develop an Emergency Response Plan for the Roebuck Bay caravan park; undertake a foreshore management plan; investigate remediation of the dune in front of the properties to Demco Drive. **Reports:** Cardno (2014) Broome Coastal Vulnerability Study. Prepared for Shire of Broome. Rev. A, 12-Sep-2014 Baird Australia. (2017) Broome Townsite Coastal Hazard Risk Management and Adaptation Plan. Prepared for Shire of Broome. 12518.101. R2.RevC, 17 March 2017.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly geotechnical and possibly sedimentology. Pathways for drain redirection. Ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	7 public assets susceptible to erosion hazard. Catalina Pl boat ramp, Heritage cemetery [not relocatable], coastal parkland/reserve (part). Services: 3 stormwater drains Private property: 1 on Hamersley St
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	7 public assets susceptible to erosion hazard. Catalina Pl boat ramp, Heritage cemetery [not relocatable], coastal parkland/reserve (part). Services: 3 stormwater drains Private property: >8 on Hammersley St including multiple lots on one street address and undeveloped lots. Some protected by erosion protection structures of limited life.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	10 public assets susceptible to erosion hazard. Catalina Place boat ramp, heritage cemetery [not relocatable], * Robinson St car park, informal parking within Town Beach Reserve, coastal parkland/reserve. Services: 5 stormwater drains Private property: >11 on Hammersley St including multiple lots on one street address and undeveloped lots. Some protected by erosion protection structures of limited life.

Existing management	Avoid (Y - Moderately wide development buffers occur along the majority of Town Beach), Retreat (N), Accommodate (N), Protect (Y - Shore control structures have been provided for nearshore assets (both private and public))
Management options for Imminent timeframe (0–5 years)	Avoid (Y - Ensure existing setback buffers are maintained), Retreat (N), Accommodate (N), Protect (Y- False talus at pindan toe to protect cemetery from prevailing conditions. Allow property owners to rebuild and strengthen failed structures)
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Avoid - None Protect - L for false talus for cemetery. No public cost for private landowners.
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Localised erosion processes cause acute erosion hazard to assets or exposed Pindan **Monitoring:** Monitoring of beach sand areas **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (Y - Ensure existing setback buffers are maintained), Retreat (N), Accommodate (Y - Modification of drainage works outlets to reduce scour effects. Consider program to encourage mangroves along whole length. Minor sand renourishment could be trialled for sensitive areas), Protect (Y - False talus at pindan toe to protect cemetery from prevailing conditions. Allow property owners to rebuild and strengthen failed structures)
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Avoid - None Accommodate - M Protect - M for false talus for cemetery. No public cost for private landowners.
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Continuous exposure of Pindan to scour (i.e. no post-storm recovery) **Monitoring:** Photographic monitoring **Alternate option:** N/A
Management and adaptation options for Projected timeframe (25+ years).	Coastal response to sea level rise (including less sheltering from mangroves) may reduce the effectiveness of the existing volume of beach sand to protect the underlying Pindan. Avoid (N), Retreat (N), Accommodate (Y - Modify existing walling to reduce near-field response (i.e. sink-source behaviour)), Protect (Y - Provide protective walling as alternative to small volume of beach sand protecting Pindan. This will result in reduced foreshore access.)
Works to avoid to achieve long-term plans	Avoid building facilities that may alter the movement of beach sediment; particularly those with a large cross-shore presence (i.e. groynes); Limit drainage structures that induce scour

Appendix D.3. Goode St, Port Hedland

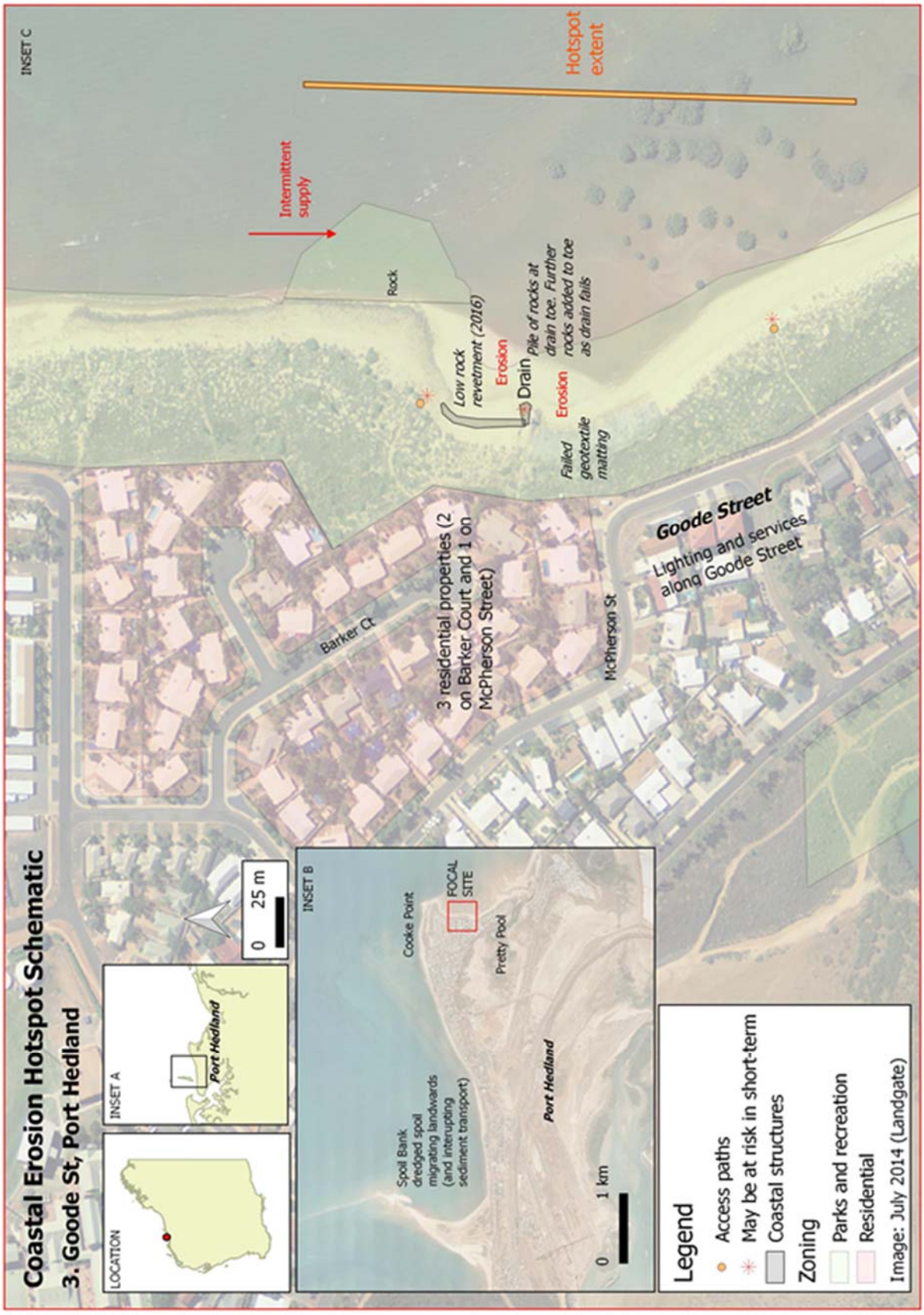

Figure D-3: Goode St, Port Hedland schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-3: Goode St, Port Hedland summary information

Hotspot No.	3
Hotspot Name	Goode St, Port Hedland
Local Coastal Manager	Town of Port Hedland
Hotspot issue	The erosion at Goode Street is primarily in response to the drain discharge and stabilisation efforts, along with downdrift erosion from the rock platform to the north. Reduced or altered sediment supply has also occurred, possibly in response to change of supply from tidal creeks, dune erosion during storm events and irregular and reduced supply along the northern rock platform. As the dune has retreated, the drain has failed and discharged further landward onto the dune, exacerbating the rate of retreat along with the impact of the rocks at the drain toe. Attempts have been made to stabilise the dune south of the drain with matting and revegetation, with a low revetment constructed in 2016 connecting the drain to the rock platform to the north. The dune buffer to private property is susceptible to a rare tropical cyclone coinciding with a high tide, as well as progressive retreat. Five publicly owned assets may be at risk of erosion damage in the area (see attached figure), with two assets at risk of damage in the short-term, including beach access paths and a drain. In the moderate to long-term, Goode Street with its associated lighting and services (power, critical water pipes), as well as three private properties (on Barker Ct and Goode St) are high-value assets at risk. This is not a high recreation use site, with a focus on walking and fishing. Individual property owners are anticipated to have an active interest in management of this foreshore.
Extent of erosion problem and hotspot characteristics	From N tip of small sandy embayment to Hall Street. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer).
CHRMAP status and findings	**CHRMAP Status:** Not Scheduled **Hazard Assessment:** Cardno (2011) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Construction of a seawall endorsed by Council, design completed in 2017. **Additional Comments:** Cardno (2011) identifies geotechnical investigation required to quantify erosion hazard predictions at this location. **Reports:** Cardno (2011) Port Hedland Coastal Vulnerability Study. Prepared for LandCorp. Report Rep1022p Rev. 2, 10-Aug-2011
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Geotechnical and pathways for drain redirection. Ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	2 public assets susceptible to erosion hazard. Access paths (2). Services: Drain
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	5 public assets susceptible to erosion hazard. Goode Street, access paths (2), drain. Services: Street lights, water, telecommunications, power and a drain. Private property: 3 (2 on Barker Circuit and 1 on McPherson Street)
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	5 public assets susceptible to erosion hazard. Goode Street, access paths (2), drain. Services: Street lights, water, telecommunications, power and a drain. Private property: 3 (2 on Barker Circuit and 1 on McPherson Street)
Existing management	Avoid (Y - Moderate erosion buffers to residential properties are present), Retreat (N), Accommodate (N), Protect (Y - Low level revetment to protect drain)

Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (Y- Reduce drain flows (compensation basin/ diffuser). Relocate drain to reduce rate of sediment loss) Protect (Y - (Option) Extend low wall further south of drain inlet)
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - M Protect – L
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: Acute erosion threat to existing properties for short-term (but recovery happens) **Monitoring**: Buffer width **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (N), Retreat (N), Accommodate (N), Protect (Y -Renourishment may be used as a localised offset to short-term storm erosion) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Protect - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: Progressive erosion means that existing properties are continuously subject to acute erosion hazard **Monitoring**: Buffer width **Alternate option**: N/A
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y - General net coastal retreat is likely to require retreat of the near-coast infrastructure), Accommodate (N), Protect (Y - Renourishment may be used as a localised offset to short-term storm erosion. Alternative is large armour structure connecting rock features (unlikely to be cost-effective))
Works to avoid to achieve long-term plans	Additional stormwater drainage; Armouring that causes increased sediment mobility due to reflection

Appendix D.4. Laurentius Point, Port Hedland

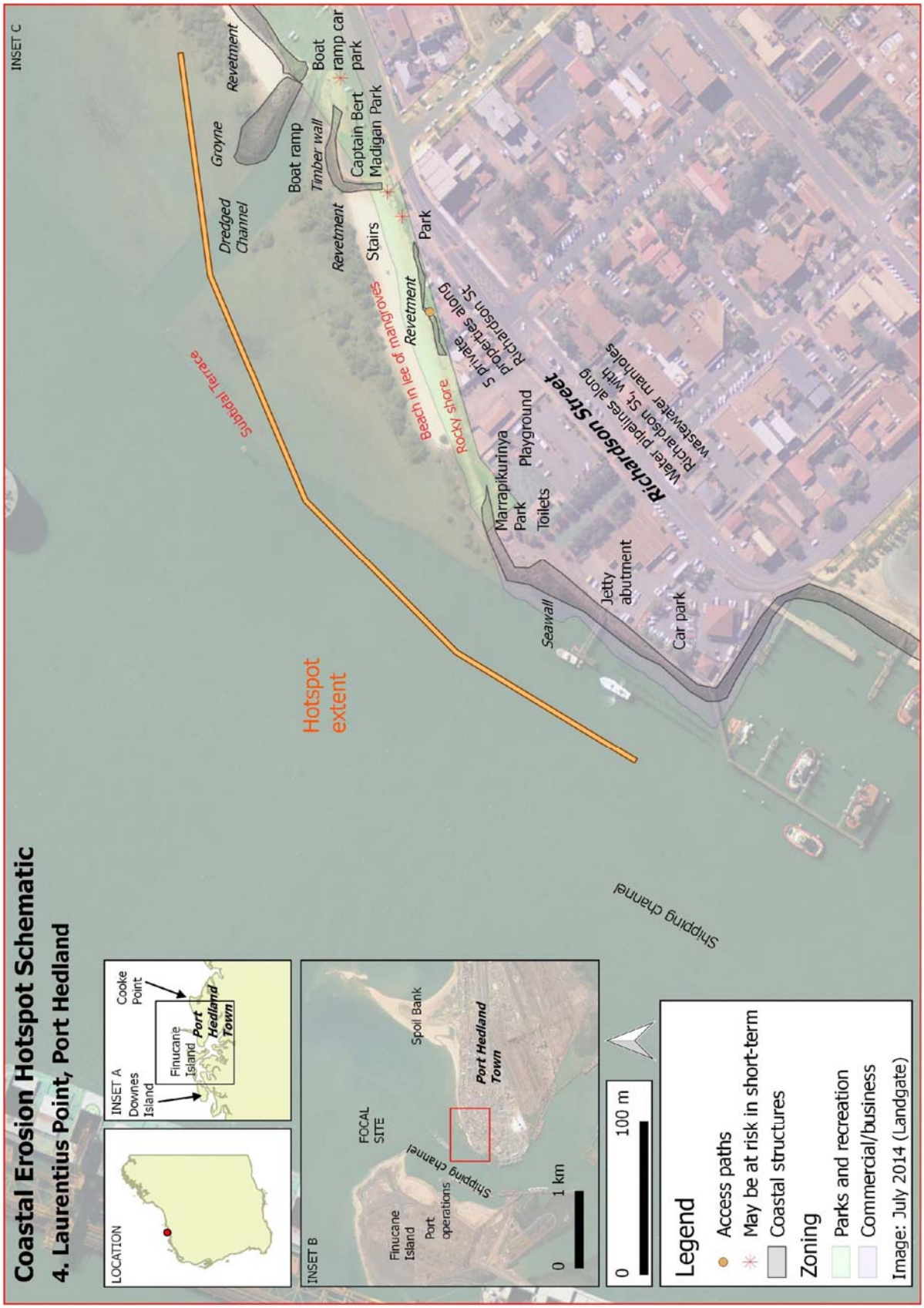

Figure D-4: Laurentius Point, Port Hedland schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-4: Laurentius Point, Port Hedland summary information

Hotspot No.	4
Hotspot Name	Laurentius Point, Port Hedland
Local Coastal Manager	Town of Port Hedland
Hotspot issue	Laurentius Point in Port Hedland is a beach perched on a broad rock/mud platform, backed by rock outcrops, steep embankments and engineered structures. The urban-industrial shore was initially the eastern shore of a tidal creek that has now been stabilised and partially reclaimed at the harbour entrance. Works undertaken include rock revetments, a timber wall, jetties and a channel dredged for a boat ramp. Laurentius Point has survived many tropical cyclones, but is susceptible to damage in extreme events. The dredged port channel may have increased the exposure to wave action and erosive stress from ship wakes, particularly during high spring tides. Eight publicly owned assets may be at risk of erosion damage in the area (see attached figure), with three assets at risk in the short-term; the stairs near the boat ramp, a nearby sand access track and the small section of car park between the timber wall and the boat ramp. Five private properties along Richardson Street may be at risk in this timeframe. In the mid to long-term, possible failure of the rock seawalls occurring intermittently along the length of the site could result in erosion damage to the jetty abutment, the Richardson Street car park, Marrapikurinya Park, Captain Bert Madigan Park and approximately 50m of Richardson Street. In addition, as observed from site photos from 2015, the short section of foreshore between the boat ramp and the old timber walling is susceptible to erosion during tropical cyclone events leaving a small section of car park at risk of damage. The main recreational uses at this site are boat launching, picnicking and park use, fishing and walking. Non-governmental stakeholders likely to have an interest in how this foreshore is managed include members of industry (Pilbara Ports Authority, Port Hedland Industries Council, BHP, FMG, and Roy Hill), local business on Wedge Street and surrounds, and members of the community (Care for Hedland Environmental Group, Port Hedland Yacht Club, and Port Hedland Seafarers).
Extent of erosion problem and hotspot characteristics	Rocky Shore along Richardson Street from the boat ramp to the Esplanade. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Apparent costs of likely forms of erosion mitigation are high. • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer).
CHRMAP status and findings	**CHRMAP Status:** Northern Regions Planning Team encouraging Town to undertake CHRMAP process to deal with development along peninsular and around Pretty Pool **Hazard Assessment:** Cardno (2011) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Nil **Additional Comments:** Nil **Reports:** Cardno (2011) Port Hedland Coastal Vulnerability Study. Prepared for LandCorp. Report Rep1022p Rev. 2, 10-Aug-2011
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	3 public assets susceptible to erosion hazard. Stairs access, informal access track, small section of car park near boat ramp, section of car park near boat ramp not behind timber bulkhead. Private Property: 5 along Richardson Street.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	8 public assets susceptible to erosion hazard. Jetty access, stairs access, informal access track, section of Marrapikurinya Park (toilets, gazebo), boat ramp, section of car park near boat ramp not behind timber bulkhead Private Property: 5 along Richardson Street.

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	14 public assets susceptible to erosion hazard. Jetty access, stairs access, informal access track, car park seaward of Richardson Street, section of Marrapikurinya Park (toilets, playground, shaded picnic tables, gazebos), Captain Bert Madigan Park, boat ramp, boat ramp car park, 50m of Richardson Street. Services: 100AC and 200P water pipelines, 2 trafficable and 2 non-trafficable wastewater manholes. Private Property: 5 along Richardson Street.
Existing management	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Shore control structures have been provided for some nearshore assets including rock revetments and timber walling)
Management options for Imminent timeframe (0–5 years)	It is recommended to clarify existing hazard level - site walkover to confirm material / armouring Avoid (N), Retreat (N), Accommodate (N), Protect (Y - maintenance of existing revetment and walling)
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: Beach in front of scarp / revetment less than 0.3m above toe of revetment. **Monitoring**: Visual / define beach level relative to fixed point / post **Alternate option:** Small scale renourishment.
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** It is expected that sand episodically lost from the beach is unlikely to recover. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Deepen revetment to 0.5m below sand surface)
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Protect - H
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: Scarp or revetment gets wet on high tide (without substantial surge). Revetment unstable. **Monitoring**: Photographic, looking for tidal wrack / scarp erosion. Aerial imagery to monitor changes cross broader spoil bank and tertiary sediment cell **Alternate option:** Revetment upgrade at end of functional life. Retreat - dependent on land value relative to defence cost.
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Once exposed to regular tidal inundation, stress on the scarp / revetment is expected to increase substantially. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Tie revetment in to rock)
Works to avoid to achieve long-term plans	Development encroachment towards the scarp on private properties. Avoid permanent recreational infrastructure closer to the scarp.

Appendix D.5. Warne St & Yacht Club Exmouth

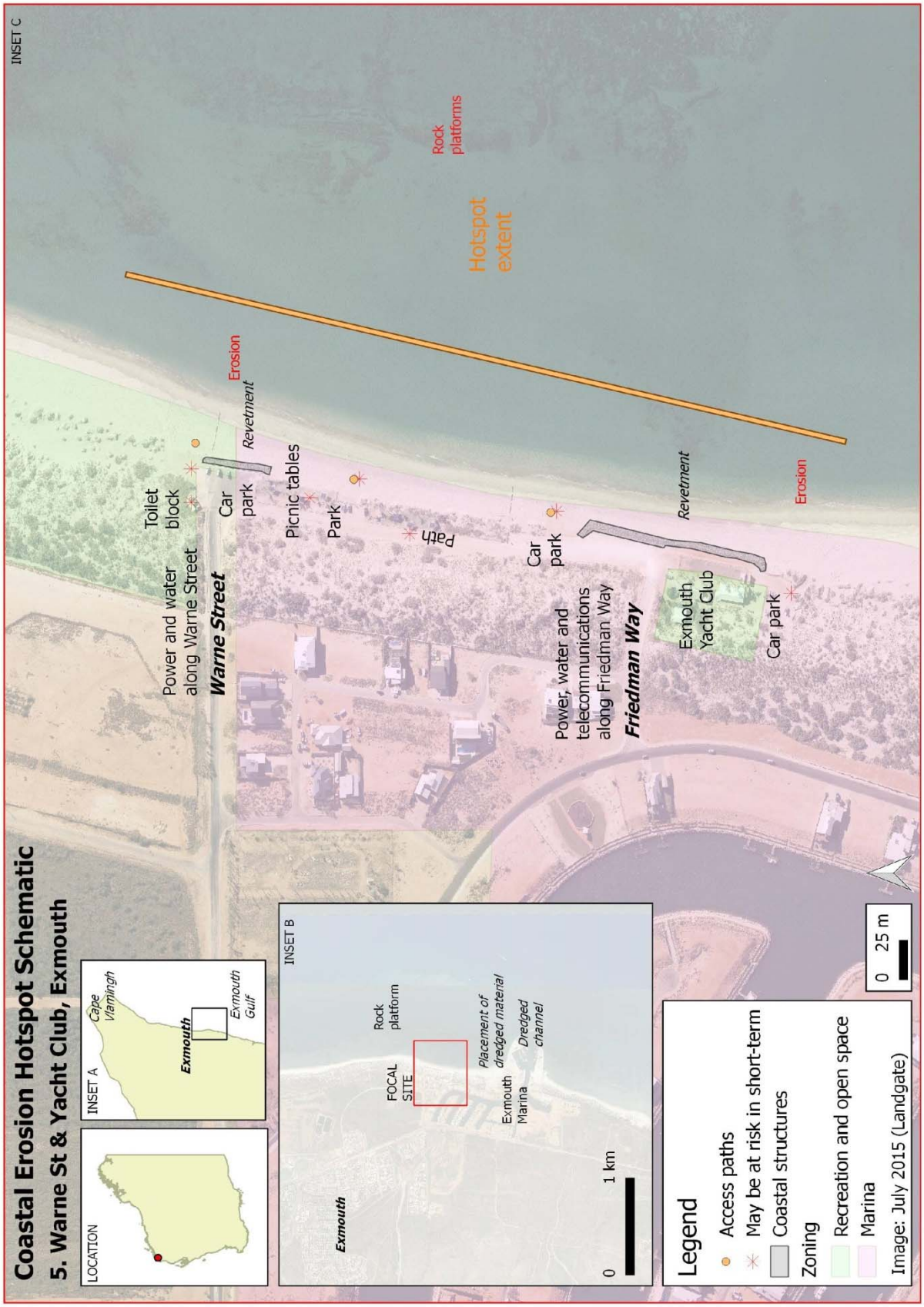

Figure D-5: Warne St & Yacht Club Exmouth schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-5: Warne St & Yacht Club Exmouth summary information

Hotspot No.	5
Hotspot Name	Warne St & Yacht Club Exmouth
Local Coastal Manager	Shire of Exmouth
Hotspot issue	Recreational and yacht club facilities have been placed seaward of a foredune on an eroding coast perched on a rock platform. The marina interrupts the bi-directional transport, resulting in sediment loss offshore of the platform during southwards transport which is subsequently unavailable to be transported north. Rates of erosion and sediment loss may be enhanced by tropical cyclone activity. Sporadic sand bypassing is undertaken to the north of the marina, including placement of material dredged from the marina. The facilities in the area of interest are also subject to inundation by storm surge and washover. Facilities were installed coincidentally with two revetments, which have recently been reconstructed. The northern revetment was reconstructed further landward and the southern revetment was reconstructed to approximately double the length. Fifteen publicly owned assets may be at risk of erosion damage in the area (see attached figure), with seven assets at risk of damage by tropical cyclone activity in the short-term. This includes the path, three car parks (including N extent of northern one), the toilet block, picnic tables and the park; as well as possible damage to the leasehold land of Exmouth Yacht Club (not the building). Eight further publicly owned assets of Friedman Way and associated services (power, water, phone), Warne Street and associated services (power and water), and the Exmouth Yacht Club buildings may be at risk in the longer-term. The beach is used for vehicle access for trailerable vehicles, walking, swimming, car parking and fishing.
Extent of erosion problem and hotspot characteristics	From 85m S of Friedman Way to 25m N of Warne Street Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Not Scheduled **Hazard Assessment:** Damara (2012) - Qualitative regional hazard assessment, secondary compartment North West Cape to Learmonth ranked as low vulnerability. **Management & Adaptation Options:** Nil **Additional Comments:** Nil **Reports:** Damara (2012) The Coast of the Shires of Shark Bay to Exmouth, Gascoyne, Western Australia: Geology, Geomorphology & Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and the Department of Transport.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	7 public assets susceptible to erosion hazard. Path along foreshore, 3 car parks (*Warne St [including N extent of this one], middle, Yacht Club), toilet block, picnic tables, park. Leasehold: 1 (Exmouth Yacht Club, not buildings)
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	8 public assets susceptible to erosion hazard. Path along foreshore, 3 car parks (*Warne St, middle, Yacht Club), toilet block, picnic tables, park, yacht club building (leasehold) Leasehold: 1 (Exmouth Yacht Club) building
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	15 public assets susceptible to erosion hazard. Road (Friedman Way, Warne Street), path between these roads, 3 car parks (*Warne St, middle, Yacht Club), toilet block, picnic tables, park, leasehold building of Exmouth Yacht Club. Services: Friedman Way (power, water, phone), Warne St (power, water). Leasehold: 1 (Exmouth Yacht Club) building

Existing management	Avoid (N), Retreat (N), Accommodate (Y - Sand bypassing every 2-3 years on average), Protect (Y -Protection of access points)
Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (Y - Maintain and repair existing revetments; Use soft engineering works to support recreational area) Protect (N) Review lease agreements with Yacht Club to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: Failure of revetments with coastal retreat **Monitoring**: Structural assessment (post-event) **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (N), Retreat (N), Accommodate (Y - Rebuild revetments landward after erosion. Existing revetments are minor structures, badly made, and would be better removed, modify bypassing practices to achieve greater efficiency), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Accommodate - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: Inadequate area to provide beach access **Monitoring**: Width behind revetment **Alternate option**: N/A
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y - Remove Town Beach facilities & relocate landward), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Permanent road works; Hard engineering protection; Extension of revetments.

Appendix D.6. Pelican Point, Carnarvon

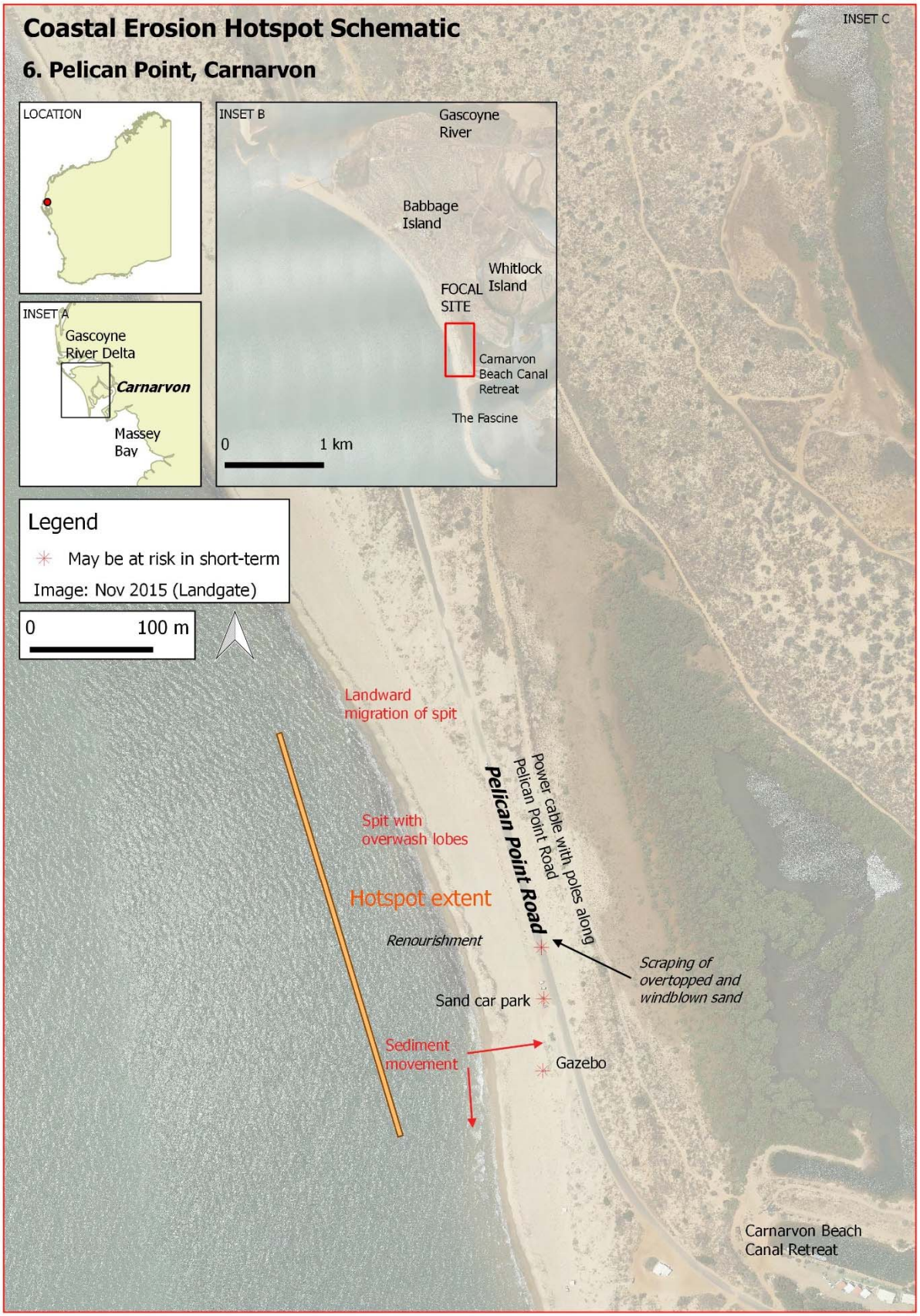

Figure D-6: Pelican Point, Carnarvon schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-6: Pelican Point, Carnarvon summary information

Hotspot No.	6
Hotspot Name	Pelican Point, Carnarvon
Local Coastal Manager	Shire of Carnarvon
Hotspot issue	Pelican Point Road was constructed along an active spit to access the canal development of Northwater Estate. The spit is part of the Gascoyne River delta, with intermittent sediment supply and reworking of sediments by waves. The road is susceptible to sand drift from wind. The site is exposed to wave attack and overtopping associated with storms and tropical cyclones. The access road remains highly vulnerable to storm erosion, despite accretion from sand deposited during river floods. It is expected the spit will continue to migrate landward over time. Present management includes sand renourishment adjacent to Pelican Point Road from Teggs Channel dredging, as well as scraping of overtopped and windblown sediments. Four publicly own assets may be at risk of erosion damage in the area in the short-term (see attached figure). This includes Pelican Point Road and the associated power services, the sand car park (ie vehicle access), and the gazebo on the beach. The road length at risk will increase with time, with up to 700m susceptible in the long-term. Pelican Point Road is essential access for users of the boat ramp, and Carnarvon Beach Canal Retreat, as well as beach users who access the area for beach use, recreational fishing, water sports, and 4WD use.
Extent of erosion problem and hotspot characteristics	Along spit towards Pelican Point where road is located close to the coast. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high.
CHRMAP status and findings	**CHRMAP Status:** Not Scheduled **Hazard Assessment:** GEMS (2009) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Nil **Additional Comments:** The Shire of Carnarvon has previously undertaken sand nourishment to protect the road. **Reports:** Cardno (2012) Babbage Island coastal management report. Prepared for the Shire of Carnarvon. *NOT REVIEWED* GEMS (2009) Cyclonic Inundation and Coastal Process Modelling Carnarvon. Prepared by Global Environmental Modelling Systems for Department of Planning & Infrastructure. Rev. V1-4, 12-Jun-2009 SKM (2002) Babbage Island ocean beach foreshore assessment. Prepared for the Shire of Carnarvon. Jul-2002. *NOT REVIEWED*
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly littoral transport and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	4 public assets susceptible to erosion hazard. Pelican Point Road (approx. 210m), 1 gazebo on beach, sand car park (vehicle access) Services: HV power cable with power poles along Pelican Point Rd
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	4 public assets susceptible to erosion hazard. Pelican Point Road (approx. 520m), 1 gazebo on beach, sand car park (vehicle access) Services: HV power cable with power poles along Pelican Point Rd
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	4 public assets susceptible to erosion hazard. Pelican Point Road (approx. 670m), 1 gazebo on beach, sand car park (vehicle access) Services: HV power cable with power poles along Pelican Point Rd

Existing management	**Note**: This is one of the few swimming beaches in Carnarvon Avoid (N), Retreat (N), Accommodate (Y - scraping of overtopped and windblown sediments), Protect (Y - renourishment adjacent to the road)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Existing road is subject to sand drift and erosion when dune erosion/ overtopping occurs. Avoid (N), Retreat (N), Accommodate (Y - Road safety signs / inspection. Dune building and road repair. Clear sand drift), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: Width of dune <10m; Frequency of sand drift on road more than 12x per year; or drift more than 0.2m depth more than 3x per year. **Monitoring**: Visual inspection, dune buffer width measurement, drift reporting. **Alternate option:** Retreat. Maintenance cost for sand drift on the road to dictate if small scale renourishment is pursued.
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Existing dune will become too narrow for effective strengthening, requiring local road relocation (there is limited space to do this). Avoid (N), Retreat (Y - locally relocate road and services), Accommodate (Y - Offset dune mobility with constructed dune, ideally with a strong core (e.g. cobble)), Protect (N)
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Accommodate - L (assuming sediment is sourced locally)
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: Spit breach open for longer than two months. **Monitoring**: Visual. Annual inspection (by vessel). Identification of breaching likely to be achieved practically through liaison with Carnarvon Yacht Club. **Alternate option:** Construction of causeway approach (strongly not recommended).
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Closure of the Fascine has reduced the long-term stability of Pelican Point and Babbage Island spit. Failure (breach or collapse) of the spit is expected to occur prior to permanent loss of road access. Note: Restricting the Canal Estate to vessel access only requires consideration of expectations around the service life of the facility. Avoid (N), Retreat (Y - Site access by vessel only. Remove road), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Protecting road with large scale renourishment or structures; or constructing a causeway across mangroves (too much money). Also avoid increasing density in the canal estate.

Appendix D.7. Monkey Mia

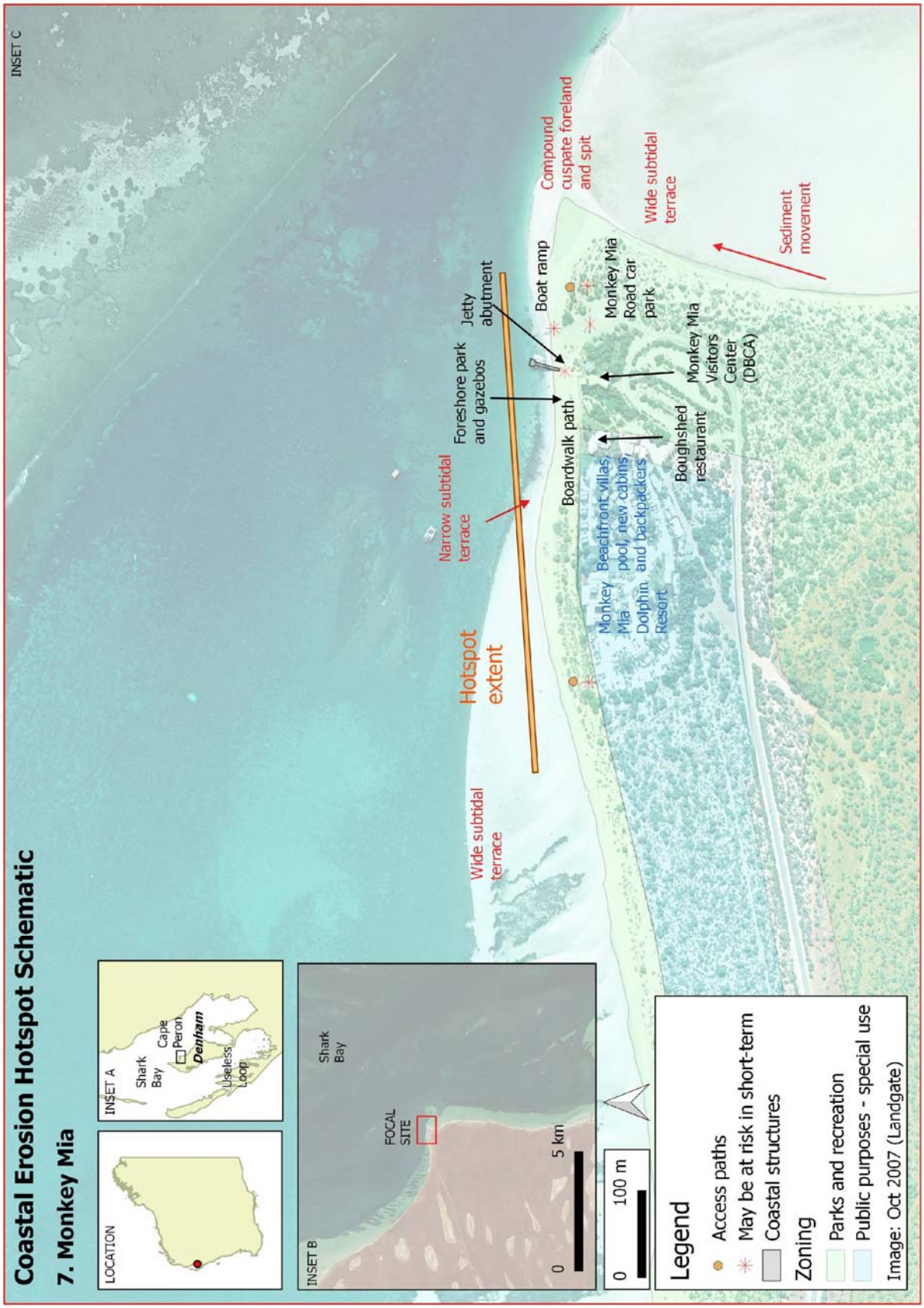

Figure D-7: Monkey Mia schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-7: Monkey Mia summary information

Hotspot No.	7
Hotspot Name	Monkey Mia
Local Coastal Manager	Shire of Shark Bay
Hotspot issue	Monkey Mia is a tourist site on the northern shore of a cuspate foreland within the Shark Bay World Heritage Area. Sediment exchanges between the foreland, beach and adjoining spits; influenced by the underlying rock and tidal channels. Monkey Mia Dolphin Resort has its main facilities in an area with a narrow subtidal terrace, making it more susceptible to erosion by wave action than the adjacent foreshore. This site is in a cyclonic region, with no known history of storm attacks, but is at risk in the short term from erosion via wave attack. The site is relatively low-lying and is at risk of inundation from a tropical cyclone (not considered in this assessment). The development has been built close to shore to allow connectivity with the dolphins and boat launching. The site was originally established as a caravan park in the 1970's, expanded to a resort in the 1980's with further expansion in the 2000's. Present management includes avoidance of hazards in areas with sufficient beach/dune buffer in front of development, and some low walling fronting a narrow section of foreshore. No hard engineering structures are permitted for new developments (EPA 2005). This site is a Special Control Area under the Local Planning Scheme with any works requiring approval by the Shire of Shark Bay and Department of Biodiversity, Conservation and Attractions. Fifteen publicly owned assets may be at risk of erosion damage in the area (see attached figure), six of which may be at risk in the short term, including the Monkey Mia Road loop car park, two jetty abutments, a boat ramp, the boardwalk and sand access paths along the beach (counted as one combined asset). In the longer-term, the DBCA visitors centre, leasehold facilities at the Monkey Mia Dolphin Resort (beachfront villas, cabins, Boughshed Restaurant, backpackers and pool), toilets and the associated foreshore park and gazebos may be at risk. The beach has high visitor numbers with the main uses for dolphin interactions, walking, and boat launching and swimming.
Extent of erosion problem and hotspot characteristics	Northern side of cuspate foreland in proximity to Monkey Mia Dolphin Resort. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** CHRMAP preparation in progress accompanying structure plan proposal **Hazard Assessment:** Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Nil **Additional Comments:** Nil **Reports:** MP Rogers October 2016 RAC Developments Monkey Mia Resort CHRMAP
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Ongoing coastal movement data collection, possibly geotechnical
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	5 public assets susceptible to erosion hazard. Car park at Monkey Mia Road loop, access to 2 jetties, boat ramp, informal access paths
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	13 public assets susceptible to erosion hazard. Car park at Monkey Mia Road loop, access to 2 jetties, boat ramp, informal access paths, foreshore park, gazebos in parks, Monkey Mia Dolphin Resort [5 assets], DBCA visitors centre Leasehold: Approx. 5 private assets, including resort/hotel/bar and some cabins (Beach front villas, pool, new cabins, Boughshed restaurant, backpackers)

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	13 public assets susceptible to erosion hazard with more area impacted (i.e. higher cost) than 5-25. Car park at Monkey Mia Road loop, access to 2 jetties, boat ramp, informal access paths, foreshore park, gazebos in parks, Monkey Mia Dolphin Resort [5 assets], DBCA visitors centre Leasehold: Including resort/hotel/bar, some cabins and backpackers (Beach front villas, pool, new cabins, Boughshed restaurant, backpackers)
Existing management	Avoid (Y - some areas of the resort have buffer to development), Retreat (N), Accommodate (N), Protect (Y - low walling presently fronts the narrow section of foreshore - unknown if this has formal approval)
Management options for Imminent timeframe (0–5 years)	Existing walling should only act to reduce sensitivity to erosion-recovery cycles. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Renourish at focal areas only, where direct beach access is required). Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. Review lease agreements with Monkey Mia Dolphin Resort to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L Prepare Plans - 50k Review lease agreement -50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: End of life for structures adjacent to coast; Erosion leading to walling failure causing damage to landward structures; **Monitoring**: Structural evaluation (every 2-3 years) **Alternate option:** If beach retreats causes walling failure, remove infrastructure.
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** General coastal retreat may be possible over this timeframe. Avoid (N), Retreat (Y - replace unprotected structures with alternatives to landward), Accommodate (N), Protect (Y - Continue use of existing walling, without adaptation / strengthening) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Protect - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: erosion stress on areas adjacent to walling. <5m to buildings, and erosion causing stress to existing walling **Monitoring**: Buffer width monitoring. Photographs of walling. **Alternate option:** Retreat - remove entire length of walling OR Protect - replace walling with strengthened structures.
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Progressive erosion will cause wall failure and eventually threaten existing buildings. Avoid (N), Retreat (Y - maintain function with retreat), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	EPA (2005) says not to protect. Only protect locally at focal access point commensurate with the timeframe of the asset. (No extension to existing walling) Interrupting sediment transport along the terrace and lower beach. (Do not project seaward). Any development without a clear agreement for erosion mitigation or plan for retreat with triggers.

Appendix D.8. Denham Townsite

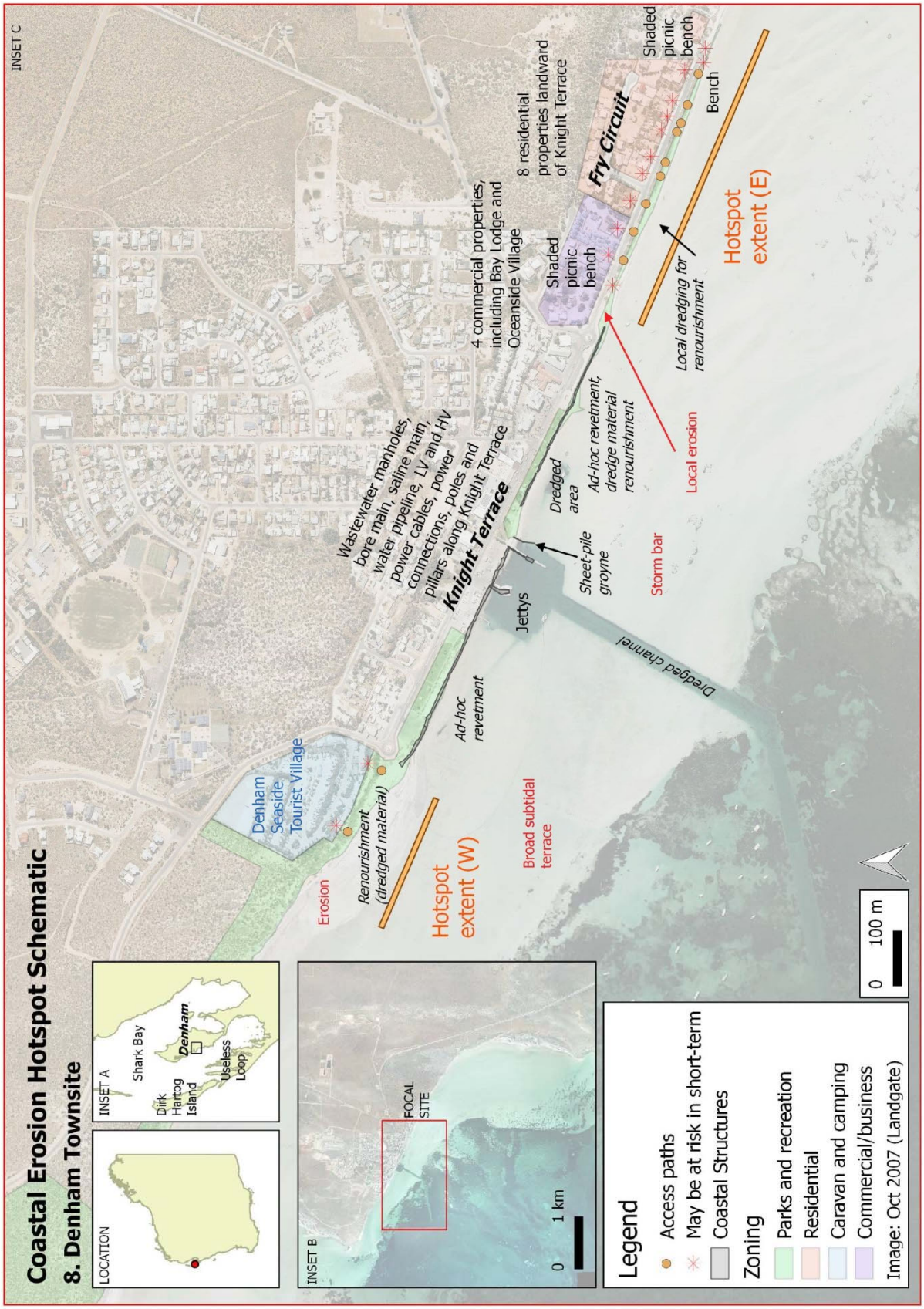

Figure D-8: Denham Townsite schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-8: Denham Townsite summary information

Hotspot No.	8
Hotspot Name	Denham Townsite
Local Coastal Manager	Shire of Shark Bay
Hotspot issue	The Denham foreshore is built on a storm bar with reclamation seaward of Knight Terrace. It was initially reclaimed via the pearling technique of dredging and dumping shells on the shore and subsequently from disposal of dredged material for the harbour and access channel (1978, 1980, 1986, 1990, 1997, 2004 and 2015). The reclaimed foreshore is susceptible to erosion and inundation (not considered in this assessment). Erosion is managed in the town through construction of a revetment and renourishment. The hotspot is separated into two sections, east and west of the existing revetment (see attached figure), excluding the central section of foreshore protected by the recently refurbished revetment, jetty and harbour. At the time of site selection it was deemed that the revetment had been reconstructed across the broader extent. The central portion of the foreshore should be assessed in future hotspot investigations. The eastern hotspot covers the extent of Knight Terrace and is at the northern end of a sediment transport pathway with some sediment supply from the subtidal terrace. The foreshore has been nourished in conjunction with a revetment at the eastern cul de sac on Knight Terrace. The western hotspot covers the Denham Seaside Tourist Village and is more vulnerable to erosion than the east, but has less public assets susceptible to erosion hazard of erosion damage. It is more vulnerable due to interruption of sediment transport along the terrace by the dredged channel. The present coastal alignment is maintained by the ongoing disposal of dredged material from the harbour and channel, although no formal agreement is in place for this arrangement. Ten publicly owned assets may be at risk of erosion damage in the area, with most in the east (see attached figure). Seven assets may be at risk in the short-term, including sand access paths (counted as one combined asset), benches, a shaded picnic table and water services (wastewater, water bore mains, saline main pipes and a local water pipeline). In the medium- to longer-term, an additional three assets are at risk, including up to 500m of Knight Terrace, a short section of Fry Circuit and electricity services along Knight Terrace. Twelve private properties may be at risk from erosion in the medium- to longer-term including Bay Lodge and Oceanside Village, with an additional seven vacant lots. The leasehold Denham Seaside Tourist Village may be at risk in the medium to long-term. The hotspots extend beyond the focal recreation areas of town with these sites used for walking and fishing.
Extent of erosion problem and hotspot characteristics	Hotspot is separated into two components (W and E) adjacent to the Knight Terrace revetment. The east hotspot covers the extent of Knight Terrace with residential area to landward and the west covers the Denham Seaside Tourist Village. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Scheduled for 2017-18 **Hazard Assessment:** Nil **Management & Adaptation Options:** Nil **Additional Comments:** Nil **Reports:** Nil
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	7 public assets susceptible to erosion hazard. 13 informal access paths, benches, picnic table/hut. Services: 5 trafficable wastewater manholes, bore main, saline main, 80AC water pipeline

Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	11 public assets susceptible to erosion hazard. 13 informal access paths, 530m of Knight Terrace, 20m of Fry Circuit, benches, picnic table/hut, Denham Seaside Tourist Village Services: 5 trafficable wastewater manholes, bore main, saline main, 80AC water pipeline, LV power cables, HV power distribution cables, power connector points, power poles and pillars along Knight Terrace. Private Property: 19 on Knight Terrace, including Bay Lodge and Oceanside Village (and seven vacant lots). Leasehold: Denham Seaside Tourist Village
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	11 public assets susceptible to erosion hazard. 13 informal access paths, 530m of Knight Terrace, 60m of Fry Circuit, benches, picnic table/hut, Denham Seaside Tourist Village. Services: 5 trafficable wastewater manholes, bore main, saline main, 80AC water pipeline, LV power cables, HV power distribution cables, power connector points, power poles and pillars along Knight Terrace. Private Property: 19 on Knight Terrace, including Bay Lodge and Oceanside Village (and seven vacant lots). Leasehold: Denham Seaside Tourist Village
Existing management	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - (West) Renourishment using dredged material from channel and harbour (ongoing) and (East) local dredging to renourish focal areas of erosion in front of road. Small revetment at cul de sac. Note: partially upgraded revetment located between the two hotspots)
Management options for Imminent timeframe (0–5 years)	***West*** **Anticipated behaviour:** gradual erosion of renourished materials, with minor rapid storm loss**.** Avoid (N), Retreat (N), Accommodate (N), Protect (Y - renourishment with dredge materials) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. ***East*** **Anticipated behaviour:** Minor episodic storm loss, releasing sand drift onto road area. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - minor embankment repairs and revegetation as required) Review lease agreements with caravan park to clarify responsibilities for coastal erosion mitigation.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - M Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	***West*:** **Trigger for next level management**: loss of sand buffer (i.e. distance to assets is <10m) **Monitoring**: Buffer width **Alternate option:** Retreat ***East*:** **Trigger for next level management:** Foredune is unable to support vegetation, with more than 30% by length either scarped or denuded of vegetation. Alternate trigger is sand drift on the road for more than 2 occasions per year. **Monitoring:** Photographic Monitoring **Alternate option:** Protect - Bioengineer the foredune area.

Management and adaptation options for Expected timeframe (5–25 years)	***West*** **Anticipated behaviour:** Available volume of renourishment insufficient to prevent net erosion**.** Avoid (N), Retreat (Y - retreat at some point in front row of chalets), Accommodate (N), Protect (Y - renourishment from another dredging campaign will extend life. Terrestrial renourishment materials must be analysed for appropriate beach use grade and quality prior to use) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. ***East*** **Anticipated behaviour**: Net erosion causing contraction of foredune**.** Avoid (N), Retreat (N), Accommodate (Y - dune management to deal with drift and shift towards protect), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Accommodate - L Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	***West*:** **Trigger for next level management**: Existing sources for renourishment insufficient (i.e. supply does not occur as a beneficial use of dredging). **Monitoring**: n/a **Alternate option:** Protect - find a source of sediment to use for renourishment OR extend walling (not recommended). ***East*:** **Trigger for next level management:** Exposure of existing road sub-base for more than 20m along Knight Terrace. **Monitoring:** Photographic / measurement. **Alternate option:** Protect - extend walling (not recommended).
Management and adaptation options for Projected timeframe (25+ years).	***West*** **Anticipated behaviour:** Buffer retreat (erosion) impacting on caravan park area. Avoid (N), Retreat (Y - Broad scale managed retreat), Accommodate (N), Protect (N) ***Central*** Protect (Y - adapt existing walling to cater for any deepening occurring across the terrace) ***East*** **Anticipated behaviour:** Widespread retreat along the length of Denham foreshore. Avoid (N), Retreat (Y - three properties. Note: Longer-term may need to retreat all 12 properties along Knight Terrace), Accommodate (Y - change access to properties and extend Fry circuit, truncating Knight Terrace west of commercial area), Protect (N)
Works to avoid to achieve long-term plans	***West*:** Keep tourist village to be leasehold and modify lease to have a management trigger for retreat. Any development that limits capacity for long-term retreat of knight terrace. ***East*:** Stop borrowing sand from terrace for local renourishment. Avoid seaward extension of infrastructure/development past the existing foreshore seawall line

Appendix D.9. Horrocks Foreshore

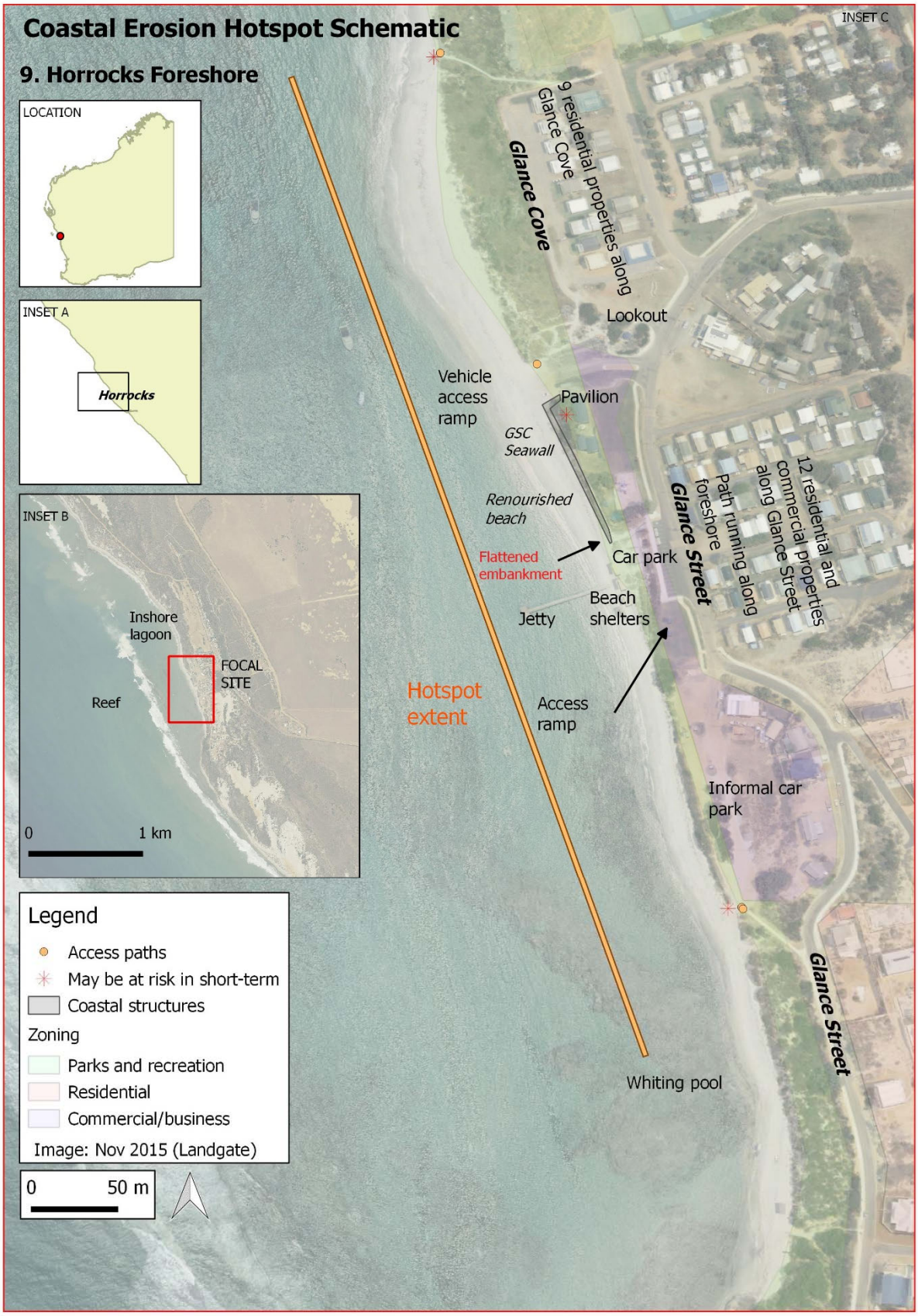

Figure D-9: Horrocks Foreshore schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-9: Horrocks Foreshore summary information

Hotspot No.	9
Hotspot Name	Horrocks Foreshore
Local Coastal Manager	Shire of Northampton
Hotspot issue	Horrocks townsite was freeholded from a Lands Department leasehold holiday cottage. The freeholding, removal of many cottages in the 1970's and subsequent establishment of recreational facilities on a foreshore subject to cyclic erosion has resulted in a coastal management issue. Horrocks beach is within an inshore basin, fronted by reef, which provides shelter from unattenuated ocean waves except under storm conditions, when storms are from the NW or during periods of higher mean sea level. Sand is shifted along the broader foreshore within the basin. A geosynthetic sand container seawall was installed in 2011 to protect the pavilion, toilet block and park from erosion, along with regrading of the slope of the foreshore south of the jetty for safety. Fifteen publicly owned assets may be at risk of erosion damage in the area (see attached figure), with five assets at risk of damage in the short-term, including beach shelters (easily replaced and maintained when required) and beach access points. In the longer term, assets within the commercial and business zone are high value assets at risk, including Glance Street and its lighting and services (water, power, and communications) as well as private properties along Glance Street and Glance Cove. The beach is used for walking, swimming, boat launching, fishing, surfing, snorkelling and driving. The Horrocks Progress Association has an active interest in the management of the coast.
Extent of erosion problem and hotspot characteristics	From SE end of Glance street informal carpark to N end of North Circuit. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status**: Not Scheduled **Hazard Assessment:** Essential Environmental (2015) - Qualitative assessment identifies risk of erosion to Horrocks Beach. **Management & Adaptation Options:** Essential Environmental (2015) identifies the following coastal management options: managed retreat, design of facilities to facilitate shoreline movement and periodic erosion and/or accretion of the beach; maintenance and re-build of the dune buffer; engineering protection. **Additional Comments:** Nil **Reports:** Essential Environmental (2015) Horrocks Beach Coastal Management Strategy. Prepared by Essential Environmental for Shire of Northampton. Rev. 4, 9-Apr-2015 Coastal Focus (2012) Horrocks Beach Foreshore Restoration Plan: A Community Project. Prepared for the Horrocks Progress Association and the Shire of Northampton.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Littoral transport and possibly geotechnical
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	5 public assets susceptible to erosion hazard. Four gazebos, access paths.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	11 public assets susceptible to erosion hazard. Path, vehicle access ramp, car park, park with pavilion, toilet block and four gazebos, access paths.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	16 public assets susceptible to erosion hazard. Glance Street, Glance Cove, path, vehicle access ramp, jetty, car park, strip parking, park with pavilion, toilet block and four gazebos, access paths. Services: water, power and telecommunications. Private properties: 21 (12 residential and commercial on Glance St, 9 on Glance Cove).

Existing management	Avoid (N), Retreat (Y - Relocated town lookout), Accommodate (Y -Bank regrading at scarps near jetty. Increasing safety and theoretically increases stability), Protect (Y - GSC revetment installed in 2011 to protect the pavilion, toilet block and park)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Storm erosion will result in enhanced erosion of foreshores adjacent to GSC structure, transferring hazard including erosion of adjacent vehicle access to the beach, in combination with ongoing stormwater scour. Avoid (N), Retreat (N), Accommodate (Y -Increased maintenance at toe of vehicle access ramp. Avoid overinvestment in fixed infrastructure), Protect (Y-Maintain GSC revetment, increased maintenance of vehicle access ramp to N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L Protect - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management**: Intolerable threats to foreshore to the S of the GSC revetment by acute erosion following progressive retreat in response to foreshore stabilisation. Intolerable undermining of vehicle access area to the N. **Monitoring**: Buffer width remaining N and S of GSC revetment. **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Progressive general retreat will be locally exacerbated by protection structures (e.g. GSC revetment) extending seaward of the adjacent foreshore, due to the transfer of erosion stress. Erosion into town centre car park anticipated. Avoid (N), Retreat (Y - Relocate facilities further landward (pavilion, toilet block, lookout again, vehicle access ramp, car parking in commercial/business centre)), Accommodate (N), Protect (Y -Some renourishment for emergency response to episodic erosion. Maintain GSC revetment with increased maintenance of the vehicle access ramp to N until trigger is reached. Then remove.) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management**: Car park and properties seaward of Glance Street in commercial/business district threatened by acute storm erosion following continued retreat and reaction to foreshore stabilisation. **Monitoring**: Buffer width to car park at jetty and buffer width to properties in commercial/business district. **Alternate option**: N/A
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Long-term retreat will threaten commercial/business area seaward of Glance Street, car park on Glance Street, loss of parkland with pavilion and intrusion into the caravan park; as well as Glance Cove and 9 properties along Glance Cove. Possible damage to Glance St in the South (depends on supply of sand from the S) Avoid (N), Retreat (Y -Retreat of private property to establish alternate foreshore reserve locations and re-establish facilities. Relocate carpark near jetty. Remove front row of 9 holiday shacks along Glance Cove), Accommodate (N), Protect (Y - Some renourishment for emergency response to episodic erosion. Provide seawall structure to protect Glance Street with private properties in the S (not recommended))

Works to avoid to achieve long-term plans	Investment in recreation facilities 50m N of the GSC revetment. High value or long-term facilities seaward of Glance Street, increased development of the business/commercial district seaward of Glance Street; along with further development to the N of Glance Cove. Further stabilisation of the foreshore because any foreshore stabilisation interrupts the fluctuating transport and will result in locally enhanced erosion.

Appendix D.10. Drummond Cove, Geraldton

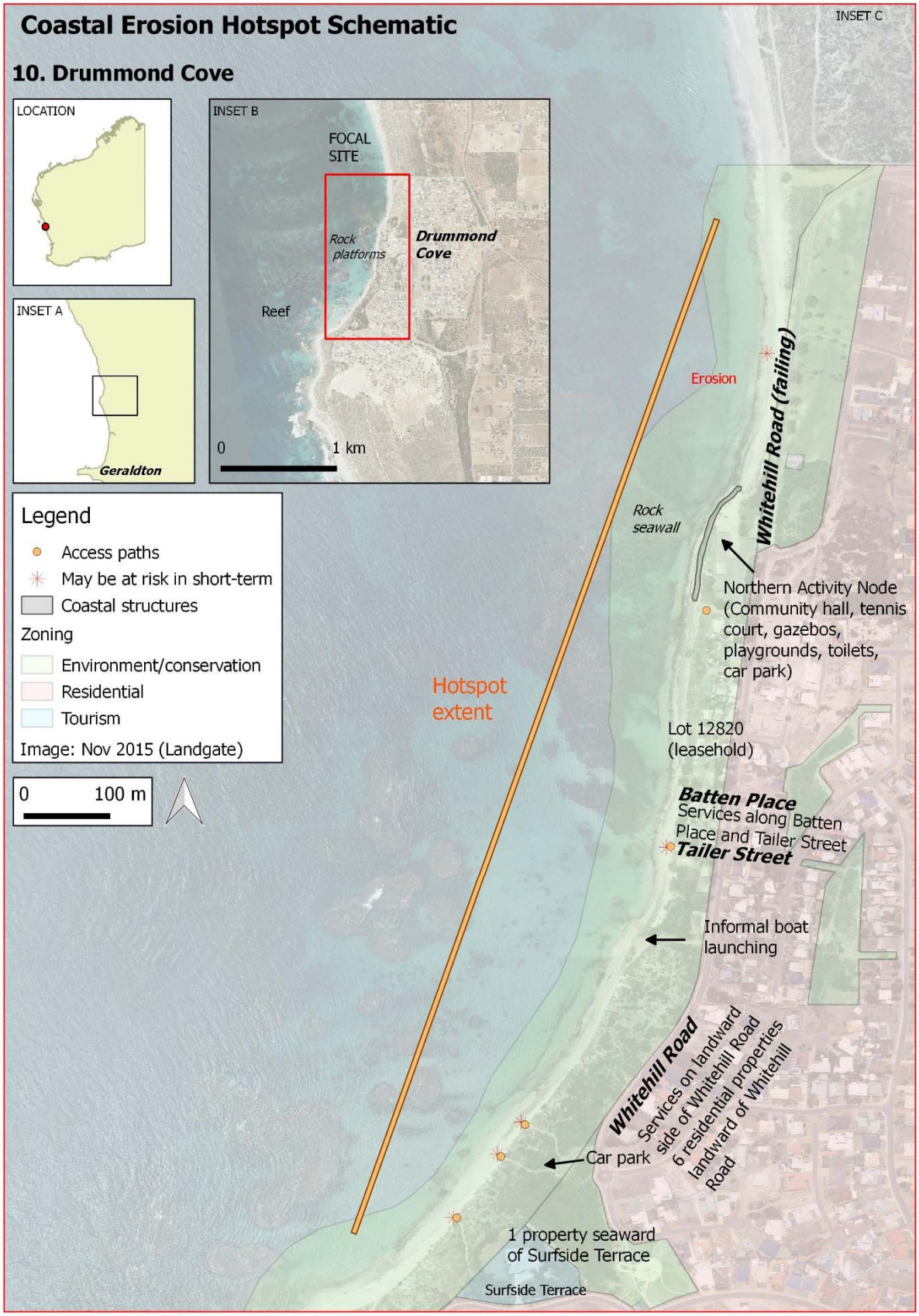

Figure D-10: Drummond Cove, Geraldton schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-10: Drummond Cove, Geraldton summary information

Hotspot No.	10
Hotspot Name	Drummond Cove, Geraldton
Local Coastal Manager	City of Greater Geraldton
Hotspot issue	Drummond Cove is on the updrift flank of a tombolo, a sandy headland tied to a rock outcrop, resulting in variability in foreshore position due to rock control, reef protection and sediment supply. Historically, recreational facilities have been located too close to the variable foreshore, exposed to erosion and inundation. Car parks, sport courts and shelters have been eroded, with a rock revetment installed to protect the Northern Activity Node in 2013. This has exacerbated downdrift erosion, further contributing to the loss of Whitehill Road. The extent of the underlying rock platform, and the influence on future foreshore stability is not known. Twelve publicly owned assets may be at risk of erosion damage in the area (see attached figure), with two assets at risk of damage in the short-term, including Whitehill Road and the beach access points. Assets in the Northern Activity Node (tennis court, gazebos, playgrounds, toilets, car park) are located behind a rock revetment. The properties in Lot 12820 along Whitehill Road are leasehold and are scheduled to be removed with some buildings already demolished. In the longer term, Whitehill Road, underlying services and up to 7 private properties (1 on Surfside Terrace, 6 on Whitehill Road) are high-value assets at risk. The Drummond Cove Progress Association have an active interest in the foreshore and consulted with community in 2014 regarding the future use of Lot 12820.
Extent of erosion problem and hotspot characteristics	Drummond Cove Suburb from just S of Drummond Cove Road to 2 Surfside Terrace Glenfield in the South, and includes Whitehill Road. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparent costs of likely forms of erosion mitigation are high. • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** In Progress **Hazard Assessment:** MRA (2016) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Next stages of CHRMAP schedule to commence in 2017. Partial retreat is currently being implemented with the removal of leasehold properties to the west of Whitehill Road. **Additional Comments:** Nil **Reports:** MRA (2016) Town Beach to Drummond Cove Inundation & Coastal Processes Study. Prepared by M P Rogers & Associates for City of Greater Geraldton. Report R675 Rev. 0, 23-Mar-2016 Codesign Studio Limited (2014) Drummond Cove Beach Front Community Engagement Report and Design Guidelines. Prepared for Drummond Cove Progress Association. Rev. 01, Feb-2014
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Geotechnical, littoral transport and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	2 public assets susceptible to erosion hazard. Whitehill Road, toe of access paths. Leasehold: Shacks on Lot 12820 (no commercial/community interest so not included as public asset)
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	9 public assets susceptible to erosion hazard. Whitehill Road, *Northern Activity Node behind rock revetment (Community hall, tennis court, gazebos, playgrounds, toilets, car park), informal boat launching at Seacrest Way, toe of access paths. Leasehold: Shacks on Lot 12820 (no commercial/community interest so not included as public asset)

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	11 public assets susceptible to erosion hazard. Whitehill Rd, Car park in S, *Northern Activity Node behind rock revetment (Hall, tennis court, gazebos, play-grounds, toilets, car park), informal boat launching at Seacrest Way, toe of access paths. Services: power, fiber and water. Leasehold: Shacks on Lot 12820 (not commercial/community. Not a public asset) Private properties: 7 (1 on Surfside Terrace and 6 on Whitehill Road).
Existing management	Retreat of properties on Lot12820, protect Northern Activity Node and allow Whitehill Road to retreat. Avoid (N), Retreat (Y - Ongoing removal of houses on Lot 12820. Allow failure of Whitehill Road), Accommodate (N), Protect (Y - Rock revetment at northern activity node. Renourishment in 2016 (5000m3) and 2017 (3000m3).)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Further retreat anticipated. Avoid (N), Retreat (Y - Continued removal of houses on Lot 12820. Alternate siting of a road and services required for Whitehill Road now. Alternate siting required for land uses in the northern activity node now), Accommodate (N), Protect (Y- Maintain rock revetment at northern activity node until alternate siting of facilities occurs) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - M Protect - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Further retreat from present (eroded) position within 5 years **Monitoring:** Buffer width **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Progressive general retreat. Removal of rock revetment should reduce the focal nature of erosion and disperse the stress along the broader foreshore. Avoid (N), Retreat (Y -Remove services and roads in Lot 12820 as they become under threat. Ensure rock revetment is removed once northern activity node facilities moved. Continued removal of houses on Lot 12820 (at cost to lessee)), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** southern Whitehill Road or Estuary Way threatened by acute storm erosion following continued retreat **Monitoring:** Buffer width to southern Whitehill Road, Estuary Way or Boat Cove. **Alternate option:** N/A
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Long-term retreat will threaten broader foreshore including private properties landward of Whitehill Road, Estuary Way or Boat Cove. Avoid (N), Retreat (Y - Retreat of residential properties. Develop alternate access driveways for private properties adjacent to Whitehall Road, Estuary Way and Boat Cove. Develop alternate sites for services underlying Whitehill Road), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	High value or long-term facilities either side of Whitehill Road, Estuary Way and Boat Cove. Foreshore stabilisation. Stop infill and further investment.

Appendix D.11. Sunset Beach, Geraldton

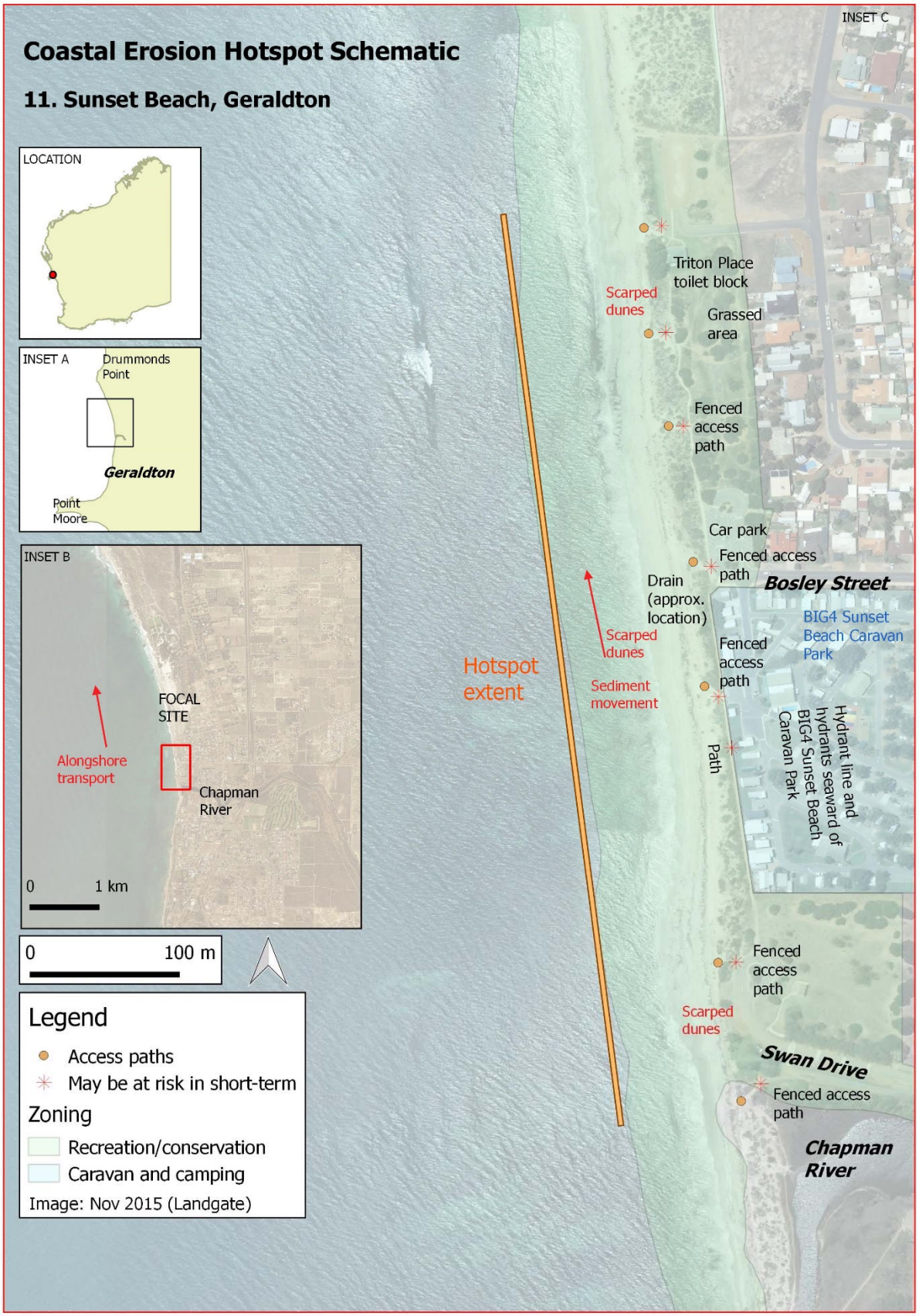

Figure D-11: Sunset Beach, Geraldton schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-11: Sunset Beach, Geraldton summary information

Hotspot No.	11
Hotspot Name	Sunset Beach, Geraldton
Local Coastal Manager	Greater Geraldton
Hotspot issue	The Sunset Beach hotspot extends from the northern extent of the Chapman River mouth (at Swan Drive) through to Triton Place, within a broader section of coast between Point Moore and Drummonds Point. The coast is subject to storms, wind and waves, with some shelter from offshore reefs and intermittent exchange of sand between the coast and the bar across the river mouth. The foreshore is modified, with active dunes levelled during the initial site development and pindan soil placed over the levelled area (Kerr 1984). Some sand is lost from the beach into small, active blowouts with ongoing scarping along the coast attributed to occasional storm erosion and reduced resilience due to historic modifications. Localised erosion occurs due to a stormwater drain discharged onto the scarp. Past management has included the truncation and removal of Swan Drive, as well as efforts to mitigate the impact of stormwater outfall through diversion to the Bosley Street POS. Seventeen publicly owned assets may be at risk of erosion damage in the area (see attached figure), seven of which may be at risk in the short-term. This includes four fenced access paths, 200m of path fronting the BIG4 Sunset Beach Holiday Park, a stormwater drain and two sand access paths (counted as one combined asset). In the medium to longer-term, Bosley Street car park, a grassed park area, the toilet block at Triton Place, services seaward of the holiday park (fire hydrants and hydrant line) and 100m of Swan Drive may be at risk. The leasehold BIG4 Sunset Beach Holiday Park is at risk in the medium-term; the proposed lease extension (ending 2051) includes an increase to the portion of the lease subject to managed retreat, in line with recent studies. Sunset beach is a local beach with a variety of recreational uses including swimming, snorkelling, fishing, and park use and beach activities. Sunset Beach Community Group is a non-governmental stakeholder that is likely to have an active interest in how this foreshore is managed.
Extent of erosion problem and hotspot characteristics	Sunset Beach between the northern extent of the Chapman River mouth (at Swan Drive), to Triton Place. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability).
CHRMAP status and findings	**CHRMAP Status:** In Progress - Next stages of CHRMAP schedule to commence in 2017. CHRMAP for whole coastline draft report due in Feb 2018 **Hazard Assessment:** MRA (2016) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Next stages of CHRMAP schedule to commence in 2017. Management options up to 2030 previously identified by Worley Parsons (2010) as: managed retreat; capital sand nourishment with ongoing sand nourishment; or buried seawall with ongoing sand nourishment. **Additional Comments:** Nil **Reports:** MRA (2016) Town Beach to Drummond Cove Inundation & Coastal Processes Study. Prepared by M P Rogers & Associates for City of Greater Geraldton. Report R675 Rev. 0 Worley Parsons (2010) Coastal Processes Study - Greys Beach to Sunset Beach. Prepared by Worley Parsons for the City of Geraldton-Greenough. Report 301012-01151
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Renourishment source, possibly geotechnical and ongoing coastal movement data collection. NACC photo monitoring is ongoing.
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	6 public assets susceptible to erosion hazard. 4 fenced access paths, footpath in front of holiday park (230m), and 2 informal access tracks.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	12 public assets susceptible to erosion hazard. 70m of Swan Dr, BIG4 Sunset Beach Holiday Park, 4 fenced access paths, footpath in front of holiday park (230m), Bosley Street carpark, 2 informal access tracks, grassed area, toilet block (Triton Pl). Services: Hydrant line with 10 non-trafficable manholes, 7 hydrant tees and 3 hydrants

	Leasehold: Sunset Beach Holiday Park
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	16 public assets susceptible to erosion hazard. 100m of Swan Dr, BIG4 Sunset Beach Holiday Park, 4 fenced access paths, footpath in front of holiday park (230m), end of Bosley Street, Bosley Street carpark, 2 informal access tracks, grassed area, toilet block (Triton Place). Services: Hydrant line with 10 non-trafficable manholes, 7 hydrant tees and 3 hydrants Leasehold: Sunset Beach Holiday Park
Existing management	**Existing behaviour:** Modified foreshore. When the site was first developed, the dunes were levelled, and pindan soil was deposited seaward over levelled area to form a scarp (Kerr 1984). Avoid (N), Retreat (Y - Swan Drive was truncated and removed previously (referred to in Kerr 1984). Drainage modified to remove discharge onto dunes), Accommodate (N), Protect (Y - Renourishment may have occurred)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Limited existing threat from storm erosion. Sand dunes are presently unstable. Avoid (N), Retreat (N), Accommodate (Y - sand drift management; restrict access to dunes by fencing; Review lease agreement), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. Review lease agreements with caravan park to clarify responsibilities for coastal erosion mitigation and for facilitation of future retreat.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Accommodate - L (assuming no compensation for caravan park lease agreement) Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Dune width <5m. **Monitoring:** Buffer width measurement **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Front of lease and associated buildings will be threatened by storm erosion following moderate retreat. Avoid (N), Retreat (Y - particular focus on front row of buildings at caravan park, hydrant line (services), with consideration of toilet block and car parks), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M (assuming no compensation required for leasehold buildings) Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5-25 years)	**Trigger for next level management:** Buffer width of less than 15m from HSD. **Monitoring:** Buffer width measurement (Aerial imagery). **Alternate option:** Accommodate - property level protection (housing design to tolerate dune movement).
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Progressive erosion will cause landward relocation of dune processes, with potential for storm threat to properties and leases. Avoid (N), Retreat (Y - Rolling (i.e. as needed), managed retreat), Accommodate (N), Protect (N)

Works to avoid to achieve long-term plans	Erosion has been an issue for >30 years. Development should be discontinued. Hard protection structures should be avoided, as their implementation in the short term may threaten retreat options in the long term. Avoid any further development/formalisation of the caravan park (i.e. converting from lease to freehold).

Appendix D.12. Beresford, Geraldton

Figure D-12: Beresford, Geraldton schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-12: Beresford, Geraldton summary information

Hotspot No.	12
Hotspot Name	Beresford, Geraldton
Local Coastal Manager	City of Greater Geraldton
Hotspot issue	A management option of a breakwater extension, groyne extension and three revetments has been approved for Beresford foreshore, an already modified foreshore on a rock platform. The management option includes the creation of an artificial beach. The Midwest Ports Authority will continue the sand bypassing exercise to the north. It is likely to be difficult to retain the sandy beach on the rock platform under rising sea levels. Nine publicly owned assets may be at risk of erosion damage in the area (see attached figure), with only two assets at risk of damage in the short-term, including beach access points and a staircase access to the beach. In the longer term, Chapman Road, the associated lighting and services (gas, communications fibre, phone, water, power) and 10 private properties on Chapman Road are high-value assets at risk. The main foreshore uses are walking, cycling, using the parks and fishing.
Extent of erosion problem and hotspot characteristics	North of Batavia Coast Marina along Chapman Road between Phelps St and Mabel Street Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** In Progress - Next stages of CHRMAP schedule to commence in 2017 **Hazard Assessment:** MRA (2016) - Erosion risk identified as Imminent (0-5 years) **Management & Adaptation Options:** Contract awarded for the construction of protection structures & sand nourishment **Additional Comments:** Site of ongoing sand nourishment from sand bypassing by the Mid-West Ports Authority. **Reports:** MRA (2016) Town Beach to Drummond Cove Inundation & Coastal Processes Study. Prepared by M P Rogers & Associates for City of Greater Geraldton. Report R675 Rev. 0, 23-Mar-2016
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Sedimentology, possibly geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	3 public assets susceptible to erosion hazard. Path (N), stairs access, access paths (4),
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	5 public assets susceptible to erosion hazard. * Chapman Road, foreshore path, stairs access, park with gazebo, access paths (4)
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	9 public assets susceptible to erosion hazard. Chapman Road, park with gazebo, stairs access, 4 access paths. Services: lights, gas, fiber, phone, water, power. Private property: 10 landward of Chapman Road
Existing management	Avoid (Y - Buffer to road reserve has been established by previous relocation of rail reserve), Retreat (N), Accommodate (Y - Port sand bypassing program), Protect (Y -Seawalls constructed along segments of foreshore)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Existing rates of sand bypassing have proven ineffective to support coastal stability, with progressive erosion greater than the volume of placed material. Avoid (N), Retreat (Y - Small capacity to relocate dual use path), Accommodate (Y - Increased effectiveness of sand bypassing is required (improved placement and frequency)), Protect (Y - Extension of existing coastal protection alongshore)

Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - L Accommodate - L Protect - H
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	Trigger for next level management: Road reserve under threat from acute erosion. Damage to dual use path could be used, or flanking of existing revetments. Monitoring: Photographic monitoring. Alternate option: N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Alongshore transfer of erosion (to downdrift) is likely to occur in response to any protection works. This may partly reduce north of Beresford due to change in aspect. Avoid (N), Retreat (N), Accommodate (Y - Sand bypassing will require placement near Cecily Street), Protect (Y - Protection to extend the 1.5km length of Beresford)
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Accommodate - M Protect - H
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Sand bypassing not effective at providing beach amenity **Monitoring:** Beach stability **Alternate option:** N/A
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Higher sea levels are likely to reduce the shelter provided by reefs and sand retention on the rock platforms. Cross-shore loss likely. Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Protection using continuous seawall)
Works to avoid to achieve long-term plans	Mass renourishment exercises (due to inefficiency. The sand from pages beach which is used for renourishment is far too fine to be of enduring value. The original beach is known to have been quite coarse (above 0.5 mm))

Appendix D.13. Point Moore, Geraldton

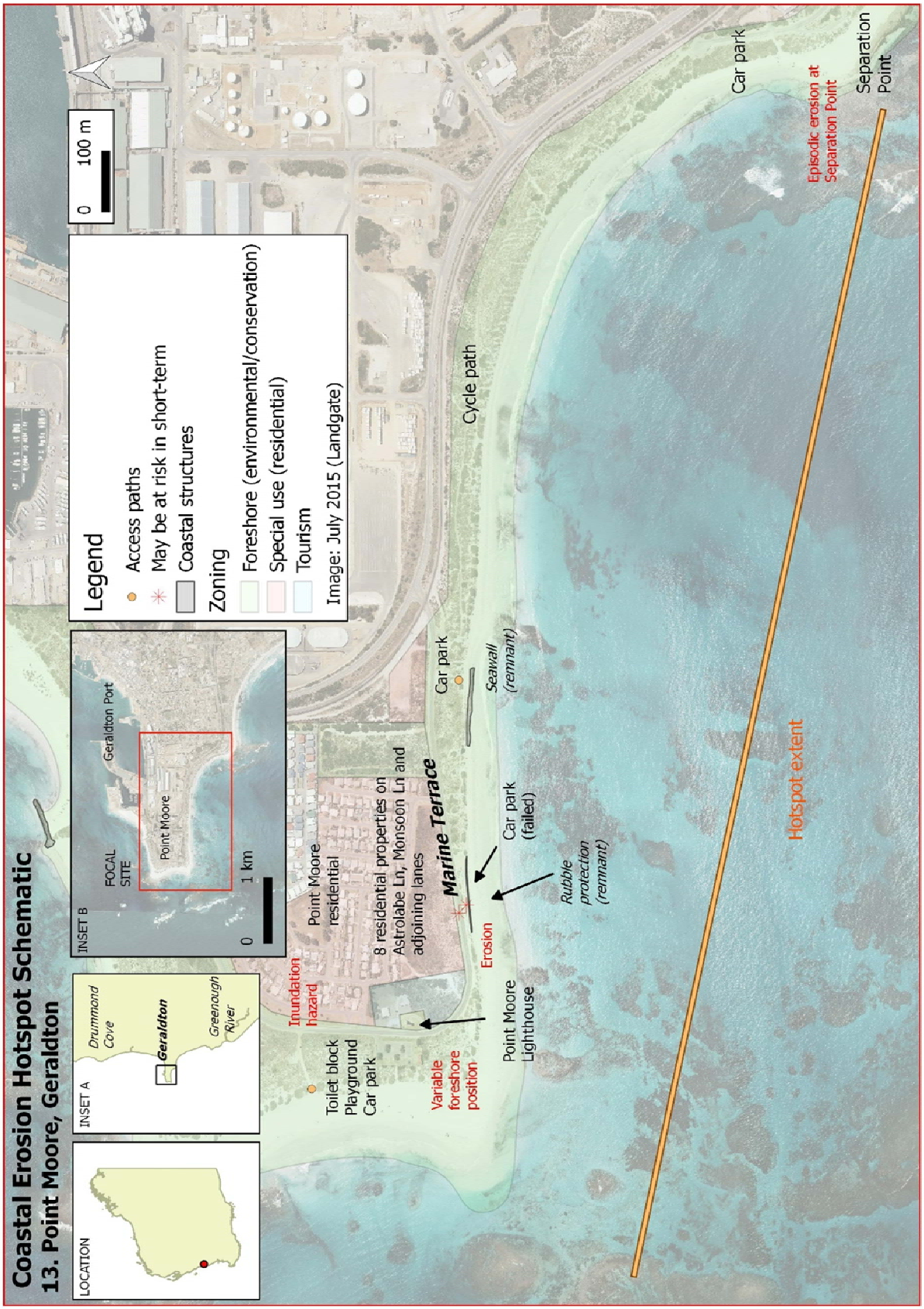

Figure D-13: Point Moore, Geraldton schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-13: Point Moore, Geraldton summary information

Hotspot No.	13
Hotspot Name	Point Moore, Geraldton
Local Coastal Manager	City of Greater Geraldton
Hotspot issue	Greys Beach is located on southern Point Moore, a complex of cuspate forelands with rock outcrops and variable sediment supply controlling the beach position. The southern shore of Point Moore (Greys) is presently eroding and migrating, whereas the west and north facing shores are accretionary. It is anticipated erosion will be cyclic and progressive at this site, with downdrift erosion adjacent to rock outcrops. There is inundation hazard to the Point Moore residents due to the low lying nature of the land. Management of the site has included moving Wilcox Drive landward in the 1960s, dumping tyres, dumping rock (not designed as a revetment), installing fences and allowing the loss of a car park. Eight publicly owned assets may be at risk of erosion damage in the area (see attached figure), with three assets at risk of damage in the short-term, including a failed carpark, beach access paths and Marine Terrace. In the longer term, eight private properties may be impacted, as well as the lighthouse. The foreshore is used for swimming, cycling, walking, car parking and the playground. The community group Friends of Point Moore have an interest in the management of the foreshore.
Extent of erosion problem and hotspot characteristics	Southern side of tombolo subject to erosion with facilities threatened. Northern side susceptible to inundation. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** In Progress - Next stages of CHRMAP schedule to commence in 2017 **Hazard Assessment:** MRA (2016) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Partial protection recently implemented with the construction of a seawall at the toe of the dune at Greys Beach. **Additional Comments:** Management options for the next 20 years previously identified by Worley Parsons (2010) as: managed retreat; capital sand nourishment with ongoing sand nourishment; or buried seawall with ongoing sand nourishment. **Reports**: MRA (2016) Town Beach to Drummond Cove Inundation & Coastal Processes Study. Prepared by M P Rogers & Associates for City of Greater Geraldton. Report R675 Rev. 0, Worley Parsons (2010) Coastal Processes Study - Greys Beach to Sunset Beach. Prepared by Worley Parsons for the City of Geraldton-Greenough. Report 301012-01151, 16-Sep-2010 MRA (2017) Cape Burney to Greys Beach Inundation & Coastal Processes Study. Prepared by M P Rogers & Associates for City of Greater Geraldton, Report R810 Rev 0. NOT REVIEWED. Provided subsequent to the assessment of this hotspot.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	3 public assets susceptible to erosion hazard. Marine Terrace Road, car park (failing), access paths.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	3 public assets susceptible to erosion hazard. Marine Terrace Road, car park (failing), access paths.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	9 public assets susceptible to erosion hazard. Marine Terrace road, cycle path, car park x 3, toilet block, playground, lighthouse, access points, Leasehold may be impacted in this timeframe. Private property: 8 on Astrolabe Ln, Monsoon Ln and adjoining lanes (Belair Lifestyle Village)

Existing management	Removal of carpark following severe storm erosion. Avoid (N), Retreat (Y - removal of car park), Accommodate (N), Protect (N)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Storm erosion will affect carparks, cause sand drift on Marine Terrace and provide and possibly erode Marine Terrace. Avoid (N), Retreat (Y - Removal of carparks following severe storm erosion), Accommodate (Y - Manage sand drift (brushing & fencing), provide alternative viewing decks (piled), Reduce carparks, use unpaved surface), Protect (N) Consider use of sandbags as emergency protection to prevent beach pollution by carpark material, to be removed immediately afterwards) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - L Accommodate - L Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Storm erosion threat to Marine Terrace (already under threat) **Monitoring:** Dune width **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Sensitivity to erosive phases will increase. Avoid (N), Retreat (Y - Relocate/truncate Marine Terrace), Accommodate (Y - Enhance tendency for dune growth by building brush node on the southern side of West End), Protect (N) Consider use of sandbag groyne at West End to temporarily help support Marine Terrace prior to relocation. Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H Accommodate - L Protect - L Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Sand drift on to road creates safety liability (more frequent than 1-2 times per year) **Monitoring:** Dune width & mobility (sand sheet coverage) **Alternate option**: Rock groyne at West End to modify arcuate beach structure to retain sand on Greys Beach.
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Under a sea level rise scenario, Marine Terrace will become part of active foredune area. Avoid (N), Retreat (Y - Relocate/truncate Marine Terrace), Accommodate (N), Protect (N)
Works to avoid to achieve long-term plans	Rebuilding in the foredune. Revetments, as they will rapidly fail. Groynes built partly along the arcuate beach and therefore will cause downdrift erosion

Appendix D.14. Grannies Beach, Irwin

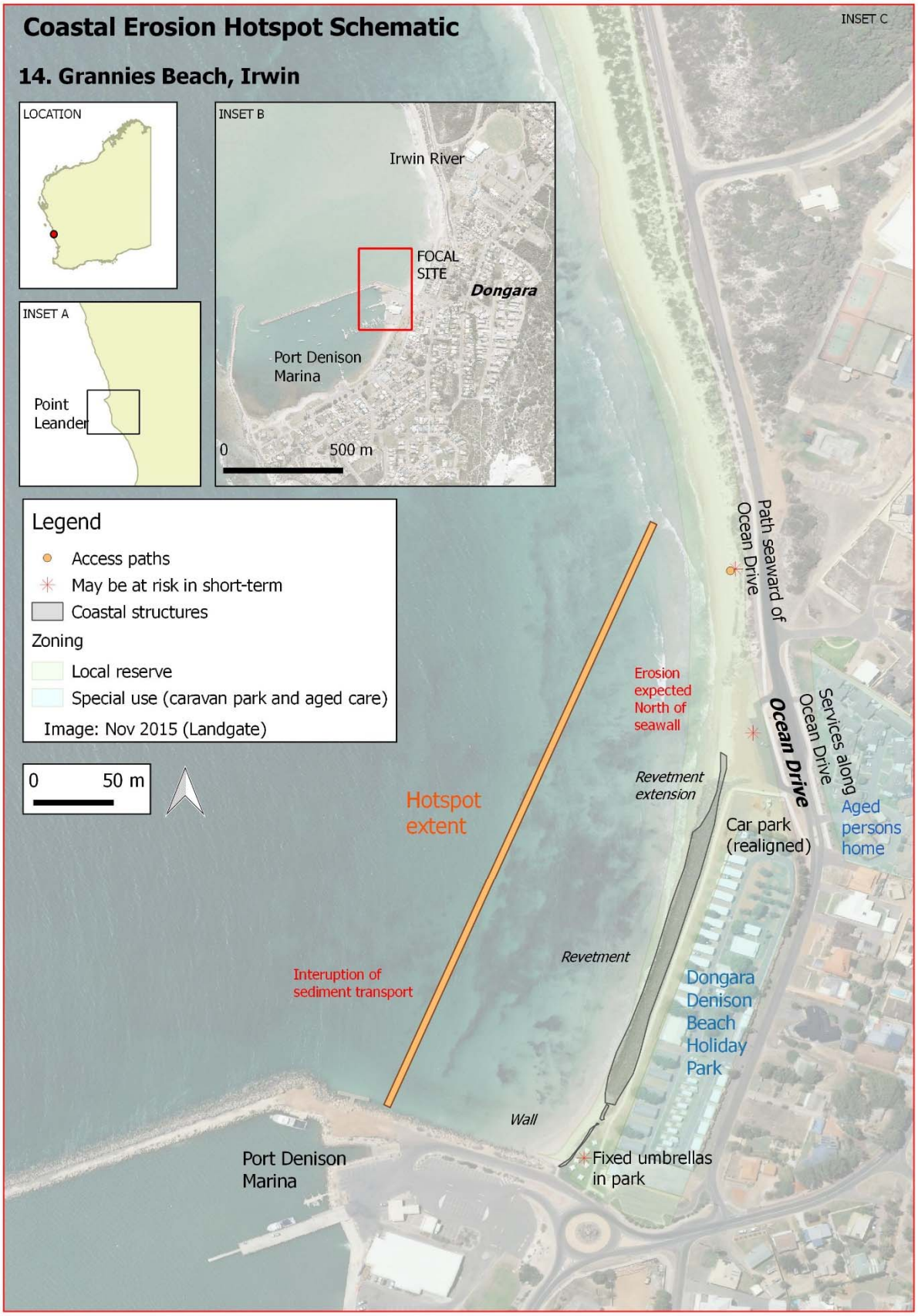

Figure D-14: Grannies Beach, Irwin schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-14: Grannies Beach, Irwin summary information

Hotspot No.	14
Hotspot Name	Grannies Beach, Irwin
Local Coastal Manager	Shire of Irwin
Hotspot issue	Erosion at Grannies Beach in Dongara has occurred progressively in response to construction of the Port Denison Marina modifying an embayment and truncating sediment transport from the south. Grannies Beach was originally in the central part of a half heart shaped embayment controlled by rock outcrops at Leander Point and in the vicinity of the Irwin River mouth. It was intermittently supplied by sediment from the south, bioproduction from offshore reefs, and sediment discharge from the Irwin River during flood events; the latter two components have been insufficient to compensate for the loss of sand from the south. Erosion has threatened the Dongara Denison Beach Holiday Park, which would have been sited as a relocatable asset, resulting in the construction of a rock revetment. This revetment has enhanced erosion due to regularly reflecting wave action creating a loss of a permanent beach, and transfer of the erosion hazard to the north. Most recently the revetment was extended north and the car park was modified. Eight publicly owned assets may be at risk of erosion damage in the area (see attached figure), with four assets at risk of damage in the short-term, including shade umbrellas, beach access points, the path and the reconstructed car park. In the longer term, Ocean Drive, Marine Heights, the leasehold caravan park, and associated services (critical water pipeline, phone, and power), as well six private properties are high-value assets at risk. The main recreational uses of the site are swimming, surfing, windsurfing/kitesurfing, walking and cycling. The Dongara community have an active interest in the management of this foreshore.
Extent of erosion problem and hotspot characteristics	From N side of Port Denison Marina to 95m N of Marina Heights Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Complete **Hazard Assessment:** Curtin (2016) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options**: 2016 CHRMAP - Study area Shire of Irwin coastline, with focus on key beaches. Recommendations Granny's Beach and Surf Beach by 2021: to monitor coastal processes; and investigate the need for coastal protection structures to protect/defend areas from erosion. **Additional Comments:** Nil **Reports:** Shire of Irwin, Curtin University and the Northern Agricultural Catchments Council (2016) Coastal Hazard Risk Management and Adaptation Plan (CHRMAP), June 2016. Curtin (2016) Modelling of Coastal Inundation and Erosion Process at Shire of Irwin Coastal Region. Prepared by Curtin University for the Shire of Irwin. 30-Mar-2016
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Renourishment source and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	4 public assets susceptible to erosion hazard. Path, car park, fixed umbrellas, access paths
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	7 public assets susceptible to erosion hazard. Ocean Drive (north of rock revetment), path, car park (N end), park at S end with fixed umbrellas, access paths, caravan park. Leasehold: caravan park

Assets susceptible to erosion hazard in Projected timeframe (25+ years)	9 public assets susceptible to erosion hazard. Ocean Drive, Marine Heights and services, path, car park, park at S end with fixed umbrellas, access paths, caravan park. Services: Telecommunications, power, water, fiber. Leasehold: caravan park
Existing management	Avoid (N - Minor erosion buffer to road), Retreat (N), Accommodate (N), Protect (Y - Maintain existing revetment)
Management options for Imminent timeframe (0–5 years)	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - Maintain existing revetment) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms. Review lease agreements with caravan park to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Protect - L Prepare Plans - 50k Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Acute erosion threat to Ocean Drive or sand drift compromising vehicle safety **Monitoring:** Buffer width **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (N), Retreat (Y - Remove path seaward of Ocean Drive; Relocate Ocean Drive), Accommodate (N), Protect (Y -Extend revetment 150m to protect the road (southern end)) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H Protect - M Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Acute erosion threat to Ocean Drive or sand drift compromising vehicle safety **Monitoring:** Buffer width **Alternate option:** Retreat of caravan park and removal of revetment (preferred, but unlikely to be practical)
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y - Relocate road. Retreat of caravan park and removal of revetment (likely to be impractical)), Accommodate (N), Protect (Y - Extend revetment to protect the road)
Works to avoid to achieve long-term plans	Development along Ocean Drive, particularly north of Richardson Rd; Use of terminal groyne structures to retain sand in front of the caravan park revetment.

Appendix D.15. Cervantes

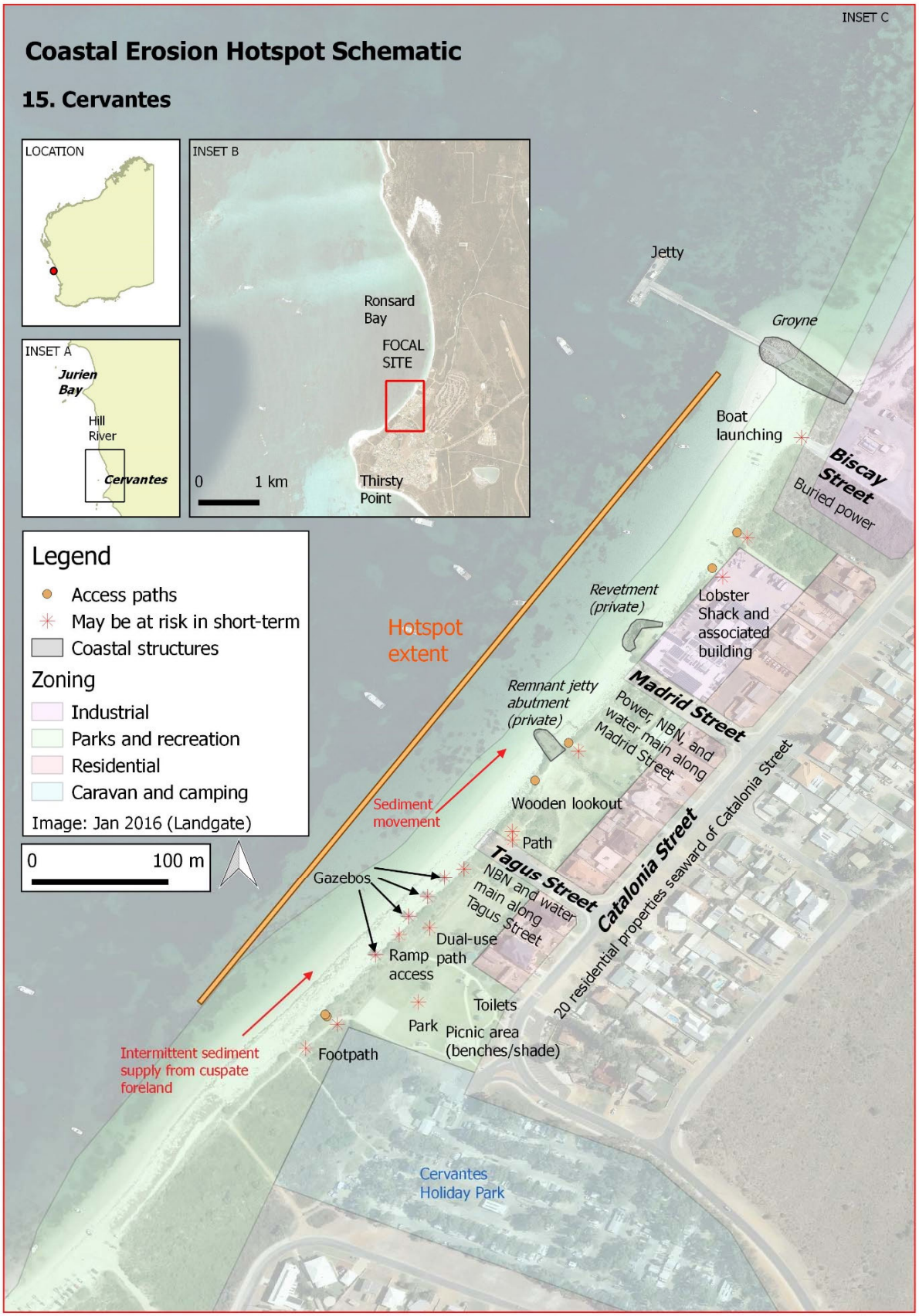

Figure D-15: Cervantes schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-15: Cervantes summary information

Hotspot No.	15
Hotspot Name	Cervantes
Local Coastal Manager	Shire of Dandaragan
Hotspot issue	The Cervantes hotspot is focused on the original crayfishing settlement along Catalonia Street between the holiday park and the boat launching at Biscay Street. The area is low-lying, formerly a beach-ridge plain, on the northern flank of a cuspate foreland (Thirsty Point) with a history of shoreline mobility. The broader foreland is susceptible to migration, retreat, reduction in onshore sediment supply, fluctuations in beach width and dune mobility. The foreshore southeast of the hotspot (northern flank of Thirsty Point) has been accumulating some sediment lost from the Cervantes hotspot for decades. Existing ad-hoc structures were installed as jetty abutments for private crayfish operators in the 1960's. Many jetties have been removed, with remnant revetments/jetty abutments contributing to downdrift erosion problems. The groyne at the northeast of the site (jetty abutment) encourages sand storage to the southwest. A limestone retaining wall and beach scraping is undertaken at the Lobster Shack. The area is currently subject to a rezoning application from light industrial to special use tourism. Twenty five publicly owned assets may be at risk of erosion damage in the area (see attached figure), 14 of which may be at risk in the short-term. This includes non-paved footpath, five sand access paths (counted as one combined asset), 120m of a dual-use path, two beach access ramps, four gazebos, Catalonia park, path seaward of Tagus Street, a wooden lookout, a sandy boat launching area and leasehold land associated with the RAC Cervantes Holiday Park (with no built assets at risk). In the longer-term a further 11 public assets may be at risk including 70m of Tagus Street, 80m of Biscay Street, 70m of Madrid Street, services (power [buried and overhead], NBN, water main), toilet block, shaded picnic benches, jetty abutment and a gas storage facility at Biscay Street. In the longer-term, approximately 22 private properties may be at risk, including the Lobster Shack building and grounds. Recreational uses of this foreshore include walking, swimming, fishing, beach volleyball, boat launching, boating and picnicking; with commercial fishing. The main non-governmental stakeholders that are likely to have an active interest in how this foreshore is managed include the Cervantes Ratepayers Association and Coastcare Group.
Extent of erosion problem and hotspot characteristics	Foreshore along Catalonia Street between Cervantes Holiday Park and the boat launching at Biscay Street. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Apparently limited capacity to manage future erosion using existing coastal protection measures where extension of works is likely to exacerbate erosion transfer (transfer).
CHRMAP status and findings	**CHRMAP Status:** In Progress. Draft report due July 2017. **Hazard Assessment:** MRA (2016) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** Final stages of CHRMAP recently awarded to Cardno **Additional Comments:** Adaptive capacity of existing structures not considered in MRA (2016) **Reports:** MRA (2016) Coastal Erosion Hazard Assessment, Ledge Point, Lancelin and Cervantes. Prepared by MP Rogers & Associates for the Shire of Gingin and Shire of Dandaragan. Report R721, Rev. 2, Apr-2016. Damara (2012) The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology and Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and Department of Transport.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Possibly sandbar dynamics and ongoing coastal movement data collection

Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	13 public assets susceptible to erosion hazard. 80m informal track, 5 informal access paths, 120m of DUP, 2 access ramps, 4 beach gazebos, park at SW end of Catalonia Street, 50m footpath seaward of Tagus Street, wooden lookout, informal boat launching Leasehold: land within RAC Holiday Park leasehold impacted, but no buildings. Not counted as a public asset.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	15 public assets susceptible to erosion hazard. 80m informal track, 5 informal access paths, 120m of DUP, 2 access ramps, 4 beach gazebos, park at SW end of Catalonia Street, 30m of Tagus Street, 50m footpath seaward of Targus Street, wooden lookout, 10m Biscay Street, informal boat launching Leasehold: land within RAC Holiday Park leasehold impacted, but no buildings. Not counted as a public asset.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	24 public assets susceptible to erosion hazard. 85m informal track, 5 informal access paths, 120m of DUP, 2 access ramps, 4 beach gazebos, park at SW end of Catalonia Street, benches/shade, toilet block, 70m of Tagus Street, 50m footpath seaward of Tagus Street, wooden lookout, 80m Biscay Street, road to jetty at Biscay Street, informal boat launching, gas storage facility at Biscay Street, 70m of Madrid Street. Services: buried LV cable along Biscay Street, overhead HV lone at Madrid Street, in-service NBN cables at Madrid Street and Tagus Street, Sections of 100AC water main along Tagus Street and Madrid Street. Private Properties: 22 private properties on Catalonia Street, including Lobster Shack building and grounds. Leasehold: land within RAC Holiday Park leasehold impacted, but no buildings. Not counted as a public asset.
Existing management	**Existing behaviour:** Extensive erosion of foreshore with private jetties. Many jetties have been removed. The existing structures along the coast are mainly abutments of removed jetties. Avoid (Y - in the south western section there is still buffer to some private properties), Retreat (N), Accommodate (N), Protect (Y - Two old jetty abutments have been maintained acting as revetments. Large jetty abutment (groyne) at the east encourages sand storage. Lobster shack undertakes beach scraping into foredunes and has a limestone retaining wall)
Management options for Imminent timeframe (0–5 years)	Avoid (Y - In the south western section there is still buffer to some private properties (e.g. along Tagus and Madrid Street).), Retreat (Y - possible minor realignment and migration of gazebos. Avoid rebuilding. All assets should be temporary and focus on relocatable structures), Accommodate (N), Protect (Y - possible upgrade of structure may be required at Lobster shack (cost to lessee)) Review lease agreements with Lobster Shack and caravan park to clarify responsibilities for coastal erosion mitigation
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Avoid - None Retreat - L Protect - cost to lessee Review Lease Agreement - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Loss of sand buffer to public assets <5m. **Note:** if any dredge plant is in the area it may be considered economically worthwhile to renourish before trigger is reached. **Monitoring:** Buffer width **Alternate option:** Protect - increased use of coastal protection structures.
Management and adaptation options for Expected timeframe (5–25 years)	Avoid (N), Retreat (N), Accommodate (N), Protect (Y - renourish using the considerable sand volume deposit at cuspate foreland) Preparation of planning frameworks for retreat in next level of management and identify funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Protect - H Prepare plans - 50k

Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Available sand resource inadequate for renourishment for >1 year. **Monitoring:** Engineering inspection / beach profiles **Alternate option:** Protect - import large amount of material for renourishment.
Management and adaptation options for Projected timeframe (25+ years).	Avoid (N), Retreat (Y - managed retreat for properties seaward of Catalonia Street (approx. 22)), Accommodate (Y - ramp may require redesign to avoid being smothered with sand), Protect (Y - increase protection of the lobster shack [privately funded])
Works to avoid to achieve long-term plans	Rebuilding in same spot, and any development of foreshore (low lying land). Any broad protection structures. Don't use reserve. Don't encroach on land when it fluctuates. Development north of the service jetty groyne.

Appendix D.16. Grey

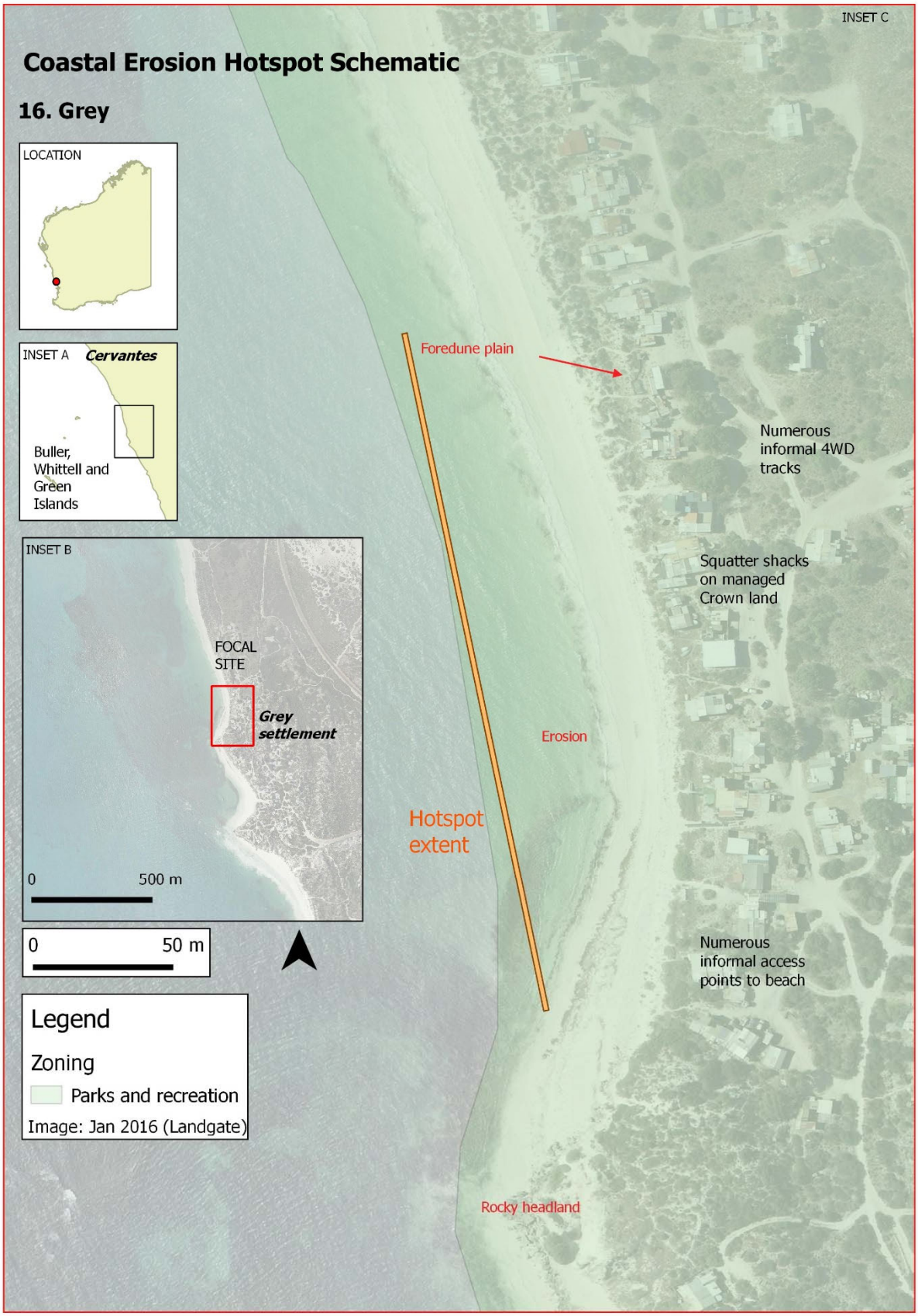

Figure D-16: Grey schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-16: Grey summary information

Hotspot No.	16
Hotspot Name	Grey
Local Coastal Manager	DBCA
Hotspot issue	Grey is located on a 172 hectare managed reserve in a low-lying beach ridge plain on the northern updrift side of a rocky headland. The reserve is under the management of the Department of Biodiversity, Conservation and Attractions (DBCA). The shore is sheltered by offshore and inshore reefs, and is backed to landward by a low foredune, a broad swale and secondary dune ridge. Retreat is expected to occur northward of the rock control, with retreat to follow the patterns of evident beach ridges and foredunes. The hotspot is focused from the rocky headland for 250m to the north. The Wheatbelt Planning and Infrastructure Framework (WAPC, 2015) and Shire of Dandaragan's draft Local Planning Strategy (2016) identify Grey as a recreation and tourism destination, with no permanent settlement. Recreational use is currently focused on walking, fishing, swimming and driving along the beach. There are shacks at Grey but no approved settlement. The DBCA is examining options for tourist and recreational uses at Grey in consultation with other agencies and the shack license holders.
Extent of erosion problem and hotspot characteristics	For 250m north of the rocky headland. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Not Scheduled **Hazard Assessment:** Oceanica (2015) - Immediate risk of erosion identified (existing buffer <S1) for areas not founded on rock. **Management & Adaptation Options:** DBCA is seeking to rationalise the use of vulnerable coastal shacks **Additional Comments:** Qualitative regional hazard assessment contained in Damara (2012) **Reports:** BMT Oceanica (2015) Coastal Vulnerability Assessment of the Wedge and Grey Coast. Prepared by BMT Oceanica Pty Ltd in association with BMT JFA Pty Ltd & Damara WA Pty Ltd for Department of Parks and Wildlife. Report 1189_001/1, Sep-2015. Damara (2012) The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology and Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and Department of Transport.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	Geotechnical and ongoing coastal movement data collection
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	No public assets susceptible to erosion hazard (note: shacks are private assets). All informal access points and vehicle access are uncontrolled access on managed Crown land.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	No public assets susceptible to erosion hazard (note: all shacks are private assets). All informal access points and vehicle access are uncontrolled access on managed Crown land.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	No public assets susceptible to erosion hazard (note: all shacks are private assets). All informal access points and vehicle access are uncontrolled access on managed Crown land.

Existing management	**Note:** The Legislative Council Standing Committee on Environment and Public Affairs inquiry into shack sites in WA recommends that the responsible Minister and managing authority instruct leaseholders and shack owners to remove the shacks at Grey and, as a priority, develop the area to provide the public with low impact, nature-based, affordable visitor facilities and accommodation, including camping and caravanning facilities. The State Government is examining options for Grey to determine if this location can meet the requirements for public recreation and tourism use in conjunction with a level of shack retention that contributes to the opportunities for public use. This consideration is being undertaken in consultation with current shack leaseholders. Any future development of Grey will be subject to State planning requirements and will address equity of access and use, building safety, health and amenity, coastal processes and provide for environmentally sustainable public outcomes. Avoid (Y - some of the northern shacks and eastern shacks have sufficient setback), Retreat (N), Accommodate (N), Protect (N)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Few shacks immediately susceptible to storm erosion. Avoid (N), Retreat (Y - remove shacks (shack owner responsibility) and rehabilitate informal access tracks. Shacks should be removed before construction material eroded and litters foreshore), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify responsibilities and funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - L (assuming shack owners are responsible for removing shacks) Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Remove shacks with <10m remaining to +1mAHD contour (roughly 1-year WL). An alternate trigger should apply to shacks founded on moderate elevation rock. **Monitoring:** Buffer width **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Moderate number of shacks subject to storm erosion and progressive retreat. Avoid (N), Retreat (Y - remove shacks (shack owner responsibility) and rehabilitate informal access tracks. Shacks should be removed before construction material eroded and litters foreshore), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify responsibilities and funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - M (assuming shack owners are responsible for removing shacks) Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Remove shacks with <10m remaining to +1mAHD contour (roughly 1-year WL). (Trigger to continually be applied to the most seaward shack remaining). An alternate trigger should apply to shacks founded on moderate elevation rock. **Monitoring:** Buffer width **Alternate option:** N/A
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Large number of shacks subject to storm erosion following progressive retreat and sea level rise. Avoid (N), Retreat (Y - remove shacks and rehabilitate informal access tracks. Shacks should be removed before construction material eroded and litters foreshore), Accommodate (N), Protect (N)

Works to avoid to achieve long-term plans	Avoid formalising shacks. No new shacks. Avoid protection (any erosion mitigation structures).

Appendix D.17. Wedge

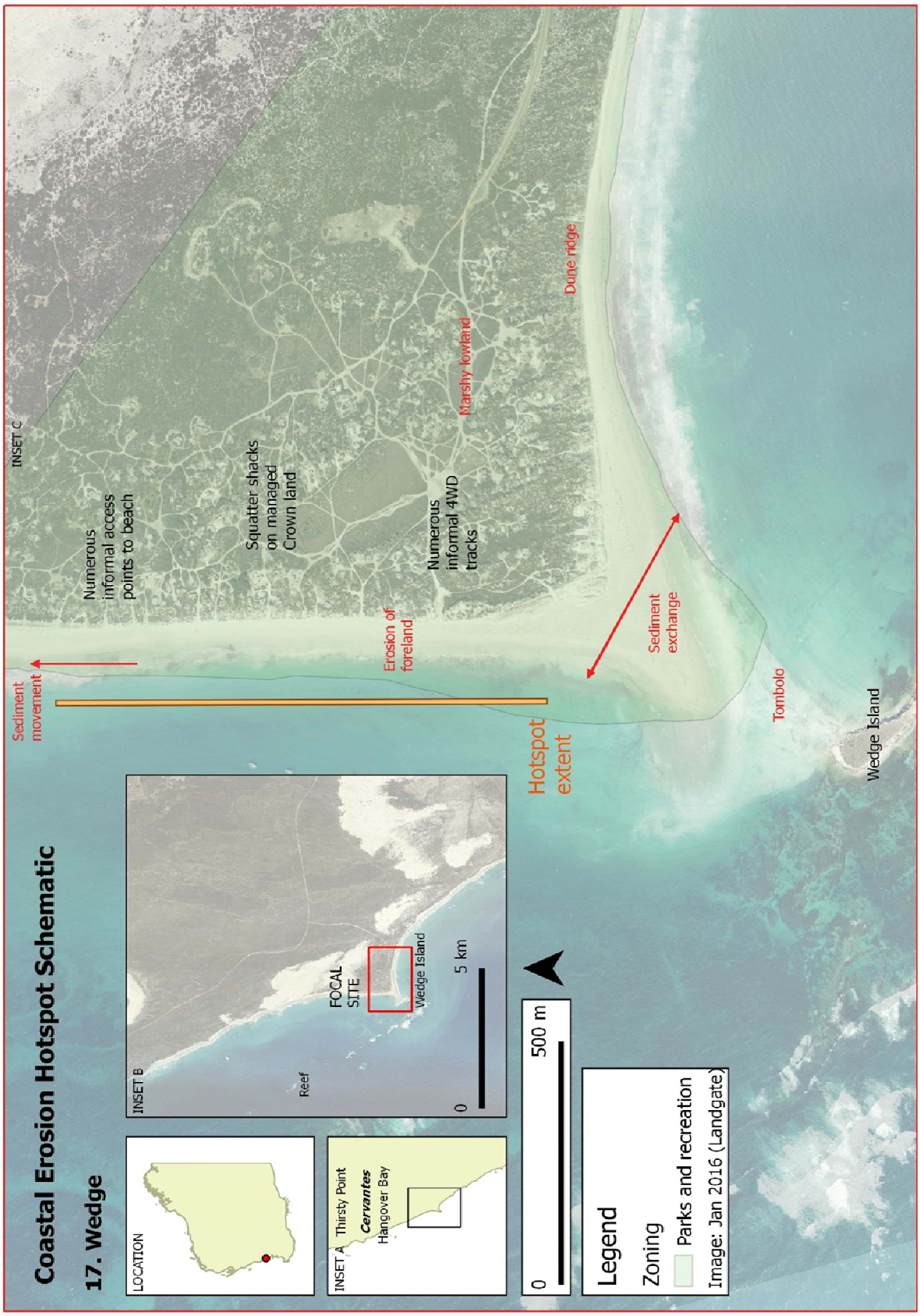

Figure D-17: Wedge schematic

This hotspot profile must be read in conjunction with the Disclaimer on p.78 on the cover of Appendix D.

Table D-17: Wedge summary information

Hotspot No.	17
Hotspot Name	Wedge
Local Coastal Manager	DBCA
Hotspot issue	Wedge is located on a 213 hectare managed reserve and is under the management of the Department of Biodiversity, Conservation and Attractions (DBCA). Wedge is a very low lying of cuspate foreland in the lee of Wedge Island, with the plain behind the narrow frontal dune ridge very close to the mean high water level. It is a highly volatile cuspate foreland subject to landform retreat, as small changes in mean sea level may cause landform migration. The hotspot is focused on the western flank of the foreland. The Wheatbelt Planning and Infrastructure Framework (WAPC, 2015) and Shire of Dandaragan's draft Local Planning Strategy (2016) identify Wedge as a recreation and tourism destination, with no permanent settlement. Recreational use is currently focused on walking, fishing, swimming, surfing, boat launching and driving along the beach. There are shacks at Wedge but no approved settlement. The DBCA is currently examining options for tourist and recreational uses at Wedge and Grey in consultation with other agencies and the shack license holders.
Extent of erosion problem and hotspot characteristics	On the west facing foreshore of the tombolo in the lee of Wedge Island. Hotspot characteristics: • Infrastructure close to the existing shore, or landward of progressively and rapidly eroding coast (proximity). • Typically subject to progressive or episodic erosion (instability). • Very highly valued by the community, as nominated by local government (community).
CHRMAP status and findings	**CHRMAP Status:** Not Scheduled **Hazard Assessment:** BMT Oceanica (2015) - Immediate risk of erosion identified (existing buffer <S1) **Management & Adaptation Options:** DBCA is seeking to rationalise the use of vulnerable coastal shacks **Additional Comments:** Qualitative regional hazard assessment contained in Damara (2012) **Reports:** BMT Oceanica (2015) Coastal Vulnerability Assessment of the Wedge and Grey Coast. Prepared by BMT Oceanica Pty Ltd in association with BMT JFA Pty Ltd & Damara WA Pty Ltd for Department of Parks and Wildlife. Report 1189_001/1, Sep-2015. Damara (2012) The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology and Vulnerability. Prepared by Damara WA Pty Ltd and Geological Survey of Western Australia for the Department of Planning and Department of Transport.
Coastal dynamics studies for a level 3 assessment. Further detail in Table 4-2.	N/A
Assets susceptible to erosion hazard in Imminent timeframe (0–5 years)	No public assets susceptible to erosion hazard (note: shacks are private assets). All informal access points and vehicle access are uncontrolled access on managed Crown land.
Assets susceptible to erosion hazard in Expected timeframe (5–25 years)	No public assets susceptible to erosion hazard (note: shacks are private assets). All informal access points and vehicle access are uncontrolled access on managed Crown land.
Assets susceptible to erosion hazard in Projected timeframe (25+ years)	No public assets susceptible to erosion hazard (note: shacks are private assets). All informal access points and vehicle access are uncontrolled access on managed Crown land.

Existing management	**Note:** The Legislative Council Standing Committee on Environment and Public Affairs inquiry into shack sites in WA recommends that the responsible Minister and managing authority instruct leaseholders and shack owners to remove the shacks at Wedge and, as a priority, develop the area to provide the public with low impact, nature-based, affordable visitor facilities and accommodation, including camping and caravanning facilities. The State Government is examining options for Wedge to determine if this location can meet the requirements for public recreation and tourism use in conjunction with a level of shack retention that contributes to the opportunities for public use. This consideration is being undertaken in consultation with current shack leaseholders. Any future development of Wedge will be subject to State planning requirements and will address equity of access and use, building safety, health and amenity, coastal processes and provide for environmentally sustainable public outcomes. Avoid (Y - some of the shacks have sufficient setback), Retreat (N), Accommodate (N), Protect (N)
Management options for Imminent timeframe (0–5 years)	**Anticipated behaviour:** Few shacks immediately susceptible to storm erosion. Avoid (N), Retreat (Y - remove shacks (shack owner responsibility) and rehabilitate informal access tracks. Shacks should be removed before construction material eroded and litters foreshore), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify responsibilities and funding mechanisms.
Approximation of cost for Imminent timeframe (0–5 years) options (L/M/H)	Retreat - L (assuming shack owners are responsible for removing shacks) Prepare Plans - 50k
Trigger for next level management, monitoring and alternate management option (Imminent timeframe 0–5 years)	**Trigger for next level management:** Remove shacks with <10m remaining to +1mAHD contour (roughly 1-year WL). **Monitoring:** Buffer width **Alternate option:** N/A
Management and adaptation options for Expected timeframe (5–25 years)	**Anticipated behaviour:** Moderate number of shacks subject to storm erosion and progressive retreat. Avoid (N), Retreat (Y - remove shacks (shack owner responsibility) and rehabilitate informal access tracks. Shacks should be removed before construction material eroded and litters foreshore), Accommodate (N), Protect (N) Preparation of planning frameworks for retreat in next level of management and identify responsibilities and funding mechanisms.
Approximation of cost for Expected timeframe (5–25 years) options (L/M/H)	Retreat - H (assuming shack owners are responsible for removing shacks. More area to rehabilitate than Grey) Prepare plans - 50k
Trigger for next level management, monitoring and alternate management option (Expected timeframe 5–25 years)	**Trigger for next level management:** Remove shacks with <10m remaining to +1mAHD contour (roughly 1-year WL). (Trigger to continually be applied to the most seaward shack remaining.) **Monitoring:** Buffer width **Alternate option:** N/A
Management and adaptation options for Projected timeframe (25+ years).	**Anticipated behaviour:** Large number of shacks subject to storm erosion following progressive retreat and sea level rise. Avoid (N), Retreat (Y - remove shacks and rehabilitate informal access tracks. Shacks should be removed before construction material eroded and litters foreshore), Accommodate (N), Protect (N)

Works to avoid to achieve long-term plans	Avoid formalising shacks. No new shacks. Avoid protection (any erosion mitigation structures).