Referral of proposed action

Project title: Western Australia Shark Hazard Mitigation Drum Line Program

1 Summary of proposed action

NOTE: You must also attach a map/plan(s) and associated geographic information system (GIS) vector (shapefile) dataset showing the location and approximate boundaries of the area in which the project is to occur. Maps in A4 size are preferred. You must also attach a map(s)/plan(s) showing the location and boundaries of the project area in respect to any features identified in 3.1 & 3.2, as well as the extent of any freehold, leasehold or other tenure identified in 3.3(i).

1.1 **Short description**

Use 2 or 3 sentences to uniquely identify the proposed action and its location.

The Western Australian Government proposes to set up to 72 baited drum lines off metropolitan and south west coastal regions of Western Australia. Drum lines will be set at approximately 1km offshore of popular beaches within two Marine Monitored Areas (MMAs) in the metropolitan and south west regions of Western Australia from 15 November to 30 April each year.

The proposed action includes a provision for responding to identified shark threats and incidents at any time within all Western Australian waters.

The proposed action will take place between 15 November and 30 April for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017, after which the program will be subject to review.

1.2 **Latitude and longitude**

	Latitude			Longitude		
location point	degrees	minutes	seconds	degrees	minutes	seconds

Lists of coordinates describing the metropolitan and south west MMAs are provided at Attachments 1 and 2 and electronically as .xlsx files.

Shapefiles for the following have been provided as an electronic attachment:

- MMAs for the metropolitan and south west regions;
- proposed drum line deployment areas;
- 3nm Western Australian waters;
- bathymetry for the project area off the Western Australian coastline;
- Fish Habitat Protection Areas;
- Marine Parks;
- shark monitoring stations; and
- extent of drum line locations 2013/14 for the metropolitan and south west regions

1.3 **Locality and property description**

Provide a brief physical description of the property on which the proposed action will take place and the project location (eg. proximity to major towns, or for off-shore projects, shortest distance to mainland).

The drum lining program is to take place in Western Australian waters, at approximately 1km offshore of popular beaches and surfing spots in the metropolitan and south west regions of the state. The metropolitan MMA extends from Ocean Reef (-31° 44.6038', 115° 43.3727') to Port Beach (-32° 2.4354', 115° 44.4630') and the south west MMA extends from Quindalup (-33° 37.8569', 115° 8.9470') to Prevelly (-33° 58.9200', 114° 59.3834').

Static drum lines will not be deployed within any gazetted or proposed marine sanctuary zone or gazetted or proposed recreation zone in any Western Australian marine park as designated under the *Conservation and Land Management Act 1984.* Static drum lines will not be placed within any Fish Habitat Protection Areas as designated under the *Fish Resources Management Act 1994.*

Maps showing the drum line deployment areas for the 2013/14 trial program in the metropolitan and south west regions in relation to marine protected areas are at Attachments 3 and 4.

Maps showing the proposed drum line deployment areas for the proposed action in the metropolitan and south west regions in relation to marine protected areas are at Attachments 5 and 6.

Temporary drum lines deployed in response to identified shark threats and incidents may be set anywhere within Western Australian waters.

1.4 **Size of the development footprint or work area (hectares)**

The area of the metropolitan MMA is 34km² (3 400ha) and is 35km long.

The total area of the south west MMA is 81km² (8 100ha) and is 85km in total. Drum lines will be set within a minimum of 28km² (2 800ha) and along 29km during Phase 2 of the south west deployment and within a maximum of 48km² (4 800ha) and along 52km during Phase 3 of the south west deployment

The two MMAs account for approximately 0.05-0.07% of all Western Australian waters and approximately 0.5-0.7% of the Western Australian coastline.

Calculations are provided at Attachment 7.

1.5 **Street address of the site**

Not Applicable

1.6 **Lot description**

Describe the lot numbers and title description, if known.

Not Applicable

1.7 **Local Government Area and Council contact (if known)**

If the project is subject to local government planning approval, provide the name of the relevant council contact officer.

Not Applicable

1.8 **Time frame**

Specify the time frame in which the action will be taken including the estimated start date of construction/operation.

The proposed action will take place between 15 November and 30 April for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017, after which the program will be subject to review.

1.9	**Alternatives to proposed action** Were any feasible alternatives to taking the proposed action (including not taking the action) considered but are not proposed?		No
		X	**Yes** you must also complete section 2.2
1.10	**Alternative time frames etc** Does the proposed action include alternative time frames, locations or activities?		No
		X	**Yes** you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).
1.11	**State assessment** Is the action subject to a state or territory environmental impact assessment?		No
		X	**Yes** you must also complete Section 2.5
1.12	**Component of larger action** Is the proposed action a component of a larger action?	X	**No**
			Yes, you must also complete Section 2.7
1.13	**Related actions/proposals** Is the proposed action related to other actions or proposals in the region (if known)?	X	**No**
			Yes, provide details:
1.14	**Australian Government funding** Has the person proposing to take the action received any Australian Government grant funding to undertake this project?	X	**No**
			Yes, provide details:
1.15	**Great Barrier Reef Marine Park** Is the proposed action inside the Great Barrier Reef Marine Park?	X	**No**
			Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

NOTE: It is important that the description is complete and includes all components and activities associated with the action. If certain related components are not intended to be included within the scope of the referral, this should be clearly explained in section 2.7.

2.1 Description of proposed action

This should be a detailed description outlining all activities and aspects of the proposed action and should reference figures and/or attachments, as appropriate.

Drum Lining Operations

The Western Australian Government is proposing to set up to 72 baited drum lines at approximately 1km offshore of selected high use beaches and surfing spots within designated MMAs in the metropolitan and south west coastal regions of Western Australia. The number of static drum lines in the water will not exceed 60 at any one time, with 12 drum lines kept in reserve for responding to a shark threat or incident.

The proposed action follows the Shark Drum Line Deployment, Management and Associated Services trial drum lining program undertaken in Western Australian waters between 25 January and 30 April 2014. Catch data from 25 January to 16 March 2014 from the trial is provided at Attachment 8. A full review of the trial program will be undertaken after 30 April 2014 and will be provided as part of this referral in approximately late June 2014.

The proposed action will take place between 15 November and 30 April for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017, after which the program will be subject to review.

Contractor(s) will be procured by the Western Australian Government to undertake the required drum lining activities[1]. Drum lines will be monitored between 6am and 6pm, seven days a week, subject to weather and sea conditions. A decision not to operate will be made by the master/skipper of the vessel and in consultation with the Department of Fisheries Operations Manager and associated risk assessments in considering any possible danger to crew, vessels or safe operating conditions. Drum lines will be baited at the start of each day, as required throughout the day, and as part of the last patrol of the day. In the event that a vessel cannot operate due to inclement weather, the lines will be re-baited as soon as is practicable at the resumption of patrols.

A preference will be for the use of shark as bait where attainable. Where shark is not available, other suitable baits including mackerel, tuna, bonito, snapper, salmon and demersal fish, all of which have been used during the 2013/14 drum lining trial, will be sourced.

The drum line configuration to be used will be similar to that shown at Attachment 9(a). The configuration will include a minimum of two Polyform buoys and no smaller than an approximately sized 25/0 stainless steel circle hook, which will be sourced and used wherever possible[2]. The hook will sit approximately two metres below the surface of the water, and will be anchored to the sea bed using an approximately weighted 8-12 kg anchor by a length, dependent upon water depth and local conditions, of polypropylene rope. Each component of the rig is sectioned using swivel shackles. An optional third float may be added to the rig for more effective handling of an animal, in particular in rough sea conditions. The additional float configuration will be similar to that shown at Attachment 9(b).

Beaches have been selected in consultation with Surf Life Saving WA and with consideration of beach attendance statistics and patrol times. Surfing WA and local recreational water users were also consulted to identify popular surfing spots. A copy of the Surf Life Saving WA Beach Attendance Statistics and full

[1] In the event that, for whatever reason, a contractor cannot fulfil its obligations, or circumstances arise that prevent a contractor from fulfilling its obligations, the Department of Fisheries may be requested to operate until such time that the contractor is able to resume its operations in accordance with contractual requirements.

[2] Should supply become an issue an alternative sized circle hook, but no smaller than 25/0, will be agreed with the Federal Department of the Environment.

description of the criteria used to select locations for drum line placements for the 2013/14 trial are provided at Attachments 10 and 11. The same criteria have been used to identify beaches for inclusion in this proposed action.

The metropolitan MMA extends from Ocean Reef (-31° 44.6038', 115° 43.3727'), approximately 30kms north of Perth, to Port Beach (-32° 2.4354', 115° 44.4630'), approximately 20kms south of Perth. A map of the metropolitan MMA is at Attachment 12. Up to 30 static drum lines are proposed to be set at approximately 1km offshore of high use beaches within this MMA between 15 November and 30 April.

The south west MMA extends from Quindalup (-33° 37.8569', 115° 8.9470'), approximately 240kms south of Perth, to Prevelly (-33° 58.9200', 114° 59.3834'), approximately 280kms south of Perth. A map of the south west MMA is at Attachment 13. Up to 30 static drum lines are proposed to be set at approximately 1km offshore in each of three phases within this MMA:

- Phase 1: at popular surfing spots between Moses Rock and Prevelly – 15 November to early December.
- Phase 2: at high use beaches and popular surfing spots between Dunsborough and Three Bears – early December to early February to coincide with school holidays and Surf Life Saving WA patrols.
- Phase 3: at popular surfing spots between Yallingup and Prevelly from approximately the second week of February until 30 April.

A map showing the three phases of deployment in the south west region is at Attachment 14.

Target species are any white shark (*Carcharodon carcharias*), tiger shark (*Gaelocerdo cuvier*) or bull shark (*Carcharhinus leucas*) with a total length of three metres or greater.

Any sharks that are less than three metres total length, and which are in a condition to be released, will be tagged using a Conventional Fin Tag[3], photographed, measured, and data recorded on a daily log sheet. An example of a Conventional Fin Tag is at Attachment 15. Tagged sharks that are released from drum lines will assist in providing an indication of recapture rates, and therefore a potential indication of the survival rates, of released sharks in the program. Internal and/or external acoustic tags may also be administered to sharks in line with current Department of Fisheries protocols[4]. The ability to acoustically tag sharks will add valuable data to the Department of Fisheries Shark Monitoring Network research program.

Target species (any white shark, tiger shark or bull shark with a total length of three metres or greater) will be humanely destroyed. Current direction on the humane destruction of large sharks involves the use of a firearm. Animals that are dead or destroyed will be photographed, tagged using a numbered Kangaroo Tag, and transported offshore for disposal. All disposals will take place within State waters i.e. less than three nautical miles offshore. An example of a Kangaroo Tag is at Attachment 16.

In consultation with local research institutions, provisions may be put in place to facilitate access to carcasses and/or specimens of sharks which are destroyed or found dead as part of the program. The provision of access to animals will add value to existing research projects within Western Australia. Authority to consign shark carcasses or specimens to research institutions is sought as part of the proposed action. Authority for shark researchers[5] to conduct sampling *in-situ* on a drum lining vessel, and/or transport samples back to relevant institutions or laboratories is also sought. The relevant permits for possession of protected species would be sought by the research institutions independently and separate to this proposal. Relevant authorisations to conduct research on protected fauna under the

[3] The option of using a fin tag that can also take a tissue sample of the shark upon application is currently being investigated. If applicable, a genetic analysis of local shark populations may be viable.
[4] The method of capture and tagging adopted in Western Australia for white sharks is taken from procedures developed by CSIRO and Sydney Aquarium which have been assessed through formal animal welfare committees. Any application of acoustic tags will only be undertaken by trained operators.
[5] A list of nominated shark researchers and research institutions can be provided.

Fish Resources Management Act 1994 and the *Wildlife Conservation Act 1950* will be sought at a state level.

For non-target sharks which are released from drum lines *in-situ,* the contractor will notify a designated Department of Fisheries Operations Manager of the size, sex and species of shark to be released. Surf Life Saving WA and relevant authorities will be made aware of the release of a shark in proximity to a high use beach area and take appropriate actions to notify the public.

It is proposed that any sharks that are not commercially or totally protected, under State or Federal legislation, and that are dead or destroyed (in a case where a shark has been deemed not in a condition to survive), be used for re-baiting of drum lines. Evidence from the Queensland Shark Control Program suggests the use of shark as bait is effective at deterring other marine predators from the drum lines and therefore minimising by catch (Queensland DPI, 2006; J Krause *pers comm*).

Data sheets containing information on the size, sex and species of animal captured on the drum line, the animal's condition, action taken, photo numbers and tag numbers will be maintained and provided, together with photographs, to the contract manager on a weekly basis. An example data sheet is at Attachment 17.

Public reporting of catch data will be on a monthly basis via publication on the Department of Fisheries website.

To ensure that the contractor complies with contract, permit and legislative requirements and conditions, a minimum of ten observer trips on each vessel between 15 November and 30 April each year will be undertaken, with additional trips undertaken as required. Observers will be present on the first trip of each season on each vessel to observe the start of operations and deployment of drum lines within each MMA. The observers' role will be to observe the performance of the contractor and ensure contractual and legislative conditions are being met. Observers will be officers from agencies including, but not limited to, the Department of Fisheries, Department of Parks and Wildlife and Department of the Premier and Cabinet. Reports will be completed following each observer trip in each region. A summary of observer trips undertaken so far during the 2013/14 program is at Attachment 18. An example of an observer trip report is at Attachment 19.

Training will be provided to contractors prior to the commencement of operations to assist in determining the condition of a shark and emphasise safe handling practices. Training will be provided by officers experienced in the handling of marine animals from the Department of Fisheries and the Department of Parks and Wildlife with reference to safe work methods including minimising stress to animals and safety of crew.

Meetings between the contractor and contract manager will also be held to ensure clear lines of communication and understanding of all contract requirements. Meetings will be held prior to the commencement of operations, ad-hoc and as required throughout the operational phase of the program and following the completion of the program post 30 April each year.

Responding to a shark threat or incident

The proposed action also includes a provision for responding to identified shark threats and attacks within all Western Australian waters, including the temporary deployment of drum lines[6]. All Western Australian waters refers to coastal waters between the territorial sea baseline, usually the low water line along the coast, and a line three nautical miles seaward from the baseline as defined by Geoscience Australia. Marine protected areas are not excluded and in the event of a shark attack, or a shark considered to be posing an imminent threat to public safety, temporary drum lines may be deployed in consultation with the Department of Fisheries and the Department of Parks and Wildlife, as per the current Department of Fisheries "Guidelines for Fishing for Sharks Posing an Imminent Threat to Public Safety".

[6] The maximum number of drum lines in the water at any one time will not exceed 72.

In the event of an attack, or the presence of a shark considered to be posing a threat to public safety, anywhere in Western Australian waters, either the contracted vessel, Department of Fisheries vessel or other available agency vessel will attend the scene of the incident or sighting and deploy up to five drum lines. No more than 60 static drum lines will be in the water at any one time, therefore providing capacity to deploy temporary drum lines in response to at least two incidents concurrently (where up to five drum lines may be deployed at each location). In the event that more than two incidents occur simultaneously, a corresponding number of static drum lines would be removed from the water in either the metro or south west areas, to allow for the temporary deployment of drum lines at the scene of the incident or sighting, ensuring that no more than a total of 72 drum lines are deployed at any time.

The drum lines used in a response scenario will be of a similar configuration as those described as part of the drum lining proposed action (see Attachment 9). Drum lines would be set for a maximum of one hour in response to a sighting, or for a maximum of one week in response to a shark attack.

Drum lines deployed in response to a sighting would be monitored continuously during the time of deployment. Drum lines which are set in response to an attack will be closely monitored between 6am and 6pm for the duration of the deployment.

Temporary drum lines in a response scenario may be set anywhere off of the coastline but no further than 1km offshore. The setting of drum lines will be dependent upon the response scenario (fatality/attack/sighting), location and environmental conditions.

The criteria for determining a shark threat and associated response actions are at Attachment 20. The Department of Fisheries "Guidelines for Fishing for Sharks Posing an Imminent Threat to Public Safety" are at Attachment 21.

2.2 Alternatives to taking the proposed action

This should be a detailed description outlining any feasible alternatives to taking the proposed action (including not taking the action) that were considered but are not proposed (note, this is distinct from any proposed alternatives relating to location, time frames, or activities – see section 2.3).

2.2.1 Take no further action

The Western Australian Government has already committed more than $20million over four years to 2015-16 for a broad range of shark hazard mitigation measures in direct response to the number of recent shark related fatalities.

Aerial surveillance contracted through Surf Life Saving WA (2012-2017)

In the metropolitan region, helicopter surveillance operates between Dawesville (Mandurah), Capricorn (Yanchep) and Rottnest Island. Aerial patrols operate between 6.30am and 4.30pm seven days a week between 1 September and 30 April each year[7]. This represents approximately 221 flying days per year. In the 2012/13 season the Surf Life Saving WA metropolitan helicopter reported 123 shark sightings.

In the south west region, helicopter surveillance operates between Bunbury and Margaret River. Aerial patrols operate between 7am and 5pm seven days a week between late November and early February[8]. This represents approximately 72 flying days per year. In the 2012/13 season the Surf Life Saving WA south west helicopter reported 162 shark sightings.

Jet skis for enhanced beach patrols

In December 2012 Surf Life Saving WA was granted additional funding of $500,000 for the acquisition and implementation of additional resources to allow for extended beach patrol services through the use of jet skis. The funding provided for the acquisition of twelve new jet skis, modification to equipment, personal protective equipment, program operational costs and recruitment and training of additional operators. Jet skis operate between 6am and 10am on weekdays, and between 6am and 8am on

[7] Aerial patrols operate on weekends only during September.
[8] Exact dates are adjusted annually to coincide with school and university holidays.

weekends and public holidays. For the period November 2013 to February 2014 this represented 600 weekday patrol hours and 410 weekend and public holiday patrol hours.

Positive benefits to shark hazard mitigation from extended beach patrols using jet skis are already evident with jet skis spotting sharks at a number of beaches, raising the alarm and assisting in water evacuations and beach closure procedures.

Construction of a watch tower at Cottesloe beach (metropolitan region)
In January 2012 the Western Australian Premier announced a $300,000 contribution to Cottesloe Surf Life Saving Club for the construction of a watchtower at Cottesloe Beach, one of the most popular beaches in the metropolitan region of Western Australia, and site of two shark fatalities in recent years. The watchtower is due to be completed by the end of 2014.

Shark Response Unit
The Shark Response Unit at the Department of Fisheries was created in early 2012 and has received $3.75m over five years to 2015/16. The Unit conducts research into shark populations and movements, improves response plans and procedures, and provides advice and information to members of the public to assist them in making informed decisions when using the aquatic environment. The Department of Fisheries patrol vessel *Hamelin* has also been commissioned to the Unit to improve the management of shark hazards and carry out important shark research and tagging activities along the Western Australian coast.

The Unit promotes the importance of reporting shark sightings to the Western Australian Water Police and assists in the development and coordination of the communication and response processes that follow. Information from sightings and tagged shark detections is made available to the public on websites and Twitter, and by SMS to response agencies allowing beaches to be closed where possible. The Unit assists with coordination and response to incidents, heightened alerts, certain types of shark attacks and sharks considered an imminent threat.

Several legislative amendments have been made to prohibit activities that may change the behaviour of sharks and attract sharks to major tourist or population areas. Dedicated shark tourism, such as commercial cage diving is now banned under the *Fish Resources Management Regulations 1995* (FRMR) (R.128OA). A ban on the use of mammal and bird offal and blood for berley for the purposes of attracting sharks has also been put in place under the FRMR.

The Unit has commenced a four year community engagement strategy to explore the use of community-based programs to contribute to public safety along the Western Australian coast. An extensive survey of community views on sharks, and preferred means of communicating about shark hazard, has been completed. Two major outcomes include a shark specific website, and a mobile phone app. to provide up to date information on the latest sightings.

The recently launched SharkSmart website www.sharksmart.com.au is designed to give detailed, accurate information for those interested in, or concerned about, sharks near beaches. Information on the site includes:

- advice on what to do if a person spots a shark;
- how to reduce the chance of encountering a shark;
- details of the Western Australian Government's shark research and hazard mitigation initiatives;
- latest research outcomes, including long term shark monitoring data and videos that reveal the travel patterns of 29 tagged sharks in Western Australian waters;
- the latest research on shark behaviour; and
- information on the biology of sharks found in local waters.

The BeachSafe mobile app. is a quick ready reference for beachgoers. The Western Australian Government partnered with Surf Life Saving WA and provided $50,000 to deliver a shark module as part of an overall beach safety app. The app provides information relevant to any shark sightings, beach

closures as a result of shark sightings and other beach safety information in real time from the Surf Life Saving WA communications centre.

Research
Four major research projects have either been completed, or are underway at the Department of Fisheries to better understand white sharks in Western Australia and the likely effectiveness of any community safety interventions. These are:

- expansion of the Western Australian Government's shark monitoring network. This ongoing program uses acoustic monitoring and tagging to collect information on the occurrence and movements of white sharks (and some other species) in Western Australian waters. The information collected will be used to assess any factors associated with shark hazard risk, and provide safety agencies with near real-time alerts of the presence of tagged sharks at key locations, enabling beaches to be closed. Maps of shark monitoring station locations are at Attachments 22 and 23;
- a correlation study exploring possible links between shark sightings, interactions or attacks and locations, weather conditions, water temperatures and the activity of other marine mammals that might attract sharks (FOP 109, 2012);
- an examination of white shark population numbers which is due out in 2014; and
- a beach netting study to look at the effectiveness of shark meshing, and shark exclusion barriers. This study formed the basis for the trial of a beach enclosure at Old Dunsborough.

Applied research programs
The Western Australian Government has committed grants of up to $300,000 over a period of up to three years to universities, research institutes and industry to focus on non-lethal shark hazard detection and deterrent systems, including bubble curtains, chemical repellents, the development of the SharkShield device designed for mounting on surfboards and acoustic signature masking. A summary of all applied research programs is at Attachment 24.

Imminent threat policy
In November 2012 the then Western Australian Minister for Fisheries granted an exemption under the *Fish Resources Management Act 1994* to allow fishing for white sharks (*Carcharodon carcharias*) and whaler sharks (Family Carcharhinidae) for the purpose of public safety under the Department of Fisheries Imminent Threat Policy (see Attachment 21). Operational responses have been enacted five times under the imminent threat guidelines since the inception of the policy.

The measures above represent a comprehensive set of shark hazard mitigation strategies which the Western Australian Government has already implemented. However, the death of a male surfer in November 2013 represented the seventh fatality in Western Australia in three years by shark attack, and consequently the option of simply maintaining the measures already in place and doing nothing more was considered unviable.

2.2.2 Shark proof beach enclosures
Following a study on the feasibility of beach enclosures the Western Australian Government provided $165,370 to the City of Busselton to construct a trial enclosure.

In January 2014 an enclosure at Old Dunsborough was constructed in the State's south west. The enclosure extends about 100 metres from the shore, runs parallel with the beach for 300 metres, and is constructed from heavy gauge netting. The specifications for the enclosure are similar to the barriers used successfully on the Gold Coast in Queensland and are designed to prevent sharks from entering the area.

Enclosures are most effective at low energy beaches and are therefore not suited to all coastal environments. A review of the trial enclosure will be conducted and a report provided to the Western Australian Government in June 2014. Pending the outcome of the review, additional suitable areas for enclosures along the Western Australian coastline may be identified.

2.2.3 Catch and release

Some jurisdictions, including New South Wales, have undertaken to release sharks captured as part of their shark control programs, including potentially dangerous species. The Western Australian Government considered this approach as part of the referral, however concluded it to be inappropriate for dealing with captured white sharks in Western Australia. In considering public safety, determining acceptable release locations for potentially dangerous sharks would be challenging and present additional public liability risks. Moreover, transporting large sharks offshore is logistically difficult, with the additional stress placed on the animals from extended transport likely to lead to either mortality of sharks in transit, or decreased chance of survival post-release.

2.2.4 Expansion of the shark monitoring network

The Western Australian Government's Shark Monitoring Network comprises 250 data recording and 24 satellite-linked real-time reporting devices. The program commenced in 2009 and more than 140 white sharks, 200 whaler sharks and 20 tiger sharks have been tagged with compatible acoustic transmitters. Since 2009, the satellite linked receivers have generated almost 700 detection alerts from which numerous beach closures have been instigated, contributing to beach user safety.

The receiver network has benefited from additional government funding ($2.5million) and receiver infrastructure roll outs which have significantly improved the number and geographic scale of both data logging and real-time receivers. This has not only provided an increase in real time detections, but also a unique dataset for white shark (and other shark species) movements around the south, south-west and lower west coasts. These data are providing the first validated information about when, where and why this species occurs off populated parts of the State, how long sharks spend in different areas and what environmental conditions may lead to increased risks of attacks. Additional roll outs have taken place during the summer of 2013/14, supporting the importance the Western Australian Government places on the receiver network.

2.2.5 Shark deterrents

The Western Australian Government considered the promotion and subsidy of the SharkShield as a means to offering additional protection to water users. While these devices may provide protection for surfers and divers they are unsuitable for use by swimmers in crowded areas, children, pregnant women and people fitted with pacemakers. The promotion of the SharkShield as a means to offering increased safety measures to water users at popular beaches therefore was not considered a viable option.

2.2.6 Beach closures

Beach closures are currently enacted in accordance with Surf Life Saving WA and Western Australian Government guidelines and protocols. While beach closures are effective at reducing the level of risk to water users, anecdotal evidence provided by Surf Life Saving WA suggests that the more frequently beaches are closed, the less responsive and compliant beach users become. It has also been suggested that beach closures are considered an annoyance and frustration by water users, particularly on hot days, and are considered an impediment to public amenity. Enhancing the criteria further for triggering beach closures in response to shark sightings was therefore not considered a stand-alone viable alternative.

2.2.7 The use of netting in addition to, or instead of, drum lines

In New South Wales, a total of 51 ocean beaches from Wollongong to Newcastle are currently netted between September and April each year using bottom-set mesh nets. This program has proven effective at reducing fatalities from shark attack, with only one death at a protected beach since the introduction of the Shark Meshing Program in 1937.

The Shark Control Program operating in Queensland utilises a combination of approximately 366 drum lines and 6.5kms of nets along 85 beaches. In the 44 year history of the program there has been only one fatal shark attack at a protected beach.

The province of KwaZulu-Natal in South Africa has a shark control program offering protection to 80 bathing areas over 320kms of coastline. The program uses a combination of nets, similar to those employed in Queensland, and drum lines. Gear is deployed throughout the year, but is removed during the annual sardine run in June and July to avoid capture of predators following the sardine shoals. The control program in KwaZulu-Natal has been effective in reducing the number of shark attacks in the province by 90% per annum (Curtis, et al. 2012). In 2007 South Africa replaced 4kms of nets at 17 beaches with 76 drum lines as a means to reduce the capture of non-target species.

In the Brazilian region of Recife a combination of bottom set long lines and drum lines was employed along a 20km stretch of coastline between 1992 and 2011. Hook based systems were used to minimise the environmental impact of the program. The shark attack rate decreased by around 97% during the time that fishing operations were conducted (Hazin and Alfonso, 2013).

Evidence suggests that catch rates of non-target species are much lower on drum lines than in nets (Dudley *et al.,* 1998; Gribble, 1998; Cliff and Dudley, 2006). The Western Australian Government, in its consideration of the shark hazard mitigation policy examined data on these programs. The Western Australian Government concluded that nets would not form part of the policy and that the exclusive use of a limited number of drum lines would offer the most effective protection for water users with the least environmental impact.

2.2.8 Target sharks smaller than three metres

In determining the size of shark to be targeted the Western Australian Government looked to other shark control programs and available scientific literature for guidance.

The Queensland Shark Control program targets sharks greater than two metres. The shark control program in Recife, Brazil does not specify a size of shark, but targets Potentially Aggressive Sharks (PAS), defined by the International Shark Attack File as large sharks which have previously been implicated in unprovoked attacks on humans. South Africa does not stipulate a size of shark that is targeted in its shark control program.

The Western Australian Government therefore considered the option of targeting sharks two metres or greater in total length. However, research also suggests that, white sharks in particular, experience a switch in diet from predominantly fish to a diet of mammals at approximately three metres in size (Estrada *et al*. 2006) and that these sharks are more likely to be associated with human interactions. In addition, when looking at the history of shark incidents in Western Australia, a significant number are believed to have involved sharks of approximately three metres in length or greater.

In considering the research, and in an effort to address any potential impacts on shark populations, the Western Australian Government therefore committed to targeting only white, tiger and bull sharks that are three metres or greater in total length.

2.2.9 Extending period of deployment of drum lines beyond 30 April

The Western Australian Government considered placing drum lines outside the period of proposed deployment (15 November and 30 April). However, the Government is cognisant of the environmental factors to be considered in setting static drum lines through Western Australian waters during winter months. The proposed action in this referral has been specifically developed to avoid entanglement with humpback and southern right whales which migrate annually along the Western Australian coast between May and October.

2.2.10 Reduced monitoring of drum lines

The proposed action in this referral requires drum lines to be monitored between 6am and 6pm, seven days a week for the duration of the deployment. Reducing the level of servicing of drum lines was an option for reducing the cost of the program. However, regular monitoring of drum lines increases the chance of successful release of by catch, and as such the Western Australian Government committed to daily monitoring of all drum lines.

2.3 Alternative locations, time frames or activities that form part of the referred action

If you have identified that the proposed action includes alternative time frames, locations or activities (in section 1.10) you must complete this section. Describe any alternatives related to the physical location of the action, time frames within which the action is to be taken and alternative methods or activities for undertaking the action. For each alternative location, time frame or activity identified, you must also complete (where relevant) the details in sections 1.2-1.9, 2.4-2.7, 3.3 and 4. Please note, if the action that you propose to take is determined to be a controlled action, any alternative locations, time frames or activities that are identified here may be subject to environmental assessment and a decision on whether to approve the alternative.

Responding to a shark threat or incident

In addition to setting static drum lines within the two MMAs, the referral includes a provision for responding to identified shark threats and attacks within all Western Australian waters, including the temporary deployment of drum lines. All Western Australian waters refers to coastal waters between the territorial sea baseline, usually the low water line along the coast, and a line three nautical miles seaward from the baseline as defined by Geoscience Australia. Marine protected areas are not excluded and in the event of a shark attack, or a shark considered to be posing an imminent threat to public safety, temporary drum lines may be deployed in consultation with the Department of Fisheries and the Department of Parks and Wildlife, as per the current Department of Fisheries "Guidelines for Fishing for Sharks Posing an Imminent Threat to Public Safety".

In the event of an attack, or the presence of a shark deemed to pose a threat to public safety, anywhere in Western Australian waters, either the contracted vessel, Department of Fisheries vessel or other available agency vessel will attend the scene of the incident or sighting and deploy up to five additional drum lines. No more than 60 static drum lines will be in the water at any one time, therefore providing capacity to deploy temporary drum lines in response to at least two incidents (where up to five drum lines may be deployed at each location). In the event that more than two incidents occur simultaneously, a corresponding number of static drum lines would be removed from the water in either the metro or south west areas, to allow for the temporary deployment of drum lines at the scene of the incident or sighting, ensuring that no more than a total of 72 drum lines are deployed at any time.

The drum lines used in a response scenario will be similar to the configuration of those described as part of the drum lining proposed action (see Attachment 9). Drum lines would be set for a maximum of one hour in response to a sighting, or for a maximum of one week in response to a shark attack.

Drum lines deployed in response to a sighting would be monitored continuously during the time of deployment. Drum lines which are set in response to an attack will be closely monitored between 6am and 6pm for the duration of the deployment.

Drum lines may be set anywhere off of the coastline but no further than 1km offshore. The placement of drum lines will be dependent upon the response scenario (fatality/attack/sighting), location and environmental conditions.

The criteria for determining a shark threat and associated response actions are at Attachment 20. The Department of Fisheries "Guidelines for Fishing for Sharks Posing an Imminent Threat to Public Safety" are at Attachment 21.

2.4 Context, planning framework and state/local government requirements

Explain the context in which the action is proposed, including any relevant planning framework at the state and/or local government level (e.g. within scope of a management plan, planning initiative or policy framework). Describe any Commonwealth or state legislation or policies under which approvals are required or will be considered against.

Fish Resources Management Act 1994

Under the *Fish Resources Management Act 1994* (FRMA) white sharks are prescribed as 'totally protected fish' and cannot be taken, held in possession, sold or purchased or consigned. Similarly, all whaler sharks with an interdorsal measurement greater than 70cm are 'totally protected fish' (tiger sharks and bull sharks are members of the whaler family).

Section 7 of the FRMA provides that the Western Australian Minister for Fisheries may, by instrument in writing, exempt a specified person or class of persons from all or any provisions of that Act.

The Western Australian Government was granted an exemption in January 2014 under s 7(2)(c) to undertake the 2013/14 drum lining program for the purpose of 'public safety'. This exemption expires on 30 April 2014. A further exemption will be sought from the Minister for Fisheries for the proposed action under this referral.

Wildlife Conservation Act 1950
Under the *Wildlife Conservation Act 1950* (WC Act), the white shark is fauna which is wholly protected throughout the state of Western Australia under s 14(1) and is declared to be in need of special protection under s 14(4). Without proper authority, a person capturing and killing a white shark commits an offence under ss. 16(1) and 17(2) of the WC Act.

In January 2014, under regulation 15 of the *Wildlife Conservation Regulations 1970* the Director General of the Department of Parks and Wildlife issued a Licence to Take Fauna for Public Purposes to the contractor engaged to undertake the 2013/14 drum lining activities. This licence expires on 1 May 2014. A further licence to take fauna will be sought for the proposed action under this referral.

Environmental Protection Act 1986
On 12 March 2014 the Western Australian Environmental Protection Authority (EPA) provided a response to a third party referral of the 2013/14 Western Australian Shark Drum Line Deployment, Management and Associated Services. The EPA concluded that the EPAs objectives for Marine Fauna could be met with a high level of confidence due to the limited extent of the proposal in both duration and geographic footprint. The EPA considered the program was unlikely to have a significant effect on the environment and therefore did not warrant formal environmental impact assessment under the *Environmental Protection Act 1986.* A copy of the EPAs decision is at Attachment 25.

A concurrent referral of the proposed action has also been made to the Western Australian EPA under s38(1) of the *Environmental Protection Act 1986.*

White Shark Recovery Plan
The Western Australian Government recognises the Australian National Recovery Plan for the White Shark (*Carcharodon carcharias*) published in 2013 and its importance to the population status of the white shark in Australian waters.

The Western Australian Government remains committed to contributing to research. A study of white shark population numbers is currently underway at the Department of Fisheries, with $2 million also committed to shark tagging and tracking[9].

Acoustically tagged white sharks and the Shark Monitoring Network currently provide:

- A more accurate understanding of white sharks' large-scale movements from South Australia into the south west and lower west coast regions of Western Australia.
- Data to examine what environmental conditions contribute to the apparently fluctuating abundance of white sharks off the lower west and south west coasts of Western Australia.
- Evidence of whether individual sharks repeatedly visit particular locations and whether sharks tagged in the area are residential or non-residential in those areas.
- A system for alerting public safety officials and the public about tagged sharks' movements close to populated areas, beaches and surf breaks in Perth and the south west.

The Federal Minister for the Environment recently committed $379,000 to white shark research in southern and western Australia. This project, being developed with the Western Australian Department of Fisheries will help address the lack of knowledge of the size and trend of white shark populations in

[9] Additional shark research is currently being discussed between the Department of the Premier and Cabinet and Department of Fisheries.

the region. The project will also aim to locate juvenile or nursery aggregation areas for white sharks to enable new genetic and electronic tagging techniques to be used.

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

If you have identified that the proposed action will be or has been subject to a state or territory environmental impact statement (in section 1.11) you must complete this section. Describe any environmental assessment of the relevant impacts of the project that has been, is being, or will be carried out under state or territory legislation. Specify the type and nature of the assessment, the relevant legislation and the current status of any assessments or approvals. Where possible, provide contact details for the state/territory assessment contact officer.

Describe or summarise any public consultation undertaken, or to be undertaken, during the assessment. Attach copies of relevant assessment documentation and outcomes of public consultations (if available).

A concurrent referral of the proposed action has also been made to the Western Australian EPA under s38(1) of the *Environmental Protection Act 1986.*

Contact details for the assessment contact officer at the EPA are:
Kim Taylor – General Manager
08 6145 0971
kim.taylor@epa.wa.gov.au

2.6 Public consultation (including with Indigenous stakeholders)

Your referral must include a description of any public consultation that has been, or is being, undertaken. Where Indigenous stakeholders are likely to be affected by your proposed action, your referral should describe any consultations undertaken with Indigenous stakeholders. Identify the relevant stakeholders and the status of consultations at the time of the referral. Where appropriate include copies of documents recording the outcomes of any consultations.

Extensive consultation was undertaken with Surf Life Saving WA throughout the development of the shark hazard mitigation policy. The Western Australian Government has continued to work closely with Surf Life Saving WA throughout the implementation of the program.

A list of stakeholders engaged through the development of the shark hazard mitigation policy is at Attachment 26.

On 12 March 2014 the Western Australian Environmental Protection Authority (EPA), provided a response to a third party referral of the 2013/14 Western Australian Shark Drum Line Deployment, Management and Associated Services. The EPA concluded that the EPA's objectives for Marine Fauna could be met with a high level of confidence due to the limited extent of the proposal in both duration and geographic footprint. The EPA considered the program was unlikely to have a significant effect on the environment and therefore did not warrant formal environmental impact assessment under the *Environmental Protection Act 1986* (see Attachment 25 for a copy of the EPAs decision).

2.7 A staged development or component of a larger project

If you have identified that the proposed action is a component of a larger action (in section 1.12) you must complete this section. Provide information about the larger action and details of any interdependency between the stages/components and the larger action. You may also provide justification as to why you believe it is reasonable for the referred action to be considered separately from the larger proposal (eg. The referred action is 'stand-alone' and viable in its own right, there are separate responsibilities for component actions or approvals have been split in a similar way at the state or local government levels).

Not Applicable

3 Description of environment & likely impacts

3.1 Matters of national environmental significance

Describe the affected area and the likely impacts of the proposal, emphasising the relevant matters protected by the EPBC Act. Refer to relevant maps as appropriate. The interactive map tool can help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in your area of interest.

Your assessment of likely impacts should refer to the following resources (available from the Department's web site):

- specific values of individual World Heritage properties and National Heritage places and the ecological character of Ramsar wetlands;
- profiles of relevant species/communities (where available), that will assist in the identification of whether there is likely to be a significant impact on them if the proposal proceeds;
- *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*; and
- associated sectoral and species policy statements available on the web site, as relevant.

Your assessment of likely impacts should consider whether a bioregional plan is relevant to your proposal. The Minister has prepared four marine bioregional plans (MBP) in accordance with section 176. It is likely that the MBP's will be more commonly relevant where listed threatened species, listed migratory species or a Commonwealth marine area is considered.

Note that even if your proposal will not be taken in a World Heritage area, Ramsar wetland, Commonwealth marine area, the Great Barrier Reef Marine Park or on Commonwealth land, it could still impact upon these areas (for example, through downstream impacts). Consideration of likely impacts should include both direct and indirect impacts.

3.1 (a) World Heritage Properties

Description

Shark Bay and Ningaloo Coast are listed as World Heritage areas. Shark Bay is approximately 900kms north of Perth, and the Ningaloo Coast is approximately 1300kms north of Perth. The two MMAs are not in the vicinity of the World Heritage areas and therefore pose no impact on any features of the protected areas. Consideration has been given to any potential impacts on the two World Heritage areas resulting from the temporary deployment of drum lines in response to a shark attack or a shark considered to be posing a threat to public safety.

Nature and extent of likely impact

Address any impacts on the World Heritage values of any World Heritage property.

In the event of a shark attack or a shark considered to be posing a threat to public safety, a vessel may be deployed to set up to five temporary drum lines within the boundaries of the Shark Bay or Ningaloo Coast World Heritage Areas. A direction to set gear in a response scenario with be made in consultation with the Department of Fisheries and the Department of Parks and Wildlife, as per the current Department of Fisheries "Guidelines for Fishing for Sharks Posing an Imminent Threat to Public Safety". Lines will be set to target a specific shark, and while the capture of a target shark cannot be guaranteed, lines will be closely monitored for the duration of their deployment (up to one hour in response to a sighting, and up to one week following an attack) thereby significantly minimising the potential for capture of a non-target species.

Any impacts on the marine environment or any species within the marine environment, including listed threatened and migratory species, in these areas is therefore considered to be negligible.

3.1 (b) National Heritage Places

Description

Shark Bay and Ningaloo Coast are listed as National Heritage areas. Shark Bay is approximately 900kms north of Perth, and the Ningaloo Coast is approximately 1300kms north of Perth. The two MMAs are not in the vicinity of the National Heritage areas and therefore pose no impact on any features of the protected areas. Consideration has been given to any potential impacts on the two World Heritage areas resulting from the temporary deployment of drum lines in response to a shark attack or a shark considered to be posing a threat to public safety.

Nature and extent of likely impact

Address any impacts on the National Heritage values of any National Heritage place.

In the event of a shark attack or a shark considered to be posing a threat to public safety, a vessel may be deployed to set up to five temporary drum lines within the boundaries of the Shark Bay or Ningaloo Coast National Heritage Areas. A direction to set gear in a response scenario with be made in consultation with the Department of Fisheries and the Department of Parks and Wildlife, as per the current Department of Fisheries "Guidelines for Fishing for Sharks Posing an Imminent Threat to Public Safety". Lines will be set to target a specific shark, and while the capture of a target shark cannot be guaranteed, lines will be closely monitored for the duration of their deployment (up to one hour in response to a sighting, and up to one week following an attack) thereby significantly minimising the potential for capture of a non-target species.

Any impacts on the marine environment or any species within the marine environment, including listed threatened and migratory species, in these areas is therefore considered to be negligible.

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

Not Applicable

Nature and extent of likely impact

Address any impacts on the ecological character of any Ramsar wetlands.

3.1 (d) Listed threatened species and ecological communities
Description

There are no threatened ecological communities listed on the EPBC Protected Matters Database within the proposed MMAs for the metropolitan and south west regions.

There are 38 threatened species listed on the EPBC Protected Matters Database for the metropolitan MMA and 45 threatened species listed for the south west MMA.

The Protected Matters Reports are at Attachment 27 for the metropolitan region and at Attachment 28 for the south west region (search conducted 02/04/2014).

In addition, the white shark (*Carcharodon carcharias*) and the grey nurse shark (*Carcharias taurus*) are listed as Vulnerable under s 178 of the EPBC Act and are therefore considered under the matters of national environmental significance.

Nature and extent of likely impact
Address any impacts on the members of any listened threatened species (except a conservation dependent species) or any threatened ecological community, or their habitat.

White shark
Research advice provided by the Department of Fisheries on the Western Australian shark hazard mitigation policy and associated drum lining activities for 2013/14 advised that the number of white sharks expected to be caught in the program, and particularly those in the size range ≥3m, to 30 April 2014, to likely be less than 10. This advice was based on the low rates of capture of white sharks during the targeted fishing and tagging operations that have been completed off Western Australia in the past few years, and the low catch rates of white sharks in drum lining programs in Queensland.

The research advice concluded that, even if the total number of white sharks killed in the program to 30 April 2014 is in the order of 10 to 20 then this would still likely have a negligible impact on the total stock size of the population of white sharks. A copy of the research advice from the Department of Fisheries is at Attachment 29.

As at 18 March 2014, no white sharks had been captured on drum lines (see Attachment 8 for current catch data from the 2013/14 drum lining program).

A further risk assessment has been undertaken by the Department of Fisheries in considering the spatial and temporal extents of the drum lining program that forms part of this referral. The research advice concludes that, with a program running between November and April each year, fewer than 10 white sharks in the target size range would be expected to be caught each year, with very few of those expected to be sexually mature i.e. greater than 4.5 metres. The deployment of static drum lines between 15 November and 30 April for a period of three years within two MMAs is therefore considered highly likely to only have a negligible impact on the total size, and ongoing dynamics, of the western Australian population of white sharks . A copy of the updated research advice from the Department of Fisheries is at Attachment 30.

In 2005 the Threatened Species Scientific Committee (the Committee) examined the case for listing the New South Wales and Queensland shark control programs as a Key Threatening Process (KTP) under the EPBC Act (Threatened Species Scientific Committee, 2005). The Committee investigated potential impacts of the programs on a number of species at risk, including white sharks. The recommendation from the Committee to the former Minister for Environment and Heritage was that the programs not be listed as a KTP under the EPBC Act, as they did not constitute an increased risk of population decline to species at risk. Given the Western Australian proposed action is on a much more limited geographic and temporal scale than either of the programs examined by the Committee, the proposed action is unlikely to constitute a significant impact on the status of white sharks.

Grey nurse shark
Research advice provided by the Department of Fisheries on the Western Australian shark hazard mitigation policy and associated drum lining activities for 2013/14 and a subsequent risk assessment undertaken by the Department of Fisheries on the three year drum lining program being proposed, advised that, unlike in other regions, grey nurse sharks have never been subjected to targeted fishing (commercial or recreational) in Western Australia. The only significant source of mortality has been from incidental capture. Catch and catch rate data from the demersal gillnet fishery, prior to their listing, indicates that grey nurse sharks were relatively abundant in temperate Western Australian waters in the mid-late 1990s and that the population was stable.

The research advice also indicated the expected number of captures of this species as part of the drum lining program to be low, and that if caught, their biological characteristics should allow for a high chance of survival following release due to their ability to buccally ventilate and maintain neutral buoyancy. The risk to the stock from drum lining activities is considered therefore to be negligible.

As at 18 March 2014, no grey nurse sharks had been captured on drum lines and therefore the catch data supports the hypothesis of no impact on populations (see Attachment 8 for current catch data from the 2013/14 drum lining program).

In addressing the significant impact criteria under the Significant Impact Guidelines 1.1, the proposed action in this referral is considered to be unlikely to have a significant impact on the western Australian populations of either the white shark or grey nurse shark. There is not considered to be a real chance or possibility of any of the following occurring for either the white shark or grey nurse shark species as a result of the proposed action:

- *a long-term decrease in the size of the population*

White sharks: The expected very low level of annual and therefore cumulative mortality from drum lines over the next three years is highly likely to only have a negligible impact on the total size and ongoing dynamics of the western Australian population of white sharks.

Grey nurse sharks: The level of capture of grey nurse sharks is expected to be minimal to nil. In addition their ability to be released alive even in the unlikely event one is captured means that there will be no impact on their overall population from this strategy.

- *a reduction in the area of occupancy*

White sharks: The level of capture of white sharks is not expected to generate any measurable decline in total abundance therefore there will not be any impact on their overall range.

Grey nurse sharks - Given the level of capture of grey nurse sharks is expected to be minimal to nil there will be no impact on their overall distribution including within the MMAs.

- *any fragmentation of an existing important population into two or more populations*

- *any adverse effects to habitat critical to the survival of the species*

- *any disruption in the breeding cycle of an important population*

White sharks: Fewer than 10 white sharks in the target size range would be expected to be caught each year, with very few of those expected to be sexually mature i.e. greater than 4.5 metres. The deployment of static drum lines is therefore considered highly likely to only have a negligible impact on the total size, and ongoing dynamics, of the western Australian population of white sharks

Grey nurse sharks: The available evidence suggests the western population of grey nurse sharks is relatively abundant in temperate Western Australian waters and that the population is stable. There are likely to be no mortalities through this program and as such disruption to the breeding cycle is not a consideration. So far, no grey nurse sharks have been caught in the trial program supporting the initial assessment that the risk to this population is negligible.

- *any modification, destruction, removal or isolation or decrease in the availability or quality of habitat to the extent that the species is likely to decline*

- *any introduction of invasive species or disease*

- *any substantial interference with the recovery of either species*

White sharks: The most plausible scenarios of their current compared to unexploited population size, fishing mortalities and life history characteristics suggest that the western Australian white shark population either did not decline significantly or if it did, it has "recovered" to at least stable levels since the reduction in fishing effort and mortality and their listing as protected species nearly two decades ago. The expected very low level of annual and therefore cumulative mortality from drum lines over the next three years is highly likely to only have a negligible impact on the total size and ongoing dynamics of the western Australian population of white sharks.

Grey nurse sharks: Unlike populations in eastern state regions, the western population of grey nurse shark has never been subjected to targeted fishing (commercial or recreational). Consequently, there is no evidence that the western population has ever been significantly reduced. Instead, the available evidence suggests this population is relatively abundant in temperate WA waters and that the population was stable. Recovery is not applicable and as there is likely to be no mortalities through this program this is not an issue. So far, none of these sharks have been caught in the WA program supporting the initial assessment that the risk to this population is negligible.

The 38 listed threatened species in the metropolitan MMA and 45 listed threatened species in the south west MMA include sea birds, turtles, whales, the Australian sea-lion, and sharks. The proposed action is considered unlikely to have an impact on, or interact with, any of the listed threatened species (see Attachments 29 and 30 for the Department of Fisheries Research Advice).

Sea birds

The hook of each drum line sits approximately two metres below the surface of the water. The size and circle design of the hook with a closed gape are designed to reduce the potential for interacting with sea birds. As at 18 March 2014, no interactions with sea birds have been recorded.

Turtles

Turtles are not common in the more temperate like regions where the MMAs are located. Individuals of most turtle species are therefore highly unlikely to be in the vicinity of the MMAs and therefore even interact with the drum lines. The size and circle like design of the hooks make it a remote likelihood that any turtle will be captured on the drum lines. Furthermore, as the lines are monitored frequently, there is a likelihood of successfully releasing alive any turtles that are captured or entangled in the lines. Should an interaction with a turtle occur, arrangements will be made for assistance from the marine animal disentanglement team at the Department of Parks and Wildlife. The proposal therefore represents a negligible risk to marine reptiles.

Whales

The time period (November–April) occurs outside the typical migration and breeding seasons for the whale species that migrate along the Western Australian coast reducing the likelihood of encountering drum line ropes. In addition, the positioning of these lines will be inshore of where the majority of movements occur plus the use of single floats reduces the likelihood of entanglements if they are encountered. Although a small number of whales have become entangled in gillnets in south east Queensland (26 in 16 years) no whale entanglements have occurred on Queensland's drum lines. Should entanglement of one of these species occur, the Department of Parks and Wildlife has considerable expertise in disentanglement procedures. Furthermore these whale populations are generally considered to have recovered significantly from their previously threatened status, consequently from a stock sustainability perspective even in the extremely remote likelihood that an entanglement occurs and causes a death, this would still represent a negligible risk to the stock.

Australian sea lion
There are no records of these species having been captured on large hooks off of Western Australia and none have been captured in the program to date. The size and design of the hooks make it a remote likelihood that any individual pinniped will become captured as part of this program and therefore the program poses a negligible risk.

Whale sharks
Whale sharks are not common in the more temperate waters of the MMAs and the time period of deployment (November-April) occurs outside the typical presence of whale sharks in tropical Western Australian waters. Individuals of whale shark are therefore highly unlikely to be in the vicinity of the MMAs and interact with the drum lines.

Consideration has been given to potential impacts on threatened species in the event that temporary drum lines are deployed anywhere in Western Australian waters in response to a shark attack or a shark considered to be posing a threat to public safety. The drum lines used in a response scenario will be similar to the configuration of those described as part of the drum lining proposed action (see Attachment 9). In these circumstances, lines will be set to target a specific shark, and while the capture of a target shark cannot be guaranteed, lines will be closely monitored for the duration of their deployment. Drum lines deployed in response to a sighting would be monitored continuously during the time of deployment, up to a maximum of one hour. Drum lines which are set in response to an attack will be closely monitored between 6am and 6pm for the duration of the deployment, up to a maximum of one week. It is therefore considered unlikely that the setting of temporary drum lines in response to a shark attack or shark sighting considered to be posing a threat to public safety will have an impact upon any of the listed threatened species.

3.1 (e) Listed migratory species

Description

The white shark (*Carcharodon carcharias*) is listed as a migratory species under the EPBC Act and under Appendix 1 (A1) of the International Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

The EPBC Protected Matters Database lists 36 migratory species in the metropolitan MMA and 34 migratory species in the south west MMA. Species listed include whales, turtles, sea birds, dolphins and manta rays (see Attachments 27 and 28 for Protected Matters Reports).

Nature and extent of likely impact

Address any impacts on the members of any listed migratory species, or their habitat.

As at 18 March 2014, no white sharks had been captured on drum lines (see Attachment 8 for current catch data from the 2013/14 drum lining program). As at 18 March 2014 the only non-shark by catch taken on a drum line was one north-west blowfish (*Lagocephalus sceleratus*). There have been no recorded interactions with sea birds, dolphins, whales, manta rays, turtles, or any other demersal scalefish.

In addressing the significant impact criteria under the Significant Impact Guidelines 1.1, the proposed action in this referral is considered unlikely to have an impact on the migrating populations of white sharks through Western Australian waters.

In addressing all migratory species listed under the Protected Matters Reports, the proposed action is considered unlikely to have an impact on the species listed, including all sea birds, dolphins, whales, manta rays and turtles (see Attachment 30 for the Department of Fisheries Research Advice April 2014).

Sea birds

The hook of each drum line sits approximately two metres below the surface of the water. The size and circle design of the hook with a closed gape are designed to reduce the potential for interacting with sea birds. As at 18 March 2014, no interactions with sea birds have been recorded.

Dolphins

Given the size and shape of the hooks used, it is highly unlikely that dolphins will be captured by the drum line gear. Dolphins are reported as scavenging bait off of hooks in Queensland but very few have actually been captured in 16 years of drum line operations and all were released alive. The Western Australian program therefore poses a negligible risk to any dolphin species or population that may overlap with these MMAs.

Whales

The time period (November–April) occurs outside the typical migration and breeding seasons for the whale species that migrate along the Western Australian coast reducing the likelihood of interactions. In addition, the positioning of these lines will be inshore of where the majority of movements occur plus the use of single floats reduces the likelihood of entanglements if they are encountered. Although a small number of whales have become entangled in gillnets in south east Queensland (26 in 16 years) no whale entanglements have occurred on Queensland's drum lines. Should entanglement of one of these species occur, arrangements will be made for assistance from the marine animal disentanglement team at the Department of Parks and Wildlife.

Turtles and manta rays

Turtles and manta rays are not common to temperate like regions where the MMAs are located. Individuals of these species are therefore highly unlikely to be in the vicinity of the MMAs and therefore even interact with the drum lines. The size and circle design of the hooks used in the drum line

configuration make it a remote likelihood that any turtles or manta rays will be captured on the drum lines. Furthermore, as the lines are monitored frequently, there is a likelihood of successfully releasing alive any turtles or manta rays that are captured or entangled in the lines. Should an interaction with a turtle occur, arrangements will be made for assistance from the marine animal disentanglement team at the Department of Parks and Wildlife. The proposal therefore represents a negligible risk to these species.

Consideration has been given to potential impacts on migratory species in the event that temporary drum lines are deployed anywhere in Western Australian waters in response to a shark attack or a shark considered to be posing a threat to public safety. In these circumstances, lines will be set to target a specific shark, and while the capture of a target shark cannot be guaranteed, lines will be closely monitored for the duration of their deployment (up to one hour in response to a sighting, and up to one week following an attack). Close monitoring of the drum lines will significantly minimise the potential for capture of non-target species.

There is therefore not considered to be a real chance or possibility that the proposed action will:

- substantially modify, destroy or isolate an area of important habitat for the migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

3.1 (f) Commonwealth marine area

(If the action is in the Commonwealth marine area, complete 3.2I instead. This section is for actions taken outside the Commonwealth marine area that may have impacts on that area.)

Description

The potential for flow-on effects to Commonwealth marine areas from impacts on species targeted in the drum line program, in particular white and tiger sharks.

Nature and extent of likely impact

Address any impacts on any part of the environment in the Commonwealth marine area.

Collectively, the drum line program will operate for a short time period in each of just three years. The footprint of the operation is extremely small compared to the distribution of the species most likely to be directly affected (white and tiger sharks) with relatively small numbers of individuals likely to be captured and even less killed compared to their total stock size. The program will therefore generate only negligible impacts on each of the affected species. Consequently it is not plausible that these negligible impacts would generate a measurable impact on the broader Leeuwin-Naturalitse meso-scale ecosystem which covers all the continental shelf waters in this area of the West Coast Bioregion, including Commonwealth marine waters. Consequently, the removal of only several tonnes of a common species of shark, the tiger shark, per annum from two small areas of the West Coast bioregion by this program would not have any measurable effect on the functioning of the broader marine ecosystems within this bioregion and therefore represents a negligible risk.

3.1 (g) Commonwealth land
(If the action is on Commonwealth land, complete 3.2(d) instead. This section is for actions taken outside Commonwealth land that may have impacts on that land.)

Description
If the action will affect Commonwealth land also describe the more general environment. The Policy Statement titled *Significant Impact Guidelines 1.2 – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* provides further details on the type of information needed. If applicable, identify any potential impacts from actions taken outside the Australian jurisdiction on the environment in a Commonwealth Heritage Place overseas.

Not Applicable

Nature and extent of likely impact

Address any impacts on any part of the environment in the Commonwealth land. Your assessment of impacts should refer to the *Significant Impact Guidelines 1.2 – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* and specifically address impacts on:

- ecosystems and their constituent parts, including people and communities;
- natural and physical resources;
- the qualities and characteristics of locations, places and areas;
- the heritage values of places; and
- the social, economic and cultural aspects of the above things.

3.1 (h) The Great Barrier Reef Marine Park

Description

Not Applicable

Nature and extent of likely impact

Address any impacts on any part of the environment of the Great Barrier Reef Marine Park.

Note: If your action occurs in the Great Barrier Reef Marine Park you may also require permission under the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act). If so, section 37AB of the GBRMP Act provides that your referral under the EPBC Act is deemed to be an application under the GBRMP Act and Regulations for necessary permissions and a single integrated process will generally apply. Further information is available at www.gbrmpa.gov.au

---

3.1 (i) A water resource, in relation to coal seam gas development and large coal mining development

Description

If the action is a coal seam gas development or large coal mining development that has, or is likely to have, a significant impact on water resources, the draft *Policy Statement Significant Impact Guidelines: Coal seam gas and large coal mining developments—Impacts on water resources* provides further details on the type of information needed.

Not Applicable

Nature and extent of likely impact

Address any impacts on water resources. Your assessment of impacts should refer to the draft *Significant Impact Guidelines: Coal seam gas and large coal mining developments—Impacts on water resources*.

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

You must describe the nature and extent of likely impacts (both direct & indirect) on the whole environment if your project:

- is a nuclear action;
- will be taken by the Commonwealth or a Commonwealth agency;
- will be taken in a Commonwealth marine area;
- will be taken on Commonwealth land; or
- will be taken in the Great Barrier Reef marine Park.

Your assessment of impacts should refer to the *Significant Impact Guidelines 1.2 – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* and specifically address impacts on:

- ecosystems and their constituent parts, including people and communities;
- natural and physical resources;
- the qualities and characteristics of locations, places and areas;
- the heritage values of places; and
- the social, economic and cultural aspects of the above things.

3.2 (a)	**Is the proposed action a nuclear action?**	X	**No**
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment		

3.2 (b)	**Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?**	X	**No**
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment		

3.2 I	**Is the proposed action to be taken in a Commonwealth marine area?**	X	**No**
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))		

3.2 (d)	**Is the proposed action to be taken on Commonwealth land?**	X	**No**
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))		

3.2 I	**Is the proposed action to be taken in the Great Barrier Reef Marine Park?**	X	**No**
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))		

3.3 Other important features of the environment

Provide a description of the project area and the affected area, including information about the following features (where relevant to the project area and/or affected area, and to the extent not otherwise addressed above). If at Section 2.3 you identified any alternative locations, time frames or activities for your proposed action, you must complete each of the details below (where relevant) for each alternative identified.

3.3 (a) Flora and fauna

As per 3.1(d) and 3.1(e)

3.3 (b) Hydrology, including water flows

Not Applicable

3.3 I Soil and Vegetation characteristics

Not Applicable

3.3 (d) Outstanding natural features

As per 3.3(h)

3.3 I Remnant native vegetation

Not Applicable

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

Not Applicable

3.3 (g) Current state of the environment

Not Applicable

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

As per 3.1(a) and 3.1(b)

3.3 (i) Indigenous heritage values

Not Applicable

3.3 (j) Other important or unique values of the environment

Describe any other key features of the environment affected by, or in proximity to the proposed action (for example, any national parks, conservation reserves, wetlands of national significance etc).

The following Western Australian Marine Parks managed by the Department of Parks and Wildlife are located within the MMAs designated under this proposed action:

- Marmion Marine Park (metropolitan); and
- Ngari Capes Marine Park (south west)

The Cottesloe Fish Habitat Protection Area (FHPA) managed by the Department of Fisheries is located within the metropolitan Marine Monitored Area (see Attachments 5 and 6 for maps).

Static drum lines will not be deployed within any gazetted or proposed marine sanctuary zone or gazetted or proposed recreation zone in any Western Australian marine park as designated under the *Conservation and Land Management Act 1984.* Static drum lines will not be placed within any Fish Habitat Protection Areas as designated under the *Fish Resources Management Act 1994.*

3.3 (k) Tenure of the action area (eg freehold, leasehold)

Not Applicable

3.3 (l) Existing land/marine uses of area

Not Applicable

3.3 (m) Any proposed land/marine uses of area

Not Applicable

4 Measures to avoid or reduce impacts

Note: If you have identified alternatives in relation to location, time frames or activities for the proposed action at Section 2.3 you will need to complete this section in relation to each of the alternatives identified.

Provide a description of measures that will be implemented to avoid, reduce, manage or offset any relevant impacts of the action. Include, if appropriate, any relevant reports or technical advice relating to the feasibility and effectiveness of the proposed measures.

For any measures intended to avoid or mitigate significant impacts on matters protected under the EPBC Act, specify:
- what the measure is,
- how the measure is expected to be effective, and
- the time frame or workplan for the measure.

Examples of relevant measures to avoid or reduce impacts may include the timing of works, avoidance of important habitat, specific design measures, or adoption of specific work practices.

Provide information about the level of commitment by the person proposing to take the action to implement the proposed mitigation measures. For example, if the measures are preliminary suggestions only that have not been fully researched, or are dependent on a third party's agreement (e.g. council or landowner), you should state that, that is the case.

Note, the Australian Government Environment Minister may decide that a proposed action is not likely to have significant impacts on a protected matter, as long as the action is taken in a particular manner (section 77A of the EPBC Act). The particular manner of taking the action may avoid or reduce certain impacts, in such a way that those impacts will not be 'significant'. More detail is provided on the Department's web site.

For the Minister to make such a decision (under section 77A), the proposed measures to avoid or reduce impacts must:
- clearly form part of the referred action (eg be identified in the referral and fall within the responsibility of the person proposing to take the action),
- be must be clear, unambiguous, and provide certainty in relation to reducing or avoiding impacts on the matters protected, and
- must be realistic and practical in terms of reporting, auditing and enforcement.

More general commitments (eg preparation of management plans or monitoring) and measures aimed at providing environmental offsets, compensation or off-site benefits CANNOT be taken into account in making the initial decision about whether the proposal is likely to have a significant impact on a matter protected under the EPBC Act. (But those commitments may be relevant at the later assessment and approval stages, including the appropriate level of assessment, if your proposal proceeds to these stages).

4.1 Exclusive use of drum lines with no inclusion of nets or longlines

The Western Australian Government is committed to using only drum lines, with no inclusion of nets or longlines, for the duration of the proposed action.

Nets have been an integral part of the successful shark control programs in South Africa, New South Wales and Queensland. Although these programs have proved effective in protecting water users from shark attack, the benefits have been accompanied by an environmental cost. Catches are not confined to shark species posing a risk to humans and also include a diverse range of non-shark species.

In order to reduce the environmental impact of the programs, authorities in Queensland and South Africa are replacing nets with drum lines, with South Africa recently replacing 4 km of nets with 76 drum lines (Cliff and Dudley 2011). The annual by catch on the drum lines has proven to be very low compared to adjacent nets (Cliff and Dudley 2011).

The Queensland program now has approximately 366 drum lines in place, with drum lines providing the sole protection at certain beaches (Queensland DPI, 2006).

Longlines are a significant component of the shark control program in Recife, Brazil; responsible for around 93% of the catch (Hazin et al 2013). Longlines however are responsible for high levels of by catch and potential interference with marine craft.

4.2 Specific gear and bait designed to reduce by catch

Non-standard, approximately size 25/0 circle hooks have been specifically employed to target only large sharks, and reduce the number of smaller sharks caught. Circle hooks have also been shown to be effective in increasing the survival rate of non-target sharks released from drum lines (Godin, A,. et al 2012). A photo of the 25/0 circle hook that has been used in the 2013/14 drum lining trial, compared to 12/0 and a 14/0 size circle hooks, is at Attachment 31.

Baited hooks are to be set a minimum of approximately two metres below the surface of the water in an effort to reduce interaction with sea birds (in particular shearwaters and gannets). To date, no interactions with sea birds and drum lines have been recorded.

The use of shark as bait has been employed in Queensland in order to reduce by catch (particularly turtles) and to deter dolphins from interfering with the bait (Queensland DPI, 2006). Based on this information the Western Australian Government has indicated a preference for shark as bait to form part of the proposed action under this referral.

Catch data from the current Western Australian 2013/14 drum lining trial program to 16 March 2014 demonstrates an extremely low rate of non-shark by catch (<0.01%) and high success rate of release of non-target sharks. Of 107 target sharks caught in the program, 33 have been three metres total length or greater. 74 target sharks less than three metres total length have been caught on the lines, of which 62 (84%) have been successfully released.

A detailed analysis of catch from the current drum line program will be conducted as part of a review of the program following its completion on 30 April 2014.

4.3 Limited number of drum lines and area of deployment

The two MMAs in which drum lines are to be deployed as part of the proposed action represent approximately 0.05-0.07% of all Western Australian waters. The distance over which drum lines are proposed to be set represents approximately 0.5-0.7% of the Western Australian coastline (see Attachment 7 for calculations and Attachments 12 and 13 for maps of MMAs).

The drum lines will be deployed in MMAs limited to high use areas patrolled by Surf Life Saving WA and popular surfing spots in inner coastal areas, at approximately 1km offshore. Static drum lines will not be deployed within any gazetted or proposed marine sanctuary zone or gazetted or proposed recreation zone in any Western Australian marine park as designated under the *Conservation and Land Management Act 1984*. Drum lines will not be placed within any Fish Habitat Protection areas as designated under the *Fish Resources Management Act 1994*.

4.4 Limited period of deployment of drum lines

The proposed action will take place between 15 November and 30 April for three years, commencing 15 November 2014 and ceasing 30 April 2017, after which the program will be subject to review.

The proposed action in this referral has been specifically developed to avoid entanglement with humpback and southern right whales which migrate annually along the Western Australian coast between May and October.

Restricting the deployment of the drum lines to the period of 15 November to 30 April will minimise impacts on the white shark population, being the months of least white shark activity in metropolitan and south western coastal waters (FOP 109, 2012) whilst correlating with the time of highest activity by water users.

4.5 Regular patrols of drum lines

The proposed action requires drum lines to be monitored between 6am and 6pm, seven days a week. Regular patrols of the drum lines should be effective in increasing the survival rate of non-target animals released from the lines.

4.6 Contract management

To ensure that the contractor undertaking the drum lining activities complies with contract, permit and legislative requirements and conditions, a minimum of ten observer trips on each vessel between 15 November and 30 April each year will be undertaken, with additional trips undertaken as required. Observers will be present on the first trip of each season on each vessel to observe the deployment of drum lines within each MMA. The observers' role will be to observe the performance of the contractor and ensure contractual and legislative conditions are being met. Observers will be officers from agencies including, but not limited to, the Department of Fisheries, Department of Parks and Wildlife and Department of the Premier and Cabinet. Reports will be completed following each observer trip in each region (see Attachment 18 for a summary of observer trips undertaken and Attachment 19 for an example post-observer report). Meetings between the contractor and contract manager will also be held to ensure clear lines of communication and understanding of all contract requirements. Meetings will be held prior to implementation, ad-hoc and as required throughout the operational phase of the program and following the completion of the program post 30 April each year.

4.7 Western Australian expertise in marine animal disentanglement

The Department of Parks and Wildlife provides access to a team of experts with extensive experience in the disentanglement of, and best practice handling techniques, of marine animals. The Department of Parks and Wildlife were consulted during the development and implementation of the 2013/14 drum line trial program. In the event of a marine animal entanglement in a drum line, the Department of Fisheries Operations Manager will contact the disentanglement team at the Department of Parks and Wildlife to arrange for the provision of assistance. Contractor training of best practice animal handling techniques and protocols will be provided by officers from the Department of Parks and Wildlife prior to the commencement of operations.

4.8 Ongoing improvements to the program

In order to continually improve upon operations, knowledge and training, the Department of Fisheries has provided post-catch data interrogation and qualification to ensure that data logs are being completed accurately. Experts in species identification at the Department of Fisheries have provided clarification on species descriptions from catch records and photos on two occasions and this information has been disseminated back to the operator to improve upon knowledge bases and experience. The Department of Fisheries will continue to provide this post-catch support as part of the proposed action in this referral.

4.9 Tender requirements

As part of the tender process for selection of a contractor(s), minimum standards of operation and certain technical specifications will be required. These will include vessel specifications, including a requirement for a ramp to provide for reduced stress to animals and more effective lifting of animals onto deck; the size and speed of the vessel; specifications around the firearm; access to continuous water flow on deck for animal handling, and a preference for a contractor with prior shark and large marine animal handling experience.

The contractor will be required to provide at a minimum the following:

(i) the organisational capacity to perform including relevant skills and experience within the organisation in performing similar requirements;
(ii) suitably qualified personnel, including an outline of their experience in the handling of large marine animals;
(iii) staffing levels on the vessel;
(iv) firearms licence and associated provisions;
(v) contingency planning and capability including potential for deployment of an alternative vessel of similar specifications and equipping in the event of mechanical breakdown or unserviceability;
(vi) the ability to undertake and record accurate size measurement of marine animals on, and or alongside, the vessel;
(vii) the ability to undertake basic research as required, such as species identification, sexing, size measurement and fin tagging;

(viii) winch capable of minimum 1.5 tonnes lifting capacity and suitable to bring a 1.5 tonne shark (or other marine animal) on board the vessel, and return it to the ocean for safe release;
(ix) ramp or suitable and approved alternative system (such as a sling, or conveyor system) capable of bringing aboard, and supporting the release of, a large marine animal to minimise further stress to the animal;
(x) firearm (12 gauge shotgun as a minimum), secure storage and relevant licences;
(xi) pumping equipment or deck wash system suitable to ventilate gills of live sharks on an ongoing basis while the animal is on deck prior to release.

4.10 Contractor training

Prior to the commencement of operations, the contractor(s) will be provided with training by officers from the Department of Fisheries and Department of Parks and Wildlife in best practice animal handling techniques including minimising stress to animals, determining the condition of a shark and safe work practices. A copy of the Department of Fisheries Field Identification Guide to Western Australian Sharks and Shark-like Rays[10] and Operator Protocol guidebooks similar to that at Attachment 32 will be provided to the contractor prior to the commencement of operations.

[10] http://www.fish.wa.gov.au/documents/occasional_publications/fop001.pdf

5 Conclusion on the likelihood of significant impacts

Identify whether or not you believe the action is a controlled action (ie. Whether you think that significant impacts on the matters protected under Part 3 of the EPBC Act are likely) and the reasons why.

5.1 Do you THINK your proposed action is a controlled action?

X	No, complete section 5.2
	Yes, complete section 5.3

5.2 Proposed action IS NOT a controlled action.

Specify the key reasons why you think the proposed action is NOT LIKELY to have significant impacts on a matter protected under the EPBC Act.

5.2.1 White sharks

White sharks that will be caught

Research advice from the Department of Fisheries advises that the number of white sharks, three metres and above that will be caught and destroyed is likely to be less than 10 and that very few of these are expected to be sexually mature i.e. greater than 4.5 metres.. The researchers advise that this level of mortality would have a negligible impact on the total population of white sharks.

This advice is based on the low catch rates of white sharks on drum lines in Queensland (approximately three per annum) (Queensland Department of Agriculture, Fisheries and Forestry), and the low rates of capture of white sharks during the fishing operations by Western Australian Department of Fisheries officers conducted as part of the white shark tagging and monitoring program.

This estimate is reinforced by catch data from the KwaZulu-Natal shark control program in South Africa. Between February 2007 and February 2010 the mean catch rate per annum of all white sharks was eight per year (Cliff and Dudley,2011). Under this program, 76 drum lines are deployed in fixed positions throughout the year; although in some years, some lines are removed during the sardine run in June and July (Cliff and Dudley,2011).

In Western Australia the drum lines will be deployed over a limited time frame in only approximately 0.05-0.07% of Western Australia waters. Based on the South African catch data for drum lines it is likely that there will be a total catch rate of less than 10 white sharks each summer and that a number of the animals caught will be less than three metres in length and therefore released.

Measures to increase the survival of non-target white sharks

In order to increase the survival of non-target white sharks (i.e. less than three metres total length), the Western Australian Government will employ the use of circle hooks. These hooks have been shown to decrease the at-vessel mortality rates of sharks (Godin 2012). Due to their design, circle hooks tend to minimise deep hooking in potentially lethal internal regions and instead typically hook fish in the upper jaw.

The drum lines will be monitored seven days a week between the hours of 6am and 6pm reducing the amount of time non-target sharks are hooked. In addition, vessels servicing the drum lines will be configured to enable removal of sharks from the lines in a manner that will minimise injury to the animal.

5.2.2 Grey nurse sharks – western population

Research advice provided by the Department of Fisheries advises that, unlike in other regions, grey nurse sharks have never been subjected to targeted fishing (commercial or recreational) in Western Australia. The only significant source of mortality has been from incidental capture. Catch and catch rate

data from the demersal gillnet fishery, prior to their listing, indicates that grey nurse sharks were relatively abundant in temperate Western Australian waters in the mid-late 1990s and that the population was stable.

The research advice also indicates the expected number of captures of this species as part of the drum lining program to be low, and that if caught, their biological characteristics should allow for a high chance of survival following release. The risk to the stock from drum lining activities was considered therefore to be negligible.

5.3 Proposed action IS a controlled action

Type 'x' in the box for the matter(s) protected under the EPBC Act that you think are likely to be significantly impacted. (The 'sections' identified below are the relevant sections of the EPBC Act.)

	Matters likely to be impacted
	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
	Protection of the environment from Commonwealth actions (section 28)
	Commonwealth Heritage places overseas (sections 27B and 27C)

Specify the key reasons why you think the proposed action is likely to have a significant adverse impact on the matters identified above.

6 Environmental record of the responsible party

NOTE: If a decision is made that a proposal needs approval under the EPBC Act, the Environment Minister will also decide the assessment approach. The EPBC Regulations provide for the environmental history of the party proposing to take the action to be taken into account when deciding the assessment approach.

		Yes	No
6.1	**Does the party taking the action have a satisfactory record of responsible environmental management?** **Provide details** The Department of the Premier and Cabinet is compliant with all applicable Federal and State legislation.	X	
6.2	**Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application – ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?** **If yes, provide details**		X
6.3	**If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?** **If yes, provide details of environmental policy and planning framework**	N/A	
6.4	**Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?** **Provide name of proposal and EPBC reference number (if known)** The Department of the Premier and Cabinet applied for an exemption under Section 158 of the EPBC Act for the drum line trial in 2013/14. This application was approved.	X	

7 Information sources and attachments

(For the information provided above)

7.1 References

- List the references used in preparing the referral.
- Highlight documents that are available to the public, including web references if relevant.

- Advice to the Minister for Environment from the Threatened Species Scientific Committee on amendments to the EPBC Act. Report 21 March 2005 at http://www.environment.gov.au/node/14596
- Cliff, G.,Dudley, S.F.J. (2011) Reducing the environmental impact of shark-control programs: a case study from KwaZulu-Natal, South Africa. *Marine and Freshwater Research*, 2011, **62**, 700-709
- Curtis. T.H, Bruce. B.D, Cliff. G., Dudley. S.F.J., Klimley. P.A., Kock. A.A, Lea. R.N., Lowe. C.G., McCosker. J.E., Skomal. G.B., Werry. J.M., and West. J.G., *Responding to the Risk of White Shark Attack, Updated Statistics, Prevention, Control Methods, and Recommendations,* **Chapter 31**. in Global Perspectives on the Biology and Life History of the White Shark ed. Domeier. M.L. CRC Press, 2012.
- Dudley, S.F.J., Haestier, R.C., Cox,K.R., and Murray,M. (1998). Shark control: experimental fishing with baited drumlins. *Marine and Freshwater Research* **49**, 653-661.doi:10.1071/MF98026
- Estrada, J.A., Rice, A.N., Natanson, L.J. and Skomal, G.B. (2006) Use of Isotopic Analysis of Vertebrae in Reconstructing Ontogenetic Feeding Ecology in White Sharks. *Ecology*, **87** (4), 2006 pp829 -834.
- FOP 109, (2012). A correlation study of the potential risk factors associated with white shark attacks in Western Australian waters. Department of Fisheries Occasional Publication No. 109, 2012.
- Godin,A.C., Carlson, J.K., Burgener, V. (2012). The effect of circle hooks on shark catchability and at-vessel mortality rates in longline fisheries. *Bulletin of Marine Science.* **88**(3):469-483. 2012
- Gribble,N.A., McPherson, G., and Lane,B. (1998). Effect of the Queensland Shark Control Program on non-target species: whales, dugong, turtle and dolphin: a review. *Marine and Freshwater Research* **49**, 645-651. Doi:10.1071/MF97053
- Hazin, F.H.V., and Alfonso, A.S. A green strategy for shark attack mitigation off Recife, Brazil. Animal Conservation, The Zoological Society of London. 2013
- Queensland Department of Agriculture, Fisheries and Forestry, Shark Catch Numbers 2001 – 2013 at http://www.daff.qld.gov.au/fisheries/services/shark-control-program/catch-numbers
- Queensland Department of Primary Industries and Fisheries. 2006. *A Report on the Queensland Shark Safety Program.*

7.2 Reliability and date of information

For information in section 3 specify:

- source of the information;
- how recent the information is;
- how the reliability of the information was tested; and
- any uncertainties in the information.

7.3 Attachments

Indicate the documents you have attached. All attachments must be less than three megabytes (3mb) so they can be published on the Department's website. Attachments larger than three megabytes (3mb) may delay the processing of your referral.

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the project locality (section 1)	✓	3: Metropolitan drum line locations for the 2013/14 trial program in relation to marine protected areas 4(a):South west region drum line locations for Phase 1 of the 2013/14 trial in relation to marine protected areas 4(b):South west region drum line locations for Phase 2 of the 2013/14 trial in relation to marine protected areas 5: Drum line deployment areas for the proposed action in the metropolitan region in relation to marine protected areas 6: Drum line deployment areas for the proposed action in the south west region in relation to marine protected areas 7: Calculations of the size of the area over which the proposed action is to take place 12: Map of the metropolitan Marine Monitored Area 13: Map of the south west Marine Monitored Area 14: Map of the three proposed phases of drum line deployment in the south west region
	GIS file delineating the boundary of the referral area (section 1)	✓	
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3)	✓	(as above)

If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)	✓	25: The Environmental Protection Authority Notice Under Section 39A(3)
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)	✓	26: Stakeholders engaged through the development of the shark hazard mitigation policy 29: Research Advice on the Proposed Shark Mitigation Strategy using drum lines for January to April 2014 30: Research Advice on the Proposed Shark Mitigation Strategy using drum lines for the period November 2014 – April 2017
	copies of any flora and fauna investigations and surveys (section 3)		
	technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)		(as above)
	report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)		(as above)

8 Contacts, signatures and declarations

NOTE: Providing false or misleading information is an offence punishable on conviction by imprisonment and fine (s 489, EPBC Act).

Under the EPBC Act a referral can only be made by:

- the person proposing to take the action (which can include a person acting on their behalf); or
- a Commonwealth, state or territory government, or agency that is aware of a proposal by a person to take an action, and that has administrative responsibilities relating to the action[11].

Project title: Western Australian Government Shark Hazard Mitigation Drum Line Program

8.1 Person proposing to take action

This is the individual, government agency or company that will be principally responsible for, or who will carry out, the proposed action.

If the proposed action will be taken under a contract or other arrangement, this is:

- the person for whose benefit the action will be taken; or
- the person who procured the contract or other arrangement and who will have principal control and responsibility for the taking of the proposed action.

If the proposed action requires a permit under the Great Barrier Reef Marine Park Act[12], this is the person requiring the grant of a GBRMP permission.

The Minister may also request relevant additional information from this person.

If further assessment and approval for the action is required, any approval which may be granted will be issued to the person proposing to take the action. This person will be responsible for complying with any conditions attached to the approval.

If the Minister decides that further assessment and approval is required, the Minister must designate a person as a proponent of the action. The proponent is responsible for meeting the requirements of the EPBC Act during the assessment process. The proponent will generally be the person proposing to take the action[13].

Name	Mr Peter Conran
Title	Director General
Organisation	The State of Western Australia (Department of the Premier and Cabinet)
I / ABN (if applicable)	61313082730
Postal address	Locked Bag 3001, West Perth, WA 6872
Telephone	(08) 6552 5000
Email	
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence. I agree to be the proponent for this action.

Signature Date

[11] *If the proposed action is to be taken by a Commonwealth, state or territory government or agency, section 8.1 of this form should be completed. However, if the government or agency is aware of, and has administrative responsibilities relating to, a proposed action that is to be taken by another person which has not otherwise been referred, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.*

[12] *If your referred action, or a component of it, is to be taken in the Great Barrier Reef Marine Park the Minister is required to provide a copy of your referral to the Great Barrier Reef Marine Park Authority (GBRMPA) (see section 73A,* EPBC Act*). For information about how the GBRMPA may use your information, see http://www.gbrmpa.gov.au/privacy/privacy_notice_for_permits.*

[13] *If a person other than the person proposing to take action is to be nominated as the proponent, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.*

8.2 Person preparing the referral information (if different from 8.1)

Individual or organisation who has prepared the information contained in this referral form.

Name	
Title	
Organisation	
I / ABN (if applicable)	
Postal address	
Telephone	
Email	
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence.
Signature	Date

ATTACHMENTS

1: List of coordinates defining the metropolitan Marine Monitored Area

2: List of coordinates defining the south west Marine Monitored Area

3: Metropolitan drum line locations for the 2013/14 trial program in relation to marine protected areas

4(a): South west region drum line locations for Phase 1 of the 2013/14 trial in relation to marine protected areas

4(b): South west region drum line locations for Phase 2 of the 2013/14 trial in relation to marine protected areas

5: Drum line deployment areas for the proposed action in the metropolitan region in relation to marine protected areas

6: Drum line deployment areas for the proposed action in the south west region in relation to marine protected areas

7: Calculations of the size of the area over which the proposed action is to take place

8: Catch data from 25 January to 16 March 2014 from the 2013/14 Western Australian drum line trial

9(a): Primary drum line configuration for the proposed action

9(b): Optional third float addition to the drum line configuration for the proposed action

10: Surf Life Saving WA Beach Attendance Statistics

11: Criteria for determining drum line placement for 2013/14 trial

12: Map of the metropolitan Marine Monitored Area

13: Map of the south west Marine Monitored Area

14: Map of the three proposed phases of drum line deployment in the south west region

15: A photo of a Conventional Fin Tag

16: A photo of a Kangaroo Tag

17: Example data sheet from the 2013/14 Western Australian drum line trial

18: A summary of observer trips undertaken during the 2013/14 Western Australian drum line trial

19: An example of an observer trip report

20: Criteria for determining a shark threat and response guidelines

21: Guidelines for fishing for sharks posing an imminent threat to public safety

22: Locations of shark monitoring stations in the metropolitan region

23: Locations of shark monitoring stations in the south west region

24: Summary of applied research programs

25: The Environmental Protection Authority Notice Under Section 39A(3)

26: Stakeholders engaged through the development of the shark hazard mitigation policy

27: EPBC Act Protected Matters Report for the metropolitan MMA

28: EPBC Act Protected Matters Report for the south west MMA

29: Research advice on the proposed shark mitigation strategy using drum lines for January to April 2014

30: Research advice on the proposed shark mitigation strategy using drum lines for the period November 2014 – April 2017

31: Photo of different hook sizes

32: Example of operator protocols guidebook

1.

ID	Latitude (DDM)	Longitude (DDM)	Latitude (DMS)	Longitude (DMS)	Latitude (DD)	Longitude (DD)
1	-32° 2.130'	115° 43.891'	-32° 2' 7.780"	115° 43' 53.440"	-32.03549437	115.731511
2	-32° 2.038'	115° 43.990'	-32° 2' 2.280"	115° 43' 59.371"	-32.03396654	115.7331586
3	-32° 1.521'	115° 44.224'	-32° 1' 31.243"	115° 44' 13.470"	-32.0253453	115.737075
4	-32° 1.390'	115° 44.372'	-32° 1' 23.379"	115° 44' 22.341"	-32.02316082	115.7395392
5	-32° 1.062'	115° 44.426'	-32° 1' 3.727"	115° 44' 25.549"	-32.01770202	115.7404303
6	-32° 0.907'	115° 44.417'	-32° 0' 54.445"	115° 44' 24.993"	-32.01512358	115.7402758
7	-32° 0.763'	115° 44.455'	-32° 0' 45.799"	115° 44' 27.274"	-32.01272185	115.7409095
8	-32° 0.357'	115° 44.418'	-32° 0' 21.431"	115° 44' 25.064"	-32.00595313	115.7402955
9	-32° 0.098'	115° 44.409'	-32° 0' 5.855"	115° 44' 24.538"	-32.00162629	115.7401496
10	-31° 59.814'	115° 44.387'	-31° 59' 48.850"	115° 44' 23.244"	-31.99690283	115.7397901
11	-31° 59.521'	115° 44.407'	-31° 59' 31.281"	115° 44' 24.427"	-31.99202245	115.7401187
12	-31° 59.169'	115° 44.485'	-31° 59' 10.111"	115° 44' 29.073"	-31.98614181	115.7414091
13	-31° 58.918'	115° 44.492'	-31° 58' 55.055"	115° 44' 29.515"	-31.98195974	115.7415319
14	-31° 58.648'	115° 44.559'	-31° 58' 38.868"	115° 44' 33.554"	-31.97746342	115.7426538
15	-31° 58.520'	115° 44.569'	-31° 58' 31.172"	115° 44' 34.119"	-31.97532558	115.7428109
16	-31° 58.288'	115° 44.596'	-31° 58' 17.281"	115° 44' 35.738"	-31.97146706	115.7432604
17	-31° 57.623'	115° 44.594'	-31° 57' 37.393"	115° 44' 35.650"	-31.96038701	115.743236
18	-31° 57.342'	115° 44.602'	-31° 57' 20.502"	115° 44' 36.145"	-31.95569509	115.7433735
19	-31° 57.066'	115° 44.554'	-31° 57' 3.932"	115° 44' 33.265"	-31.95109209	115.7425736
20	-31° 56.721'	115° 44.564'	-31° 56' 43.258"	115° 44' 33.858"	-31.94534942	115.7427382
21	-31° 55.918'	115° 44.597'	-31° 55' 55.054"	115° 44' 35.790"	-31.93195956	115.743275
22	-31° 55.464'	115° 44.611'	-31° 55' 27.839"	115° 44' 36.651"	-31.9243997	115.7435142
23	-31° 54.381'	115° 44.649'	-31° 54' 22.835"	115° 44' 38.968"	-31.90634303	115.7441577
24	-31° 54.180'	115° 44.683'	-31° 54' 10.799"	115° 44' 40.996"	-31.90299981	115.744721
25	-31° 53.841'	115° 44.637'	-31° 53' 50.481"	115° 44' 38.237"	-31.89735573	115.7439547
26	-31° 53.264'	115° 44.596'	-31° 53' 15.835"	115° 44' 35.784"	-31.88773201	115.7432734
27	-31° 53.008'	115° 44.535'	-31° 53' 0.497"	115° 44' 32.076"	-31.88347137	115.7422434
28	-31° 52.807'	115° 44.474'	-31° 52' 48.446"	115° 44' 28.446"	-31.88012388	115.7412351
29	-31° 52.616'	115° 44.406'	-31° 52' 36.989"	115° 44' 24.375"	-31.87694137	115.7401041
30	-31° 52.418'	115° 44.424'	-31° 52' 25.052"	115° 44' 25.446"	-31.87362546	115.7404018

31	-31° 52.328'	115° 44.462'	-31° 52' 19.685"	115° 44' 27.742"	-31.87213464	115.7410395
32	-31° 51.808'	115° 44.448'	-31° 51' 48.489"	115° 44' 26.851"	-31.8634691	115.7407918
33	-31° 51.122'	115° 44.411'	-31° 51' 7.342"	115° 44' 24.663"	-31.85203956	115.7401842
34	-31° 50.667'	115° 44.369'	-31° 50' 40.018"	115° 44' 22.156"	-31.8444494	115.7394876
35	-31° 50.425'	115° 44.326'	-31° 50' 25.487"	115° 44' 19.566"	-31.84041314	115.7387682
36	-31° 50.261'	115° 44.263'	-31° 50' 15.674"	115° 44' 15.809"	-31.83768722	115.7377247
37	-31° 50.071'	115° 44.144'	-31° 50' 4.271"	115° 44' 8.630"	-31.83451969	115.7357304
38	-31° 49.856'	115° 43.980'	-31° 49' 51.348"	115° 43' 58.789"	-31.83093008	115.7329968
39	-31° 49.540'	115° 43.732'	-31° 49' 32.387"	115° 43' 43.918"	-31.82566307	115.7288661
40	-31° 49.196'	115° 43.440'	-31° 49' 11.765"	115° 43' 26.410"	-31.8199346	115.7240027
41	-31° 48.920'	115° 43.254'	-31° 48' 55.213"	115° 43' 15.251"	-31.8153369	115.7209032
42	-31° 48.686'	115° 43.112'	-31° 48' 41.139"	115° 43' 6.718"	-31.81142746	115.7185329
43	-31° 48.387'	115° 43.020'	-31° 48' 23.218"	115° 43' 1.207"	-31.8064494	115.717002
44	-31° 48.177'	115° 43.052'	-31° 48' 10.617"	115° 43' 3.120"	-31.80294909	115.7175335
45	-31° 48.000'	115° 43.131'	-31° 48' 0.002"	115° 43' 7.877"	-31.80000043	115.7188548
46	-31° 47.528'	115° 43.307'	-31° 47' 31.710"	115° 43' 18.395"	-31.79214153	115.7217764
47	-31° 46.843'	115° 43.313'	-31° 46' 50.591"	115° 43' 18.765"	-31.78071984	115.7218792
48	-31° 46.285'	115° 43.171'	-31° 46' 17.073"	115° 43' 10.284"	-31.77140916	115.7195234
49	-31° 45.757'	115° 43.037'	-31° 45' 45.444"	115° 43' 2.213"	-31.7626234	115.7172815
50	-31° 45.233'	115° 42.911'	-31° 45' 14.008"	115° 42' 54.668"	-31.75389111	115.7151854
51	-31° 45.015'	115° 42.864'	-31° 45' 0.901"	115° 42' 51.868"	-31.7502503	115.7144079
52	-31° 44.773'	115° 42.771'	-31° 44' 46.369"	115° 42' 46.271"	-31.74621359	115.7128529
53	-31° 44.604'	115° 43.373'	-31° 44' 36.226"	115° 43' 22.362"	-31.74339608	115.7228783
54	-31° 44.904'	115° 43.485'	-31° 44' 54.270"	115° 43' 29.075"	-31.74840831	115.724743
55	-31° 45.409'	115° 43.592'	-31° 45' 24.544"	115° 43' 35.544"	-31.75681787	115.7265399
56	-31° 45.926'	115° 43.750'	-31° 45' 55.584"	115° 43' 44.976"	-31.76544	115.72916
57	-31° 46.118'	115° 43.774'	-31° 46' 7.104"	115° 43' 46.452"	-31.76864	115.72957
58	-31° 46.447'	115° 43.898'	-31° 46' 26.832"	115° 43' 53.904"	-31.77412	115.73164
59	-31° 46.749'	115° 43.938'	-31° 46' 44.947"	115° 43' 56.253"	-31.77915183	115.7322926
60	-31° 46.903'	115° 43.976'	-31° 46' 54.192"	115° 43' 58.548"	-31.78172	115.73293
61	-31° 47.329'	115° 43.969'	-31° 47' 19.717"	115° 43' 58.152"	-31.78881033	115.7328199
62	-31° 47.688'	115° 43.924'	-31° 47' 41.280"	115° 43' 55.416"	-31.7948	115.73206

63	-31° 47.950'	115° 43.836'	-31° 47' 57.014"	115° 43' 50.179"	-31.79917055	115.7306053
64	-31° 48.093'	115° 43.811'	-31° 48' 5.580"	115° 43' 48.684"	-31.80155	115.73019
65	-31° 48.193'	115° 43.756'	-31° 48' 11.606"	115° 43' 45.368"	-31.80322398	115.7292689
66	-31° 48.271'	115° 43.680'	-31° 48' 16.236"	115° 43' 40.800"	-31.80451	115.728
67	-31° 48.352'	115° 43.652'	-31° 48' 21.096"	115° 43' 39.144"	-31.80586	115.72754
68	-31° 48.737'	115° 43.859'	-31° 48' 44.230"	115° 43' 51.511"	-31.81228622	115.7309753
69	-31° 48.857'	115° 43.934'	-31° 48' 51.444"	115° 43' 56.064"	-31.81429	115.73224
70	-31° 48.943'	115° 44.039'	-31° 48' 56.592"	115° 44' 2.364"	-31.81572	115.73399
74	-31° 49.447'	115° 44.443'	-31° 49' 26.832"	115° 44' 26.592"	-31.82412	115.74072
75	-31° 49.555'	115° 44.507'	-31° 49' 33.312"	115° 44' 30.408"	-31.82592	115.74178
76	-31° 49.657'	115° 44.615'	-31° 49' 39.396"	115° 44' 36.924"	-31.82761	115.74359
77	-31° 49.879'	115° 44.739'	-31° 49' 52.768"	115° 44' 44.323"	-31.83132449	115.7456454
78	-31° 50.095'	115° 44.884'	-31° 50' 5.676"	115° 44' 53.016"	-31.83491	115.74806
79	-31° 50.228'	115° 44.935'	-31° 50' 13.704"	115° 44' 56.112"	-31.83714	115.74892
80	-31° 50.329'	115° 44.956'	-31° 50' 19.737"	115° 44' 57.362"	-31.83881595	115.7492671
81	-31° 50.395'	115° 45.008'	-31° 50' 23.676"	115° 45' 0.504"	-31.83991	115.75014
82	-31° 50.547'	115° 45.019'	-31° 50' 32.820"	115° 45' 1.116"	-31.84245	115.75031
83	-31° 50.632'	115° 45.002'	-31° 50' 37.896"	115° 45' 0.108"	-31.84386	115.75003
84	-31° 50.700'	115° 45.036'	-31° 50' 42.027"	115° 45' 2.134"	-31.84500756	115.7505928
85	-31° 50.882'	115° 45.086'	-31° 50' 52.944"	115° 45' 5.148"	-31.84804	115.75143
86	-31° 50.989'	115° 45.046'	-31° 50' 59.352"	115° 45' 2.772"	-31.84982	115.75077
87	-31° 51.344'	115° 45.099'	-31° 51' 20.628"	115° 45' 5.940"	-31.85573	115.75165
88	-31° 51.670'	115° 45.108'	-31° 51' 40.194"	115° 45' 6.507"	-31.86116492	115.7518074
89	-31° 51.841'	115° 45.080'	-31° 51' 50.436"	115° 45' 4.824"	-31.86401	115.75134
90	-31° 52.058'	115° 45.108'	-31° 52' 3.504"	115° 45' 6.480"	-31.86764	115.7518
91	-31° 52.270'	115° 45.097'	-31° 52' 16.176"	115° 45' 5.832"	-31.87116	115.75162
93	-31° 52.429'	115° 45.107'	-31° 52' 25.716"	115° 45' 6.444"	-31.87381	115.75179
94	-31° 52.558'	115° 45.037'	-31° 52' 33.456"	115° 45' 2.196"	-31.87596	115.75061
95	-31° 52.614'	115° 45.104'	-31° 52' 36.840"	115° 45' 6.264"	-31.8769	115.75174
96	-31° 52.783'	115° 45.128'	-31° 52' 46.956"	115° 45' 7.704"	-31.87971	115.75214
97	-31° 52.871'	115° 45.166'	-31° 52' 52.248"	115° 45' 9.936"	-31.88118	115.75276
98	-31° 52.949'	115° 45.165'	-31° 52' 56.964"	115° 45' 9.900"	-31.88249	115.75275

99	-31° 53.024'	115° 45.198'	-31° 53' 1.428"	115° 45' 11.880"	-31.88373	115.7533
100	-31° 53.523'	115° 45.260'	-31° 53' 31.398"	115° 45' 15.578"	-31.89205486	115.7543272
101	-31° 54.188'	115° 45.323'	-31° 54' 11.268"	115° 45' 19.404"	-31.90313	115.75539
102	-31° 54.421'	115° 45.282'	-31° 54' 25.272"	115° 45' 16.920"	-31.90702	115.7547
103	-31° 54.827'	115° 45.299'	-31° 54' 49.608"	115° 45' 17.964"	-31.91378	115.75499
104	-31° 55.360'	115° 45.269'	-31° 55' 21.596"	115° 45' 16.163"	-31.92266564	115.7544896
105	-31° 55.719'	115° 45.250'	-31° 55' 43.150"	115° 45' 15.025"	-31.92865291	115.7541737
106	-31° 55.514'	115° 45.245'	-31° 55' 30.845"	115° 45' 14.703"	-31.92523464	115.7540841
107	-31° 56.035'	115° 45.231'	-31° 56' 2.094"	115° 45' 13.860"	-31.93391487	115.75385
108	-31° 56.518'	115° 45.228'	-31° 56' 31.083"	115° 45' 13.692"	-31.94196742	115.7538033
109	-31° 56.783'	115° 45.200'	-31° 56' 46.992"	115° 45' 12.017"	-31.94638674	115.7533381
110	-31° 56.893'	115° 45.216'	-31° 56' 53.596"	115° 45' 12.981"	-31.94822119	115.7536057
111	-31° 57.090'	115° 45.188'	-31° 57' 5.400"	115° 45' 11.304"	-31.9515	115.75314
112	-31° 57.269'	115° 45.239'	-31° 57' 16.128"	115° 45' 14.364"	-31.95448	115.75399
113	-31° 58.269'	115° 45.238'	-31° 58' 16.140"	115° 45' 14.256"	-31.97115	115.75396
114	-31° 58.493'	115° 45.206'	-31° 58' 29.574"	115° 45' 12.370"	-31.97488174	115.7534361
115	-31° 58.672'	115° 45.206'	-31° 58' 40.296"	115° 45' 12.348"	-31.97786	115.75343
116	-31° 58.953'	115° 45.125'	-31° 58' 57.180"	115° 45' 7.524"	-31.98255	115.75209
117	-31° 59.171'	115° 45.130'	-31° 59' 10.248"	115° 45' 7.812"	-31.98618	115.75217
118	-31° 59.608'	115° 45.038'	-31° 59' 36.472"	115° 45' 2.282"	-31.99346434	115.7506338
119	-31° 59.738'	115° 45.050'	-31° 59' 44.304"	115° 45' 2.988"	-31.99564	115.75083
120	-31° 59.826'	115° 45.022'	-31° 59' 49.560"	115° 45' 1.332"	-31.9971	115.75037
121	-31° 59.948'	115° 45.079'	-31° 59' 56.868"	115° 45' 4.716"	-31.99913	115.75131
122	-32° 0.086'	115° 45.044'	-32° 0' 5.148"	115° 45' 2.628"	-32.00143	115.75073
123	-32° 0.191'	115° 45.080'	-32° 0' 11.448"	115° 45' 4.788"	-32.00318	115.75133
124	-32° 0.397'	115° 45.051'	-32° 0' 23.832"	115° 45' 3.060"	-32.00662	115.75085
125	-32° 0.825'	115° 45.100'	-32° 0' 49.500"	115° 45' 5.976"	-32.01375	115.75166
126	-32° 0.955'	115° 45.049'	-32° 0' 57.276"	115° 45' 2.952"	-32.01591	115.75082
127	-32° 1.052'	115° 45.066'	-32° 1' 3.144"	115° 45' 3.960"	-32.01754	115.7511
130	-32° 1.234'	115° 45.043'	-32° 1' 14.016"	115° 45' 2.556"	-32.02056	115.75071
131	-32° 1.321'	115° 45.049'	-32° 1' 19.236"	115° 45' 2.916"	-32.02201	115.75081
132	-32° 1.576'	115° 44.988'	-32° 1' 34.572"	115° 44' 59.280"	-32.02627	115.7498

133	-32° 1.657'	115° 44.948'	-32° 1' 39.432"	115° 44' 56.868"	-32.02762	115.74913
134	-32° 1.799'	115° 44.793'	-32° 1' 47.928"	115° 44' 47.580"	-32.02998	115.74655
135	-32° 2.435'	115° 44.463'	-32° 2' 26.122"	115° 44' 27.782"	-32.04058941	115.7410507

2.

ID	Latitude (DDM)	Longitude (DDM)	Latitude (DMS)	Longitude (DMS)	Latitude (DD)	Longitude (DD)
1	-33° 59.087'	114° 58.645'	-33° 59' 5.220"	114° 58' 38.688"	-33.98478323	114.9774134
2	-33° 58.801'	114° 58.511'	-33° 58' 48.083"	114° 58' 30.651"	-33.98002301	114.9751809
3	-33° 58.305'	114° 58.304'	-33° 58' 18.311"	114° 58' 18.235"	-33.97175301	114.9717319
4	-33° 57.799'	114° 58.185'	-33° 57' 47.946"	114° 58' 11.098"	-33.9633183	114.9697496
5	-33° 57.540'	114° 58.193'	-33° 57' 32.386"	114° 58' 11.566"	-33.95899621	114.9698796
6	-33° 57.260'	114° 58.356'	-33° 57' 15.604"	114° 58' 21.338"	-33.95433437	114.972594
7	-33° 57.078'	114° 58.799'	-33° 57' 4.673"	114° 58' 47.919"	-33.95129809	114.9799776
8	-33° 55.898'	114° 58.842'	-33° 55' 53.906"	114° 58' 50.538"	-33.9316405	114.9807051
9	-33° 55.478'	114° 58.604'	-33° 55' 28.658"	114° 58' 36.215"	-33.92462724	114.9767265
10	-33° 53.053'	114° 58.378'	-33° 53' 3.205"	114° 58' 22.692"	-33.88422355	114.9729699
11	-33° 51.878'	114° 57.920'	-33° 51' 52.708"	114° 57' 55.213"	-33.86464102	114.9653371
12	-33° 51.646'	114° 57.911'	-33° 51' 38.742"	114° 57' 54.683"	-33.8607616	114.9651897
13	-33° 51.454'	114° 58.087'	-33° 51' 27.248"	114° 58' 5.206"	-33.85756895	114.9681128
14	-33° 50.614'	114° 59.046'	-33° 50' 36.826"	114° 59' 2.786"	-33.84356264	114.9841072
15	-33° 49.707'	114° 59.013'	-33° 49' 42.424"	114° 59' 0.763"	-33.82845104	114.9835453
16	-33° 49.183'	114° 59.188'	-33° 49' 10.977"	114° 59' 11.263"	-33.8197159	114.9864621
17	-33° 48.641'	114° 59.173'	-33° 48' 38.475"	114° 59' 10.363"	-33.81068762	114.986212
18	-33° 48.387'	114° 59.211'	-33° 48' 23.246"	114° 59' 12.649"	-33.80645709	114.986847
19	-33° 47.632'	114° 59.338'	-33° 47' 37.943"	114° 59' 20.303"	-33.7938731	114.9889729
20	-33° 46.642'	114° 58.980'	-33° 46' 38.518"	114° 58' 58.823"	-33.7773662	114.9830064
21	-33° 46.309'	114° 58.738'	-33° 46' 18.542"	114° 58' 44.280"	-33.77181735	114.9789668
22	-33° 45.719'	114° 58.675'	-33° 45' 43.151"	114° 58' 40.498"	-33.76198627	114.977916
23	-33° 45.163'	114° 58.879'	-33° 45' 9.751"	114° 58' 52.725"	-33.75270869	114.9813125
24	-33° 44.868'	114° 58.662'	-33° 44' 52.094"	114° 58' 39.706"	-33.74780382	114.9776961
25	-33° 44.571'	114° 58.660'	-33° 44' 34.259"	114° 58' 39.629"	-33.74284979	114.9776747
26	-33° 42.785'	114° 58.111'	-33° 42' 47.070"	114° 58' 6.680"	-33.71307502	114.9685223
27	-33° 42.372'	114° 57.851'	-33° 42' 22.299"	114° 57' 51.059"	-33.70619419	114.9641832
28	-33° 42.000'	114° 57.858'	-33° 42' 0.010"	114° 57' 51.493"	-33.70000279	114.9643037
29	-33° 41.546'	114° 57.974'	-33° 41' 32.787"	114° 57' 58.426"	-33.69244091	114.9662295
30	-33° 41.293'	114° 58.348'	-33° 41' 17.597"	114° 58' 20.896"	-33.68822133	114.9724712

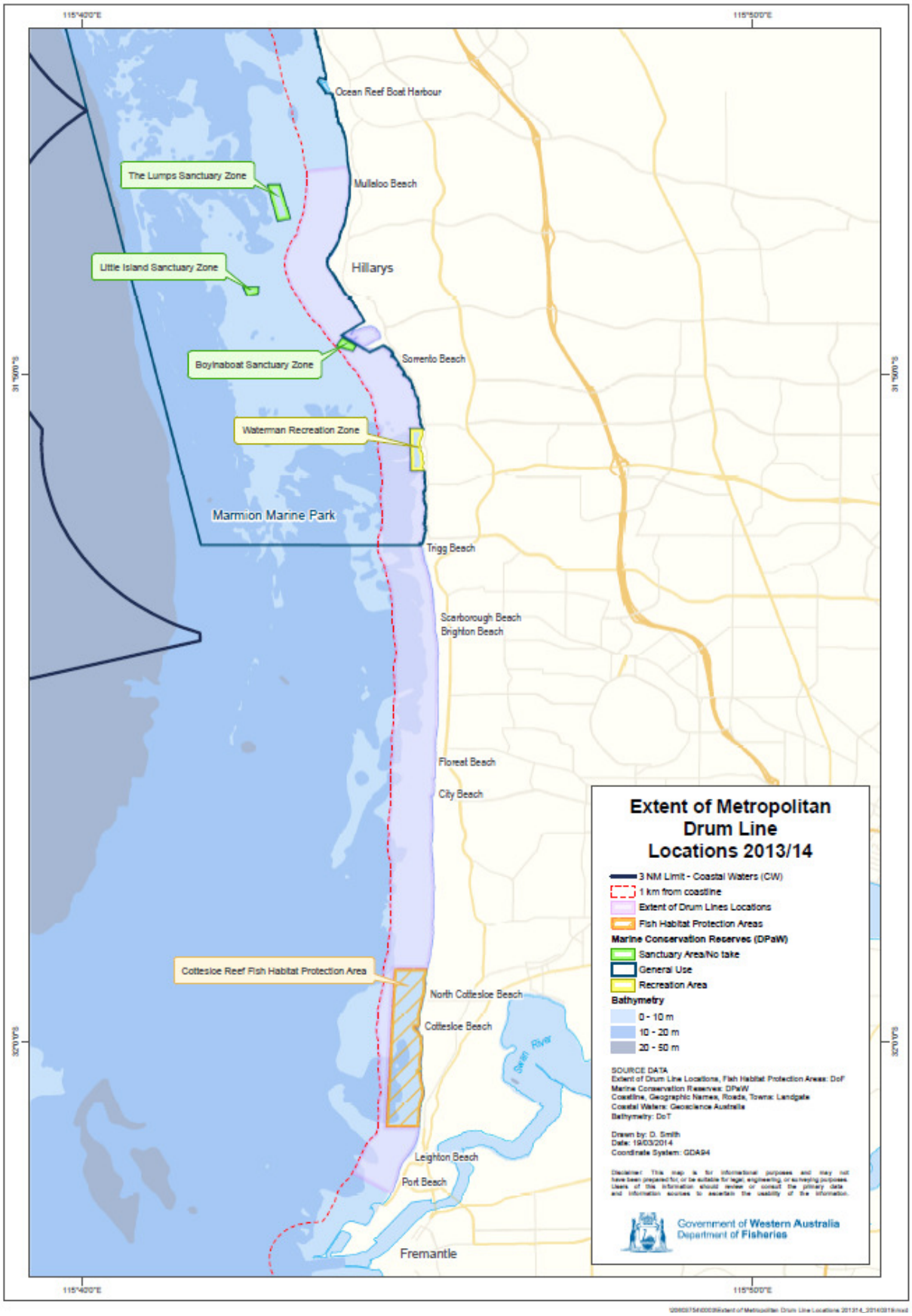
31	-33° 41.308'	114° 58.864'	-33° 41' 18.453"	114° 58' 51.841"	-33.68845928	114.981067
32	-33° 41.118'	114° 58.900'	-33° 41' 7.103"	114° 58' 53.983"	-33.68530649	114.9816619
33	-33° 40.733'	114° 58.786'	-33° 40' 43.975"	114° 58' 47.130"	-33.67888194	114.9797583
34	-33° 40.385'	114° 58.926'	-33° 40' 23.095"	114° 58' 55.589"	-33.67308201	114.9821081
35	-33° 39.924'	114° 58.923'	-33° 39' 55.470"	114° 58' 55.375"	-33.66540825	114.9820486
36	-33° 39.696'	114° 59.114'	-33° 39' 41.747"	114° 59' 6.833"	-33.66159651	114.9852315
37	-33° 39.623'	114° 59.167'	-33° 39' 37.374"	114° 59' 10.044"	-33.66038164	114.9861234
38	-33° 39.503'	114° 59.444'	-33° 39' 30.200"	114° 59' 26.641"	-33.65838884	114.9907336
39	-33° 39.464'	114° 59.742'	-33° 39' 27.844"	114° 59' 44.523"	-33.65773448	114.9957007
40	-33° 39.400'	114° 59.819'	-33° 39' 23.989"	114° 59' 49.127"	-33.65666373	114.9969797
41	-33° 39.132'	115° 0.015'	-33° 39' 7.928"	115° 0' 0.905"	-33.65220224	115.0002514
42	-33° 38.999'	115° 0.310'	-33° 38' 59.923"	115° 0' 18.598"	-33.64997863	115.0051662
43	-33° 38.971'	115° 0.564'	-33° 38' 58.278"	115° 0' 33.812"	-33.64952178	115.0093921
44	-33° 38.615'	115° 0.567'	-33° 38' 36.898"	115° 0' 34.017"	-33.64358264	115.0094493
45	-33° 38.176'	115° 0.707'	-33° 38' 10.583"	115° 0' 42.446"	-33.63627294	115.0117906
46	-33° 37.861'	115° 0.991'	-33° 37' 51.640"	115° 0' 59.463"	-33.63101106	115.0165175
48	-33° 33.734'	114° 59.619'	-33° 33' 44.068"	114° 59' 37.157"	-33.56224108	114.9936546
49	-33° 32.562'	114° 59.804'	-33° 32' 33.698"	114° 59' 48.252"	-33.54269394	114.9967366
50	-33° 31.808'	114° 59.469'	-33° 31' 48.463"	114° 59' 28.146"	-33.53012849	114.9911516
51	-33° 31.219'	115° 0.040'	-33° 31' 13.128"	115° 0' 2.410"	-33.52031321	115.0006694
52	-33° 31.376'	115° 1.800'	-33° 31' 22.550"	115° 1' 47.987"	-33.52293062	115.0299963
53	-33° 31.736'	115° 2.518'	-33° 31' 44.135"	115° 2' 31.069"	-33.52892625	115.0419637
54	-33° 32.099'	115° 2.672'	-33° 32' 5.927"	115° 2' 40.321"	-33.5349796	115.0445335
55	-33° 32.054'	115° 3.248'	-33° 32' 3.254"	115° 3' 14.859"	-33.53423721	115.0541275
56	-33° 32.134'	115° 3.491'	-33° 32' 8.048"	115° 3' 29.459"	-33.53556883	115.058183
57	-33° 32.339'	115° 4.002'	-33° 32' 20.321"	115° 4' 0.095"	-33.53897805	115.066693
58	-33° 32.712'	115° 4.248'	-33° 32' 42.730"	115° 4' 14.897"	-33.54520272	115.0708047
59	-33° 32.949'	115° 4.464'	-33° 32' 56.915"	115° 4' 27.849"	-33.54914311	115.0744024
60	-33° 33.113'	115° 4.529'	-33° 33' 6.783"	115° 4' 31.755"	-33.55188425	115.0754875
61	-33° 33.280'	115° 5.100'	-33° 33' 16.779"	115° 5' 5.997"	-33.55466093	115.084999
62	-33° 33.669'	115° 5.647'	-33° 33' 40.149"	115° 5' 38.820"	-33.56115242	115.0941167
63	-33° 34.844'	115° 6.673'	-33° 34' 50.637"	115° 6' 40.352"	-33.58073244	115.1112088

64	-33° 35.604'	115° 7.009'	-33° 35' 36.217"	115° 7' 0.512"	-33.59339355	115.116809
65	-33° 36.170'	115° 7.066'	-33° 36' 10.183"	115° 7' 3.943"	-33.60282851	115.1177619
66	-33° 36.759'	115° 7.520'	-33° 36' 45.534"	115° 7' 31.172"	-33.61264842	115.1253256
67	-33° 37.092'	115° 8.014'	-33° 37' 5.493"	115° 8' 0.824"	-33.61819239	115.1335621
68	-33° 37.172'	115° 8.565'	-33° 37' 10.316"	115° 8' 33.887"	-33.61953232	115.1427463
69	-33° 37.373'	115° 9.237'	-33° 37' 22.395"	115° 9' 14.194"	-33.62288742	115.1539427
70	-33° 37.857'	115° 8.947'	-33° 37' 51.416"	115° 8' 56.821"	-33.63094892	115.1491169
72	-33° 37.719'	115° 8.022'	-33° 37' 43.123"	115° 8' 1.296"	-33.62864531	115.1336935
73	-33° 37.319'	115° 7.151'	-33° 37' 19.138"	115° 7' 9.043"	-33.62198282	115.1191787
74	-33° 36.674'	115° 6.485'	-33° 36' 40.421"	115° 6' 29.079"	-33.611228	115.1080775
75	-33° 36.574'	115° 6.499'	-33° 36' 34.425"	115° 6' 29.936"	-33.60956238	115.1083155
76	-33° 36.360'	115° 6.226'	-33° 36' 21.575"	115° 6' 13.574"	-33.60599319	115.1037707
77	-33° 36.143'	115° 6.330'	-33° 36' 8.608"	115° 6' 19.817"	-33.60239104	115.1055047
78	-33° 35.231'	115° 6.092'	-33° 35' 13.835"	115° 6' 5.502"	-33.58717641	115.1015283
79	-33° 34.892'	115° 5.780'	-33° 34' 53.544"	115° 5' 46.821"	-33.58154009	115.0963391
80	-33° 34.552'	115° 5.419'	-33° 34' 33.132"	115° 5' 25.152"	-33.57587	115.09032
81	-33° 34.419'	115° 5.218'	-33° 34' 25.111"	115° 5' 13.078"	-33.57364204	115.086966
82	-33° 34.220'	115° 5.283'	-33° 34' 13.187"	115° 5' 16.984"	-33.57032983	115.088051
83	-33° 34.110'	115° 5.112'	-33° 34' 6.609"	115° 5' 6.704"	-33.5685024	115.0851957
84	-33° 33.970'	115° 5.026'	-33° 33' 58.180"	115° 5' 1.565"	-33.56616101	115.083768
85	-33° 33.895'	115° 4.891'	-33° 33' 53.712"	115° 4' 53.436"	-33.56492	115.08151
86	-33° 33.381'	115° 3.692'	-33° 33' 22.864"	115° 3' 41.501"	-33.55635103	115.061528
87	-33° 32.839'	115° 3.409'	-33° 32' 50.333"	115° 3' 24.522"	-33.54731473	115.0568116
88	-33° 32.698'	115° 3.080'	-33° 32' 41.904"	115° 3' 4.785"	-33.54497334	115.0513293
89	-33° 32.770'	115° 2.545'	-33° 32' 46.221"	115° 2' 32.714"	-33.54617259	115.0424206
90	-33° 32.580'	115° 1.969'	-33° 32' 34.800"	115° 1' 58.152"	-33.543	115.03282
91	-33° 32.147'	115° 1.829'	-33° 32' 8.805"	115° 1' 49.747"	-33.5357791	115.0304852
92	-33° 32.100'	115° 1.589'	-33° 32' 6.000"	115° 1' 35.328"	-33.535	115.02648
93	-33° 31.860'	115° 0.408'	-33° 31' 51.600"	115° 0' 24.480"	-33.531	115.0068
94	-33° 31.959'	115° 0.293'	-33° 31' 57.540"	115° 0' 17.604"	-33.53265	115.00489
95	-33° 32.260'	115° 0.457'	-33° 32' 15.612"	115° 0' 27.432"	-33.53767	115.00762
96	-33° 32.602'	115° 0.527'	-33° 32' 36.132"	115° 0' 31.608"	-33.54337	115.00878

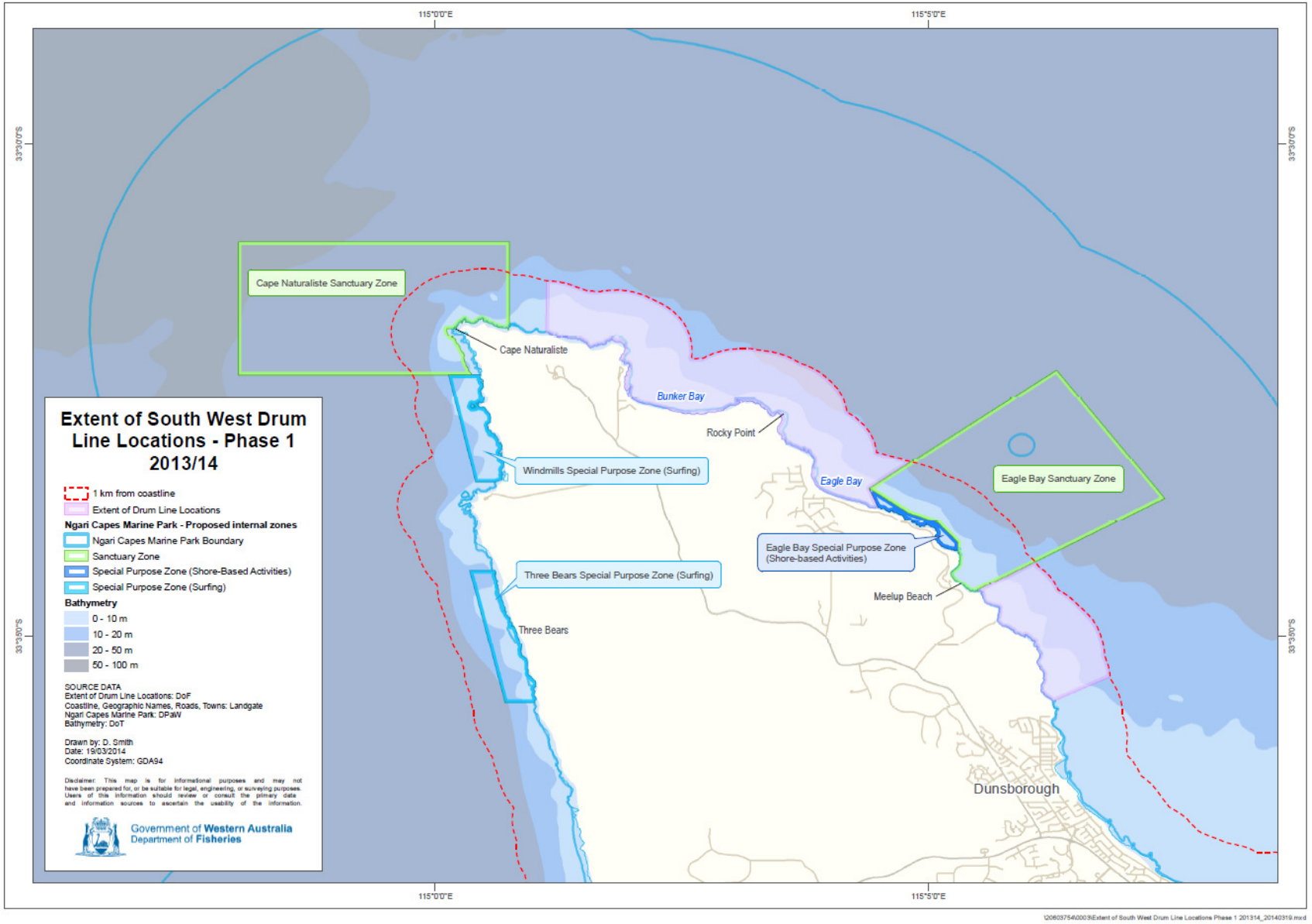
97	-33° 32.971'	115° 0.642'	-33° 32' 58.236"	115° 0' 38.520"	-33.54951	115.0107
98	-33° 33.343'	115° 0.695'	-33° 33' 20.593"	115° 0' 41.694"	-33.55572026	115.0115815
99	-33° 33.549'	115° 0.601'	-33° 33' 32.966"	115° 0' 36.050"	-33.55915735	115.0100138
100	-33° 33.656'	115° 0.414'	-33° 33' 39.353"	115° 0' 24.837"	-33.56093138	115.0068992
101	-33° 33.860'	115° 0.459'	-33° 33' 51.624"	115° 0' 27.540"	-33.56434	115.00765
102	-33° 34.452'	115° 0.686'	-33° 34' 27.120"	115° 0' 41.184"	-33.5742	115.01144
103	-33° 34.917'	115° 0.778'	-33° 34' 55.037"	115° 0' 46.709"	-33.58195462	115.0129747
104	-33° 35.078'	115° 0.897'	-33° 35' 4.704"	115° 0' 53.820"	-33.58464	115.01495
105	-33° 35.804'	115° 1.095'	-33° 35' 48.229"	115° 1' 5.697"	-33.59673038	115.0182493
106	-33° 36.548'	115° 1.418'	-33° 36' 32.868"	115° 1' 25.068"	-33.60913	115.02363
107	-33° 37.977'	115° 1.703'	-33° 37' 58.620"	115° 1' 42.204"	-33.63295	115.02839
108	-33° 39.327'	115° 1.238'	-33° 39' 19.620"	115° 1' 14.268"	-33.65545	115.02063
109	-33° 39.676'	115° 0.779'	-33° 39' 40.572"	115° 0' 46.728"	-33.66127	115.01298
110	-33° 40.217'	114° 59.959'	-33° 40' 13.007"	114° 59' 57.519"	-33.67027962	114.9993107
111	-33° 40.489'	114° 59.825'	-33° 40' 29.316"	114° 59' 49.488"	-33.67481	114.99708
112	-33° 41.714'	114° 59.494'	-33° 41' 42.828"	114° 59' 29.616"	-33.69523	114.99156
113	-33° 42.044'	114° 59.174'	-33° 42' 2.610"	114° 59' 10.443"	-33.70072504	114.9862343
114	-33° 41.882'	114° 58.522'	-33° 41' 52.944"	114° 58' 31.332"	-33.69804	114.97537
115	-33° 42.536'	114° 58.802'	-33° 42' 32.184"	114° 58' 48.144"	-33.70894	114.98004
116	-33° 45.032'	114° 59.561'	-33° 45' 1.944"	114° 59' 33.648"	-33.75054	114.99268
117	-33° 45.337'	114° 59.552'	-33° 45' 20.232"	114° 59' 33.095"	-33.75562012	114.9925264
118	-33° 45.739'	114° 59.366'	-33° 45' 44.340"	114° 59' 21.933"	-33.76231664	114.9894259
119	-33° 45.941'	114° 59.496'	-33° 45' 56.439"	114° 59' 29.750"	-33.76567763	114.9915972
120	-33° 46.098'	114° 59.414'	-33° 46' 5.862"	114° 59' 24.824"	-33.76829504	114.990229
121	-33° 46.223'	114° 59.525'	-33° 46' 13.368"	114° 59' 31.488"	-33.77038	114.99208
122	-33° 47.560'	115° 0.038'	-33° 47' 33.576"	115° 0' 2.268"	-33.79266	115.00063
123	-33° 49.381'	114° 59.883'	-33° 49' 22.872"	114° 59' 52.980"	-33.82302	114.99805
124	-33° 49.934'	114° 59.694'	-33° 49' 56.061"	114° 59' 41.652"	-33.83223909	114.9949034
125	-33° 50.893'	114° 59.672'	-33° 50' 53.592"	114° 59' 40.344"	-33.84822	114.99454
126	-33° 51.440'	114° 59.111'	-33° 51' 26.388"	114° 59' 6.684"	-33.85733	114.98519
127	-33° 51.648'	114° 59.355'	-33° 51' 38.880"	114° 59' 21.300"	-33.8608	114.98925
128	-33° 51.876'	114° 59.183'	-33° 51' 52.560"	114° 59' 10.968"	-33.8646	114.98638

129	-33° 51.930'	114° 58.932'	-33° 51' 55.800"	114° 58' 55.920"	-33.8655	114.9822
130	-33° 51.869'	114° 58.672'	-33° 51' 52.135"	114° 58' 40.341"	-33.86448204	114.9778724
131	-33° 54.358'	114° 59.334'	-33° 54' 21.492"	114° 59' 20.040"	-33.90597	114.9889
132	-33° 54.725'	114° 59.170'	-33° 54' 43.524"	114° 59' 10.176"	-33.91209	114.98616
133	-33° 54.939'	114° 59.321'	-33° 54' 56.340"	114° 59' 19.248"	-33.91565	114.98868
134	-33° 55.616'	114° 59.437'	-33° 55' 36.948"	114° 59' 26.232"	-33.92693	114.99062
135	-33° 56.933'	114° 59.578'	-33° 56' 55.968"	114° 59' 34.656"	-33.94888	114.99296
137	-33° 57.269'	114° 59.503'	-33° 57' 16.164"	114° 59' 30.192"	-33.95449	114.99172
138	-33° 57.458'	114° 59.312'	-33° 57' 27.468"	114° 59' 18.708"	-33.95763	114.98853
139	-33° 57.562'	114° 59.138'	-33° 57' 33.732"	114° 59' 8.304"	-33.95937	114.98564
140	-33° 57.659'	114° 58.957'	-33° 57' 39.564"	114° 58' 57.396"	-33.96099	114.98261
141	-33° 57.680'	114° 58.820'	-33° 57' 40.788"	114° 58' 49.188"	-33.96133	114.98033
142	-33° 58.179'	114° 59.143'	-33° 58' 10.740"	114° 59' 8.592"	-33.96965	114.98572
143	-33° 58.678'	114° 59.326'	-33° 58' 40.692"	114° 59' 19.536"	-33.97797	114.98876
144	-33° 58.920'	114° 59.383'	-33° 58' 55.200"	114° 59' 23.002"	-33.982	114.9897227

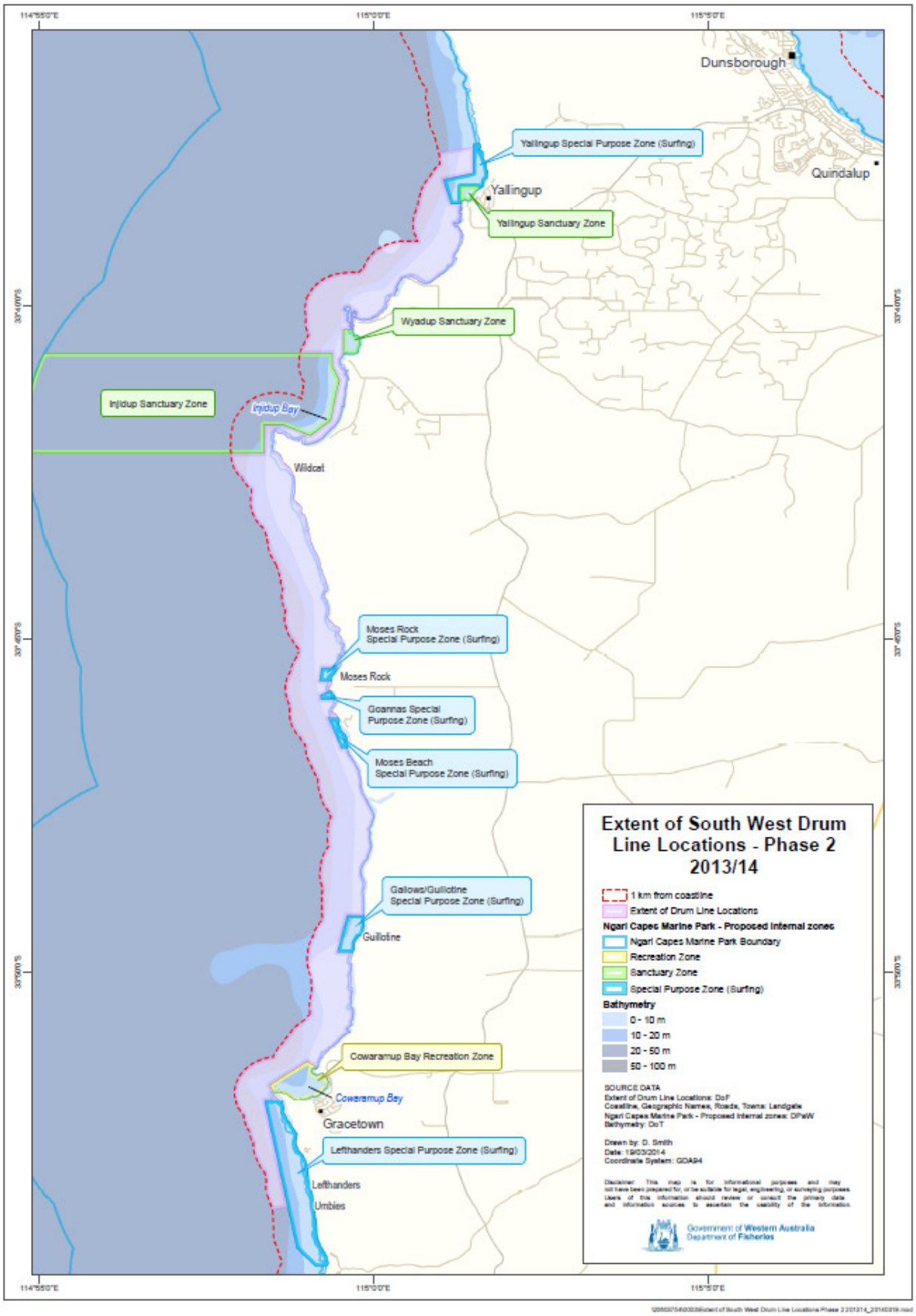
3.


115°40'0"E
115°50'0"E
31°50'0"S
32°0'0"S
Ocean Reef Boat Harbour
The Lumps Sanctuary Zone
Mullaloo Beach
Little Island Sanctuary Zone
Hillarys
Boyinaboat Sanctuary Zone
Sorrento Beach
Waterman Recreation Zone
Marmion Marine Park
Trigg Beach
Scarborough Beach
Brighton Beach
Floreat Beach
City Beach
Cottesloe Reef Fish Habitat Protection Area
North Cottesloe Beach
Cottesloe Beach
Swan River
Leighton Beach
Port Beach
Fremantle
Extent of Metropolitan Drum Line Locations 2013/14
3 NM Limit - Coastal Waters (CW)
1 km from coastline
Extent of Drum Lines Locations
Fish Habitat Protection Areas
Marine Conservation Reserves (DPaW)
Sanctuary Area/No take
General Use
Recreation Area
Bathymetry
0 - 10 m
10 - 20 m
20 - 50 m
SOURCE DATA
Extent of Drum Line Locations, Fish Habitat Protection Areas: DoF
Marine Conservation Reserves: DPaW
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Bathymetry: DoT
Drawn by: D. Smith
Date: 19/03/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

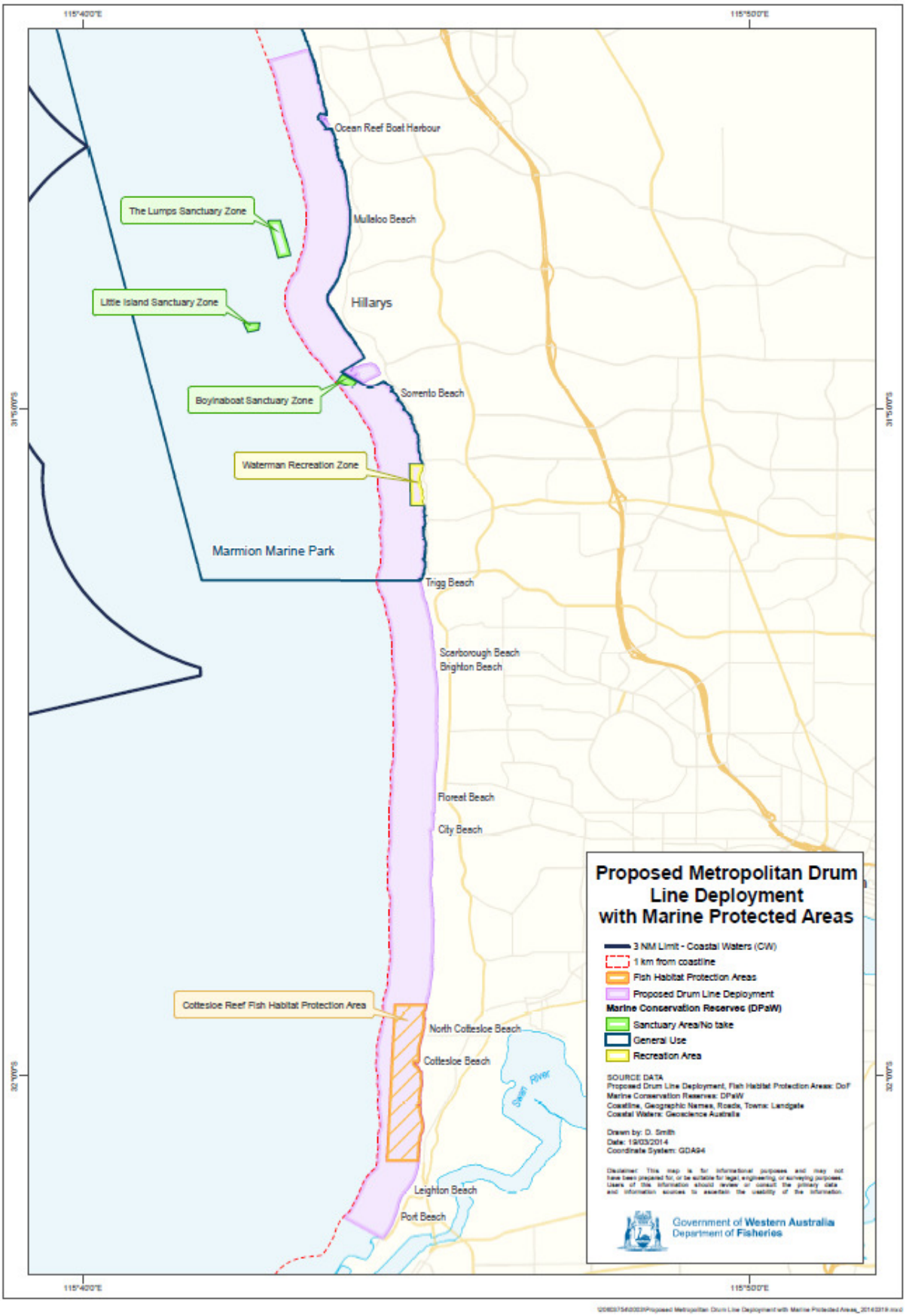
4 (a).


115°0'0"E
115°5'0"E
33°3'0"S
33°5'0"S
Cape Naturaliste Sanctuary Zone
Cape Naturaliste
Bunker Bay
Rocky Point
Windmills Special Purpose Zone (Surfing)
Eagle Bay
Eagle Bay Sanctuary Zone
Eagle Bay Special Purpose Zone (Shore-based Activities)
Three Bears Special Purpose Zone (Surfing)
Meelup Beach
Three Bears
Dunsborough
Extent of South West Drum Line Locations - Phase 1 2013/14
1 km from coastline
Extent of Drum Line Locations
Ngari Capes Marine Park - Proposed internal zones
Ngari Capes Marine Park Boundary
Sanctuary Zone
Special Purpose Zone (Shore-Based Activities)
Special Purpose Zone (Surfing)
Bathymetry
0 - 10 m
10 - 20 m
20 - 50 m
50 - 100 m
SOURCE DATA
Extent of Drum Line Locations: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Ngari Capes Marine Park: DPaW
Bathymetry: DoT
Drawn by: D. Smith
Date: 19/03/2014
Coordinate System: GDA94
Disclaimer: This map is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.
Government of Western Australia
Department of Fisheries

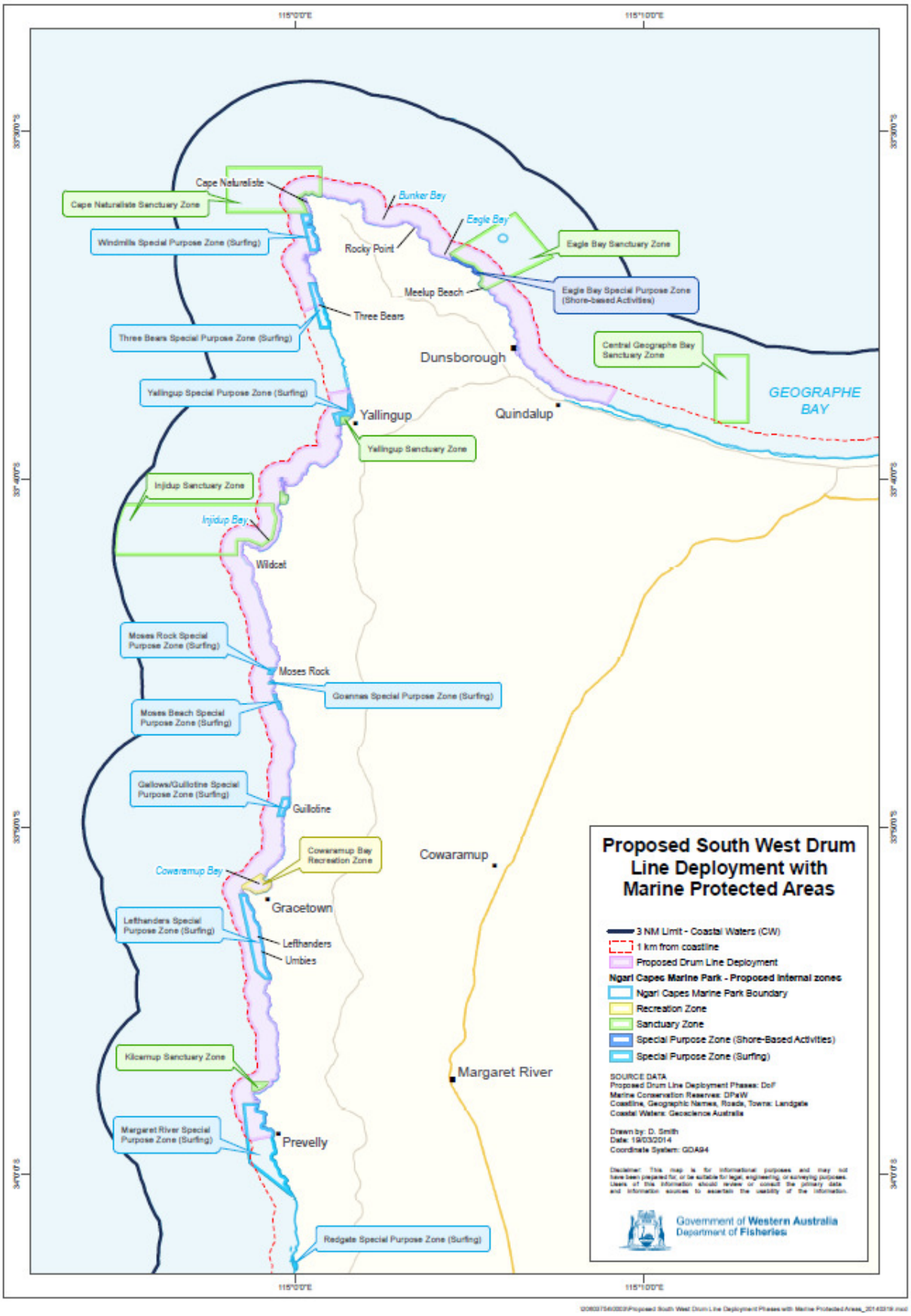
4 (b).


Dunsborough
Quindalup
Yallingup Special Purpose Zone (Surfing)
Yallingup
Yallingup Sanctuary Zone
Wyadup Sanctuary Zone
Injidup Sanctuary Zone
Injidup Bay
Wildcat
Moses Rock Special Purpose Zone (Surfing)
Moses Rock
Goannas Special Purpose Zone (Surfing)
Moses Beach Special Purpose Zone (Surfing)
Gallows/Guillotine Special Purpose Zone (Surfing)
Guillotine
Cowaramup Bay Recreation Zone
Cowaramup Bay
Gracetown
Lefthanders Special Purpose Zone (Surfing)
Lefthanders
Umbies
Extent of South West Drum Line Locations - Phase 2 2013/14
1 km from coastline
Extent of Drum Line Locations
Ngari Capes Marine Park - Proposed internal zones
Ngari Capes Marine Park Boundary
Recreation Zone
Sanctuary Zone
Special Purpose Zone (Surfing)
Bathymetry
0 - 10 m
10 - 20 m
20 - 50 m
50 - 100 m
SOURCE DATA
Extent of Drum Line Locations: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Ngari Capes Marine Park - Proposed internal zones: DPaW
Bathymetry: DoT
Drawn by: D. Smith
Date: 19/03/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

5.


115°40'0"E
115°50'0"E
31°55'0"S
32°0'0"S
Ocean Reef Boat Harbour
The Lumps Sanctuary Zone
Mullaloo Beach
Little Island Sanctuary Zone
Hillarys
Boylnaboat Sanctuary Zone
Sorrento Beach
Waterman Recreation Zone
Marmion Marine Park
Trigg Beach
Scarborough Beach
Brighton Beach
Floreat Beach
City Beach
Cottesloe Reef Fish Habitat Protection Area
North Cottesloe Beach
Cottesloe Beach
Swan River
Leighton Beach
Port Beach
Proposed Metropolitan Drum Line Deployment with Marine Protected Areas
3 NM Limit - Coastal Waters (CW)
1 km from coastline
Fish Habitat Protection Areas
Proposed Drum Line Deployment
Marine Conservation Reserves (DPaW)
Sanctuary Area/No take
General Use
Recreation Area
SOURCE DATA
Proposed Drum Line Deployment, Fish Habitat Protection Areas: DoF
Marine Conservation Reserves: DPaW
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Drawn by: D. Smith
Date: 19/03/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

6.


115°0'0"E
115°10'0"E
33°30'0"S
33°40'0"S
33°50'0"S
34°0'0"S
Cape Naturaliste
Cape Naturaliste Sanctuary Zone
Windmills Special Purpose Zone (Surfing)
Bunker Bay
Eagle Bay
Rocky Point
Eagle Bay Sanctuary Zone
Eagle Bay Special Purpose Zone (Shore-based Activities)
Meelup Beach
Three Bears
Three Bears Special Purpose Zone (Surfing)
Dunsborough
Central Geographe Bay Sanctuary Zone
GEOGRAPHE BAY
Yallingup Special Purpose Zone (Surfing)
Yallingup
Quindalup
Yallingup Sanctuary Zone
Injidup Sanctuary Zone
Injidup Bay
Wildcat
Moses Rock Special Purpose Zone (Surfing)
Moses Rock
Gownes Special Purpose Zone (Surfing)
Moses Beach Special Purpose Zone (Surfing)
Gallows/Guillotine Special Purpose Zone (Surfing)
Guillotine
Cowaramup Bay Recreation Zone
Cowaramup
Cowaramup Bay
Gracetown
Lefthanders Special Purpose Zone (Surfing)
Lefthanders
Umbies
Kilcarnup Sanctuary Zone
Margaret River
Margaret River Special Purpose Zone (Surfing)
Prevelly
Redgate Special Purpose Zone (Surfing)
Proposed South West Drum Line Deployment with Marine Protected Areas
3 NM Limit - Coastal Waters (CW)
1 km from coastline
Proposed Drum Line Deployment
Ngari Capes Marine Park - Proposed internal zones
Ngari Capes Marine Park Boundary
Recreation Zone
Sanctuary Zone
Special Purpose Zone (Shore-Based Activities)
Special Purpose Zone (Surfing)
SOURCE DATA
Proposed Drum Line Deployment Phases: DoF
Marine Conservation Reserves: DPaW
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Drawn by: D. Smith
Date: 19/03/2014
Coordinate System: GDA94
Disclaimer: This map is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.
Government of Western Australia
Department of Fisheries

7.

Area

	km^2	% of WA Waters covered by MMAs	Formula	Unrounded values
WA Waters (Area)	116000			
Metropolitan Marine Monitored Area	34	0.03	(34/116000 * 100)	0.029310345
Proposed South West Drum Line Deployment - Phase 2	28	0.02	(28/116000 * 100)	0.024137931
Proposed South West Drum Line Deployment - Phase 3 (includes Phase 1 area)	48	0.04	(48/116000 * 100)	0.04137931
	Total	**0.05 - 0.07**		

Distance

	km	% of WA coastline covered by MMAs	Formula	Unrounded values
WA Mainland Coastline	12895			
Coastline covered by the Metropolitan Marine Monitored Area	35	0.3	(35/12895*100)	0.271423032
Proposed South West Drum Line Deployment - Phase 2	29	0.2	(29/12895 * 100)	0.22489337
Proposed South West Drum Line Deployment - Phase 3 (includes Phase 1 distance)	52	0.4	(52/12895 * 100)	0.403257076
	Total	**0.5 - 0.7**		

Percentage of Western Australian waters covered by the MMAs: **0.05%-0.07%**
Percentage of Western Australian coastline covered by MMAs: **0.5-0.7%**

Distance calculations for Western Australia's coastline are taken from Geoscience Australia's GEODATA Coast 100K 2004. This is a topographic representation primarily based on the mean high water mark.

Areas of Western Australia waters were calculated using Geoscience Australia's (GA) 3 nautical mile layer from the Australian Maritime Boundaries dataset and the GA GEODATA Coast 100K 2004 (mean high water mark representation).

8. Catch Data for Shark Drum Line Deployment Western Australia: 25 January - 16 March 2014

METROPOLITAN REGION						
DATE	**TIME**	**LOCATION**	**SPECIES**	**SIZE**	**SEX**	**STATUS**
31-01-2014	11:00	North Cottesloe	Tiger	1.8m	F	Alive/Released
31-01-2014	11:25	Cottesloe	Tiger	2.6m	F	Alive/Released
01-02-2014	06:45	Leighton	Tiger	2.6m	F	Dead
01-02-2014	10:30	Scarborough	Tiger	2.34m	F	Alive/Released
04-02-2014	06:35	North Cottesloe	Tiger	1.73m	*F*	Alive/Released
04-02-2014	12:35	Mullaloo	Tiger	2.51m	*F*	Alive/Released
04-02-2014	16:49	City Beach	Tiger	2.91m	F	Alive/Released
05-02-2014	06:30	Leighton	Tiger	2.0m	F	Dead
05-02-2014	07:30	Scarborough	Tiger	2.3m	F	Alive/Released
07-02-2014	07:07	Scarborough	Tiger	Approx. 2.0m	Undetermined	Dead
07-02-2014	14:51	Floreat	Tiger	2.37m	F	Alive/Released
08-02-2014	06:23	City Beach	Tiger	2.2m	F	Alive/Released
08-02-2014	07:39	Mullaloo	Tiger	2.5m	Undetermined	Alive/Released
08-02-2014	07:53	Mullaloo	Tiger	2.2m	Undetermined	Dead
08-02-2014	12:55	Leighton Beach	Tiger	1.93m	M	Alive/Released
08-02-2013	16:26	Port Beach	Tiger	2.16m	F	Alive/Released
10-02-2014	06:13	Leighton Beach	Tiger	2.8m	F	Alive/Released
10-02-2014	06:38	Leighton Beach	Tiger	2.5m	F	Alive/Released
10-02-2014	07:30	City Beach	Tiger	2.7m	F	Alive/Released
10-02-2014	07:41	City Beach	Tiger	2.8m	M	Alive/Released
10-02-2014	15:16	Mullaloo	Tiger	2.79m	F	Alive/Released
11-02-2014	06:30	Leighton Beach	Tiger	3.73m	F	Alive/Destroyed
11-02-2014	14:06	Scarborough	Tiger	3.7m	F	Alive/Destroyed
12-02-2014	06:13	Leighton Beach	Tiger	3.5m	F	Alive/Destroyed
13-02-2014	06:37	Leighton Beach	Tiger	2.12m	F	Alive/Released
13-02-2014	07:36	Floreat	Tiger	2.36m	F	Alive/Released
13-02-2014	08:03	Floreat	Tiger	2.36m	M	Alive/Released
13-02-2014	09:07	Mullaloo	Tiger	2.2m	M	Alive/Released
13-02-2014	09:30	Mullaloo	Tiger	3.47m	M	Alive/Destroyed
13-02-2014	16:30	Floreat	Tiger	Approx. 2.8m	F	Alive/Released
14-02-2014	06:45	Leighton Beach	Tiger	2.4m	F	Alive/Released
14-02-2014	07:32	North Cottesloe	Tiger	2.33m	F	Alive/Released

14-02-2014	07:56	Floreat	Tiger	Unknown	F	Alive/Self-Released
14-02-2014	09:38	North Cottesloe	Tiger	1.82m	F	Alive/Released
14-02-2014	14:26	Trigg	Tiger	2.85m	M	Dead
14-02-2014	16:13	Scarborough	Tiger	2.31m	F	Alive/Released
14-02-2014	16:46	Floreat	Tiger	2.2m	F	Alive/Released
14-02-2014	17:04	Floreat	Tiger	2.25m	F	Alive/Released
14-02-2014	17:20	Floreat	Tiger	1.53m	F	Alive/Released
15-02-2014	06:11	Leighton Beach	Tiger	1.55m	M	Alive/Released
15-02-2014	07:00	Floreat	Tiger	2.5m	M	Alive/Released
15-02-2014	07:35	Scarborough	Tiger	2.8m	M	Alive/Released
16-02-2014	06:45	Floreat	Tiger	2.4m	F	Alive/Released
17-02-2014	06:48	Scarborough	Tiger	2.0m	M	Alive/Released
17-02-2014	07:08	Scarborough	Tiger	2.72m	F	Alive/Released
17-02-2014	13:03	Floreat	Tiger	2.36m	F	Alive/Released
18-02-2014	07:10	Trigg	Tiger	2.48m	F	Alive/Released
18-02-2014	06:37	Floreat	Northwest Blowfish	-	-	Alive/Released
19-02-2014	06:57	Floreat	Tiger	2.25m	F	Alive/Released
19-02-2014	07:41	Trigg	Tiger	2.71m	F	Alive/Released
20-02-2014	06:40	Leighton Beach	Tiger	2.3m	F	Dead
20-02-2014	11:20	Floreat	Tiger	2.07m	F	Alive/Released
20-02-2014	12:19	Leighton Beach	Tiger	1.83m	F	Dead
21-02-2014	06:51	Floreat	Tiger	4.5m	F	Alive/Destroyed
21-02-2014	10:00	Mullaloo	Tiger	2.8m	M	Alive/Released
24-02-2014	07:48	Mullaloo	Tiger	2.56m	Unknown	Alive/Released
25-02-2014	15:02	Trigg	Tiger	1.88m	M	Alive/Released
25-02-2014	15:47	Mullaloo	Tiger	3.18m	F	Alive/Destroyed
25-02-2014	17:35	Mullaloo	Tiger	4.2m	F	Alive/Destroyed
26-02-2014	07:15	Floreat	Tiger	3.06m	F	Dead
26-02-2014	14:10	Port Beach	Tiger	2.99m	F	Alive/Released
27-02-2014	06:23	Leighton Beach	Tiger	2.2m	M	Alive/Released
27-02-2014	07:15	North Cottesloe	Tiger	Unknown	Unknown	Alive/Self-Released
04-03-2014	07:12	Floreat	Tiger	2.43m	F	Alive/Released
06-03-2014	13:43	Mullaloo	Tiger	3.73m	F	Alive/Destroyed
07-03-2014	13:55	Scarborough	Tiger	1.65m	F	Alive/Released
08-03-2014	15:47	Floreat	Tiger	3.8m	F	Alive/Destroyed

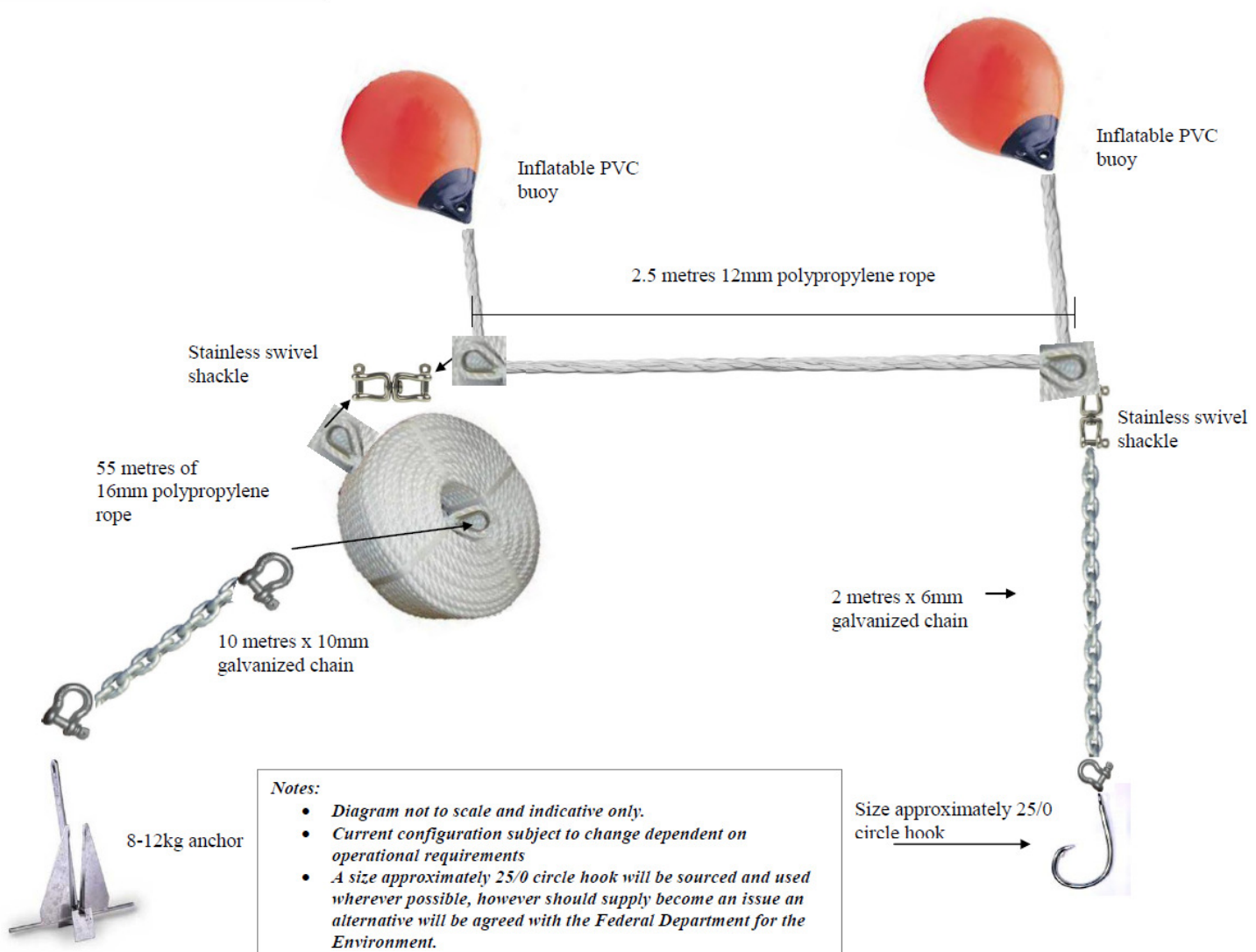
09-03-2014	12:50	Port Beach	Tiger	3.75m	F	Alive/Destroyed
10-03-2014	07:45	Floreat	Dusky Whaler	2.9m	F	Alive/Released
11-03-2014	08:15	Mullaloo	Tiger	2.22m	F	Alive/Released
13-03-2014	07:50	Floreat	Tiger	1.94	F	Alive/Released
13-03-2014	09:03	Mullaloo	Tiger	3.7m	F	Alive/Destroyed
15-03-2014	07:51	Mullaloo	Tiger	3.71m	F	Alive/Destroyed
15-03-2014	09:57	Floreat	Tiger	3.9m	F	Alive/Destroyed

SOUTH WEST REGION						
DATE	**TIME**	**LOCATION**	**SPECIES**	**SIZE**	**SEX**	**STATUS**
26-01-2014	08:30	Meelup Beach	Tiger	3.3m	F	Alive/Destroyed
29-01-2014	11:30	Rocky Point	Mako	2.0m	M	Dead
01-02-2014	07.15	Eagle Bay	Mako	1.7m	Undetermined	Dead
01-02-2014	11:30	Eagle Bay	Tiger	3.5m	F	Alive/Destroyed
01-02-2014	17:15	Rocky Point	Tiger	3.2m	F	Alive/Destroyed
02-02-2014	06:30	Old Dunsborough	Tiger	2.7m	F	Alive/Released
02-02-2014	07:45	Castle Rock	Tiger	3.5m	F	Alive/Destroyed
03-02-2014	07:15	Castle Rock	Tiger	3.0m	M	Alive/Destroyed
03-02-2014	14:00	Castle Rock	Tiger	3.0m	M	Alive/Destroyed
04-02-2014	07:00	Castle Rock	Tiger	3.1m	M	Alive/Destroyed
05-02-2014	06:30	Old Dunsborough	Tiger	2.5m	F	Alive/Released
05-02-2014	07:45	Old Dunsborough	Tiger	3.0m	M	Alive/Destroyed
05-02-2014	11:15	Castle Rock	Tiger	2.3m	F	Alive/Released
06-02-2014	11:45	Cape Naturaliste	Spinner*	1.8m	F	Alive/Released
06-02-2014	17:10	Old Dunsborough	Tiger	2.1m	F	Alive/Released
07-02-2014	07:00	Castle Rock	Tiger	3.3m	M	Alive/Destroyed
07-02-2014	09:30	Rocky Point	Tiger	Approx. 3.0m	M	Dead
07-02-2014	17:30	Old Dunsborough	Tiger	3.3m	M	Alive/Destroyed
08-02-2014	06:30	Castle Rock	Tiger	2.75m	F	Dead
08-02-2014	08:02	Eagle Bay	Tiger	2.75m	F	Dead
09-02-2014	07:00	Castle Rock	Tiger	2.5m	M	Alive/Released
11-02-2014	08:30	Rocky Point	Tiger	3.1m	F	Alive/Destroyed
11-02-2014	09:20	Bunker Bay	Tiger	4.1m	F	Alive/Destroyed
20-02-2014	07:00	Yallingup	Tiger	2.4m	F	Alive/Released

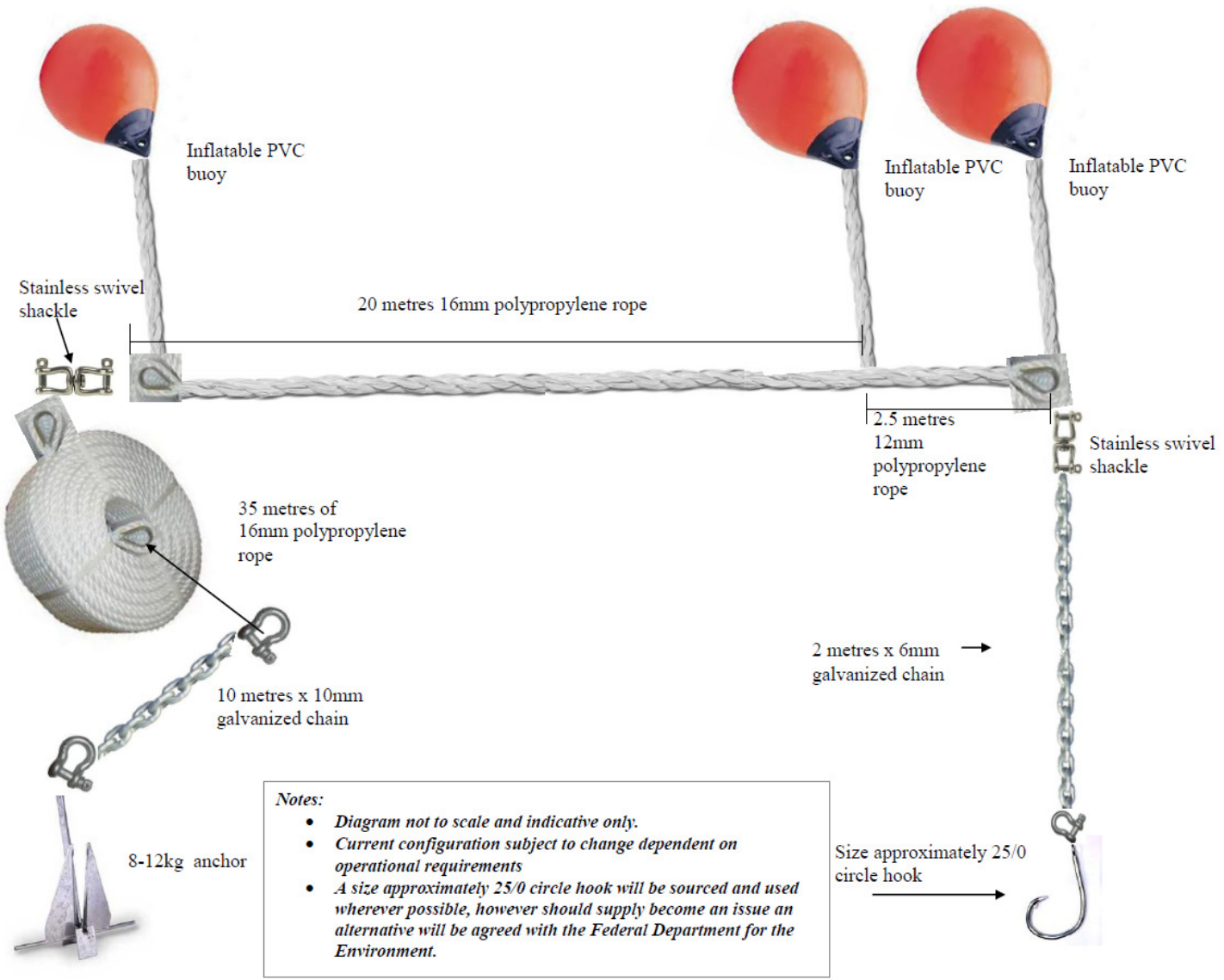
22-02-2014	07:45	Moses Rocks	Tiger	3.2m	M	Alive/Destroyed
22-02-2014	09:45	Cowaramup Point	Tiger	2.5m	F	Alive/Released
24-02-2014	08:30	North Point Cowaramup	Tiger	2.66m	M	Alive/Released
26-02-2014	07:25	South Injidup Point	Tiger	3.0m	M	Alive/Destroyed
26-02-2014	10:20	Lefthanders	Tiger	2.66m	F	Alive/Released
27-02-2014	15:00	North Point Cowaramup	Tiger	3.0m	F	Alive/Destroyed
28-02-2014	08:15	Moses Rocks	Tiger	3.8m	F	Alive/Destroyed
28-02-2014	10:00	Guillotine	Tiger	3.1m	F	Alive/Destroyed
2-03-2014	09:00	Cowaramup	Tiger	2.5m	M	Alive/Released
2-03-2014	09:35	Cowaramup Point	Tiger	2.7m	F	Dead
5-03-2014	17:00	Injidup Point	Undetermined	Approx. 3m	Undetermined	Alive/Self-Released
08-03-2014	07:40	Injidup Point	Tiger	2.68m	F	Alive/Released
09-03-2014	08:00	Moses Rocks	Tiger	3.2m	M	Alive/Destroyed

*Note: Previously reported as a Blacktip shark (common name), but now referred to more appropriately as Spinner shark.

9 (a).


Inflatable PVC buoy
Inflatable PVC buoy
2.5 metres 12mm polypropylene rope
Stainless swivel shackle
Stainless swivel shackle
55 metres of 16mm polypropylene rope
2 metres x 6mm galvanized chain
10 metres x 10mm galvanized chain
8-12kg anchor
Size approximately 25/0 circle hook
Notes:
Diagram not to scale and indicative only.
Current configuration subject to change dependent on operational requirements
A size approximately 25/0 circle hook will be sourced and used wherever possible, however should supply become an issue an alternative will be agreed with the Federal Department for the Environment.

9 (b).


Inflatable PVC buoy
Inflatable PVC buoy
Inflatable PVC buoy
Stainless swivel shackle
20 metres 16mm polypropylene rope
2.5 metres 12mm polypropylene rope
Stainless swivel shackle
35 metres of 16mm polypropylene rope
2 metres x 6mm galvanized chain
10 metres x 10mm galvanized chain
8-12kg anchor
Size approximately 25/0 circle hook
Notes:
Diagram not to scale and indicative only.
Current configuration subject to change dependent on operational requirements
A size approximately 25/0 circle hook will be sourced and used wherever possible, however should supply become an issue an alternative will be agreed with the Federal Department for the Environment.

10.

Surf Life Saving WA Beach Attendance Statistics							
Surf Life Saving Patrolled Beach	**2012/2013**	**2011/2012**	**2010/2011**	**2009/2010**	**2008/2009**	**2007/2008**	**2006/2007**
Albany (Middleton Beach)**	44,160	47,492	44,938	53,995	280,015	21,741	8,492
Binningup*	5,572	6,901	17,153	15,370	15,612	4,718	3,215
Broome (Cable Beach)*	17,200	18,388	14,066	11,424	14,285	4,678	34,721
Busselton*	1,658	525	2,757	1,149	978	NA	NA
Champion Bay*	8,314	8,537	7,419	6,956	1,988	4,725	2,707
Bunbury*	20,749	19,777	14,761	15,902	20,509	16,739	7,652
City Beach**	566,856	300,207	343,551	404,556	236,977	227,299	207,090
Coogee*	33,820	53,175	51,201	51,366	44,497	34,916	29,645
Cottesloe**	602,683	800,041	1,032,618	737,771	603,862	352,547	329,538
Dalyellup*	3,307	4,311	2,951	19,178	1,677	101	NA
Denmark*	6,849	5,220	6,790	5,283	3,340	3,631	7,126
Dongara Denison*	10,706	10,393	8,331	14,162	5,183	12,169	932
Esperance*	5,517	5,538	4,051	5,168	2,930	3,972	2,603
Floreat**	131,253	46,635	54,236	41,165	29,491	19,884	15,419
Leighton*	158,414	144,868	117,429	193,828	266,227	241,371	80,422
Geraldton**	26,759	32,000	22,463	23,166	25,885	14,668	9,103
Mandurah (San Remo Beach)*	4,033	3,854	5,701	3,498	4,091	3,812	1,380
Mullaloo**	363,269	349,741	306,579	293,069	293,933	152,218	107,860
North Cottesloe*	50,354	39,905	41,274	35,764	51,065	39,260	25,435
Port Bouvard*	7,658	9,949	8,515	8,003	8,945	7,900	4,248
Quinns Mindarie**	62,162	51,120	61,188	48,415	41,756	21,952	9,242
Scarborough*	190,624	192,959	126,528	164,665	122,055	274,726	15,035
Secret Harbour**	290,947	195,783	175,090	128,873	99,126	73,263	23,242
Smiths Beach^	127,960	80,855	95,364	138,168	173,779	29,566	55,941
Sorrento**	154,661	114,629	135,729	121,270	143,567	50,015	40,223
Swanbourne*	14,253	7,769	18,428	3,878	3,224	4,886	4,863
Trigg Beach*	98,209	113,637	89,516	94,273	77,914	99,594	45,851
Yanchep**	110,343	110,652	141,700	123,797	108,195	25,963	19,551
Rottnest Island (The Basin)**	46,364	74,643	NA	NA	NA	NA	NA
Bunker Bay**	119,947	89,783	NA	NA	NA	NA	NA
Meelup**	175,789	135,290	NA	NA	NA	NA	NA
Yallingup**	112,409	151,109	136,059	144,398	208,510	33,282	67,731
Penguin Island^	61,143	15,663	NA	NA	NA	NA	NA
Hillary's^	227,993	107,276	124,289	131,414	79,134	39,392	49,064
Margaret River (Rivermouth)**	NA	NA	140,047	73,592	NA	NA	49,051
TOTAL	**3,861,935**	**3,348,625**	**3,210,675**	**3,039,924**	**2,968,750**	**1,818,988**	**1,208,331**
Key							
* weekends only							
** seven day a week patrols							
^ weekday patrols only							

11.

Western Australian Shark Hazard Mitigation Policy – Criteria for Drum Line Placement for 2013/14 trial

1. Beach use

Surf Life Saving WA (SLSWA) Beach Attendance Statistics for the 2012/13 season were used to guide decision on the beaches at which drum lines were to be set. Beaches with seven day a week SLSWA patrols were prioritised for drum line placement.

Surfing WA and local recreational water users were consulted to identify popular surfing spots between Cape Naturaliste and Prevelly.

2. Distance offshore and water depth

Advice was sought from SLSWA and Surfing WA as to the maximum distance offshore of water based activities. At approximately 1km distance from shore interactions with surfers, swimmers and other water users should be mostly avoided. 1km offshore also correlates with the extent patrolled by SLSWA.

Shark control equipment in Queensland, including nets and drum lines, is set approximately 350m from shore and sits approximately along the 10m depth contour.

At 1km offshore, in the metropolitan region water depth was found to be between 9-13m and between 5-30m in the south west region.

3. Benthic habitat

Sea bed habitat was considered to ensure no drum lines were placed over reef structures or other fragile benthic habitat.

4. Marine Protected Areas

The following Department of Parks and Wildlife and Department of Fisheries Marine Protected Areas were identified–

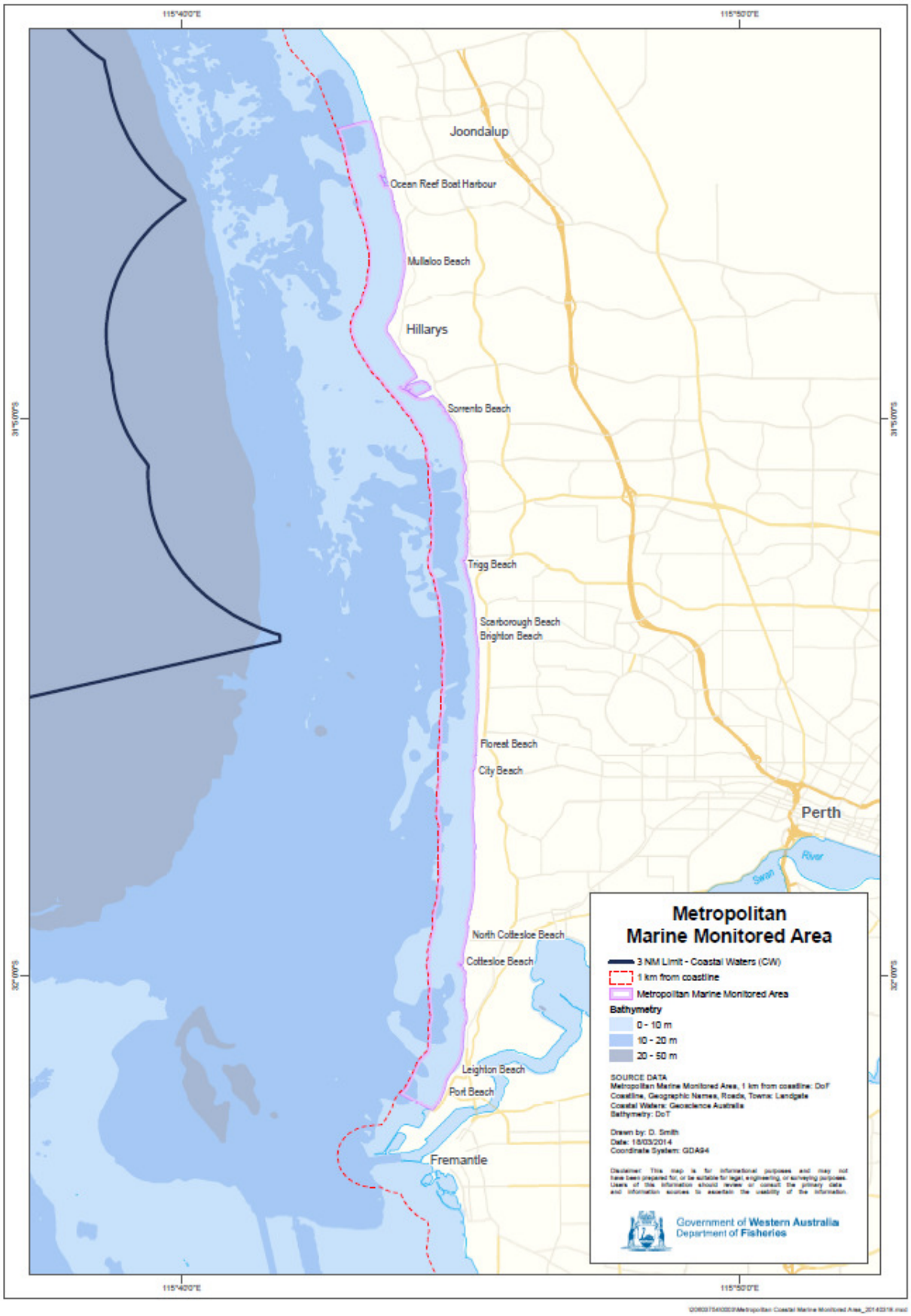
- Cottesloe Reef Fish Habitat Protection Area (FHPA)
- Waterman's Reef Observation Area
- Marmion Marine Park
- The Ngari Capes Marine Park

The Cottesloe FHPA, Waterman's Reef Observation Area and all sanctuary and recreation zones within the Marmion Marine Park were excluded for permanent drum line placement. All proposed and gazetted sanctuary and recreation zones within the Ngari Capes Marine Park were excluded for permanent drum line placement.

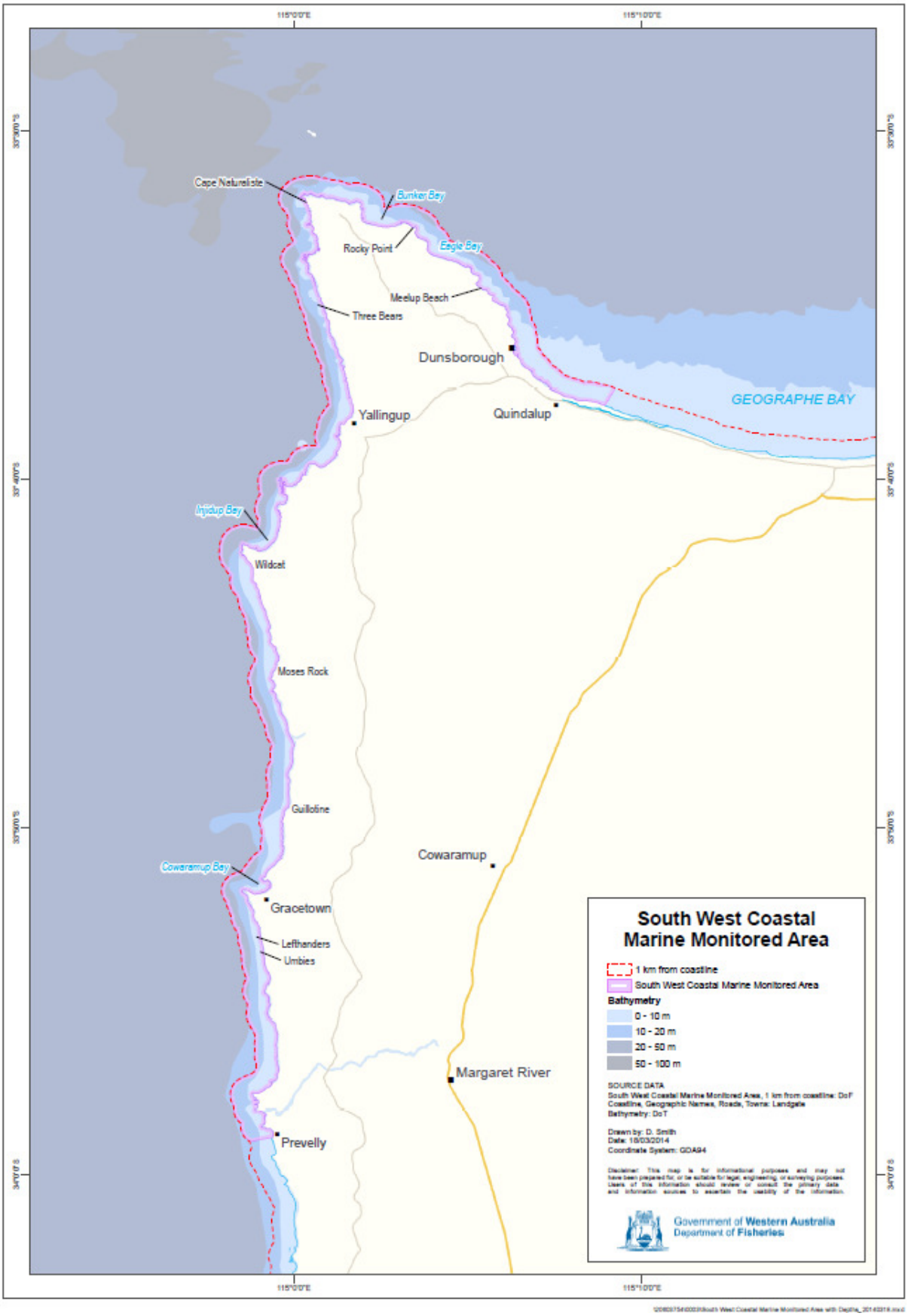
5. Shark activity

Data on shark activity from the Department of Fisheries and the SLSWA Twitter feed was used to identify areas of high densities of shark sightings.

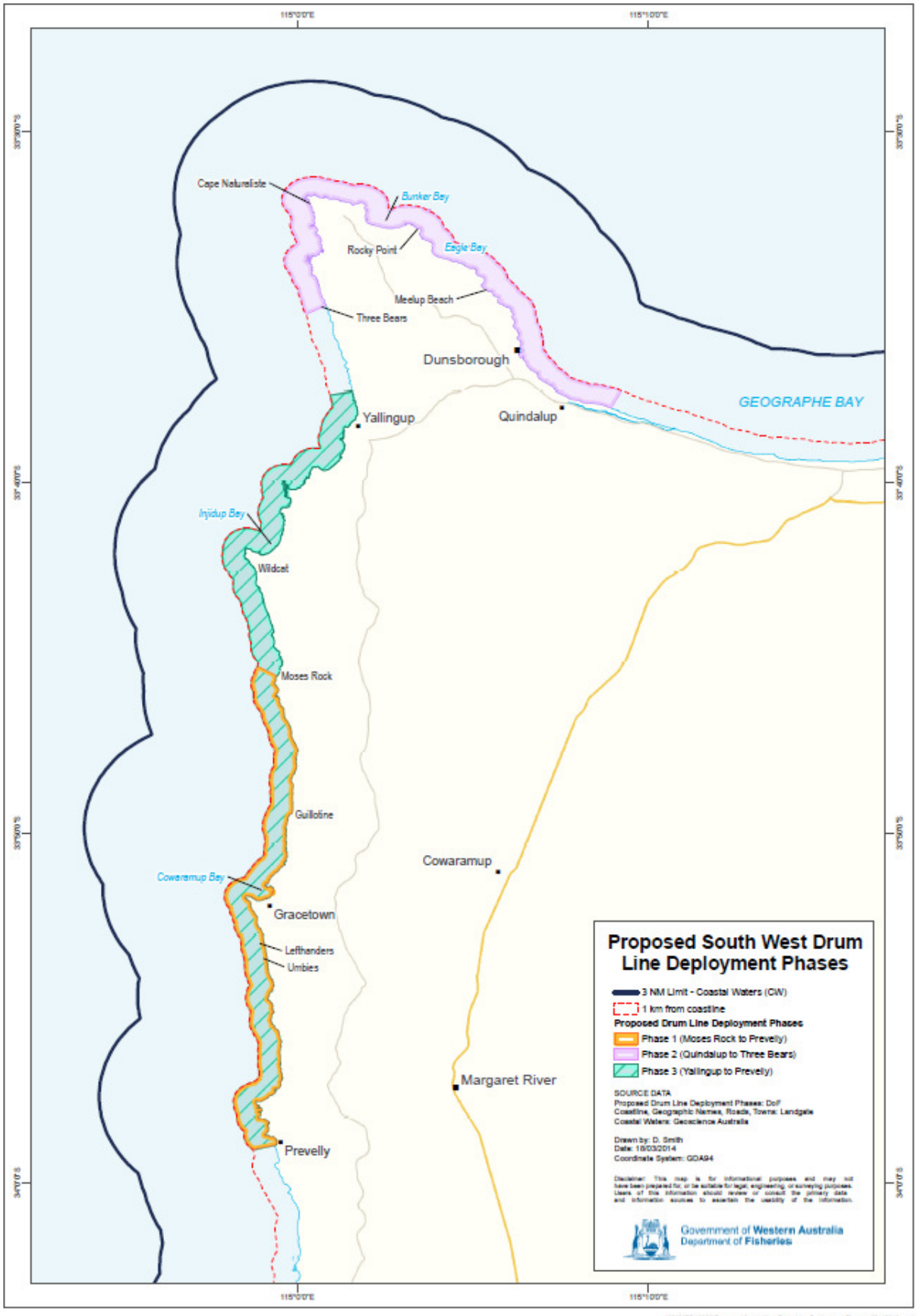
12.


115°40'0"E
115°50'0"E
31°50'0"S
32°0'0"S
Joondalup
Ocean Reef Boat Harbour
Mullaloo Beach
Hillarys
Sorrento Beach
Trigg Beach
Scarborough Beach
Brighton Beach
Floreat Beach
City Beach
Perth
Swan River
North Cottesloe Beach
Cottesloe Beach
Leighton Beach
Port Beach
Fremantle
Metropolitan
Marine Monitored Area
3 NM Limit - Coastal Waters (CW)
1 km from coastline
Metropolitan Marine Monitored Area
Bathymetry
0 - 10 m
10 - 20 m
20 - 50 m
SOURCE DATA
Metropolitan Marine Monitored Area, 1 km from coastline: DoT
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Bathymetry: DoT
Drawn by: D. Smith
Date: 18/03/2014
Coordinate System: GDA94
Disclaimer: This map is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.
Government of Western Australia
Department of Fisheries

13.


115°00'E
115°10'E
33°30'S
33°40'S
33°50'S
34°00'S
Cape Naturaliste
Bunker Bay
Rocky Point
Eagle Bay
Meelup Beach
Three Bears
Dunsborough
GEOGRAPHE BAY
Yallingup
Quindalup
Injidup Bay
Wildcat
Moses Rock
Guilloline
Cowaramup
Cowaramup Bay
Gracetown
Lefthanders
Umbies
Margaret River
Prevelly
South West Coastal Marine Monitored Area
1 km from coastline
South West Coastal Marine Monitored Area
Bathymetry
0 - 10 m
10 - 20 m
20 - 50 m
50 - 100 m
SOURCE DATA
South West Coastal Marine Monitored Area, 1 km from coastline: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Bathymetry: DoT
Drawn by: D. Smith
Date: 18/03/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

14.


115°0'0"E
115°1'0"E
33°50'0"S
33°40'0"S
33°30'0"S
34°0'0"S
Cape Naturaliste
Bunker Bay
Rocky Point
Eagle Bay
Meelup Beach
Three Bears
Dunsborough
GEOGRAPHE BAY
Yallingup
Quindalup
Injidup Bay
Wildcat
Moses Rock
Guillotine
Cowaramup
Cowaramup Bay
Gracetown
Lefthanders
Umbies
Margaret River
Prevelly
Proposed South West Drum Line Deployment Phases
3 NM Limit - Coastal Waters (CW)
1 km from coastline
Proposed Drum Line Deployment Phases
Phase 1 (Moses Rock to Prevelly)
Phase 2 (Quindalup to Three Bears)
Phase 3 (Yallingup to Prevelly)
SOURCE DATA
Proposed Drum Line Deployment Phases: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Drawn by: D. Smith
Date: 18/03/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

15.

16.

17.

Shark Drum Line Deployment, Management and Associated Services Inspection Log

INSPECTION, RESEARCH AND CATCH RECORD											
DRUM LINE GPS	**TIME INSPECTED**	**SPECIES**	***SPECIES HEALTH**	****ACTION**	**SIZE (cm)**	**SEX**	*****RESEARCH ANIMAL**	**RESEARCH TAG NO.**	**DISPOSAL TAG NO.**	**PHOTO NUMBER**	**NOTES**
ML2	13:43	Tiger	A	D	373 total	F	N	N	1921	IMG 6912	
					326 fork					IMG 6918	
					148 interd					IMG 6909	

*
A = Alive
N = Near Dead
D = Dead

**
R = Retained
D = Disposed
RL = Released

***
Y = Yes
N = No

18.

Shark Drum Line Observer Trips 2013/14

Date	Location/Vessel	Participant/s
29-01-2014	Quindalup (South West)	DPC Officer
31-01-2014	Quindalup (South West)	DoF Officer
04-02-2014	Quindalup (South West)	Inspector from Construction, Regional & Primary Industries Branch WorkSafe
06-02-2014	Quindalup (South West)	DPC Officer
13-02-2014	Gracetown (South West)	DPC Officers
18-02-2014	Fremantle (Metro)	DPC Officer
20-02-2014	Canal Rocks (South West)	DoF Officer
21-02-2014	Canal Rocks (South West)	DoF Officer
08-03-2014	Fremantle (Metro)	DPC Officer
18-03-2014	Fremantle (Metro)	DPaW Officer
20-03-2014	Fremantle (Metro)	DoF Officer

DPC – Department of the Premier and Cabinet
DoF – Department of Fisheries
DPaW – Department of Parks and Wildlife

19.

SW CONTRACTOR OBSERVER TRIP

31-1-14
06:00- 09:45
Regional Fisheries Management Officer, South

A pre-trip safety inspection was conducted by the contractor advising of location of life raft, lifejackets, radio, EPIRB, flares and process in the event of an emergency.

Required Documentation

All required forms were complete and up to date in Excel format on the contractors on board computer. This included the first deployment worksheet, vessel inspection log book, drum line maintenance log book (refer below), and the catch and research log book. The rapid response worksheet and final retrieval worksheet had not been required to date.

The contractor advised he had not been recording the GPS location of each drum line deployment every drop. He said with only one deckhand it was impractical to type these into the computer each drop as he often had wet hands and it would take too much time. He had been recording GPS locations manually on a note pad and marked each drop location on his GPS plotter. He advised that the drum lines were re-set each day within 50m of the same location so recording the GPS locations for each drop was unnecessary. If there was a requirement to move the gear then the new location was recorded manually and on the plotter.

The contractor advised he would be happy for the Department to download his GPS plotter tracks and marks of each drop. He understood the Vessel Monitoring System may also allow for this.
The contractor suggested that if the Excel spreadsheets could be linked to his GPS plotter then the exact location of each drop could be recorded every drop.

GPS Software

The vessel uses Microplot 7 chart display and Seafarer (Australian Hydrographic Office National Charts). A Separate Furuno GPS is being used.
Both are in WGS 84 datum. I advised that all Sanctuary coordinates and Departmental GPS data are in the GDA 94 datum so he would need to change to GDS 94. The contractor advised he would change the datum to GDA 94.

Sanctuary Zones

The contractor is aware he cannot set gear in the Ngari Capes Sanctuary Zones. The coordinates provided to him electronically are in decimal degrees format and his GPS plotter is in degrees-minutes- seconds format. He requested assistance converting the formats so he could put the exact locations in his plotter. Fisheries and Marine Officers have been contacted to assist with this but until it occurs, he was staying well away from the Sanctuary Zone borders.

Bait

Imported blue mackerel (three per hook) were being used. The tail of each mackerel was wired to the hook and the hook set through the head/gills of each fish. The mackerel are approximately 250gm each and 30cm long. The contractor advised he was trying to source gummy shark heads and fish heads from a Margaret River fish processor.

Gear

Fifteen lines were set each day and seven spares were on board. The gear was spaced 500m apart and the contractor did not think any more lines could be set in the area without them being very close together. He believed he had good coverage of the area and any more lines could pose issues with recreational boaters on busy days. The sanctuary zone areas he was required to stay out of

reduced the number of lines that could be set and one commercial purse seine operator had requested he space his gear a bit further apart off Bunker Bay, so his purse seine fishing operations were not adversely affected. Photos of the hooks, lines, gear set-up are at.

I reiterated that no more than 31 drum lines could ever be in the water at any one time and five spares must be on board in case a rapid response deployment was required (total of 36 lines for the South West MMA). The contractor understood this was a requirement of the Commonwealth Exemption.

One of the 25'0 circle hooks had straightened while a 3m shark was under tow to the disposal site. A large swell had caused the boat to jerk and the pressure straightened the hook. The shark was still secured by a tail rope and taken to the disposal site. The vessel was towing at 7 knots.

Rapid Response

The contractor's phone is always on charge in the wheel house but vessel engine noise and the contractor being on deck assisting with the gear means his phone will not always be heard. If the contractor does not pick up his phone immediately and a rapid response is required, he recommended contacting Dunsborough Sea Rescue (7am to 7 pm) and advising them to call F.V. Boranup Beach on Channel 16 VHF requesting he pick up his mobile phone. The contractor will also monitor 2183 HF radio.

Destroying Sharks

The operator is currently using a .22 calibre rifle with 40gn subsonic ammunition. I advised that Departmental staff used a smokey with a solid shotgun cartridge for destroying sharks. The contractor owns a shot gun and would try to source similar shotgun shells for destroying large sharks.

Shark Disposal

Sharks were being disposed of at Wright Bank 1.4 nautical miles offshore. This was the closest, deepest site in 52m of water. The first two sharks had not been tagged as the contractor had not been provided with tags to date. I provided him with four bags of tags and he would tag all sharks being disposed of through the dorsal fin in future.

20.

Western Australian Shark Threat or Incident: Response Criteria

The following must be confirmed before initiating a response –

1. Report made within one hour of sighting and response able to be in place within one hour of report being made.
2. Location is clear (e.g. land or ocean marker or GPS waypoint).
3. The sighting is credible. This assessment can include the source of the report (Surf Life Saving WA, commercial fisher, Government Agency vessel) or by contacting the individual reporting the sighting.
4. The shark is believed to have a length of three metres or greater and be within 1km of the shore.
5. Where possible the shark species is identified as a target species under the Western Australian shark hazard mitigation policy.
6. The Department of Fisheries Operations Manager is satisfied that public safety is of concern (beach is occupied, shark remains in the vicinity, shark is close to shore etc.).
7. The Land Manager (or delegated authority) must agree to, and have capacity to give effect to, beach closure for the period of deployment and removal of shark hazard.
8. In the event that the Land Manager will not agree to beach closures the deployed vessel will still attend and place drum lines 1km off shore.

Clarification on the following will assist in the confirmation and initiation of a response

- Person reporting the sighting can explain how they determined the length of the shark and the detail is plausible.
- Length can be gauged in comparison to an object i.e. the reporter's water vessel or other visual marker.
- Person can explain how they determined distance from beach and the detail is plausible.
- Person can describe any patterns or particular features of the shark's body, assisting in species identification.
- Environmental conditions are favourable to water visibility.
- Sighting can be verified by another person.

A decision on the deployment of resources in the event of a shark threat or attack will be made by the Department of Fisheries Operations Manager.

Procedure To Be Followed to Initiate a Response

- Identify resources to support deployment operation (e.g. vessel availability, beach closures, aerial support).
- Obtain verification that beaches have been cleared as appropriate.
- The deployed vessel attends the site and sets up to five baited drum lines.
- In responding to a sighting, the drum lines must be moved back out to approximately 1km offshore within one hour of arrival at the site, and/or removed from the water no more than one hour after arrival at site.
- In responding to an attack, up to five drum lines may be set in the vicinity of the attack zone. Drum lines will be moved out to no further than 1km offshore and maintained and monitored for a maximum of seven days.

21.

GUIDELINES FOR FISHING FOR SHARKS POSING AN IMMINENT THREAT TO PUBLIC SAFETY

Background

Following five fatal shark attacks in Western Australia over the twelve months to September 2012, the Government announced additional policies to mitigate the risk of further attack.

One of the policies created the potential for a protected shark species to be taken before a fatal attack where it is deemed to be posing an imminent threat to public safety.

This policy only applies in State waters, (typically within three nautical miles of shore) where the relevant Minister has issued an appropriate exemption for this purpose. The policy does not apply in Commonwealth waters where a similar exemption would be required from the Federal Environment Minister.

An exemption had previously been issued by the Minister for Fisheries allowing authorised Department of Fisheries, (Department) officers to take certain sharks considered to be posing an imminent threat to public safety in State waters. Imminent threat had been interpreted under that exemption as applying to situations where:

- a fatal shark attack had already occurred;
- the relevant shark appeared to be remaining in surrounding waters; and
- there was a reasonable likelihood of people also being in those waters.

The following guidelines have been developed to assist decision makers[1], in applying the new exemption and Government policy. The guidelines are not definitive as it is recognized that every situation where they are applied is likely to be different. Decision makers will, therefore, need to exercise judgment based on the available information which may be limited.

Confirmed Sightings

Experience has shown that the identification of sharks can be difficult, with various reported sightings subsequently being attributed to sea mammals and fish. Accordingly, sightings should be verified before consideration is given to the threat of imminent attack.

Verification of a sighting should have regard to:

- the experience of the person making the sighting. (For example, sightings from experienced commercial fishers, Surf Life Saving WA representatives and officers from the Department and other relevant government agencies have tended to be more reliable than reports from the general public);

[1] In most instances it is expected that the decision maker will be the Director General of the Department of Fisheries

1

- the amount of detail the informant is able to provide on the shark and its' behaviour; and
- whether the sighting is supported by photographic evidence or corroborated by other reported sightings.

Determining Imminent Threat

Where a shark attack has been confirmed, consideration should be given to whether the shark continues to pose an imminent threat of further attack. Factors to be considered in this assessment should include:

- the veracity of the report;
- whether a shark has been sighted in the vicinity of the attack. (These sightings should typically be reported within hours of the attack to be relevant, though further sightings may be considered relevant in certain circumstances, particularly where the sightings are consistent with known facts about the shark that conducted the attack);
- the likelihood that the subsequent sighting is the same shark involved in the original attack; and
- the likelihood of people entering or remaining in the water without knowing the imminent threat posed by the shark.

In any event, an order to set capture gear may be warranted following a fatal attack in an effort to recover coronial evidence.

In the absence of an attack having taken place, a confirmed shark sighting may still be considered to pose an imminent threat in circumstances where there is considered to be a High Hazard and a High Risk.

High Hazard

Circumstances may be considered a high hazard when the confirmed sighting relates to a shark that is likely to be a species with a history of attacking people.

High Risk

Circumstances may be considered a high risk where the confirmed sighting occurs:

- within proximity of popular beaches. (Guidance may be taken in this regard to the Surf Life Saving WA beach closure protocol which relates to sightings within one kilometre);
- during daylight hours;
- in conditions that are likely to be conducive to people using the water; and
- measures to clear people from the water and keep them out for a reasonable period are unlikely to be effective in removing the imminent threat. (Guidance may be taken in this regard to the Surf Life Saving WA beach closure protocol which provides for beaches to be closed for 24hours following the last sighting after a fatal attack and one hour where a beach is closed in the absence of an attack).

Any assessment of the circumstances should consider whether there is a plausible explanation(s) for the shark sighting that is likely to be temporary. In some circumstances there may be prevailing conditions, such as the presence of a whale carcass, or seasonal fish aggregations which explain the presence of a shark. These circumstances may be consistent with high hazard and high risk but conducive to management without an order to set capture gear being required, (bearing in mind that an order to set capture gear should be predicated on public safety grounds, rather than public amenity).

Assessment of the circumstances should also recognise that an order to set capture gear may heighten the risk of attack. For example:

- the setting of capture gear may attract additional sharks to the proximity of popular beaches; and
- capturing a tagged shark may eliminate a key indicator of a temporary high hazard in the proximity of a popular beach.

Any consideration of the circumstances should be predicated on the expectation that people will exercise a reasonable level of responsibility for their own actions, including abiding by instructions from authorities to remain out of the water.

Negating an Imminent Threat

Where a shark is found to be posing an imminent threat of attack, consideration should initially be given to options for negating the threat.

Reasonable efforts should be made to inform people, (including relevant authorities) about the imminent threat. Standard shark hazard response procedures should also be implemented, such as:

- closing adjacent beaches to the public;
- ordering people from the water;
- re-tasking the shark surveillance helicopter(s) operated by Surf Life Saving WA;
- post sighting or incident details on social media services; and
- using additional media to warn people of the threat.

Feasibility and Capability

Where a shark is considered to be posing an imminent threat of attack and reasonable efforts to negate the imminent threat have failed, the feasibility and capability of taking the shark should be assessed. This assessment should have regard to whether:

- a commercial fisher, who has been contracted and authorised for the purpose, can respond to the location within one hour of the sighting;
- a suitable rigid hulled vessel with appropriately trained personnel, capture equipment and bait can respond to the location within one hour of the last confirmed sighting if a contracted commercial fisher is not available;

- the master of the vessel has deemed current and forecast marine conditions as safe working conditions for the deployment and retrieval of the capture gear, (with or without a hooked shark);
- the relevant authorities (such as local Government, land manager or surf lifesaving clubs) have agreed to administer beach closures in waters within proximity of areas where capture gear is set;
- the setting of capture gear could attract additional sharks to the area or pose an unreasonable risk of capture/entanglement of other wildlife;
- the setting of capture gear and potential taking of a shark will pose an unreasonable risk to the health and safety of relevant staff, contractors and the community; and
- the long-term benefit to public safety of tagging the shark (which will add to the knowledge of shark behaviours), might outweigh the arguments for destroying a captured shark.

Consultation

Where the decision maker believes it may be appropriate to issue an order for a shark(s) be taken due to an imminent threat to public safety, it is desirable that he/she first consult with the Director General of the Department of Environment and Conservation (DEC) and the Director General of the Department of the Premier and Cabinet, (DPC) unless he/she considers the threat so imminent that action must be taken immediately.

Where possible, the Directors General of DEC and DPC should be provided with a copy of the proposed decision sheet, (**Attachment A**) to assist their consideration. In the event that either, or both, of the Directors General are unavailable, the decision maker is authorised to proceed.

Managing the carcass

If a shark is subsequently captured and destroyed, consideration also needs to be given to whether the shark carcass should be retained or disposed of at sea.

Where the shark is suspected of having been involved in a fatal attack the carcass should be retained if possible and surrendered as potential coronial evidence.

In other instances, efforts should be made to maximize the research value from the carcass as such work could potentially provide insights into alternative methods to deter sharks away from humans. The carcass should be retained for research by the Department or other research providers where practical. However, it is recognized that circumstances many not be conducive to retaining the carcass. For example, many locations around the State do not have suitable coastal facilities for unloading a one or two tonne shark carcass and then transporting it to appropriate research centres.

Where retention of the shark carcass is not practical, efforts should still be made to maximize the research value through options such as the securing of tissue samples before the carcass is disposed of at sea.

Advice should also be provided to the relevant State and Federal government authorities where the order to set capture gear results in a protected species being destroyed.

Rescinding an order

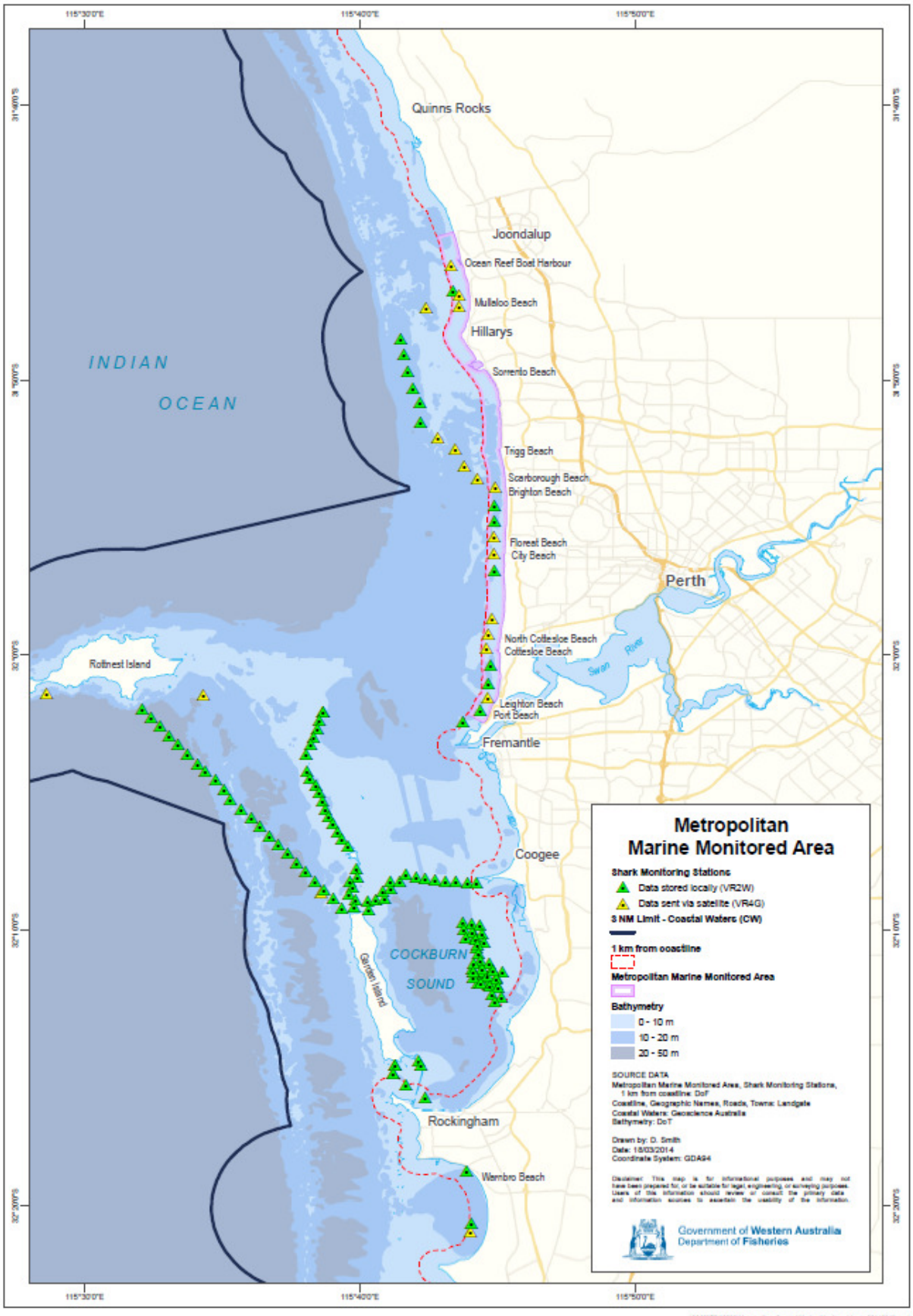
The order to take a shark is only expected to remain in place while there continues to be an imminent threat of attack, (refer above). A decision to rescind the order should have regard to whether:

- there have been any further sightings of a shark in the vicinity;
- reasonable period has elapsed to significantly diminish the likelihood of a shark being captured that poses an imminent threat. (Guidance may be taken in this regard to the Surf Life Saving WA beach closure protocol mentioned above);
- continued bait in the water may unnecessarily attract other sharks to the area; and
- reasonable and adequate steps have been undertaken to inform people of the reported hazard.

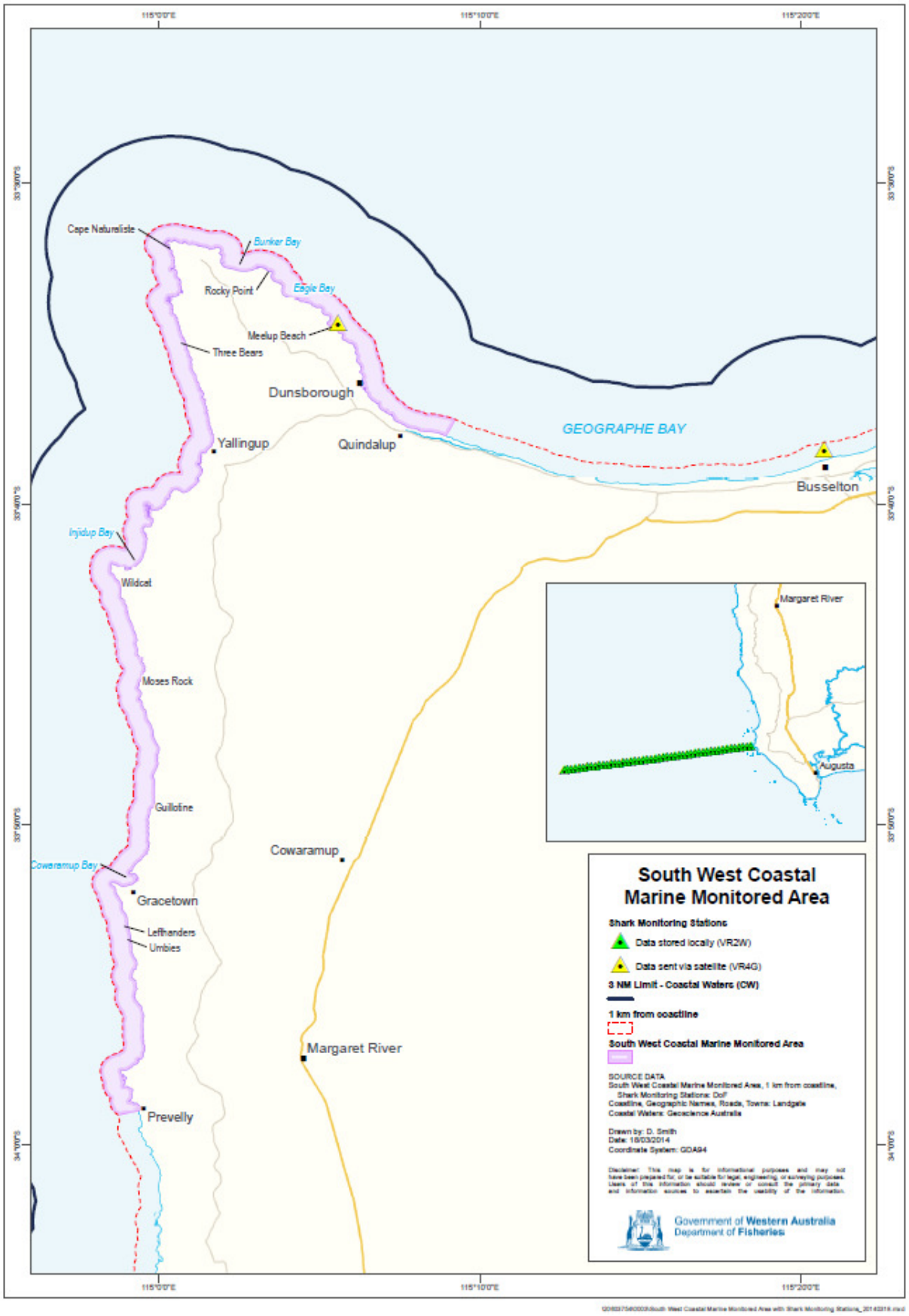
A decision maker specified in the exemption, (typically the Director General of the Department) may rescind an order to set gear and take a shark if he/she is satisfied that the imminent threat has passed. Information regarding the decision should then be conveyed to the public.

Last updated 23 November

22.


115°30'0"E
115°40'0"E
115°50'0"E
31°40'0"S
32°00'0"S
32°10'0"S
32°20'0"S
Quinns Rocks
Joondalup
Ocean Reef Boat Harbour
Mullaloo Beach
Hillarys
Sorrento Beach
Trigg Beach
Scarborough Beach
Brighton Beach
Floreat Beach
City Beach
Perth
North Cottesloe Beach
Cottesloe Beach
Swan River
Rottnest Island
Leighton Beach
Port Beach
Fremantle
Coogee
INDIAN
OCEAN
COCKBURN
SOUND
Garden Island
Rockingham
Wembro Beach
Metropolitan
Marine Monitored Area
Shark Monitoring Stations
Data stored locally (VR2W)
Data sent via satellite (VR4G)
3 NM Limit - Coastal Waters (CW)
1 km from coastline
Metropolitan Marine Monitored Area
Bathymetry
0 - 10 m
10 - 20 m
20 - 50 m
SOURCE DATA
Metropolitan Marine Monitored Area, Shark Monitoring Stations, 1 km from coastline: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Bathymetry: DoT
Drawn by: D. Smith
Date: 18/03/2014
Coordinate System: GDA94
Disclaimer: This map is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.
Government of Western Australia
Department of Fisheries

23.


115°0'0"E
115°10'0"E
115°20'0"E
33°30'0"S
33°40'0"S
33°50'0"S
34°0'0"S
Cape Naturaliste
Bunker Bay
Rocky Point
Eagle Bay
Meelup Beach
Three Bears
Dunsborough
Yallingup
Quindalup
GEOGRAPHE BAY
Busselton
Injidup Bay
Wildcat
Moses Rock
Guillotine
Cowaramup Bay
Gracetown
Leftbanders
Umbies
Prevelly
Cowaramup
Margaret River
Margaret River
Augusta
South West Coastal Marine Monitored Area
Shark Monitoring Stations
Data stored locally (VRZW)
Data sent via satellite (VR4G)
3 NM Limit - Coastal Waters (CW)
1 km from coastline
South West Coastal Marine Monitored Area
SOURCE DATA
South West Coastal Marine Monitored Area, 1 km from coastline, Shark Monitoring Stations: DoF
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Drawn by: D. Smith
Date: 18/03/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

24. Applied Research Program

- The Government has invested $2 million in an applied research program.
- Grants of up to $300,000 over a period of up three years were provided to Western Australian-based organisations, including universities, research institutes and industry.
- The funded research focuses on systems to detect hazardous sharks and deter attacks on ocean users.

Research grants to detect hazardous sharks

Project	Researcher	Funding	Description
Sonar imaging and detection of sharks	Curtin University Centre for Marine Science and Technology (Dr Miles Parsons)	$273,468	Evaluate the effectiveness of imaging sonar for underwater detection of sharks, identify the most likely detection method and create a framework for producing commercially viable shark detection.
Advanced vision system for automatic shark detection and tracking	University of Western Australia School of Computer Science and Software Engineering (Professor Mohammed Bennamoun)	$203,234	Develop an advanced vision system for real-time automatic shark detection and tracking, by developing a novel set of advanced image processing algorithms.
Development and testing of a low impact acoustic-based shark detection system	University of Western Australia School of Physics (Dr Shane Chambers)	$252,417	Develop and test a low impact acoustic-based shark detection system.

Research grants to deter shark attack

Project	Researcher	Funding	Description
Development and testing of novel shark deterrents	University of Western Australia Oceans Institute (Assoc Professor Nathan Hart)	$222,221	Develop and test novel shark deterrents including bubble curtains, underwater sounds and strobe lights.
Testing and enhancement of existing shark deterrents	University of Western Australia Oceans Institute (Professor Shaun Collin)	$220,573	Independently test and possibly enhance existing shark deterrents including electric devices, acoustic repellents and chemical repellents.
Integrated surfboard electronic shark deterrent to protect surfers	Shark Shield Pty Ltd (Lindsay Lyon CEO)	$300,000	Develop and test an integrated surfboard electronic shark deterrent to protect surfers.
Characterisation and masking of acoustic signatures of beach-goers that may attract sharks	Curtin Uni – Centre for Marine Science and Technology (Professor Christine Erbe)	$130,124	Characterise and mask acoustic signatures of beach-goers that may attract sharks.
A case of a mistaken identity? Discovering the sensory cues that trigger shark attacks	University of Western Australia Oceans Institute (Assoc Professor Nathan Hart)	$284,620	Discover the visual, electrical and hydrodynamic cues that trigger shark attack and develop specific design criteria for shark repellent or masking devices.

25.

Environmental Protection Authority

GOVERNMENT OF WESTERN AUSTRALIA

Director General
Department of the Premier and Cabinet
Dumas House
2 Havelock Street
WEST PERTH WA 6005

Our Ref 14-522310

NOTICE UNDER SECTION 39A(3)
Environmental Protection Act 1986

PROPOSAL:	**Shark Drum Line Deployment, Management and Associated Services**
LOCATION:	**Within defined marine monitoring areas in the Metropolitan and South West regions**
PROPONENT:	**Director General of the Department of the Premier and Cabinet on behalf of the State of Western Australia**
DECISION:	**Not Assessed – Public Advice Given**

The Environmental Protection Authority (EPA) understands that you are undertaking the above proposal which has been referred to the Authority for consideration of its potential environmental impact.

This proposal raises a number of environmental issues. However, the EPA has decided not to subject this proposal to the environmental impact assessment process and the subsequent setting of formal conditions by the Minister for Environment under Part IV of the *Environmental Protection Act 1986* (EP Act). Nevertheless, the EPA provides the attached advice to you as the proponent, and other relevant authorities on the environmental aspects of the proposal.

The EPA's decision to not assess the proposal is open to appeal. There is a 14-day period, closing 26 March 2014. Information on the appeals process is available through the Office of the Appeals Convenor's website, www.appealsconvenor.wa.gov.au, or by telephoning 6467 5190.

Dr Paul Vogel
CHAIRMAN
For the Environmental Protection Authority
Under Notice of Delegation No. 30 dated 24 January 2013

12 March 2014

Encl

Level 4, The Atrium, 168 St Georges Terrace, Perth, Western Australia 6000
Telephone 08 6145 0800 Facsimile 08 6145 0895 Email info@epa.wa.gov.au
Locked Bag 10, East Perth WA 6892
www.epa.wa.gov.au

PUBLIC ADVICE UNDER SECTION 39A(7) ENVIRONMENTAL PROTECTION ACT 1986

Background

As part of a broader program of shark hazard mitigation (see details below), the Government of Western Australia is implementing a shark hazard mitigation strategy which involves the deployment of baited drum lines to capture target species of large sharks (the proposal).

The proposal involves the deployment of up to 72 baited drum lines and rapid response within marine monitoring areas (MMA) in the metropolitan and the South West regions until 30 April 2014. The proposal commenced on 25 January 2014 in the South West and 31 January 2014 in the metropolitan region.

The target species include white sharks (*Carcharodon carcharias*), tiger sharks (*Galeocerdo cuvier*) and bull sharks (*Carcharhinus leucas*) over three metres in length. The non-target species caught, including all sharks less than three metres are to be released alive if possible.

The proposal was referred to the Environmental Protection Authority (EPA) under section 38 of the *Environmental Protection Act 1986* on 14 January 2014.

The EPA received a considerable number of public comments during the seven day public comment period about the proposal. The comments and issues raised have been considered by the EPA in its decision and the advice and recommendation detailed below.

The EPA has considered the proposal in accordance with the requirements of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Impact Assessment Administrative Procedures 2012*. In making its decision on whether to assess the proposal, the EPA considered the 10 principles of the significance test as detailed in clause 7 of the *Environmental Impact Assessment Administrative Procedures 2012,* including:

- values, sensitivity and quality of the environment which is likely to be impacted;
- extent (intensity, duration, magnitude and geographic footprint) of the likely impacts;
- consequence of the likely impacts (or change);
- resilience of the environment to cope with the impacts or change;
- cumulative impacts with other projects;
- level of confidence in the prediction of impacts and the success of proposed mitigation;
- objects of the Act, polices, guidelines, procedures and standards against which a proposal can be assessed;
- presence of strategic planning policy framework;

- presence of other statutory decision-making processes which regulate the mitigation of the potential effects on the environment to meet the EPA's objectives and principles for EIA; and
- public concern about the likely effects of the proposal, if implemented, on the environment.

1. Environmental Factor

The EPA identified **Marine Fauna** to be the preliminary environmental factor relevant to this proposal. The EPA's objective for this environmental factor is to maintain the diversity, geographic distribution and viability of fauna at the species and population levels.

No other preliminary environmental factors were identified as relevant to the EPA's decision as to whether or not to assess this proposal.

The EPA considers that, based on information:

- provided with the referral of the proposal under section 38A of the EP Act;
- derived from its own inquiries; and,
- derived from comments received from the public,

and having regard to the objects and principles set out in Part 4A of the EP Act, the proposal does not warrant formal environmental impact assessment under the EP Act.

2. Advice and Recommendations regarding Environmental Issues

The EPA received a considerable number of public comments during the seven day public comment about the proposal. In total the EPA received in the order of 10,000 comments through the EPA's consultation hub, 450 emails (half of which were pro forma) and approximately 12,000 comments forwarded from the Conservation Council of Western Australia.

The majority of the comments received were opposed to the proposal and requested the EPA undertake a formal assessment. Specifically, comments were of the view that the EPA should set the level of assessment at Assessment on Proponent Information (API), Category B (environmentally unacceptable) or at Public Environmental Review (PER) to provide for the opportunity for public submissions to be submitted on the proposal.

The majority of public comments focused on the following issues:

- the use of science based evidence to support the use and effectiveness of the program to reduce shark attacks;
- the need to evaluate non-lethal alternatives such as early detection, alarm systems and community education;

- the need for public engagement in the development and implementation of a broader program; and
- the potential ecological impacts associated with the program such as loss of apex predators on ecosystem processes, impacts to the white shark population and impacts to other marine fauna through by-catch (environmental issues detailed further below).

The majority of the public comments received were about the activity of deploying drum lines for catching and destroying sharks regardless of the duration and timing of deployment (as defined in this proposal).

In considering the potential impacts of the proposal on marine fauna, the EPA has had particular regard to:

- the findings and conclusions set out in the Department of Fisheries (DoF)'s *Research Advice on the Proposed Shark Mitigation Strategy using drum lines for January to April 2014,* which was published on the EPA's website along with the referral information on 12 February 2014. The advice concluded that the proposal posed a negligible risk to the target species of sharks, most of the non-target species of marine fauna and the broader ecosystem. The Dusky whaler was the only species identified as potentially requiring additional management interventions resulting from the strategy but this was considered to be unlikely;
- the mitigation strategies to reduce impacts to non-target species including the use of significantly large hooks, the use of no more than 36 drum lines in each marine monitoring area, and the daily monitoring and maintenance of drum lines from 6:00am to 6:00pm, seven days a week,
- the most up to date catch data which shows that it is mostly tiger sharks caught and the most recent advice received from the DoF which reiterated its advice that the proposal is still unlikely to have a measurable impact on the total tiger shark population in WA and therefore still represents a negligible risk; and
- the fact that there have been no by-catch of marine mammals and turtles, which increases the confidence in the DoF's predictions in its Research Advice.

As such, the EPA has concluded that the EPA's objectives for Marine fauna can be met with a high level of confidence because of the limited extent of the proposal in terms of the duration and geographic footprint. The EPA also considers that impacts to target and non-target species can be regulated under the *Fish Resources Management Act 1994* and the *Wildlife Conservation Act 1950*. Accordingly the EPA considers that the proposal is unlikely to have a significant effect on the environment and does not warrant formal environmental impact assessment under the EP Act.

3. Other advice

Broader shark hazard mitigation program

The EPA notes that the current proposal for shark drum line deployment, management and associated services is a proposal within a broader shark hazard mitigation program.

The Government's shark hazard mitigation program includes:

- aerial and beach shark patrols;
- research into shark hazard mitigation strategies including the use of non-lethal alternatives;
- improved monitoring of tagged sharks for short term response and longer term research;
- improved coordination with respect to shark sightings and warning systems; and
- community awareness and engagement.

The EPA supports the continuation and further development of a broader program to monitor and research shark behaviour and investigate non-lethal alternatives in order to further minimise the potential environmental impacts to marine fauna.

Should there be intentions to implement a new proposal to deploy baited drum lines on an ongoing basis after 30 April 2014, then the EPA recommends that this new proposal be referred to the Authority in the context of the Government's broader shark hazard mitigation program. The referral should be accompanied by information and results from this current proposal and its environmental impacts, including the type, size, sex and number of species caught.

26.

Stakeholders engaged in review of imminent threat policy in early December 2013

All meetings took place in the Office of the Minister for Fisheries, unless otherwise stated.

Former Director General; Department of Fisheries
Current Director General; Department of Fisheries
Shark Response Unit; Department of Fisheries
Research Division; Department of Fisheries
Margaret River Board Riders and Yallingup Board Riders
Surf Life Saving WA
Recfishwest
Western Australian Fishing Industry Council
Surfing WA
Mullaloo Surf Club
Former chair of Fisheries Research and Development Corporation (FRDC)
Scientist from the University of Western Australia
Scientist from Bond University
West Australians for Shark Conservation
Recreational water users
WA Abalone Industry Association (external meeting)
Fisheries Research and Development Corporation (FRDC) (external meeting)
Scientist from the Marine Conservation Science Institute, USA (telephone)
Scientist from James Cook University, Qld (telephone)
Scientist from the University of Sydney (telephone)
Commercial fisher (telephone)
Manager of the Qld Shark Control Program (telephone)
Department of Fire and Emergency Services (telephone)
Director General; Department of Parks and Wildlife (telephone)
WA Water Police (written correspondence)
PADI Aware (written correspondence)
CSIRO (written correspondence)

27.

Australian Government
Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 03/04/14 14:41:22

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 0.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	38
Listed Migratory Species:	36

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	60
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	3
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	42
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans amsterdamensis Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir [25911]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Diuris purdiei		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica		
Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Lepidosperma rostratum		
Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto)		
Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Sterna anaethetus		
Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia		
Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii		
Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta (sensu stricto)		
Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida		
Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta birostris		
Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Reptiles		
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Marmion Marine Park	WA	Indicative Place
Whitfords Coastal Strip	WA	Indicative Place
Historic		
Elizabeth Shipwreck	WA	Registered

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus declinatus Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

28.

Australian Government
Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 03/04/14 14:19:21

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 0.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	45
Listed Migratory Species:	34

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	55
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	2
State and Territory Reserves:	2
Regional Forest Agreements:	1
Invasive Species:	26
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans amsterdamensis Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis		
Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta		
Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi		
White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida		
Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Congregation or aggregation known to occur within area
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea		
Australian Sea-lion [22]	Vulnerable	Species or species habitat may occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir [25911]	Vulnerable	Breeding known to occur within area
Plants		
Banksia nivea subsp. uliginosa		
Swamp Honeypot [82766]	Endangered	Species or species habitat likely to occur within area
Banksia squarrosa subsp. argillacea		
Whicher Range Dryandra [82769]	Vulnerable	Species or species habitat may occur within area
Caladenia caesarea subsp. maritima		
Cape Spider-orchid [64856]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Caladenia viridescens		
Dunsborough Spider-orchid [56776]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Calectasia cyanea		
Blue Tinsel Lily [7669]	Critically Endangered	Species or species habitat may occur within area
Centrolepis caespitosa		
[6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. C Coast Plain (R.D.Royce 4872)		
Royce's Waxflower [82023]	Vulnerable	Species or species habitat may occur within area
Darwinia foetida		
Muchea Bell [83190]	Critically Endangered	Species or species habitat may occur within area
Drakaea elastica		
Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat may occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus phylacis		
Meelup Mallee [56422]	Endangered	Species or species habitat known to occur within area
Gastrolobium papilio		
Butterfly-leaved Gastrolobium [78415]	Endangered	Species or species habitat may occur within area
Sphenotoma drummondii		
Mountain Paper-heath [21160]	Endangered	Species or species habitat may occur within area
Wurmbea calcicola		
Naturaliste Nancy [64691]	Endangered	Species or species habitat known to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Congregation or aggregation known to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area

Name	Threatened	Type of Presence
Phaethon rubricauda		
Red-tailed Tropicbird [994]		Breeding known to occur within area
Puffinus assimilis		
Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna anaethetus		
Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna bergii		
Crested Tern [816]		Breeding known to occur within area
Sterna caspia		
Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Thalassarche cauta (sensu stricto)		
Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida		
Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura australe		
Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei		
Gale's Pipefish [66191]		Species or species habitat may occur within area
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus		
Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps		
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus		
West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus		
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis		
Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus		
Prophet's Pipefish [66250]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Congregation or aggregation known to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis		
Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus		
Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata		
Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus		
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Bunker Bay Geological Site	WA	Registered
Leeuwin - Naturaliste Ridge Area	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Leeuwin-Naturaliste	WA
Sugar Loaf Rock	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

29.

Research Advice on the Proposed Shark Mitigation Strategy using drum lines for January to April 2014

Research Division - January 2014

File No 2475/13

Background

In direct response to the unprecedented shark related fatalities that have occurred in WA over the past several years, the WA Government has increased funding to initiate or enhance a series of shark hazard mitigation programs. In November 2013, a surfer in the south West of the State became the seventh fatality in three years which has prompted the Government to take a more proactive approach to mitigation of shark attacks. In addition to the shark hazard mitigation strategies outlined above, the Government is now proposing an additional strategy (Strategy) for public safety purposes which includes Marine Monitored Areas (MMA) in the metropolitan and south west regions within which drum lines will be deployed at specified beaches to catch specified large sharks and a rapid response deployment where large sharks that have been identified as a threat will be targeted.

Proposed Strategy

The Strategy will involve deploying up to 36 baited drum lines in coastal waters about one kilometre off specified beaches in both of the MMAs (a total of 72). It is understood that the contractors will bait, maintain and patrol the drum lines from 0600 hours to 1800 hours, 7 days per week from a commencement date in January 2014 through to 30 April 2014. Where the baited drum lines capture white, tiger or bull sharks greater than three metres in length, the contractor is to humanely destroy the shark using a firearm. The deceased shark is to then be tagged and removed to a specified distance offshore and discarded. If the baited drum lines catch any other animals, and if they are not in a condition to survive, the contractor is to humanely destroy, tag and discard the animal.

Risk Mitigation

The use of drum lines to capture sharks is only designed to have a localised impact on the relative number of individuals of the targeted species (white sharks, tiger sharks and bull sharks) within the MMAs, not significantly affect total population size. It is recognised that the use of drum lines is likely to capture species other than the target shark species therefore to mitigate against the risks associated with the potential bycatch of, in particular, dolphins, sea lions, marine turtles, and grey nurse sharks, the following is proposed-

- Drum line contractors will be required to maintain detailed records of all catches and provide this information to relevant authorities for assessment purposes.
- Appropriate gear will be used, including significantly large hooks that limit the types and sizes of non-targeted individuals likely to be captured.

1

- Daily monitoring and maintenance of drum lines from 6.00am to 6.00pm to ensure any species that may be unintentionally caught are freed and released as soon as possible.
- Aerial and land patrols of beaches at which drum lines will be deployed, so that the drum line contractor can be notified of any animals that may be in distress.
- The drum line program is controlled and limited in its operation, ceasing at the end of April 2014.
- The drum line program will be assessed throughout and after its operation by relevant stakeholders, including technical experts from the Department of Fisheries and the Department of Parks and Wildlife (DPaW).

Summary of Assessments

Standard risk assessment protocols (ISO 31000, 2009) were used to complete risk analyses associated with the proposed Strategy for each of the targeted species and the expected suite of non-target species that may interact with the drum line gear. These assessments only considered the likelihoods of different levels of impact based on the current proposal starting in January 2014 and ending in April 2014. It was not an assessment of the risks that would be associated with a continuing/ongoing program- a separate assessment would have to be completed for this situation.

The use of drum lines to capture sharks is designed to have a localised impact on the relative number of individuals of the targeted species within the MMAs, the killing of a few isolated individuals of the target species over a short period of time is therefore unlikely to generate even a measurable effect on these species at a population level. Hence for these species the proposed strategy poses a negligible risk

Given the mitigation strategies outlined, the strategy poses negligible risks to most other non-targeted species and the broader ecosystem. The only non-targeted species for which there was some immediate concern was dusky whalers for which their recovery program is designed around having minimal impacts on larger individuals. Depending upon the level of capture of this species and what proportion is released alive, the broader assessment of their status may need to be revisited, the results of which may have implications for the commercial fisheries that operate on this species.

Detailed Assessments of Ecological Risks from Proposed Strategy

Methodology

The assessment of risks associated with the proposed Strategy were undertaken in the context that they will form part of the determination of whether exemptions should be granted for this to occur during the proposed period. In the context of assessing the risks of this proposed strategy, a "significant" impact would be one for which there was a reasonable likelihood that the level of impacts generated on any of these species would be such that these would

materially affect the longer term population dynamics at a whole of population level. It was also completed on the basis that the operations will be undertaken as outlined above and was therefore not an assessment of the risks associated with this same set of activities operating in perpetuity. We suggest that if this or a similar strategy is to be undertaken beyond this current proposal period, a further assessment of cumulative impacts is undertaken, and that this should incorporate relevant data collected during the current proposal period.

The calculation of risk was completed using standard risk assessment protocols as used by the Department (e.g. Jones & Fletcher, 2012) which are based on the ISO 31000 (2009) international standard protocols. We completed a risk analysis associated with the proposed strategy for each of the targeted species and the expected suite of non-target species that may interact with the drum line gear. The consequence and likelihood tables used are presented at the end of this paper.

The key information (the key references consulted are provided at the end of this paper) used to generate the risk scores included:

- the rates of capture of these species recorded in drum line programs in south east Qld and other locations
- the rates of capture using similar equipment in WA for tagging purposes
- research survey information for the lower south west region
- commercial catch and catch rate information for relevant WA fisheries
- relevant stock assessment information as presented within the annual Status Reports of the Fisheries and Aquatic Resources in Western Australia and previously in Fisheries Research Reports.
- relevant biological and behavioural information on these species
- other relevant information on these species and methods including the 2012 review by McPhee and the 2012 correlation study completed by the Department.

Assessment of Risks to Targeted Species

White Sharks

The use of drum lines to capture sharks is designed to have a localised impact on the relative number of individuals of this and other targeted species within the MMAs, it is not designed to generate a significant reduction in overall population numbers.

Based on the low rates of capture of white sharks during the targeted fishing operations that have been completed off WA in the past few years (designed to enable tagging of these sharks), plus the low catch rates of white sharks obtained in drum lines programs off Qld, the number of white sharks expected to be caught by this program by April 2014, especially those in the target size range (>3m) is likely to be less than 10. Current research on the population size of the western population of white sharks in Australia (west of Bass Strait) suggests that this is in the order of few to several thousand. It is possible it has been

increasing over the past decade or more given the rate of attacks per population through this period has been increasing. Consequently, even if the total number of white sharks killed in this program up to the end of April is in the order of 10 to 20 then this is still likely to have only a negligible impact on the total stock size of this population of white sharks. Such a level would therefore be unlikely to even be measurable against background variations. This represents a negligible risk.

Tiger Sharks

Given the geographic location of the MMAs is at the southern end of the distribution of this tropical species, the catch rates are likely to be lower than obtained off Qld. However, despite this, the catch rates for this species off WA are still expected to be higher than would be obtained for white sharks. Most of these are likely to be less than three metres and hence many may be released alive. Therefore the number of tiger sharks expected to be killed in this program may only be in the order of 10-20 which would again be considered to have an insignificant impact on this population. Given the broad northern geographic extent of this species and the lack of commercial fishing that now occurs in most areas of northern WA where they are mostly located, the number that could be caught before a measurable change in their total population would occur is likely to be in the order of 100s. Consequently, it is unlikely that this would even have a measurable impact making the proposed strategy a negligible risk to this species.

Bull sharks

This species most commonly occurs in nearshore and estuarine waters. In south west Australia it predominantly occurs in the Swan and Canning rivers. Given the offshore location of the drum line program the number expected to be caught in this program is very low. Therefore there is only a remote likelihood that this strategy will have any impact on this species making this a negligible risk.

Assessment of Risks to non- targeted species and the broader ecosystem

Other Elasmobranchs (sharks and rays)

The majority of sharks likely to be captured in this program are expected to be of non-targeted species. Some of these non-target species (dusky and sandbar sharks) are part of dedicated commercial fishery management recovery programs, especially the larger individuals of these species.

For sandbar sharks, the current acceptable catch of large individuals by the Northern Shark fishery (in addition to the catch of juveniles by the temperate fishery) was 20 t annually. This would equate to several hundred individuals. As the northern shark fishery has not operated in the past five years, the capture of sandbar sharks by the drum line program is not likely to have an unacceptable impact on this recovery program. This represents a low risk

For dusky sharks, the recovery program which has been successful in generating significant recovery over the past decade assumes minimal capture of large individuals. Therefore, if a

significant number of large dusky sharks were captured and killed this could affect the rate of their recovery and represents the highest potential risk for this drum line program. If the numbers killed through this program exceeds 30 then a reassessment of the stock assessment and potentially the management arrangements for the commercial fishery would need to be undertaken. Such an outcome within the time period of the proposal is unlikely therefore it assessed as a low- moderate risk.

Teleosts (Demersal scalefish)

The design of the gear makes it highly unlikely that any of the main demersal scalefish species will be caught in the proposed WA program. Only two teleosts have been captured in the Qld drum line program used in SE Qld. This therefore represents a negligible risk

Other Protected species

Grey Nurse

Unlike other regions, Grey Nurse Sharks have never been subjected to targeted fishing (commercial or recreational) in Western Australia (WA). The only significant source of mortality has been from incidental capture. Catch and catch rate data from the demersal gillnet fishery, prior to their listing, indicates that Grey Nurse Sharks were relatively abundant in temperate WA waters in the mid-late 1990s and that the population was stable. In addition, the expected number of captures of this species is low and their survival prior to release should be high given their biological characteristics. The risk to this stock from this proposal is therefore negligible.

Seals/Sealions

There are no records of these species having been captured on large hooks off WA. Therefore there is only remote likelihood that any individual pinniped will become captured as part of this program and therefore it is a negligible risk.

Turtles

The distribution of turtles means that they are not common in the target region of WA. This means that individuals of most turtle species are highly unlikely to even interact with the drum lines. Furthermore, as the lines are monitoring frequently, based on Qld data there is a high likelihood of successfully releasing alive any turtles that are captured. The proposal therefore represents a negligible risk.

Whales

The Strategy period occurs outside the typical migration and breeding seasons for the pygmy blue whale, Antarctic blue whale, southern right whale and humpback whale minimising likelihood of entanglement in drum line ropes. In addition the positioning of these lines will be inshore of where the majority of movements occur. Should entanglement of one of these species occur, DPaW has expertise in disentanglement procedures. Furthermore these whale

populations are no longer in threatened status hence from an ecological perspective the risks generated by any entanglement even if it occurs would be negligible.

Dolphins

Given size of the hooks used it is highly unlikely that any dolphins can be captured by this gear. They are reported as scavenging off the hooks in Qld but very few have actually been captured in 20 years of drum line operations and all were released alive. Therefore this short term program poses a negligible risk.

Ecological Effects

Given the short time period of this program, the small footprint of the operation compared to the distribution of the species, and relative numbers of individuals that may be captured compared to the total stock sizes of the affected species, this program would not have any measurable effect on broader ecosystem functioning representing a negligible risk

Advice

The potential risks to targeted and non-targeted species arising from implementation of the set of activities listed within the proposed Marine Monitored Areas strategy were assessed using standard ISO 31000 based, risk analysis procedures based on the information currently available.

The strategy as proposed, was assessed as posing only negligible risks to the three targeted species, most of the non-targeted species and the broader ecosystem. Dusky whaler was the only species identified potentially requiring additional management interventions resulting from this strategy, but this is unlikely.

A significant factor in determining these risk levels was the set of risk mitigation procedures that have been proposed, especially the short duration of the proposed activities (January – April 2014) plus the limited geographic extent of their operation compared to the broad distribution of most of the potentially affected species.

If this program, or a similar strategy was to continue beyond the current proposal period (Jan-April 2014) and/or be extended to other geographic areas, another risk assessment should be undertaken that also examines for the potential of cumulative impacts to be generated.

Dr Rick Fletcher
Executive Director Research
10 January 2014

RISK ASSESSMENT CATEGORIES AND LEVELS

LIKELIHOOD LEVELS

1. Remote -Never heard of but not impossible here. (<5% probability)
2. Unlikely - May occur here, but only in exceptional circumstances. (>5%)
3. Possible - Clear evidence to suggest this is possible in this situation. (>30%)
4. Likely - It is likely, but not certain, to occur here. (>50%)
5. Certain -It is almost certain to occur here (>90%)

CONSEQUENCE LEVELS

STOCKS (target and non-target)

1. Measurable but minor levels of depletion to stocks.
2. Maximum acceptable level of depletion of stock.
3. Level of depletion unacceptable but still not affecting recruitment levels of stock
4. Level of depletion of fish stocks are already (or will definitely) affect future recruitment potential/levels of stock.
5. Permanent or widespread and long term depletion of key fish stocks, close to extinction levels.

ECOSYSTEMS

1. Measurable but minor change in the environment or ecosystem structure but no measurable change to function
2. Maximum acceptable level of change in the environment/ecosytem structure with no material change in function.
3. Ecosystem function altered to an unacceptable level with some function or major components now missing &/or new species are prevalent.
4. Long term, significant impact with an extreme change to both ecosystem structure and function. Different dynamics now occur with different species/groups now the major targets of capture or surveys.
5. Permanent or widespread long term damage to the environment. Total collapse or complete shift of ecosystem processes.

RISK LEVELS

Description	Risk Score (C x L)	Risk Level
Negligible	0 - 2	1
Low	3 - 6	2
Medium	7 - 10	3
High	11- 16	4
Severe	17 -25	5

KEY REFERENCES CONSULTED

Chidlow et al., (2006) Identification of Western Australian Grey Nurse Shark aggregation sites - Final Report to the Australian Government, Department of the Environment and Heritage, May 2006. *Fisheries Research Report* No. 155, Department of Fisheries, Western Australia, 48p.

Department of Fisheries (2012) A correlation study of the potential risk factors associated with white shark attacks in Western Australian waters. *Fisheries Occasional Paper* 109. Department of Fisheries, WA.

Department of Fisheries (2013) State of the Fisheries and Aquatic Resources of Western Australia 2012/13.

Dudley, SFJ (1997). A comparison of the shark control programs of New South South Wales and Queensland (Australia) and KwaZulu-Natal (South Africa). *Ocean Coastal Management* 34;1-27

Jones, J.B. and W.J. Fletcher (2012) Assessment of the risk associated with the release of abalone sourced from abalone hatcheries for enhancement or marine grow-out in the open ocean areas of WA. *Fisheries Research Report No. 227, Department of Fisheries, Western Australia 20pp*

McAuley, R. and Simpfendorfer C. (2003). Catch composition of the Western Australian temperate demersal gillnet and demersal longline fisheries, 1994 to 1999, *Fisheries Research Report* No. 146, Department of Fisheries, Western Australia, 78 pp.

McAuley, et al. (2005) Biology and stock assessment of the thickskin (sandbar) shark, *Carcharhinus plumbeus*, in Western Australia and further refinement of the dusky shark, *Carcharhinus obscurus*, stock assessment, Final FRDC Report – Project 2000/134, *Fisheries Research Report* No. 151, Department of Fisheries, Western Australia, 132p.

McPhee, D (2012). Likely effectiveness of netting or other capture programs as a shark hazard mitigation strategy in Western Australia. *Fisheries Occasional Paper* 108. Department of Fisheries, WA.

Sumpton et al., (2011) Gear selectivity of large-mesh nets and drumlines used to catch sharks in the Queensland Shark Control Program. *African Journal Marine Science*. 33:37-43

Government of Western Australia
Department of Fisheries

Fish for the future

Mr Kim Taylor
General Manager
Office of the Environmental Protection Authority
Locked Bag 10 East Perth, **WA 6892**

Your Ref -AC01-2014-004
Our Ref- 2475/13; R103147

Cc Mr Stuart Smith

RE: SHARK DRUM LINE DEPLOYMENT, MANAGEMENT AND ASSOCIATED SERVICES

In relation to your enquiry regarding the risk status to tiger sharks from this program, I can confirm that DoF considers the current strategy is still unlikely to have a measurable impact on the total tiger shark population in WA and therefore still represents a negligible risk.

Tiger sharks are a relatively abundant, tropical and subtropical shark species with a geographic distribution that extends from the west coast of WA over the northern half of Australia to NSW. Within much of its range in WA, this species is subjected to only minor levels of exploitation. There is minimal retained catch by commercial fishing because their flesh is not marketable so they are not targeted. Furthermore their inadvertent capture is also low in WA because of a prohibition on the use of commercial shark fishing gear off large areas of the north-west coast since 1993, a cessation of commercial shark fishing in northern WA in 2008 and statewide restrictions on the retention of shark catches for commercial purposes. Similarly their level of recreational capture is very low due to current regulations.

In summary, the combination of (1) the extremely small footprint of the drumline activities relative to the total distribution of this species in WA; (2) the very short term nature of the program; (3) the total mortalities for the program still likely to be within the types of magnitude outlined within the original risk assessment; (4) the minimal levels of mortality in other areas of WA - are all consistent with this current program still only posing a negligible risk to the tiger shark population of WA.

As presented in the original assessment, if drumlining activities are to continue beyond the current program, a further review of all risks (including those to tiger sharks) should be completed to assess the potential for cumulative impacts. Such a review would utilise the data collected during the current drumline program.

Yours sincerely

Dr Rick Fletcher
EXECUTIVE DIRECTOR – RESEARCH
28 February 2014

Western Australian Fisheries and Marine Research Laboratories, PO Box 20, North Beach, Western Australia 6920
Telephone +61 8 9203 0111 Facsimile +61 8 9203 0199 Website http://www.fish.wa.gov.au
Location: 39 Northside Drive, Hillarys Boat Harbour, Western Australia 6025. ABN 55 689 794 771

30. Advice on the Proposed Shark Mitigation Strategy using drum lines for the period November 2014 - April 2017

Department of Fisheries, Research Division - April 2014

File No 2475/13

Background

In direct response to the unprecedented number of shark related fatalities that occurred in WA over the past several years, starting in 2008 the WA Government funded a number of initiatives in order to mitigate the risks of further bites and fatalities including a series of research programs, enhancements to the level of shark monitoring and aerial patrols. In November 2013, a surfer in the south west of the State became the seventh fatality in just over three years, which prompted the Government to take a more proactive approach to mitigation of shark attacks. The Government therefore proposed, in combination with the extensive shark hazard mitigation strategies already in place, use of an additional direct action strategy (Strategy) for public safety purposes. This proposal involved fishing for large sharks using large-hook drum lines within two Marine Monitored areas (MMAs) located off the metropolitan and south west regions (see Map Figure 1). Within these two MMAs, large (300cm Total Length or greater) white sharks, tiger sharks and bull sharks will be targeted by (i) drum lines being routinely deployed at specified beaches and (ii) vessels will rapidly respond by deploying some of the available drum lines in instances where large sharks have been identified as a threat within these areas.

After obtaining necessary State and Commonwealth approvals, an initial deployment of up to 36 baited drum lines in each MMA began in early January 2014 and will cease on 30 April 2014. It is proposed that a similar program will be undertaken for three years beginning in November 2014 after which a major review will be completed.

Proposed strategy

The proposed Strategy will still involve deploying only up to 36 baited drum lines in coastal waters about one kilometre off specified beaches in each of the MMAs. This number will cover both (i) routine deployment and (ii) rapid response (maximum number of drum lines for the Strategy is 72). Contractors will be required to bait, maintain and patrol the drum lines between 0600 hours to 1800 hours, 7 days per week over a three year period from 15 November through to 30 April each year, commencing 2014.

White, tiger or bull sharks 300 cm Total Length (TL) or greater captured on these drum lines will be destroyed by the contractor using a firearm. Any other captured animals that are not in a condition to survive will also be destroyed. Deceased sharks (whether destroyed or killed by their capture) will be fitted with uniquely-identified disposal tags and removed to a specified distance offshore and discarded or, where practical, retained for scientific study.
Captured animals that are considered to have a chance of survival will be released as swiftly and carefully as possible. As long as it will not reasonably compromise their chances of survival, released sharks may be tagged with conventional fin tags and genetic samples will also be taken. Provision will also be made for some electronic tagging if such tagging is determined to be scientifically beneficial and to not compromise sharks' survival rates.

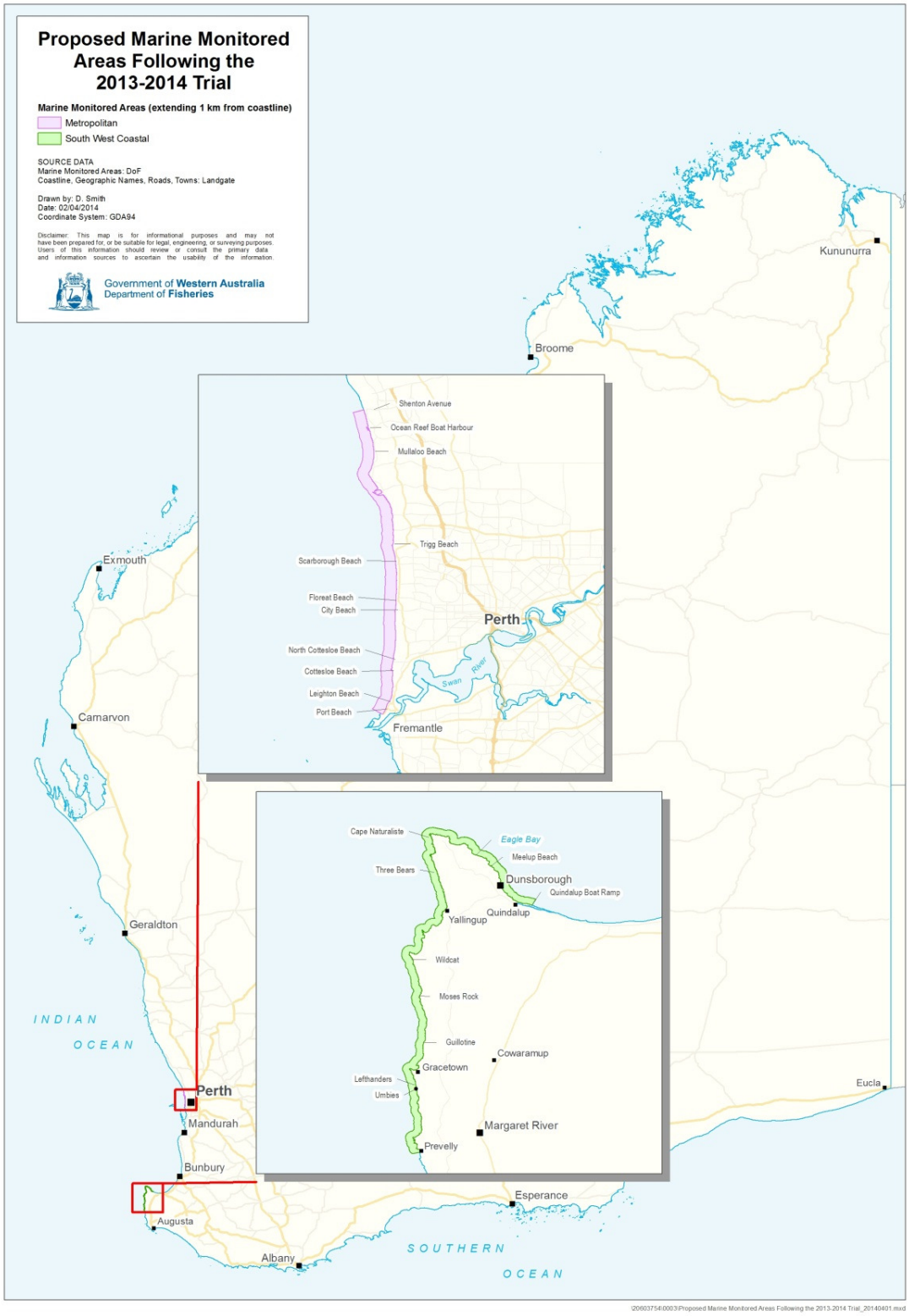


Figure 1. Map of Western Australia indicating the size and location of the two Marine Monitored Areas.

Risk mitigation

The Strategy is designed to reduce the risk of human-shark interactions within defined and limited MMAs and not to alter the status or recovery of any shark stock. The use of a limited number of drum lines to capture sharks within the MMAs is therefore designed to only have a localised impact on the abundance of large individuals of specified shark species (white, tiger and bull sharks 300 cm TL or greater) within these MMAs, not to significantly affect the total population size of these species. Based on the experiences in other locations, it is recognised that the use of drum lines can capture species other than the target sharks. To minimise the risks associated with the potential capture of non-target species, specifically dolphins, sea lions, turtles and non-target sharks, the following is proposed.

The likelihood capture and/or mortality of non-target species is reduced by-

- The gear used includes significantly larger hooks than used elsewhere in the world for this purpose, with a hook design that has a closed gape. These two features should substantially limit the types and sizes of non-targeted individuals likely to be captured. This gear configuration has already proven highly effective in limiting the number of non-target, bycatch species that have been captured so far in the current (January – April 2014) WA program compared to other drum line and netting programs. Importantly, only one non-shark individual has been captured to date.

- Daily monitoring and maintenance of drum lines between 0600 hours to 1800 hours to ensure any species or small (< 300 cm TL) target species that may be unintentionally caught are freed and released as soon as possible

- Aerial and land patrols operate at most of the beaches where the drum lines will be deployed, so that the drum line contractor can be notified of any captures.

- The drum line program will be limited in its area (two MMAs) and time of operation (5.5 months per year).

The risks associated with any impacts of capture and/or mortality of non-target species are also minimised because they will be closely monitored to ensure that the rates and composition of capture are consistent with those expected and used in determining the risk evaluations. This will include:

- The program is proposed to operate for only three years after which a review will be undertaken.

- Drum line contractors will be required to maintain detailed records of all catches and provide this information to relevant authorities for assessment purposes.

- The drum line program will continue to be assessed throughout and after its operation by relevant technical experts from the Department of Fisheries and, where necessary, the Department of Parks and Wildlife (DPaW).

- The range or levels of acceptable catch will be developed for each of the target species and other potential bycatch species. The actual numbers will be examined against these ranges each year to ensure that the risks levels have not materially altered.

- If a major change in the rate of captures for any species occurs within a season, an additional review can be undertaken prior to the standard annual review.

Summary of assessments

Using international standard (ISO 31000, 2009) risk analysis methods, assessments were completed for each of the targeted species and the potential suite of non-target species that may interact with the drum line gear associated with the proposed Strategy. These assessments consider the likelihoods of different levels of impact on the population size of each of the species based on the current proposal for the Strategy of a three year program running from 15 November to 30 April each year starting in November 2014.

The use of drum lines to capture sharks is designed to only have a localised impact on the relative number of individuals of the targeted species within each of the MMAs. The killing of relatively small numbers of each target species over a short period of time is therefore unlikely to generate even a measurable effect on these species at a population level given their large distributions. Consequently for these species the proposed strategy poses a negligible risk.

Only the tiger shark (*Galeocerdo cuvier*) has been captured in sufficient numbers during the initial program (January – March 2014) to require a more detailed analysis than presented in the initial risk assessment (DOF, 2014). This includes comparing expected annual drum line catches with historical State-wide catch levels plus documentation of the current set of extensive shark fishing restrictions in place across much of its distribution in WA.

There were concerns prior to the program becoming operational that the dusky shark (*Carcharhinus obscurus*) recovery program that includes strategies to minimise mortality rates of individuals older than 10 years of age may have been affected by the drum line program. To date only one dusky shark has been captured. The magnitude of the catch of this species has so far posed a negligible threat to the sustainability of this commercially-important stock. If the catches increase to material levels there is the option to adjust the management of the commercial fisheries that operate on this species.

Assessments of ecological risks from proposed strategy

Methodology

Ecological risk assessments have been undertaken to assist in determining whether exemptions to relevant State and Commonwealth legislation should be granted for the proposed Strategy. In the context of assessing the risks of this proposed strategy, a "significant" impact would be one for which there was a reasonable likelihood that the number of individuals of a species that are captured and ultimately died from this program would materially affect the longer term sustainability and population dynamics at the whole of population level, or would affect the ecosystem at a regional level. It does not assess the risks associated with the social concerns about the capture of sharks.

The risk analyses assume that the activities will be undertaken in accordance with the terms outlined above between 15 November and 30 April each year for a three year term in the two MMAs and only with the specified number of drum lines (maximum of 72).

The calculation of risk levels was completed using standard risk assessment protocols (e.g. Jones & Fletcher, 2012), which are based on the ISO 31000 (2009) and AS:HB89 (2012) international standard protocols. A separate risk analysis was completed for each of the target species and the non-target species that may be caught by, or entangled in, the proposed drum line gear. The consequence and likelihood tables used are presented in Appendix 1.

The key information (see Appendix 2 for key references consulted) used to generate the risk scores included:

- the rates of capture of these species recorded in drum line programs in south east Qld and other locations
- the rates of capture using similar equipment in WA for tagging purposes
- research survey information for the lower south west region
- commercial catch and catch rate information for relevant WA fisheries
- relevant stock assessment information as presented within the annual State of Fisheries Aquatic Resources of WA and previously in Fisheries Research Reports.
- relevant biological and behavioural information on these species
- other relevant information on these species and methods including the 2012 review by McPhee and the 2012 correlation study completed by the Department.
- rates and composition of capture in the WA drum line program January- March 2014.

WA drum line catch (January to March 2014)

Catches in WA drum lines during the period January 25 – March 16 2014 have almost exclusively been comprised of tiger sharks (Figure 2).

Tiger Sharks: In total, 105 tiger sharks were caught (69% in the Metro region; 31% in the South west region). Of these, 11 (10%) were dead upon gear retrieval with a total of 61 tiger sharks released alive (58%) with the remainder destroyed, either because they were in a poor condition upon capture, or they were 300 cm TL or larger (Figure 3).

Most tiger sharks caught in the Metropolitan region were directly measured (TL in cm) but for some captures no size data is available. Where sharks were not brought on deck, markings on the side of the vessel were used to gauge lengths. Individual tiger sharks captured have ranged in size from 153 – 450 cm TL (mean size = 275 cm TL, SD = 63 cm, n = 88 tiger sharks) with a larger size range of tiger sharks captured in the Metropolitan region (Figure 4).

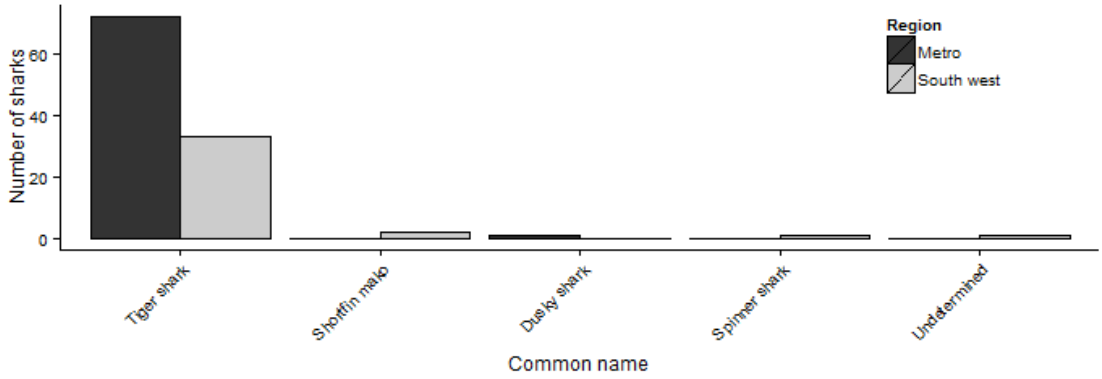


Figure 2. Shark catch (including those killed and released) from Western Australian drum lines deployed in the Metropolitan and South West regions from January 25 to March 16 2014

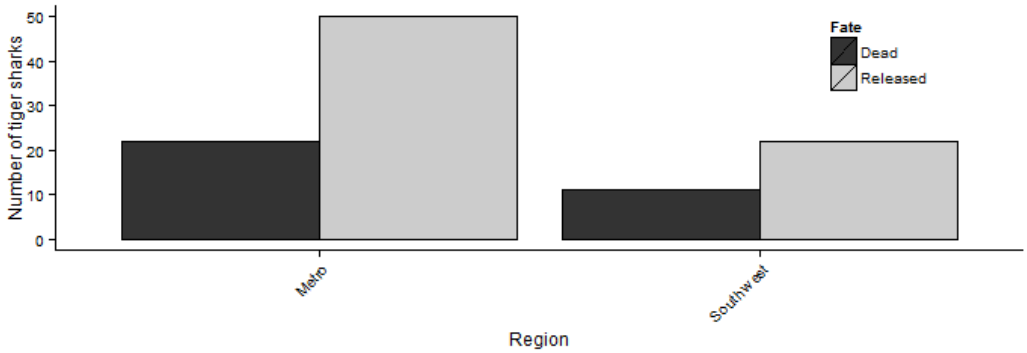


Figure 3. Fate of tiger sharks caught on Western Australian drum lines deployed in the Metropolitan and South west regions from January 25 to March 16 2014. Dead = animals dead upon gear retrieval and sharks that were destroyed

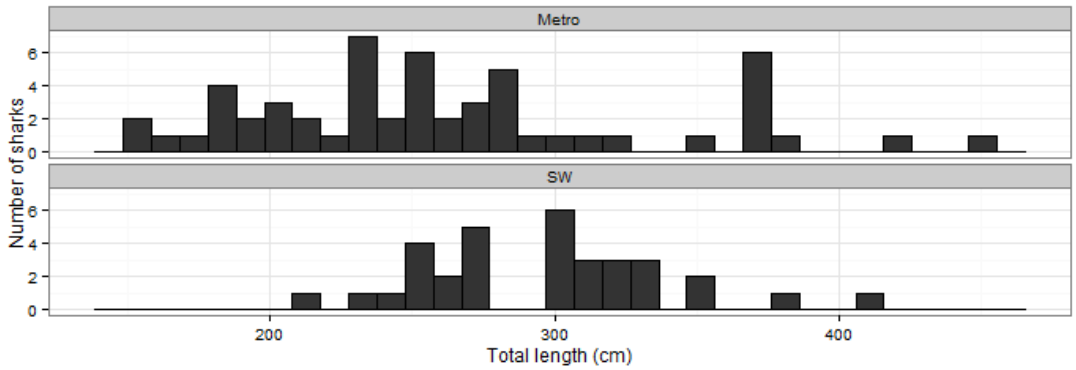


Figure 4. Total length (TL, in cm) of all tiger sharks caught in the Metropolitan and South west (SW) during January 25 to March 16 2014. N = 88 sharks because not all sharks were measured.

Based on length-weight conversions (Kohler et al. 1996) the estimated weight of tiger sharks killed in this program assuming 100% survival of released sharks would be approximately 7 tonnes. Given the very large hook size and that one electronically tagged shark appeared to die after release, the total mortality is likely to be higher. The maximum amount, even assuming no survival is estimated to be only 17 tonnes, the most likely figure will be somewhere in between.

Other Species: Few other species or individuals have been caught so far by the WA drum line program (Figure 2). These include one or two individuals of dusky shark, mako shark, spinner shark and only one non-shark – a single north-west blowfish (*Lagocephalus sceleratus*).

Comparison with shark control measures used elsewhere

Drum lines, long lines and gillnets have been used to target potentially dangerous sharks in other locations including Queensland, New South Wales, South Africa, Brazil and Hawaii (McPhee, 2012; Table 1). Direct comparisons between the operations of different shark control measures are complicated by a number of factors. These include differences in oceanographic conditions and therefore regional species composition, background abundance levels and movements of different shark species, histories of commercial fishing effort, fishery management and marine conservation measures plus differences in available data series and how long after initiation of the programs that the data were started to be collected. In addition, gear types, hooks sizes and bait types also vary among these programs.

In terms of the number of hooks used, the WA program is similar to the drum line program coordinated by the Natal Sharks Board in KwaZulu-Natal, South Africa but much smaller than the number used in the Queensland drum line program (Table 1). In WA, the hook size (shank length and hook diameter) is much larger than used elsewhere and the gape of the hooks has been closed compared to the standard J hooks. As was predicted in the initial risk assessment (DOF, 2014), the larger hook size and closed gape used in WA appears responsible for the very low numbers of non-shark bycatch species captured so far (only 1 north-west blowfish).

Similar to WA, tiger sharks form a major component of the Queensland drum line catch, and to a lesser extent the long line catch in Brazil and to an even lesser extent South Africa (Figure 5, Table 1). This pattern probably reflects differences in average water temperatures and the tropical/subtropical distribution of this species.

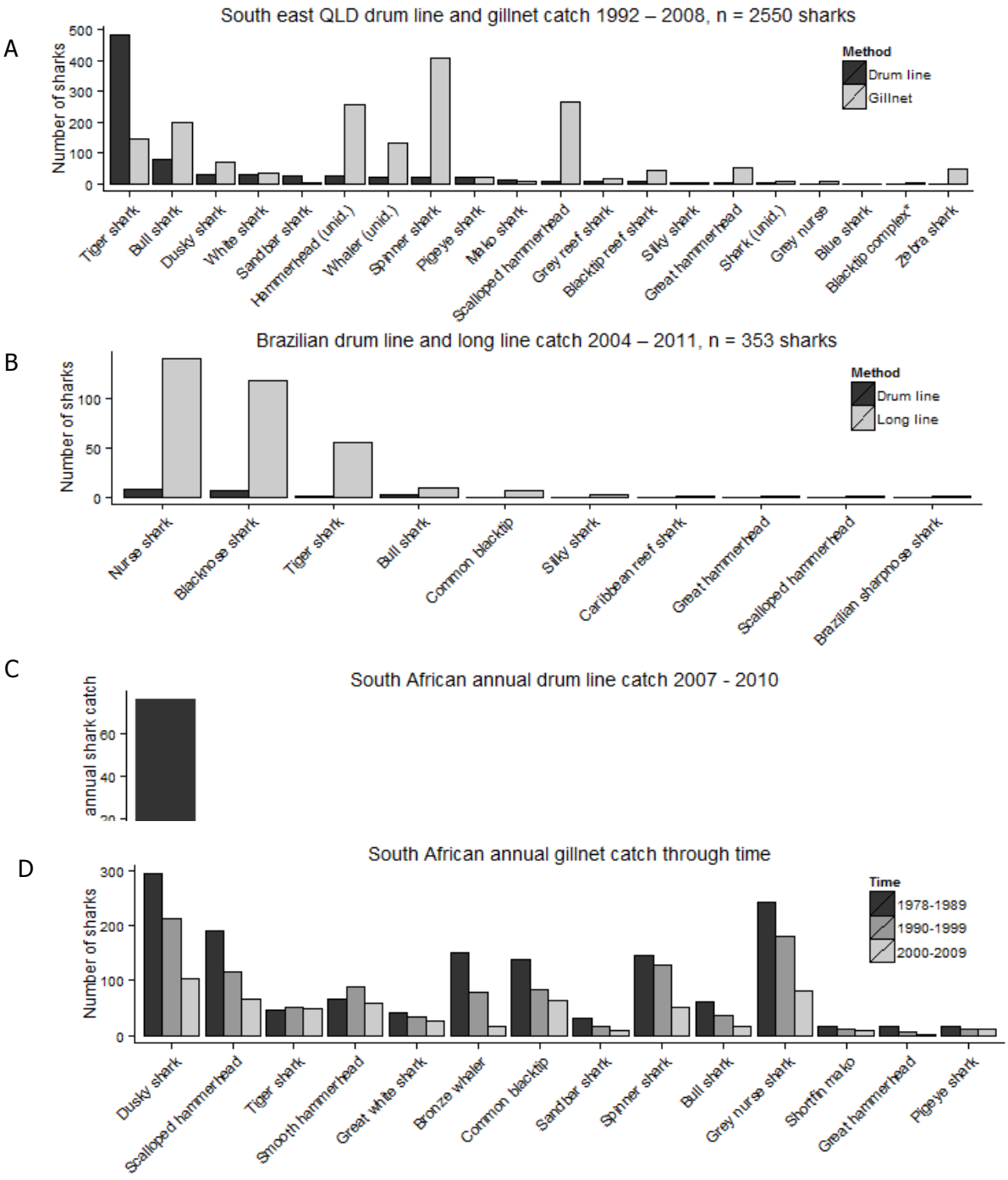


Figure 5. Shark catch from shark control measures in (A) south east Queensland, (B) Recife, Brazil, (C) KwaZulu-Natal (KZN) South Africa – drum line and (D) KZN – gillnets. Note that graph (C) and (D) shows the annual catch and not the total catch. * = less than one shark a year. Graphs reproduced from data presented in Cliff and Dudley (2011), Sumpton et al. (2011) and Hazin and Afonso (2013).

Table 1.Examples of shark control measures using drum lines, long lines or gillnets

Location	Time scale	Gear used	Fishing duration	Target species	Main shark species caught	Non-shark bycatch
Western Australia	January to April 2014	Drum lines - 72 hooks (25/0 Customised – Closed Gape – circle like) initially baited with Bonito, Mackerel and since with miscellaneous fish and elasmobranch heads and frames. Set approx. 1 km offshore.	24 hours a day. Hooks are baited or checked at least once a day.	White shark, tiger shark, bull shark Those less than 3m are released	Tiger shark	1 north-west blowfish (silver toadfish, *Lagocephalus sceleratus*).
Queensland [1]	Ongoing from 1962	Drum lines - 352 hooks (14/0 Mustad J design) baited with sea mullet and set in water 8 – 10 m depth. 35 hooks set off south east Queensland beaches. Hooks are checked 20 days a month. Gillnets – Approx. 35 surface large-mesh nets (186 m TL, 6 m drop, stretched mesh size of 50 cm) set in water 8 – 10 m depth.	24 hours a day. Hooks are baited and checked 20 days a month. 24 hours a day. Nets are checked 20 days a month.	Bull shark, tiger shark, white shark Most killed	Tiger shark, bull shark	Drum lines and Gillnets- Mostly loggerhead turtle (approx.10 per year at Gold Coast, Sunshine Coast and Rainbow Beach). Also small number of green turtle, leatherback turtle, common dolphin, bottlenose dolphin, white-spot eagle ray, *Manta* spp . and other rays.
New South Wales [2]	Ongoing from 1937	Gillnets – Bottom-set large-mesh nets used at 51 beaches (150 m TL, 6 m drop, stretched mesh size of 50 – 60 cm) set in water 10 – 12 m depth.	Soak time varies from 12 – 96 hours. Nets are set every weekend day and nine week days per month from September to April.	White shark, bull shark Most are found dead	Hammerhead shark, whaler shark (*Carcharhinus*. Spp), angel shark	Currently around 5 bottlenose dolphins a year.
South Africa [3]	Ongoing from 2005	Drum lines – 79 hooks (14/0 Mustad J design) baited with Southern Rover or Jacobever species. Gillnets – 23.4 km of netting used along a 320 km stretch of coast (most nets are 214 m long, 6.3 m deep and 300 – 500 m offshore).	24 hours a day (although hooks and nets are sometimes removed in winter during the 'sardine run'). Hooks and nets are checked daily from Monday – Friday.	Bull Shark, white Shark Alive sharks are towed as far offshore as possible, tagged and released.	Dusky Shark, scalloped hammerhead	Drum lines - Less than 10 animals a year consisting of *Manta* spp., loggerhead turtles, leatherback turtle, other turtles, long-beaked and common dolphins.
Brazil [4]	2004 to 2011	Drum lines – 23 lines with two different hook types and sizes (9/0 J-style and 17/0 circle) baited with Moray Eels or Oilfish. Long lines – Two lines (100 hooks per line, same hooks size and bait as drum lines).	Drum lines fished 24 hours a day and hooks baited and checked daily at dawn. Long line hooks had an average soak time of 15 hours.	Tiger Shark, bull shark Live animals were relocated, tagged and released.	Nurse Shark, Tiger Shark	Less than 100 teleosts a year (mostly Ariidae). Eight turtles Cheloniidae) in total.
Hawaii [5]	1959 to 1976	Long lines – various configurations with up to 100 hooks at any one time. Skipjack tuna was the main bait. Light long lines and hand lines were also fished sporadically between 18 – 118 m depth).	Not reported for each gear type.	Tiger Shark, Most were killed.	Sandbar Shark, Tiger Shark	None reported in the Wetherbee et al. 1994 publication.

1 = Sumpton et al. (2011); 2 = Reid et al. (2011); 3 = Cliff and Dudley (2011); 4 = Hazin and Afonso (2013); 5 = Wetherbee et al. (1994). Other drum line shark mitigation measures may have been deployed elsewhere. Note that the shank length and gape diameter of hooks varies among models making direct comparisons of hook size difficult.

Recent Brazilian shark hazard mitigation measures have focussed on relocating tiger sharks caught on long lines and drum lines away from popular beaches. This approach has coincided with a reduction in the number of shark bite incidents at local Recife beaches and, in theory, has the potential of a reduced impact on this stock. In South Africa attempts are made to tow dangerous sharks offshore, although the distance depends on sea conditions, condition of the shark and how secure the shark is noosed alongside the boat (Geremy Cliff *pers. comm*). The survival rate of transported sharks is not reported and may well be lower the further they are moved.

It is unlikely that such an approach would be appropriate for dealing with captured sharks in WA. Transporting large sharks the significant distance necessary to get them away from WA coastal waters would be logistically impractical and could lead to the mortality of sharks in transit. Moreover, from bather safety and public liability perspectives, determining acceptable release locations especially for potentially dangerous white sharks would be extremely challenging and would reduce the amount of time available for contractors to check other hooks and release non-target sharks.

Assessment of risks to targeted species

White sharks

The use of drum lines to capture sharks in WA is intended to have a localised impact on the relative number of individuals of this and other targeted species within the MMAs. It is not designed to generate a significant reduction in overall population numbers. The lack of any white shark captures in the initial 3 month period within the MMA locations is not surprising, it was predicted that few would be captured at this time of the year.

When the program operates between November and April, based on catch rates of white sharks in local west coast fisheries, tagging programs and drum line programs that operate on other white shark populations, fewer than 10 white sharks in the target size range (>3m) are expected to be caught each year very few of which would be sexually mature (> 4.5 m). This would lead to a likely cumulative catch of less than 25 white sharks (>3m) over the three year period and fewer than ten mature sharks (> 4.5m).

The level of annual catch would be consistent with the low annual catches of white sharks that have been sustained for decades through the drum line and netting programs off Queensland and NSW and much lower than the numbers (estimated to be > 50) previously caught each year as bycatch by commercial fishing prior to the major reductions in effort that occurred in the mid 1990's.

Estimating the current status and size of the western white shark population size (west of Bass Strait) has been difficult due to the lack of long term monitoring information. Recent research has focused on reconstructing the likely historical catch levels generated from all sources (including commercial and recreational fishing plus whaling) in combination with different life history scenarios and initial population sizes to generate potential fishing mortalities for the western white shark population based on available lines of evidence. These include the catch rates of white sharks by commercial fishers across periods before, during and after the highest levels of white shark captures occurred, trends in the rate of attacks per head of population over the past 20 years and encounter (observed) rates by abalone divers.

The most plausible scenarios of current compared to unexploited population size, fishing mortalities and life history characteristics suggest that the western Australian white shark population either did not decline significantly or if it did, it has "recovered" to at least stable levels since the reduction in fishing effort and mortality and their listing as protected species nearly two decades ago. The results of these analyses suggest that the size of this western population is therefore likely to be in the order

of at least a few to several thousand individuals[14]. As such, the expected very low level of annual and therefore cumulative mortality from drum lines over the next three years is highly likely to only have a negligible impact on the total size and ongoing dynamics of the western Australian population of white sharks.

Tiger sharks

Tiger sharks are a relatively abundant, tropical and subtropical shark species with a geographic distribution that extends from the west coast of WA over the northern half of Australia to southern NSW. The drum lines deployed for the WA Strategy are located at the southern end of their range on the west coast of Australia (Figure 5). This species is currently subjected to only minor levels of exploitation elsewhere along the WA coast.

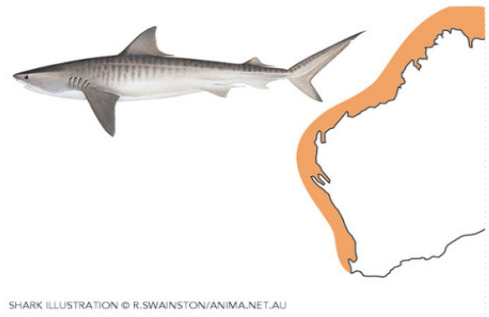


Figure 6. Distribution of the tiger shark in WA

Tiger sharks have only been fished at irregular intervals at a range of different locations mostly in the tropical (northern) part of their WA range. In the late 1980s tiger sharks were caught on drop lines in Shark Bay and during 1996 – 2006 plus significant catches of tiger sharks occurred on longlines in northern WA shark fisheries with a peak in annual catch of 81 tonnes in 2004 – 05 (Figure 6). Tiger shark landings in the West Coast Demersal Gillnet and Demersal Longline Fishery also reached 8 tonnes in 2005 – 2006 and small numbers of tiger sharks were also caught in the Eighty Mile Beach, the Kimberley Gillnet and Barramundi Fishery and the Pilbara Fish Trawl Fishery (Heupel and McAuley, 2007). The combined annual mortality based on these historical catches far exceeds the expected annual catch from the WA drum lines.

Currently there is minimal retained catch of tiger sharks by commercial fishing throughout WA because their flesh is not marketable so they are not targeted. Furthermore their inadvertent capture is also low in WA because of a prohibition on the use of commercial shark fishing gear off large areas of the north-west coast since 1993, plus a general prohibition on the use of metal trace wire and large hooks in November 2006 and a dramatic decrease in and cessation of commercial shark fishing effort in northern WA in 2005 and 2008/09, respectively and the closure to commercial shark fishing off the metropolitan coast in 2008. Furthermore, there are statewide restrictions on the retention of shark catches for commercial purposes. Similarly the level of legitimate recreational fishing mortality is very low due to current regulations and recreational fishing practices (Ryan et al. 2013). Therefore the annual catch of tiger sharks in the last eight years across WA has been minimal.

The stock status of tiger sharks in WA has not been formally assessed. Catch rate data for the northern shark fisheries revealed a decline from 0.20 kg hook^{-1} in 1998/1999 to 0.06 kg hook^{-1} in 2001/02. Significantly, the catch rate remained relatively stable from 2001/02 until the end of the time series (2004/05) which was the time period when the highest tiger shark catch levels were

[1] A report that outlines the plausible scenarios for the western white shark population will be available online in April/May 2014, followed by a more extensive report of the biology and potential impacts of fisheries on the white shark population.

occurring in this fishery (Figure 7, Heupel and McAuley, 2007) suggesting this level of capture may not have been affecting local abundance.

More recent catch rate data from a long term time series of annual fisheries-independent longline surveys (2001 – 2013) shows a steady increase in the catch rate for this species in the WA region north of 29^{o} (Figure 8). This survey is ongoing and will therefore continue to provide data on tiger sharks within this more central part of their distribution in WA.

In summary, the combination of (1) the extremely small footprint and southerly location (which is at the edge of their distribution) of the drum line activities relative to the total distribution of this species in WA; (2) the very short term nature of the proposed program – three years; (3) the likely annual rate of captures (the majority being released) are less than previously reported from historical commercial fishing activities (now ceased) and are similar to that captured by research surveys (all of which are released); (4) the minimal levels of mortality of this species generated by fisheries in other areas of WA; are all consistent with the proposed activities only posing a negligible risk to the WA population of tiger sharks.

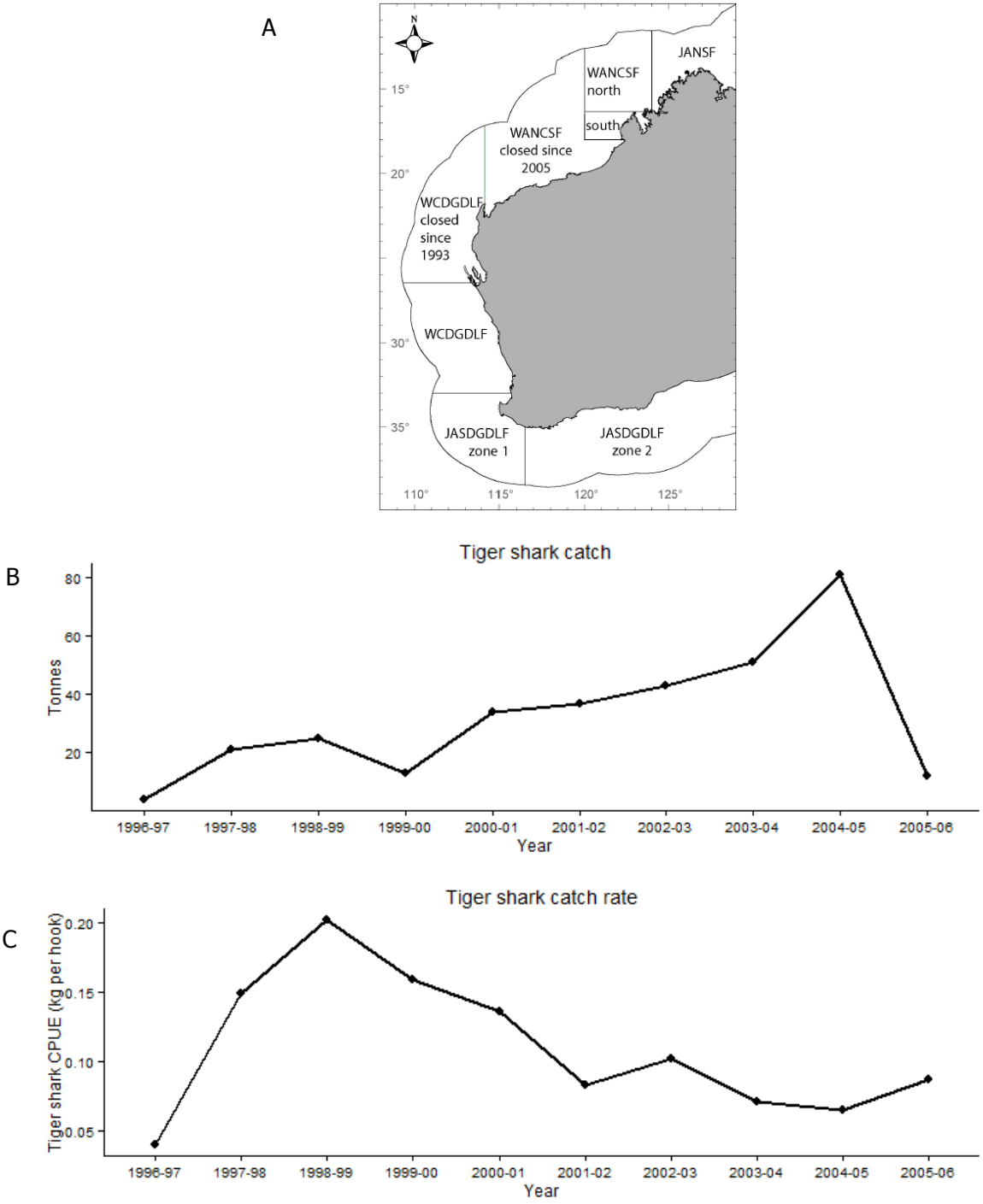


Figure 7 (A) Distribution of the Western Australian target shark fisheries (Map taken from Heupel and McAuley 2007). Note that the area off the metropolitan coast is now also closed to commercial shark fishing, (B) tiger shark catch in the northern shark fisheries (Western Australian North Coast Shark Fishery (WANCSF) and the Joint Authority Northern Shark Fishery (JANSF) and (c) tiger shark catch rate in the northern shark fisheries

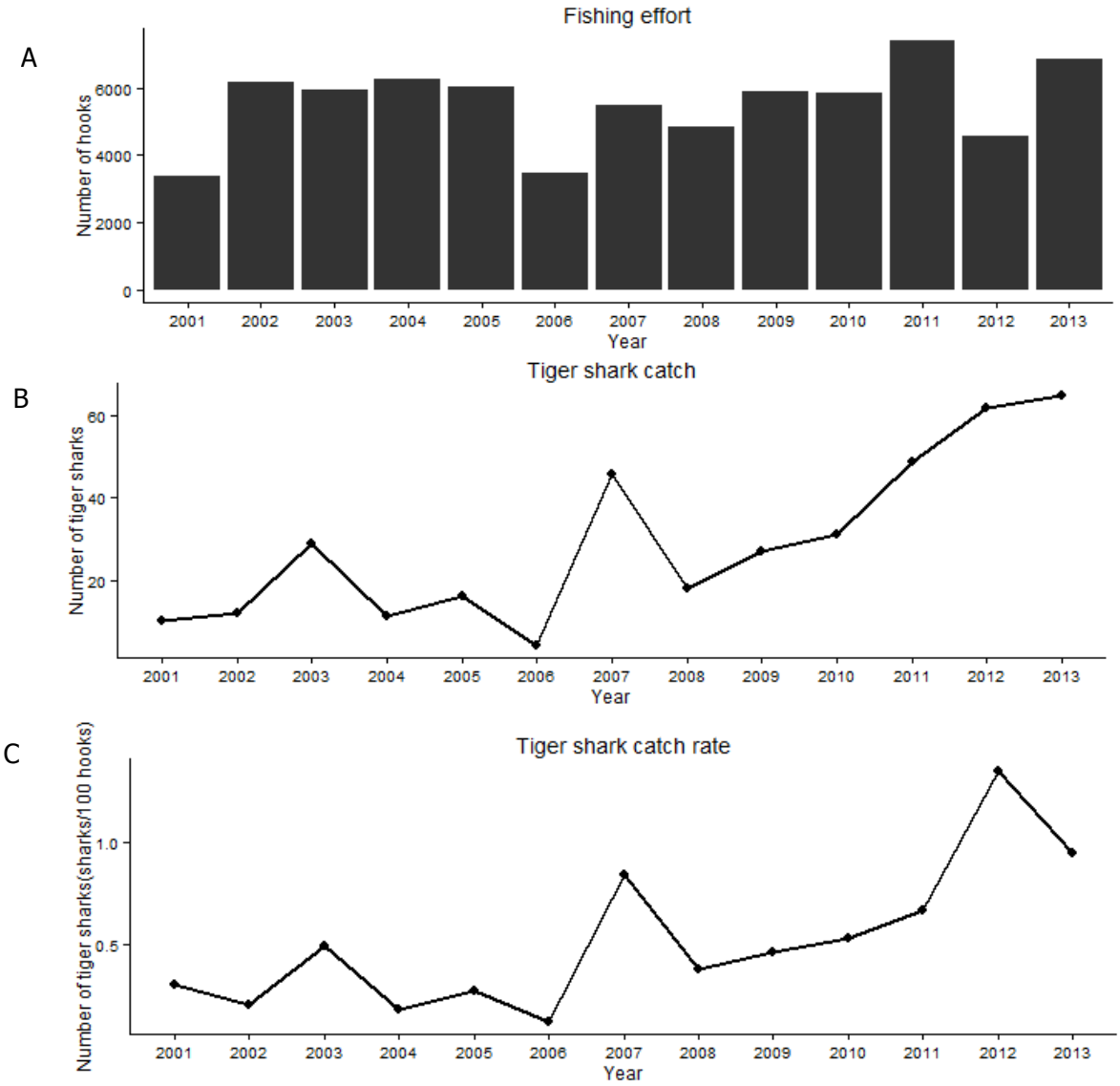


Figure 8 (A) Fishing effort (B) tiger shark catch and (C) tiger shark catch rate in a fisheries-independent survey of sharks north of 29°S latitude during 2001 – 2013

Bull sharks

All available data from more than 20 years of dedicated Department of Fisheries' shark research suggest that this species' distribution within the MMAs is largely confined to the Swan/Canning system. Given the apparent scarcity/absence of bull sharks in near-shore marine waters off south-western WA, the expected number of bull sharks that will be caught in this program is negligible. Therefore, there is a remote likelihood that this strategy will have any impact on this species' population, making the overall risk of this program impacting any bull shark population(s) occurring in the MMAs negligible.

Assessment of risks to non- targeted species and the broader ecosystem

Other elasmobranchs (sharks and rays)

One of the program's most important and economically valuable bycatch species is the dusky shark (*Carcharhinus obscurus*). The western Australian dusky shark stock supports significant commercial fisheries and is the subject of a well-designed and successful recovery plan.

For dusky sharks, the recovery program which has been successful in generating significant recovery over the past decade assumes minimal capture of large individuals. Therefore, if a significant number of large dusky sharks were killed (e.g. more than 30 individuals yr^{-1}) through the drum lie program, these activities could affect the rate of their recovery. If the numbers killed through this program begin to exceed 30 per year, a reassessment of management arrangements for the commercial fishery would need to be undertaken. Given the very low capture rate experienced in the program to date (only one), such an outcome occurring within the three year time period of the proposal is now unlikely. Therefore it is assessed as a low risk but with trigger limits to be established.

Demersal scalefish

The design of the gear (e.g. large hooks size) makes it highly unlikely that any of the main demersal scalefish species will be caught in the proposed WA program. Only two teleosts (both tuna, *Thunnus* spp.) were captured on drum lines in southeast Qld over a 16 year period and so far no demersal scalefish have been caught in WA drum lines. This therefore represents a negligible risk

Other Protected species

Grey Nurse

Unlike populations in eastern state regions, the population of Grey Nurse Sharks in WA have never been subjected to targeted fishing (commercial or recreational). Incidental catch and catch rate data from the demersal gillnet fishery, prior to their listing in the mid-late 1990s indicates that Grey Nurse Sharks were relatively abundant in temperate WA waters and that the population was stable (Cavanagh et al., 2003; Chidlow, et al . 2006). In addition, the number of captures of this species is expected to be very low and their survival prior to release should be high given their ability to buccally ventilate and maintain neutral buoyancy. So far, none of these sharks have been caught in the WA program supporting the initial assessment that the risk to this population is negligible.

Seals/Sealions

There are no records of these species having been captured on large hooks off WA and none have been captured in the program to date. The size and design of the hooks make it a remote likelihood that any individual pinniped will become captured as part of this program and therefore the program poses a negligible risk.

Turtles

Turtles are not common in the more temperate like regions where the MMAs are located. Individuals of most turtle species are therefore highly unlikely to be in the vicinity of the MMAs and therefore even interact with the drum lines. The size and circle like design of the hooks make it a remote likelihood that any turtle will be captured on the drum lines. Furthermore, as the lines are monitored frequently, there is a likelihood of successfully releasing alive any turtles that are captured or entangled in the lines. The proposal therefore represents a negligible risk

Whales

The time period (November–April) occurs outside the typical migration and breeding seasons for the whale species that migrate along the WA coast reducing the likelihood of encountering drum line ropes. In addition, the positioning of these lines will be inshore of where the majority of movements occur plus the use of single floats reduces the likelihood of entanglements if they are encountered. Although a small number of whales have become entangled in gillnets in south east Queensland (26 in 16 years) no whale entanglements have occurred on Queensland's drum lines. Should entanglement of one of these species occur, DPaW has considerable expertise in disentanglement procedures. Furthermore these whale populations are generally considered to have recovered significantly from their previously threatened status, consequently from a stock sustainability perspective even in the extremely remote likelihood that an entanglement occurs and causes a death, this would still represent a negligible risk to the stock (see also Stoklosa, 2013).

Dolphins

Given the size and shape of the hooks used, it is highly unlikely that dolphins will be captured by this gear. Dolphins are reported as scavenging off the hooks used in Queensland but even though their J shaped hooks are more likely to enable dolphins to be caught, very few have actually been captured in 16 years of drum line operations and all were released alive. Therefore, the WA program poses a negligible risk to any dolphin species or population that may overlap with these MMAs.

Ecological Effects

Collectively, the program will only operate for a short time period in each of just three years. The footprint of the operation is extremely small compared to the distribution of the species most likely to be directly affected with relatively small numbers of individuals likely to be captured and even less killed compared to their total stock size. The program will therefore generate only negligible impacts on each of the affected species. Consequently it is not plausible that these negligible impacts would generate a measurable impact on the broader Leeuwin-Naturalitse meso-scale ecosystem (IMCRA, 2006) which covers the all the continental shelf waters in this area of West Coast Bioregion, including Commonwealth marine waters. Consequently, the removal of only several tonnes of a common species of shark per annum from two small areas of the West Coast bioregion by this program would not have any measurable effect on the functioning of the broader marine ecosystems within this bioregion and therefore represents a negligible risk.

Advice

The potential risks to targeted and non-targeted species arising from implementation of the set of activities listed within the proposed Marine Monitored Areas strategy were assessed using international standards (ISO 31000, 2009) based, risk analysis procedures using the information currently available.

The strategy as proposed was assessed as posing only negligible risks to the three targeted species, most of the non-targeted species and the broader ecosystem. The potential catch of dusky sharks (*Carcharhinus obscurus*) which was previously identified as an issue that may require additional management interventions (DoF 2014), but the magnitude of catches that would require this intervention has not been realised (only one caught to date).

A significant factor in determining these risk levels was the set of risk mitigation procedures that have been proposed, especially the short duration of the proposed activities (15 November – 30 April) for just three years, plus the very limited geographic extent of their operation compared to the broad

distribution of the potentially affected species and the gear configuration (including hook size and design) which has demonstrably kept the level of bycatch species to a minimum, especially non sharks species.

If this program, or a similar strategy was to continue beyond the current three year proposal period (2017) and/or be extended to other geographic areas, another risk assessment should be undertaken that examines potential cumulative impacts.

It is also recommended that annual reviews are undertaken. Furthermore if the rates of capture begin to materially exceed those outlined above, a within season review would also be warranted. Appropriate trigger levels will be established to meet this requirement.

Dr Rick Fletcher
Executive Director Research
3 April 2014

Appendix 1 - RISK ASSESSMENT CATEGORIES AND LEVELS

LIKELIHOOD LEVELS

1. Remote - Never heard of but not impossible here. (<5% probability)
2. Unlikely - May occur here, but only in exceptional circumstances. (>5%)
3. Possible - Clear evidence to suggest this is possible in this situation. (>30%)
4. Likely - It is likely, but not certain, to occur here. (>50%)
5. Certain -It is almost certain to occur here (>90%)

CONSEQUENCE LEVELS

STOCKS (target and non-target)

0. No measurable decline
1. Measurable but minor levels of depletion to stocks.
2. Maximum acceptable level of depletion of stock.
3. Level of depletion unacceptable but still not affecting recruitment levels of stock
4. Level of depletion of fish stocks are already (or will definitely) affect future recruitment potential/levels of stock.
5. Permanent or widespread and long term depletion of key fish stocks, close to extinction levels.

ECOSYSTEMS

0. No Measurable change.
1. Measurable but minor change in the environment or ecosystem structure but no measurable change to function
2. Maximum acceptable level of change in the environment/ecosytem structure with no material change in function.
3. Ecosystem function altered to an unacceptable level with some function or major components now missing &/or new species are prevalent.
4. Long term, significant impact with an extreme change to both ecosystem structure and function. Different dynamics now occur with different species/groups now the major targets of capture or surveys.
5. Permanent or widespread long term damage to the environment. Total collapse or complete shift of ecosystem processes.

RISK LEVELS

Description	Risk Score (C x L)	Risk Level
Negligible	0 - 2	1
Low	3 - 6	2
Medium	7 - 10	3
High	11- 16	4
Severe	17 -25	5

Appendix 2 Key References consulted or cited.

Cavenagh et al., (2003) The conservation status of Australian chondrichthyans: report of the IUCN Shark Specialist Group Australia and Oceania Regional Red List Workshop, University of Queensland, Brisbane, p. 170.

Chidlow et al., (2006) Identification of Western Australian Grey Nurse Shark aggregation sites - Final Report to the Australian Government, Department of the Environment and Heritage, May 2006. *Fisheries Research Report* No. 155, Department of Fisheries, Western Australia, pp 48.

Cliff, G and Dudley, S. F. J. (2011). Reducing the environmental impact of shark-control programs: a case study from KwaZulu-Natal, South Africa. Marine and Freshwater Research 62: 700-709.

Department of Fisheries (2012) A correlation study of the potential risk factors associated with white shark attacks in Western Australian waters. *Fisheries Occasional Paper* 109. Department of Fisheries, WA.

Department of Fisheries (2013) State of the Fisheries and Aquatic Resources of Western Australia 2012/13.

Department of Fisheries (2014) Research Advice on the Proposed Shark Mitigation Strategy using drum lines for January to April 2014. Department of Fisheries, Western Australia, January 2014. Published on EPA website 12 February 2014. 8 pp.

Dudley, SFJ (1997). A comparison of the shark control programs of New South Wales and Queensland (Australia) and KwaZulu-Natal (South Africa). *Ocean Coastal Management* 34:1-27.

Hazin, F.H.Z. and Afonso, A.S. (2013). A green strategy for shark attack mitigation off Recife, Brazil. Animal Conservation. In press.

Heupel, M and McAuley, R. (2007). Sharks and rays (Chondrichthyans) in the North-west Marine Region. Final report to Department of the Environment and Water Resources, National Oceans Office Branch, 123 pp.

IMCRA (2006). A guide to the integratged marine and coastal regionalisation of Australia. V 4.0. www.environment.gov.au/coasts/mpb/publications/imcra/pubs/imcra4.pdf

ISO (2009) Risk management – principles and guidelines. 31000. International Organisation of Standards, Geneva. Switzerland 24pp.

Jones, J.B. and Fletcher, W.J. (2012) Assessment of the risk associated with the release of abalone sourced from abalone hatcheries for enhancement or marine grow-out in the open ocean areas of WA. *Fisheries Research Report* No. 227, Department of Fisheries, Western Australia 20pp.

Kohler, N et al. (1996) Length-length and length-weight relationships for 13 shark species from the Western North Atlantic. NOAA Technical Memorandum NMFS-NE-110, 29 pp.

Ryan, K et al. (2013). An integrated system to survey boat-based recreational fishing in Western Australia 2011/2012. *Fisheries Research Report* No. 249, Department of Fisheries, Western Australia, 162 pp.

McAuley, R. and Simpfendorfer C. (2003). Catch composition of the Western Australian temperate demersal gillnet and demersal longline fisheries, 1994 to 1999, *Fisheries Research Report* No. 146, Department of Fisheries, Western Australia, 78 pp.

McAuley, R et al. (2005) Biology and stock assessment of the thickskin (sandbar) shark, *Carcharhinus plumbeus*, in Western Australia and further refinement of the dusky shark, *Carcharhinus obscurus*, stock assessment, Final FRDC Report – Project 2000/134, *Fisheries Research Report* No. 151, Department of Fisheries, Western Australia, 132 pp.

McPhee, D (2012). Likely effectiveness of netting or other capture programs as a shark hazard mitigation strategy in Western Australia. *Fisheries Occasional Paper* 108. Department of Fisheries, WA.

Reid D. et al. (2011) Decadal trends in shark catches and effort from the New South Wales, Australia, shark meshing program 1950 – 2010. Marine and Freshwater Research 62: 676-693.

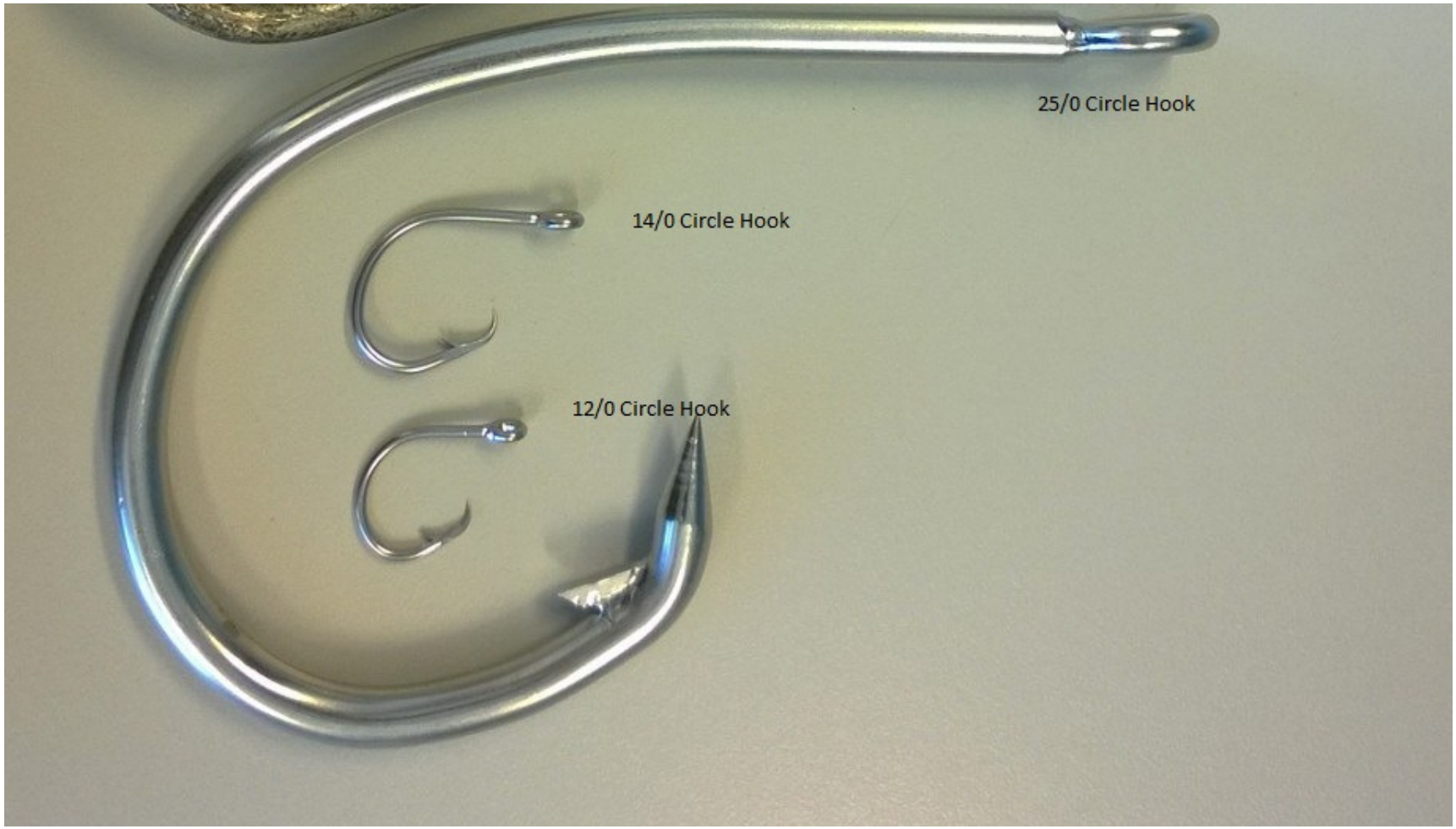
Standards Australia (2012) Risk Management – Guidelines on risk assessment techniques. HB 89. SIA Global International. 92pp.

Stoklosa R. 2013. West Coast Lobster Fishery Ecological Risk Assessment 20 February 2013. Fisheries Occasional Paper 118. Department of Fisheries, Western Australia. 99pp.

Sumpton, W. et al., (2011) Gear selectivity of large-mesh nets and drumlins used to catch sharks in the Queensland Shark Control Program. *African Journal Marine Science* 33:37-43.

Wetherbee et al., (1994) A review of shark control in Hawaii with recommendations for future research. *Pacific Science* 48, (2): 95-115.

31.



32.

Government of **Western Australia**

Shark Drum Line Deployment, Management and Associated Services

CONTRACTOR PROTOCOLS

START OF CONTRACT

The Contractor will meet with a team drawn from the following agencies in relation to roles and responsibilities:

1. Department of the Premier and Cabinet
2. Department of Fisheries
3. Department of Parks and Wildlife

The Contractor will be provided with an Operations Protocol pack which will include:

1. Scenario protocols
2. Contact Numbers
3. Maps of the MMA
4. A range of coordinates for drum line deployment
5. Security Information
6. Reporting Procedures
7. Meeting requirements
8. Communications

Drum Lines

1. The Contractor will be provided with 36 drum lines.
2. 30 drum lines will be deployed.
3. The remaining 6 drum lines will remain on the vessel at all times for incident or sighting response.

Security

The Contractor may meet with resistance from protestors.

The Contractor will have the necessary contact numbers for assistance.

In the event of the following the Contractor will call:

- Protestors swimming/boating around the drum lines – Department of Transport
- Protestor vandalising drum line – WA Police
- Protestor removing bait or marine animals from the drum line – Department of Fisheries

The Contractor is not to engage with protestors in any way.

DRUM LINE OPERATIONS

Target Species
Target species are white (*Carcharodon carcharias*), bull (*Carcharhinus leucas*) and tiger (*Galeocerdo cuvier*) sharks of 3m total length and greater.

Hours of operation
Hours of operation are between 6am and 6pm, seven days a week.

Daily requirements
1. Check drum lines throughout each day and re bait as required.
2. Complete final check of drum lines at the end of each day and re bait as required.
3. Ensure a minimum of 6 drum lines on board the vessel at all times.

Observers
1. Observers from agencies including, but not limited to, the following must be permitted onto the vessel at any time throughout the contract:
   a. Department of Parks and Wildlife
   b. Department of the Premier and Cabinet
   c. Department of Fisheries

By Catch, Non Target Shark Species, Or Target Species Under 3m In Length, On Drum Line

1. Identify catch on a drum line.
2. Manage marine animal depending on its condition -
   a. The animal is considered healthy and has a reasonable chance of survival - release as quickly as possible.
   b. The animal is dead – tag the animal and store on deck, cover securely for disposal. Photograph catch, with tag number clearly visible.
   c. The animal is considered to not have a reasonable chance of survival - destroy humanely, tag and store on deck, cover securely for disposal. Photograph catch, with tag number clearly visible.
3. If the animal is to be released, advise Operations Manager, who will advise relevant agencies if shark is being released near a SLSWA beach.
4. Complete log book.
5. Contact to be made with Operations Manager in relation to marine mammal and turtle by catch for DPaW.

Target Shark Species 3m Or Greater Caught On Drum Line

1. Target shark species 3m or greater identified on drum line.
2. Humanely destroy target species 3m or greater, if not already dead.
3. Bring animal on board the vessel and cover securely.
4. Check animal for internal and external research tags. Tag and photograph the animal and record in log book.
5. Drum line is rebaited and returned to its position.
6. Contact Contract Manager and Operations Manager to advise of target species catch.
7. Animal to be disposed of offshore in State waters

RESPONDING TO A SHARK THREAT OR ATTACK

SHARK SIGHTING

1. Operations Manager advises Contractor of confirmed sighting in the MMA.
2. Operations Manager confirms location and requests deployment to the site.
3. Contractor advises estimated time of arrival.
4. Contractor places appropriate gear in the water and slowly patrols the area.
5. The Contract vessel must be approximately 1km offshore within 1 hour of arrival at site.

SHARK ATTACK

1. Operations Manager requests Contractor to attend shark attack site, providing location specifics.
2. Contractor advises Operations Manager of estimated time of arrival to site.
3. Contractor to set 5 drum lines in the attack zone.
4. Drum lines to be gradually moved to approximately 1km offshore.
5. Drum lines remain overnight and in place for a maximum period of 7 days.

REPORTING PROTOCOLS

The following reports are to be completed:

1. Bait Purchase Report (or similar)
2. First Deployment Worksheet
3. Vessel Inspection Log Book
4. Drum Line Maintenance Log Book
5. Catch and Research Log Book
6. Response Log Book
7. Final Retrieval Worksheet

All Log Books and photographs are to be emailed to the Contract Manager by close of business Sunday each week.