GPO Box 1700, Canberra ACT 2601
Email: FOI@csiro.au
ABN 41 687 119 230

This document was created in response to a Freedom of Information request made to CSIRO.

FOI Number: FOI2016/42

Date: 8 August 2016

Request: Correspondence between the CSIRO and all other departments of the WA Government regarding the WA Shark Hazard Mitigation Drum-Line Program, specifically:
- Department of Premier and Cabinet
- WA Office of Science
- WA Department of Fisheries
- WA Department of Environment
- WA Environmental Protection Authority

Document(s): 1-13

For more information, please refer to CSIRO's FOI disclosure log at www.csiro.au/FOILog

1a

From: Bruce, Barry (O&A, Hobart)
Sent: Thursday, 11 September 2014 1:30 PM
To: Anthony Sutton s47F
Cc: Kathryn Schell s47F Hans Jacob s47F Nadia Miraudo s47F
Subject: RE: Embargoed Report to CSIRO

Thanks Anthony

Barry

1b

From: Anthony Sutton [mailto s47F
Sent: Thursday, 11 September 2014 1:10 PM
To: Bruce, Barry (O&A, Hobart)
Cc: Kathryn Schell; Hans Jacob; Nadia Miraudo
Subject: FW: Embargoed Report to CSIRO

Dear Barry,

As discussed yesterday, please find attached an "embargoed" copy of the EPA Report on the Shark Drum Lines, which will be released today at 2.00pm (Australian Western Standard Time). A covering letter is also attached.

Please also note that the EPA's Media Officer will also be providing the Communications Officer for CSIRO, Simon Torok, with the media material prior to the Report release.

If you have any questions, please don't hesitate to give me a call.

Regards

Anthony Sutton
Director, Assessment and Compliance Division
Office of the EPA
Ph: s47F
E-mail: s47F

1c

From: Kathryn Schell [mailto: s47F
Sent: Thursday, 11 September 2014 12:18 PM
To: Bruce, Barry (O&A, Hobart)
Cc: Nadia Miraudo; Hans Jacob
Subject: RE: Report Release

Thanks Barry

I have included our media officer in this email so she is aware that Simon should be contacted in the first instance.

Cheers

Kathryn

1d

From: Bruce, Barry (O&A, Hobart)
Sent: Thursday, 11 September 2014 12:16 PM
To: Kathryn Schell < s47F
Subject: RE: Report Release

Hi Katherine

I spoke to Paul yesterday afternoon – he was able to brief me which was appreciated. I also agreed that my name could be mentioned with respect to the Peer Review should he be asked who in CSIRO was involved. I took this decision on Paul's request and in recognition that I will be the CSIRO spokesperson anyway – so it will become immediately obvious if CSIRO is contacted. However, Simon Torok should be given as the first point of call for media requesting any comment from CSIRO so we can manage responses to any calls.

Regards

Barry

1e

From: Bruce, Barry (O&A, Hobart)
Sent: Wednesday, 10 September 2014 4:14 PM
To: Kathryn Schell < s47F
Subject: RE: Report Release

Hi Kathyrn

I think our emails probably just crossed.

Yes- the 'Peer Reviewer' can be identified as a team from CSIRO Marine Research in Hobart.

Simon Torok is our communications manager. He would be a good point of contact into CSIRO. Simon will provide me with details of media who have asked for comment. Simon is based at our Victorian site (not in Tasmania).

Cheers

Barry

Simon Torok
Communications Manager

Email: s47F
Phone: s47F

1f

From: Kathryn Schell [mailto: s47F
Sent: Wednesday, 10 September 2014 4:10 PM
To: Bruce, Barry (O&A, Hobart)
Subject: Report Release

Good afternoon Barry

Further to our earlier conversation, please feel free to give Dr Paul Vogel, EPA Chairman a call on s47F to discuss your queries.

It would be appreciated if you could:

1. Confirm that the Peer Reviewer can be identified as CSIRO Marine Research in Hobart.
2. Provide contact details for your media officer?
   Our media officer Nadia Miraudo will contact them prior to release of the report.

Kind Regards

Kathryn

Kathryn Schell
Principal Environmental Officer
Infrastructure Branch

Office of the **Environmental Protection Authority**

The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 10, East Perth, Perth WA 6892

direct: s47F reception: 08 6145 0800 | fax: 08 6145 0895
email: s47F | web: www.epa.wa.gov.au

1g

From: Bruce, Barry (O&A, Hobart)
Sent: Thursday, 10 July 2014 8:53 PM
To: Anthony Sutton < s47F
Subject: Re: Peer Review

No problem, Anthony

Your office told me you were away.

Cheers

Barry

1h

On 10/07/2014, at 8:29 PM, "Anthony Sutton" < s47F wrote:

Barry,

...sorry about the delay in responding – I have been out of the office. Thank you for the report.

Regards

Anthony

1i **From:** s47F [mailto: s47F
Sent: Thursday, 10 July 2014 8:23 AM
To: Hans Jacob
Cc: Michael Christensen; Anthony Sutton
Subject: RE: Peer Review

Hi Hans

The report was sent to Anthony earlier today. I will arrange a copy to be sent to your email address as well. Please advise when you receive it.

Cheers

Barry

1j **From:** Hans Jacob s47F
Sent: Thursday, 10 July 2014 10:14 AM
To: Bruce, Barry (O&A, Hobart)
Cc: Michael Christensen; Anthony Sutton
Subject: RE: Peer Review

Hello Barry

If the Peer Review has been approved, and it is going to be sent out this morning, could you please also CC myself, as Anthony is on a site visit this morning.

Thanks
Hans

1k **From:** Bruce, Barry (O&A, Hobart)
Sent: Wednesday, 9 July 2014 7:46 PM
To: Anthony Sutton < s47F
Cc: Bax, Nic (O&A, Hobart) s47F
Subject: Re: Peer Review

Thanks Anthony

We received sign off from the Flagship Director this evening, so no problem getting it to you tomorrow morning.

Regards

Barry

1l On 09/07/2014, at 7:29 PM, "Anthony Sutton" s47F wrote:

Dear Barry,

Thanks for the up date. I fully understand and appreciate the need to ensure an appropriate level of review and sign off within CSIRO.

It would greatly assist the EPA in meeting its assessment timeline if the Peer Review could be received by lunchtime (WA time) tomorrow as the document needs to be included in the EPA Meeting Agenda Papers and sent to the proponent by 3.00pm Thursday.

Regards

Anthony

1m **From:** Bruce, Barry (O&A, Hobart)
Sent: Wednesday, 9 July 2014 5:17 PM
To: Anthony Sutton < s47F
Cc: Bax, Nic (O&A, Hobart) s47F
Subject: Peer Review

Hi Anthony

I just spoke briefly to your office – I understand that you are away.

We have completed the report and have received local (Hobart) signoff. However, due to the subject matter we also required approval from our Flagship Director, Ken Lee before submitting it to you. Ken is currently looking at the document and we expect to hear from him shortly. Given the time here, it is most likely that you will not receive the report until tomorrow morning.

Regards

Barry

1n

From: Bruce, Barry (O&A, Hobart)
Sent: Friday, 4 July 2014 9:33 AM
To: Anthony Sutton s47F
Subject: RE: Peer Review WA Shark Drum Line Program

Hi Anthony

My direct number is s47F will be out of the office for the next 20 mins – will call you on my return.

Cheers

Barry

1o

From: Anthony Sutton s47F
Sent: Friday, 4 July 2014 9:13 AM
To: Bruce, Barry (O&A, Hobart)
Subject: RE: Peer Review WA Shark Drum Line Program

Hi Barry,

I have mis-placed your phone number – can you please call me on s47F when you have a spare minute.

Many Thanks

Anthony

1p

From: Anthony Sutton s47F
Sent: Thursday, 3 July 2014 5:58 PM
To: Bax, Nic (O&A, Hobart); Bruce, Barry (O&A, Hobart)
Subject: RE: Peer Review WA Shark Drum Line Program

Dear Nic and Barry,

I hope all is well.

Can either of you please give me a call at your earliest convenience to discuss administrative arrangements for submitting to the EPA the peer review of the WA Shark Drum Lines Program.

Many thanks

Anthony Sutton
Director, Assessment and Compliance Division
Office of the EPA
Ph: s47F
E-mail: s47F

1q

From: Bruce, Barry (CMAR, Hobart)
Sent: Tuesday, 3 June 2014 4:14 PM
To: Kathryn Schell s47F
Subject: Re: Peer Review of Shark Drum Line Program

Thanks Kathryn

I am mindful of the timeframes in the terms of reference, my commitments to field work and to other projects over the next few months, as well as the normal end of financial year administrative busy period.

If we are contracted to proceed, it may be most expedient to use a standard CSIRO Fast-track agreement, we have used this for previous similar scale work with the WA Gov.

Regards

Barry

1r On 03/06/2014, at 4:05 PM, "Kathryn Schell" [redacted] wrote:

Hi Barry

My Director is currently reviewing the information and our response, we will be in a position to provide you with a response tomorrow.

I have addressed the correspondence to Nic Bax as discussed, thank you for providing his contact details.

I will email the correspondence to Nic and cc yourself as soon as it is signed.

Regards

Kathryn

1s **From:** Bruce, Barry (CMAR, Hobart)
Sent: Tuesday, 3 June 2014 3:23 PM
To: Kathryn Schell [redacted]
Subject: RE: Peer Review of Shark Drum Line Program

Hi Kathryn

We were wondering how things were going with respect to the assessment of our quote for the Peer Review – I'll need to lock in the time frame to complete the work and other commitments are already starting to build up.

Let me know if there is anything further to discuss, otherwise as discussed last week – Nic Bax would be the best conduit.

Regards

Barry

1t **From:** Bruce, Barry (CMAR, Hobart)
Sent: Wednesday, 28 May 2014 7:04 PM
To: Anthony Sutton [redacted]
Cc: Bax, Nic (CMAR, Hobart) [redacted]
Subject: EPA peer review

Dear Anthony

I refer to your recent correspondence (dated 22 May 2014) seeking a peer review to assist the Environmental Protection Authority (EPA) in its assessment of the proposal to implement the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 by the State of Western Australia. I note that your correspondence clearly articulated the terms of reference, scope and milestone schedule for such a review, included associated documents and requested a quote to cover the costs associated with the peer review.

I have discussed your request further within CSIRO. Based on those discussions I can confirm that CSIRO is willing and able to undertake the peer review. The review, if the quote below is acceptable, would be led by me but advice from other CSIRO staff with relevant expertise (e.g. population assessment and modeling) would be incorporated into the review where appropriate. In this respect although CSIRO proposes that I would undertake the substantive work required for the review, the review service and associated products should be seen and identified as a CSIRO-led review rather than an individual effort.

The quote below includes all time-related costs associated with the proposed review in accordance with stated estimates of time required and the time frames within which the review components need to be delivered.

CSIRO quote for peer review services as specified to the EPA:

$9,545 (exclusive of GST)

Please note that this quote does not include the provision of additional services as stated in Section 5 of the 'Scope of Work for the Peer Reviewer' – including travel to and attendance at EPA Board meetings or further advice in relation to potential appeals which may be

received in relation to the EPA's Report and Recommendations. These services may be the subject of additional costs that would be mutually agreed between our agencies.

Feel free to give me a call if you need to discuss.

Yours sincerely

Barry Bruce
Senior Research Scientist
CSIRO Marine & Atmospheric Research
Hobart Tasmania

1u

From: Bruce, Barry (CMAR, Hobart)
Sent: Friday, 23 May 2014 10:00 AM
To: Kathryn Schell [redacted]
Cc: Michael Christensen [redacted] Anthony Sutton [redacted]
Subject: RE: Peer Review of Shark Drum Line Program

Dear Kathryn

Thank you for your email below. I will consider the documents provided, discuss with our management team and provide a response/quote by 28 May as requested.

Regards

Barry

1v

From: Kathryn Schell [redacted]
Sent: Thursday, 22 May 2014 6:53 PM
To: Bruce, Barry (CMAR, Hobart)
Cc: Michael Christensen; Anthony Sutton
Subject: Peer Review of Shark Drum Line Program

Dear Barry

Further to you expression of interest, please find attached terms of reference and a request for a quote and in relation to the Peer Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017.

It would be appreciated if you could respond direct to Anthony Sutton by 28 May 2014.

Kind Regards

Kathryn

Kathryn Schell
Principal Environmental Officer
Infrastructure Branch

Office of the **Environmental Protection Authority**

The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 10, East Perth, Perth WA 6892

direct [redacted] | reception: 08 6145 0800 | fax: 08 6145 0895
email: [redacted] web: www.epa.wa.gov.au

1w

From: Bruce, Barry (CMAR, Hobart)
Sent: Tuesday, 20 May 2014 9:48 AM
To: Anthony Sutton [redacted]
Cc: Kathryn Schell [redacted] Michael Christensen [redacted]
Subject: RE: Expression of Interest - Peer Review of Shark Drum Line Program

Hi Anthony

That should be fine.

Regards

Barry

1x **From:** Anthony Sutton [redacted]
Sent: Monday, 19 May 2014 9:06 PM
To: Bruce, Barry (CMAR, Hobart)
Cc: Kathryn Schell; Michael Christensen
Subject: RE: Expression of Interest - Peer Review of Shark Drum Line Program

Dear Barry,

Thank you for your e-mail and the CV.

The Office of the EPA is currently in the process of finalising the "Terms of Reference" for the Peer Review and we are aiming to send this document to you, together with an estimate of the amount of work involved and the approximate timing, before the end of this week.

In terms of timing, the work involved is likely to fall in the weeks of 30 June to 4 July 2014 (approx. 24 hours work to review Public Environmental Review document) and the week of 4 August to 8 August 2014 (approx. 16 hours work to review proponent's "Response to Public submission" on PER, including peer review comments). Please let me know if this proposed timing presents any immediate concerns.

Regards

Anthony Sutton
Director, Assessment and Compliance Division
Office of the EPA
Ph: [redacted]
E-mail: [redacted]

1y **From:** Bruce, Barry (CMAR, Hobart)
Sent: Friday, 16 May 2014 9:43 AM
To: Anthony Sutton [redacted]
Subject: RE: Expression of Interest - Peer Review of Shark Drum Line Program

Hi Anthony

Good chatting yesterday.

I have attached a basic CV as requested.

Regards

Barry Bruce

1z **From:** Anthony Sutton [redacted]
Sent: Thursday, 15 May 2014 11:27 AM
To: Bruce, Barry (CMAR, Hobart)
Cc: Michael Christensen; Kathryn Schell
Subject: Re: Expression of Interest - Peer Review of Shark Drum Line Program

Bruce,

Thanks - I will give a call later today.

Anthony

Sent from my IPad

1aa **From:** Bruce, Barry (CMAR, Hobart)
Sent: Thursday, 15 May 2014 10:55 AM
To: Anthony Sutton [redacted]
Cc: Michael Christensen [redacted] Kathryn Schell [redacted]
Subject: RE: Expression of Interest - Peer Review of Shark Drum Line Program

Hi Anthony

Thanks for your email (and phone call) – I am happy to provide a peer review as requested within the time frame stated.

I just tried to call you back with no luck.

I will be out of my office for the next couple of hours -- perhaps we could we could chat further after that.

Regards

Barry Bruce

1ab

From: Anthony Sutton [redacted s47F]
Sent: Wednesday, 14 May 2014 10:11 AM
To: Bruce, Barry (CMAR, Hobart)
Cc: Michael Christensen; Kathryn Schell
Subject: Expression of Interest - Peer Review of Shark Drum Line Program

Dear Barry,

As you may have heard the Western Australian government has recently completed a shark mitigation program involving the deployment of baited drum lines to capture and destroy certain sharks along popular Perth metropolitan and south-west swimming and surfing beaches. Following the completion of this trial the Department of the Premier and Cabinet (DPC) on behalf the State of Western Australia is seeking to implement a similar program over a three year period, from 15 November to 30 April, commencing 15 November 2014 and concluding on 30 April 2017.

The trial was referred to the Western Australian Environmental Protection Authority (EPA) under the Environmental Protection Act 1986 and the EPA subsequently determined that the trial (which ran from late January 2014 to 30 April 2014) would not be subject to a formal environmental impact assessment. This was largely due to the limited temporal extent of the program.

Following referral of this current proposal the EPA has determined (22 April 2014) that a formal environmental impact assessment is required and the level of assessment has been set at Public Environmental Review (PER), with a 4 week public review period. This decision was made with regard to the temporal extent and to take into account cumulative impacts. The PER is the highest level of assessment and allows for public consultation in the EPA's assessment process. The EPA also determined that it would provide the Environmental Scoping Document (ESD) for the proponent's PER.

As part of the environmental assessment process, the EPA is seeking to commission a peer review by an authority in the field. Your name has been put forward by the Commonwealth Department of the Environment and as such this email is seeking your interest in undertaking this work.

It is anticipated that the Peer Review would undertake the following works:
Undertake peer review of the of the technical information in the proponent's PER document and provide a Peer Review Report to the EPA on the adequacy of the PER in addressing requirements of the ESD.
Undertake review of the technical information in the proponent's response to the Peer Review Report and the pertinent issues raised in public submissions and determine if the proponent has adequately dealt with the comments, advice and issues raised. Provide close out report to the EPA.

The timing of the above would be as follows:
Initial review conducted during the 4 public review period (approximately 2-27 June) with the report due on or around 30 June 2014.
Close out review conducted following receipt of the proponents response (approximately 25 July – 4 August) with close out report due on or around 4 August 2014.

If you could please advise on your interest and availability for the above it would be appreciated. Should you be interested further details will be provided.

For your interest there is some further information also available on the EPA's website at http://www.epa.wa.gov.au/Pages/default.aspx.

Anthony Sutton
Director, Assessment and Compliance Division
Office of the EPA
Ph: [redacted s47F]
E-mail: [redacted s47F]

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Dr Barry Bruce
Senior Research Scientist
CSIRO Marine & Atmospheric Research
GPO Box 1538
HOBART TAS 7001

Our Ref: *AC01-2014-0070*
Enquiries: *Anthony Sutton,* s47F
Email: s47F

Via e-mail: s47F

Dear Dr Bruce

PEER REVIEW WESTERN AUSTRALIAN SHARK HAZARD MITIGATION DRUM LINE PROGRAM 2014-2017 (ASSESSMENT NO. 2005)

I refer to our recent email correspondence in which the Office of the Environmental Protection Authority (OEPA) sought your interest, and you indicated your availability and willingness, to undertake a peer review commissioned by the Environmental Protection Authority (EPA) to assist in its assessment of the State of Western Australia, proposal to implement the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (the program).

The OEPA has now prepared a draft Terms of Reference which includes a Scope of Works for the Peer Reviewer (Attachment 1). It would be appreciated if you could review Terms of Reference and the provide a quote to undertake the required Scope of Works for the Peer Reviewer as summarised below in Table 1.

Table 1.

	Activity/Deliverable	**Dates**	**Estimated hours**
1	Peer Review of PER document and preparation of a Peer Review Report as outlined in the attached Terms of Reference - Scope of work for Peer Reviewer point 1 and 2.	Public Review Period 9 June – 4 July (4 weeks) **Report due 4 July.**	24 hours
2	Undertake review of the proponent's response to the Peer Review Report and public and preparation of a Close Out Report as outlined in the attached Terms of Reference - Scope of work for Peer Reviewer point 3 and 4.	Response to Submissions Review 1-7 August (1 week) **Report due 7 August.**	16 hours
3	Provide other services and technical advice as requested as outlined in the attached Terms of Reference - Scope of work for Peer Reviewer point 5.	Details to be provided as requested by EPA.	To be advised.

The Atrium Level 8, 168 St Georges Terrace, Perth, Western Australia 6000.
Postal Address: Locked Bag 10, East Perth, Western Australia 6892.

Telephone: s47F
Facsimile: (08) 6145 0845.
Website: www.epa.wa.gov.au

Please note that the time frames for finalisation of the Peer Review Report and Close Out Report are based on the agreed milestones as outlined in Table 2 of the ESD. Any changes to these timelines resulting in a change to dates for the activities/ deliverable will be agreed in writing. It is anticipated that the EPA's assessment of the proposal, and hence any requests for further services or technical advice, will be complete by late September 2014.

Could you please confirm in writing your willingness and ability to undertake the works as outlined in the Terms of Reference and provide a quote by 28 May 2014. Your response should be sent via e-mail to s47F

Following receipt of the requested information the OEPA will consider your response, and if acceptable, provide acceptance of your offer.

I have also enclosed a copy of the *Environmental Impact Assessment Administrative Procedures 2012* which outlines the environmental impacts assessment process in Western Australian for you information. The proposal subject to the Peer Review is being assessed at the level of Public Environmental Review which is outlined in Section 10.2.2.

Should you have any questions in relation please contact Anthony Sutton on s47F s47F

Yours sincerely

s47F

Anthony Sutton
DIRECTOR

22 May 2014

Encl.
Attachment 1 : Terms of Reference
Attachment 2.: EIA Administrative Procedures 2012

cc:

Peer review of the Western Australian Shark Hazard Mitigation Drum Line Program (2014 – 2017)

Proposal

The Director General of the Department of the Premier and Cabinet on behalf of the State of Western Australia, proposes to implement the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (the program). The program forms part of a number of hazard mitigation strategies in place and is intended to reduce the likelihood of shark attacks within Western Australia.

The program involves the establishment of two Marine Monitored Areas (MMA) in the metropolitan and South West regions of Western Australia (Attachment 1, Figures 1 and 2). The program proposes the deployment of up to 60 static drum lines within the MMAs and allow for the temporary placement of drum lines anywhere in State waters at any time following an identified shark threat or incident. Drum lines will be managed to ensure that there will not be more than 72 drum lines in the water at any one time.

The target sharks which are intended to be captured and destroyed include white sharks (Carcharodon carcharias), tiger sharks (Galeocerdo cuvier) and bull sharks (Carcharhinus leucas) greater than or equal to 300 cm in total length. All other marine fauna unintentionally caught including all sharks less than 300 cm in total length are considered non-target marine fauna.

The static drum line component of the program is proposed to take place from 15 November to 30 April, over a three year period, commencing 15 November 2014 and concluding on 30 April 2017. The program will be subject to review following its conclusion.

Background

The Environmental Protection Authority (EPA) is formally assessing the proposal under Section 38 of the *Environmental Protection Act 1986* at the level of Public Environmental Review (PER) with a 4 week public review period. The EPA has prepared and approved an Environmental Scoping Document (ESD) with one Environmental Factor – Marine Fauna (Attachment 1). The proponent is required to produce a PER document in accordance with the ESD.

Due to the primary importance of marine fauna, and in particular sharks, to the assessment the EPA has commissioned an independent peer review from an authority in the field, to provide advice on the findings, conclusions and proposed management for the implementation of the proposal.

The purpose of this document is to specifythe terms of reference forthe peer review.

Scope of Work for Peer Reviewer

The following scope of work is required for the peer review of the Western Australian Shark Hazard Mitigation Drum Line Program (2014 –2017).

1. Undertake a peer review of the findings and conclusions of the PER document for the Western Australian Shark Hazard Mitigation Drum Line Program (2014 – 2017) to determine whether it meets the requirements of the ESD (as required by Table 1, Work and Output required, points 1. and 2), and the significance of impacts from implementation of this proposal on marine fauna.
2. Provide a Peer Review Report* to the EPA outlining the findings of the review required by 1. above, by 4 July 2014.
3. Undertaken a peer review of the proponent's response to the:
   a. initial Peer Review Report; and
   b. pertinent issues raised following the 4 week public review period;

   and determine if the advice, comments, and issues raised have been adequately addressed by the proponent.
4. Provide the EPA with a final Close Out Report* outlining the findings of the review required by 3. above, by 7 August 2014.
5. Provide other services and technical advice as requested by the EPA to assist it in its assessment of the proposal. This may include attendance at an EPA board meeting and advice in relation to potential appeals which may be received in relation to the EPA' s Report and Recommendations.

*Please note that this Terms of Reference, the Peer Review Report and Close Out Report will be made publicly available by the EPA.

Attachment 1: Environmental Scoping Document Western Australian Shark Hazard Mitigation Drum Line Program (2014 – 2017)

From: Kathryn Schell [redacted]
Sent: Tuesday, 3 June 2014 8:07 PM
To: Bax, Nic (O&A, Hobart)
Cc: Bruce, Barry (O&A, Hobart); Anthony Sutton
Subject: Peer Review WA Shark Hazard Mitigation Drum Line Program 2014-2017 (Ass No. 2005)
Attachments: OEPA to CSIRO Acceptance Peer Review (Ass No. 2005).pdf; Att 1 (part 2) ESD WA Shark Hazard Mitigation Drum Line Program.pdf

Dear Professor Nic Bax

Pleased find attached correspondence from the Office of the Environmental Protection Authority accepting the offer and quote by CSIRO to undertake the Peer Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (Assessment No. 2005).

If you require anything further please contact either myself or Anthony Sutton.

Regards

Kathryn

Kathryn Schell
Principal Environmental Officer
Infrastructure Branch

Office of the **Environmental Protection Authority**

The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 10, East Perth, Perth WA 6892

direct: [redacted] reception: 08 6145 0800 | fax: 08 6145 0895
email: [redacted] web: www.epa.wa.gov.au

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Prof NJ Bax
Director
NERP Marine Biodiversity Hub
CSIRO
GPO Box 1538
HOBART TAS 7001

Via e-mail: [redacted]

Our Ref: AC01-2014-0070
Enquiries: Anthony Sutton, [redacted]
Email: [redacted]

Dear Prof Bax

ADVICE OF ACCEPTANCE OF OFFER FOR REQUEST - PEER REVIEW WESTERN AUSTRALIAN SHARK HAZARD MITIGATION DRUM LINE PROGRAM 2014-2017 (ASSESSMENT NO. 2005)

I refer to recent email correspondence advising that the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is willing and able to undertake the a peer review commissioned by the Environmental Protection Authority (EPA) to assist in its assessment of the State of Western Australia proposal to implement the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (the program), and associated quote.

The Office of the Environmental Protection Authority (OEPA) is pleased to accept your offer. Acceptance of this offer constitutes an agreement between CSIRO and the General Manager, OEPA.

The agreement is for the provision of a peer review and deliverables as outlined in the attached Peer Review Terms of Reference - Peer Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (Attachment 1).

The following details have been accepted:

Price:	$9,545 (exclusive of GST).
Key Deliverables:	Peer Review Report - 4 July 2014; and
	Close Out Report - 7 August 2014.

The OEPA notes that the above price does not include the provision of additional services as stated in the Peer Review Terms of Reference, Section 5 of the 'Scope of Work for the Peer Reviewer' – including travel to and attendance at EPA Board meetings or further advice in relation to potential appeals which may be received in relation to the EPA's Report and Recommendations. These services may be the subject of additional costs that would be mutually agreed between our agencies.

The Atrium Level 8, 168 St Georges Terrace, Perth, Western Australia 6000.
Postal Address: Locked Bag 10, East Perth, Western Australia 6892.

Telephone: [redacted]
Facsimile: (08) 6145 0845.
Website: www.epa.wa.gov.au

Please note that the time frames for finalisation of the Peer Review Report and Close Out Report are based on the agreed milestones as outlined in Table 2 of the Environmental Scoping Document provided as part of the Terms of Reference. Any changes to these milestones resulting in a change to time frames for the activities/ deliverables will be agreed in writing.

It is anticipated that the EPA's assessment of the proposal, and hence any requests for further services or technical advice, will be complete by late September 2014.

As the Contract Authority, the OEPA is also responsible for major dispute resolution, extensions, variations and termination. The OEPA Representative for this agreement is Anthony Sutton, Director Assessment and Compliance Division (phone s47F

Invoices must be sent to Office of the EPA, Finance, Locked Bag 10, East Perth WA 6892 or via email to oepa.finance@epa.wa.gov.au.

I look forward to the involvement of the CSIRO in the EPA's assessment of this proposal.

Yours sincerely

s47F

Anthony Sutton
Director
Assessment and Compliance Division

3 June 2014

Encl.
Attachment 1: Terms of Reference - Peer Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017

Peer review of the Western Australian Shark Hazard Mitigation Drum Line Program (2014 – 2017)

Proposal

The Director General of the Department of the Premier and Cabinet on behalf of the State of Western Australia, proposes to implement the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (the program). The program forms part of a number of hazard mitigation strategies in place and is intended to reduce the likelihood of shark attacks within Western Australia.

The program involves the establishment of two Marine Monitored Areas (MMA) in the metropolitan and South West regions of Western Australia (Attachment 1, Figures 1 and 2). The program proposes the deployment of up to 60 static drum lines within the MMAs and allows for the temporary placement of drum lines anywhere in State waters at any time following an identified shark threat or incident. Drum lines will be managed to ensure that there will not be more than 72 drum lines in the water at any one time.

The target sharks which are intended to be captured and destroyed include white sharks (Carcharodon carcharias), tiger sharks (Galeocerdo cuvier) and bull sharks (Carcharhinus leucas) greater than or equal to 300 cm in total length. All other marine fauna unintentionally caught, including all sharks less than 300 cm in total length, are considered non-target marine fauna.

The static drum line component of the program is proposed to take place from 15 November to 30 April, over a three year period, commencing 15 November 2014 and concluding on 30 April 2017. The program will be subject to review following its conclusion.

Background

The Environmental Protection Authority (EPA) is formally assessing the proposal under Section 38 of the *Environmental Protection Act 1986* at the level of Public Environmental Review (PER) with a 4 week public review period. The EPA has prepared and approved an Environmental Scoping Document (ESD) with one Preliminary Key Environmental Factor – Marine Fauna (Attachment 1). The proponent is required to produce a PER document in accordance with the ESD.

Due to the primary importance of marine fauna, and in particular sharks, to the assessment the EPA has commissioned an independent peer review from an authority in the field, to provide advice on the findings, conclusions and proposed management for the implementation of the proposal.

The purpose of this document is to specify the terms of reference for the peer review.

Scope of Work for Peer Reviewer

The following scope of work is required for the peer review of the Western Australian Shark Hazard Mitigation Drum Line Program (2014 –2017).

1. Undertake a peer review of the findings and conclusions of the PER document for the Western Australian Shark Hazard Mitigation Drum Line Program (2014 – 2017) to determine whether it meets the requirements of the ESD (as required by Table 1, Work and Output required, points 1. and 2), and the significance of impacts from implementation of this proposal on marine fauna.
2. Provide a Peer Review Report* to the EPA outlining the findings of the review required by 1. above, by 4 July 2014.
3. Undertaken a peer review of the proponent's response to the:
   a. initial Peer Review Report; and
   b. pertinent issues raised following the 4 week public review period;

   and determine if the advice, comments, and issues raised have been adequately addressed by the proponent.
4. Provide the EPA with a final Close Out Report* outlining the findings of the review required by 3. above, by 7 August 2014.
5. Provide other services and technical advice as requested by the EPA to assist it in its assessment of the proposal. This may include attendance at an EPA board meeting and advice in relation to potential appeals which may be received in relation to the EPA' s Report and Recommendations.

*Please note that this Terms of Reference, the Peer Review Report and Close Out Report will be made publicly available by the EPA.

Attachment 1: Environmental Scoping Document Western Australian Shark Hazard Mitigation Drum Line Program (2014 – 2017)

ENVIRONMENTAL SCOPING DOCUMENT

PROPOSAL:	**Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (Assessment No. 2005)**
LOCALITY:	**Western Australian State waters**
PROPONENT:	**Director General, the Department of the Premier and Cabinet on behalf of the State of Western Australia**
LEVEL OF ASSESSMENT:	**Public Environmental Review with a four week public review period**
EPBC REFERENCE:	**EPBC2014/7174**

This Environmental Scoping Document (ESD) is provided to define the form, content and timing of the Public Environmental Review (PER) document to be prepared in accordance with the Western Australian *Environmental Protection Act 1986* (EP Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)..

The preliminary key environmental factor to be addressed is identified in Section 2. The generic guidelines for the format of an environmental review document are attached (Attachment 1). Other supporting guidance is available on the Environmental Protection Authority's (EPA's) website www.epa.wa.gov.au.

The environmental review document must adequately address all elements of this scoping document prior to approval being given to commence the public review.

The Environmental Protection Authority expects the proponent to fully consult with interested members of the public and relevant stakeholders, and to take due care in ensuring any other relevant environmental factors which may be of interest to the public and stakeholders are addressed. The PER should document the results of all consultation undertaken.

1. Introduction

The EP Act sets out that where a proposal is considered to be likely to have a significant environmental impact it will be subject to an assessment by the Environmental Protection Authority (EPA) under section 38 of the EP Act. This proposal is being assessed by way of a Public Environmental Review (PER) because it raises a preliminary key environmental factor. The EPA will, at the conclusion of its assessment, prepare a report on the outcome of its assessment of the proposal and give the assessment report to the Minister for Environment. In accordance with the requirements of the EP Act, the Minister for Environment will then decide whether or not the proposal may be implemented, and, if the proposal may be implemented, the conditions and procedures that implementation of the proposal should be subject to.

The procedure for a PER is described in the Western Australian EP Act *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012.* The proponent should have regard to the Administrative Procedures when preparing the PER (refer to Clause 10.2.4).

As this proposal is subject to a PER, the proponent is required to produce a PER document in accordance with an approved Environmental Scoping Document (ESD). The purpose of the ESD is to:

- develop proposal-specific guidelines to direct the proponent on the preliminary key environmental factor for the proposal that should be addressed in preparing the PER document; and
- identify the necessary impact predictions for the proposal and the information on the environmental values required to carry out the assessment.

The EPA has determined that it will prepare and issue the ESD (this document) outlining the scope and content of the PER to be prepared, in relation to this proposal.

The EPA, in its formulation of the ESD, undertakes consultation with the proponent regarding the details of the proposal, the preliminary key environmental factor and the scope of works required and expected outcomes. In addition the EPA will consult with the relevant government agencies. In many cases the Office of the Environmental Protection Authority (OEPA) will act for the EPA.

ESDs prepared by the EPA are not subject to a public review period. The ESD will be available on the EPA website (www.epa.wa.gov.au) upon finalisation and must be included as an appendix in the PER document.

The proponent will then be required to prepare a PER document in accordance with the ESD. When the EPA is satisfied that the PER document:

- focuses only on the preliminary key environmental factor, not on other factors which fall below the significance threshold as outlined in Environmental Assessment Guideline 9 *Application of a significance framework in the environmental impact assessment process;*

- demonstrates that all studies identified in the scoping document have been undertaken, and presents the findings of those studies, including how the proposal or its management has been informed by the outcome of any studies;
- demonstrates that the proposal can meet the EPA's objectives through the mitigation hierarchy; and
- is concise,

the proponent will be required to release the document for a public review period of 4 weeks.

An important aspect of the environmental impact assessment process is the review by the public. The EPA requires public input into the possible environmental impacts of this proposal and its implementation. The EPA expects the proponent to fully consult with interested members of the public and relevant stakeholders, and to take due care in ensuring any other relevant environmental factors which may be of interest to the public and stakeholders are succinctly addressed. The PER should document the matters raised in consultation, ideally in a table.

The EPA considers that adequate consultation can be demonstrated when the stakeholders:

- are included in the consultation process and are able to make their concerns known;
- are kept informed about the potential and actual environmental impacts; and
- receive responses to the concerns raised, including identifying how the proposal has been modified and/or identifying management measures that will be implemented to address the concerns raised.

To facilitate adequate public input, the PER document should be made available as widely as possible and at a reasonable cost consistent with *Environmental Impact Assessment (Part IV Division 1 and 2) Administrative Procedures 2012* (refer to clause 10.2.5) and the guidelines in Attachment 1.

2. Specific Guidelines for the Preparation of the Environmental Review

2.1 The proposal

The Director General of the Department of the Premier and Cabinet (DPC) on behalf of the State of Western Australia, proposes to implement the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (the program). The program forms part of a number of hazard mitigation strategies in place and is intended to reduce the likelihood of shark attacks within Western Australia.

The program involves the establishment of two Marine Monitored Areas (MMA) in the metropolitan and South West regions of Western Australia (refer to Figures 1 and 2). The program is proposed to involve the deployment up to 60 static drum lines within the MMAs and allow for the temporary placement of drum lines anywhere in State waters at any time following an identified shark threat or incident. Drum lines will be

managed to ensure that there will not be more than 72 drum lines in the water at any one time.

The target sharks which are intended to be captured and destroyed include white sharks (*Carcharodon carcharias*), tiger sharks (*Galeocerdo cuvier*) and bull sharks (*Carcharhinus leucas*) greater than or equal to 300 cm in total length. All other marine fauna unintentionally caught including all sharks less than 300 cm in total length are considered non-target marine fauna.

The program is proposed to take place from 15 November to 30 April, over a three year period, commencing 15 November 2014 and concluding on 30 April 2017. The program will be subject to review following its conclusion.

The PER document will need to provide detailed justification for the proposal, including a genuine evaluation of options or alternatives considered in the planning and design of the program to avoid or minimise environmental impacts to the preliminary key environmental factor identified in Section 2.2, consistent with the *Environmental Impact Assessment (Part IV Division 1 and 2) Administrative Procedures 2012* (refer to clause 5(3)).

The PER document will need to define the proposal consistent with Environmental Assessment Guideline 1 *Defining the Key Characteristics of a Proposal* (May 2012) (EAG 1). EAG 1 describes how to define the key proposal characteristics for the purposes of assessing the proposal and subsequent incorporation in the Ministerial approval statement. It is expected that the PER will set out the details of the proposal with respect to the:

- proposed activities including static drum line deployment and temporary drum line deployment in response to identified shark threats or incidents;
- geographic extent and timing of the activities; and
- protocols developed for the deployment of shark drum lines within the Marine Monitored Areas, and other areas, following the identification of a shark threat or incident.

Should the proponent propose to change the proposal, as described above and shown in Figures 1 and 2, during the assessment process the EPA may consider these changes without a revised proposal being referred to the EPA, if it considers that the change is unlikely to significantly increase any impact that the proposal may have on the environment, under Section 43A of the EP Act.

2.2 Preliminary Key Environmental Factor, scope of works and policy documents relevant to this proposal

The PER should give a detailed assessment of the preliminary key environmental factor identified for this proposal. At this stage, the EPA believes the preliminary key environmental factor, objective and work required is detailed in Table 1.

Table 1 – Preliminary Key Environmental Factor and scope of works relevant to the proposal

Marine Fauna	
EPA objective	To maintain the diversity, geographic distribution and viability of fauna at the species and population levels.

Potential impacts	The proposal (as set out in section 2.1 and to be detailed in the PER) has the potential to impact on:
	• the target sharks[1] which includes White, Tiger and Bull sharks;
	• non-target marine fauna[2] which includes:
	  o all sharks under 300 cm in total length; and
	  o other marine fauna including non-target shark species, non-shark fish species, marine mammals and reptiles, and seabirds, and
	• marine fauna diversity through the removal of apex predators.
	[1]The target sharks are defined as white sharks (*Carcharodon carcharias*), tiger sharks (*Galeocerdo cuvier*) and bull sharks (*Carcharhinus leucas*) greater than or equal to 300 cm in total length. White sharks are listed rare or likely to become extinct under the *Wildlife Conservation Act 1950* (WC Act) and totally protected under the *Fish Resources Management Act 1994* (FRM Act). Tiger and bull sharks with an interdorsal measurement greater than 70 cm are totally protected under the FRM Act.
	[2]Non-target marine fauna are defined as all other fauna unintentionally caught as a result of this program, including all sharks below 300 cm in total length, all non-target shark species, all non-shark fish species, marine mammals, reptiles and seabirds.

Work and output required	The proposal consists of two components: i. the deployment of static drum lines in MMAs from 15 November to 30 April, commencing 15 November 2014 and concluding 30 April 2017; and ii. the temporary deployment of drum lines in response to an identified shark threat or incident anywhere within State waters[3] at any time. The work and output required is as follows. 1. Present scientifically sound predictions of the nature, extent, and duration of potential impacts from all activities associated with the proposal, on target sharks and non-target marine fauna. In doing so, set out the scientific confidence associated with the likelihood and consequence of potential impacts, including reference to technical data, scientific papers or other information relied upon in predicting potential impacts. The predictions shall be informed by the following: a. an evaluation of the environmental impacts from the Shark Drum Line Trial (trial), which ran from late January 2014 to 30 April 2014, including the predicted catch data, actual catch data for all species, and effectiveness of measures to minimise impacts on non-target marine fauna; b. predicted catch rates for the target sharks and non-target marine fauna; c. a determination of the acceptable range or levels of catch/mortality of target sharks (to maintain the viability of the target sharks at the population level), based on the most contemporary estimates of the

	population size of the target sharks and non-target marine fauna, and consideration of their biological characteristics (reproductive rates etc); and d. an examination of the cumulative impacts on target sharks, non-target marine fauna and marine fauna diversity through the removal of apex predators associated with the proposed implementation of the program over time and within the context of other projects. 2. Provide a draft operational management plan which includes measures to avoid and, where avoidance is not possible, minimise impacts and mortality to non-target marine fauna. The draft operational management plan shall: a. define the performance objectives, describe the management measures and outline the monitoring (including biological sampling) and reporting procedures and potential contractual requirements; b. address catch or trigger criteria and the corresponding contingency actions that would be implemented it they are reached; c. include a program of regular surveillance and inspections of the drum lines; d. include marine fauna handling procedures to maximise survival of non-target marine fauna; e. incorporate best-practice measures based on the evaluation of the trial detailed in 1.a. (above) and through a review of shark control programs in other jurisdictions (including consideration of animal welfare and measures to reduce entanglement from migrating whales); and f. address the implication of the proposal on marine parks and reserves[4]. 3. Based on the work required in 1. and 2. above, demonstrate how the mitigation hierarchy - avoid, minimise, rectify and offset - has been incorporated into the development of the program, (including the completion of Environmental Offsets Reporting Form in EPA, Guidance Statement No. 19 Environmental Offsets – Biodiversity, 2008) to achieve the EPA's objective for marine fauna. This should include details of any compensatory measures that provide benefits to the impacted species, such as population research, that will be undertaken as a part of the program. [3]State waters are coastal waters typically within three nautical miles of the shore. [4]Marine park and reserve as defined in the *Conservation and Land Management Act 1984*.

This preliminary key environmental factor must be addressed within the environmental review document for the public to consider the impacts of the proposal and proposed management, and make informed comment to the EPA. All technical reports, modelling and referenced documents (not currently in the public domain) used in the preparation of the PER document should be included as appendices to the document. Documents used in the preparation of the PER must not contain disclaimers that preclude their public availability.

The EPA anticipates addressing this factor in its report to the Minister for Environment.

2.3 Other Environmental Issues

During the course of the preparation of the document if there are other environmental factors consider to be relevant they should be included in the PER following consultation with the EPA.

2.4 Matters of National Environmental Significance (MNES)

The Commonwealth Minister for the Environment has determined that the proposal is a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it is likely to have a significant impact on one or more Matters of National Environmental Significance (MNES).

It has been determined that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A).

The proposed action is likely to have a significant impact because it targets the listed and vulnerable migratory White Shark (*Carcharodon carcharias*). The white shark is also listed in Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals.

This proposal is being assessed by way of an accredited process with the EPA under the bilateral agreement with the Commonwealth Government made under section 47 of the EPBC Act. The bilateral agreement allows the Commonwealth Minister for the Environment to rely on the PER process of the State of Western Australia in assessing the action under the EPBC Act.

The PER document should contain a separate section identifying MNES, discussing how these matters have been addressed within the document and discussing any offsets proposed to address impacted MNES. Attachment 2 sets out the requirements for information that must be included in the PER document to address EPBC Act requirements.

Provide evidence and supporting information on the proposal in relation to requirements for decisions about threatened species and communities and migratory species (as required by section 139 and section 140 of the EPBC Act).

Once submissions have been received on the PER and the proponent has prepared an adequate Response to Submissions report, the assessment process under the EP Act and EPBC Act will continue. The assessment report on the proposed action prepared by the EPA and provided to the Western Australian Minister for Environment is forwarded to the Commonwealth Minister for the Environment who will then make a decision as to whether or not the proposal should be approved under the EPBC Act. This is separate from any Western Australian approval that may be required.

2.5 Agreed Assessment Milestones

EPA Environmental Assessment Guideline No. 6 *Timelines for EIA of Proposals* addresses the responsibilities proponents and EPA for achieving timely and effective assessment of proposals.

This timeline (Table 2) is agreed between the EPA and the proponent. Proponents are expected to meet the agreed proposal assessment timeline, and in doing so, provide adequate, quality information to inform the assessment. Proponents will need to allocate sufficient time to undertake the necessary studies to the appropriate standard and incorporate the outcomes of the studies into the PER.

Where an agreed timeline is not being met by the proponent, or if adequate information is not submitted by the proponent, the timeline for subsequent steps will be re-established. Where the OEPA is unable to meet a date in the agreed timelines the proponent will be advised and the timeline adjusted.

The EPA will report to the Minister for Environment on whether the agreed proposal assessment timeline has been met. Where the timeline has not been met, the reasons for this will be identified.

Table 2: Agreed Milestones for the proposal for bilateral assessment

Key Stage of Proposal	Agreed Milestone
EPA approval of ESD Document	mid May 2014
Proponent submits PER Document	late May to early June 2014
EPA authorises release of PER Document	early June 2014
Proponent releases approved PER Document	early June 2014
Public Review of PER Document (four weeks)	June to early July 2014
OEPA summarises Public Submissions	mid July 2014
Proponent provides response to Public Submissions	late July 2014
OEPA reviews response to Public Submissions	mid August 2014
OEPA assesses proposal for consideration by EPA	late August 2014
Preparation and finalisation of EPA Report (including consultation on draft conditions with proponent and key Government agencies)	early September 2014

2.6 Decision Making Authorities

At this preliminary stage, the EPA has identified the following Decision Making Authorities (DMAs) (see Table 3). These Decision Making Authorities are constrained from making any decision that could have the effect of causing or allowing the proposal to be implemented. Throughout the assessment process further DMAs may be identified.

Table 3: Nominated Decision Making Authorities

Decision Making Authority	Relevant Legislation
Minister for Fisheries	*Fish Resources Management Act 1994*
Minister for Environment	*Wildlife Conservation Act 1950*

DMAs are not prevented from parallel processing, up to the point of their decision, so that their views can inform the ministerial consultation process.

3. Preparation of the Environmental Review Document

Guidance on the recommended format for the Environmental Review document is detailed through Attachment 1 of this document. Further guidance material including the Environmental Assessment Guidelines (EAG) mentioned can be found on the Environmental Protection Authority's (EPA's) website at www.epa.wa.gov.au.

When the EPA is satisfied with the standard of the environmental review document (see EAG 6 Section 4.3) it will provide a written sign-off, giving approval to advertise the document for public review. The review document may not be advertised for release before written approval is received.

The proponent is responsible for advertising the release and availability of the PER in accordance with the guidelines which will be issued to the proponent by the OEPA. The EPA must be consulted on the timing and details for advertising the document.

Figure 1- Location of the Metropolitan Marine Monitored Area

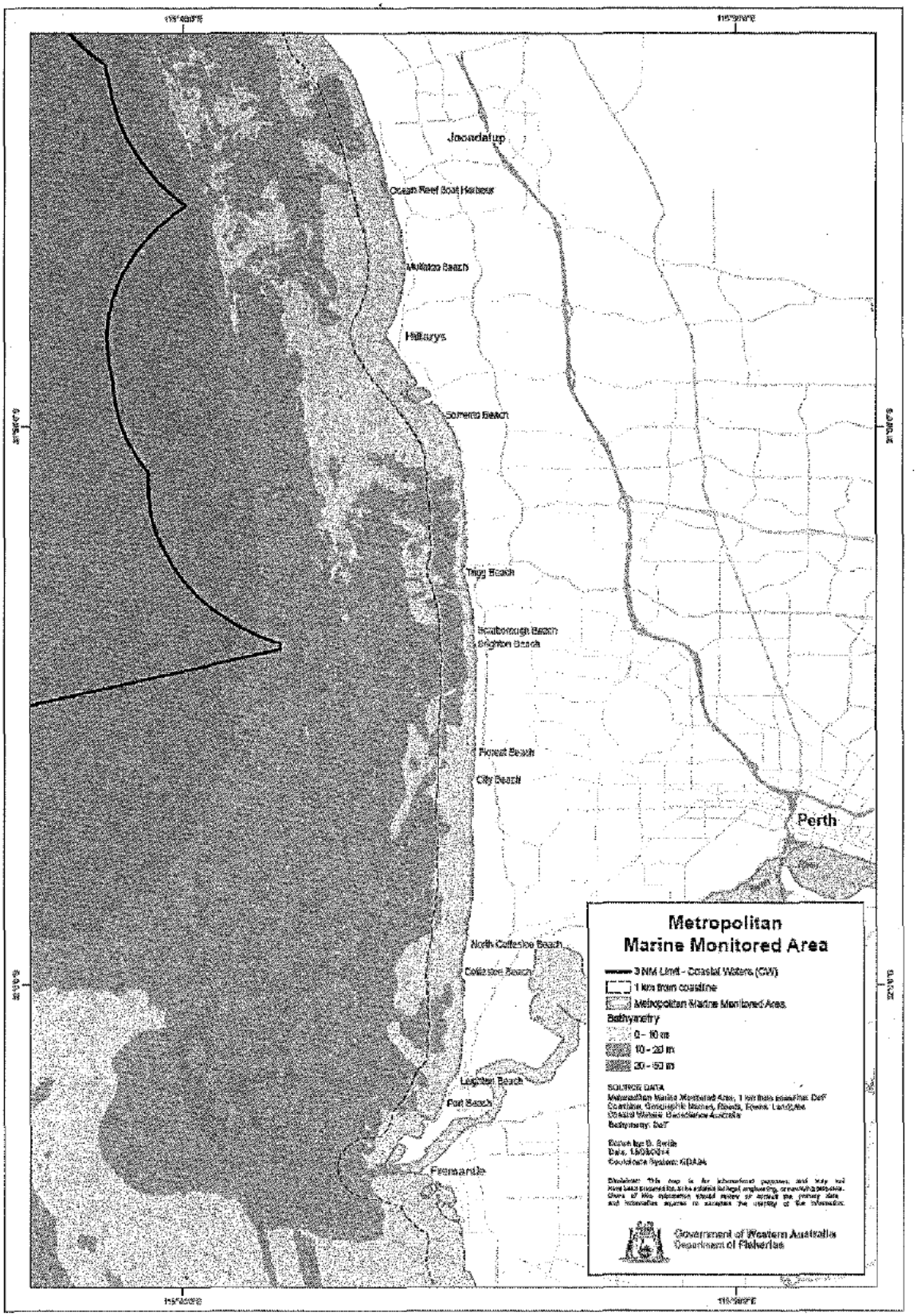
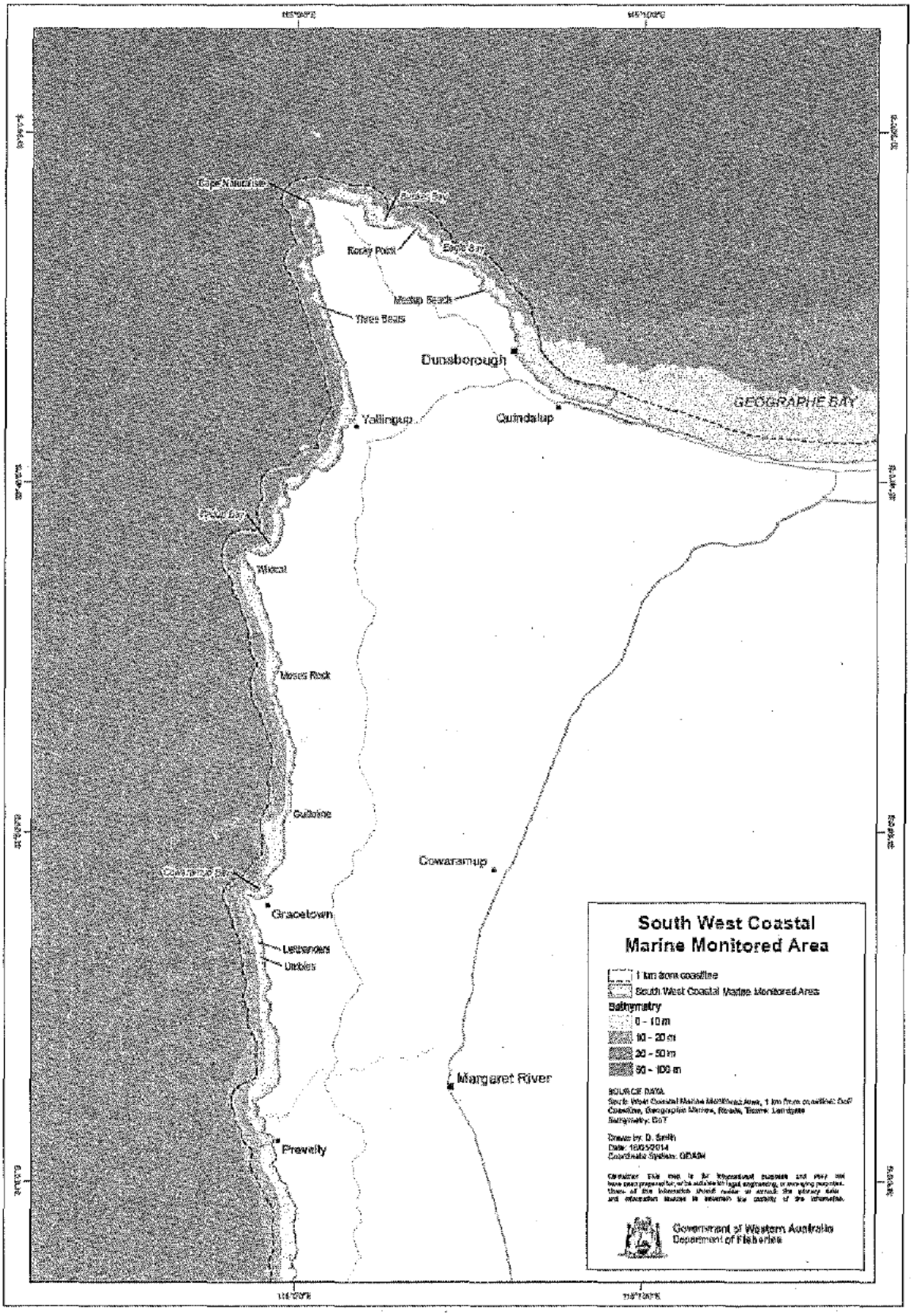


Figure 2- Location of the South West Marine Monitored Area



Attachment 1

Guidelines for Preparing a Public Environmental Review

GOVERNMENT OF WESTERN AUSTRALIA

Office of the Environmental Protection Authority

The Atrium,
Level 8, 168 St Georges Terrace,
Perth, Western Australia 6000.
Telephone: (08) 6467 5000.
Facsimile: (08) 6467 5557.

Postal Address: Locked Bag 33,
Cloisters Square, Perth, Western Australia 6850.
Website: www.epa.wa.gov.au

PER GUIDELINES

Guidelines for Preparing a Public Environmental Review

Contents

These generic guidelines are provided to assist the preparation of the proponent's environmental review document.

Project specific information related to the proposal, environmental factors, impacts, management, consultation and proposed investigations are required to be outlined in the environmental scoping document prepared by the proponent (refer to www.epa.wa.gov.au/). The environmental scoping document, along with these generic guidelines, comprise the EPA-agreed project guidelines.

The environmental review document must address all elements of the agreed environmental scoping document and these guidelines prior to approval being given to commence the public review. Where relevant, the environmental review document must also address any requirements of the Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (refer to the Department of Sustainability, Environment, Population and Communities website at www.environment.gov.au). The Commonwealth may, through bilateral agreements, delegate to the State the responsibility for conducting assessments consistent with the provisions of the agreement.The Environmental Protection Authority (EPA) expects the proponent to fully consult with interested members of the public and relevant stakeholders, and to ensure that any other key environmental factors, which may be of interest to the public and stakeholders, are addressed. The environmental review should document the results of all consultation undertaken.

Guidelines for preparing a Public Environmental Review

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to:

- describe the proposal;
- describe the receiving environment;
- outline the potential impacts of the proposal on factors of the environment;
- identify the proposed management strategies to ensure those environmental factors are appropriately protected;
- address the principles of environmental protection; and
- demonstrate that the proposal should be judged by the EPA to be environmentally acceptable.

Throughout the assessment process it is the objective of the EPA to help the proponent to design the proposal to improve the protection to the environment. The Office of the EPA administers the environmental impact assessment process on behalf of the EPA Board.

The primary purpose of the environmental review is to provide to the EPA information on the proposal within the local and regional framework, with the aim of emphasising how the proposal may impact the key environmental factors and how those impacts may be mitigated and managed so as to be environmentally acceptable.

How the proponent will outline the environmental setting of the proposal, address environmental principles and issues/factors and their management, and undertake consultation during the preparation of the environmental review are required to be described in the Environmental Scoping Document (ESD).

To assist proponents, the EPA has published a series of *Environmental Assessment Guidelines, Environmental Protection Bulletins*, *Position Statements* and associated *Guidance for the Assessment of Environmental Factors* which provides an indication of the EPA's views on matters of environmental importance and expectations about how to address specific factors. Proponents should ensure that they are aware of and utilise the information in these documents.

The language used in the body of the environmental review should be kept simple and concise, noting that the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the environmental review. The environmental review will form the legal basis for the Minister for Environment's approval of the proposal and therefore the environmental review should include a description of all the main and ancillary components of the proposal.

Information used to reach conclusions should be properly referenced, including personal communications. Such information should not be misleading or presented in a way that could be construed to mislead readers. Assessments of the significance of an impact should be soundly based rather than unsubstantiated

opinion, and each assessment should lead to a discussion of the management of the environmental factor.

2. Objectives of the environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal, so that the Minister for Environment can consider approval of a well-defined project;
- provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, are minimised and can be acceptably managed;
- communicate clearly with stakeholders (including the public and government agencies), so that the EPA can obtain informed comment to assist in providing advice to government; and
- provide a document which clearly sets out the reasons why the proposal should be judged by the EPA and the Minister for Environment to be environmentally acceptable.

3. Preparation of the environmental review document

Proponents are encouraged to maintain close contact with the Office of the EPA project officer during the preparation of the environmental review. The environmental review should be provided to the Office of the EPA project officer as a draft for comment. At this stage the document should have all figures produced in the final format and colours.

The proponent and Office of the EPA project officer/manager should agree on the time to be taken to review the draft, taking into account the level of consultation during the environmental review preparation, Office of the EPA project officer's availability, the need for external review and any peer review arranged by the proponent. Revision of the document may be requested to ensure that it addresses all topics and issues in these guidelines, can be read by the educated layperson, contains no significant error of science and meets the required format.

Where the proposal is subject to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the environmental review should also address requirements under that Act. These can be obtained from www.environment.gov.au.

When the EPA is satisfied with the standard of the environmental review document it will provide a written sign-off to the proponent, giving approval to advertise the document for public review. The review document should not be advertised for release before written approval is received.

Following approval to release the review for public comment, the final environmental review document should be provided to the Office of the EPA project officer in both hard copy and electronic form, including figures and spatial data in the required format.

Proponents are to prepare and publish the environment review and appendices in electronic format (CD and on the internet), although there remains the requirement

for printed copies of the document. This should be discussed with the Office of the EPA project officer early in the preparation of the environmental review document.

4. Contents of the environmental review document

The environmental review document should include an executive summary, introduction and at least the following:

4.1 The proposal

General requirements

The environmental review document should provide a comprehensive description of the proposal including its location (address and certificate of title details where relevant). Specific matters requiring attention are:

- the identification of the proponent and proposal location;
- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, and decision making authorities and involved agencies; and
- alternatives considered, including location options. This section should provide analysis of alternatives in the following hierarchy that moves from broad/strategic to increasingly narrow/project specific in nature:
    - Need/meeting needs – is this development needed? Consider no-action alternative.
    - Mode/meeting general goals – is this development proposal the best way to meet the general goal? Consider alternative technologies or options.
    - Location/meeting project objectives spatially – what is the best location for the project. Consider alternative locations with a view to minimising environmental impacts.
    - Timing/meeting project objectives temporally – what is the best sequence of development for components of the project?
    - Implementation mechanisms/designing project – What is the best way to optimise the project so as to minimise environmental impacts? Consider detailed site design. layout, technologies and mitigation strategies.

Brief description of the proposal which is the subject of these guidelines

A description of the proposal and location, in sufficient detail to enable readers to clearly understand the nature and scale of the proposal, and to support later discussion of impacts. This should include an outline of the various components of the proposal (including how this proposal relates to other operations or proposals).

Spatial data on the proposal and its location should be provided in the form of both hard copy maps and in accordance with the electronic requirements set out in the Referral Form, available on www.epa.wa.gov.au.

Key characteristics of the proposal

The Minister's statement will bind the proponent to implementing the proposal in accordance with any technical specifications and key characteristics[1] in the environmental review document. It is important therefore, that the level of technical detail in the environmental review, while sufficient for environmental assessment, does not bind the proponent in areas where the project is likely to change in ways that have no environmental significance.

Include a description of the key components of the proposal, including the nature and extent of works proposed. This information must be summarised in the form of a table, an example of which follows:

Table 1: Key characteristics (example only)

Element	Description
Life of project (mine production)	< 5 yrs (continual operation)
Size of ore body	682 000 tonnes (upper limit)
Depth of mine pit	less than 30m
Water table depth	50m below ground surface
Area of disturbance (including access)	100 hectares
Mine operation	Daylight hours only, Monday to Friday
List of major components • pit • waste dump • infrastructure (water supply, roads, etc)	refer 'Plans, specifications, charts' section immediately below for details of map requirements
Ore mining rate • maximum	 • 200 000 tonnes per year
Solid waste materials • maximum	 • 800 000 tonnes per year
Water supply • source • maximum hourly requirement • maximum annual requirement	 • XYZ borefield, ABC aquifer • 180 cubic metres • 1 000 000 cubic metres
Fuel storage capacity and quantity used	50 000 litres; 300 000 litres per year

[1] Changes to the key characteristics of the proposal following final approval would require assessment of the change. Depending on the significance of the change, it would be assessed under either s45C if the environmental impacts are not significant, or section 46 or section 38 if the change is significant. Changes to other aspects of the proposal are generally inconsequential and can be implemented without further assessment. It is prudent to consult with the Department of Environment and Conservation about changes to the proposal.

Plans, specifications, charts

Provide adequately dimensioned plans showing clearly the location and elements of the proposal which are significant from the point of view of environmental protection. Locate and show dimensions (for progressive stages of development, if relevant) of all relevant components of the proposal.

Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection are of relevance here.

Always include:

- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context; and, if appropriate,
- a process chart / mass balance diagram showing inputs, outputs and waste streams.

The plan/s should include contours, north arrow, scale bar, legend, grid coordinates, the source of the data, and a title. The dates of any aerial photos should be shown. Mapping should be provided in electronic form to meet the following specifications:

- Datum: GDA94
- Projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA)
- Format: Arcview shapefile (...shp), Arcinfo coverages, Microstation or AutoCAD (.dgn, .dwg, .dxf.)

Other logistics

- timing and staging of project; and
- ownership and liability for other aspects related to the proposal, such as waste during transport, disposal operations and long-term disposal (where appropriate to the proposal).

4.2 The environment

Provide a description of the existing environment in a local and regional context, with an emphasis on those aspects that may affect or be affected by the proposal, including:

- key ecosystem processes;
- biodiversity;
- existing site condition; and
- other environmental issues that may be constraints or fatal flaws to the proposal.

4.3 Environmental factors and principles

The environmental review should focus on the key or more significant environmental issues and the environmental factors associated with these issues. The EPA has often combined several factors which have clear relationships into environmental issues or broadly interpreted a single factor to encompass a range of related

impacts. These may be significant in a local, regional or cumulative context. Where this occurs, it is important that the factors are still identified.

The identification of key issues and key environmental factors for the proposal must be incorporated into the proponent's environmental scoping document and agreed by the EPA.

The EPA has prepared a *Guide to Preparing an Environmental Scoping Document* and a *Guide to EIA Environmental Principles, Factors and Objectives* to assist proponents of proposals being formally assessed. These guides are available at www.epa.wa.gov.au.

The environmental factors should be addressed within the environmental review document for the public to consider and make comment to the EPA. The EPA is required to address key environmental factors in its report to the Minister for Environment.

Reference to relevant *Environmental Protection Bulletins* and *Position Statements* and demonstration of compliance with associated *Environmental Assessment Guidelines* and *Guidance for the Assessment of Environmental Factors* should be included in the discussion about environmental issues/ factors.

The EPA expects the proponent to fully consult with interested members of the public and take due care in ensuring all other key environmental factors, which may be of interest to the public, are addressed.

Additional environmental factors may be identified during the preparation of the environmental review. These should be addressed in the PER. On-going consultation with the EPA and other relevant agencies is recommended. The Office of the EPA can advise on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

The EPA will expect to see a discussion of the extent to which best practice will be applied to the proposal and also an explanation of how the principles of environmental protection have been given attention, where appropriate.

Discussion under each environmental issue/factor should include:

- a description of where this factor fits into the broader environmental / ecological context (only if relevant - may not be applicable to all factors);
- a clear definition of the area of assessment for this factor;
- the EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal and how is it significant;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal apply best practice and does it meet the EPA's objective as defined above;

- if not, what environmental management is proposed to ensure the EPA's objective is met; and
- predicted outcome.

The proponent should provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings as shown in Table 2:

Table 2: Environmental factors and management (example only)

Environ-mental Factor	EPA Objective	Existing environment	Potential impact	Environmental management	Predicted outcome
BIOPHYSICAL					
vegetation	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b	Proposal avoids all areas of communit y types 20b and 3b	Surrounding area will be fully rehabilitated following construction	Community types 20b and 3b will remain untouched Area surrounding will be revegetated with seed stock of 20b and 3b community types
POLLUTION MANAGEMENT					
Dust	To ensure that emissions do not adversely affect the environment or health, welfare and amenity of people and nearby land uses by meeting statutory requirements and acceptable standards	Light industrial area - three other dust producing industries in close vicinity Nearest residential area is 800 metres	Proposal may generate dust on two days of each working week.	Dust Control Plan will be implemented	Dust can be managed to meet EPA's objective

SOCIAL SURROUNDINGS					
Visual amenity	To ensure that aesthetic values are considered and that measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.	Area already built-up	This proposal will contribute negligibly to the overall visual amenity of the area	Main building will be in 'forest colours' and screening trees will be planted on road	Proposal will blend well with existing visual amenity and the EPA's objective can be met

4.4 Principles

The proponent should provide a table showing how consideration has been given to the principles of environmental protection, as shown in Table 3:

Table 3: Consideration given to principles (example only)

Principle	**Relevant Yes/No**	**If yes, consideration**
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options. (c)	**No**	Investigations required to provide sufficient information to address potential environmental impacts.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	See 3. Information on long-term emissions, greenhouse gas emissions, with respect to Guidance Statement No. 12.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	Flora and fauna surveys to be undertaken. DRF, TECs etc. to be checked. Quantity of vegetation loss.
4. Principles relating to improved valuation, pricing and incentive mechanisms (1) Environmental factors should be included	No	

in the valuation of assets and services. (2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.		
5. *The principle of waste minimisation* All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	

4.5. Environmental management

The EPA expects the proponent to have in place an environmental management system (EMS) appropriate to the scale and impacts of the proposal, including provisions for performance review and a commitment to continuous improvement.

The system may be integrated with quality and health and safety systems and should include the following elements:

- environmental policy and commitment;
- planning of environmental requirements;
- implementation of environmental requirements;
- measurement and evaluation of environmental performance; and
- review and improvement of environmental outcomes.

A description of the environmental management system should be included in the environmental review documentation. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability should be incorporated into the approach on environmental management.

The environmental management system should include plans to manage the key environmental factors, define the performance objectives, describe the resources to

be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

5. Public consultation

A description of the public participation and consultation activities undertaken by the proponent in preparing the environmental review should be provided. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross-reference should be made with the description of environmental management of the factors which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

6. Conclusion

The environmental review document should indicate the proponent's view of the environmental costs and benefits of the proposal. This should be a synthesis of the preceding relevant information and aim to show how the proposal would achieve an overall net environmental benefit.

When presenting this synthesis, the proponent should note that the proponent's own commercial arrangements and aspects such as employment opportunities, including economic benefits that might accrue as a result of these, are not matters that the EPA can consider in its assessment.

Where relevant, the implications of the adoption in the proposal design and operation of best practicable measures to minimise environmental impacts should be mentioned. Proponents should also note how the proposal addresses the object and Principles set out in s4A of the EP Act.

Proponents are also requested to outline the basis upon which they believe the EPA should conclude that the proposal is environmentally acceptable.

7. Availability of the environmental review

The EPA expects the proponent to provide copies of the PER for distribution free of charge to the EPA, Office of the EPA and relevant government agencies, local governments, libraries and other organisations.

The EPA expects copies of the environmental review documentation to be distributed through electronic means (CD and internet), but a number of printed copies will also be required. The specific number of copies required, the type of copy, and the means of distribution, are invariably case-specific and should be agreed with the Office of the EPA project officer/manager during the early stages of preparation of the environmental review document.

Example of distribution requirements:

		Hard copy format	CD format
Supplied to EPA for:			
	Library/Reading Room	2	5
	EPA Members	5	-
	Office of the EPA	3	2
	Minister	1	-
Distributed by Proponent to:			
Government Departments	Department of Environment and Conservation Regional Office	1	1
	Department of Water	2	1
	Department of Mines and Petroleum	2	1
	Department of Indigenous Affairs	1	1
Local Government	Shire	2	-
Libraries	J S Battye Library	3	-
	Shire Library	2	-
	Local Libraries	2	-
Others	Conservation Council of WA	1	-
	Interest Groups	1	-

Attachment 1

The first page of the proponent's environmental review document must be the following invitation to make a submission, with the parts in square brackets amended to apply to each specific proposal. Its purpose is to explain what submissions are used for and to detail why and how to make a submission.

It is the EPA that is inviting submissions. Therefore the invitation should be distinguishable from the Proponent's environmental review document. This is achieved by printing the invitation on different coloured paper (from the environmental review document) and ensuring that no Proponent identifiers, such as name or logos, appear on the invitation, including in headers and footers.

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. Both electronic and hard copy submissions are most welcome.

[The proponent] proposes [brief description of proposal]. In accordance with the *Environmental Protection Act 1986* (EP Act), a Public Environmental Review (PER) has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of [4] weeks from **[date]** closing on **[date]**.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992* (FOI Act), and may be quoted in full or in part in the EPA's report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposal. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether and the reason why you want your submission to be confidential.

Information in submissions will be deemed public information unless a request for confidentiality of the submission is made in writing and accepted by the EPA. As a result, a copy of each submission will be provided to the proponent but the identity of private individuals will remain confidential to the EPA.

The closing date for submissions is: [date]

The EPA prefers submissions on PER documents to be made electronically on its consultation hub at https://consultation.epa.wa.gov.au.

Alternatively, submissions can be

- posted to: Chairman, Environmental Protection Authority, Locked Bag 33, CLOISTERS SQUARE WA 6850, Attention: (project officer); or
- delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth, Attention: (project officer); or

If you have any questions on how to make a submission, please ring the EPA assessment officer, xxxxxx on 6467 xxxx.

Attachment 2

Advertising the environmental review

The proponent is responsible for advertising the release and arranging the availability of the environmental review document in accordance with the following guidelines:

Format and content of the advertisement

The Office of the EPA should approve the format and content of the advertisement before it appears in the media. For joint State-Commonwealth assessments, the Commonwealth also has to approve the advertisement. The advertisement should be consistent with the attached example (Attachment 3).

Note that the Office of the EPA project officer's name should appear in the advertisement.

Size

The size of the advertisement should be two newspaper columns (about 10 cm) wide by about 14 cm long. Dimensions less than these would be difficult to read.

Location

The approved advertisement should appear in the news section of the Saturday or Monday edition of the main daily paper (*The West Australian*), and in the news section of the main local paper.

Timing

Within the guidelines already given, it is the proponent's prerogative to set the time of release, although the Office of the EPA should be kept informed. The advertisement should appear at the commencement of the public review period. For PERs with a review period in excess of 4 weeks, the same advertisement should appear again two weeks prior to the closure of the public review period. The advertisement should not go out before the report is actually available to the public, or the review period may need to be extended.

Throughout the public review period, the document should be freely available for distribution in both CD and hard copy forms and as a download from the proponent's website. If the document is unavailable during the review period, the submissions period will need to be extended to reflect the delays.

Attachment 3 Example of the newspaper advertisement

Proponent Name

Public Environmental Review

TITLE OF PROPOSAL

(Public Review Period: [date] to [date])

[Proponent] is planning to [brief description of proposal].

A Public Environmental Review (PER) has been prepared by the company to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The PER describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

[Proponent] has prepared a project summary which is available free of charge from the company's office address. The PER is available for examination on the following web site – www.xxxxxxxx.com.au.

Copies of the PER may be purchased for [$10] from:
Company Name
Street
Suburb/Town WA Postcode
Telephone: (08) 9xxx xxxx

A CD version of the PER can be obtained from the above address.

Copies of the PER will be available for examination at:

- Department of Environment and Conservation
  Library/Reading Room
  4th Floor, The Atrium
  168 St Georges Terrace
  PERTH WA 6000
- Department of Environment and Conservation Regional/District Office - if appropriate
  [address]
- [Local Authority] public libraries
- J S Battye Library

Public submissions close on DATE

The EPA prefers submissions to be made electronically on its consultation hub at https://consultation.epa.wa.gov.au

Alternatively submissions can be

- posted to: Chairman, Environmental Protection Authority, Locked Bag 33, CLOISTERS SQUARE WA 6850, Attention: (project officer); or
- delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth, Attention: (project officer).

If you have any questions on how to make a submission, please ring the EPA assessment officer, xxxxxx on 6467 xxxx.

Attachment 4 Air quality and air pollution guide:

The Department of Environment and Conservation (DEC) is frequently required to review assessments of the air quality impact of existing or proposed sources of air pollutants. This often occurs in the course of individuals or companies meeting their obligations under the *Environmental Protection Act 1986* (the EP Act), notably environmental impact assessment under Part IV of the EP Act or in relation to Works Approvals and Licences under Part V of the EP Act. Guidance notes have been prepared to provide an understanding of the DEC's expectations with respect to air quality modelling. These may be found at

http://portal.environment.wa.gov.au/pls/portal/url/item/DCF0AF7CDA113864E03010AC6E055303

Attachment 2

MATTERS THAT MUST BE ADDRESSED IN A PER AND EIS (SCHEDULE 4 OF THE EPBC REGULATIONS 2000)

1 General information

1.01 The background of the action including:

(a) the title of the action;

(b) the full name and postal address of the designated Proponent;

(c) a clear outline of the objective of the action;

(d) the location of the action;

(e) the background to the development of the action;

(f) how the action relates to any other actions (of which the Proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action;

(g) the current status of the action; and

(h) the consequences of not proceeding with the action.

2 Description

2.01 A description of the action, including:

(a) all the components of the action;

(b) the precise location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts;

(c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts;

(d) relevant impacts of the action;

(e) proposed safeguards and mitigation measures to deal with relevant impacts of the action;

(f) any other requirements for approval or conditions that apply, or that the Proponent reasonably believes are likely to apply, to the proposed action;

(g) to the extent reasonably practicable, any feasible alternatives to the action, including:

(i) if relevant, the alternative of taking no action;

(ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action; and

(iii) sufficient detail to make clear why any alternative is preferred to another;

(h) any consultation about the action, including:

(i) any consultation that has already taken place;

(ii) proposed consultation about relevant impacts of the action; and

(iii) if there has been consultation about the proposed action — any documented response to, or result of, the consultation; and

(i) identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.

3 Relevant impacts

3.01 Information given under paragraph 2.01(d) must include

(a) a description of the relevant impacts of the action;

(b) a detailed assessment of the nature and extent of the likely short term and long term relevant impacts;

(c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;

(d) analysis of the significance of the relevant impacts; and

(e) any technical data and other information used or needed to make a detailed assessment of the relevant impacts.

4 Proposed safeguards and mitigation measures

4.01 Information given under paragraph 2.01(e) must include:

(a) a description, and an assessment of the expected or predicted effectiveness of, the mitigation measures;

(b) any statutory or policy basis for the mitigation measures;

(c) the cost of the mitigation measures;

(d) an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;

(e) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program; and

(f) a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation

measures proposed to be taken by State governments, local governments or the Proponent.

5 Other Approvals and Conditions

5.01 Information given under paragraph 2.01(f) must include:

(a) details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including:

(i) what environmental assessment of the proposed action has been, or is being carried out under the scheme, plan or policy; and

(ii) how the scheme provides for the prevention, minimisation and management of any relevant impacts;

(b) a description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action;

(c) a statement identifying any additional approval that is required; and

(d) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.

6 Environmental record of person proposing to take the action

6.01 Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:

(a) the person proposing to take the action; and

(b) for an action for which a person has applied for a permit, the person making the application.

6.02 If the person proposing to take the action is a corporation — details of the corporation's environmental policy and planning framework.

7 Information sources

7.01 For information given the PER/EIS must state:

(a) the source of the information; and

(b) how recent the information is; and

(c) how the reliability of the information was tested; and

(d) what uncertainties (if any) are in the information.

From: Kathryn Schell [redacted s47F]
Sent: Friday, 6 June 2014 6:26 PM
To: Michael Christensen; Hans Jacob
Cc: Bruce, Barry (O&A, Hobart); Bax, Nic (O&A, Hobart)
Subject: Shark PER Release

Hey Guys

Can you please make sure you email the link to the PER to Nic Bax and cc Barry Bruce at CSIRO on Monday (preferably with the letter) but either way, I said we would email so they had all the available time.

[redacted s47F]

Cheers

Kath

From: Michael Christensen <s47F
Sent: Wednesday, 25 June 2014 1:23 PM
To: Bax, Nic (O&A, Hobart)
Cc: Bruce, Barry (O&A, Hobart); Hans Jacob
Subject: FW: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Release of PER document

Dear Prof Bax

This email is to just touch base with you to check that you have received the hard copy PER and whether you needed anything further to undertake the peer review.

If you can please let me know whether you have received it and if you do need anything further it would be appreciated.

Kind regards

Michael Christensen

From: Michael Christensen
Sent: Monday, 9 June 2014 9:20 AM
To: s47F
Cc: Anthony Sutton; Hans Jacob; Kathryn Schell; s47F
Subject: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Release of PER document

Dear Prof Bax

Please find attached a letter from the Office of the Environmental Protection Authority regarding the Public Environmental Review (PER) document for the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017.

The original letter and a hard copy of the PER is being mailed to your address. In the interim, please find below a link to the proponent's website and the electronic version of the PER.
http://www.dpc.wa.gov.au/Consultation/Pages/PublicEnvironmentalReview.aspx

Kind regards

Michael Christensen
Environmental Officer
Infrastructure Assessment Branch
Office of the **Environmental Protection Authority**
The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 33, Cloisters Square, Perth WA 6850
direct: s47F | reception: 08 6145 0800 | fax: 08 6145 0895
email: s47F | web: www.epa.wa.gov.au

Office of the
Environmental Protection Authority

From: Hans Jacob [redacted]
Sent: Monday, 30 June 2014 11:07 AM
To: Bax, Nic (O&A, Hobart); Michael Christensen
Cc: Bruce, Barry (O&A, Hobart)
Subject: RE: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Release of PER document

Nic

Your suggestion to provide us with an outline of areas is good one and we'd be happy to receive it.

Also happy to have a phone hook-up anytime soon if you wish to seek clarification on WA EPA assessment process and the Environmental scoping document.

Thanks

Hans

Hans Jacob
Manager
Infrastructure Assessment Branch
Office of the **Environmental Protection Authority**
The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 33, Cloisters Square, Perth WA 6850
direct: [redacted] | reception: 08 6145 0800 | fax: 08 6145 0895
email: [redacted] web: www.epa.wa.gov.au

Office of the
Environmental Protection Authority

From: [redacted]
Sent: Wednesday, 25 June 2014 12:32 PM
To: Michael Christensen
Cc: [redacted] Hans Jacob
Subject: RE: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Release of PER document

Dear Michael

Thank you, we received the hard copy PER last week. We are still digesting it (!) and will let you know whether we need any further information to interpret the report or clarify what would be useful to include in the review. As there is not much time to address comments on the review, I wonder whether it would be useful to provide at an earlier stage an outline of the areas that we are intending to address, so that we can see whether we both have the same understanding of the scope?

Regards

Nic

From: Michael Christensen [redacted]
Sent: Wednesday, 25 June 2014 1:23 PM

To: Bax, Nic (CMAR, Hobart)
Cc: Bruce, Barry (CMAR, Hobart); Hans Jacob
Subject: FW: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Release of PER document

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Cc: Anthony Sutton; Hans Jacob; Kathryn Schell; s47F
Subject: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Release of PER document

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email: s47F web: www.epa.wa.gov.au

Office of the
Environmental Protection Authority

CSIRO
www.csiro.au

Western Australian Shark Hazard Mitigation Drum Line Program 2014 – 2017

Peer review report

July 2014

Client: Government of Western Australia - Environmental Protection Authority

Western Australian Shark Hazard Mitigation Drum Line Program 2014 – 2017

Peer review report

July 2014

Government of Western Australia - Environmental Protection Authority

Contents

Scope of the review

This document provides a peer review of the Western Australian Shark Hazard Mitigation Drum Line Program 2014–17 (the drum line program) as commissioned by the Western Australian Environmental Protection Authority (EPA). The review specifically considers the information provided by the Department of Premier and Cabinet (DPC), identified herein as 'the proponent', within the Western Australian Shark Hazard Mitigation Drum Line Program 2014–17: Public Environmental Review document, identified herein as the 'PER'.

The three year program was referred to the EPA for assessment under section 38(1) of the *Environment Protection Act 1986* (EP Act) and to the Commonwealth Department of the Environment (DotE) for assessment under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Under the Terms of Reference, this review provides advice to the EPA on the findings, conclusions and proposed management for the implementation of the Western Australian Shark Hazard Mitigation Drum Line Program 2014–2017, specifically with respect to points 1 and 2 as identified in the Work and Output required as stated in Table 1 of the Environmental Scoping Document (ESD).

Specific review points:

The following provides specific comments based on the review of the proponent's information as provided in the Public Environmental Review (PER), against the Environmental Scoping Document (ESD). The comments are identified against specific points of reference listed in Table 1 of the ESD where appropriate.

Establish clear measurable objectives and performance measures, including trigger points and corresponding management actions

This is a requirement under the Environmental Scoping Document (ESD 2a + b[1]) and is poorly addressed by the proponent. The drum line program has the potential to be a long-term program, continuing for an unspecified timeframe (after the initial three-year period) if it is approved. It is very important that the management plan has clear and measurable objectives to identify what constitutes success along with a well-specified monitoring program that includes performance indicators and reference points (preferably target and limit) to determine when or whether success is achieved. These reference points should also be designed to determine if the program is not achieving its objectives and thus requires adjustment or cancellation.

There remains a need to establish clear maximum levels of catch (trigger-points) for each species (these are not set out in the management plan) and to identify actions that will be taken if these maximum levels are reached or exceeded. Such actions might include a reduction in effort (reducing the number of drum lines in operation) or an increase in offsets. A 'review' of catches at the end of the program or at the end of each year, while an important part of monitoring may be too late for any effective management response.

An agreed process to develop maximum catch levels for each species is required. These maximum levels should be linked to the overall objectives and subject to revision as additional information becomes available.

The management of the program would be greatly improved by establishing a management advisory committee similar to those operating under fisheries management. Such a committee would be responsible for overseeing the management and reporting of the program including the establishment of objectives, reference points and corresponding management actions. Such committees usually have an independent chairperson, an expert with the specific scientific expertise required to support the committee, and stakeholder representatives as appropriate. In this case a DPC representative, a Department of Fisheries – Western Australia (DoF) research member, an independent research member, an environment/conservation member and other relevant stakeholders would be appropriate.

Operational data

Summary data provided in the PER document from the trial program are not sufficient to adequately monitor and assess the program. A lack of suitable data collection would limit the ability of the proponent to undertake robust assessments of population-level impacts on all species captured and would prevent an overall population assessment of white sharks in particular – (ESD 2c).

[1]Refers to identified points in the 'Work and Output Required' section of Table 1 in the Environmental Scoping Document

The type of information required to improve monitoring and guide management in both the static and rapid response components of the program, should include but not be restricted to:

- number of drumlines active each day (time of deploy/retrieval for each)
- location of each drumline (latitude/longitude) and catch recorded (including zero catch)
- frequency + time of checking + time of baiting/rebaiting
- type of bait used on each drumline
- catch depredation rates
- bait loss or indication of shark interaction with baits noted for each
- species caught (including photo validation of all sharks taken)
- length, sex of all species taken
- activity/viability status of captured sharks
- reporting the capture of tagged sharks

Biological sampling of captured sharks

Any future assessment of the program, if it proceeds, would be compromised if sufficient data were not collected from the start. Failure to do so is one of the significant issues limiting an overall understanding of the initial impact of the NSW shark program, as data collected in the early part of the program were incomplete (Reid and Krogh 1992). The capture of sharks targeted by the WA program represents an opportunity for those animals to contribute to an assessment of population size and trends as well as provide information that will reduce uncertainty in demographic parameters used in population modelling. This would in turn inform future management decisions. Sampling of white sharks in particular would be vital. It is important to recognize that contributing samples to research should not be seen as a reason for endorsing the proponent's program but, that not collecting such samples where it is possible to do so would not comply with best practice (ESD 2e) and limit the ability to adequately monitor and improve the program. It is important that such data collection is established as a standard part of the program rather than being introduced on an 'as per request basis'.

It is extremely important that all dead or euthanized white sharks and other listed species (e.g. mako and grey nurse) be landed and returned to the DoF for examination by trained staff. Important samples would include:

- tissue sampling for genetic analyses;
- a full biological examination (e.g. morphormetrics, tissue sampling for genetics, vertebral samples for aging, reproductive state, stomach contents)
- other samples to be provided for specialist value adding research programs on request.

A tissue sample should be retained from all released white sharks for genetic assessment and to contribute to estimates of population size.

It is critical that these data and samples be collected by DoF to ensure consistency in data collection and longevity in data management. Specific samples such as vertebrae and tissue (for genetic analysis) should be submitted to a central long-term repository (e.g. CSIRO, museum).

Ideally all sharks (including tiger sharks) should be sampled to provide adequate data on all species impacted. Where possible, all dead and euthanized sharks should be landed and a full biological examination performed. Where this is not possible, sampling should be undertaken onboard the capture vessel prior to disposal of the carcass. Sampling and data collection should include:

- an accurate measure of total or fork length
- sex and reproductive state

- tissue sampling (genetics)
- vertebrae (aging)
- an assessment of injuries sustained during capture (e.g. hook damage)

Investigation of post-release survival for all species – priority for white sharks

Post release mortality is unknown for the sharks caught in the program but as indicated by the proponent, it may be high. Research on post-release mortality would improve the proponent's overall ability to assess and monitor impacts. Such data combined with catch depredation rates are likely to provide information on whether sharks suffering short-term post release mortality may be attracting other sharks to the local area and changing the rate of catch.

Improve the accuracy of data collection from commercial fisheries within WA regarding white shark bycatch

Understanding the overall impact of the program would be greatly improved by gaining a better estimate of cumulative impacts on white sharks across the range of the south western population. This would require a dedicated program to provide more robust estimates of the current level, regional and interannual variability and trend in white shark catches for fisheries in WA and other jurisdictions across the population's range, including where possible, the collection of biological samples from sharks taken in these fisheries (ESD 1d).

Avoid targeting tagged sharks

The detection of tagged sharks provides immediate opportunities for actions to mitigate risk other than setting additional drumlines in an attempt to capture. It is important that the detection of tagged sharks not automatically initiate the rapid response component of the program. Such an exemption would be consistent with the ESD mitigation hierarchy of – avoid, minimise, rectify and offset (ESD 3). A decision tree listing the alternative actions that could be taken on detection of a tagged shark, and when each option would be used, should be developed to support rapid decision making.

Avoid areas of known white shark aggregations

The conclusion of negligible risk posed by the program to white sharks in particular is based on the proponent's estimate of shark capture rates in similar programs elsewhere and capture rates by DoF research staff when previously operating in the Marine Monitored Areas (MMAs). The rapid response component of the program (RR), however, is not restricted to the MMAs and may occur anywhere in WA waters. Setting of RR drumlines in areas where white sharks are known to aggregate (e.g. in the vicinity of finfish schools [e.g. snapper - *Pagrus auratus*], around whale carcasses [floating or stranded], or around seal colonies) could rapidly elevate catch levels and increase the risk of population impact. These areas should be exempt from RR deployments.

Gear configuration

The proponent's identifies the use of extremely large hooks in the program (25-O cited). If the rate of significant injury or post-release mortality is high in non-target animals, the proponent should consider using more conventional hook sizes. This may require an assessment that balances a higher catch rate of non-target animals with the benefit of releasing these in better condition.

Detailed comments pertaining to the PER document

Clear, measurable objectives and performance measures, including trigger points and corresponding management actions

The stated aims of the proponent's drum line program are variously described as being to *"provide additional protection from the risk of shark interactions to water users at a select number of swimming beaches and surf spots in the metropolitan and southwest regions of the State"* or more simply to capture *"potentially dangerous sharks which come into close proximity of popular swimming beaches and surf breaks during the high use summer months"*. The proponent further states that the proposed program is designed to have a localised impact on the abundance of target sharks and is not designed to significantly affect the total size of these species. These aims by themselves have no clear measures of what would constitute success. However, their implicit goal is to improve public safety.

The proponent indicates that the drum line program is not considered to be a permanent shark hazard mitigation strategy and that *"..it is hoped that at some time in the future, drum lines may be able to be replaced with alternative mitigation strategies"*. This suggests it will be the success in developing these alternative strategies, as opposed to any measured success of the drumline program per se, which will dictate the period over which the drumline program may eventually be run. However effective monitoring against agreed criteria will be essential to estimating the value of the program.

The proponent clearly indicates that the scope of the assessment *"does not include an examination of the degree to which the use of drum-lines would reduce risks associated with human-shark interactions"*. Such an assessment is not a requirement under the ESD or the referral process under the EPBC Act. However, the management of the program would be improved by such an assessment given that reducing such risks is the implicit goal of the program.

A review of the QLD Shark Control Program recommended that a series of formal reference-points be determined (QDPI&F 2006), although that review failed to recommend what such reference points might be based around, or what actions might be taken should a (limit) reference point be reached. For the proponent, a simple reference point might be reaching or exceeding the anticipated annual catch, or another specified catch point, of any target species (e.g. 10 individuals in the case of white sharks). Reference points are, however, of little value unless reaching or exceeding them instigates a predetermined and agreed management response or action, such as a redirection or reduction in effort. An open-ended, no limit catch of target species (particularly listed/migratory species) would be a demonstrably poor management arrangement for the program and could not be considered as being environmentally sensitive, compliant with the EPBC Act or meeting Australia's obligations under international treaties (e.g. CMS[2]). Ensuring there are clearly defined and measurable objectives ensures that agreed triggers and ensuing actions can support those objectives and that management decisions are rational, defensible and transparent. Such management frameworks are standard in fisheries and environmental management and should be applied here.

While it may be possible, over time, to monitor the local and total biological impacts of the drum-line program on different shark populations, it will be much harder to evaluate the program's success in the context of its implicit, overarching goal of improving public safety. Given the higher than expected capture rate of tiger sharks in the trial period of the program (including 50 over the target 3m TL)[3], it is clear that

[2] Convention on Migratory Species

[3] The proponent's report does not specifically state the number of tiger sharks over 3m TL that were caught during the trial drum-line program. This number was calculated based in the information in Figure 3 of Appendix 7.

the number of sharks within the MMAs (at least for that species) is higher than previously considered. It is therefore reasonable to assume that the presence of tiger sharks in the vicinity of beaches within these MMAs, and hence the encounter frequency between tiger sharks and waters-users, is also much higher than previously considered. It is thus notable that no attacks in either MMA have been attributed to tiger sharks despite their obvious presence during periods of high in-water use and their demonstrated capability to injure humans[4]. This suggests, as noted in other areas, that the presence of sharks alone is a poor indicator of attack risk and that the variability in the number of attacks recorded is a poor indicator of the overall status of shark populations. This conclusion concurs with some statements within the proponent's document (e.g. Appendix 9) but is at odds with other sections of that same document and other areas of the proponent's report in general that imply a more direct relationship. It also presents a challenge for the proponent's implementation of an 'imminent threat/rapid response' as the sighting or detection[5] of a shark > 3 m TL does not, by itself, indicate that shark poses an imminent threat of attack. Sharks, even those over 3 m TL, are natural and likely frequent visitors to near-shore waters along areas of the WA coast including within the MMAs. Detections of tagged sharks are likely to constitute only a small proportion of the total number of visitors.

The numbers of sharks in the MMAs are likely to be more tightly correlated with the number of human-shark encounters (the occurrence of sharks and people in close proximity). However, these data are not recorded and many - if not the majority, of such encounters likely go unnoticed because few result in incident (= attack). The relationship between encounters and incidents is likely complex, time-variant, spatially variable and non-linear[6]. The removal of any shark that has the potential by nature of its size and identity (species) to bite a person no doubt reduces the risk of such an incident occurring. What is unclear is whether that particular shark would have posed an imminent threat to public safety, or to what extent the overall level of risk within a region is reduced by its removal. Shark control programs work best when they reduce the population size of sharks within the area in which they cover (i.e. the MMAs) and specifically along the beaches that such programs operate. This occurs as a consequence of either localised depletion, continuing interception of sharks entering these areas, or as a result of creating a more widespread overall population decline. The extent of the localised depletion or population-wide decline required to reduce risk to an 'acceptable' level is much more difficult to identify, particularly when an acceptable level has not been identified. A zero risk of shark attack is an unattainable goal without local extinction.

The implementation of long-running shark control programs in NSW, Qld and South Africa based either primarily on large-mesh gillnets or a mix of drumline and mesh nets have seen a parallel reduction of shark-related fatalities within their footprint. However, they have not eliminated shark attacks within their footprint. The NSW shark control program operates at 51 beaches, spanning 200 km out of the approximate 1100 km of the NSW coast (Green *et al.* 2009). Despite the notable statistic of having seen only one fatality at a beach covered by the NSW shark control program, 29 shark attacks resulting in injury (approximately 20% of all attacks in NSW) have occurred at meshed beaches since the program's inception, including five attributed to white sharks. The single fatality was one of those attributed to a white shark. It is unknown how many shark attacks might have occurred if the NSW shark control program was not in operation or how many of those that have occurred may have resulted in fatality if concurrent improvements in rescue procedures and medical response times had not occurred over the same period.

There are a number of behaviours in white sharks that can lead to conflicting interpretations of the likely effect of a localised fishing activity such as the proponent's drumline program. White sharks are highly mobile and migratory, spending long periods travelling between sites of temporary residency. Satellite and acoustic tagging of white sharks have revealed long distance movements for individuals in the south-western Australian population.

[4] Identifying the species involved in shark attacks can be difficult unless tooth fragments are found or the wound/bite pattern provides clear evidence. There are scientific reports that that discuss and address these difficulties (e.g. Lowry *et al.* 2009).

[5] Refers to the detection of an acoustic tagged shark by an acoustic receiver or location data from a shark tagged with a satellite tracking tag

[6] The non-linear relationship between the incidence of shark attack and numbers of sharks is correctly noted in Appendix 4.

Examples include multiple individuals tracked moving between the Neptune Islands in South Australia, west through the Great Australian Bight, past Perth to the Exmouth region of northwest Western Australia and return (Bruce *et al.* 2006, Bruce and Bradford 2013).

Similar long distance movements are commonly reported for white sharks in eastern Australia (Bruce and Bradford 2012) and other areas of the world (Boustany *et al.* 2002, Bonfil *et al.* 2005, Weng et al. 2007, Jorgensen et al 2009, Duffy et al 2012, Domeier and Nasby-Lucas 2013). This behaviour involving long distance movements is similar to tiger sharks in Hawaii (Holland *et al.* 1999) where drum line-based shark control programs were variously trialled between 1956 and 1976 to reduce the incidence of attacks by that species. These programs failed to reduce the incidence of shark attack and were terminated (Wetherbee *et al.* 1994). It was also noted that the localised fishing for such wide-ranging sharks after an attack was of limited use if the objective was to catch the shark responsible (Holland *et al.* 1999). The proponent's rapid response policy to deploy drum lines after a shark attack incident might similarly meet with a low rate of success.

However, even comparisons to the Hawaiian shark control program may not be appropriate. White sharks can also show patterns of site and movement pathway fidelity, where some individuals may revisit certain locations, or follow similar pathways during travel periods over different years (Domeier and Nasby-Lucas 2008, Anderson *et al.* 2011, Bruce and Bradford 2012). If such cases of fidelity to the MMA regions were apparent, then sharks that followed such behaviour may be at a higher risk of capture than those that do not, with their capture resulting in an overall localised depletion (of returning animals) and hence a reduction in shark-people encounters. What is unknown is how many white sharks move through the MMAs, how many may temporarily reside in these areas (if any), of these animals - how many are likely to return over multiple years and, if a shark is removed, how long it will be before another shark adopts similar behaviour. What is also unknown, and unlikely to be known, is what percentage of sharks that occur in MMAs end up presenting a true threat to public safety by nature of their encounter circumstance.

The failure to catch any white sharks in the trial (January to April) period of the static drumline program does not necessarily reflect the limited capacity of the program do so. White sharks are more commonly encountered during the winter to early summer period in waters off the designated MMAs and a low level of capture would be expected during the time of year the trial was undertaken. The low level of catch of white sharks does not necessarily indicate that captures during the full period of the program (if implemented) can also be expected to be low. There are few data to guide what an expected level of catch might be. However, the proponent's decision to exclude static drumline fishing from the majority of the winter-spring period will no doubt reduce the level of potential impact on the species.

These uncertainties in shark behaviour make the proposed drum-line program a quite uncertain management response to the threat of white shark attacks. It is important that this aspect of the program be recognised by the managers and the public so that sufficient data are collected to test program effectiveness and that unrealistic expectations are not raised in the public using the beaches.

Operational details and draft management plan

The draft management plan contains no performance indicators that relate to the catch of target species. Thus the efficacy of the program in meeting its objectives and the risks of exceeding acceptable catch levels are not identified performance measures. This is not 'best practice'. The experimental nature of this management response suggests that this program, if approved, be trialled as a strict adaptive management approach.

Further provisions need to be established by the proponent to meet monitoring requirements of adaptive management including standard data collection and the landing for biological examination of animals caught and killed by the program.

The definition of a shark posing an *'imminent threat'* requires further clarity. It appears to have been applied to the confirmed sighting of a shark, as opposed to that shark's behaviour. Although the wording of Appendix 3: *Guidelines for fishing for sharks posing an imminent threat to public safety* suggests that sighting a shark by itself may not necessarily constitute an imminent threat, the application of this policy during at least the trial program, as identified by the proponent, appears to have been based on sightings alone. Sharks are normal visitors to inshore environments and the sighting of a shark or the ability to observe its path (e.g. from the air) provides alternative mitigation opportunities by way of beach closures, to attempts at catching and removing it.

Alternatives are also specifically available when the situation involves a shark tagged with either an acoustic tag which can be monitored by one of the proponent's VR4G iridium/GSM-linked acoustic receivers, or a satellite tracking tag. Such sharks are tagged for research purposes and provide key information on shark movements that will likely assist the proponent in understanding shark behaviour, population status and the impacts of the proposed program. If the opportunities are used well, the independent detection of acoustically tagged sharks will also provide information on the proportion of sharks entering that MMA that are being detected. The detection of tagged sharks, particularly acoustic-tagged sharks, provides immediate opportunities for actions to mitigate risk other than setting additional drumlines in an attempt to capture. The proponent should clearly identify that the detection of tagged sharks will be exempt from the rapid response component of the program. Such an exemption would be consistent with the ESD mitigation hierarchy of – avoid, minimise, rectify and offset (ESD 3).

The conclusion of 'negligible risk' posed by the program to white sharks in particular is based on the proponent's estimate of shark capture rates in similar programs elsewhere and capture rates to-date by DoF research staff in the MMA areas. The rapid response component of the program (RR), however, is not restricted to the MMAs and may occur anywhere in WA waters. Setting of RR drumlines in areas where white sharks are known to aggregate (e.g. in the vicinity of finfish schools such as seasonal snapper *Pagrus auratus* aggregations, whale carcasses - floating or stranded, or seal colonies) could rapidly elevate catch levels and increase overall population impact. These areas should be exempt from RR deployments.

The description and configuration of gear used under the program identifies circle hooks of size described as 25-O but provides no details of the dimensions of these hooks. There are no standard size definitions for hooks, and hook sizes are not comparable between manufacturers or between different hook types. Thus a 25-O hook by itself provides little information. Media images and reporting of the hook size used indicates that it is particularly large. Although the proponent identifies that this hook type was chosen to reduce the take of non-target animals, it is clear that it is reasonably effective at taking non-target sized sharks. What is not reported by the proponent is the extent of injury sustained by non-target animals when caught using this gear. The literature cited by the proponent on the benefit in using circle hooks (Godin *et al.* 2012) refers to commercially available and considerably smaller hooks. The results of Godin *et al.* (2012) would not be applicable to the proponent's gear type.

If the rate of significant injury or post-release mortality is high in non-target animals, the proponent might consider using more conventional hook sizes. This may require an assessment that balances a higher catch rate of non-target animals with the potential for releasing them in better condition.

Comments on overall risk assessment

The proponent recommends the development of a range of 'acceptable catch levels' for target species but does not identify actions to be taken if these acceptable levels are reached or exceeded. A review of catch rates at the end of each year or at the end of the program is not a 'best practice' management strategy. The setting of catch reference points and established actions to be undertaken should these be reached is a clear directive in the ESD – see also comments above on the Draft Management Plan.

The risk assessment, specifically as it relates to white sharks, draws heavily on the analyses presented in Appendix 9: *A risk-based, weight of evidence approach to determine the range of plausible estimates for the south-western Australian population of white sharks - Working Draft*. It specifically draws on estimates of population size provided in that document and the conclusion that white shark numbers are increasing. However, there are significant flaws in the conclusions presented in Appendix 9 and the lack of information provided in that document on how historical catch scenarios were developed diminishes confidence in the proponent's risk assessment for this species (see below for specific comments on Appendix 9). This does not necessarily mean that the conclusion of *negligible risk* is incorrect, but the information provided is inadequate to judge that level of risk.

It is, however, possible that white shark numbers have increased. What is most likely to have been significant for the white shark population west of Bass Strait (including WA waters) since the species protection is the reduction in effort within fisheries previously identified by Malcolm *et al.* (2001) as responsible for the highest bycatch of the species. The reduction in effort in target shark fisheries in the Southern and Eastern Scalefish and Shark Fishery (SESSF) as well as a reduction in effort in Western Australian shark fisheries (including spatial closures) have been directed at sustaining commercial species and reducing impacts on marine mammals vulnerable to the gears used. The reduction in effort has likely resulted in a reduced impact on the white shark population by means of reduced bycatch and the survival through the release of some that are caught. There is some evidence that white shark populations in other areas of the world have benefited from a combination of their protection and fisheries management actions designed to improve the status of commercial shark species (Burgess *et al.* 2014; Curtis *et al.* 2014). Thus it is also plausible that white shark populations have benefited from these similar actions in Australia, but there is little empirical data to confirm this.

The risk assessment provided by the proponent indicates that the catch of 163 tiger sharks in the January to April trial program of which at least 64 were dead or euthanized and actual mortalities likely to be significantly more was "*not considered to have exceeded those outlined within the initial risk assessment which would generate a negligible impact*". The proponent then identifies that the 'annual' catch levels of the extended program (November to April) is expected to be 300. The original risk assessment estimated that only 10-20 tiger sharks would be killed by the trial program and that the number required to induce a measurable change in the tiger shark population would be in the order of 100s. This suggests that the extended program has the capacity to create a measurable change in the population of tiger sharks, particularly if post release mortality is high. Whilst this level of impact may be sustainable, it would again be good practice for the proponent to have a clearly defined upper catch limit under the program to reduce the risk of adverse population and ecosystem level impacts.

Review of key advice documents included in the PER

Two documents listed in the Appendices contribute key information to the proponent's risk assessment and conclusions. One of these documents is a published DoF report the other is an unpublished working draft also produced by the DoF. These two documents are reviewed below.

Comments on Appendix 4: A correlation study of the potential risk factors associated with white shark attacks in western Australian waters. DoF Occasional Publication 109 (2012)

This document compares data on white shark attacks in Western Australian waters to a series of other data sets in the form of linear correlations. The report concludes that the incidence of white shark attacks in WA waters has *'slowly increased over the past two decades'* and that this has occurred at *'a rate faster than human population growth'*. This finding is similar to that reported by Curtis *et al.* (2012) in their world-wide analyses of white shark attacks, but is not consistent with the study of West (2011) who reported that the increase in incidence of shark attacks (albeit referring to incidents from all species combined) was similar to human population growth across Australia as a whole. Irrespective of these comparisons, all such studies have concluded a steady increase in the incidence of white sharks over time.

There are many difficulties when simply comparing the incidence of shark attacks to human population growth. The simple statistic of human population growth does not take into account variations in regional demographics, changes in human population distribution and variations in lifestyle and behaviour of people over time. Specifically, it does not take into account changes in recreational water use which no doubt has varied over time in WA waters.

The proponent concludes statistical or graphical support for significant or plausible correlations between shark attacks and eight out of 17 data series examined. The statistical tests used to achieve these results are not described, a quantitative level of significance is quoted in only three cases and there is no rigorous definition of how 'plausibility' was assessed when it was concluded. The report does not provide sufficient information to permit a thorough assessment of its scientific rigor.

The report, however, makes two useful observations– these are that available data in WA suggest:

a) the incidence and annual regularity of white shark attacks has slowly increased since 1995/96 and,
b) attacks by white sharks tend to occur more frequently during winter and spring.

The remaining correlations provide little useful information and, in general, are more likely to be heavily biased by hidden factors that influence the behaviour of water users and the areas that they use, rather than a relationship with shark attack.

Correlation data can be a useful method for developing hypotheses about what causes something to happen. However, the greatest limitation of such analyses is interpreting any observed correlations in a useful way. Although a causal relationship between two data sets leads to a correlation between them, a correlation may occur between two sets of data even when there is no causal relationship. A commonly expressed summary of this is the phrase *'correlation does not imply causation'* (Aldrich 1995). The report thus establishes that correlations exist between various data series and shark attacks but fails to test the validity of any of these correlations.

The proponent makes somewhat of an over-use of data in the figures of Appendix 4 with five showing different correlations defined by aggregating the same data in five different ways. The use of these multiple figures for the same data does not materially increase the significance of the results.

It is notable that the main theme implied by the findings in Appendix 4 is that the rate of white shark attacks in WA cannot be explained by human population growth. This theme is also mentioned in other sections of the PER document. Yet the proponent does not examine a direct correlation between shark attack and human population size. Notwithstanding the above caveats, when these data are examined there is a significant positive linear correlation between these two variables for the greater Perth area where the majority of attacks have occurred (Figure 1) although this relationship only explains 34% of the variability in the data.

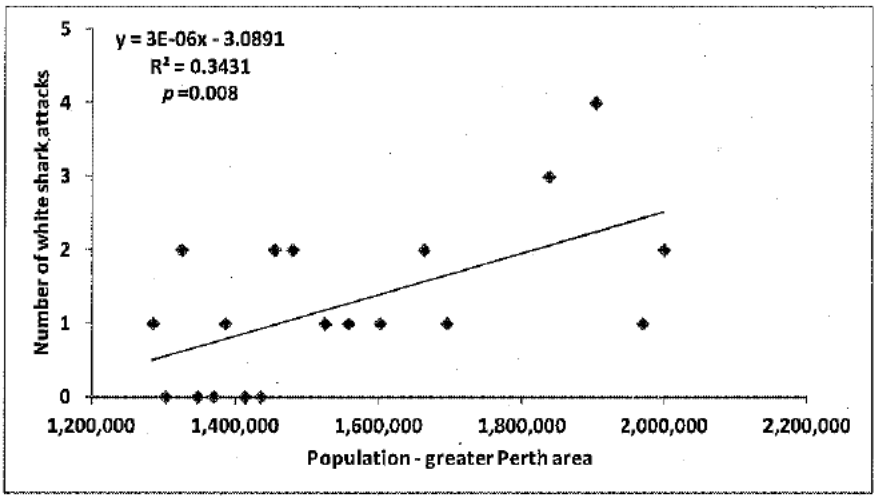

Figure 1: Correlation between the annual (financial year) incidence of white shark attacks in WA and the Greater Perth population (1995/96 to 2013/14); Shark attack data sourced from the Australian Shark Attack File; Population data sourced via the Australian Bureau of Statistics. The equation provides the details of the plotted regression line, its defined R^2 value and statistical significance (p).

Thus an equally plausible contributing factor to the slow increase in shark attacks over time is an increase in the human population size in Western Australia. This factor is ignored in Appendix 4. The actual correlation between the incidence of shark attack and population growth may be even higher as population growth and recreational water use are unlikely to have been constant over time as a result of changing patterns of wealth, demographics and lifestyle choices.

It is, however, unlikely that human population growth alone can account for all patterns observed. This suggests that there are other factors contributing to the pattern of shark attacks in Western Australian waters which may include variations in the distribution of sharks due to responses in biological and/or environmental variables and changes in their population levels. Disentangling these factors will not be easy to achieve.

It is also important to note that despite its high profile and profoundly tragic consequences, shark attack is rare in WA relative to the number of water users and the difference between no attacks and a few attacks in any one year may be random chance.

Comments on Appendix 9: A risk-based, weight of evidence approach to determine the range of plausible estimates for the south-western Australian population of white sharks (Working Draft)

This is one of the main supporting documents in the PER assessment. This document and the *'in preparation'* report from which it appears to draw significant information (Taylor *et al.* in prep) are cited by all of the proponent's other assessment documents. Appendix 9 refers to demographic modelling of white shark populations matched with a 'weight-of-evidence' approach to conclude that Australia's (south) western white shark population is either stable in number, or has been slowly increasing over the last decade and is likely to have a current level of 70-85% of virgin biomass.

The primary finding of this document states:

"The range of population estimates generated from the more plausible scenarios all indicate that the SWA population of white sharks is at least in the order of at least a few thousand individuals (>3000 for all plausible scenarios). Further, the population numbers are still > 70% of their unexploited levels with the highest likelihood scenarios all above 85% of unexploited levels. Consequently, the additional removal of a relatively small number of white sharks (<10/year – which is < 10% of current capture rates) for public safety purposes was found to have no material effect on the population numbers and therefore the viability/status of the SWA population of white sharks".

Demographic modelling is a useful exercise and, when coupled with verified data on the requisite biological parameters, can provide estimates of the vulnerability of a population to the combined effects of fishing and other non-natural sources of mortality. Such analyses have generally provided similar results for populations of white sharks where this method has previously been applied and include other examples for Australian waters (Malcolm *et al.* 2001, Hillary *et al.* 2012) and off the west coast of the US (Burgess *et al.* 2014). The results of these approaches are highly sensitive to assumptions regarding the parameters used. All of these approaches (including the proponent's) have used either the same or similar parameters and thus it is entirely unsurprising that each has reached similar population level conclusions. However, as stated by Cortes (2007) in his review of demographic modelling as applied to shark populations: *"..it is impossible to gauge the accuracy of any of these estimates without comparison with empirically derived estimates, which rarely exist"*.

Appendix 9 provides few details on how key parameters were estimated. Two of the significant parameters that dictate the predicted trajectories and current population estimates are the initial population size from which the model is run and the catch history of white sharks across the population. Modelling minimum viable population levels and population trajectories for white sharks via demographic models as used by the proponent are scientifically useful exploratory exercises but highlight the critical uncertainties and lack of information available to adequately assess current population size, population status and hence the likely impacts of any additional removals from the population. The outcomes of such modelling are heavily dependent on underlying assumptions relating to: biological parameters, initial population size (which is unknown), current/historical catches across the populations range (which are poorly documented) and either explicitly or implicitly assuming that some catches or trajectories are sustainable or more plausible compared to others (for which there are few data to adjudicate). It is important to note that such exercises are not stock assessments and they do not provide estimates of actual population size.

The proponent has arbitrarily defined a range of initial population sizes, arbitrarily defined a 'starting point' equating to a time of virgin biomass, modelled various trajectories based on assumed historical catch scenarios - the basis for which are not defined in Appendix 9, selectively culled trajectories and used the resulting model output to estimate population sizes relative to their assumed virgin biomass. These choices provide the basis for useful exploratory analyses. However, very few of the key parameters used have robust empirical measures and this is the challenge for interpreting such model outputs. Although it is

possible that the actual population and even the trajectory of the current population may fall within the boundaries of the proponent's model outputs, without empirically derived estimates it is impossible to adjudicate their veracity. There is some evidence that white shark populations in other areas of the world are increasing and have benefited from a combination of protection and fisheries management actions designed to improve the status of commercial shark species (Burgess *et al.* 2014; Curtis *et al.* 2014). Thus it is also plausible that white shark populations have benefited from similar actions in Australia. However, conclusions of possible population increases by these other studies are based on empirical data in the form of verified catch or observation rates (e.g. Lowe *et al.* 2012). The proponent provides no useful empirical data in similar to support.

The proponent then argues that they have assessed the *"plausibility"* of their demographic modelling scenarios based on the consistency of model output with *"other lines of evidence"*. The document draws information from five[7] other lines of evidence to support the conclusions of the demographic modelling, hence resulting in their *"highly innovative weight-of-evidence"* approach.

However, the data in these lines of evidence are highly ambiguous and in all cases there are either alternative plausible interpretations, caveats on the use of these data at their source have been ignored or the data have been used out of context. There is thus insufficient information within the lines of evidence to support or refute the 'plausibility' of the proponent's modelling and the support concluded in each case is highly subjective and cannot be substantiated. Thus these assessments of plausibility lack credibility.

These lines of evidence are examined in turn below.

1. WA ABALONE DIVERS OBSERVATIONS

The document refers to sightings logged by abalone divers since a specific category for reporting white shark sightings was introduced in 2007. The data are extremely sparse, primarily dealing with zero observations. When white shark sightings were aggregated over the entire 2007-2013 period, observations were limited to within 13 out of approximately 100 blocks of unspecified size (but assumed to each be 100 nm^2 based on Hart *et al.* 2013). Cumulative shark sightings over this entire seven-year period within each of the 13 blocks where sharks were reported ranged from 1 to 4. When these data were standardized for diving effort, the range within these years was approximately 0.5 to 1.7 sharks sighted per 1000 hrs of diving. Given the low numbers, the high level of zero sightings and the unstated level of reliability in reporting, it is highly unlikely that these data provide a useful index at this stage. However, the concept is a good one and abalone divers should be encouraged to report sightings over time. It will be important, however, to examine ways of verifying the extent and variability in reporting, as changes in reporting rate or motivation to report can severely bias such data, particularly when observed numbers are so low and data are examined over short time periods. Such low numbers of sightings can also be influenced by repeat observations of the same shark when diving in one area.

The document also refers to a phone survey of seven 'long-term' abalone fishers who all reported that white sharks were more abundant in 2013 compared to when they commenced diving (reported average years of diving = 20.9). Notably, however, six of the seven divers surveyed admitted that their conclusion was not based on observing more sharks, but on their perception that more sharks were present.

Given that reported observations of white sharks are so low over the time period and that comments on sharks numbers were, in the majority, not based on any increase in the number of sharks actually sighted – the conclusion by the proponent that these data are *"most consistent"* with no change or a slight increase in shark population size cannot be supported.

[7]Appendix 9 cites eight line of additional evidence. However, one of these – *'Catch Rate of Commercial WA Fishers'* forms the basis for calculating population scenarios by the demographic modelling and thus is not an 'additional line' of evidence. Two lines of evidence – 'Public reported sightings' and 'Tagging' data were judged too inconclusive to provide support.

2. NEPTUNE ISLAND SIGHTINGS

The document refers to the long-term (12 year) frequency of white shark sightings at the North Neptune Islands, South Australia reported by Bruce and Bradford (2013). This study examined the number of sharks sighted over the period 2000 to 2011, specifically focusing on the impact of changes in shark cage-diving operations before and after a sustained increase in effort in 2007. While the Bruce and Bradford study found that the number of sharks sighted per day by cage-dive operators had significantly increased after 2007, this was concluded to be caused by an increase in residency times in response to shark cage-diving operations, hence resulting in sharks temporarily accumulating at this site. The study found no similar changes at the South Neptune Islands, 12 km away, where the frequency of shark cage-diving was significantly less. The study reports no evidence of an increase in population size and states that:

"The lack of available measures of population size combined with these [observed] *interannual variations* [in the number of sharks sighted] *makes it difficult to conclude population-level changes in abundance from these data."*

White sharks are temporary residents at the Neptune Islands (which holds Australia's largest aggregation of seals) with a median residency period of 9 days (Bruce and Bradford 2013).

The proponent's conclusion that data from the Bruce and Bradford study are *"fully consistent"* with either no change or a slight increase in population size cannot be supported.

3. WA SHARK ATTACK DATA

The document refers to an increasing rate of white shark attacks in Western Australian waters since 1996 that exceeds the rate of the State's population increase, citing analyses in a Department of Fisheries Report which is included as Appendix 4 (see above for a review of Appendix 4). Notwithstanding the shortcomings of analyses presented in Appendix 4, the proponent argues that an increase in the rate of shark attack in WA could not be attributed to an increase in participation rates in water related activities, stating:

"..given that the rate for all recreational [water] *activities in WA has fallen slightly over the last decade and, specifically, for surf related sports (which is one of the main categories of activities involved in the attacks), it has fallen from 2.1% in 2005/06 to 1.2% for 2011/12"* citing ABS (2013).

The ABS (2013) report, however, clearly states with respect to the 2011/12 data on participation in surfing that the *"estimate has a relative standard error of 25% to 50% and should be used with caution"*. This warning appears not to have been considered by the proponent in their analyses. Furthermore, although the participation rate reported by the ABS for other water activities such as swimming/diving[8] in 2011/12 was also less at 9.6% than that reported in 2005/06 (9.9%), the values over the period were not reported by the ABS to be significantly different. In addition, the proponent's comparison uses the ABS participation rate rather than the numbers of people engaged in the activity. Given the increase in WA's population over the period, the ABS data translates into an increase by approximately 31,000 in the number of people participating in swimming and diving activities over since 2005/06, not a slight decrease as the proponent concludes.

An increase in the number of people participating in marine-based water activities in Western Australia is also predicted by surveys of beach use by Eliot *et al.* (2005) who concluded that there was a general increase in beach use between 1994 and 2004 by approximately 4% per annum and at some Perth beaches of up to 10% per annum over this period. The WA has consistently experienced the highest population growth rate of any Australian State over recent years (e.g. 2.9% in 2012/13) and the population of the greater Perth region has increased from 1,286,000 in 1996 by nearly 700,000 to 1,970,000 in 2013 (ABS

[8]The ABS report does not defined swimming and diving as being exclusively marine in nature

2013, DPI 2009). It would seem more plausible that WA in general, and the greater Perth region in particular, have experienced a significant increase in the number of people using marine waters for recreational purposes rather than less as the proponent's document concludes.

Despite these statistics, the number of shark attacks over the period August 2010 to July 2012 was unusually high compared to any similar period previous or since in the State and this cannot be fully accounted for by increases in water use or increases in the population size of white sharks, should the latter have occurred. The proponent reasonably concludes that the increase in the rate of attacks by white sharks relative to the WA (human) population size cannot be fully explained by an increase in the white shark population alone, as under their own calculations it would require a biologically impossible rate of increase since the species protection and specifically for the 2010 - 2012 period. This statement is in agreement with general findings on white sharks in particular by South African researchers and research on the species in eastern Australia that has concluding that the frequency of attack is poorly correlated to the local abundance of the species (Bruce and Bradford 2012, Dicken and Booth 2013). The proponent reasonably concludes that the relationship between abundance and frequency of attack is not linear.

Thus the proponent's conclusion that the observed trend in shark attacks (relative to population growth) "*would be most consistent*" with some level of increase in the white shark population also cannot be supported.

4. OTHER WHITE SHARK POPULATION ESTIMATES

The proponent compares their estimate of 'population size' with other calculations for white shark populations world-wide (including other Australian-based research). The proponent's document incorrectly states that a previous Australian study (Thomson *in* Malcolm *et al.* 2001) "*..used inputs that were largely based on annual capture data from what is now known as the eastern population*". In fact, the dominant catch data in that study (over 75%) came from what is now known as the western population and that study's conclusions are thus readily applicable within the bounds of the caveats provided.

As stated above, demographic modelling approaches (including the proponent's) to investigate white shark populations have each used either the same or similar parameters and thus it is entirely unsurprising that they have each reached similar conclusions regarding population levels. What remains unknown is how the model outputs in each case reflect the actual status and trajectory of the individual populations to which they have been applied. Comparing populations of white sharks between vastly different world regions is unlikely to be biologically sound as such simple comparisons fail to take into account differences in historical population processes and ecosystem characteristics that can result in different base level population sizes and trajectories.

Other estimates of 'population size' for Australian waters are not referred to by the proponent including those by Blower *et al.* (2012) who estimated the effective population size (N_e) for the southwest population to be approximately 700. However, this was not an estimate of all life history stages combined, had very wide confidence limits and noted that the relationship between effective population size and actual abundance (i.e. population census size or N_c) is often complex and unclear.

Given the uncertainties and biases in the population estimates from the other Australian studies and those world-wide, it is difficult to adequately compare such results between different populations and their veracity with respect to actual population sizes within the regions is unclear. It is thus unclear to what extent these data can be used to support or refute the proponent's modelled population estimates.

5. COMPARATIVE DUSKY SHARK ESTIMATES

This section provides no useful information on white sharks. The demographics of dusky sharks, as well as their ecology and fishery status, are sufficiently different to white sharks that such simple comparisons are not biologically meaningful. These comparisons give no measure of support.

6. CONCLUSION

Overall, there is little support for a *"high level of consistency in the patterns seen among independent lines of evidence"* with the model output as stated by the proponent. The problem with the 'weight-of-evidence' based approach used in this case is that it is open to significant bias depending on the qualitative 'lens' used to adjudicate the level of support provided. When used appropriately, a weight-of-evidence approach must consider all available lines of evidence, including an assessment of the veracity of 'supporting' as well as alternative interpretations of the data used. This does not appear to have been the case in the proponent's document and it correspondingly lacks credibility.

The proponent clearly identifies that Appendix 9 is a 'Working draft'. However, the findings in Appendix 9 form a substantial input to the proponent's overall risk assessment and guides their conclusions. Appendix 9 contains examples of selective use of information and cites non peer-reviewed Departmental reports that would fail the test of good science and scientific reporting. It would thus be prudent for the Department to engage one or more independent reviews of this document before it is finalized and adjust the overall risk assessment accordingly.

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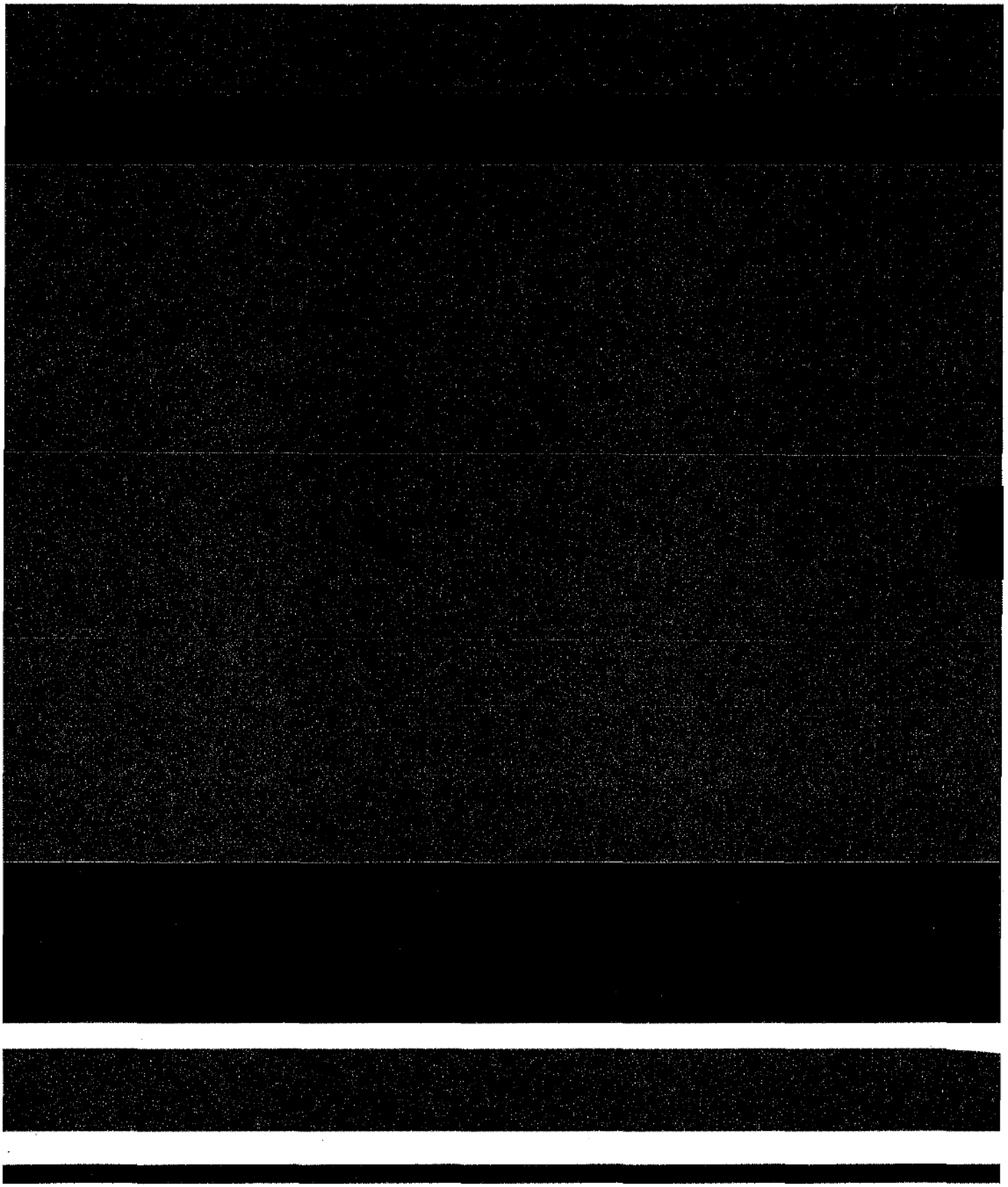

From: Hans Jacob [redacted]
Sent: Friday, 25 July 2014 2:31 PM
To: Bax, Nic (O&A, Hobart); Bruce, Barry (O&A, Hobart)
Cc: Chris Stanley; Anthony Sutton
Subject: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Peer Review Report
Attachments: Questions for peer reviewer.docx

Dear Nic/Bruce

Thank you for the Peer Review Report which was received by the Office of the EPA on 10 July 2014.

The report has been forwarded to the proponent (Department of Premier and Cabinet) for a response. The proponent's response will then be forwarded to CSIRO for a close-out of the peer review – consistent with item 2 of Table 1 in the Terms of Reference.

At the EPA Board meeting on Thursday last week, the Office of the EPA provided members with an update on the assessment stage and also attached the peer review report to the briefing papers for information and discussion. It was agreed that further clarification and advice be sought from the peer reviewer, consistent with the matters raised in that meeting and in the context of the Terms of Reference and the approved Environmental Scoping Document. I have run the questions past the members as an outcome of the meeting and they are attached to this email.

This is consistent with item 3 in Table 1 of the Terms of Reference.

I was hoping to receive a response by Wednesday next week.

Happy to discuss these questions further and the timeframe for responding.

Thanks

Hans Jacob
Manager
Infrastructure Assessment Branch
Office of the **Environmental Protection Authority**
The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 33, Cloisters Square, Perth WA 6850
direct: [redacted] | reception: 08 6145 0800 | fax: 08 6145 0895
email: [redacted] | web: www.epa.wa.gov.au

Office of the
Environmental Protection Authority

EPA/OEPA - Questions for Peer Reviewer

White shark population estimates

The WA Department of Fisheries has assessed the removal of up to 25 white sharks over a three year period is "highly unlikely to make any material effect" on the SWA population of white sharks. This is based principally on:

1. an estimated population size of a "few to several thousand" (3400-5400);
2. an assessment that "the current (2012) population levels....are at least 70% or above their pre-exploitation levels" and
3. an estimated current catch of around 100 sharks per year from the population.

The Environmental Protection Authority has noted your comments on the Department's assessment.

As well as the CSIRO, a number of submitters have referred to the paper by Blower at al. (2012) which estimated the effective population size for the southwest population to be approximately 700 breeding individuals. The paper recognises the estimate has wide confidence intervals and is preliminary due to low numbers of genetic markers and samples.

Putting aside the policy question of whether the removal of white sharks alters public safety, having regard for the paper by Blower et al, can you provide a professional, expert view on the likelihood of the removal of up to 25 white sharks over three years having a material effect on the SWA population?

Further, if you consider that the taking of up to 25 white sharks might reasonably have a material effect, can you provide a professional, expert view on a take limit for the three years that would be unlikely to have a material effect on the population?

Loss of apex predators

The EPA has noted your comments in the report that an upper defined catch limit for tiger sharks would reduce the risk of adverse ecosystem impacts associated with the proposal as the potential take of tiger sharks could constitute a measurable change in tiger shark populations.

The proponent has provided some information and undertaken a risk assessment for broader ecosystem impacts through Community Structure (pp 62-64 of the PER). It is a requirement of the ESD that the PER address the impacts due to the removal of apex predators (ESD - work and output required 1d). The proponent has formed the view that the proposal poses a negligible risk to functioning of the community structure of the marine ecosystem.

Having regard to the work required in the ESD and the potential impacts of removing apex predators, can you provide a professional, expert view on the proponent's assessment that it could be a negligible risk to ecosystem function?

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Prof NJ Bax
Director
NERP Marine Biodiversity Hub
CSIRO
GPO Box 1583
HOBART TAS 7001

Our Ref: *AC01-2014-0070*
Enquiries: *Hans Jacob,* s47F
Email: s47F

Attention: Dr Barry Bruce

Dear Professor Bax

WESTERN AUSTRALIAN SHARK HAZARD MITIGATION DRUM LINE PROGRAM 2014-2017 – PUBLIC ENVIRONMENTAL REVIEW – RESPONSE TO PUBLIC SUBMISSIONS AND PEER REVIEW

Thank you for CSIRO's Peer Review Report on the Department of Premier and Cabinet's (DPC) Public Environmental Review (PER) document which was received on 10 July 2014. Attached is the proponent's response to the summary of issues and the Peer Review Report. These documents have also been emailed to Dr Barry Bruce.

Could you please review the proponent's Response to Submissions Document, focusing on the DPC's responses to the Peer Review Report (pages 47 to 76)? This would serve as Activity/Deliverable No. 2 in Table 1 of the Terms of Reference. It is anticipated that your response will be provided to the Office of the Environmental Protection Authority on the 7 August 2014.

Should you have any questions in relation please contact Hans Jacob on s47F

Yours sincerely

s47F

Anthony Sutton
Director
Assessment and Compliance Division

30 July 2014

Encl. Response to Submissions on Public Environmental Review - Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017

The Atrium Level 8, 168 St Georges Terrace, Perth, Western Australia 6000.
Postal Address: Locked Bag 10, East Perth, Western Australia 6892.

Telephone: s47F
Facsimile: (08) 6145 0845.
Website: www.epa.wa.gov.au

s22

From: Bruce, Barry (O&A, Hobart)
Sent: Wednesday, 30 July 2014 2:49 PM
To: Hans Jacob s47F
Cc: Chris Stanley s47F Anthony Sutton s47F Bax, Nic (O&A, Hobart) s47F
Subject: RE: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Peer Review Report

Dear Hans

I have attached CSIRO's responses to the questions posed by the EPA Board as requested.

Regards

Barry Bruce

From: Hans Jacob s47F
Sent: Friday, 25 July 2014 2:31 PM
To: Bax, Nic (O&A, Hobart); Bruce, Barry (O&A, Hobart)
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Hans Jacob
Manager
Infrastructure Assessment Branch
Office of the **Environmental Protection Authority**
The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 33, Cloisters Square, Perth WA 6850
direct: s47F | reception: 08 6145 0800 | fax: 08 6145 0895
email: s47F web: www.epa.wa.gov.au

Office of the
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EPA/OEPA - Questions for Peer Reviewer

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2. an assessment that "the current (2012) population levels....are at least 70% or above their pre-exploitation levels" and
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The Environmental Protection Authority has noted your comments on the Department's assessment.

As well as the CSIRO, a number of submitters have referred to the paper by Blower at al. (2012) which estimated the effective population size for the southwest population to be approximately 700 breeding individuals. The paper recognises the estimate has wide confidence intervals and is preliminary due to low numbers of genetic markers and samples.

Putting aside the policy question of whether the removal of white sharks alters public safety, having regard for the paper by Blower et al, can you provide a professional, expert view on the likelihood of the removal of up to 25 white sharks over three years having a material effect on the SWA population?

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CSIRO response

It is important to understand the uncertainty in the modelling results that The WA Department of Fisheries (DoF) have provided. We reiterate our statement from the 'Peer Review Report'.

"*The proponent has arbitrarily defined a range of initial population sizes, arbitrarily defined a 'starting point' equating to a time of virgin biomass, modelled various trajectories based on assumed historical catch scenarios - the basis for which are not defined in Appendix 9, selectively culled trajectories and used the resulting model output to estimate population sizes relative to their assumed virgin biomass. These choices provide the basis for useful exploratory analyses. However, very few of the key parameters used have robust empirical measures and this is the challenge for interpreting such model outputs. Although it is possible that the actual population and even the trajectory of the current population may fall within the boundaries of the proponent's model outputs, without empirically derived estimates it is impossible to adjudicate their veracity*"

The most significant uncertainties are the initial population size and the cumulative annual mortality [total anthropomorphic catch + natural mortality (= total mortality)] applied to the modelled population. The PER document states that the current total annual catch of white sharks across the south-western population is 92 (71-115, 95% CI) [PER Appendix 9 - page 8]. The PER document does not articulate how that figure was obtained, only citing an unpublished (and as yet unavailable) report. Captures of white sharks are poorly and unreliably recorded in commercial fishery logbooks; efforts to validate catch history are fraught with difficulty and white shark bycatch/fishing effort relationships are not necessarily comparable between regions or over time due to regional differences in abundance and catchability of sharks, variations in the configuration of gear, management changes impacting fishing behaviour and variability in the motivation to report captures over time. A previous study by Malcolm *et al.* (2001) identified that the capture of white sharks was not well correlated with effort in the SESSF (the fishery responsible for the highest capture of white sharks in the southwest population) and thus estimating catch from effort was likely to underestimate the true fishing mortality.

Blower et al. (2012) paper

The Blower et al. (2012) paper refers to '*effective*' population size. The effective size of a population (N_e) is the size of an ideal or theoretical population experiencing the same rate of random genetic change over time as the real population under consideration. In real populations, N_e generally is usually considerably smaller than the total, or census, population size (referred to as N or N_c) and can be so by up to orders of magnitude. There are many life history and population circumstances that impact N_e and result in N_e being smaller than the true size of a population. N_e is also not strictly a measure of the number of breeding individuals (N_b) – these two values can also be very different in a population. Although generalised conversion factors between N_e and N_c are available – in practice the relationship between these parameters varies between species, between populations and can vary between time periods for the same population – particularly if there has been an historical change in population abundance. Quite simply N_e and N_c are not the same and the relationship between them is often unclear. N_e is a measure of the genetic and adaptive health of a population and is not a measure of total population size. Thus the N_e figure of 'approximately 700' sharks for the southwest population cannot be used in the context of assessing the removal of 'up to 25 sharks'.

How many can be taken?

There is no reliable way of determining this given the current uncertainty in population parameters. There are real dangers in providing 'back-of-the-envelope' calculations regarding sustainability when empirical data are poor or lacking. However, such calculations can provide a useful first-cut guide provided that the caveat of uncertainty is not overlooked. There are no reliable estimates of existing or previous population size in white sharks. Providing empirical estimates of population size is the subject of a current program of research led by CSIRO.

As indicated above, there are significant (and understandable) uncertainties in the DoF model used to inform the risk assessment for white sharks. These uncertainties present a significant challenge in any attempts at modelling populations of this species as the data fall well below that which would be acceptable for a routine fisheries-style stock assessment and alternative model structures have not been tested. Yet the outputs from this model are required to appropriately inform the level of risk posed to the population. The DoF model has yet to be published or peer-reviewed and was not available for this review. Alternative model/data

assumptions and/or model structure may provide very different results. Given these circumstances it would be prudent to be more risk averse when considering possible population impacts on white sharks.

Despite these shortcomings, if we assume that the WA Fisheries model output is near the ball-park, then taking a commonly accepted conservative estimate of sustainable harvest rate:

$H_{as} = r/2*N$

Where H_{as} = the assumed annual sustainable harvest rate; r = the maximum rate of population increase and N = current population size (= N_c in above discussion).

Table 1 provides assumed sustainable harvest rates based on the above equation and using a range of published 'r' values for white sharks[1]. Note that sustainable harvest in this context refers to total non-natural mortality for the population which includes all fishing and other anthropomorphic mortality. Values of N include the upper and lower CI bounds estimates provided by DoF and the values of 700 and 2000, the latter for completeness, which are figures that have previously appeared in published Australian population studies (including Blower et al. 2012) for comparison [Noting the point above regarding N_e vs N_c]. The dark border indicates DoF estimated population bounds. It is important to note that demographic models commonly track and estimate the number of females as opposed to the total number of animals (males + females) in the population. This is because the reproductive output (and hence replenishment rate) is a function of the number of females in the population. Although not specifically stated in the PER document, we assume that the population outputs from the DoF model refer to females only. The figures in the Table 1 below thus refer to the number of females caught.

Table 1: Assumed sustainable harvest rates for white sharks based on published ranges of maximum intrinsic growth rate (r). Note that 0.07 is the current value for r used by CSIRO.

Est. population size (N)	Assumed annual sustainable harvest rate (r/2*N) [number of sharks]			
	$r = 0.04$	$r = 0.056$	$r = 0.07$	$r = 0.08$
700	14	20	25	28
2000	40	56	70	80
3400	68	95	119	136
5400	108	151	189	216

If we assume that the population is within the bounds of that estimated by the DoF, then the annual take of 110 white sharks (100 from fishery bycatch + 10 per annum estimated from drum line) exceeds a conservative sustainable harvest rate in three of the DoF population scenarios (red highlight – i.e. a harvest rate of 110 per year would result in population decrease). It is within an (arbitrary) buffer of 30% in two (yellow highlight) and is below the rate in two (green highlight – i.e. a harvest rate of 110 per year would not result in a population decrease). The interpretation of these figures is conservative as they refer to catches of females. In reality, commercial fisheries catch both males and females as no doubt the drum-line operations would also. However, sex bias in the capture of sharks is common. A case in point is that the trial drumline program caught a significantly higher number of female tiger sharks than males.

[1]There are various definitions of intrinsic growth rate and various ways to calculate it. We don't propose to define or discuss the merits of each here.

The veracity of these calculations is limited by their underlying assumptions. In particular, the life history composition of the catch (juveniles or adults or both) will have a bearing on the sustainability of the catch. All such estimates have a degree of uncertainty that only empirical data can reduce. Current estimates of catch across the range of the population are poor, unreliable and likely to vary from year to year and by region. Under the scenarios above, relatively minor errors in catch estimation (either fisheries bycatch or drum-line catch) could result in total catches exceeding that which is sustainable. Without empirical data, discussions on estimating what is sustainable, and what is not, cannot be further progressed.

The DoF contend that an upper catch limit of 10 white sharks per year is sustainable (both MMAs and the rapid response program combined). We can neither confirm nor refute this given available data and modelling, noting again that the DoF population model is currently unpublished, it has not been reviewed by the wider scientific community and its detail were unavailable for us to review. And we also reiterate that alternative model/data assumptions and/or model structure may provide very different results to that calculated by DoF. Sustainability is dependent on the cumulative harvest from the population across its footprint (including other State and Commonwealth waters) not the take by the drum-line program alone. We reiterate that, if the program proceeds, an upper limit in catch be applied to the main species taken (tiger and white sharks). In the absence of more robust data, the upper limit for white sharks should be no more than 10 per annum across all components of the program combined, but if this is implemented it should be subject to sufficient monitoring and sampling of not only the drum-line caught sharks but also those from commercial fishery bycatch so as to improve estimates of total harvest.

Notwithstanding the policy question of whether the removal of white sharks alters public safety, the proponent is faced with a trade-off between what level of removal of sharks will reduce the risk of shark attack (the implicit objective) and what level of removal will not place the population of sharks at risk. In the absence of more robust guiding information on these issues, we reiterate that if the drum-line program continues, it should include effective monitoring, clear trigger points and decision rules and agreed actions in response to these trigger points – all linked to defined program management objectives.

Tagged white sharks in particular may offer a means of quantifying risk of encounter and defining the efficacy of the drumline program in reducing that risk. The ratio of capture of tagged vs untagged sharks combined with the number of tagged sharks detected by acoustic receivers in the MMA areas, particularly off Perth where acoustic receiver coverage is highest, may provide some data on the numbers of white sharks entering the MMA areas and the extent to which the drumline program is successful in their removal. This may provide the proponent with a means of ascertaining the level of encounter-risk mitigation (i.e. effectiveness) provided by the program and the impact on shark numbers within these areas. Although, as stated in our review, the relationship between encounter risk and risk of attack is not easily defined. However, such monitoring would help assess the efficacy of the drum-line program, thus improving the context in which to assess the risk of the program to the shark population given the high uncertainty over its population-level effect.

References

Blower, D. C., Gomez-Cabrera, M. C., Bruce, B. D., Pandolfi, J. M. and Ovenden, J. R. (2012). Population genetics of Australian white shark (*Carcharodon carcharias*) reveals a far more complicated breeding and dispersal biology than simple female-mediated philopatry. Marine Ecology Progress Series. 455: 229–244

Malcolm, H., Bruce, B.D. and Stevens, J.D.S. (2001). A review of the biology and status of white sharks in Australian waters. Final report to Environment Australia, Marine Species Protection Program. CSIRO Hobart. 114 pp.

Loss of apex predators

The EPA has noted your comments in the report that an upper defined catch limit for tiger sharks would reduce the risk of adverse ecosystem impacts associated with the proposal as the potential take of tiger sharks could constitute a measurable change in tiger shark populations.

The proponent has provided some information and undertaken a risk assessment for broader ecosystem impacts through Community Structure (pp 62-64 of the PER). It is a requirement of the ESD that the PER address the impacts due to the removal of apex predators (ESD - work and output required 1d). The proponent has formed the view that the proposal poses a negligible risk to functioning of the community structure of the marine ecosystem.

Having regard to the work required in the ESD and the potential impacts of removing apex predators, can you provide a professional, expert view on the proponent's assessment that it could be a negligible risk to ecosystem function?

CSIRO response

A full understanding of the potential impacts of the removal of up to 300 tiger sharks per annum would require a full ecosystem model populated with empirical data on trophic relationships between sharks and their prey as well as relevant linkages to other species in the region. These data are not available (and may never be available).

Tiger sharks are likely to have a seasonal abundance signal in the MMA areas and be more commonly encountered during the warmer months of the year, with their substantive range extending northwards from these regions. Despite this coinciding with the period of drum-line operations, the total catch of sharks (current commercial fisheries + drum line catches) is anticipated by the proponent to still be considerably less than historical fishing levels. We do not contest the proponent's assessment that risk to community structure is likely to be negligible. However, given the uncertainty in likely catch totals and the possible impact on tiger shark populations we maintain that an upper limit be determined for the catch of this species in order to minimise the risk of adverse effects at both species and ecosystem levels. We re-emphasize the need for effective monitoring, clear trigger points and decision rules and agreed actions in response to the trigger points – all linked to defined program management objectives. This may also provide a mechanism to reassess the risk to the tiger shark population and the broader system if the catch of tiger sharks is much higher than expected.

From: Hans Jacob [redacted]
Sent: Wednesday, 30 July 2014 6:45 PM
To: Bruce, Barry (O&A, Hobart)
Cc: Anthony Sutton; Bax, Nic (O&A, Hobart); Kathryn Schell
Subject: RE: WA Shark Hazard Mitigation Drum Line Program 2014-2017 - Peer Review Report
Attachments: OEPA to CSIRO Review RTS.PDF; DPC_Response to submissions.pdf; Draft Management Plan Ver 2 july.pdf

Thank You Barry

Attached is the proponent's response to submissions document (which also includes the proponent's response to the CSIRO Peer review report) and a cover letter from the OEPA. I have also attached the draft Management Plan as there are sections of the response to submissions which also refers to the MP.

It would be appreciated if you can respond to the OEPA letter by 7 August 2014.

Thanks
Hans

Hans Jacob

Manager
Infrastructure Assessment Branch

Office of the **Environmental Protection Authority**

The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 33, Cloisters Square, Perth WA 6850

direct: [redacted] | reception: 08 6145 0800 | fax: 08 6145 0895
email: [redacted] | web: www.epa.wa.gov.au

Office of the
Environmental Protection Authority

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Prof NJ Bax
Director
NERP Marine Biodiversity Hub
CSIRO
GPO Box 1583
HOBART TAS 7001

Our Ref: AC01-2014-0070
Enquiries: Hans Jacob, s47F
Email: s47F

Attention: Dr Barry Bruce

Dear Professor Bax

WESTERN AUSTRALIAN SHARK HAZARD MITIGATION DRUM LINE PROGRAM 2014-2017 – PUBLIC ENVIRONMENTAL REVIEW – RESPONSE TO PUBLIC SUBMISSIONS AND PEER REVIEW

Thank you for CSIRO's Peer Review Report on the Department of Premier and Cabinet's (DPC) Public Environmental Review (PER) document which was received on 10 July 2014. Attached is the proponent's response to the summary of issues and the Peer Review Report. These documents have also been emailed to Dr Barry Bruce.

Could you please review the proponent's Response to Submissions Document, focusing on the DPC's responses to the Peer Review Report (pages 47 to 76)? This would serve as Activity/Deliverable No. 2 in Table 1 of the Terms of Reference. It is anticipated that your response will be provided to the Office of the Environmental Protection Authority on the 7 August 2014.

Should you have any questions in relation please contact Hans Jacob on s47F

Yours sincerely

s47F

Anthony Sutton
Director
Assessment and Compliance Division

30 July 2014

Encl. Response to Submissions on Public Environmental Review - Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017

The Atrium Level 8, 168 St Georges Terrace, Perth, Western Australia 6000.
Postal Address: Locked Bag 10, East Perth, Western Australia 6892.

Telephone:
Facsimile: (08) 6145 0845.
Website: www.epa.wa.gov.au

GOVERNMENT OF
WESTERN AUSTRALIA

Western Australian Shark Hazard Mitigation Drum Line Program 2014-17

Response to Submissions on Public Environmental Review

EPA Assessment No. 2005 EPBC Assessment No. 2014/7174

July 2014

The Department of the Premier and Cabinet
Dumas House
Locked Bag 3001
WEST PERTH WA 6872

TABLE OF CONTENTS

LIST OF ACRONYMS

CMS	*Convention on the Conservation of Migratory Species of Wild Animals*
DoE	The Commonwealth Department of the Environment
DoF	The Department of Fisheries, Western Australia
DPaW	The Department of Parks and Wildlife, Western Australia
DPC	The Department of the Premier and Cabinet, Western Australia
EPA	The Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ESD	Environmental Scoping Document
FRDC	Fisheries Research and Development Corporation
FRMA	*Fish Resources Management Act 1994* (WA)
MMA	Marine Monitored Area
MNES	Matters of national environmental significance
MPRA	Marine Parks and Reserves Authority
PAT	Pop-up archival transmitting tag
PER	Public Environmental Review
PSAT	Pop-up satellite archival tag
SMN	Shark Monitoring Network
SPOT	Smart position and temperature tag
TL	Total length

INTRODUCTION

Between 25 January and 30 April 2014 the Western Australian Government (the Government) managed the implementation of a trial shark control drum line program. Following the trial program, the Government now proposes to set up to 72 baited drum lines, of which 60 will be at approximately 1km offshore of selected high use swimming beaches and surf breaks within designated Marine Monitored Areas (MMAs) in the metropolitan and south west coastal regions of Western Australia (the Proposal). The proposed action will take place between 15 November and 30 April for a period of three years, commencing 15 November 2014 and ceasing on 30 April 2017, after which the program will be subject to review. The Proposal also contains a provision for responding to identified shark threats and incidents within all Western Australian waters at any time, including the temporary deployment of drum lines until 30 April 2017.

Following the referral of the three year Proposal to the Western Australian Environmental Protection Authority (EPA) and to the Commonwealth Department of the Environment (DoE) for assessment, the Government submitted a Public Environmental Review (PER) to the EPA.

The PER was subject to a four week public submissions process which was open from 9 June to 7 July 2014. In accordance with 10.2.6 of the Environmental Impact Assessment Administrative Procedures 2012, the Department of the Premier and Cabinet (DPC), as proponent on behalf of the Western Australian Government, has prepared the Government's response to the summary of public submissions provided by the EPA. Responses to submissions received the Department of Parks and Wildlife (DPaW) and the Marine Parks and Reserves Authority (MPRA) and an independent peer review from CSIRO commissioned by the EPA, are also provided.

A number of submissions were made in support of the program, with many offering useful references and advice including direction on improved animal handling techniques. The Government is appreciative of the level of balanced consideration shown for the program and has taken on board the references provided. It is also noted however that a number of abusive and in some cases threatening submissions were received. It is hoped that, following consideration of the responses provided to a significant number of issues in this document, that the Government's consideration of all facets of the policy and the issue of public safety in relation to shark attack will be evident.

While the PER, proposing a further three year program for drum line deployment, was open for public submissions, the Government's "Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013-14" (the Review) was also available for download. The Review considered the 14 weeks of the trial drum line program, assessed catch data, addressed criticisms of the program, discussed alternatives, provided a comparison of shark control programs both in Australia and overseas and concluded with a list of recommendations for a future program. The Review is referenced a number of times in this Response to Submissions document and is still available for download at the DPC website at www.dpc.wa.gov.au.

The Department of Fisheries (DoF) is acknowledged for key contributions to the PER and to the responses to submissions contained in this document. No changes to the PER or the key characteristics of the proposal are being suggested as a result of the response to submissions. The Management Plan is being progressed however and a significant amount of information will be included in the final version including details on a possible gear selectivity trial, acceptable catch levels, trigger points and contingency measures and more detailed information on animal handling protocols and contractor training and research opportunities.

The Government remains confident that the proposal meets the environmental objectives of the EPA and is not expected to result in unacceptable or unsustainable impacts on marine fauna.

RESPONSE TO PUBLIC SUBMISSIONS

1. The Proposal

1.1 Justification

1.1.1 Submissions contend that the PER has not provided evidence to sufficiently justify the need for the proposal in order to enhance public safety for water users. In doing so, submitters have highlighted the following:

- **That the Department of Fisheries (DoF) commissioned paper, *Likely effectiveness of netting or other capture programs as a shark hazard mitigation strategy in Western Australia* (McPhee 2012), recommended against the use of netting or mixed netting/drum line programs on the grounds of environmental impacts.**
- **That the proposal does not consider relevant hook-only (including drum lines) examples from:**
    - **Hawaii that showed no improved safety outcomes despite a 16 year long line program that captured nearly 300 tiger sharks a year (comparable to the expected take of tiger sharks in WA's program) (Wetherbee *et al.* 1994); and**
    - **Queensland beaches where only drum lines are used. Submitters contend that shark-related fatalities in Queensland have declined in both areas with and without drum lines, with the steepest rates of decline before their installation. Further, it is considered that the effectiveness of drum lines in Queensland is difficult to evaluate as the rates of attack before and after their deployment are both very low and 83% of drum lines are deployed at locations where a fatal attack has never occurred (Meeuwig 2014).**

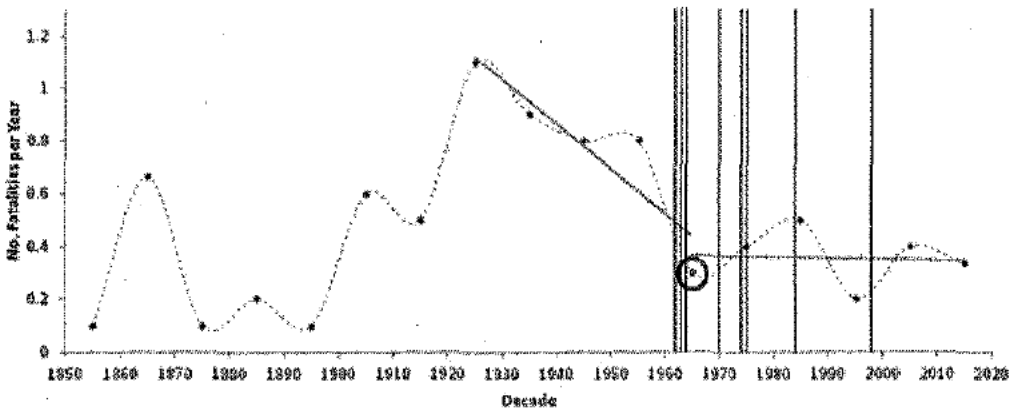
DPC Response
The PER includes a comprehensive description of the Government's overall Western Australian Shark Hazard Mitigation Strategy which includes a broad range of non-lethal measures introduced over time to address the risk of shark attack in Western Australia. The strategy represents a commitment by the Government of over $22 million and demonstrates an inherent desire to employ non-lethal methods of shark hazard mitigation. However, following the deaths of seven people in three and half years it was clear that further measures were required. The Government looked to other jurisdictions and developed a drum line program to be deployed off high use metropolitan and south west beaches and surf breaks aimed at peak usage times of the year.

While it is accepted that McPhee (2012) recommended against the establishment of a shark control program in Western Australia on environmental grounds, the analysis in this study was based primarily on the impact of netting. Discussion of the impact of drum lines on non-target species focussed on the capture of turtles in Queensland. The mostly northern distribution of turtles in Western Australia is such that they are not common in the locations where the drum lines are to be deployed (Environment Australia 2003). The measures taken during the drum line trial to avoid or minimise environmental impacts of the program, such as the use of approximate 25/0 circle hooks and monitoring the lines between 0600 and 1800 seven days a week, address many of the potential environmental impacts discussed in McPhee (2012). Based on data from the drum line trial only eight non-shark species (seven rays and one north-west blowfish) were captured and all of these animals were released alive. It should be noted that Queensland does not publish data on (non-shark) bycatch from its shark control program.

The shark control programs conducted in Hawaii are cited as an example of the inability of shark control programs to improve public safety outcomes. Six control programs of various intensities between 1959 and 1976 resulted in the capture of 2849 sharks. Standard long lines of 24 hooks per section were used in all but one of the programs to allow comparison of catch rates between programs. It should be noted that a substantial component of many of these campaigns was

research rather than risk abatement. Wetherbee *et al.* (1994) concluded that the programs did not appear to have had a measurable effect on the rate of shark attacks in Hawaii. In terms of effectiveness however, the Hawaiian programs which employed long lines and intermittent fishing campaigns, with some targeting of small sharks, cannot be compared with the Western Australian drum line program. The deployment of a series of static long lines offshore from high use areas in Hawaii were not designed to provide a barrier effect at select areas as is the design of the Western Australian program.

The effectiveness of drum lines as a component of the existing Queensland Shark Control Program has also been questioned on the basis that the rate of fatalities before and after the deployment of drum lines are both very low, with 83% of drum lines deployed at locations where a fatal attack has never occurred (Meeuwig 2014). In considering the below graph taken from Meeuwig (2014), although the trend in the mean number of fatalities shows a slight decline prior to the introduction of the drum line program, the trend line then extended is inaccurate as it includes the low point of fatalities that was recorded *after* the implementation of the program (point in red). The trend line to show the decline in rate of fatalities before the implementation of the program should therefore be depicted with a much more gentle gradient. It is also important to note that the mean number of fatalities in Queensland has stabilised following the implementation of the shark control program and has never returned to the high levels of the 1920s. The fatality rate of 0.37 per year published in Meeuwig (2014) is still significantly lower than the average fatality rate of 1.1 per year for Australia (West 2011). The Queensland and Western Australian programs are focussed on public safety. Based on the unpredictable nature of shark attack, both jurisdictions have chosen to offer a level of protection by deploying drum lines in populated areas both with a history of shark attack and at places where there has not been an attack, rather than wait for a death or serious injury to occur.



Meeuwig (2014) states that there are non-lethal techniques that can potentially achieve much better outcomes, however, no options are provided. Nonetheless, a discussion of non-lethal options and why they are currently unsuitable for Western Australia is provided in 1.2.1.

1.1.2 A number of submissions contend that the review of the shark drum line trial through Appendix 7 of the PER specifically did not 'assess the efficiency of drum lines on public safety mitigation'. Submissions contend that the proposal cannot be justified if the proponent cannot demonstrate that the proposal will enhance public safety.

DPC Response

The trial program ran for 14 weeks. It is not possible to draw conclusions on the efficacy of the program in increasing public safety over such a short period of time. The Queensland and Kwazulu-Natal programs have decades of data on which to assess the efficiency and effectiveness of their programs. Both jurisdictions place strong confidence in the effect the shark control programs are having on public safety and are proactively incorporating drum lines into their programs (Queensland DPI, 2006) (Cliff & Dudley 2011).

It is inherently difficult to assess the effectiveness of shark control programs, however this is not a reason for inaction. Although the short duration of the Western Australian trial precludes conclusions on the effectiveness of the program it is not a reason to suspend the program. While no further shark attacks cannot be guaranteed, data gathered over a three year program will add to the knowledge base of the effectiveness of shark control programs. It should be reiterated that research into non-lethal detection and deterrent technologies funded by the Government may provide complementary or alternative shark hazard mitigation options either within or at the end of the this three year period.

1.1.3 Submissions contend that the proposal is not necessary because the risk of shark attacks is so low (McPhee 2012) and that most of the shark attacks have occurred in winter and spring when the drum lines are not proposed to be deployed (with eight of the most recent 10 fatalities occurring outside of proposed time of deployment).

DPC Response

While statistically the risk of shark attack is low, the rate of shark attack has been increasing. In a subsequent paper examining the prevalence of shark bites between 1982 and 2011 in 56 countries McPhee (2014) states that "...over the period examined, the total number of unprovoked shark bites and the numbers that were fatal increased in frequency". West (2011) also provides data for Australia which show a rise in the incidence of shark attack from 6.5 incidents per year between 1990-2000 to 15 incidents per year over the last decade and links this trend with human population growth. Both authors do however acknowledge that fatalities from shark bite still represent an infrequent hazard to people undertaking water based activities.

What is significant is the increase in shark fatalities in Western Australia compared to historical levels. Western Australia experienced the third highest occurrence of fatal shark attacks in Australia in 100 years. In the last 10 years however, Western Australia has experienced the highest number of shark related fatalities in Australia with 10 fatal attacks. In the same time period, South Australia has recorded four fatalities, Queensland three, New South Wales two and Victoria, Tasmania and the Northern Territory experiencing no fatalities (Table 1).

Table 1. History of Shark Attacks in Australia

Shark Attacks	Queensland	New South Wales	**Western Australia**	South Australia	Victoria	Tasmania	Northern Territory
Last 100 Years	72	47	**20**	19	4	3	2
Last 10 Years	3	2	**10**	4	0	0	0

Ten fatal attacks have occurred in the last 10 years, seven of these in the last three and a half years. This unprecedented density of fatalities over a short period of time has had a significant impact on people's perceptions of the ocean and their enjoyment of water based activities.

Despite an increasing number of attacks, the conclusion that the risk to individuals remains low, raises the question of what the community and Government should consider to be an acceptable level of risk of shark attack. An exercise in statistical analysis does not remove the Government's duty of care to address the risk of shark attack. Crossley *et al.* (2014) have recently suggested that the low level of risk associated with the risk of shark attack cannot be reasoned with simple statistics and probability and that it is important to also look at psychological or emotional drivers of risk perception. In the case of shark attack, the consequence of the risk (e.g. the trauma associated with shark attack) outweighs the actual statistical risk or probability for most people. The low level of actual risk therefore does not justify taking no action.

Scientific research provides useful advice and guidance to the Government but this advice must be viewed in the broader policy context of the Government's obligations to protect the welfare of water users.

With regard to most shark attacks occurring in winter, outside the period of proposed drum line deployment, it should be noted that of the 11 fatalities that have occurred in Western Australia since 2000, five have occurred between November and April. Sharks are still present in Western Australian waters during the summer months, as evidenced by the drum line trial, and this is when most people are using the ocean. The proposed drum line program aims to offer an additional measure of protection to water users in the peak usage months at popular beaches and surf breaks.

1.1.4 Submissions contend that the PER does not present sufficient evidence to substantiate how the proposal would fulfil the other aim of the Program which is to restore confidence in the Western Australia's tourism industry and enhance public safety.

DPC Response

Even though the risk of shark attack is low the consequences of an attack are high resulting in a disproportionate sense of unease among members of the public. Crossley *et al.* (2014) found that this skewed risk perception means that people are more worried about shark attack than drowning despite the greater number of fatalities through drowning. Public perceptions of shark attack have been driven by media coverage emphasising the risk of attack and visual depictions of attacks. Exposure to these articles and images reinforces a primal fear of sharks (Crossley *et al.* 2014).

The long standing shark control measures in Queensland, New South Wales and South Africa were installed following heightened levels of fear of attack and a demand for shark control measures in those communities. These concerns have also resulted in community support for the installation of shark control programs more recently in Recife, Brazil and La Réunion. Following a number of attacks off of the coast of Durban, South Africa some small towns simply ceased to exist as inland tourists did not return, with Durban, which relies heavily on national and international tourism, also significantly affected. The introduction of the Kwazulu-Natal shark control program has seen the revitalisation of some of the small towns and a reversal of the negative impacts of shark attacks on the provincial economy.

The complexity of the emotional response to the risk of shark attack makes it difficult to measure changes in public confidence arising from shark control programs. In Western Australia this is compounded by the short period of the 2013-14 trial and the overwhelming negativity promulgated by opponents to the program.

Crossley *et al.* (2014) surveyed beach users in South Australia[1] and New South Wales and respondents in both regions considered beach meshing to be more effective than aerial patrols. The demand in other jurisdictions and the confidence in shark control programs observed by

[1] The study found that beach users in South Australia were aware of shark control programs even though there is no meshing or drum line program in South Australia.

Crossley *et al.* (2014) indicate that the Western Australian drum line program does have the potential to increase the level of confidence of beach users. As discussed in section 4.4 of the PER, some stakeholders reported a re-installation of confidence following the deployment of drum lines in Western Australia, particularly in the south west region. Many reports referred to a level of comfort offered at seeing a vessel patrolling just beyond the surf breaks and relief that measures were being taken to address the presence of large and potentially dangerous sharks in close proximity to high use areas. Submissions received in support of the program also noted a level of confidence that had been restored to water users.

As also discussed in section 4.4 of the PER, while it is not currently possible to quantify the exact impact of shark attacks on the economy, or the impact of introducing a drum lining program on the local economy, it should be considered likely that any further fatalities will have a significant bearing on interstate and international tourists' decision to visit the State. The potential risks to the culture of Western Australians and their association with the ocean, and to local communities should future shark fatalities occur, should also be considered when deciding whether or not the program should be implemented or rejected.

1.1.5 Submissions contend that the proposal will not achieve the objective of enhancing public safety because the sharks that are being targeted (whites and tigers) are migratory. Hence, removing some sharks with drum lines will not prevent other sharks from arriving at the Marine Monitored Areas (MMAs).

DPC Response

The objective of the Western Australian drum line program is not to target all white and tiger sharks migrating along the Western Australian coast. The design of the program is such that the drum lines are set approximately 1km offshore of popular swimming beaches and surf breaks to target large and potentially dangerous sharks that come into close proximity of populated areas.

This design is similar to the shark control programs operating off beaches in Queensland on the east coast of Australia, and Kwazulu-Natal in South Africa. In Queensland and Kwazulu-Natal drum lines are set approximately 300-500m offshore of popular beaches, and in many places in conjunction with nets. Queensland currently has approximately 330 drum lines deployed along its coast and Kwazulu-Natal has approximately 76 drum lines deployed along the southern beaches, with an intent to replace more nets with drum lines along the northern beaches in the coming year. These shark control programs, which have been operating for decades, target potentially dangerous sharks that come into close proximity of populated areas for the purpose of public safety.

The Government's proposal to set up to 60 static drum lines between 15 November and 30 April for three consecutive years is significantly more conservative in time, space and design than the long standing shark control programs operating on the east coast of Australia or in Kwazulu-Natal.

1.2 Alternatives considered

1.2.1 A number of submissions contend that the proposal does not adequately assess the use of scientifically supported, non-lethal alternatives including the South African Shark Spotter program and Brazil's tag and remove program. In doing so submitters have highlighted the following:

- **That the Shark Spotters program in Cape Town, South Africa is an example of a program which utilises non-lethal methods and has been shown to be effective in reducing shark related incidents (Kock *et al.* 2012).**
- **That the Brazil tag and remove program which uses long lines and drum lines to capture potentially aggressive sharks that are then transported and released offshore has reported a 97% reduction in shark attacks. Further the program has resulted in a lower mortality rate of about 30% for all potentially aggressive sharks (lower than the trial) and 100% survival rate for protected species captured (Hazin and Afonso 2013).**

Submissions are therefore of the view that the proponent should have undertaken a detailed evaluation of the above program's utility and applicability (in the PER under Alternatives considered) to the circumstances and conditions in the MMAs. Submitters have asked for trials of these programs to be undertaken in Western Australia, particularly in the south-west, with a view of avoiding and minimising lethal-methods of achieving the aim of the proposal. Submitters contend that such a program, combined with other existing programs such as the Shark Monitoring Network would provide an effective means of reducing the risk of shark attacks and also generate understanding of the distribution and movement of sharks.

DPC Response
Shark Spotters is a 2.5 million Rand per annum program that uses 26 people at eight beaches in five hour shifts observing white sharks from cliff and hill tops of between 50 – 100 metres. It is a specific response to a specific issue in a specific location. The topography of the land around Cape Town lends itself to observing white sharks which swim close to the surface, in an area that has previously had a high number of white shark attacks. The key point of the spotter program is the elevated position, made possible by the topography of the coastline in the area. The Western Australian coastline is largely unsuitable for this kind of surveillance opportunity, noting as well that it has a very limited coverage and is resource intensive. The construction of ~20m high watchtowers, as has been suggested by some, was considered to be an ineffective alternative to the vantages offered by high cliff tops close to shore by member of the Shark Spotters program.

In addressing the need for beach patrols and surveillance the Government has invested:

- over $2 million per annum in aerial surveillance contracted through Surf Life Saving WA;
- construction of a watchtower at the popular Cottesloe beach; and
- research into acoustic and sonar detection systems.

A number of jurisdictions have undertaken to release all sharks considered to be in a condition to survive, including potentially dangerous species. The Government considered the approach of a 'catch and release' program, however concluded it to be inappropriate for dealing with captured sharks in Western Australia. Although data from tagged tiger sharks released in Brazil shows that the animals remain at a distance from the coast for a period of time (Afonso & Hazin 2014), there is also evidence that they return to other coastal areas. In considering public safety, determining acceptable release locations for potentially dangerous sharks is challenging and presents 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 post-release survival.

With regard to the program undertaken in Recife, Brazil in addition to drum lines the program relied on extensive use of long lines and drum lines, with a total of approximately 280,000 hooks

deployed to cover only a 15 km coastline (Hazin & Afonso 2013). This compares to the 120km of coastline covered in the Marine Monitored Areas (MMAs) under the Western Australian proposal. While there was a significant decrease in shark attacks following the implementation of the shark control program in Recife, non-sharks accounted for 60% of the catch and the program reported a total mortality rate of all catch of between 22% and 25% (Afonso & Hazin 2014). It should also be noted that surfing was banned in the area that fishing was taking place which is likely to have had some impact on the reported decline in shark attacks. The Government has no desire to deploy long lines near areas of the coastline, and is equally unlikely to ban surfing off metropolitan and/or south west beaches.

Worth noting also is some recent research presented by Holmes in Durban which found that most of the 18 tiger sharks caught and released in Queensland waters initially relocated to deeper waters, but often only for a week or so before returning to their 'normal' movement behaviour (Holmes 2014).

While we must be cautious in using and interpreting research because conditions vary across jurisdictions, this research at least suggests the possibility that tiger sharks released offshore will not remain offshore. Releasing sharks therefore presents a significant risk and one that is unacceptable in the context of a public safety program, particularly in a program which is proposing to deploy drum lines for less than six months each year for only three years.

1.2.2 Submissions contend that the Eco Shark Barrier Pty Ltd deployed at Coogee Beach has been shown to be successful during its deployment from December 2013 to April 2014. Submitters have therefore questioned why the proponent has not undertaken a detailed evaluation (in the PER) of its applicability in the proposed MMAs.

DPC Response

Beach enclosures provide a physical barrier that prevent sharks from entering an area without killing the sharks or other marine life. The Eco Shark Barrier company constructed a beach enclosure at Coogee Beach in December 2013 for a three month trial. The construction cost of the structure was in the order of $250,000. The 300-metre wide enclosure stretched 73 metres out into the water and was made of interlocking cross connectors constructed out of stretchable and durable engineering polymer held in place by a series of anchors and buoys. This trial was funded by the company and supported by the City of Cockburn.

Prior to the construction of the Eco Shark Barrier at Coogee Beach the Government had conducted a study on the feasibility of beach enclosures, and provided $165,370 to the City of Busselton to construct a trial enclosure. In January 2014 an enclosure at Old Dunsborough in the State's south west was constructed. The enclosure extended approximately 100 metres from the shore, ran parallel with the beach for 300 metres, and was constructed from heavy gauge netting. The specifications for the enclosure are similar to the low maintenance 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. It should also be noted that beach enclosures protect only swimmers and offer no protection to surfers. The enclosure at Old Dunsborough remained in place until the end of April 2014. Initial feedback from the City of Busselton and beachgoers has been positive.

The Government has commissioned a review of the Old Dunsborough trial and is considering potential opportunities for the deployment of similar beach enclosures at other low energy locations in Western Australia. Pending the outcome of the review, additional suitable areas for enclosures along the Western Australian coastline may be identified.

1.2.3 A number of submission contend that novel non-lethal alternatives including bubble curtains, underwater deterrents (noise and light), and shark repellents have not been sufficiently considered (in the PER). Submissions also request that further information is provided on any future trials and opportunities for implementation.

DPC Response

Much of the research currently being undertaken into non-lethal shark deterrent and detection technologies is being funded by the Government. Almost $2million has been committed to investigate bubble curtains, underwater deterrents such as flashing lights and sounds and personal shark repellents such as the SharkShield device. A table detailing the individual research projects currently funded by the Government was included at Appendix 3 of the Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013-14 (the Review) (available on the DPC website www.dpc.wa.gov.au) and is provided here for reference. The Government is responsible for management of the research grant contracts, and receives regular progress reports and updates as to the status of the research in each area.

These technologies, and others that are being developed elsewhere, are still in the testing phase. While some show promise, no system is yet ready for confident take-up by the Government. It is hoped that at some point in the future options may become available to either complement or replace drum lines, however until more testing has been completed the Government is not prepared to replace drum lines with untested alternatives.

Shark Detection			
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.
Shark Deterrents			
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 University 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.

1.2.4 A number of submissions contend that increasing the coverage and intensity of a combination of mitigation measures which already are in place (detailed in the PER pp12-15) such as aerial and surf patrols, monitoring of tagged sharks, education campaigns and warning signage should be evaluated against the use of drum lines.

DPC Response
As described in the Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013-14 (the Review) (pp 6-7) the Government's shark hazard mitigation strategies have evolved over a number of years, with a number of phases of expansions of aerial patrols in both time and space over a number of years, two rounds of funding provided to Surf Life Saving WA for jet skis, a number of phases of funding input and development of the Shark Response Unit and Research Divisions at DoF and phases of education campaigns undertaken including development of the 'BeachSafe' smartphone application and the SharkSmart website. Despite all of this, the seventh fatality in three years occurred in November 2013. The Government did not consider the provisioning of a further round of funding to Surf Life Saving WA for even more extensive aerial patrols, funding the purchase of some more jet skis or commissioning extra beach signage to be reasonable responses to such an unprecedented spate of fatal shark attacks.

None of the existing measures were removed or reduced, with research, aerial patrols etc. continuing as before. The drum line program is intended to complement these measures.

Moreover, given the unpredictability of shark attack, and the lack of understanding of the factors involved in these attacks, as well as the consequences associated with a further attack while potential trials of 'one measure versus another' are undertaken, a comparative evaluation of the effectiveness of shark hazard mitigation measures is considered to be neither necessary nor practical.

1.2.5 Submissions strongly believe that further research needs to be done to identify alternative non-lethal measures of reducing shark attacks.

DPC Response
See 1.2.3

2. Marine Fauna

2.1 Predicted impacts – White Shark (Target Shark)

2.1.1 A number of submissions outlined that white sharks are globally threatened and are listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and that they are a listed migratory species under the Bonn Convention (CMS). As such, submitters do not support adding further pressure to white sharks. This is particularly relevant given the activity is a key threat detailed in the Recovery Plan for White Sharks (SEWPaC 2013).

DPC Response
The Government acknowledges the listing of the white shark under international treaties including CITES and the CMS, and has recently held discussions with the secretariat of the CMS. The Government also recognises the protection of white sharks in Australia under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and is aware that mortality related to shark control activities is one of several threats to white shark populations detailed in the Commonwealth Recovery Plan for the White Shark (the Recovery Plan).

The importance of the Recovery Plan and the measures being taken to support the recovery of the species are valued by the Government. The Government's Shark Monitoring Network (SMN) 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 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. Additional roll outs have taken place during the summer of 2013-14, supporting the importance the Government places on the receiver network. DoF is also actively involved in a further joint research project with CSIRO to address the lack of knowledge of the size and trend of white shark populations in southern and western Australia. This 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.

It remains however that the Government has a duty of care to the public of Western Australia. As acknowledged by the Commonwealth Minister for the Environment in his letter to the Western Australian Premier in granting a temporary exemption from Part 3 of the EPBC Act to permit the trial program between January and April 2014, public safety is a paramount consideration and the responsibility of all Governments. It is for reasons of public safety that Queensland and New South Wales choose to continue their long running shark control programs. The Government's proposal to set up to 60 static drum lines between 15 November and 30 April for three consecutive years is significantly more conservative in time, space and design than the long standing shark control programs operating on the east coast. All programs however address the issues of public safety and economic interests, which are both considered within the definition of national interest. As noted by the Commonwealth Minister for the Environment 'one does not have to agree with a policy to accept that a national interest exemption is warranted to protect against imminent threat to life, economic damage and public safety more generally'.

The data and information collected during a three year program has the potential to add to the knowledge of shark species in south western Australia, including genetic sampling, shark presence data, local oceanographic data, telemetry, catch survivability, post release mortality and age and growth through mark re-capture.

2.1.2 A number of submissions contend that there is considerable uncertainty in the predicted catch rates for the white sharks because:

DPC Response
As a general response to the specific issues identified under this theme (which are responded to separately below), the Management Plan specifies that:

1. Weekly catch data will be reviewed in the context of the risk assessment to verify catch data against predictions.
2. Appropriate trigger criteria are to be discussed and agreed with the EPA and DoE as part of its ongoing development.

These provisions will allow for contingency actions and an immediate review of the risks to be considered if actual catches exceed those predicted in the risk assessment.

- **of the variation and accuracy of predictions (<10) to actual number of white sharks caught for the shark drum line trial (0);**
- **predictions were based in part on results of the trial which was shorter than the annual duration of the proposal (Nov-April);**

DPC Response
The catch of zero (0) white sharks captured in the initial drum line trial was consistent with a prediction of less than 10. The nominal catch estimate of <10 white sharks (per year), as outlined in the PER, was based on qualitative comparison of the species' catch rates in commercial and research fishing programs in the Marine Monitored Areas (MMAs) in these times of the year, and in consideration of marked differences in type and location of fishing gear used to generate those data.

- **south western coastal waters experienced high than historical temperatures during the trial (detailed in the PER); and**

DPC Response
Yes, inter-annual changes in temperature, circulation patterns and other environmental variables have the potential to result in the number of actual catches varying between years. The anticipated number of less than 25 white sharks being captured over three years of the program, as presented in the PER, takes this potential annual environmental variation into account. In addition, the Management Plan has contingencies to deal with higher than expected catches.

- **the PER did not consider movement patters of the white shark and the fact that they are migratory species.**

DPC Response
Movement patterns of white sharks in and beyond the MMAs are currently being investigated. In terms of the program's possible local impacts on the population, '*the fact that they are migratory species*' was clearly presented in the background section on white sharks in the PER. This population trait requires that impacts need to be examined at a population level and not a local level, which is the scale at which the risk assessment was completed. Similarly, the qualitative comparison of the species' catch rates in commercial and research fishing programs in Western Australia that were used to generate the predictions (see above) have also included the fact that white sharks are highly migratory.

Given the above, submissions question whether the proponent has refined predictions, considered environmental conditions and temporal and movement variables in predicting catch rates for white sharks.

DPC Response
The predicted catches are based on qualitative comparison of the species' catch rates in commercial and research fishing programs over a range of conditions. To improve understanding of the effects of fine-scale environmental conditions in the MMAs, further data are being collected to identify environmental conditions that may lead to a greater or lesser frequency of white sharks being present in the MMAs during the season of operation. It will take a number of years of data collection to gather sufficient information to provide more precise annual levels but at such low levels this is considered critical. As stated above, the anticipated catch levels of less than 10 white sharks per year takes this variation into account.

2.1.3 A number of submissions question whether the proponent has considered demographics such as sex ratios of white sharks expected to be caught as part of this proposal and impact to the population viability. For example, if the majority of captured white sharks were breeding females (as seen for the tiger sharks in the trial) would the risk rating change?

DPC Response
The sex (and size) composition of catches is an important consideration in assessing the sustainability of any fishing activity. However, given the low expected catches of white sharks, the sex composition of these catches does not affect the risk profile and therefore the risk rating does not change.

In addition, in a demographic modelling context, the net contribution of males to population growth is generally not considered. This is mainly because males' net contribution to population growth is poorly understood and is complicated by peculiarities of elasmobranch reproductive biology, e.g. diapause (temporary pause in embryonic development) and multiple paternity. Therefore, the risk rating implicitly considers the catch being comprised exclusively of female sharks.

2.1.4 Submissions contend that the cumulative impact to the south western Australian population of white sharks has not been fully considered. For example, the south western Australian white shark is known to migrate to South Africa where a lethal shark control program is also in place. Submitters contend that consideration should be given to the combined impact of removal of migratory sharks across their full distribution to obtain a more accurate picture on the impact of the program on the population.

DPC Response
A single white shark is known to have migrated (in both directions) between South Africa and Western Australia but despite subsequent tagging of many more sharks with satellite and acoustic tags, this movement pattern has not been observed again. Blower *et al.* (2012) concluded that "*gene flow is ... severely restricted across oceans*". Thus, there is not strong evidence that this is a common 'migration route' or that the additional mortality of white sharks in South Africa is significant to the south western Australian population or vice versa. However, the cumulative impact of various sources of fishing mortality across the population's known distribution in south-western Australian waters is relevant and was considered in the modelling.

2.1.5 Submissions contend that there is a high level of uncertainty regarding the population estimates of the south western Australian white shark. The estimates provided in the PER outline that the size of population is likely to be in the range of 3,400 to 5,400 and that it has remained stable or been increasing over the past decade. Submissions contend that this is at odds with the most contemporary peer-reviewed estimates which outline that the genetically effective (breeding) population size is approximately 700 breeding individuals and close to thresholds at which adaptive potential may be lost (Blower *et al.* 2012).

DPC Response
As Blower *et al.* (2012) clearly acknowledge, their estimates have wide confidence intervals and are preliminary due to low numbers of genetic markers and samples. The results of the study must therefore be interpreted judiciously. As such, the effective genetic population size estimate of 700 breeding individuals should not be considered as an estimate of absolute contemporary abundance for this population. Nevertheless, an estimate of 700 breeding individuals is not inconsistent with a TOTAL population size of 3,400 to 5,400 individuals (i.e. total includes juveniles, immature and mature adults) as presented in the PER. It is important to note that breeding individuals of all species make up only a proportion of their total population size.

The methodology used in the DoF white shark population estimate uses an established methodology for calculating population numbers of shark species. For example, the use of catch data and observer reports forms the basis for a major review of the biology and status of white sharks conducted in 2001 by CSIRO (Malcolm *et al.* 2001). The use of mitochondrial DNA (mtDNA) for laboratory based population estimates however has been challenged as a means for determining population abundance (Bazin *et al.* 2006).

2.1.6 Submissions are seeking a clear and concise response on how the population estimate for south western Australian white shark population in Blower *et al.* 2012 were utilised in the proponent's risk assessment.

DPC Response
The population estimates used in the PER were found to be well within, and at the lower end of, the 95% confidence intervals for the estimate provided by Blower *et al.* (2012). Thus, noting the uncertainties for both approaches, the current white shark population estimates from the modelling and the genetic analyses were not inconsistent (see 2.1.5 above). In addition, Blower *et al.* (2012) acknowledged that their estimate of historic white shark population size (*HNe*)(2,218 – 330,000) "*may have an indeterminate temporal and spatial scale*" that is "*potentially unrelated to the CNe [current breeding population] estimates*".

2.2 Predicted Impacts – Tiger Shark (Target Shark)

2.2.1 A number of submissions contend that the tiger shark is being unduly targeted and should not be considered a 'target shark' given they have not been responsible for any Western Australian fatalities in 80 years.

DPC Response
The potential threat that tigers sharks pose to water users in Western Australia should not be underestimated. According to the Australian Shark Attack File, tiger sharks are believed to have been responsible for 59 unprovoked fatalities of a total of 156 in Australian waters in the last 100 years. White sharks are believed to have been responsible for 54 unprovoked fatalities in the last 100 years. Tiger sharks are therefore consistently listed as one of the top three most dangerous shark species. The International Shark Attack File (ISAF) states "the white, tiger and bull sharks are the "Big Three" in the shark attack world because they are large species that are capable of inflicting serious injuries to a victim, are commonly found in areas where humans enter the water and have teeth designed to shear rather than hold". The ISAF, in describing the tiger shark also states "the tiger shark is second only to the white shark in number of reported attacks on humans. Its large size and voraciousness make it a formidable predator in the ocean. Tiger sharks can be curious and aggressive towards humans in the water and must be considered with a great deal of respect."

The tiger shark's distribution is known to extend along the Western Australian coastline to as far south as Cape Leeuwin. As seen through the higher than expected numbers caught during the drum line trial program that ran between January and April 2014, large tiger sharks are present in the proximity of highly populated metropolitan and south west beaches and surf breaks, highlighting the potential risk to water users from interactions with tiger sharks. It would be remiss of the Government, when designing a shark control program that aims to offer an additional measure of protection to water users, to disregard one of the top three most dangerous shark species globally. For the Government to wait for a tiger shark to be implicated in a fatal attack before including it as a target species, with evidence to support its listing as one of the world's top three most dangerous shark species, would be negligent.

2.2.2 The Proposal considers that there will be a 'low risk' to the tiger shark population through capturing an estimated 900 tiger sharks over the three year period. This is because the tiger shark population is in reasonable condition, tiger sharks are relatively resilient to exploitation and the proposed catch is about 50% of historical catch levels in fisheries that are now closed. However, submitters contend that this risk rating is not justified because the proponent has not addressed the following:

- **The demographics including size and sex ratios of females to males expected to be caught as part of this proposal and the impact to the viability of the tiger shark population. Given the trial resulted in a ratio of 4 females to every 1 male tiger shark caught (for large ≥3m size class) submissions contend that such bias in catches is likely to have a disproportionate effect on population recovery and maintenance.**

DPC Response
The PER did take into account the sex ratio and life history of tiger sharks and expected catches. The consideration of these characteristics contributed to the increase in risk rating from 'negligible' to 'minor' over a three year period of the program. The PER also states that a full risk assessment should be undertaken at the end of the three year period, assisted by sampling of tiger sharks from the MMAs and other sampling programs in Western Australia. Even with the sex ratio, catches by this program still represent a relatively low level of exploitation on a very widely distributed stock that now has minimal level of captures by other sectors (see full details in the PER and also at 2.1.3 of these responses).

- **Submissions contend that the proponent's assessment of the consequence of the predicted catch rates for tiger sharks has not taken into account movement patterns and the fact that they are migratory.**

DPC Response
As considered for white sharks in 2.1.2, it was highlighted in the background to the analysis of tiger sharks that they are a wide ranging species that takes seasonal excursions. The scale of the assessment needed to be state-wide and this was the scale at which the assessment was undertaken. More detailed understanding of the movement patterns of tiger sharks in and beyond the MMAs are being investigated (see Stevens *et al.* 2009).

- **Submissions contend that the proponent has insufficiently investigated cumulative impacts to the tiger shark population because there has been no estimate provided for ongoing illegal, unreported and unregulated catch estimates of this population.**
- **A number of submissions question the proponent's reference and comparison to commercial and recreational historical catch levels as a benchmark for this proposal given the lack of evidence to support historical catch levels were ever sustainable.**

DPC Response
This was investigated in detail within section 4.2.3 the PER. One of the key lines of evidence that catch levels were sustainable is that there was no decline in commercial catch rates during the period when the highest tiger shark catch levels were occurring (early to mid-2000s). In addition, these commercial catch rates will implicitly incorporate any impacts that may arise from illegal, unreported and unregulated (IUU) catches as, if IUU catches were significant, this would be reflected in declining commercial catch rates.

Importantly, the evidence shows that historic catches of tiger sharks at levels well above that expected to occur annually during the proposed drum line program and sustained for a longer period did not appear to significantly impact the sustainability of the Western Australian tiger shark population. Thus, the impacts of the proposed activities are likely to be relatively minor compared to previous catches (see Heupel and McAuley 2007 and Salini *et al.* 2007 for more information).

While it has been commented that tiger sharks are protected under the *Fish Resources Management Act 1994* (WA), this protection applies to *all whaler sharks* with an interdorsal fin length of 70cm or greater, taken from the waters of the South Coast or West Coast Regions. The maximum size limit for fishing for whaler sharks was introduced due to overfishing of larger dusky and sandbar sharks, however there is also concern over the suitability of large whaler sharks for human consumption due to higher than recommended concentrations of heavy metals in their flesh. This protection applies to dusky, bronze, sandbar, bull, spinner and tiger sharks, and was not legislated specifically to protect tiger sharks.

- **Submissions contend that given no estimates are provided for the size of the tiger shark population in the PER there is no evidence to support the claim that there will be no measurable impact on the tiger shark population (stock assessment).**

DPC Response
It is important to recognise that lack of a population estimate(s) does not equate to an inability to manage exploitation. Many fisheries around the world are managed via proxies for population size (including catch rate trends and/or estimates of fishing mortality). Trends in catch rates and/or fishing mortality can thus be used to infer how a fished population is tracking with respect to levels of fishing pressure or levels of catch. Furthermore, even levels of catch can be successfully used to determine the status of how a fish population is performing under a regime of exploitation. This has been, and remains, a basic tenet of assessing fisheries sustainability and which has been applied to sharks species caught in the drum line program. Consideration of the expected levels of tiger shark catch against historical catches does, as stated above, suggest that the impacts of the proposed activities will be relatively minor compared to previous catches.

2.2.3 A number of submissions noted that the PER did not evaluate the survival rate of released tiger sharks (and other released animals) from the trial. Submissions request that the proponent undertakes an evaluation based on observations from the trial and through a review of the scientific literature that has examined the impact of catch and release protocols in other fish species.

DPC Response

A study by Afonso and Hazin (2014) showed no recorded tiger shark post-release mortality, suggesting that tiger sharks are particularly robust to line capture. However. as the hooks used in the trial and proposed for the next three years are unique (i.e. very large compared to those used in other programs), results from other studies of post-release survival, even for the same species, may not be comparable. Thus, until empirical data demonstrate otherwise, for the purposes of the risk assessment and predicted catch levels, the precautionary principle has been applied to *allow* for a post-release mortality of close to 100%. This suggests therefore that given post-release mortality is not *expected* to be 100%, the impacts of the program should be even lower than those predicted in the risk assessment.

Measures will be taken where possible, as part of the three year program, to assess the post release survival of released tiger sharks through the application of internal acoustic tags or fin mounted PAT/PSAT or SPOT tags. It should be noted that this type of tagging will only be undertaken upon consideration of the condition of the animal and the safety of the crew on board and in consultation with relevant research divisions and project scopes. See 2.9 and "Response to the Peer Review" of this document for further details.

2.3 Predicted Impacts – Bull Sharks (Target Shark)

2.3.1 Submissions contend that there was no information provided in the PER to assess likely impacts on Bull sharks which is listed as 'totally protected fish' under the *Fish Resources Management Act 1994*. Submissions highlighted that no data was presented regarding their population, distribution, movement or migration, or ecological functioning in the PER.

DPC Response
Based on historical commercial and research data, bull sharks are relatively rare in marine waters of south west Western Australia and are largely restricted to estuarine regions. Complementary with their rarity, it was assessed that bull sharks are not a major ecological component of the marine shark community off the Western Australian coast. Additionally, due to their scarcity in marine waters in Western Australia, it is expected that the catches of bull sharks in the program will be rare.

Notwithstanding this, bull sharks, together with tiger sharks and white sharks, are considered one of the top three most dangerous sharks globally. The Australian Shark Attack File lists the white, tiger and bull sharks as identified in fatal unprovoked shark attacks on humans in Australia. The International Shark Attack File (ISAF) states "the white, tiger and bull sharks are the "Big Three" in the shark attack world because they are large species that are capable of inflicting serious injuries to a victim, are commonly found in areas where humans enter the water and have teeth designed to shear rather than hold". The bull shark is known to have been responsible for a fatality in a lower estuary of the Swan Canning Riverpark in Perth's metropolitan region in the 1920s, and there are several recorded cases of fatal attacks by bull sharks on Australia's east coast.

2.4 Predicted Impacts – Non-target sharks and marine fauna

2.4.1 Submissions contend that there has been a lack of consideration under Matters of National Environmental Significance in the PER (pg 72) for the migratory Shortfin mako shark which is listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), particularly given that five were caught as part of the trial.

DPC Response
The PER specifically considered the risk of the program to shortfin mako (pp 59 and 73). As noted below Table 12 on page 73 of the PER, while the shortfin mako did not appear on the EPBC Act Protected Matters Report for either the metropolitan or south west MMA consideration was given to the shortfin mako due to it being listed as a migratory species under the EPBC Act.

Catches of shortfin mako sharks, *Isurus oxyrinchus*, during the trial were lower than ongoing bycatch in Western Australian commercial fisheries (cumulatively, in the order of 2 – 5 tonnes per year). The commercial fisheries bycatch figures for Western Australia for shortfin mako sharks are again negligible relative to the estimated total Australian catches (130-150 tonnes) of shortfin mako together with the likely magnitude of unreported catches by high seas fleets in international waters. It should be noted that in the Northwest Atlantic swordfish longline fishery, shortfin mako sharks represent one of three sharks commonly taken as bycatch, with thousands of tonnes of bycatch caught each year, of which approximately 30-50% die either on the line or post-release (Wimmer *et al.* 2014). This fishery has received Marine Stewardship Council (MSC) third party sustainability certification. Proposed ongoing catches of between five and 20 individuals per annum for three years as part of the drum line program represents a negligible risk to the sustainability of the South East Indian Ocean population(s).

2.4.2 A number of submissions contend that the considerations given for the Dusky whaler (which is currently under consideration for EPBC Act listing) is insufficient and the risk rating appears overly dismissive. Submissions detail that it would not take a high number of this shark to be caught for the risk to the population to increase significantly.

DPC Response
DoF is acutely aware of the risks of mortality on adult dusky sharks, a species which has a long history of exploitation but for which such exploitation was noted to be sustainable only if targeted at very young age classes. This risk was clearly identified prior to the initial drum line program (Appendix 6 of the PER) and was also detailed in section 4.2.3 of the PER. However, the level of capture that would result in an unacceptable risk was not realised by a significant margin. With better understanding of the migration patterns of larger dusky sharks, it is unlikely that their level of capture will increase to levels (i.e. greater than 30 adults per year) that would require additional management actions. Furthermore, the Management Plan has contingencies to deal with higher than expected catches in the highly unlikely situation that this arises (see McAuley *et al.* 2007 for more information).

2.4.3 Submissions question what contingency measures are available or in place for non-target sharks and marine fauna (by-catch) in the event that the catches of non-target sharks and marine fauna are above predictions.

DPC Response

The three year program has been designed to minimise bycatch of non-target sharks and marine fauna through the inclusion of the following:

1. **A larger than standard approximate 25/0 circle hook.** The use of a large hook proved successful in reducing non-shark bycatch in the trial program with only one north-west blowfish and seven rays caught in the metropolitan region, all of which were released alive. The smallest shark to be captured was 153 cm total length, with only 22 sharks less than 200cm total length caught on the drum lines. Of these, all were released alive with the exception of one. This compares to sharks caught on drum lines in Queensland in 2013 using a 14/0 J hook, with 276 sharks under 200cm caught, with 41 less than 100cm in length. 118 sharks between 200 and 300 cm in length were caught and only 36 sharks >300cm. The fate of these animals is not disclosed.
2. **A limited number of drum lines.** Up to a maximum of 60 static drum lines will be deployed at any one time.
3. **A limited area in which static drum lines are to be deployed** (<0.1% of Western Australian waters and <1% of the Western Australian coastline).
4. **Monitoring of static drum lines to occur between 0600 and 1800 hours, seven days a week.** This high level of commitment to monitoring and servicing drum lines is far more extensive than any other jurisdiction undertaking shark control activities.
5. **A limited time in which static drum lines are to be deployed** (<6 months each year).
6. **The removal of static drum lines between 1 May and 14 November each year to avoid annual whale migrations.** Despite the very low risk of whales interacting with drum lines, the Government is proposing to remove the drum lines through the winter months.
7. **A preference for the use of shark as bait to reduce interactions with other marine species.** The Government is committed to monitoring bait usage and captures to assess possible correlations between increases in catch of non-target species and the type of bait being used and respond accordingly. During the trial program there appeared to be a correlation between the use of locally caught salmon and interactions with rays in the metropolitan region. The use of salmon was subsequently discontinued to reduce the potential for interactions with rays. It is hoped that, where available, the use of shark as bait, together with catch rates, will provide useful information on bait/catch correlations. Where shark is not available, consideration will be given to using less oily fishes to aim to reduce the level of scavenging, particularly by undersize tiger sharks.
8. **No deployment of nets or any net meshing program.** In contrast to the Queensland and Kwazulu-Natal shark control programs, the Government has committed to not including nets as part of the program. Despite criticisms that the exclusion of nets from the drum line configuration will reduce the effectiveness of the program in offering protection to water users, the indiscriminate nature of nets and the high level of bycatch taken mean the Government is not prepared to deploy any nets or net meshing system off of Western Australian beaches.
9. **Defining only three target species of 300cm TL or greater.** All animals caught on drum lines that are less than 300cm TL will be released alive wherever possible. Only white, tiger or bull sharks that are 300cm TL or greater will targeted in an attempt to reduce the environmental impact of the program. This is despite the International Shark Attack File stating "...realistically, almost any shark in the right size range, roughly six feet (1.8 meters) or greater, is a potential threat to humans because, even if a bite is not intended as a directed feeding attempt on a human, the power of the jaw and tooth morphology can lead to injury" and the Queensland shark control program targeting sharks greater than two metres.
10. **The setting of hooks a suitable distance below the surface of the water to avoid interactions with seabirds.** No interactions with seabirds and the drum lines were recorded during the trial period.
11. **Maintenance of detailed records of all catches for weekly monitoring of catch data to identify potential trigger points.** Extensive data collection will be undertaken and provision

of all catch to the relevant authorities for ongoing assessment, species identification and monitoring of catch levels.

12. **The provision of training in animal handling and best practice techniques to increase the chance of survival of non-target species.** The Government is committed to engaging with the DPaW, DoF and other experts to provide contractors with additional guidance and direction on the humane handling of marine animals.
13. **Observers to be aboard each vessel on the first day of deployment and on a defined number of trips thereafter.** Observers will be officers from agencies including, but not limited to, DoF, DPaW and DPC.

As per section 4.2.3 of the PER, the risk evaluation for all non-target species and other marine fauna is negligible with risk scores of zero for all except the dusky shark which has a risk score of 1 (for more information on dusky shark catch see 2.4.2). Following the implementation of the above measures, if the catch rates of non-target species and marine fauna exceed predictions contingency measures will be implemented which may include the following:

- effort reductions achieved through non-baiting of drum line hooks overnight;
- variation of bait types;
- inclusion of acoustic pingers on drum lines (if interactions with whales and/or dolphins);
- increased effort of patrols if catch exceeding predictions in a particular location;
- additional observer trips; and
- a within-season review of the program.

The contingency measures detailed above will form part of the Management Plan.

2.5 Predicted Impacts – Ecosystem

2.5.1 The Proposal considered that broad scale ecological impacts are 'negligible' on the grounds that there was no evidence that there were ecological impacts on the ecosystem associated with shark removal during the height of the shark fishery in the region. However, no historical research from fisheries is present to support this assertion and a growing level of evidence of the effects on marine ecosystems as a result of the removal of apex predators are increasingly being identified (Ruppert *et al.* 2013, Ferretti *et al.* 2010, Heithaus *et al.* 2012). Thus, submitters contend that the posited absence of such impacts in the past merely reflects a lack of research on this topic and is not grounds for dismissing the issue in the present day.

DPC Response

As evaluated in section 4.2.3 the PER, a major decline in all apex predators over a prolonged time period is required to generate significant impacts in ecosystem functioning. Removal of predators in this context occurs at the population level and not at the individual level. As also outlined in the PER, the suite of shark species in the West Coast Bioregion has not been subject to levels of overexploitation that have resulted in changes recorded elsewhere. Furthermore, historical research was presented in the PER to support the lack of change in community structure of the fish communities of the West Coast Bioregion.

Extensive analyses and modelling of the State's fisheries was undertaken for the period from 1976 to 2005 to specifically examine the issue of trophic impacts (Hall and Wise 2011). This research included data from all fisheries in all Bioregions throughout the State, including shark fisheries. As is standard for all FRDC reports, this report was peer reviewed by FRDC before finalisation and publication.

Hall and Wise (2011 p-2) concluded that "...there is no evidence from the commercial fishery data that, from 1976 to 2005, there has been any reduction in trophic level or mean maximum length that would be expected from fishing down the food web, and thus, it appears that, at this time, ecosystem services have not been affected by fishing or other factors". These analyses included the catches of sharks (and other species) removed at the height of targeted fishing.

As fisheries management has significantly reduced the spatial extent and levels of shark fishing effort (36% in the West Coast Bioregion and more than 50% in the South Coast Bioregion; suspension of shark catches by the Northern Shark Fisheries since 2009; commercial protection of all shark species and maximum commercial and recreational size limits for whaler sharks in South Coast and West Coast Bioregions) any increases in catches by the program are more than offset by previous reductions in commercial and recreational fishing for sharks.

2.6 Predicted Impacts – Temporary drum lines

2.6.1 Submissions contend that the proponent has not sufficiently assessed the environmental impacts of the temporary drum line component of the program because it was reliant on the results and data collected from the trial. As the temporary drum line component could be deployed anywhere in state waters (temperate and tropical waters) and at any time of the year, submissions have questioned the utility of the result and data from the trial for the purpose of predicting and assessing impacts from the temporary drum line component.

DPC Response
The assessment of the potential impacts resulting from the deployment of temporary drum lines was based on 15 months of data from DoF in relation to the imminent threat policy, and on data from the 14 week drum line trial.

The DoF imminent threat policy has been in place since October 2012. Between October 2012 and January 2014 capture gear was set three times, and decision sheets prepared on another two occasions but with no capture gear subsequently set. No environmental impact from having deployed less than ten drum lines in 15 months under imminent threat has been recorded.

During the trial drum line program between January and April 2014, deployments of temporary drum lines in response to sharks considered to be posing a threat to public safety were undertaken five times, with four of those occurring in the one day in response to the same shark moving southwards through near shore metropolitan waters.

Any lines deployed in response to a shark posing a threat or following an attack are closely monitored for the duration of their deployment. In responding to a threat lines are deployed and monitored for up to one hour. In responding to an attack lines are deployed and monitored for up to one week. Close monitoring of the lines maximises the opportunity for avoiding capture of non-target animals, and in the unlikely event that a non-target animal is caught, close monitoring increases the chances of successful release.

An analysis of the trial drum line program catch data found there to be no significant environmental impacts of deploying a maximum of 60 drum lines permanently for a period of 14 weeks, with only eight non-shark species captured (seven rays and one north-west blowfish) on the lines, all of which were released alive. In considering that the impact from having static drum lines in the water permanently for 14 weeks posed no significant environmental impacts, the Government considers that any impacts resulting from the temporary deployment of a maximum of five drum lines for up to one hour in response to a shark considered to be posing a threat to the public or for up to one week following an attack, and given the close monitoring of the temporary lines during the duration of their deployment, is also likely to result in no significant environmental impacts.

2.7 Marine Sanctuary Zones

2.7.1 Submissions contend that the proposal (static and temporary drum line deployment) should not be permitted within marine sanctuary zones.

DPC Response
As stated in section 2.5.3 of the PER, static drum lines will not be deployed within any gazetted or proposed marine sanctuary or gazetted or proposed marine recreation zone in any Western Australian marine parks as designated under the *Conservation and Land Management Act 1984*.

With regard to temporary drum lines, in considering the submission to the EPA by DPaW and in line with details already contained with the Draft Management Plan under section 3.2.3, appropriate consultation will be held between DoF and DPaW prior to the deployment of temporary drum lines within any marine protected areas. It must be noted, and as acknowledged by DPaW, that in order to maximise the chances of capture of a shark posing a threat or following an incident, it may be necessary to deploy temporary drum lines within no-take areas. However, as per its submission, DPaW will provide details of the locations of long-term scientific research and monitoring sites to DPC and DoF in order that the deployment of temporary drum lines can, as far as possible, be managed to avoid these important areas.

2.8 World Heritage Areas

2.8.1 The proponent suggests that the ecological impacts on the two regional World Heritage Areas (Shark Bay and Ningaloo) will be minimal as few (if any) drum line deployments would occur in these areas. Submissions contend that this assertion ignores the fact that white and tiger sharks are wide-ranging, with individuals capable of moving over much of the coastline of WA. As such, the connectivity of the population at this scale means that the proponent cannot dismiss potential impacts of the annual removal of upward of 40 tonnes of largely female tiger sharks on these World Heritage Areas merely on the basis of deployment strategies.

DPC Response
Despite the fact that the locations of any static drum lines would be at least 500km away from Shark Bay and Ningaloo, the conclusion that there would be minimal ecological impacts on the two regional World Heritage Areas is also based on the following;

- The Gascoyne Bioregion (which includes the World Heritage areas of Shark Bay and Ningaloo; refer to Figure 3 on page 7 of the PER) is towards the northern end of the range of white sharks in Western Australia.
- As the Peer Review Report of the PER acknowledges, "the reduction in effort (in fisheries identified as having the largest white shark catches) has likely resulted in a reduced impact on the white shark population by means of reduced bycatch and (increased) survival through the release of some that are caught".
- Aside from shark control programs, white sharks have been totally protected in Western Australia, South Australia and around Australia since 1997. Thus any unintentional captures of white shark require immediate release.
- Total catches of tiger sharks have dramatically declined since the late 2000s due to management and other industry factors not related to the stock (see 2.2.2).
- As indicated in 2.5 it is contended that the potential for any broad scale ecological impacts are more than offset by previous reductions in commercial and recreational fishing for sharks. The study by Hall and Wise (2011) indicated that ecosystem services of the Gascoyne Bioregion have also not been affected by fishing or other factors.

It is therefore unlikely that the magnitude of capture of white and tiger sharks by the drum line program will produce measureable ecological impacts to the World Heritage Areas of Shark Bay and Ningaloo.

2.9 Proposed management measures

2.9.1 Submissions contend that the proponent has not adequately addressed the requirements of Table 1, section 2 of Work and output required, detailed in the Environmental Scoping Document (ESD) (Appendix 1 of the PER). It is also considered that standard protocols (particularly for euthanasia methods and animal condition assessment) to ensure animals are treated humanely and mortality to by-catch is minimised should be provided in detail. Submissions therefore contend that the following needs to be addressed, included and/or further expanded in the final Management Plan:

- **Measureable objectives that are linked to the proponent's predictions to maintain population viability for target sharks and avoidance and minimisation of impacts to reduce mortality to non-target sharks and marine fauna.**

DPC Response
As per the "*anticipated annual catch levels* " and "*risk evaluation*" defined in section 4.2.3 of the PER for each species, acceptable catch levels have been developed for each of the target species which will allow for the monitoring of catch towards the specified levels. The acceptable catch levels of target species are:

- White sharks: 25 white sharks over three years. Measures will be taken, where possible, to assess the post release survival of released white sharks through the application of internal acoustic tags or fin mounted PAT/PSAT or SPOT tags. It should be noted that this type of tagging will only be undertaken upon consideration of the condition of the animal and the safety of the crew on board and in consultation with relevant research divisions and project scopes. See "Response to the Peer Review" for further details. It should be noted that an average of 6.4 white sharks were caught each year over the ten years between 2004 and 2013 in the Queensland Shark Control Program. The fate of these animals are not published.
- Tiger sharks: 300 per year. Once again, measures will be taken where possible to assess the post release survival of released tiger sharks, however only upon consideration of the condition of the animal and the safety of the crew on board and in consultation with relevant research divisions and project scopes. It should be noted that an average of 234.4 tiger sharks were caught each year over the last ten years between 2004 and 2013 in the Queensland Shark Control Program. The fate of these animals is not published.
- Bull sharks: 10 over three years. It should be noted that an average of 102.7 bull sharks were caught each year over the ten years between 2004 and 2013 in the Queensland Shark Control Program. The fate of these animals is not published.

For more information on how the Government proposes to avoid and minimise impacts to non-target species and marine fauna please see response 2.4.3.

- **Clarification on whether drum lines are baited at night as submissions contend that animals left overnight (>12 hours) will have a higher level of mortality (particularly relevant to non-target sharks and marine fauna).**

DPC Response
Drum lines will be baited, at a minimum, at the start and end of every patrol each day. Contractors will be required to operate between the hours of 0600 and 1800. During the summer months however, many people enter the ocean prior to 0600. If drum lines were not baited overnight, this could mean that in some areas, particularly those beaches furthest from the boat launch site, may not be baited until at least 0700. This would result in early morning swimmers and surfers entering the ocean with no protection offered by the drum lines.

Under the Queensland Shark Control Program equipment is serviced every second day, New South Wales service their nets each weekend day and for nine weekdays per month and in Kwazulu-Natal gear is checked 20 times per month. The Government's proposal to monitor the

drum lines for up to 12 hours each day, every day, for the duration of the program[2] represents a far greater commitment to monitoring of drum lines, and therefore potential to successfully release bycatch, than any other shark control program.

- **To reduce animal suffering and death, the optimum period for baiting drum lines and also the maximum period between checking/inspecting of baited drum lines must be specified.**

DPC Response
Contractors will be required to operate between the hours of 0600 and 1800, seven days a week. They will be required to service the drum lines and re-bait all hooks on the first patrol of the day, and at the end of each day. Contractors will also be required to record the following data; drum line GPS, the time each drum line is inspected, the bait used, the amount of bait used, the time the hook is baited and any signs of damage, loss, vandalism or wear and tear to the gear. In addition, if an animal is found on a line contractors will also be required to record data which may include all or some of the following; the species and sex of the animal, the condition of the animal, how the animal is hooked, multiple measurements of the animal including total, interdorsal and fork lengths, the action taken (released or destroyed), tag the animal and record the tag numbers used, record the animal's condition upon release, take all required photos and record photo numbers, and, if the animal is destroyed dispose of animal within 3 nautical miles and record the disposal location. In addition to this contractors may be required to record local oceanographic data at the point of animal capture including water temperature, water depth, salinity and dissolved oxygen.

Given the high level of data recording and actions to be undertaken should an animal be caught on the line, and not accounting for any unforseen activities or impediments including adverse weather conditions, opposition activism, or a requirement to deploy temporary drum lines, it would be both impractical and unrealistic to impose a set baiting/inspection schedule upon the contractor.

- **A standard operating procedure for euthanasia that includes details of anatomy and location of brain (for all species that are likely to be encountered), point of aim, specified firearm and ammunition to be used, as well as criteria for assessing death in shot animals should be prepared and used to train operators.**

DPC Response
Specific guidelines for euthanasia and assessment of animal condition are being progressed based on advice provided by DoF and DPaW and will be finalised in the Management Plan.

- **Guidelines for assessing suitability for release, for the range of animals that could potentially be encountered, should be prepared and used to train contractors.**

DPC Response
Guidelines for assessing the suitability for release of animals are being developed based on advice provided by DoF and DPaW and will be finalised in the Management Plan.

[2] Notwithstanding an inability to operate due to indement weather

- **An evaluation by the proponent of whether contractors either have the required skills for euthanasing and assessing the health status of caught animals or an undertaking that they will be given suitable training in application of euthanasia methods and the assessment of injuries and health status of caught animals.**

DPC Response
As per Part B Section 4(b) of the tender document "Shark drum line Deployment, Management and Associated Services: DPC1605" the respondent is required to demonstrate the following:

"(i) The organisational capacity to perform the Customer Contract including relevant skills and experience within the organisation in performing similar requirements.
(ii) Suitably qualified personnel, and outline their role in providing the services described in this Request, including experience in the handling of large marine animals.
(iii) Staffing levels on the vessel to undertake the services safely.
(iv) Firearms licences and associated provisions
(v) Contingency planning and capability including the ability to deploy alternative staff and a substitute vessel of similar performance, specifications and equipping in the event of a mechanical breakdown or unserviceability.
(vi) The ability to undertake and record accurate size measurement of marine animals on and alongside the vessel.
(vii) The ability to undertake basic research as required, such as species identification, sexing, size measurement and fin tagging."

Despite a requirement in the tender process to engage with suitably qualified personnel, the Government is committed to providing suitable training prior to the commencement of the contract. Training will be provided to ensure contractors are familiar with the correct methods for humane euthanasia of large sharks and suitably identifying the condition of an animal. Guidelines based on the training will also be included in the Management Plan and ongoing support and assistance provided to the Contractors via DoF.

- **Training in disentanglement procedures of large marine animals should be passed on to contractors (if contractors lack sufficient expertise) prior to undertaking any drum line operations. The time it takes for the contractor to get in touch with the Operations Manager and relevant Department of Parks and Wildlife (DPaW) personnel may result in the death of large non-target marine species.**

DPC Response
The West Coast Rock Lobster Managed Fishery, in conjunction with DPaW has updated its Code of Practice which outlines the procedures for commercial fishers in responding to whale entanglements in rock lobster pot ropes. This Code of Practice is considered industry best practice in responding to whale entanglements. The Code of Practice encourages fishers to participate in whale disentanglement workshops to become familiar with the disentanglement team and follow safe practice procedures when responding to an entanglement. Due to the high risk, dangerous and unpredictable nature of disentanglement operations, commercial fishers are advised not to attempt a disentanglement procedure themselves without the assistance of DPaW. The Code of Practice requires commercial fishermen to report entanglements as soon as possible and to monitor the entanglement situation, with due regard for the safety of the vessel and the whale, until assistance teams arrive.

Given the contractors will be operating between 0600 and 1800 seven days a week, and the actual risk of a whale becoming entangled in a drum line is low, and even lower between the months of November and April, the chances of timely notification to the DoF Operations Manager and the disentanglement team at DPaW is high (and no different to that offered by commercial rock lobster fishermen who are not necessarily fishing every day).

In addition to this, in acknowledging a desire to reduce wherever possible the chances of capture of large non-target marine animals in the drum lines, the disentanglement team will form part of the training provided to contractors prior to the commencement of operations. The advice given to the contractors will be in line with the Code of Practice and the Government will not be asking contractors to undertake disentanglement procedures themselves.

- **The compliance plan (Appendix 2, pg 14) should include a feedback loop that means that lessons learnt during the program can be fed back into the Management Plan and incorporated in ongoing drum line operations. This is important to ensure the program can be changed/improved with increasing knowledge and experience.**

DPC Response
The Government is committed to ongoing assessment and improvement of the program, with a number of recommendations and suggestions arising from the Review of the Western Australian Shark Hazard Mitigation Program being incorporated into the three year proposal. The Management Plan allows for annual reviews of the program and a review at the end of the three year program, as well as ad-hoc reviews of the program should the situation require. It is anticipated that the reviews will offer the opportunity for feedback and improvement of the program.

As seen during the trial program that ran from January to April 2014, improvements were incorporated into the operations in both the metro and south west regions, with adaptations of fire arms, measuring equipment and tagging procedures adopted through the 14 week program. The Government is committed to ensuring operations are improved wherever possible, however it must be noted that operations must be undertaken in line with legislative conditions and restrictions.

- **Should the drum line program continue, each vessel should have an experienced and independent scientific observer collecting detailed biophysical data (species, gender, length etc.) for analysis, and all released sharks should be tagged with acoustic tags, if not satellite telemetry.**

DPC Response
The Government has committed to providing an observer on each vessel for the first day of operations in each region and for an additional nine trips in each region thereafter in each season. It is not feasible to expect an independent scientific observer to be present on each vessel for twelve hours a day, seven days a week for 5.5 months of the year. The contractors will be trained in the collection of necessary data including the species and sex of the animal, the condition of the animal, how the animal is hooked, multiple measurements of the animal including total, interdorsal and fork lengths, tagging animals with conventional fin tags, assessing the animal's condition upon release, the taking of all required photos and the humane destruction of animals where required. In addition to this contractors may be required to record local oceanographic data at the point of animal capture including water temperature, water depth, salinity and dissolved oxygen using hand-held water quality testing equipment.

In terms of tagging all sharks that are released with acoustic tags, and if not with satellite telemetry, the Government is committed to implementing a program to assess the post-release survival of released animals. However, consideration needs to be given to the condition of the animal and what further stress fitting either internal or external tags may have on the potential survivorship of the animal, and of upmost importance, to the safety of staff and crew. Discussions are being held as to the practicality of tagging released sharks, and the capacity of research bodies to record the data (particularly if tagged with SPOT or PAT/PSAT tags). It is likely that not all released sharks will be suitable for tagging, however the Government will work with research institutions to best address the practicalities of this work.

2.9.2 Submissions contend that circular hooks (to be used in the program) have been proven to greatly reduce survival for sharks that are hooked in the throat or cavity, by causing significant injuries to the animals. For larger fish and sharks the hooks are likely to penetrate through the skull of the animal, which becomes highly agitated and vigorous upon capture. Therefore submissions contend that the likelihood of mortality to undersized sharks, whether on the drum line or shortly after their release is likely to be higher than was estimated.

DPC Response

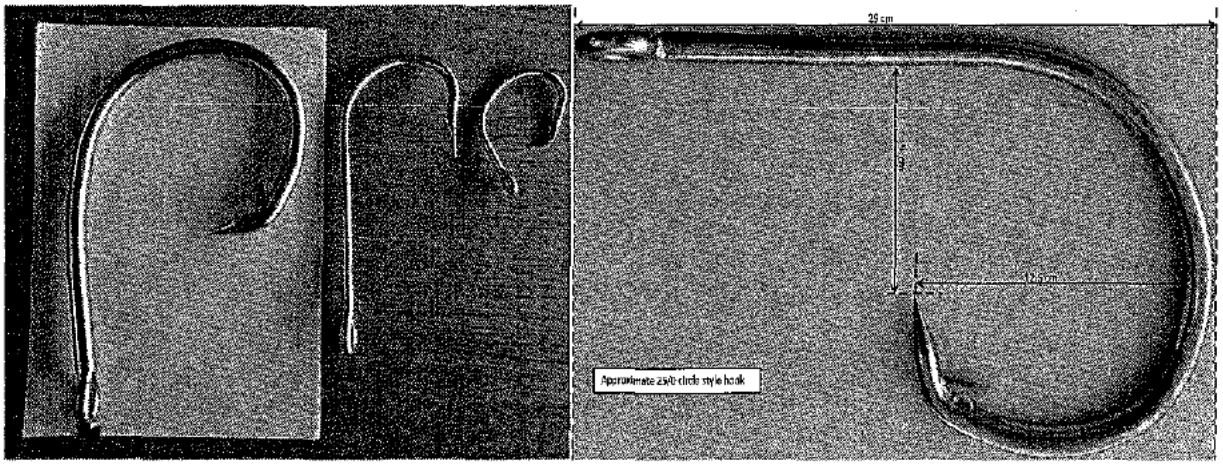
The above is an assumption for which no evidence is provided to support the claim. The use of large circle type hooks is seen as a significant measure in reducing the non-shark bycatch (which is evident in other programs that use smaller hooks) and in attempting to target larger sharks. As a consequence the Western Australian drum line program is being criticised for taking proactive measures to minimise the catch of sharks under three metres when no such limits are put on shark size in other programs; and the use of smaller hooks would likely increase not only the capture of sharks under three metres, but also non-shark bycatch.

Circle hooks are considered to be less invasive and easier to remove than J hooks and the size used in the Western Australian program is specifically designed and manufactured to minimise bycatch. Opponents of the program that consider these hooks too large, or that the program should be using the types of hooks used on long lines and drum lines in Recife, La Réunion, Queensland or Kwazulu-Natal, should acknowledge that the likely consequences of inclusion of these hooks into the Western Australian program will be an increase in non-shark bycatch and in the number of sharks under three metres caught.

For comparison, the picture on the left below show hooks used in other programs compared to the hook used in the Western Australian program:

- the smallest hook is a circle type hook used in Recife Brazil and La Réunion (right);
- the middle hook is a J hook used in Kwazulu-Natal (approximately 76 drum lines) and Queensland (approximately 330 drum lines) (centre); and
- the largest hook is an approximately sized 25/0 circle hook used in the Western Australian program (60 drum lines) (left).

The picture on the right gives the actual dimensions of the non-conventional, custom manufactured approximately sized 25/0 circle type hook used in the Western Australian program.



2.9.3 Submissions contend that the PER and Management Plan has not identified allowable catch rates for each of the target sharks and key non-target sharks and marine fauna. The allowable catch rates should be provided based on the proponents risk assessment to ensure that the viability of the population is maintained.

DPC Response
It is expected that the predicted annual catches over the three year duration of the program would provide a suitable basis for establishing allowable catch levels.

As per section 4.2.3 of the PER and 2.9.1 and Response to the Peer Review of this document, the acceptable catch rates for target species are as follows:
- White sharks: 25 over three years.
- Tiger sharks: an average of 300 per year.
- Bull sharks: 10 over three years.

As per section 4.2.3 of the PER, the *anticipated* catch levels for non-target sharks are as follows:
- Dusky sharks: <10 per year.
- Grey nurse sharks: None to only a few per year.
- Shortfin mako sharks: between five and 20 per year.
- Other non-listed elasmobranchs: between five and 20 per year, most likely to comprise of a number of species.

It should be noted that the anticipated annual catch levels presented here are a result of a risk assessment based on using a larger than standard approximately sized 25/0 circle hook. There may be an opportunity to implement a gear trial that would see the examination of different sizes and types of hooks. It is possible therefore, particularly if smaller hooks are employed, as is recommended by the peer review, that these catch levels may increase.

These details will be incorporated into the final Management Plan.

2.9.4 Submissions note that triggers and contingency actions have not been developed for the proposal. Triggers and contingency measures will be required to be detailed in the Management Plan.

DPC Response
The following figures represent levels at which contingency measures will be required to be employed. The figures are cumulative totals over the three years of operations and relate to animals that are either destroyed or are considered to have died following release (i.e. not simply catch numbers):

Trigger Points	
Target species	
White	20
Tiger	350
Bull	10
Listed elasmobranchs	
Dusky	30
Grey nurse	5
Shortfin mako	50
Non-listed elasmobranchs	
Cumulative of species	50
Other listed marine species	
Marine life including seals, sea lions, whale sharks, manta rays, dolphins, turtles and seabirds	3

Contingency Measures

Should any of the trigger points be met, contingency measures will be implemented which may include the following:

- effort reductions achieved through non-baiting of drum line hooks overnight;
- variation of bait types;
- inclusion of acoustic pingers on drum lines (if interactions with whales and/or dolphins);
- increased effort of patrols if catch exceeding predictions in a particular location;
- additional observer trips; and
- a within-season review of the program.

The trigger points and contingency measures will be incorporated into the Management Plan.

3. Other

3.1 Consultation

3.1.1 Submissions contend that the proponent has not undertaken adequate consultation during the initial stage of project development because it did not conform to the EPA's guidance for 'appropriate and effective consultation' set out in Clause 10 of the Environmental Impact Assessment Administrative Procedures 2012. Submissions also contend that the proponent only consulted with stakeholders that were in favour of or supported the proposal and not with organisations that were concerned about the environmental impacts of the proposal. Submissions also contend that the proponent should have undertaken a wider consultation process prior to referring the proposal to the EPA.

DPC Response
Extensive consultation has been undertaken with respect to the Government's drum line component of its shark hazard mitigation strategy and it is inaccurate to claim that the project development has not conformed to EPA requirements.

A third party referral of the drum line trial program was made to the EPA. The EPA subsequently concluded that the trial program would not result in significant impacts on the environment. The Government then submitted a proposal for a three year program to DoE and the EPA which was placed on the respective Department websites for public consultation. Following this process the Commonwealth Minister for the Environment announced the assessment to be under a bilateral agreement with the EPA, and the EPA determined that the Proposal should be assessed at the level of Public Environmental Review (PER). The Government submitted a comprehensive PER to the EPA which was made publicly available, peer reviewed and open to public comment for a period of four weeks. This clearly demonstrates compliance with environmental process requirements and also significant opportunities for public comment.

Development of the drum line trial was informed by consultations in late December 2013 with stakeholders including scientists from DoF, academics, water users and managers of shark control programs in other jurisdictions. The location of drum lines was and will continue to be informed by consultation with Surf Life Saving WA, DPaW and water users including surfing groups.

Following the completion of the drum line trial program there was again extensive consultation with 27 different groups and/or associations. A summary of these consultations was provided in the 'Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013–14' which can be found on the DPC website at www.dpc.wa.gov.au and also in section 3 the PER. The table is presented here again for reference. Separate consultations did not occur with the Conservation Council of Western Australia or with Sea Shepherd Australia as the views of both organisations were clear. Legal action was taken against the State by Sea Shepherd Australia which ultimately failed, the websites of both organisations presented clear statements on their views of the program, as well as views expressed through media and correspondence received by the Government.

It is inaccurate however to state that the Government only consulted with stakeholders that were in favour of the proposal. Of the 27 stakeholder groups consulted, at least eight were either strongly opposed to the program or did not offer support for the program. The Government met with many scientists and research institutions, as well as recreational water users, who were not in support of the Government. However, the Government believed it important to engage with as wide a range of stakeholders as possible, not only to glean a broad range of views, but also to take on board as much advice as possible on how to minimise and mitigate the environmental impacts of the program, for which scientists were and continue to be of great assistance.

Organisation	Date
Bouvard Fisheries (SW Contractor)	2 May 2014
The West Australian Fishing Industry Council (WAFIC)	5 May 2014
WA Police	5 May 2014
Department of Fisheries – Operations (5)	5 May 2014
Department of Fisheries – Research (2)	5 May 2014
Oceans Institute University of Western Australia	5 May 2014
Oceans Institute University of Western Australia (2)	6 May 2014
Department of Parks and Wildlife	6 May 2014
Surf Life Saving WA	6 May 2014
EventsCorp WA	6 May 2014
RecFishWest	7 May 2014
Department of Transport	7 May 2014
Western Australian Marine Science Institution (WAMSI)	7 May 2014
Surfing WA	8 May 2014
WA Sports Federation	8 May 2014
Open ocean swimmers (2)	9 May 2014
Wildlife Marine	9 May 2014
Environmental consultant	9 May 2014
Margaret River Board riders	9 May 2014
Margaret River recreational surfers (3)	9 May 2014
Margaret River Recreational Surfers	9 May 2014
WA Undersea Club	12 May 2014
Curtin Centre for Marine Science and Technology	15 May 2014
Oceans Institute University of Western Australia	15 May 2014
Queensland Shark Control Program	15 May 2014
James Cook University	16 May 2014
Numerous scientists/researchers/conservation organisations*	2-6 June 2014
Kwazulu-Natal Sharks Board (3)*	4 June 2014

*Meetings and discussions took place at the Sharks International Conference in Durban, South Africa. While the conference followed the submission of the PER to the EPA, input and advice continues to be included in the program development.

3.2 Public Safety

3.2.1 A number of submissions contend that the baited drum lines (and hooked sharks) present a serious public safety hazard as they will actually draw sharks into areas where they are deployed.

DPC Response
Concerns that baited drum lines may attract large sharks inshore, increasing the risk to people using these waters have been addressed in the 'Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013–14' which can be found on the DPC website at www.dpc.wa.gov.au. Some research indicates that scents from bait can travel up to one kilometre based on water conditions and type of bait used (work by Gilbert & Hodgson 1978). Other research indicates that the distance over which scent is an attractant for sharks is in the order of hundreds of metres as opposed to kilometres, meaning only those sharks in the vicinity of protected beaches would likely be attracted to baits (Springer & Gold 1989).

An analysis of the data from the recent drum line trial program shows that tagged sharks were in close proximity to baited drum lines, yet not one tagged shark was caught on a drum line. While the number of incidences of a tagged shark setting off an acoustic receiver in close proximity to a drum line was small, the indications are that drum lines do not necessarily attract sharks.

The drum lines deployed by the Kwazulu-Natal Sharks Board (KZN Sharks Board) and the Queensland Shark Control Program are placed between 300-500m offshore (compared to the drum lines in the Western Australian program which are placed approximately 1km offshore). There is no evidence from either the Queensland or KZN shark control programs, or from the drum line program in Recife, Brazil that drum lines attract sharks. There was a suggestion from the KZN Sharks Board that the Western Australian drum lines should be closer inshore to increase their effectiveness and that this would not pose any additional risk to water users. The KZN Sharks Board consider the amount of bait used on drum lines to be a significantly small component of the total bait deposited into the ocean by onshore anglers at swimming beaches in and around Durban. Neither the bait on the drum lines nor the bait used by anglers is considered an attractant to sharks in these areas.

3.2.2 A number of submissions contend that there is insufficient detail provided on the discarding of euthanized sharks and that they may present a hazard by attracting sharks to areas where they are dropped.

DPC Response

White, tiger and bull sharks that are ≥300cm TL, and any other animals that may be dead on the line (excluding those required to be brought to shore under DPaW conditions and research requirements) will be disposed of within state waters (a maximum of 3 nautical miles offshore) but at a safe distance from beaches and populated sites. As per the request from DPaW, carcasses will also not be disposed of within recreation or sanctuary zones of marine protected areas. There is no evidence to support the claim that the disposal of sharks at this distance from shore presents any sort of hazard. All deceased sharks in the Queensland Shark Control Program are disposed of within 5km (or 3 nautical miles) of shore, with no evidence from 50 years of operations of disposal sites presenting a hazard.

3.2.3 A number of submissions contend that the drum lines presented a navigation hazard for boat and other watercraft users given their location and lack of markings.

DPC Response

It is intended that 30 drum lines will be set along the metropolitan coast and 30 along the south west coast, which is approximately the same configuration as during the trial conducted from January to April 2014. The lines have large red fluorescent buoys attached to them which are clearly visible from a distance. In addition, they are considerably larger than similar floats attached to recreational and commercial rock lobster pots, which are a regular occurrence within the designated MMAs. Other nautical markers also exist throughout the MMAs including acoustic receiver buoys as part of the Shark Monitoring Network and marine protected area markers, among others.

It is inaccurate to say that the buoys lack any markings. The buoys used during the trial and those that will be used in the future program are clearly marked, in large black font, as *"Government of Western Australia"* and include a telephone number to report loss or damage. The Department of Transport authorised their use prior to the drum line trial and issued the relevant General Notice to Mariners prior to their deployment. This will be the same procedure for any future deployments. In addition, there will be a notification to the public through the print media and on relevant websites as to when drum lines will be in place together with a description of the gear.

During the Rottnest Channel Swim there were two drum lines that were accidently damaged by water craft. As a result (and as has already been recommended in the 'Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013–14') prior to the next Rottnest Channel Swim discussions will take place with organisers to have all metropolitan drum lines removed on the day before the event and replaced the day after.

3.3 Role of Department of Fisheries

3.3.1 A number of submissions contend that the Department of Fisheries who may be implementing the proposal have a conflict of interest given that they have provided the technical information for the PER and that they are required to regulate fisheries under the *Fish Resources Management Act 1994*.

DPC Response

The Government has let tender 'DPC1605 Shark Drum Line Deployment, Management and Associated Services' which is advertised on the Tenders WA website and closes on 28 July 2014. It is the clear preference of the Government to have these services provided by a private contractor as was the case with the former drum line trial that ran from 25 January 2014 to 30 April 2014. Through the original tender process (DPC 1596) separate private contractors were selected for the metropolitan and south west regions. However, prior to the commencement of operations the contractor selected for the metropolitan region withdrew due to level of threats by activists. As a consequence, DoF re-prioritised resources to provide the services required.

There is no active consideration for DoF to provide future static drum lining services. However, if private contractors are again intimidated by activists and decide against submitting a tender, accepting a contract or subsequently withdrawing their submission, DoF may again be considered.

RESPONSE TO THE DEPARTMENT OF PARKS AND WILDLIFE

Marine Protected Areas

1. **That where practicable, temporary drum lines are deployed outside 'no take' zones in marine parks and reserves and avoid key scientific research sites.**

DPC Response
Placement of temporary drum lines will always be in response to a specific imminent threat event and, as acknowledged by DPaW in its submission, in order to maximise the chances of capture of a shark posing a threat or following an incident, it may be necessary to deploy temporary drum lines within no-take areas. Operating procedures for the deployment of temporary drum lines include a requirement to consult with DPaW on the need for activation and the location of the drum line deployment. This consultation will ensure that temporary drum lines comply with DPaW requirements. DPaW will provide details of the locations of long-term scientific research and monitoring sites to DPC and DoF in order that the deployment of temporary drum lines can, as far as possible, be managed to avoid these important areas.

2. **That the Department of Parks and Wildlife is consulted regarding the identification of predetermined sites for static drum lines within marine parks.**

DPC Response
Prior to the commencement of the proposed 2014/15 drum line strategy consultations will occur with DPaW (and others) regarding the deployment of static drum lines (as occurred prior to deployment of drum lines in the trial conducted from January to April 2014). In addition, a meeting and/or meetings will occur between the contractors and DPaW to ensure recreation and sanctuary zones are clearly identified and drum line placements are in accordance with DPaW requirements. Throughout the deployment phase DPaW will have the opportunity to observe drum line placement and activities of contractors (as was the case in the trial program).

3. **That where possible, disposal of shark carcasses occurs outside sanctuary and recreation zones of marine parks.**

DPC Response
DPaW will be involved with the training and support provided to contractors prior to the deployment of drum lines. This training will include information and advice on the location of sanctuary and recreation zones of marine parks and with a clear directive that disposal of shark carcasses can only occur outside these zones (but still within State waters).

4. **That operator/contractor training undertaken includes the provision of information relating to marine parks and reserves.**

DPC Response
DPaW will be involved with the training and support provided to contractors prior to the deployment of drum lines. This training will include information and advice on the location of sanctuary and recreation zones of marine parks. In addition, DPaW will have the opportunity to observe the activities of contractors as and when required. Information and support on animal handling for non-fish species will be undertaken by DPaW and for sharks and other fish species by DoF.

Marine Fauna

1. **That the Department of Parks and Wildlife is consulted regarding those aspects of the management framework that have the potential to affect species that are specifically protected under the *Wildlife Conservation Act 1950*.**

DPC Response
Weekly catch data will be provided directly to DoF and DPaW. Catch data will be published on the DoF website on a monthly basis. Provision of data to respective agencies on a weekly basis will allow for cross-checking of data accuracy, species identifications and detail prior to publication, but will also ensure that there is a timely analysis of catch rates against predictions. DPaW and DoF may at any time request meetings to review the data and discuss contingencies in the event that catch rates exceed predictions.

2. **Those opportunities for fauna research associated with the drum line program are maximised and prioritised on the basis of research needs identified in the nationally endorsed recovery plans for potentially affected species.**

DPC Response
DPaW will have full access to all catch data and may at any time place an observer on a contractor's vessel to not only observe the activities of the contractor, but to also undertake research as considered necessary. Specific research proposals are also encouraged and can be incorporated into the training and support provided to contractors. In addition, DPC is liaising directly with DoF and others to identify potential research projects.

RESPONSE TO THE MARINE PARKS AND RESERVES AUTHORITY

The Marine Parks and Reserves Authority (MPRA) notes that the Marine Monitored Areas identified in the Government's drum line strategy overlap with the Marmion Marine Park off Perth and the Ngari Capes Marine Park in the south west. The MPRA notes that actions taken by the State with an intervention that kills sharks, including sharks within the Ngari Capes and Marmion Marine Parks, is done so in the interests of public safety and is therefore acceptable and necessary. The MPRA also notes that in both marine parks commercial and recreational fishing occurs and that the take from these activities is considerably greater than that which occurred during the Government's initial drum line trial. With reference to specific elements of the PER the MPRA goes on to note:

1. **The Government's efforts to minimise bycatch, the small numbers involved and the fact that no harm was caused to marine mammals or turtles during the trial.**

DPC Response
The equipment used in the drum line trial was specially designed to target large sharks and to minimise capture of undersize sharks and capture (or entanglement) of marine mammals, turtles and seabirds. Similar gear is proposed to be used during the three year program so bycatch of non-shark species are again anticipated to be very low.

2. **That opportunities should be explored to increase our scientific knowledge of the role and behaviours of sharks in local waters.**

DPC Response
This is something that the proposed drum line program is progressing through a more extensive and diverse collection of data and opportunities for the scientific community to undertake specific research. Research may include the collection of local oceanographic data at the point of animal capture, opportunities for acoustic and/or satellite tagging, a biological sampling program, age and growth studies and studies into catch and release survivability rates.

3. **That the drum line program is part of a broader mix of strategies to mitigate against shark attack.**

DPC Response
The drum line program is proposed to operate for three years. It is hoped that during this time, research being undertaken into alternative mitigation technologies may offer complementary or alternative options that may be considered as part of the overall shark hazard mitigation strategy.

4. **That the location of drum lines should take into consideration surfing zones and thereby avoid being a potential hazard to surfers (and that the current 1km extent should meet this requirement).**

DPC Response
DPC is aware of the special purpose zones for surfing in the Ngari Capes Marine Park and the desire to keep these zones free from hazards such as rock lobster pot ropes. Following requests from surfing groups in the south west, a number of drum lines were relocated around surf zones during the drum line trial program. Decisions on the future location of drum lines will be undertaken in consultation with Surf Life Saving WA, DPaW and local surfing communities.

5. **That the Department of Fisheries should be used in a wider conservation effort and not in deploying drum lines**

DPC Response
This is noted and addressed under 3.3.1. The Government has a preference for using private contractors to deploy drum lines. The services provided by DoF during the drum line trial were a direct response to the selected metropolitan contractor withdrawing their submission as a result of threats and intimidation by activists.

RESPONSE TO THE PEER REVIEW REPORT

Establish clear and measureable objectives and performance measures, including trigger points and corresponding management actions

DPC Response

As per 1.1.2, the trial drum line program ran for 14 weeks. It is not possible to draw conclusions on the efficacy of the program in increasing public safety over such a short period of time. The Queensland and Kwazulu-Natal programs have decades of data on which to assess the efficiency and effectiveness of their programs. Both jurisdictions place strong confidence in the effect the shark control programs are having on public safety and are proactively incorporating drum lines into their programs (Queensland DPI, 2006) (Cliff & Dudley 2011).

It is inherently difficult to assess the effectiveness of shark control programs, however this is not a reason for inaction. Although the short duration of the Western Australian trial precludes conclusions on the effectiveness of the program it is not a reason to suspend the program. It is unrealistic to think that any control program can achieve zero fatalities in the long term. It is also unrealistic to think that all beaches, surf breaks and dive locations can be protected. There will therefore always be a degree of risk unless people stop entering marine waters. While no further shark attacks cannot be guaranteed, data gathered over a three year program will add to the knowledge base of the effectiveness of shark control programs. "*The removal of any shark that has the potential by nature of its size and identity (species) to bite a person no doubt reduces the risk of such an incident occurring*" (page 8 of the peer review) accurately addresses the overall objective of the drum line program.

It should be reiterated that research into non-lethal detection and deterrent technologies funded by the Government may provide complementary or alternative shark hazard mitigation options either within or at the end of the this three year period.

The PER clearly states the proposal to be for a period of three years, and this was the basis upon which the DoF risk assessment was undertaken. The statement in the peer review that the drum line program has the potential "...to continue for an unspecified timeframe..." is misleading and inaccurate. Moreover, it is therefore unclear to what extent the peer review assessment of the material provided within the PER relates to the effects of the current three year proposal compared to the potential assessment of the effects of an 'ongoing program'. That a different assessment would need to be undertaken if a longer or ongoing program was proposed was clearly identified in the DoF risk assessment. Many references are also made within the PER to a desire by the Government to complement or enhance the drum lining program with non-lethal shark hazard mitigation measures should any prove to be feasible and appropriate.

The assumption that the program will continue 'for an unspecified timeframe' could potentially affect the relevance of the comments and interpretations in the peer review for the purposes of decision making by the EPA.

Catch levels and trigger points

Catch Levels

As per the 'anticipated annual catch levels' and 'risk evaluation' sections in 4.2.3 of the PER for each species, and as per the 'summary of the risk analysis, risk scores and risk evaluations' presented in section 9.4 of the Draft Management Plan, acceptable catch levels have been developed for each of the target species which will allow for the monitoring of catch towards specified levels. Acceptable catch levels have been developed on the basis that they maintain the risk ratings for each of the species at the levels presented within the DoF risk assessment. Therefore if the acceptable catch levels are exceeded, either an updated risk assessment and/or a revision to the management of the drum line operations would be required (see contingency measures below).

The acceptable catch levels of target species are:

- White sharks: 25 over three years.
- Tiger sharks: an average of 300 per year.
- Bull sharks: 10 over three years.

As per section 4.2.3 of the PER, the *anticipated* catch levels for non-target sharks are as follows:

- Dusky sharks: <10 per year.
- Grey nurse sharks: None to only a few per year.
- Shortfin mako sharks: between five and 20 per year.
- Other non-listed elasmobranchs: between five and 20 per year, most likely to comprise of a number of species.

Catches of other listed elasmobranchs including whale sharks and manta rays, and other listed marine life including seals and sea lions, turtles, whales, dolphins and seabirds are expected to be close to zero. It should be noted that these are the *anticipated* catch levels, and do not represent allowable catch levels. It is likely that, in the event that a listed elasmobranch or other listed marine animal is caught on the drum line, a within-season review of the program will take place.

The acceptable catch levels and anticipated catch levels for target and non-target marine species will be clearly identified in the Management Plan.

The following should be noted:

1. The acceptable catch levels defined here represent total catch numbers (i.e. everything that is caught on the line), and therefore also includes animals which are released. While the risk assessment assumes a 'worst case' scenario for released sharks, using a precautionary approach to deal with the uncertainty in post-release survival, it is expected that actual mortality numbers will be lower than the acceptable catch levels. This is important to note in respect to trigger levels discussed below. Efforts to monitor post-release survival of released animals, and in particular white sharks, will be undertaken using acoustic or fin mounted SPOT or PAT/PSAT tagging where possible.
2. The anticipated annual catch levels presented here are a result of a risk assessment based on using a larger than standard approximately sized 25/0 circle hook. There may be an opportunity to implement a gear trial that would see the examination of different sizes and types of hooks. It is possible therefore, particularly if smaller hooks are employed, as is recommended in the peer review, that these catch levels may increase.

Trigger Points

The following figures represent levels at which contingency measures will be required to be employed. The figures are cumulative totals over the three years of operations and relate to animals that are either destroyed or are considered to have died following release (i.e. not simply catch numbers):

Trigger Points	
Target species	
White	20
Tiger	350
Bull	10
Listed elasmobranchs	
Dusky	30
Grey nurse	5
Shortfin mako	50
Non-listed elasmobranchs	
Cumulative of species	50
Other listed marine species	
Marine life including seals, sea lions, whale sharks, manta rays, dolphins, turtles and seabirds	3

Contingency Measures

Data will be provided weekly, therefore ongoing monitoring of catches will enable prompt management actions to be taken. Should any of the trigger points described above be met, contingency measures will be implemented which may include the following:

- effort reductions achieved through non-baiting of drum line hooks overnight;
- variation of bait types;
- inclusion of acoustic pingers on drum lines (if interactions with whales and/or dolphins);
- increased effort of patrols if catch exceeding predictions in a particular location;
- additional observer trips; and
- a within-season review of the program.

The trigger points and contingency measures detailed above will be incorporated into the Management Plan.

Management Advisory Committee

DPC Response

The recommendation to establish a management advisory committee, similar to those operating under fisheries management, is based on an opinion of; a lack of performance indicators and lack of clear objectives in the program proposal; risks of exceeding catch levels under the program and notes that this does not constitute 'best practice'. The advocacy for the establishment of a management advisory committee with an independent chairperson does not consider the following:

- The clearly stated objective of this program has always been public safety, an objective that has been stated in the PER, in the review of the drum line trial, in media releases and in public comments by Government.
- While it may be standard, or even best, practice for commercial fisheries to be managed in conjunction with input from management advisory committees, and under specific acceptable catch levels (e.g. a quota managed fishery), the Government is not aware of catch levels or performance indicators, or requirements to establish management advisory committees within the Queensland Shark Control mixed gear program, the New South Wales net meshing program, the South African mixed gear program, the Recife drum line and long line program nor the program operating in La Réunion. Under the Recovery Plan for the White Shark, catch of white sharks in the Queensland and New South Wales shark control programs are only expected to be reported annually to the respective state governments (i.e. no catch levels, trigger points or contingency measures are established for these programs). Moreover, the extent of the Western Australian program in both time and space, and the measures being employed to avoid or minimise impacts are significantly more conservative than under the aforementioned programs, including significant work towards establishing acceptable catch levels, trigger points and contingency measures. While these were not finalised in the Draft Management Plan, they were in progress, and are presented above.
- The Government will; publish catch data on a monthly basis; ensure that DPaW, DoF, DPC and others entities (as considered appropriate) have full access to observing the activities of the contractors; ensure that regular meetings take place between DPaW, DoF and DPC; implement a comprehensive management plan to be endorsed by the EPA and DoE; comply with all appropriate legislative, approval and licence conditions as they apply to the program and continue the existing rigorous monitoring schedule of the drum lines of up to twelve hours a day, seven days a week (which is more comprehensive than that for shark hazard mitigation programs elsewhere in Australia and the world).

Given this extensive and transparent compliance and regulatory framework the establishment of a management advisory committee to oversee operations is considered neither necessary nor appropriate.

Operational data

DPC Response
DPC agrees with the level of information the peer review believes to be appropriate for collection as part of the program.

The DoF review of the initial drum line program identified a need for improvements to data collection:

"Due to the start-up nature of this trial program, there were a number of logistical challenges during this period which meant it was not possible to develop and implement a full program of research to utilise the drum line activities. Thus, while tags were fitted to most released sharks, there was no opportunity to systematically collect data other than the core information on the lengths and sex of captured sharks."

The following information was collected as part of the drum line trial program:

Date
Region
Location of drum line
Drum line number and GPS location
Time drum line inspected
Species caught on the line
Sex
Condition on the line
Total length
Length noted as approximate (Y/N)
Fork length (later in the program)
Interdorsal length (later in the program)
Action taken
Tag number
Photo numbers
Disposal GPS
Date bait purchased, amount, cost and type
Vessel records including start and end hours
Drum line maintenance (damage/loss/vandalism/wear and tear)
In Response To A Shark Threat Or Incident
Date
Time of notification
Time of drum line deployment
Location of drum line deployment (GPS)
Time returned to 1km offshore
Species
Sex
Condition on the line
Total length (cm)
Length noted as approximate
Action
Release status
Subsequent action (e.g. disposed/retained)
Use (e.g. research)
Existing tag (e.g. research tagging equipment)
New conventional fin tag number
Photo numbers
Disposal GPS

The DoF review of the drum line trial went on to recognise:

"Future options would still require careful consideration of how collecting other biological data (including genetic samples, tags, reproductive, dietary, age and growth, etc.) could be built into the daily drum line routine to help assess potential impacts on effected shark populations. The collection of additional biological samples and data will therefore depend on dealing with the logistical constraints such as drum line vessels' type, size, capabilities and storage facilities; distance from and type of port facilities; operator training requirements; protocols and appropriate exemptions for scientific research of protected species, etc.. "

The following information is proposed to be collected as part of the three year program:

Date
Region (metro/south west)
Location (e.g.Floreat/Quindalup)
Drum line number (e.g. FL3)
Drum line GPS
Time drum line inspected
Drum line damage/vandalism/wear and tear/loss
Bait type
Whole/partial
No. of pieces
Age when checked (e.g. when was the bait put on the hook)
Catch (Y/N)
Species
Sex
Condition on the line
Hooked (placement)
Total length (cm)
Length noted as approximate (Y/N)
Fork length (cm)
Interdorsal length (cm)
Action
Release status
Depredation (tissue loss or damage) (%)
Subsequent action (e.g. disposed/retained)
Use (e.g. research)
Existing tag (e.g. research tagging equipment)
New conventional fin tag number
New acoustic tag number
New SPOT/PAT tag number
Photo numbers
Disposal GPS
Water temperature (°C)
Water depth (m)
Dissolved oxygen (mg/l)
Salinity (PSU)
Date bait purchased
Type of bait purchased
Amount (kg)
Cost ($)
Vessel Name
Start time
Start hours
End time
End hours

In Response To A Shark Threat or Incident
Date
Time of notification
Time of drum line deployment
Location of drum line deployment (GPS)
Bait type
Whole/partial
No. of pieces
Age when checked
Time returned to 1km offshore
Catch (Y/N)
Species
Sex
Condition on the line
Hooked (placement)
Total length (cm)
Length noted as approximate
Fork length (cm)
Interdorsal length (cm)
Action
Release status
Depredation
Subsequent action (e.g. disposed/retained)
Use (e.g. research)
Existing tag (e.g. research tagging equipment)
New conventional fin tag number
New Acoustic tag number
New SPOT/PAT tag number
Photo numbers
Disposal GPS
Water temperature (°C)
Water depth (m)
Dissolved oxygen (mg/l)
Salinity (PSU)
Catch reported to DoF Operations Manager (Y/N)

A more detailed set of sampling protocols is being developed and is discussed in "Biological Sampling of Captured Sharks" below. The final data collection intended for the three year proposal will be written into the Management Plan.

Biological sampling of captured sharks

DPC Response
As per the advice provided for "Operational Data" above, DoF has identified the types of data that could be collected for all released, euthanised and deceased sharks captured in the program. DoF has highlighted the need for these data to better inform the evaluation of the program, as well as providing important information to better determine the status of shark populations and reduce uncertainty in a species' biological parameters and therefore stock status for use in any future potential risk assessments. It must be pointed out the logistics of sampling at seas and/or retaining all deceased animals is not a trivial issue.

These logistical issues are currently being considered in the context of the three year program and include:

- having the relevant approvals and permits to conduct research on listed species;
- having sufficiently trained staff on each of the vessels to undertake biological sampling;
- storage of carcasses/samples on the vessel;
- transfer of carcasses/samples to shore;
- transport of carcasses/samples to the relevant storage facility;
- suitable storage facility for carcasses/samples;
- highly visible nature of the operation and level of scrutiny and interference likely to be directed upon operators by activists which could impede operations; and
- considerations of all of the above logistics for both the metropolitan and south west regions.

The storage of data and biological samples is recognised as a primary element to be maintained by DoF, and collaboration is underway with other agencies and research institutions including the West Australian Museum to further work through the above logistical considerations.

It is noted that under 9.1.4 of the Recovery Plan for the White Shark, shark control programs in Queensland and New South Wales are required to *where feasible and practical* undertake biological recording and sampling of white sharks caught in shark control programs. This acknowledges the complexities involved in retaining and sampling carcasses of large marine animals.

Further detail on biological sampling and applicable animal handling protocols will be provided in the Management Plan, however it must be recognised that this will be an ongoing facet of the program.

Investigation of post-release survival for all species – priority for white sharks

DPC Response

As stated at 2.2.3, there are currently no data with which to evaluate post-release survival rates of released animals. As the hooks used in the trial and proposed for the next three years are unique (i.e. very large compared to those used in other programs), results from other studies of post-release survival, even for the same species, are not comparable. Thus, until empirical data demonstrate otherwise, for the purposes of the risk assessment and predicted catch levels, the precautionary principle has been applied to *allow* for a post-release mortality of close to 100%. This suggests therefore that given post-release mortality is not *expected* to be as high as 100%, the impacts of the program should be even lower than those predicted in the risk assessment.

Measures will be taken where possible, as part of the three year program, to assess the post release survival of released white (and tiger) sharks through the application of internal acoustic tags or fin mounted PAT/PSAT or SPOT tags. It should be noted that this type of tagging will only be undertaken upon consideration of the condition of the animal to withstand the procedure(s), the safety of the crew on board and in consultation with relevant research divisions and project scopes.

It is noted that under 9.1.4 of the Recovery Plan for the White Shark, tagging programs and tagging of released sharks to assess post-release mortality is required *where possible or appropriate* by the Queensland and New South Wales shark control programs. The Government is committed to undertaking research as part of the program where safe, practical and feasible.

Improve the accuracy of data collection from commercial fisheries within WA regarding white shark bycatch

DPC Response

DoF is finalising a project which reconstructs the history of white shark mortalities induced by all sources (including all commercial and recreational fisheries operating on the south-western stock) throughout the full range of the south western white shark population. This report is being finalised and has been cited in the peer review. A summary of this was presented in Appendix 9 of the PER (Taylor *et al.* in prep).

Avoid targeting tagged sharks

DPC Response

The peer review is inaccurate in the supposition that the detection of tagged sharks would automatically initiate a response to deploy temporary drum lines.

The DoF imminent threat policy applies to all Western Australian waters at all times throughout the year. The only place and time that the DoF imminent threat policy is superseded is within the two MMAs between 15 November and 30 April each year (subject to program approval).

The DoF "*Guidelines for fishing for sharks posing an imminent threat to public safety*", as provided at Appendix 3 of the PER, detail specific criteria to assist decision makers in applying the policy and approving orders to set capture gear. In addition to consideration of whether the presence of a shark constitutes a high risk or a high hazard, the guidelines also state that assessment of the circumstances should also recognise that an order to set capture gear may heighten the risk of attack as capture of a tagged shark "may eliminate a key indicator of a temporary high hazard in the proximity of a popular beach".

For the areas designated as MMAs (in the metropolitan region between Ocean Reef and Port Beach and in the south west region between Quindalup to Prevelly), between 15 November and 30 April, given a contract vessel is proposed to be on the water for up to twelve hours per day, seven days a week, presenting opportunities for faster responses, supplementary criteria for initiating a response to an identified shark threat or incident have been developed. These criteria, contained at 9.3 of the Draft Management Plan (Appendix 2 of the PER), outline the processes to be followed before initiating a response within an MMA. Notifications of acoustic detections of tagged sharks are immediately sent to relevant groups and posted on the Surf Life Saving WA Twitter feed. Surf Life Saving WA therefore have the opportunity to close beaches in the presence of tagged sharks.

It should also be noted that the Shark Monitoring Network and associated research tagging initiatives being facilitated through DoF continue to be supported by Government. The long term investment in the Shark Monitoring Network is designed to better understand white shark movements in south-western Western Australia. Information from the project is likely to provide better information to determine site fidelity and movement patterns of sharks.

Avoid areas of known white shark aggregations

DPC Response
See *"avoid targeting tagged sharks"* above.

In addition to the information above, it should be noted that the DoF imminent threat policy makes specific reference to "prevailing conditions, such as the presence of a whale carcass, or seasonal fish aggregations which explain the presence of a shark". The guidelines noted above go on to say that "these circumstances may be consistent with high risk and high hazard but conducive to management without an order to set capture gear being required". The DoF imminent threat policy therefore is considerate of white shark aggregations and options to manage a shark hazard without the deployment of temporary drum lines.

It is unlikely that, as per the guidelines under the DoF imminent threat policy, and the criteria to be followed to set temporary drum lines within an MMA, seasonal aggregations of white sharks (e.g. around snapper spawning in Cockburn Sound or in the vicinity of a whale carcass) would initiate an order to deploy temporary drum lines. For example, if a whale carcass lands or comes near a beach, the policy is for the beach to be closed to all water activities. If beaches are closed this is then not considered an imminent threat as the risk to public safety has already been reduced through other management measures.

Within the MMAs, the criteria (as described above), state that public safety must be of concern (e.g. beach is occupied, shark remains in the vicinity, shark is close to shore etc.) before initiating a response. While efforts are made to avoid areas of known white shark aggregations, and reduce or remove the hazard through other management measures where possible before initiating the deployment of temporary drum lines, it should be noted that the MMAs were designed as areas offering increased shark hazard mitigation measures to water users at peak usage times. This includes not only the deployment of static drum lines, but also through the ability of a contractor to respond quickly to identified shark threats. The DoF Operations Manager is responsible for initiating the deployment of temporary drum lines within an MMA and will do so in following the criteria set out in the Management Plan. However, it should be noted that, unlike the eastern states and South Australia, there are currently no known aggregation sites of white sharks for pupping or other reasons within either of the MMAs.

Moreover, irrespective of where white sharks are caught under the program, the overall catch limits and trigger points will apply. The risk to the population therefore does not change with the location of capture.

Gear configuration

DPC Response

The large circle type hooks used in the Western Australian program are considered to be a significant factor in reducing the risk of non-shark bycatch and limiting the number of sharks under three metres that are caught. The hook size was essentially a compromise between minimising the catch of non-target animals, but recognising that post-release mortality of any non-target species would likely be high. Should the hook size be reduced, it is highly likely that there will be a greater overall environmental impact as, based on experiences elsewhere, the species composition of the bycatch, and number of small sharks caught on smaller hooks, could increase greatly.

The Queensland Shark Control Program uses a 14/0 Mustad J Hook. Their shark catch rates on drum lines for 2013 were approximately as follows (note data on non-shark bycatch is not published):

Shark Species	Number And Size
Blacktip reef whaler	12 <100cm 45 between 100 and 157cm
Bronze whaler	1 @ 177cm
Bull whaler	3 <100cm 55 between 100 and 195cm 18 between 200 and 250cm
Common blacktip	1 @ 85cm 1 @ 110cm
Creek whaler	1 @ 110cm
Dusky whaler	1 @ 120cm 5 between 200 and 210cm 1 @ 310cm
Graceful whaler	1 @ 140cm
Great hammerhead	1 @ 85cm 4 between 150 and 195cm 1@ 245cm 1 @ 270cm
Grey nurse	1 @ 230cm
Long nose whaler	12 < 100cm 20 between 100 and 200cm 1 @ 210cm
Mako	1 @ 361cm
Pigeye whaler	2 < 100cm 3 between 100 and 180cm
Sandbar whaler	2 < 100cm 19 between 100 and 190cm 1 @ 275cm
Scalloped hammerhead	1 @ 45cm 2 between 165 and 195cm 1 @ 270cm 1 @ 330cm
Sharptooth	2 between 163 and 190cm 5 between 200 and 260cm
Spot-tail whaler	5 < 100cm 21 between 100 and 145cm
Tawny	17 between 200 and 270cm

Tiger	2 < 100cm 54 between 100 and 195cm 63 between 200 and 295cm 33 between 300 and 395cm 2 >400cm
White shark	1 @ 265cm 1 @ 270cm

A gear selectivity trial may be incorporated into the program to investigate the effectiveness of J hooks versus circle hooks of comparable sizes.

Overall risk assessment

The risk assessment, specifically as it relates to white sharks, draws heavily on the analyses presented in Appendix 9: A risk-based, weight of evidence approach to determine the range of plausible estimates for the south-western Australian population of white sharks - Working Draft. It specifically draws on estimates of population size provided in that document and the conclusion that white shark numbers are increasing. However, there are significant flaws in the conclusions presented in Appendix 9 and the lack of information provided in that document on how historical catch scenarios were developed diminishes confidence in the proponent's risk assessment for this species (see below for specific comments on Appendix 9). This does not necessarily mean that the conclusion of negligible risk is incorrect, but the information provided is inadequate to judge that level of risk.

DPC Response

The risk rating generated by the risk assessment for white sharks was not based on the conclusion that white shark numbers are increasing. The risk rating was based on the assessment of the potential impact on the most conservative plausible estimate of population size, which in this case was for a population that was not increasing. The assessment is therefore based on a 'worst case' scenario. The risk analysis section states:

"All lines of evidence indicate the size of the southwestern population is either stable or increasing over the past decade. With anticipated captures less than 10 white sharks per year, the proposed Drum line Program would add less than 10% to the current annual levels of capture. Therefore, even using the most conservative plausible estimate of current population size (> 3100), with the expected very low levels of additional annual mortality the modelling identify this would generate minimal effects on the population size."

That the additional mortality that the three year drum line program would generate would be less than 10% of the current level of annual mortality, across a very short time period in relation to the life history of this species with none of the estimates indicating this population is in imminent danger, are the two most important pieces of information in determining the relative risk of the program to this population, not whether the population was increasing.

"All of these estimates indicate that the population size is well above the level where risks to population viability and longer term sustainability would be of concern. Consequently, the proposed additional removal of a relatively small number of white sharks (< 10/year – less than 10% of the current estimated level of annual capture) for public safety purposes in the two MMAs is highly unlikely to make any material effect on this population."

It should also be noted that, as per 2.1.3, the risk assessment assumes a worst case scenario in terms of sex ratios of animals caught on the lines. The trigger point of 20 white sharks over three years assumes a catch of 100% females, and of three metres or greater in total length. While the exact size at which female white sharks become sexually mature is unclear, they are thought to reach sexual maturity at approximately >430cm (Casey & Pratt 1985, Cliff *et al.* 1989, Bruce 1992). It is therefore unlikely that a) every white shark caught in the drum line program is female and b) that if every white shark caught in the drum line program is female, that they are all >430cm and therefore represent a breeding female. The risk in terms of a breeding population of 700 females can therefore still be considered negligible.

It is, however, possible that white shark numbers have increased. What is most likely to have been significant for the white shark population west of Bass Strait (including WA waters) since the species protection is the reduction in effort within fisheries previously identified by Malcolm *et al.* (2001) as responsible for the highest bycatch of the species. The reduction in effort in target shark fisheries in the Southern and Eastern Scalefish and Shark Fishery (SESSF) as well as a reduction in effort in Western Australian shark fisheries (including spatial closures) have been directed at sustaining commercial species and reducing impacts on marine mammals vulnerable to the gears used. The reduction in effort has likely resulted in a reduced impact on the white shark population by means of reduced bycatch and the survival through the release of some that are caught. There is some evidence that white shark populations in other areas of the world have benefited from a combination of their protection and fisheries management actions designed to improve the status of commercial shark species (Burgess *et al.* 2014; Curtis *et al.* 2014). Thus it is also plausible that white shark populations have benefited from these similar actions in Australia, but there is little empirical data to confirm this.

DPC Response

The likely effects on the bycatch levels of white sharks that have resulted from the changes to the management arrangements for the shark fisheries that operate in the area where the southwestern population of white sharks reside have been assessed with the results outlined in Appendix 9 of the PER. This study found:

"The annual estimated number of white shark captures across the WA to western Bass Strait region (see Fig. 1) has decreased substantially from a maximum estimate level in 1988 of 261 per year (182-357 95% CI) to the current annual estimate across the entire population of 92 (71-115, 95% CI). The reduction in catch level has largely been due to the reductions in fishing effort in the two main fisheries which were aimed at improving the sustainability of target shark species (e.g. school and gummy sharks)."

This reduction in effort was also noted in a detailed ecosystem modelling study of the marine ecosystem off South Australia (Goldsworthy *et al.* 2013). This modelling used one of the most intensive sampling regimes undertaken in Australia to determine trophic relationships across a wide number of species. Ecosystem simulations indicate that the functional group "pelagic sharks", which includes white sharks, have most likely experienced population growth and this "appears to be primarily to be driven by reductions in fishing mortality".

Consistent with these studies, the comments in the peer review seem to suggest support for the notion that the current risks to white sharks may have been substantially reduced and an increase in the white shark population is therefore plausible.

The risk assessment provided by the proponent indicates that the catch of 163 tiger sharks in the January to April trial program of which at least 64 were dead or euthanized and actual mortalities likely to be significantly more was *"not considered to have exceeded those outlined within the initial risk assessment which would generate a negligible impact"*. The proponent then identifies that the 'annual' catch levels of the extended program (November to April) is expected to be 300. The original risk assessment estimated that only 10-20 tiger sharks would be killed by the trial program and that the number required to induce a measurable change in the tiger shark population would be in the order of 100s. This suggests that the extended program has the capacity to create a measurable change in the population of tiger sharks, particularly if post release mortality is high. Whilst this level of impact may be sustainable, it would again be good practice for the proponent to have a clearly defined upper catch limit under the program to reduce the risk of adverse population and ecosystem level impacts.

DPC Response
This comment is completely consistent with the conclusion presented in the risk assessment which stated:

"If the levels of capture of tiger sharks generated by this program remain within the anticipated levels combined with assuming high levels of release mortality rates this level of annual mortality (40t) for three years it would be possible (Likelihood Level 3) for the program to generate a minor consequence (Consequence Level 1). This would represent a potentially measurable but relatively small decrease in their total abundance could occur.

The requirement to have annual acceptable levels of capture are covered in 2.9.1 and within the Response to the Peer Review sections of this document.

Comments on Appendix 4: A correlation study of the potential risk factors associated with white shark attacks in Western Australian waters.

General Response to Reviewer's comments on FOP 109

Historically there has been a wide range of subjective opinions and theories being cited in the press and elsewhere about what conditions, times and other factors increase the likelihood of a human-white shark interaction that may have been misleading the public.

As a result, the study that is reported in Fisheries Occasional Publication 109 (2012) (FOP 109) was undertaken to test whether there was any validity in these theories and determine if any factors were plausible in explaining the occurrence or frequency of shark attacks. These results have enabled the Government to consider any plausible factors as part of their overall shark hazard mitigation policy.

Given the available data, it was not possible to undertake either a detailed modelling or complex statistical exercise as white shark attacks in Western Australia (and elsewhere) are rare events. This is even stated in the peer review on page 13 of the report, "*It is also important to note that despite its high profile and profoundly tragic consequences, shark attack is rare in WA relative to the number of water users and the difference between no attacks and a few attacks in any one year may be random chance.*"

Finally, it would not have been appropriate from a public safety perspective to completely dismiss the possibility of some relationships just because a significant correlation could not be found. This would be opposite to employing the environmental precautionary principle. Consequently, FOP 109 also examined whether those factors which were examined, but that did not generate a clear result based on quantitative analysis, should still remain plausible.

For example "*it must be noted that given the small size of the dataset available, it was difficult in some cases to conclusively examine each of the related factors and generate definitive conclusions. In such cases it was therefore determined whether a particular factor should remain as being plausible*" and "*while there was no definitive evidence of the effect of seal colonies on attack rates, these results may reflect relatively lower levels of human water activity in these regions. Therefore it remains plausible that there is an increased risk of attack near these colonies*".

This document compares data on white shark attacks in Western Australian waters to a series of other data sets in the form of linear correlations. The report concludes that the incidence of white shark attacks in WA waters has *'slowly increased over the past two decades'* and that this has occurred at *'a rate faster than human population growth'*. This finding is similar to that reported by Curtis *et al.* (2012) in their world-wide analyses of white shark attacks, but is not consistent with the study of West (2011) who reported that the increase in incidence of shark attacks (albeit referring to incidents from all species combined) was similar to human population growth across Australia as a whole. Irrespective of these comparisons, all such studies have concluded a steady increase in the incidence of white sharks over time.

DPC Response

That FOP 109 found an increase in the rate of shark attacks even after accounting for population growth is significantly different to that found by West (2011). An increase in the rate of attacks per person has very different social and biological implications compared to just an increase in the number of attacks purely as a function of population size.

There are many difficulties when simply comparing the incidence of shark attacks to human population growth. The simple statistic of human population growth does not take into account variations in regional demographics, changes in human population distribution and variations in lifestyle and behaviour of people over time. Specifically, it does not take into account changes in recreational water use which no doubt has varied over time in WA waters.

DPC Response
An attempt to use broad human distribution (see figure 3) was undertaken. Page 4 of FOP 109 states "*distribution of attacks appears strongly related to where the majority of the population resides and therefore where the highest levels of water activities are being undertaken. The pattern also probably reflects differences in where white sharks are more likely to occur along the WA coast*".

Accounting for changes in participation rates was not included in FOP 109, however the updated assessment present in Appendix 9 of the PER did examine this aspect and found that *"this increasing rate per resident was unlikely to have been generated by increased participation rates in water related activities given that the rate for all recreational activities in WA has fallen slightly over the past decade and, specifically, for surf related sports (which is one of the main categories of activities involved in the attacks), it has fallen from 2.1% in 2005/06 to 1.2% for 2011/12 (ABS, 2013)."*

In addition, a subsequent study provided a useful additional analysis of recreational water usage (surfing, diving, swimming). An independent study of shark bite risks in Western Australia by Sprivulis (2014) included an analysis of the Australian Sports Commission's published surveys on participation in recreational activities. Sprivulis (2014) examined these data and determined that "*despite significant total population growth in Western Australia, water sport participation data for Western Australia in the 10 years 2001-2010 showed a non-significant decreasing trend from 4,171,000 to 3,394,000 surf sport or diving episodes per year*".

Consequently, factors other than human population growth and participation rates must be involved in the increasing rate of attacks that has been experienced off Western Australia in the past two decades.

The proponent concludes statistical or graphical support for significant or plausible correlations between shark attacks and eight out of 17 data series examined. The statistical tests used to achieve these results are not described, a quantitative level of significance is quoted in only three cases and there is no rigorous definition of how 'plausibility' was assessed when it was concluded. The report does not provide sufficient information to permit a thorough assessment of its scientific rigor.

DPC Response
The objective of the report was to determine what factors/conditions were plausible in increasing or decreasing the frequency and likelihood of a white shark attack and not to invoke causative mechanisms. "*These correlation based analyses were aimed at determining whether improved guidance could be provided to the WA public for use in evaluating their personal risk profiles when considering undertaking activities in the marine environment*" (page 3). Thus, FOP 109 was written for a popular audience and hence published as an FOP and not as a peer reviewed research report.

Nonetheless, as outlined above, FOP 109 acknowledged the scarcity of white shark attacks, limited data on a range of other factors and gaps in data sets. Where possible, quantitative statistical correlation analyses were completed. Where even this was not possible a qualitative, graphical analysis was undertaken.

The results section of FOP 109 (pages 4 – 9) summarises patterns (correlations) in the datasets and states if there was or wasn't a significant correlation or clear pattern or trend in the data. If

there was a correlation then it was identified what the next steps should be. If there was not a correlation, the 'plausibility' was assessed on subjective, expert opinion assessment based on the patterns seen in the dataset and other information.

It should be noted that a wide range of other factors (some highly speculative) are present in the wider community (e.g. influence of whale migrations) and these were not included due to the difficulties in using the data.

The report, however, makes two useful observations- these are that available data in WA suggest:

a) the incidence and annual regularity of white shark attacks has slowly increased since 1995/96 and,

b) attacks by white sharks tend to occur more frequently during winter and spring.

The remaining correlations provide little useful information and, in general, are more likely to be heavily biased by hidden factors that influence the behaviour of water users and the areas that they use, rather than a relationship with shark attack.

DPC Response

In addition to the two observations noted above, this study identified that the relative risk of white shark attack appears to be higher for activities undertaken further offshore from the coast, particularly in cooler waters (< 20°C). Activities undertaken in shallow water close to the mainland, and especially when the water is relatively warm (> 22°C), appear to have the lowest relative risk. This is a very important public policy outcome.

FOP 109 has been successful at dismissing some of the more widely held 'beliefs' which in a public policy context is equally important. Thus it was also important to identify that time of day and weather conditions had no clear effect on the risk of shark attack.

FOP 109 led to the development of web page for the public that provides greater guidance when making personal risk assessments of water usage and considering the risk of white shark attack (www.sharksmart.com.au).

Correlation data can be a useful method for developing hypotheses about what causes something to happen. However, the greatest limitation of such analyses is interpreting any observed correlations in a useful way. Although a causal relationship between two data sets leads to a correlation between them, a correlation may occur between two sets of data even when there is no causal relationship. A commonly expressed summary of this is the phrase *'correlation does not imply causation'* (Aldrich 1995). The report thus establishes that correlations exist between various data series and shark attacks but fails to test the validity of any of these correlations.

DPC Response

It is agreed that correlation does not imply causation but the main point of this study was to identify where more future, more detailed research should be focused. If there is no correlation associated with an issue there is no point looking for any mechanism. That this was a preliminary study was documented clearly in numerous locations within FOP 109 text.

For example in relation to increasing attack rate it states:

Investigations into the long term trend, the cycles and the recent spike in attacks are currently underway.

"..."*Differences among years in oceanographic conditions are also expected to be associated with inter-annual variations in white shark abundance in the regions along the WA coast. Any quantification of this, however, would be reliant on the further data being collected through research activities such as the shark monitoring (tagging) program and a more detailed*

investigation of the oceanographic data across this 20 year period which are both part of the next phase of this study."

Next Steps

Studies have been initiated to investigate the factors that may be associated with the upwards trend in the rate of attacks over the past 20 years. This will also examine any factors that may be associated with the cycles observed in the relative number of incidents during this period and especially any factors that may be associated with changes in conditions during the past 12 months.

Any additional information that is found through these studies that may further assist the public to update their personal risk assessments for when, where and what water based activities they may be considering will be added to the community education material.

The proponent makes somewhat of an over-use of data in the figures of Appendix 4 with five showing different correlations defined by aggregating the same data in five different ways. The use of these multiple figures for the same data does not materially increase the significance of the results.

DPC Response
There appears to be a misunderstanding regarding the figures, as Figure 1 examines the change in number of attacks over the 20 year time period whereas Figure 2 examines the change in the rate of attacks per head of population over this per time period. These are two very different analyses with very different implications.

Presenting all three methods for assessing these two variables (by calendar year, financial year and pooled across two years) was done to ensure there was no possibility of only picking the one that showed the 'best' relationship. It should be highlighted that pooling among years is an appropriate approach when the data are patchy and has attributes akin to a random distribution.

The positive correlations found for both the number of attacks and the rate of attacks per head of population over the past twenty years are important findings.

It is notable that the main theme implied by the findings in Appendix 4 is that the rate of white shark attacks in WA cannot be explained by human population growth. This theme is also mentioned in other sections of the PER document. Yet the proponent does not examine a direct correlation between shark attack and human population size. Notwithstanding the above caveats, when these data are examined there is a significant positive linear correlation between these two variables for the greater Perth area where the majority of attacks have occurred (Figure 1) although this relationship only explains 34% of the variability in the data.

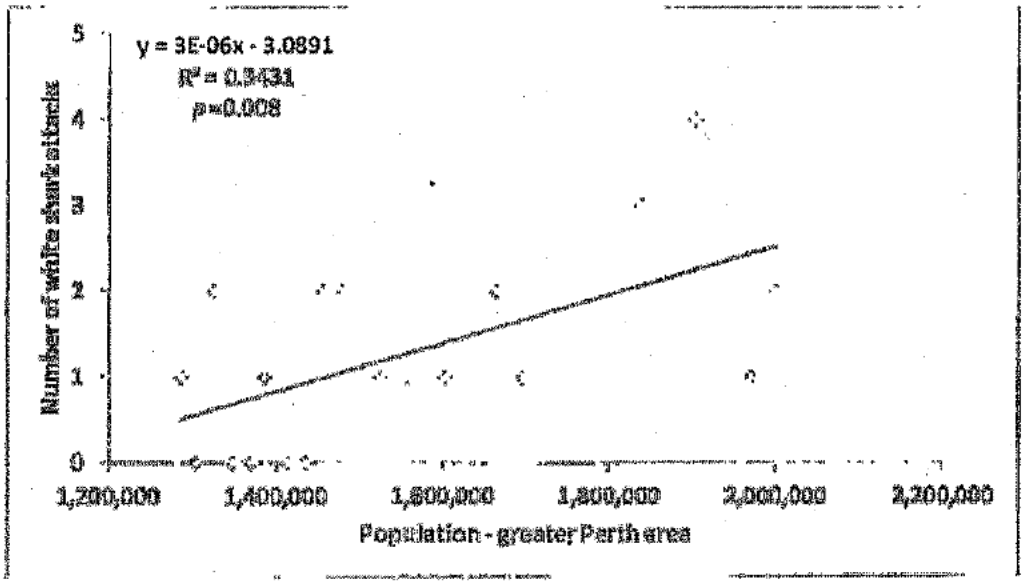


Figure 1: Correlation between the annual (financial year) incidence of white shark attacks in WA and the Greater Perth population (1995/96 to 2013/14); Shark attack data sourced from the Australian Shark Attack File; Population data sourced via the Australian Bureau of Statistics. The equation provides the details of the plotted regression line, its defined R^2 value and statistical significance (p).

DPC Response

Figure 1 is effectively assessing attacks against increasing population size because time in this instance is a proxy for population size. That a correlation was found between attacks and population size is not unexpected assuming consistent rates of participation. What was more surprising was finding that the rate of attacks per head of population had also been increasing. this identified that population size alone should not be used to 'explain' the observed increases.

The assessment of the rate of attacks investigates if there has been a change in the risk of attack to an individual, not just whether the total number of attacks has changed. If there was no change in the rate of attacks then it would be more likely that the observed increase was largely due to increasing population numbers. FOP 109 also identifed that shorter term factors are also important.

As stated above, page 4 states, "*This suggests that the risk of attack has been increasing through this 20 year period beyond that expected from human population growth. Furthermore last year's* (2011-12) *rate was well above this trend.*"

Given that a significant change in the rate of attacks was identified, it was no longer appropriate to only use population growth to try to explain the data.

Thus an equally plausible contributing factor to the slow increase in shark attacks over time is an increase in the human population size in Western Australia. This factor is ignored in Appendix 4. The actual correlation between the incidence of shark attack and population growth may be even higher as population growth and recreational water use are unlikely to have been constant over time as a result of changing patterns of wealth, demographics and lifestyle choices.

DPC Response
The comment seems to mix two elements. Part of the increase in the number of attacks is likely to be the increase in population size. However, as stated above that does not explain all of the increases observed, as the rate per head of population has also increased.

While it may remain plausible that it is only due to population increase, it is not 'equally plausible' as stated. For that to occur there would have had to have been no increase in the rate of attacks per head of population. It is not appropriate to ignore the significant increase in the rate of attacks to justify a position.

It is, however, unlikely that human population growth alone can account for all patterns observed. This suggests that there are other factors contributing to the pattern of shark attacks in Western Australian waters which may include variations in the distribution of sharks due to responses in biological and/or environmental variables and changes in their population levels. Disentangling these factors will not be easy to achieve.

DPC Response
Human population numbers will have an influence on shark attacks but is unlikely to be the sole factor to account for patterns observed. This is due to a range of factors that complicate the interpretation of numbers of people in Western Australia (e.g. distribution, use of marine waters, weather and climate events, shark behaviour, distribution and population size etc.).

Comments on Appendix 9: A risk-based, weight of evidence approach to determine the range of plausible estimates for the south-western Australian population of white sharks (working draft).

Demographic modelling is a useful exercise and, when coupled with verified data on the requisite biological parameters, can provide estimates of the vulnerability of a population to the combined effects of fishing and other non-natural sources of mortality. Such analyses have generally provided similar results for populations of white sharks where this method has previously been applied and include other examples for Australian waters (Malcolm *et al.* 2001, Hillary *et al.* 2012) and off the west coast of the US (Burgess *et al.* 2014). The results of these approaches are highly sensitive to assumptions regarding the parameters used.

All of these approaches (including the proponent's) have used either the same or similar parameters and thus it is entirely unsurprising that each has reached similar population level conclusions. However, as stated by Cortes (2007) in his review of demographic modelling as applied to shark populations: *"..it is impossible to gauge the accuracy of any of these estimates without comparison with empirically derived estimates, which rarely exist".*

DPC Response

The modelling approach used in this study was not identical to the other studies mentioned in two major respects.

Firstly, the study did not just use a single set of defined parameters to generate the scenarios. Two different suites of parameter values were generated; one used more standard biological parameters and the other used a more conservative set. In addition, each biological parameter used in each set incorporated a level of uncertainty. Furthermore the resultant matrices were then used in a dynamic manner to model the potential impacts that fishing may have had on white shark population size and trajectories since 1940. This approach has not been done before.

In addition, the outputs of the different scenarios generated from the demographic modelling were examined 'to gauge the accuracy' using available empirical and other data. Consequently the methods outlined in the peer review are precisely what was done in the study, using a weight of evidence approach which is the most appropriate and robust framework to systematically complete the exercise.

Appendix 9 provides few details on how key parameters were estimated. Two of the significant parameters that dictate the predicted trajectories and current population estimates are the initial population size from which the model is run and the catch history of white sharks across the population. Modelling minimum viable population levels and population trajectories for white sharks via demographic models as used by the proponent are scientifically useful exploratory exercises but highlight the critical uncertainties and lack of information available to adequately assess current population size, population status and hence the likely impacts of any additional removals from the population. The outcomes of such modelling are heavily dependent on underlying assumptions relating to: biological parameters, initial population size (which is unknown), current/historical catches across the populations range (which are poorly documented) and either explicitly or implicitly assuming that some catches or trajectories are sustainable or more plausible compared to others (for which there are few data to adjudicate). It is important to note that such exercises are not stock assessments and they do not provide estimates of actual population size.

DPC Response

The study is a working draft that relies on the details for some sections being contained in more detailed reports (Taylor *et al*, in prep, Braccini *et al.*, in prep). The biological data used for the parameter values comes from a chapter written for this report, prepared by CSIRO.

The issues identified in the peer review for developing the population scenarios and estimates are well known and apply to all stock assessment techniques. The dynamic methodology used here was akin to a standard stock assessment technique because it generated historical estimates of total female population size from 1940 to present, including historical levels, trajectories and current levels, rather than a single point estimate as is generated by most demographic models.

It was in recognition of some of the biological parameter values being not well known that a range of different scenarios was generated. Each of these scenarios was then examined against the other available data to refine which were more plausible. This approach is identical in concept to the quantitative stock assessment approach of having a computer program run minimisation routines of a suite of parameter values (with uncertainties) to generate a set that best fit with ancillary data, the output of which being a median estimate of stock abundance with confidence limits. There was not considered to be sufficient quantitative data to apply this approach. Hence a more qualitative assessment approach was used that generated ranges of more plausible values, which collectively can be used to describe the confidence levels.

It was also acknowledged that each of the different additional lines of evidence may have some issues: *"it is acknowledged that there are uncertainties associated with each of the available lines of evidence and life history parameters. If used by themselves, none is likely to be sufficient to discern current plausible population levels and trajectories for the southwestern Australian population of white sharks. The clear advantage of using a risk based weight of evidence approach is that while each line of evidence may have issues, their collective use substantially increases the overall robustness of the conclusions that can be made."*

The proponent has arbitrarily defined a range of initial population sizes, arbitrarily defined a 'starting point 'equating to a time of virgin biomass, modelled various trajectories based on assumed historical catch scenarios - the basis for which are not defined in Appendix 9, selectively culled trajectories and used the resulting model output to estimate population sizes relative to their assumed virgin biomass. These choices provide the basis for useful exploratory analyses. However, very few of the key parameters used have robust empirical measures and this is the challenge for interpreting such model outputs. Although it is possible that the actual population and even the trajectory of the current population may fall within the boundaries of the proponent's model outputs, without empirically derived estimates it is impossible to adjudicate their veracity. There is some evidence that white shark populations in other areas of the world are increasing and have benefited from a combination of protection and fisheries management actions designed to improve the status of commercial shark species (Burgess *et al.* 2014; Curtis *et al.* 2014). Thus it is also plausible that white shark populations have benefited from similar actions in Australia. However, conclusions of possible population increases by these other studies are based on empirical data in the form of verified catch or observation rates (e.g. Lowe *et al.* 2012). The proponent provides no useful empirical data in similar to support.

DPC Response

As outlined above, the approach taken in this study was not different to that undertaken in other stock assessment processes throughout the world. The set of starting values, whilst broad, was not arbitrary. The starting levels were not time based as all scenarios started in 1940 prior to any material level of white shark captures. Full details on determining the different starting levels of between 2,000 and 10,000 will be provided in Braccini *et al.* (in prep). In particular, the starting values at the lower end were directly constrained by whether or not the population would have survived to the present day based on its ability to actually accommodate historical levels of fishing mortality.

The additional lines of evidence (which are empirical data which in some cases are observer based) were used to 'adjudicate' among the various scenarios. It appears then that the peer review supports the approach taken in the study.

The proponent then argues that they have assessed the *"plausibility"* of their demographic modelling scenarios based on the consistency of model output with *"other lines of evidence"*. The document draws information from five* other lines of evidence to support the conclusions of the demographic modelling, hence resulting in their *"highly innovative weight-of-evidence"* approach.

***Appendix 9 cites eight line of additional evidence. However, one of these - *'Catch Rate of Commercial WA Fishers'* forms the basis for calculating population scenarios by the demographic modelling and thus is not an 'additional line' of evidence. Two lines of evidence - 'Public reported sightings' and 'Tagging' data were judged too inconclusive to provide support.**

DPC Response

It is not correct to dismiss the use of the time series of catch rates to discriminate among the scenarios as it was part of the development of the catch history. Use of these types of data in this context is entirely consistent with the similar use of catch rate data in the quantitative assessment models that are applied across many data rich fisheries. Tuning a model to catch rates to determine stock size is one of the most common methods used in fisheries.

The time series of historical catches was determined by combining the catch rates determined from 'interviews with fishers' with the 'fishing effort reported in logbooks' (i.e. these two variables were independent) using a linear modelling approach. In a traditional fisheries model, an initial population size consistent with the catch rate, catch, and effort data would be estimated using a maximum likelihood approach. In the case of the white shark 'fishery', for each of a number of alternative initial population sizes, a time series of population abundance is calculated by removing the estimated catches from the population, which is assumed to possess biological characteristics consistent with those of white sharks. While the resulting trajectories of relative abundance are consistent with the removal of the estimated catches, the extent to which they are consistent with the trend in catch rates is determined by the value of the initial population. By appropriate 'tuning' of the initial population estimate, it would be possible to 'fit' the relative abundances to the catch rates. Because of the quality of the white shark data, however, it is appropriate that, rather than fitting the model using a maximum likelihood approach, comparison of the trend in relative population abundance with the trend exhibited by the three catch rates should be considered as one of the lines of evidence determining the level of support for each of the different levels of initial population size.

Consequently, the conclusion in the peer review that these data cannot be used to assess among the different scenarios is inaccurate.

However, the data in these lines of evidence are highly ambiguous and in all cases there are either alternative plausible interpretations, caveats on the use of these data at their source have been ignored or the data have been used out of context. There is thus insufficient information within the lines of evidence to support or refute the 'plausibility' of the proponent's modelling and the support concluded in each case is highly subjective and cannot be substantiated. Thus these assessments of plausibility lack credibility.

DPC Response

As outlined above, while there may be some uncertainties within the data this does not automatically mean they are not useful. Similarly, while alternative explanations were in some of the cases developed in the peer review, that does not mean they were equally as plausible or that they were even consistent with a proposed alternative scenario.

"it is acknowledged that there are uncertainties associated with each of the available lines of evidence and life history parameters. If used by themselves, none is likely to be sufficient to discern current plausible population levels and trajectories for the southwestern Australian population of white sharks. The clear advantage of using a risk based weight of evidence approach is that while each line of evidence may have issues, their collective use substantially increases the overall robustness of the conclusions that can be made."

"Using basic statistical theory it is possible to determine when it becomes improbable that a scenario is plausible based on the relative number of relevant lines of evidence that are considered inconsistent with the scenario."

Similarly, whilst other explanations may be possible to be constructed, it was outlined in the introduction of the draft report that "*the appropriate focus for applying the precautionary approach has been towards human safety such that if there are potential threats to human safety, the lack of full scientific certainty should not be used to postpone measures to prevent further harm.*

Thus, while uncertainty is recognised, this should not automatically preclude the use of these data where it is consistent with a particular scenario.

1. WA ABALONE DIVERS OBSERVATIONS

The document refers to sightings logged by abalone divers since a specific category for reporting white shark sightings was introduced in 2007. The data are extremely sparse, primarily dealing with zero observations. When white shark sightings were aggregated over the entire 2007-2013 period, observations were limited to within 13 out of approximately 100 blocks of unspecified size (but assumed to each be 100 nm2 based on Hart *et al.* 2013). Cumulative shark sightings over this entire seven-year period within each of the 13 blocks where sharks were reported ranged from 1 to 4. When these data were standardized for diving effort, the range within these years was approximately 0.5 to 1.7 sharks sighted per 1000 hrs of diving. Given the low numbers, the high level of zero sightings and the unstated level of reliability in reporting, it is highly unlikely that these data provide a useful index at this stage. However, the concept is a good one and abalone divers should be encouraged to report sightings over time. It will be important, however, to examine ways of verifying the extent and variability in reporting, as changes in reporting rate or motivation to report can severely bias such data, particularly when observed numbers are so low and data are examined over short time periods. Such low numbers of sightings can also be influenced by repeat observations of the same shark when diving in one area. The document also refers to a phone survey of seven 'long-term' abalone fishers who all reported that white sharks were more abundant in 2013 compared to when they commenced diving (reported average years of diving = 20.9). Notably, however, six of the seven divers surveyed admitted that their conclusion was not based on observing more sharks, but on their perception that more sharks were present. Given that reported observations of white sharks are so low over the time period and that comments on sharks numbers were, in the majority, not based on any increase in the number of sharks actually sighted - the conclusion by the proponent that these data are *"most consistent"* with no change or a slight increase in shark population size cannot be supported.

DPC Response

The telephone survey and the logbook are not the same. They are different datasets collected by different groups independent of each other. Only the logbook data were used and these are not based on perceptions but on daily catch returns filled in by all divers.

The potential concerns raised in the peer review that there could be 'repeat sightings' is at odds with other concerns of low observation rates. Repeat sightings would only be an issue if the divers were frequently reporting more than one shark per trip; this is not the case. Therefore, no issues have been raised that would indicate that these data are completely inaccurate, only that they may be imprecise, which is acknowledged.

Given that only a simple trend line analysis of these data was possible, the assessment of consistency was restricted to whether the population trajectory over the past decade for each scenario was static or upwards, which would be the most consistent with these data, or if the population trend was downwards, which would be less consistent with these data.

It is much less plausible that there has been a major decline in shark numbers over this period and for the trend in diver observations of white sharks not to show any reflection of this.

2. NEPTUNE ISLAND SIGHTINGS

The document refers to the long-term (12 year) frequency of white shark sightings at the North Neptune Islands, South Australia reported by Bruce and Bradford (2013). This study examined the number of sharks sighted over the period 2000 to 2011, specifically focusing on the impact of changes in shark cage-diving operations before and after a sustained increase in effort in 2007. While the Bruce and Bradford study found that the number of sharks sighted per day by cage-dive operators had significantly increased after 2007, this was concluded to be caused by an increase in residency times in response to shark cage-diving operations, hence resulting in sharks temporarily accumulating at this site. The study found no similar changes at the South Neptune Islands, 12 km away, where the frequency of shark cage-diving was significantly less. The study reports no evidence of an increase in population size and states that *"The lack of available measures of population size combined with these* [observed] *interannual variations*in the number of sharks sighted] *makes it difficult to conclude population-level changes in abundance from these data."* White sharks are temporary residents at the Neptune Islands (which holds Australia's largest aggregation of seals) with a median residency period of 9 days (Bruce and Bradford 2013). The proponent's conclusion that data from the Bruce and Bradford study are *"fully consistent"* with either no change or a slight increase in population size cannot be supported.

DPC Response

That it may be difficult to use these data to assess changes is not the same as impossible.

The assessment of consistency for a scenario against these data was not (as implied in the peer review) restricted to those that showed an increase. It was also applied to those with static trajectories in line with the authors analyses that at least some of the increase in total sightings was due to increases in 'effort'. That other factors are involved in affecting the short term observations of shark numbers at these sites does not alter the conclusion that the longer term trends they have documented are fully consistent with either no change or potentially a slight increase in total shark numbers. This long term trend is not, however, consistent with a decline in shark numbers which would be the alternative outcome. The peer review did not outline how a major decline (which was the trajectory for some of the alternative scenarios) in the population could have been occurring over the past 20 year period without some observed decline in the 'standardised rate of observation'. Such a situation would also have a much lower level of plausibility.

3. WA SHARK ATTACK DATA

The document refers to an increasing rate of white shark attacks in Western Australian waters since 1996 that exceeds the rate of the State's population increase, citing analyses in a Department of Fisheries Report which is included as Appendix 4 (see above for a review of Appendix 4). Notwithstanding the shortcomings of analyses presented in Appendix 4, the proponent argues that an increase in the rate of shark attack in WA could not be attributed to an increase in participation rates in water related activities, stating *"..given that the rate for all recreational* [water] *activities in WA has fallen slightly over the last decade and specifically, for surf related sports (which is one of the main categories of activities involved in the attacks),it has fallen from 2.1% in 2005/06 to 1.2% for 2011/12"* citing ABS (2013). The ABS (2013) report, however, clearly states with respect to the 2011/12 data on participation in surfing that the *"estimate has a relative standard error of 25% to 50% and should be used with caution"*. This warning appears not to have been considered by the proponent in their analyses. Furthermore, although the participation rate reported by the ABS for other water activities such as swimming/diving8 in 2011/12 was also less at 9.6% than that reported in 2005/06 (9.9%), the values over the period were not reported by the ABS to be significantly different. In addition, the proponent's comparison uses the ABS participation rate rather than the numbers of people engaged in the activity. Given the increase in WA's population over the period, the ABS data translates into an increase by approximately 31,000 in the number of people participating in swimming and diving activities over since 2005/06, not a slight decrease as the proponent concludes. An increase in the number of people participating in marine-based water activities in Western Australia is also predicted by surveys of beach use by Eliot *et al.* (2005) who concluded that there was a general increase in beach use between 1994 and 2004 by approximately 4% per annum and at some Perth beaches of up to 10% per annum over this period. The WA has consistently experienced the highest population growth rate of any Australian State over recent years (e.g. 2.9% in 2012/13) and the population of the greater Perth region has increased from 1,286,000 in 1996 by nearly 700,000 to 1,970,000 in 2013 (ABS 2013, DPI 2009). It would seem more plausible that WA in general, and the greater Perth region in particular, have experienced a significant increase in the number of people using marine waters for recreational purposes rather than less as the proponent's document concludes. Despite these statistics, the number of shark attacks over the period August 2010 to July 2012 was unusually high compared to any similar period previous or since in the State and this cannot be fully accounted for by increases in water use or increases in the population size of white sharks, should the latter have occurred. The proponent reasonably concludes that the increase in the rate of attacks by white sharks relative to the WA (human) population size cannot be fully explained by an increase in the white shark population alone, as under their own calculations it would require a biologically impossible rate of increase since the species protection and specifically for the 2010 - 2012 period. This statement is in agreement with general findings on white sharks in particular by South African researchers and research on the species in eastern Australia that has concluding that the frequency of attack is poorly correlated to the local abundance of the species (Bruce and Bradford 2012, Dicken and Booth 2013). The proponent reasonably concludes that the relationship between abundance and frequency of attack is not linear. Thus the proponent's conclusion that the observed trend in shark attacks (relative to population growth) *"would be most consistent"* with some level of increase in the white shark population also cannot be supported.

DPC Response

The issues outlined regarding the relative effect of population increases and rates of participation on the rates of attack per head of population were discussed in detail under the "Comments on Appendix 4" section of this document.

Comments regarding the variance in ABS data and therefore that the level of participation may be the same across the period are noted, however this does not support a conclusion that the increase is therefore just population growth. Rather, even if participation has remained the same that still supports the conclusion that the increase in the rate of attacks per head of population is

generated by factors other than population size and participation, one of the plausible options being an increase in shark population.

The conclusion in the report did not state that this increase in the rate of shark attacks definitely represents an increase in population numbers, only that it was plausible and would be most consistent with this pattern. It was also clearly pointed out that the doubling in the rate of attacks was not likely to be a reflection of the absolute increase in shark numbers. Nonetheless, that the total abundance of sharks must ultimately affect the total number of shark attacks at some point is axiomatic; if there are no sharks there can be no attacks. Hence, it is entirely plausible that an increase in the rate of shark attacks is consistent with some level of increase in shark numbers. It is much less plausible that it is associated with a decline in shark numbers.

The discussion in the peer review of local observations related to numbers versus attacks is interesting but not relevant to determining cause and effect patters at the entire state level.

4. OTHER WHITE SHARK POPULATION ESTIMATES

The proponent compares their estimate of 'population size' with other calculations for white shark populations world-wide (including other Australian-based research). The proponent's document incorrectly states that a previous Australian study (Thomson in Malcolm et al. 2001) "..used inputs that were largely based on annual capture data from what is now known as the eastern population". In fact, the dominant catch data in that study (over 75%) came from what is now known as the western population and that study's conclusions are thus readily applicable within the bounds of the caveats provided. As stated above, demographic modelling approaches (including the proponent's) to investigate white shark populations have each used either the same or similar parameters and thus it is entirely unsurprising that they have each reached similar conclusions regarding population levels. What remains unknown is how the model outputs in each case reflect the actual status and trajectory of the individual populations to which they have been applied. Comparing populations of white sharks between vastly different world regions is unlikely to be biologically sound as such simple comparisons fail to take into account differences in historical population processes and ecosystem characteristics that can result in different base level population sizes and trajectories. Other estimates of 'population size' for Australian waters are not referred to by the proponent including those by Blower et al. (2012) who estimated the effective population size (Ne) for the southwest population to be approximately 700. However, this was not an estimate of all life history stages combined, had very wide confidence limits and noted that the relationship between effective population size and actual abundance (i.e. population census size or Nc) is often complex and unclear. Given the uncertainties and biases in the population estimates from the other Australian studies and those world-wide, it is difficult to adequately compare such results between different populations and their veracity with respect to actual population sizes within the regions is unclear. It is thus unclear to what extent these data can be used to support or refute the proponent's modelled population estimates.

DPC Response

It is acknowledged that the study by Blower *et al.* (2012) was not included in the DoF study. This will be incorporated in future versions of the study.

As outlined in the peer review the Blower *et al.* (2012) estimate of 700 was for 'effective population size' or 'breeding pairs' and not the total population (i.e. total includes juveniles, immature and mature adults) as was estimated in the DoF study. Given that the drum line program may potentially interact with white sharks across all these life history stages and sexes, and not only with breeding individuals, the assessment of risk needs to relate to the total population. As Blower *et al.* (2012) clearly acknowledge, their estimates have wide confidence intervals and are preliminary due to low numbers of genetic markers and samples, and therefore must be interpreted judiciously.

The methodology used in the DoF white shark population estimate uses an established methodology for calculating population numbers of shark species. For example, the use of catch data and observer reports forms the basis for a major review of the biology and status of white sharks conducted in 2001 by CSIRO (Malcolm *et al.* 2001). The use of mitochondrial DNA (mtDNA) for laboratory based population estimates however has been challenged as a means for determining population abundance (Bazin *et al.* 2006).

Nevertheless, an estimate of 700 breeding individuals is not inconsistent with a total population size of 3,400 to 5,400 individuals as presented in the PER. Given that the proportion of this population that would be of breeding size/age is likely to be in the order of 15-30% (based on modelled population structures) using the Blower *et al.* (2012) estimate this would generate a total stock in the order of 2,500-4,600 individuals for the south western population. This range is similar to that generated through the DoF weight of evidence approach.

5. COMPARATIVE DUSKY SHARK ESTIMATES

This section provides no useful information on white sharks. The demographics of dusky sharks, as well as their ecology and fishery status, are sufficiently different to white sharks that such simple comparisons are not biologically meaningful. These comparisons give no measure of support.

DPC Response

The comparative assessment of dusky sharks is related to their relative rates of capture by the same fisheries, not their comparative demographic characteristics.

The generation of abundance estimates for a population that has low levels of information by using data (such as catch rates) that are compared with species for which there are high levels of information is an approach that has been promoted by CSIRO researchers (e.g. Punt *et al.* 2011). Consequently, this approach was appropriate for use in this situation with the primary motivation to potentially provide information that may have helped determine the potential upper limit of the white shark population size. The resultant analysis did not help greatly with the discrimination among scenarios as the calculated estimates were too wide. This does not however mean it was an invalid exercise or that we should not report the outcomes.

6. CONCLUSION

Overall, there is little support for a *"high level of consistency in the patterns seen among independent lines of evidence"* with the model output as stated by the proponent. The problem with the 'weight-of-evidence' based approach used in this case is that it is open to significant bias depending on the qualitative 'lens' used to adjudicate the level of support provided. When used appropriately, a weight-of-evidence approach must consider all available lines of evidence, including an assessment of the veracity of 'supporting' as well as alternative interpretations of the data used. This does not appear to have been the case in the proponent's document and it correspondingly lacks credibility.

DPC Response

The comments in the peer review that there was little support for a high level of consistency in the patterns seen among the independent lines of evidence is demonstrably incorrect. All of the lines of evidence either showed stable or increasing trends with none showing evidence of a decline. This represents a high level of consistency.

With respect to the efficacy of these lines of evidence, the peer review has identified that there are uncertainties in each of the lines of evidence and has therefore expressed reservations regarding any conclusions being made given the imprecision of the data sets. The peer review appears to suggest that unless data are without issues (which is unlikely to be available for the white shark), they should be completely rejected. This is not an appropriate position to adopt, especially within a risk assessment context.

In terms of issues with the individual lines of evidence, while the peer review identified elements of uncertainty (which DoF also acknowledge), the conclusions as to the lack of any value for each of these lines of evidence in discriminating among the alternative scenarios were incorrect. For example, some that are highly suitable have been dismissed in the peer review. The reason given in the peer review for not including the analysis of the catch rate line of evidence was inappropriate and this is a strong line of evidence that can clearly help discriminate the level of plausibility of the different scenarios generated by the demographic analysis.

For others (abalone diver and cage diving observers) the peer review identified issues with the line of evidence precision but not their accuracy. Finally, the alternative hypothesis proposed (shark attack data) of it all being population growth was not consistent with all the analyses that were available. Hence the plausibility of this hypothesis was lower than that used in the weight of evidence analysis.

Again reiterating from above "*. . .it is acknowledged that there are uncertainties associated with each of the available lines of evidence and life history parameters. If used by themselves, none is likely to be sufficient to discern current plausible population levels and trajectories for the southwestern Australian population of white sharks. The clear advantage of using a risk based weight of evidence approach is that while each line of evidence may have issues, their collective use substantially increases the overall robustness of the conclusions that can be made".*

Blower *et al.* 2012 provides total stock estimates that have a range very similar to those developed in the DoF draft report. Furthermore an additional study based on the ecosystem modelling undertaken by Goldsworthy *et al.* (2013) indicates that pelagic shark biomass, which includes white sharks, has been increasing since reductions in shark fishing occurred in the 1990s. This independent, peer-reviewed result is consistent with the some of the more plausible scenarios identified in this assessment.

It is important to point out that each of the individual scenarios presented in the assessment at this stage are only considered plausible and not definitive; this is a very important distinction. Moreover, the use of the types of ancillary data as presented within this highly structured assessment were similar to those used as the basis for the original listing of white sharks. Consequently if these types of data are not appropriate to examine for trends from which conclusions can be drawn on population status then this suggests the original listing of the white shark was possibly not appropriate.

Finally, the DoF study is being completed to assist in the development of public safety policy for which "*...the appropriate focus for applying the precautionary approach has been towards human safety such that if there are potential threats to human safety, the lack of full scientific certainty should not be used to postpone measures to prevent further harm*".

Thus, while uncertainty is recognised this should not automatically preclude the use of these data where it is consistent with a particular scenario.

"*Consequently, in terms of the assessment of the potential risks to human safety, this series of analyses provides sufficient evidence to conclude that it is at least plausible that there may have been some (albeit small) increase in white shark numbers since their protection. It is important to reflect that the inverse of this situation (similar types of evidence, mostly from eastern Australia, which were indicative of population declines) was used in the 1990s as the basis to list this species as vulnerable (EA, 2002).*"

The proponent clearly identifies that Appendix 9 is a 'Working draft'. However, the findings in Appendix 9 form a substantial input to the proponent's overall risk assessment and guides their conclusions. Appendix 9 contains examples of selective use of information and cites non-peer-reviewed Departmental reports that would fail the test of good science and scientific reporting. It would thus be prudent for the Department to engage one or more independent reviews of this document before it is finalized and adjust the overall risk assessment accordingly.

DPC Response
The assertion that information has been used selectively is refuted, but it is accepted that, as is entirely appropriate in a risk assessment context, non-peer reviewed reports and unpublished data have been used. To not include all available information would have been highly inappropriate.

Furthermore, given its draft status some of the analyses still need to be added or refined.

As with all research reports, it is planned to have each of the reports peer reviewed prior to their finalisation and formal publication. Based on the comments in the peer review we will revise the text to more clearly outline the difference between plausible and definite estimates and how consistency with a scenario was determined and how uncertainty in the each line of evidence was accommodated.

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GOVERNMENT OF
WESTERN AUSTRALIA

Western Australian Shark Hazard Mitigation Drum Line Program 2014-17

Management Plan

July 2014

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DEFINITIONS

In this Plan:

DoE	means the Commonwealth Department of the Environment
DoF	means the Western Australian Department of Fisheries
DoF Operations Manager	means the officer at the Department of Fisheries responsible for operational liaison
DPaW	means the Western Australian Department of Parks and Wildlife
DPC	means the Western Australian Department of the Premier and Cabinet
EP Act	means the *Environmental Protection Act 1986* (WA)
EPA	means the Western Australian Environmental Protection Authority
EPBC Act	means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth)
FHPA	Fish Habitat Protection Area as defined under the FRMA
Fork length	means the horizontal distance from the tip of the snout to the fork of the tail
FRMA	means the *Fish Resources Management Act 1994* (WA)
Interdorsal fin length	means the horizontal distance between the first and second dorsal fins measured from the first dorsal fin origin to the second dorsal fin insertion
Marine Monitored Area (MMA)	means the areas in which static drum lines may be deployed (as defined in section 3.2.1)
Marine protected area	means any marine protected area designated under the *Conservation and Land Management Act 1984* or the FRMA
MNES	means matters of national environmental significance as defined under the EPBC Act
Non-target species	means all vertebrate species that are not target species.
Observer program	means the provision of individuals to observe operational performance of the Program
PER	means the Public Environmental Review submitted by the Government to the EPA and DoE.
Plan	means this document titled "Management Plan for the Western Australian Shark Hazard Mitigation Drum Line Program 2014-17"

Program	means the Western Australian Shark Hazard Mitigation Drum Line Program 2014-17
Static drum lines	means drum lines to be set continuously (or as directed by the Proponent) at approximately 1km offshore of popular swimming beaches and surf breaks within the MMAs between 15 November and 30 April each year and monitored daily.
Temporary drum lines	means drum lines deployed in response to an identified shark threat or incident anywhere in Western Australian waters at any time, until 30 April 2017. Temporary drum lines would be set for a maximum of one hour in response to a sighting or for up to one week in response to an incident.
Target species	means, in reference to static drum lines, any white shark (*Carcharodon carcharias*), tiger shark (*Galeocerdo cuvier*) or bull shark (*Carcharhinus leucas*) with a total length of three metres or greater; or in reference to temporary drum lines, any shark considered to be posing a threat or responsible for an incident.
Total length	means the distance from the snout to a point on the horizontal axis intersecting a perpendicular line extending downward from the tip of the upper caudal lobe to form a right angle
WC Act	means the *Wildlife Conservation Act 1950* (WA)
Western Australian waters	has the same meaning defined by Geoscience Australia and is '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'

1 INTRODUCTION

1.1 Name of Plan

This document is the Management Plan (the Plan) for the Western Australian Shark Hazard Mitigation Drum Line Program 2014-17 (the Program).

1.2 Purpose of the Plan

To set out the aims and objectives, management arrangements, operational protocols, monitoring, compliance and reporting requirements for the delivery of a three year drum line program off the metropolitan and south west coasts of Western Australia.

1.3 Date of commencement

This Plan will come into force on 15 November 2014 and will be in force for a period of three years between 15 November and 30 April 2014-17.

1.4 Definition of the drum line program

(1) The activity of drum lining is herein defined as the setting of up to:
   a. 60 static baited drum lines within the metropolitan and south west region Marine Monitored Areas (MMAs) (see section 3 and Attachment 9.1); and
   b. up to 12 temporary drum lines for responding to identified shark threats or incidents anywhere in Western Australian waters (see Attachment 9.2).

(2) Target species in reference to static drum lines are any white shark (*Carcharodon carcharias*), tiger shark (*Galeocerdo cuvier*) or bull shark (*Carcharhinus leucas*) three metres or greater in total length. Target species in reference to temporary drum lines are any shark considered to be posing a threat or responsible for an incident (see section 5 and Attachment 9.5).

(3) Static drum lines will be set between 15 November and 30 April each year for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017.

(4) Static drum lines are to be set approximately 1km (0.53 nautical miles) offshore off popular swimming beaches and surf breaks within the two MMAs.

(5) Temporary drum lines may be set at any time throughout the year to 30 April 2017.

1.5 Authority for the activity

The Program is authorised by approvals granted under the *Environmental Protection Act 1986* (WA) (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The Program also take place under exemptions from the *Fish Resources Management Act 1994* (WA) (FRMA) and licences under the *Wildlife Conservation Act 1950* (WA) (WC Act).

1.6 Proponent of the activity

The Proponent is taken to mean the Western Australian Department of the Premier and Cabinet (DPC).

1.7 Environmental assessment

This Plan is a requirement under the PER which was conducted under bilateral agreement between the EPA and DoE under the EP Act and the EPBC Act respectively.

2 AIMS AND OBJECTIVES

2.1 Development of the program

The Program has been developed following; a close examination of shark control programs in other jurisdictions; consultation with a wide range of stakeholders; input from public submission processes, and recommendations arising from the Review of the Western Australian Shark Hazard Mitigation Drum Line Program 2013-14 to avoid, minimise and rectify environmental impacts.

2.2 Program aims

The aims of the Program are:

(1) To offer an additional and complementary measure of shark hazard mitigation at high use swimming beaches and surf breaks during peak periods of usage to the shark hazard mitigation strategies already in place.

(2) To deliver an additional measure of shark hazard mitigation whilst minimising environmental impacts.

2.3 Performance objectives

The performance objectives of the Program are to:

(1) Maintain the diversity and geographic distribution of fauna at the species and population level through the use of 'best practice' environmental impact mitigation methodologies.

(2) Not jeopardise the survival or conservation status of threatened species, populations and ecological communities, or cause species that are not threatened to become threatened.

(3) Minimise impacts to non-target species.

(4) Collect relevant catch, biological and operational data to allow for ongoing monitoring of the Program and annual and post Program reviews.

(5) Use data collected from Program to increase knowledge and understanding of marine systems, marine species biology, population levels and movement patterns.

2.4 Performance Indicators

Performance Indicator (1)

Target species catch levels remain within the acceptable catch levels (see section 4.4).

Performance indicator (2)

Non-target species catch levels remain within the acceptable catch levels (see section 4.4).

Performance indicator (3)

If trigger points (see section 4.5) are met, appropriate contingency measures (see section 4.6) are implemented.

Performance indicator (4)

4.1 Catch data provided weekly to DoF and DPaW.

4.2 Catch data provided to the EPA within seven days of the end of each month of the Program.

4.3 Notification of catch rates meeting trigger points and details of contingency actions to be taken provided to the EPA within seven days of meeting trigger level.

4.4 Reports on catch data, operational performance, effectiveness of management measures and recommendations for program changes provided to the EPA within one month of the close of each Program season.

4.5 A final evaluation of the Program including; an analysis of catch data; operational performance; effectiveness of management measures, and contributions to research provided to the EPA within three months of 30 April 2017.

Performance indicator (5)

Biological samples taken from all listed species where feasible and practical.

3 RESTRICTIONS ON TIMING AND LOCATION

3.1 Timing

3.1.1 Static drum lines

Static drum lines will be set between 15 November and 30 April each year for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017.

3.1.2 Temporary drum lines

Temporary drum lines may be set at any time during the year until 30 April 2017 in response to identified shark threats or incidents.

3.2 Location

3.2.1 Static Drum Lines

(1) The metropolitan MMA extends from Ocean Reef (-31° 44.6038', 115° 43.3727') to Port Beach (-32° 2.4354', 115° 44.4630').

(2) The south west MMA extends from Quindalup (-33° 37.8569', 115° 8.9470') to Prevelly (-33° 58.9200', 114° 59.3834').

Up to 30 static drum lines are proposed to be set in each of three phases within the south west MMA as follows.[1]

Phase 1:	At popular surf breaks between Moses Rock and Prevelly – November to early December.
Phase 2:	At high use swimming beaches and popular surf breaks 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 surf breaks between Yallingup and Prevelly from approximately the second week of February until 30 April.

3.2.2 Temporary Drum Lines

Temporary drum lines may be deployed anywhere in Western Australian waters in response to identified shark threats or incidents until 30 April 2017.

3.2.3 Marine protected areas

(1) The MMAs overlap with the Marmion Marine Park and Cottesloe FHPA in the metropolitan region and with the Ngari Capes Marine Park in the south west region.

(2) Static drum lines will not be deployed within any gazetted or proposed marine sanctuary zone or gazetted or proposed marine recreation zone in any Western Australian marine parks as designated under the *Conservation and Land Management Act 1984*. Static drum lines will not be placed within any FHPA as designated under the FRMA.

(3) Temporary drum lines may be set anywhere in Western Australian waters at any time, including within marine protected areas in response to an identified shark threat or incident.

As detailed in Section 5 of the Plan, if an identified shark threat or incident requires a response within a marine protected area, appropriate consultation will be held between the DoF Operations Manager and DPaW prior to giving an order to deploy.

[1] This schedule may vary depending on changes to Surf Life Saving WA patrols, following consultation with the surfing community in the south west or other logistical considerations.

4 MANAGEMENT MEASURES

4.1 Drum line deployment

(1) Baited drum lines will be deployed within the metropolitan and south west MMAs.
(2) DPaW and DoF will be consulted on the locations for deployment of static drum lines.
(3) The GPS location of all drum lines will be recorded upon initial deployment on 15 November each year, if moved throughout the season, and upon final retrieval on 30 April each year.
(4) The drum line array in each MMA will be monitored and serviced between 0600 and 1800 seven days per week.

4.2 Bait

(1) Where available, a preference will be for the use of shark. Where shark is not available, consideration will be given to using less oily fishes to reduce scavenging.
(2) Bait to be checked at both the commencement of, and prior to the end of, each patrol day and at all other times lines are checked.[2] All used baits shall be disposed of on-shore. See section 4.10.3 for details on data to be recorded.

4.3 Drum line specifications

Each drum line will comprise of a minimum of two Polyform buoys and a large (no smaller than an approximate 25/0 circle) design hook. The hook is to sit a minimum of approximately two metres below the surface of the water, and be anchored to the sea bed using an approximately weighted 8-12 kg anchor by a length of polypropylene rope (length of rope dependent upon water depth and local conditions). Each component of the rig is to be sectioned, primarily through the use of swivel shackles. A third float may be added for more effective handling of an animal, in particular in rough sea conditions. Diagrams of the drum line configurations are at Attachment 9.3.

4.4 Acceptable catch levels

The acceptable catch levels for target species, and anticipated catch levels for non-target species under the Program are as follows:

Acceptable catch level for target species	
White	25 over three years
Tiger	an average of 300 per year
Bull	10 over three years
Anticipated catch levels for non-target species	
Dusky	<10 per year
Grey nurse	None to only a few per year
Shortfin mako	between five and 20 per year
Other non-listed elasmobranchs	between five and 20 per year, most likely to comprise of a number of species

Catches of other listed elasmobranchs including whale sharks and manta rays, and other listed marine fauna including seals and sea lions, turtles, whales, dolphins and seabirds are expected to be close to zero. It should be noted that these are the *anticipated* catch levels, and do not represent allowable catch levels. In the event that a listed elasmobranch or other listed marine animal is caught on the drum line, a within-season review of the program will take place.

4.5 Trigger points

The following figures represent levels at which contingency measures will be required to be employed. The figures are cumulative totals over the three years of operations and relate to animals that are either destroyed or are considered to have died following release (i.e. not simply catch numbers):

[2] In the event that a vessel cannot operate due to inclement weather lines will be re-baited as soon as practicable at the resumption of patrols.

Trigger Points	
Target species	
White	20
Tiger	350
Bull	10
Listed elasmobranchs	
Dusky	30
Grey nurse	5
Shortfin mako	50
Non-listed elasmobranchs	
Cumulative of species	50
Other listed marine fauna	
Marine life including seals, sea lions, whale sharks, manta rays, dolphins, turtles and seabirds	3

4.6 Contingency measures

Data will be provided to DPC and to DoF and DPaW on weekly basis. Ongoing monitoring of catches will enable prompt management actions to be taken. Should any of the trigger points described above be met, contingency measures will be implemented which may, dependent upon the trigger that has been met, include the following:

- effort reductions achieved through non-baiting of drum line hooks overnight;
- variation of bait types;
- inclusion of acoustic pingers on drum lines (if interactions with whales and/or dolphins);
- increased effort of patrols if catch exceeding predictions in a particular location;
- additional observer trips; and
- a within-season review of the program.

4.7 Animal handling protocols

Best practice animal handling protocols will be employed to minimise the stress on captured animals and assist in post-release survival of non-target animals (see Attachment 9.4).

Consideration has been given to the following:
(1) hook removal;
(2) measuring the shark;
(3) bringing a large shark on board a vessel;
(4) methods to restrain a shark;
(5) maximising chance of survival of sharks once removed from the water;
(6) maximising chance of survival of sharks once returned to the water;
(7) determining the condition of a shark;
(8) humane euthanasia of sharks;
(9) responding to a marine mammal entanglement.

4.8 Operational protocols

4.8.1 Drum line maintenance

1. Each drum line to be checked for damage/loss/wear and tear/signs of vandalism as part of daily patrols.
2. Items to be checked -
   a) Poly form A3 series inflatable surface buoy and writing
   b) Shackles and swivels
   c) Rope
   d) Hook
   e) Chain

f) Anchor

3. Repair or replace any gear as required and complete the data records.
4. Vandalism to drum lines to be recorded and reported to DoF Operations Manager.

4.8.2 Non-target species

1. Identify species.
2. Manage animal depending on its condition (see Attachment 9.4 for assessing the condition of a shark):
   a) The animal is considered healthy and has a reasonable chance of survival – record all relevant data – measure, sex, tag, photograph, take biological samples (*to be expanded*) etc. (see section 7).
   b) The animal is dead –tag the animal, photograph with tag number clearly visible, take biological samples and store on deck, cover securely for disposal..
   c) The animal is considered to not have a reasonable chance of survival - destroy humanely (see Attachment 9.4 for humane euthanasia), tag and photograph catch, with tag number clearly visible store on deck, take biological samples, cover securely for disposal..
3. Contact to be made with DoF Operations Manager in relation to any marine mammal or turtle caught for transfer to DPaW.
4. If shark is >2.5m, DoF Operations Manager to advise relevant agencies if shark is being released in the vicinity of a populated beach.

4.8.3 Target shark species (≥3m)

1. Target shark species (≥3m TL) identified.
2. Follow the directions in Attachment 9.4 for humane euthanasia and handling, if shark 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 data.
5. DoF Operations Manager advised of catch.
6. Conduct appropriate biological sampling (*to be expanded*) (see section 7).
7. If the animal is too large to bring on board, tow target species offshore, remaining in State waters, for disposal.
8. Retain animal on board if required for research purposes.

4.8.4 Disposal site

Sharks must be disposed of within State waters (i.e. within 3 nautical miles) and away from populated areas. Sharks must also not be disposed of within any proposed or gazetted marine recreation or sanctuary zones as designated under the *Conservation and Land Management Act* 1984.

4.9 Vessel and associated requirements

Vessels to have the following capabilities and/or equipment:

(1) approximate draft - 1.5 m or less;
(2) approximate length – 15 m or greater;
(3) deck space longer than 6 m;
(4) Automatic Location Communicator (ALC) capabilities, and ability to maintain a GPS Track log;
(5) 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 release;
(6) all lifting equipment rated for safe working loads in excess of 1.5 tonne;
(7) ramp or suitable and approved alternative system (such as a sling, or conveyor system) capable of bringing a large marine animal on board minimising further injury to the animal;
(8) approximate cruising speed of 20 knots;

(9) ability to store retained catch on board the vessel;
(10) vessels surveyed to carry above-deck loads in excess of 1.5 tonne;
(11) firearm (12 gauge shotgun as a minimum), secure storage and relevant licences; and
(12) pumping equipment or deck wash system suitable to ventilate gills of live sharks prior to release.

4.10 Record keeping

4.10.1 Photography

(1) photograph all animals caught on drum lines to establish species and size (ensuring safety of crew and no undue additional stress to the animal). Photographs should include metadata files including the time and date of image capture; and
(2) record photo numbers for each capture.

4.10.2 Tagging

(1) Dead or destroyed animals to be fitted with uniquely numbered kangaroo tags and tag numbers to be recorded.
(2) Uniquely numbered conventional fin tags to be fitted to animals being released and tag numbers recorded.
(3) Acoustic, telemetry or other research tags including PAT/PSAT or SPOT may also be fitted to animals as directed.

4.10.3 Data records

Data records for each day of operation will be maintained and provided to the Proponent on a weekly basis. Data records will include the following:

Date
Region (metro/south west)
Location (e.g.Floreat/Quindalup)
Drum line number (e.g. FL3)
Drum line GPS
Time drum line inspected
Drum line damage/vandalism/wear and tear/loss
Bait type
Whole/partial
No. of pieces
Age when checked (e.g. when was the bait put on the hook)
Catch (Y/N)
Species
Sex
Condition on the line
Hooked (placement)
Total length (cm)
Length noted as approximate (Y/N)
Fork length (cm)
Interdorsal length (cm)
Action
Release status
Depredation (tissue loss or damage) (%)
Subsequent action (e.g. disposed/retained)
Use (e.g. research)
Existing tag (e.g. research tagging equipment)
New conventional fin tag number
New acoustic tag number
New SPOT/PAT tag number
Photo numbers

Disposal GPS
Water temperature (°C)
Water depth (m)
Dissolved oxygen (mg/l)
Salinity (PSU)
Date bait purchased
Type of bait purchased
Amount (kg)
Cost ($)
Vessel Name
Start time
Start hours
End time
End hours
In Response To A Shark Threat or Incident
Date
Time of notification
Time of drum line deployment
Location of drum line deployment (GPS)
Bait type
Whole/partial
No. of pieces
Age when checked
Time returned to 1km offshore
Catch (Y/N)
Species
Sex
Condition on the line
Hooked (placement)
Total length (cm)
Length noted as approximate
Fork length (cm)
Interdorsal length (cm)
Action
Release status
Depredation
Subsequent action (e.g. disposed/retained)
Use (e.g. research)
Existing tag (e.g. research tagging equipment)
New conventional fin tag number
New Acoustic tag number
New SPOT/PAT tag number
Photo numbers
Disposal GPS
Water temperature (°C)
Water depth (m)
Dissolved oxygen (mg/l)
Salinity (PSU)
Catch reported to DoF Operations Manager (Y/N)

Additional data or information may be requested to be recorded by the Proponent at any time. See section 7 for further details.

4.11 Training

Training will be provided, prior to the commencement of operations each year, on the following:

(1) baiting and setting drum lines;

(2) fitting of fin tags;
(3) data recording;
(4) animal handling techniques (see 4.7 and Attachment 9.4);
(5) euthanasia of animals;
(6) photographic requirements;
(7) techniques for obtaining specimens for research;
(8) techniques for accurately measuring captured animals; and
(9) shark species identification.

5 RESPONDING TO AN IDENTIFIED SHARK THREAT OR INCIDENT

The following process is to be followed in the event that a shark is considered to be posing a threat to public safety or following a shark attack:

(1) DoF Operations Manager to advise the location of the shark (see Attachment 9.5 for criteria for initiating a response).
(2) Up to five drum lines to be set at the location of the shark within one hour of the notification.
(3) Drum lines are to be set for a maximum of one hour in response to a sighting, or for a maximum of one week in response to an incident.
(4) In responding to a sighting, drum lines are to be moved out to approximately 1km offshore within one hour after arrival at the site and/or lines removed from the water no more than one hour after arrival at site.
(5) If an animal is caught the procedures set out in Sections 4.7 and 4.8 are to be followed.

If an identified shark threat or incident requires a response within a marine protected area (see Section 3.2.3) appropriate consultation will be held between the DoF Operations Manager and DPaW prior to deploying temporary drum lines.

6 COMPLIANCE PLAN

1) Meetings will be held with the relevant parties to ensure clear lines of communication and understanding of all operational requirements. Meetings will be held prior to the commencement of operations each year, as required throughout the operational phase of the Program and following the completion of the Program post 30 April each year.
2) Data records (see Section 4.10.3) are to be provided, together with photographs, to the Proponent on a weekly basis. Data records will then be provided to DoF and DPaW on a weekly basis and to the EPA within seven days from the end of each month of the deployment.
3) Notification of catch rates reaching trigger points and details of contingency actions taken will be provided to the EPA within seven days of meeting a trigger point.
4) Reports will be provided to the EPA within one month of the close of each Program season.
5) To ensure compliance with the Plan a minimum of 10 observer trips on each vessel will be undertaken between 15 November and 30 April each year, 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 operational performance and ensure the objectives of the Plan are met. Observers will be officers from agencies including, but not limited to, DoF, DPaW and DPC. Reports will be completed following each observer trip in each region.
6) The Proponent will provide training prior to the commencement of operations (see Section 4.11). Training will be provided by officers experienced in the setting of fishing gear and handling of marine animals from DoF and DPaW as well as others with expertise in the relevant areas. Training will refer to safe work methods including minimising stress to animals and safety of crew.

7 RESEARCH COMPONENT OF THE PROGRAM

Access to animals protected under the EPBC Act for research purposes will only be facilitated in association with the relevant approvals. Subject to the approvals, relevant authorisations to conduct research on protected fauna under the FRMA and WC Act will be sought at a State level.

7.1.1 Core research to be undertaken by Government

(1) Biological samples will be collected from all white sharks where practical and appropriate. For white sharks that are euthanised as part of the Program this may include; fin clips or other tissue samples for genetics and/or vertebral samples for age and growth studies. For white sharks which are caught and released as part of the Program this may include; fin clips or other tissue samples for genetics; internal acoustic tagging for movement patterns and alert systems as part of the Shark Monitoring Network; fin mounted SPOT or PAT/PSAT tagging for vertical and horizontal movement patterns and injections with tetracycline and conventional fin tags for mark-capture and age and growth studies. Biological samples will be collected for other shark species where practical and appropriate.
(2) Data will be collected on bait usage to ascertain correlations with catch and bait.
(3) Water quality data, including water temperature, salinity, dissolved oxygen and water depth will be collected at the point of animal capture to ascertain correlations between shark presence and local oceanographic conditions.
(4) A gear selectivity trial may be undertaken during the Program to determine the effectiveness of different size hooks on minimising catch of non-target species and undersize sharks. Hooks no smaller than an approximate 25/0 circle design will be used at all times.
(5) Presence data of sharks will be added to the Atlas of Living Australia where considered appropriate.

The details of how the biological sampling will be undertaken are being progressed with DoF and the Museum of Western Australia.

7.1.2 Potential for further research by external institutions

The Program offers significant opportunities for other shark research including:
a) analysis of blood samples (lactic acid/stress on the line);
b) analysis of DNA samples (genetics);
c) tagging and tracking of animals (more extensive as potential access to tiger sharks and other species caught on the lines);
d) life history and reproduction studies;
e) access to tissue samples and other physiological/neurosensory features; and
f) studies based on catch and effort.

An invitation will be extended to researchers at the University of Western Australia and Curtin University to submit research proposals to be undertaken as part of the Program. Other interested parties not listed may also submit research proposals for consideration by the Proponent.

It is anticipated that data collected as part of the three year Program will add to the knowledge of sharks in south western Western Australian waters including behaviour, movement patters, site fidelity, post-release survival, reproduction, age and growth and sensory systems.

In addition to research opportunities available through the Program, research in Western Australia into white shark populations and aggregation areas is continuing, with a joint Commonwealth funded program continuing into 2014-15. Telemetry studies also continue at DoF as part of the Shark Monitoring Network.

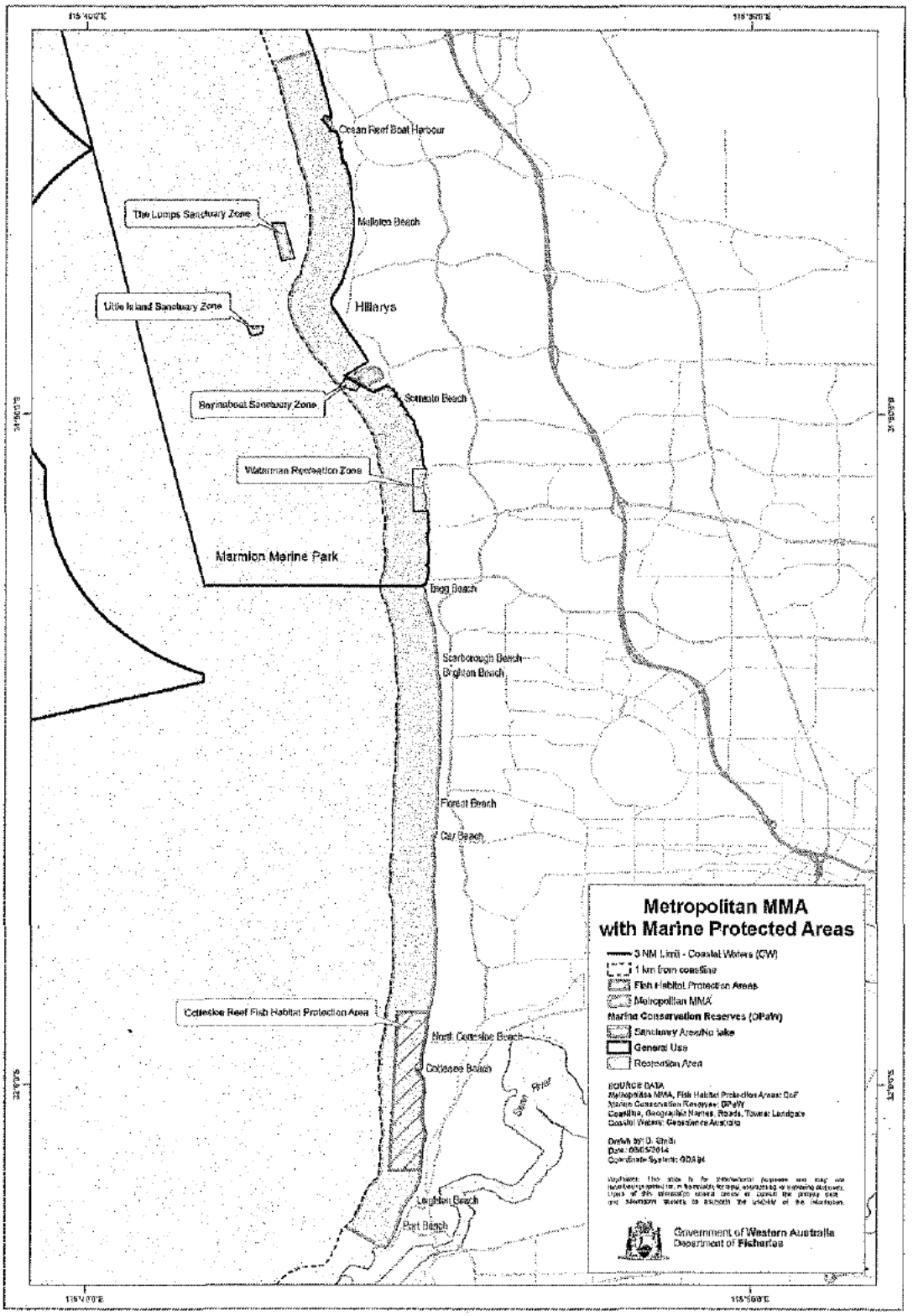
8 PROGRAM REVIEW AND MONITORING

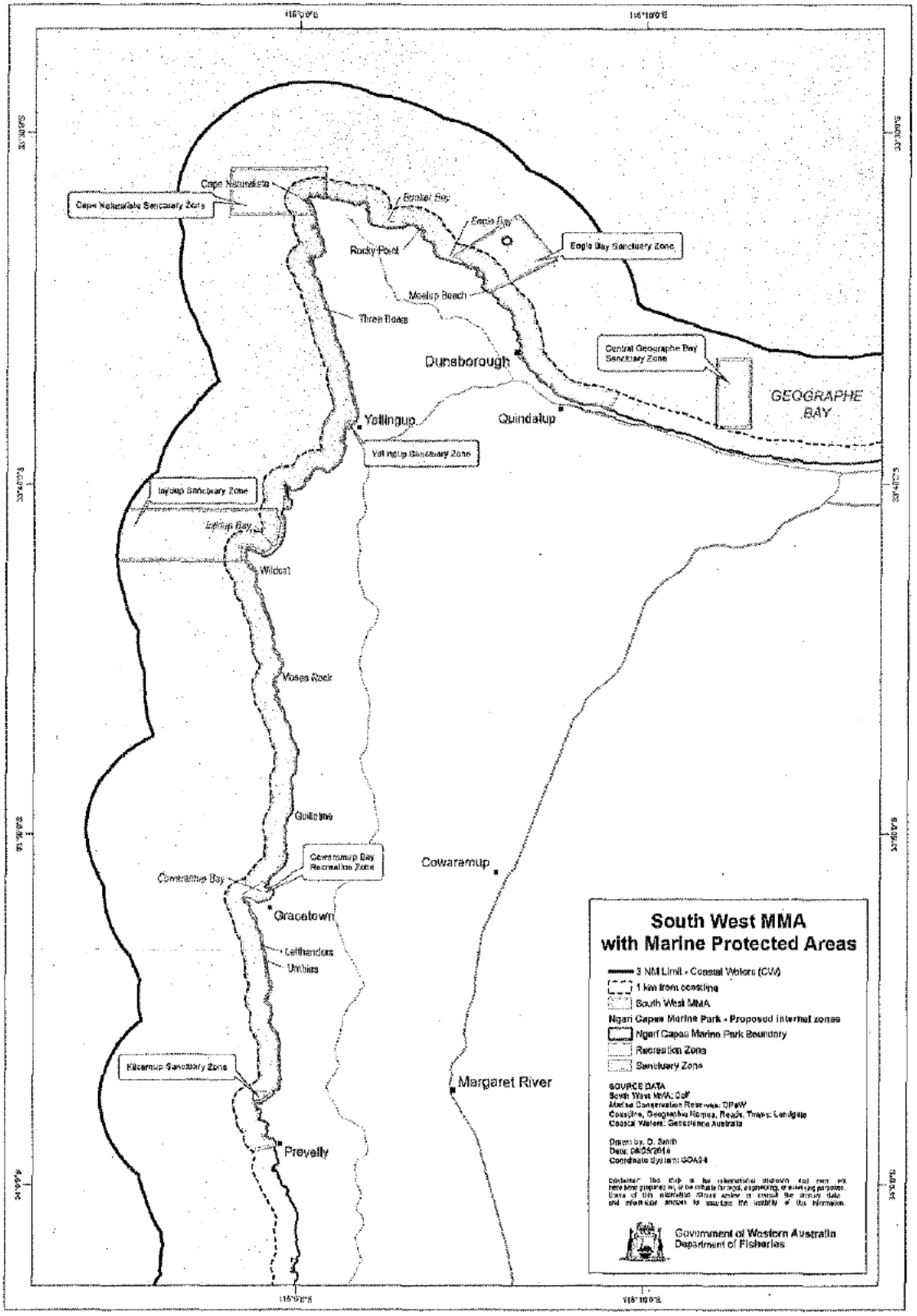
The Program will be reviewed annually at the end of each season (e.g. post 30 April each year). The report will include information on catch data and catch data analyses, operational performance, effectiveness of management measures and recommendations for program changes.

A final evaluation at the end of the three year program (post 30 April 2017) will be undertaken and will include an analysis of all catch data, operational performance, effectiveness of management measures and contributions to research.

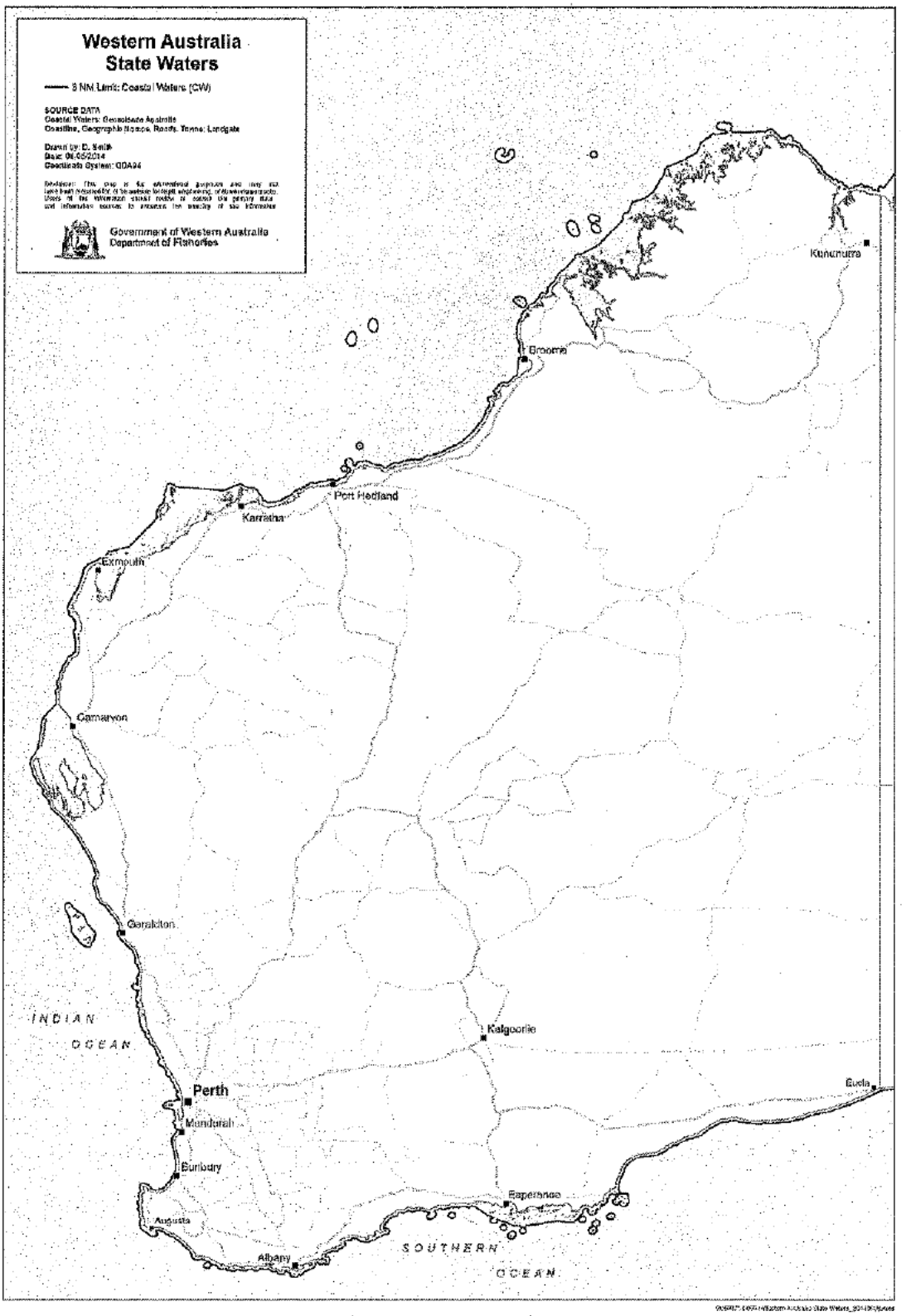
9 ATTACHMENTS

9.1 Location and extent of the MMAs in relation to marine protected areas

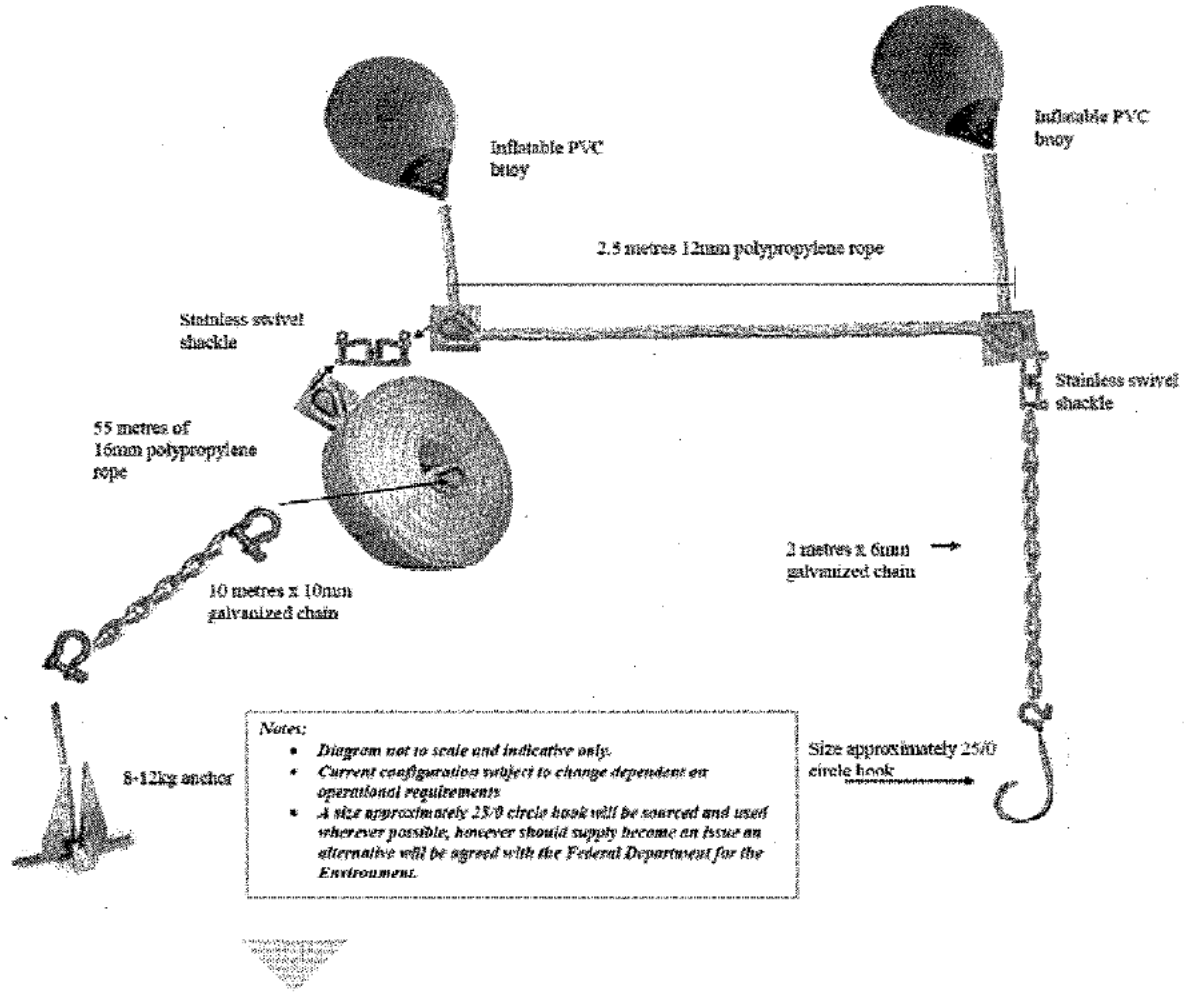


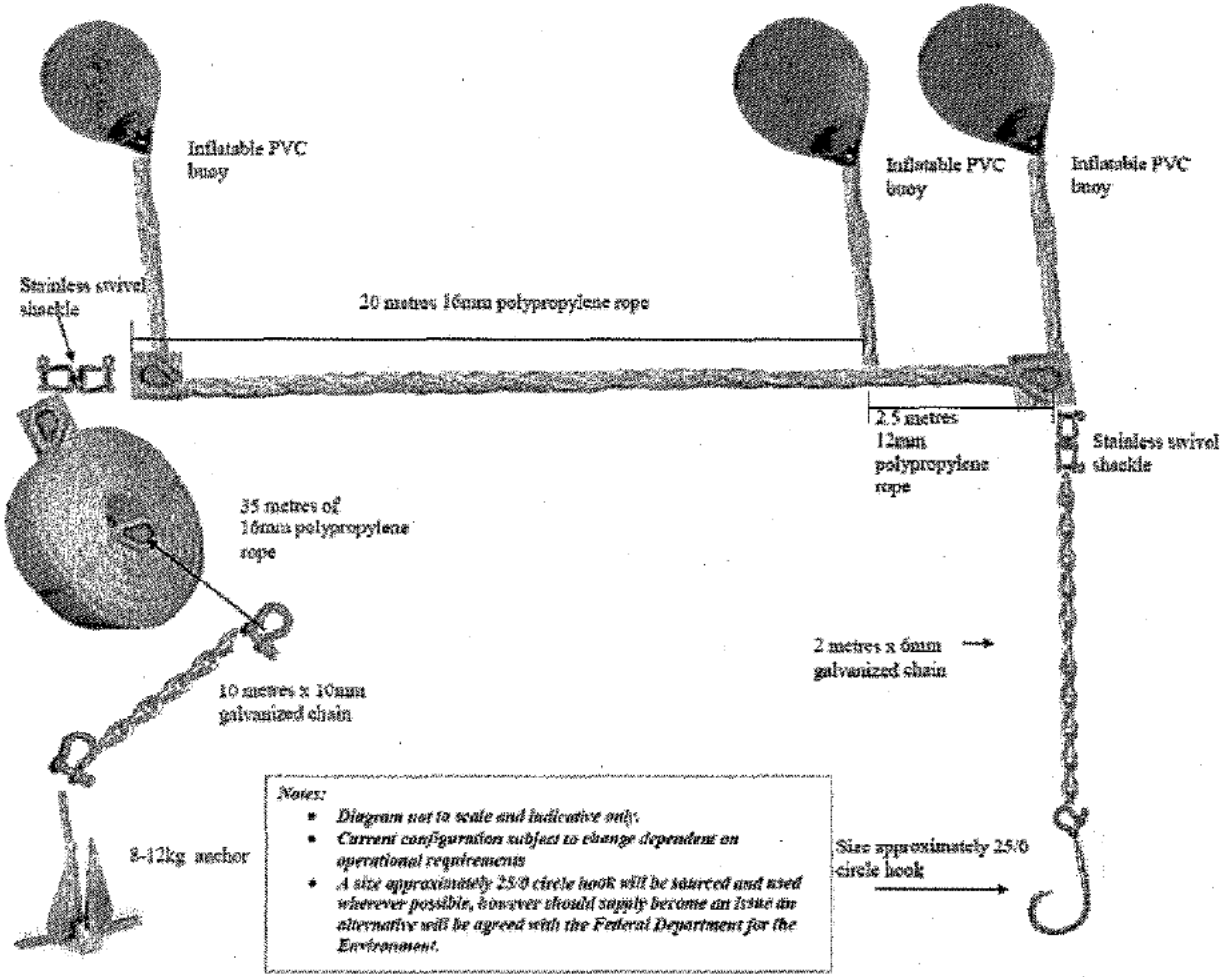

Cape Naturaliste
Cape Naturaliste Sanctuary Zone
Bunker Bay
Eagle Bay
Eagle Bay Sanctuary Zone
Rocky Point
Meelup Beach
Three Bores
Dunsborough
Central Geographe Bay Sanctuary Zone
GEOGRAPHE BAY
Yallingup
Quindalup
Yallingup Sanctuary Zone
Injidup Sanctuary Zone
Lefroy Bay
Wildcat
Mosea Rock
Guilderton
Gawarramup Bay Recreation Zone
Cowaramup Bay
Cowaramup
Gracetown
Leeuwin
Umbilup
Kilcarnup Sanctuary Zone
Margaret River
Prevelly
South West MMA with Marine Protected Areas
3 NM Limit - Coastal Waters (CW)
1 km from coastline
South West MMA
Ngari Capes Marine Park - Proposed Internal zones
Ngari Capes Marine Park Boundary
Recreation Zone
Sanctuary Zone
SOURCE DATA
South West MMA: DoF
Marine Conservation Reserves: DPaW
Coastline, Geographic Names, Roads, Towns: Landgate
Coastal Waters: Geoscience Australia
Drawn by: D. Smith
Date: 08/05/2014
Coordinate System: GDA94
Government of Western Australia
Department of Fisheries

State Waters – Potential temporary drum line deployments



9.2 Drum line configurations




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
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.
Size approximately 25/0 circle hook

9.3 Animal handling protocols (draft)

GOVERNMENT OF
WESTERN AUSTRALIA

Western Australian Shark Hazard Mitigation Drum Line Program 2014-17

Animal Handling Protocols

July 2014

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Purpose

There have been 10 deaths from shark attacks in Western Australian waters in the last 10 years, with seven of these in the last three and a half years. Following the latest fatal attack at Gracetown on 23 November 2013, the Western Australian Government decided in the interest of public safety to complement the existing shark hazard mitigation strategies with the deployment of a limited number of drum lines over a limited time period of the metropolitan and south west coasts. Drum lines have been a component of successful measures to reduce the risk of shark attack in Queensland, South Africa and Brazil.

Between 25 January and 30 April 2014, a maximum of 60 static baited drum lines were set off popular swimming beaches and surf spots in the metropolitan and south west regions of Western Australia. Lines were set approximately 1km offshore and monitored for twelve hours a day, seven days a week. The drum lines were designed to target species of concern to public safety - white shark (*Carcharodon carcharias*), tiger shark (*Galeocerdo cuvier*) and bull shark (*Carcharhinus leucas*) with a length of three metres or greater.

Following the conclusion of the trial the Government's proposal to continue the program for a further three years was the subject of a Public Environmental Review conducted jointly by the Environmental Protection Authority and the Commonwealth Department of the Environment.

A requirement of the PER was the preparation of a Management Plan and the development of appropriate animal handling protocols. The protocols are designed to ensure that the operations of the drum line program are conducted in a manner which does not cause undue suffering to either the target animals or bycatch.

Scope

The protocols contained in this document apply to the management measures for the drum line program set out in Section 4.0 of the Management Plan.

Approved Methods

Non-target sharks

Assess status of animal when first found on line

- Assess the status of the animal and the potential risk to handlers (e.g. is it too aggressive to handle/is it too weak to handle).

Securing the shark

- Secure the animal to the vessel. Where possible attach a tail rope around the posterior of the shark and tie off on the vessel. An additional rope should be placed around the head of the shark and secured to the vessel. This will reduce the stress on the hook. If only the tail rope, or neither of these ropes can be secured on the shark, secure the shark to the vessel using the length of chain and rope attached to the hook.
- If able to do so, and in considering the condition of the animal to be taken out of the water, bring the animal on board the vessel. This should be done using a ramp, or if available, a sling. If a tail rope and/or head rope has/have been secured use this/these to guide the animal to the ramp on
    - Attach a rope around the tail of the animal.
- Lead the animal to the rear of the vessel, secure the tail rope to a winch and bring the animal on board via the stern ramp.

Maximising the chance of survival once on board the vessel

- Cover the animals head with a wet cloth and run seawater through the mouth to oxygenate the gills once the animal is removed from the water.

Removing the hook

- Once able to do so, remove the hook, measure, tag and release the animal in the water.
- Use a de-hooking device to remove hooks where practicable.
- Use pressure on the dorsal fin where restraint of the shark is required.

Determining the condition of the animal

- i.e. should it be returned to the water

Maximising the chance of survival once returned to the water

- Return the animal to the water holding the shark facing the current while the boat is underway until it recovers sufficiently to swim away.

Where is has been determined that euthanasia may be required.

- How to decide whether euthanasia may be necessary:
- Often the severity of wounds from hooking or entanglement on the line will indicate a level of trauma that will make post release survival unlikely.
- Confirmation of severe impairment can be determined through assessment of the reflex activity of the protective membrane covering the shark's eye. This membrane is triggered during feeding activity to protect the eye. A reflex activity test may be conducted by directing a small burst of seawater at a distance of approximately 4 cm at the centre portion of one eye from a 10ml plastic needless syringe. Full deployment of the membrane indicates a high chance of survival a partial or absent response indicates a low chance of survival.

Procedure for euthanasia. Refer to Section 4.0.

Other Species

In all cases of the capture of non- target species the Operations Manager, Department of Fisheries must be notified. Where it has been determined that the animal is fit for release remove the hook, record details of the capture on the log sheets and release the animal.

Deceased animals designated as listed species must be returned to shore for collection by officers of the Department of Parks and Wildlife.

- Take an initial size measurement to assess the length of the shark (i.e. is it clearly <3m TL or clearly ≥3m TL). This can be done by using guiding markers on the side of the vessel from a fixed point (such as the winch).If additional measure,

Determination of species
In addition to a briefing on species identification an information folder containing images of the distinguishing characteristics of each target species will be provided. This information should be used determine the species of the captured shark.

Determination of size
Animals should be measured from the tip of the snout to the posterior tip of the upper lobe of the caudal fin. A diagram showing this measurement is included in the information folder.

Where the animal is within 10cm either side of the target length (3m TL) three measurements should be taken and recorded and the average used.

Euthanasia Procedure

Priorities
Euthanasia of target sharks and those determined to be unlikely to survive following release should be directed by the following factors in order of priority:

1) Human safety
2) Animal welfare
3) Practicality

Firearms

Rifles
Rifles of .22 calibre may be used with appropriate ammunition. The firearm should be used at close range.

Shotguns
Shotguns may be used as an alternative to rifles for euthanasia of sharks. As with rifles they must be used with appropriate ammunition at close range.

Personnel
Two people are required for the euthanasia process:
1) The shooter, responsible for euthanasia of the animal
2) The overseer, responsible for ensuring that all bystanders are at a safe distance from the procedure.

Recommended aim points

Shooting should always be directed at the dorsal surface of the animal aiming towards the middle back of the head *(to be further defined).*

Confirming death

Mortality of the shark can be determined through assessment of the reflex activity of the protective membrane covering the shark's eye. This membrane is triggered during feeding activity to protect the eye. A reflex activity test may be conducted by directing a small burst of seawater at a distance of approximately 4 cm at the centre portion of one eye from a 10ml plastic needless syringe. No response to the above procedure and lack of movement is indicative of death.

If there is any doubt as to whether the animal is dead follow-up shooting must be employed.

Competencies and Approvals

Occupational Health and Safety

Firearms

Physical injury from the animal

Storage of equipment

Disposal of the carcass

Marine mammal entanglement

DPaW disentanglement team

References

9.4 Criteria for initiating a response to an identified shark threat or incident

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 take into account the source of the report (Surf Life Saving WA, commercial fisher, agency vessel) or be confirmed by contacting the individual reporting the sighting.
6. The DoF 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 e.g. 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.

Procedure to be followed to initiate a response:

1. Identify resources to support deployment operation (e.g. vessel availability, beach closures, aerial support).
2. Obtain verification that beaches have been cleared as appropriate.
3. The deployed vessel attends the site and sets up to five baited drum lines.
4. 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 (per response).
5. 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 (per incident).

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

9.5 Summary of the risk analysis, risk scores and risk evaluations for the Program

Component	Risk Analysis	Risk Scores	Risk Evaluation
TARGET SPECIES			
White shark	With catch levels expected to be < 10 individuals per year there is only a **remote likelihood** (Likelihood Level 1) that this would have a minor level of consequence (Consequence Level 1) on the total size, or migratory patterns, of the southwestern Australian population of white sharks.	1	Negligible
Tiger shark	If the levels of capture of tiger sharks remain within the expected levels (~40 tonne per year) and assuming high levels of release mortality rates, it would be **possible** (Likelihood Level 3) for the Proposal to generate a **minor consequence** (Consequence Level 1).	3	Low
Bull shark	Expected capture rate is none to a few individuals each year. Therefore there is a **high likelihood** the Proposal will have **no impact** (Consequence Level 0).	0	Negligible
NON-TARGET SPECIES			
Dusky shark	If the annual level of capture and mortality of large dusky sharks remains in the revised expected range (< 10), there is now only a **remote likelihood** (Likelihood Level 1) of **a minor level of impact** (Consequence Level 1).	1	Negligible
Other non- listed elasmobranchs	There is a **high likelihood** (Likelihood Level 5) that few individuals from each of the other species of sharks and rays will be caught and therefore generate **negligible impacts** (Consequence Level 0).	0	Negligible
Demersal scalefish	There is a **high likelihood** (Likelihood Level 5) that **no demersal scalefish** will be caught and also that few, if any, other finfish species will be caught (Consequence Level 0).	0	Negligible
PROTECTED OR LISTED SPECIES			
Grey nurse shark	There is a **high likelihood** that no grey nurse sharks will be caught and, even if a few are caught they will most likely be able to be released alive resulting in **no** or **negligible impacts** (Consequence Level 0).	0	Negligible
Shortfin mako shark	There is a **high likelihood** that the Proposal will have a **negligible impact** (Consequence Level 0) on the shortfin mako shark population of Australia.	0	Negligible
Other listed elasmobranchs	There is a **high likelihood** (Likelihood Level 5) that no whale sharks, manta rays or other listed species of sharks and rays will be caught resulting in **no** or **negligible impacts** (Consequence Level 0).	0	Negligible
Seals and sea lions	With no seal or sea lion captures anticipated to occur there is a **high likelihood** of **no impact** (Consequence Level 0).	0	Negligible
Turtles	With no captures of turtles anticipated to occur there is a **high likelihood** of **no impact** (Consequence	0	Negligible

	Level 0).		
Whales	With no captures of whales anticipated to occur there is a **high likelihood** of **no impact** (Consequence Level 0).	0	Negligible
Dolphins	With no captures of dolphins anticipated to occur there is a **high likelihood** of **no impact** (Consequence Level 0).	0	Negligible
Seabirds	With no captures of seabirds anticipated to occur there is a **high likelihood** of **no impact** (Consequence Level 0).	0	Negligible
ECOSYSTEM			
Habitat	The extremely small footprint of the anchors used for the drum lines and the high resilience of the sandy substrates where most are deployed results in a **high likelihood** (Likelihood Level 5) of only **negligible impacts** (Consequence Level 0).	0	Negligible
Community structure	The high historical level of commercial catch of sharks in this region was not found to have generated any measurable shift in the community structure for the broader fish community. Now that this catch has been reduced by half, an additional ~45 tonne of all species of sharks to be captured under the Proposal is **highly likely** (Likelihood 5) to have **no measurable effect** (Consequence Level 0) on the community structure of the West Coast Bioregion.	0	Negligible

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Western Australian Shark Hazard Mitigation Drum Line Program:

Peer Review Close Out Report

August 2014

Client: Government of Western Australia - Environmental Protection Authority

Western Australian Shark Hazard Mitigation Drum Line Program: Peer Review Close Out Report

August 2014

Government of Western Australia - Environmental Protection Authority

Contents

Western Australian Shark Hazard Mitigation Drum Line Program: Peer Review Close Out Report

Review of 'DPC Response to Submissions on Public Environmental Review'

August 7, 2014

1.1 General comments

We note the responses provided by the DPC to the public submissions and to our PER Review. We note that the DPC have addressed many of the concerns and issues as well as adopting some of the recommendations suggested. The DPC has addressed a number of issues that our PER Review specifically sought clarity on.

There are several responses on the underlying modelling and risk assessment specifically for white sharks that we do not agree with, and others that we do agree with. However, this only emphasizes the uncertainty that would face any assessment of the data available on white sharks. Captures of white sharks are poorly and unreliably recorded in commercial fishery logbooks; efforts to validate catch history are fraught with difficulty and white shark bycatch/fishing effort relationships are not necessarily comparable between regions or over time due to regional differences in abundance, in the catchability of sharks, variations in the configuration of gear, management changes impacting fishing behaviour and variability in the motivation to report captures over time. A previous study by Malcolm *et al.* (2001) identified that, unlike WA-based fisheries where there are lower levels of capture, the catch of white sharks was not well correlated with fishing effort in the SESSF (the fishery responsible for the highest capture of white sharks in the southwest population and outside of Western Australian State waters). Their conclusion was that estimating overall catch from effort was unlikely to estimate the true fishing mortality.

Although the DPC has made reasonable attempts to improve and utilise recorded catch data, these underlying uncertainties make assessments of current stock status highly speculative to the point where they are of limited use to inform management. Continuing to look at existing data will not improve the advice and is of less importance than how to manage risk and impact going forward (to both the public and the white shark population).

The DPC is faced with a trade-off between what level of removal of sharks will significantly reduce the risk of shark attack (their duty of care/social objective) and what level of removal will not place populations of sharks at risk or negatively impact the ecosystem of which they are part (the environmental objective). We recognize that the scientific process to support an environmental objective of providing a long-term sustainable catch from the white shark population, may be quite different to that required to support an objective of acceptable risk to the white shark population over a 3-year (drum-line) program. This is one of the reasons why we consider it important to be as explicit as possible on the program objectives.

The PER and the Referral of the proposed program focuses on the environmental objective. However, the two (social and environmental) are integrally linked and we reiterate that the management of the proposed program would be greatly strengthened by identifying performance measures for both. This will also provide the best level of decision-support for any future consideration to extend, re-commence or redesign components of the proposed program and a framework to evaluate the efficacy of any alternative mitigation measures if they are required. We reiterate that doing so requires effective monitoring, clear trigger points, decision rules and agreed actions in response to these trigger points – all linked to defined program management objectives. The DPC have now addressed some of these issues in their management

plan. We advise that some should be strengthened to assist the DPC in their decision process and these issues are dealt with under the specific comments below.

1.2 Establish clear and measureable objectives and performance measures, including trigger points and corresponding management actions.

DPC write that..."..'The removal of any shark that has the potential by nature of its size and identity (species) to bite a person no doubt reduces the risk of such an incident occurring' (page 8 of the peer review) accurately addresses the overall objective of the drum line program."

The DPC clearly define the 'duty of care/social' objective of the program is to reduce the risk of shark attack. This is not disputed. By their response, the DPC effectively define that the capture of a single shark of a size and species capable of biting a person would fulfil that objective. While the successful capture and destruction of any target sharks can be considered as a measure of performance relative to this objective, we reiterate that the DPC should consider ways to estimate the extent to which the removals of the proposed program significantly reduce risk as an additional performance measure. The WA Government's duty of care is not disputed – the reason for this additional performance measure (as discussed in more detail below) is to provide the DPC with a robust level of evidence to underpin decisions regarding such shark mitigation measures into the future.

We note that the program also has an environmental objective to ensure that the overall viability of populations of target sharks (white sharks in particular) is not compromised.

DPC write that..."The statement in the peer review that the drum line program has the potential '.. to continue for an unspecified timeframe ...' is misleading and inaccurate."

That the current program is proposed for a period of three years is not in question. However, the PER document states "it is hoped that effective alternative or complementary mitigation measures to drumlines may become available in the future." The challenge for the DPC will be in the event that such measures are not forthcoming. If a firm decision has already been made not to seek a continuation of the drum program beyond the 3-yr period, then this needs to be clearly stated. Such a decision would influence the estimation of environmental risk and hence the environmental objective.

Experience with shark control programs elsewhere suggests that once implemented, they can be hard to cease without good data and robust scientific advice, or the social acceptance, to underpin such a decision. If no application is made to extend the drum line program after 3 years, it will be important that the DPC has the information to evaluate the efficacy of the program and demonstrate to the public that it has either met its overall objective(s) or that there is other evidence to suggest that continuation is not warranted (e.g. if the program did not result in a significant reduction in risk; other options come online) and that no continuation of the drum-line program is warranted. A failure of the program to significantly reduce the risk of shark attack, should that be the outcome, is not failure of the resolve to achieve duty-of-care, it provides a measured and valid reason to seek an alternative strategy. If the program does not satisfactorily perform against its overall performance measures, or any decrease in risk is not permanent, then it will also be important to review the program to determine the implications of ceasing it. No scientific information has been presented to indicate that the program will satisfactorily perform against performance measures within the 3 year period, nor that any reduction in risk would be permanent. We reiterate the need to adjudicate the program against performance measures to provide the DPC with the information required to underpin future decisions on shark attack risk mitigation.

1.3 Management Advisory Committee

We note the DPC's comments that other shark control programs do not include a Management Advisory Committee, performance indicators, trigger limits or catch limits. However, we note that the most recent review of the Queensland shark control program recommends formal trigger events be determined (PER Appendix 14, page 4). Although not a feature of other shark control programs, establishing such measures would be consistent with best practice in environmental/fisheries decision-support processes and would establish WA as a leading jurisdiction in this space.

1.4 Descriptive terminology

We note the following in the 'Response to Submissions' in reference to comparisons drawn between a drumline-based shark control program in Hawaii and that proposed by the DPC for WA:

"The deployment of a series of static long lines offshore from high use areas in Hawaii were not designed to provide a barrier effect at select areas as is the design of the Western Australian program."

We agree that different shark control programs and specifically the Hawaiian program and the proposed WA program are not easily compared. However, we note that the proposed program and the DPC might be better served by not referring to the drumline program as a 'barrier'. This is one of the common public misconceptions about other shark control programs - particularly the net-based program in NSW. Shark control programs including that proposed by the DPC do not provide a barrier. They are fishing programs designed to catch a proportion of sharks within their area of operation. Referring to the DPC program as 'a barrier' or "providing a barrier effect" implies that sharks will be excluded from the area. This will not be the case and a proportion of sharks entering the Marine Monitored Areas will continue to pass through the drum line area and visit inshore waters during the program as part of their normal behaviour. This point is recognized by the DPC in their comment that: "An analysis of the data from the recent drum line trial program shows that tagged sharks were in close proximity to baited drum lines, yet not one tagged shark was caught on a drum line." Keeping this message clear will avoid the perception that all risk of attack has been mitigated.

1.5 Catch levels and trigger points

The statement of an Acceptable Catch Limit (ACL) for target species is an improvement to the management plan. DPC state that the ACLs for target species are:

White shark: **25 over the three year period**
Tiger shark: **900 over the three year period**
Bull sharks: **10 over the three year period**

We also note that the clear articulation of 'Trigger Points' (TP) for both target and non-target species is a significant improvement to the management plan. The stated TPs for target and non-target species are as follows:

Trigger Points	
Target species	
White	20
Tiger	350
Bull	10
Listed elasmobranchs	
Dusky	30
Grey nurse	5
Shortfin mako	50
Non-listed elasmobranchs	
Cumulative of species	50
Other listed marine species*	
Marine life including seals, sea lions, whale sharks, manta rays, dolphins, turtles and seabirds	3

The setting of trigger points at catch levels below 'acceptable catch limits' is also a very good response. We do note that the Trigger Points relate to the numbers of sharks destroyed or considered to have died rather than catch numbers. The assessment of catch against Trigger Points is thus dependent on the DPC having robust estimates of post-release mortality. This suggests that research in this area is a key requirement and should be addressed as a priority. We note the risk assessment provided by the DPC in the original PER document assumes a 100% mortality rate of captured animals. Without additional information on post-release mortality, catch numbers alone should be used to identify Trigger Points.

1.6 Contingency Measures

The DPC identify the following Contingency Measures (actions) that may be taken in the event that Trigger Points are reached.

"Should any of the trigger points described above be met, contingency measures will be implemented which may include the following:

- **effort reductions achieved through non-baiting of drum line hooks overnight;**
- **variation of bait types;**
- **inclusion of acoustic pingers on drum lines (if interactions with whales and/or dolphins);**
- **increased effort of patrols if catch exceeding predictions in a particular location;**
- **additional observer trips; and**
- **a within-season review of the program.**

The trigger points and contingency measures detailed above will be incorporated into the Management Plan."

Clear statements of actions ('Contingency Measures') to be taken in the event of reaching or exceeding a trigger point also represent clear improvements in-line with the PER review advice. However, particularly in the case of white sharks, the stated contingency measures may not avoid the program exceeding the acceptable catch limit for this species.

A further improvement would be to strengthen these actions given that the stated acceptable catch limits relate to the "environmental objective" of minimising the risk to shark populations.

The management plan does not articulate 'contingency measures' should acceptable catch limits be reached or exceeded. Given that the duty of care/social objective to reduce the risk of shark attack by removing target sharks would have been achieved on reaching the acceptable catch limit of any of the nominated target species, then an environmentally responsible measure would be to cease the program

should an acceptable catch limit for any species be achieved. We strongly suggest that decision rules for contingency measures be adopted prior to the commencement of the program should it be approved.

1.7 Biological sampling of captured sharks

We support the comprehensive set of operational data and biological sampling identified by DoF.

"(1) Biological samples will be collected from all white sharks where practical and appropriate. For white sharks that are euthanised as part of the Program this may include; fin clips or other tissue samples for genetics and/or vertebral samples for age and growth studies. For white sharks which are caught and released as part of the Program this may include; fin clips or other tissue samples for genetics; internal acoustic tagging for movement patterns and alert systems as part of the Shark Monitoring Network; fin mounted SPOT or PAT/PSAT tagging for vertical and horizontal movement patterns and injections with tetracycline and conventional fin tags for mark-capture and age and growth studies. Biological samples will be collected for other shark species where practical and appropriate."

The research component of the management plan shows significant improvements including the statement of collecting core research data on white sharks in particular. We reiterate that the collection of samples would be greatly improved if dead and euthanased white sharks were returned to shore for a full examination by DoF staff. This is standard procedure in the NSW shark control program and provides for the most complete research benefit from killed animals. Given the relatively small number of white sharks under the DPC's 'acceptable catch limit', doing so is unlikely to present significant resource expenditure under the program. While agreeing with DPC, that *"the logistics of sampling at sea and/or retaining all deceased animals is not a trivial issue"*, we note that in the event that dead sharks cannot be returned to shore – at least a biological sample for genetic analysis should be made in addition to standard data on length and sex would provide some of the most important information contributing to monitoring this population and any effects of the drum line program on it.

It is noted that the management plan includes the statement that *"Biological samples will be collected for other shark species where practical and appropriate"*. This is a positive statement; however, we argue that including tiger sharks as a core part of the sampling program is warranted given that the DPC is now aware that the catches of this species will dominate and be high.

We reiterate that it is important, if the program is approved, that sufficient data are collected to scientifically review, adjudicate and provide evidenced-based advice which the DPC (and EPA) can consider when deciding to cancel, modify or continue the program.

"(4) A gear selectivity trial may be undertaken during the Program to determine the effectiveness of different size hooks on minimising catch of non-target species and undersize sharks. Hooks no smaller than an approximate 25/0 circle design will be used at all times."

The gear selectivity trial is noted and its inclusion similarly strengthens the research component of the management plan. However, the DPC indicates that hooks no smaller than 25-O would form the basis of the gear trial – which may examine at best the impact of 'J' vs 'circle' hooks of 25-O. The trial of more standard-sized hooks is recommended from both the perspective of reducing the injuries likely to be sustained to non-target animals as well as on a cost effective basis. Purpose-made '25-O' hooks are no doubt an expensive option compared to off-the-shelf sizes used in other shark control programs. The program would benefit from trialling more conventional sized hooks and testing the premise that bycatch is reduced by using large hooks. This would also assist in identifying gear that best balances possible increased levels of bycatch with the ability to release non-target animals in condition more conducive to their survival. The use of more conventional sized hooks (combined with the use of appropriate wire trace rather than chain) may also permit the release of non-target animals by cutting the trace and leaving the

hook in place which is the standard and recommended best practice release method for bycatch in commercial and recreational fisheries. Determining and, if necessary, improving the post-release mortality of sharks is a critical component for the program so that it can adequately assess when Trigger Points have been reached and contingency measures are required.

A key part of the program and its monitoring will be information on catch and effort. The management plan would be further strengthened if such analyses were included as 'Core research undertaken by Government' instead of being listed under 'potential research by other agencies'. Similar to commercial fisheries data – there is a need to ensure that such data are monitored, analysed and stored in a consistent manner – rather than being at the convenience of, for example, a university-based project. We recognise that this may be the intent, as catch and effort analyses are mentioned in the 'program review and monitoring' section. However, it is not clear in the way these sections are described. This will become particularly important should the program be continued beyond its current three-year proposed timeframe (although duly noting that an extension is not the current intention).

The proponent clearly identifies a plan to investigate post-release survival of non-target animals. However, this is not mentioned in the research component of the management plan. As mentioned above, this information will be critical to adjudicating when a Trigger Point is reached. It should be included under 'Core research undertaken by Government' – we assume this was intended and is an oversight.

1.8 Improve the accuracy of data collection from commercial fisheries within WA regarding white shark bycatch.

DPC note that: "DoF is finalising a project which reconstructs the history of white shark mortalities induced by all sources (including all commercial and recreational fisheries operating on the south-western stock) throughout the full range of the south western white shark population."

We support this reconstruction of white shark mortalities but we recognize the inherent uncertainties in such an exercise. We reiterate that existing catch and effort data, no matter what effort or techniques are applied to improve it, comes with such a high degree of uncertainty that its usefulness to inform management actions is compromised. Continuing to look to the past will not improve current assessments. We emphasize the importance of effectively recording current white shark mortalities across the geographic footprint of the population (which includes not only Western Australia but other jurisdictions). While trigger points have been established for the mortalities of white sharks under this program (20 animals over 3 years), it is the total cumulative mortality across the population that is the key value of interest in assessing status. Therefore ongoing efforts to record current mortalities of the white shark from commercial fishing and any other known sources should be undertaken. This needs to be across the footprint of the population including in jurisdictions outside Western Australia.

1.9 CSIRO research cited in response to PER review of 'weight of evidence' approach

We reiterate that there are several responses on the underlying modelling and risk assessment specifically for white sharks that we do not agree with, and others that we do agree with. However, this only emphasizes the uncertainty that would face any assessment of the data available on white sharks. We do note that the DPC response to our review of Appendix 9 refers to two published scientific papers one of CSIRO origin, the other that included CSIRO staff. It is important that the points raised are clarified.

The DPC response states in reference to Goldsworthy et al. (2013):

"This modelling used one of the most intensive sampling regimes undertaken in Australia to determine trophic relationships across a wide number of species. Ecosystem simulations indicate that the functional group "pelagic sharks", which includes white sharks, have most likely experienced population growth and this "appears to be primarily to be driven by reductions in fishing mortality".

The Goldsworthy *et al.* (2013) model of the GAB ecosystem incorporates 'pelagic sharks' as a functional group which means that data for all species that were incorporated were added together and treated as a single 'population'. This is a standard and convenient ecosystem modelling technique. However, it also means that one cannot infer species-specific information from a modelled trend that integrates data across all species. In reality, some species included within a functional group may see a projected increase while others decrease. What is important to note is that the Goldsworthy model did not contain any data specifically relating to white sharks – therefore using their model output to infer the population status of white sharks is uninformative and may well be erroneous.

The DPC response in reference to inferring population size for white sharks (which have a low level of information) from catch data on dusky sharks (which have a much high level of information), states:

"The generation of abundance estimates for a population that has low levels of information by using data (such as catch rates) that are compared with species for which there are high levels of information is an approach that has been promoted by CSIRO researchers (e.g. Punt *et al.* 2011)."

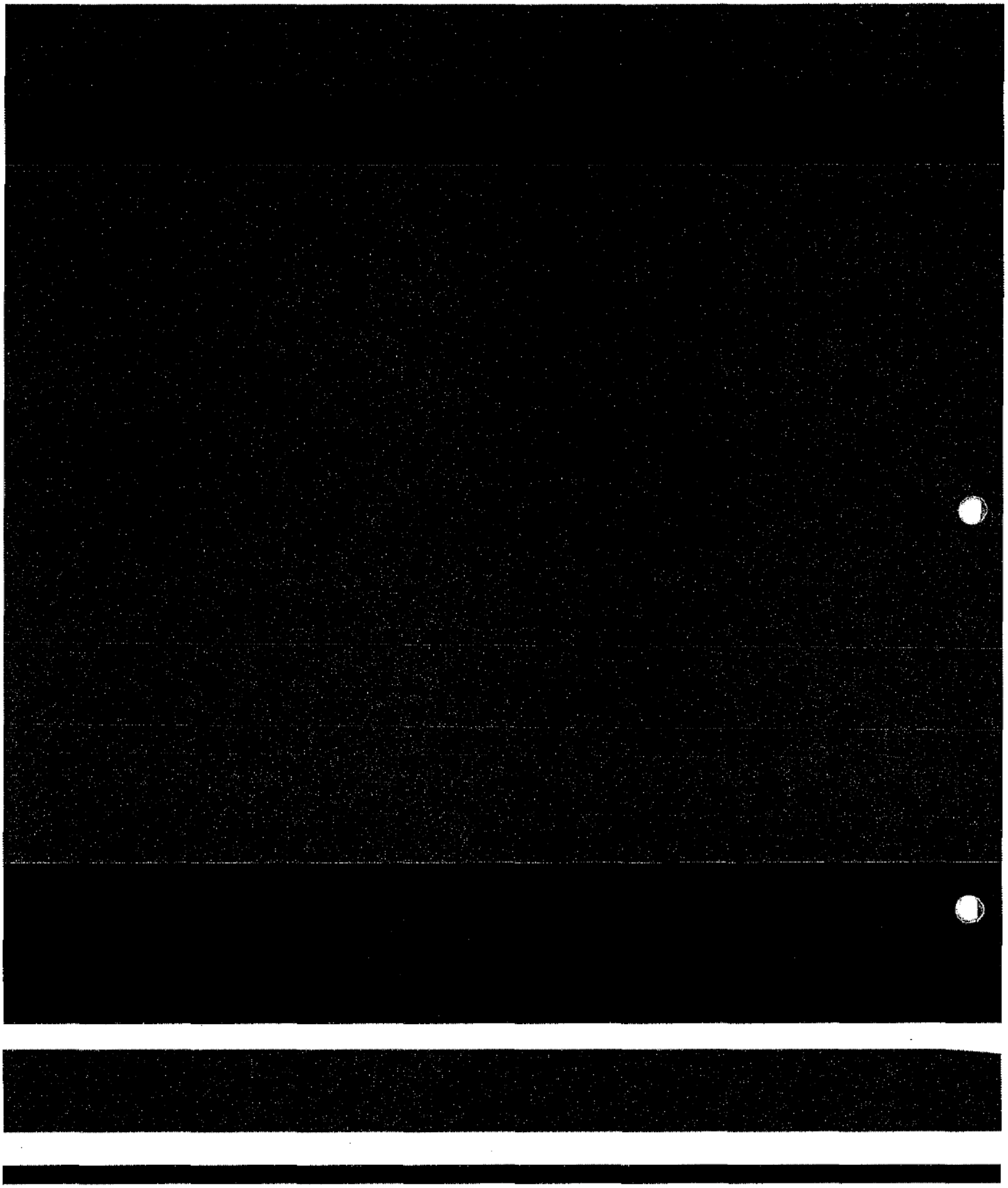
The calculations of white shark numbers based on with dusky shark population estimates and catch rates do not represent the use of the data-poor techniques as presented by Punt *et al.* (2011). The Punt *et al.* paper focuses on trends in fishing mortality between species – the DPC's analyses requires that fishing mortality, not the trend in fishing mortality, is the same between neonate dusky sharks and white sharks in order to make the comparison. This is highly unlikely and the authors of the Punt *et al.* paper warn against such comparisons. It is unlikely that these analyses can offer useful information that would support or refute estimates of population size in this context.

1.10 References

Goldsworthy et al. (2013). Trophodynamics of the eastern Great Australian Bight ecosystem: Ecological change associated with the growth of Australia's largest fishery. Ecological Modelling 255: 38–57

Malcolm, H., Bruce, B.D. and Stevens, J.D.S. (2001). A review of the biology and status of white sharks in Australian waters. Final report to Environment Australia, Marine Species Protection Program. CSIRO Hobart. 114 pp

Punt, A. E., Smith, D.C. and Smith A.D.M. (2011). Among-stock comparisons for improving stock assessments of data-poor stocks: the "Robin Hood" approach. Journal of Marine Science 68:972–981



From: Donna Weston [redacted]
Sent: Thursday, 11 September 2014 4:17 PM
To: DG Parks and Wildlife [redacted] DG Fisheries [redacted] city@busselton.wa.gov.au; 'stirling@stirling.wa.gov.au'; 'mail@cambridge.wa.gov.au'; 'council@nedlands.wa.gov.au'; 'council@cottesloe.wa.gov.au'; 'admin@mosmanpark.wa.gov.au'; 'admin@eastfremantle.wa.gov.au'; 'info@fremantle.wa.gov.au'; 'amrshire@amrshire.wa.gov.au'; 'info@joondalup.wa.gov.au'; Bax, Nic (O&A, Hobart)
Cc: Bruce, Barry (O&A, Hobart)
Subject: EPA Report 1527 Shark Drumline PER 110914 Others
Attachments: Rep 1527 Shark Drumline PER 110914.pdf

PUBLICATION OF ENVIRONMENTAL PROTECTION AUTHORITY REPORT NO. 1527 WESTERN AUSTRALIAN SHARK HAZARD MITIGATION DRUM LINE PROGRAM 2014-2017 (ASSESSMENT 2005)
PROPONENT: DIRECTOR GENERAL, DEPARTMENT OF THE PREMIER AND CABINET ON BEHALF OF THE STATE OF WESTERN AUSTRALIA

The Environmental Protection Authority (EPA) has today released its Report and Recommendations on the above proposal. The EPA Report is attached and is available through the EPA website at www.epa.wa.gov.au.

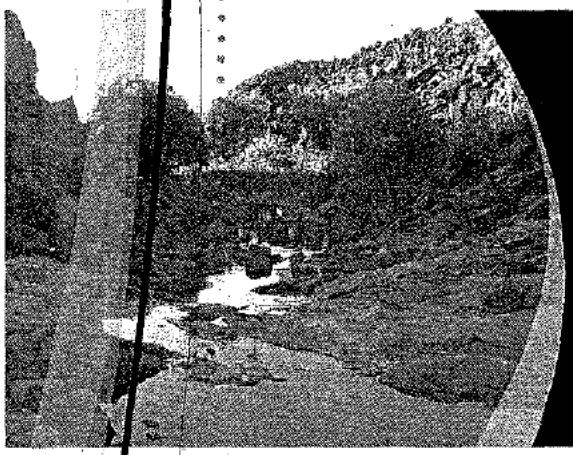
The EP Act prohibits the implementation of the proposal until the Minster for Environment has authorised its implementation, or otherwise.

Kind regards

Donna Weston
Communications Coordinator
Office of the **Environmental Protection Authority**
The Atrium, Level 8, 168 St Georges Terrace, Perth
Locked Bag 10, East Perth WA 6892
direct: [redacted] reception: 08 6145 0800 | fax: 08 6145 0895
email: [redacted] web: http://www.epa.wa.gov.au
@EPA_WA

Office of the
Environmental Protection Authority

Report and recommendations of the Environmental Protection Authority



Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017

Director General, Department of the Premier and Cabinet
on behalf of the State of Western Australia

Report 1527

September 2014

Public Environmental Review
Environmental Impact Assessment Process Timelines

Date	Progress stages	Time (weeks)
22/04/2014	Level of assessment set	
16/05/2014	Final ESD approved	3
09/06/2014	Public Environmental Review Document (PER) released for public review	3
07/07/2014	Public review period for PER document closed	4
13/08/2014	Final Proponent Response to Submissions Received	5
21/08/2014	EPA meeting	1
8/09/2014	Provision of EPA Report provided to the Minister for Environment	3
11/09/2014	Publication of EPA report (three days after report provided to the Minister)	3 days
25/09/2014	Close of appeals period	2 weeks

Timelines for an assessment may vary according to the complexity of the project and are usually agreed with the proponent soon after the level of assessment is determined.

In this case, the Environmental Protection Authority met its timeline objective in the completion of the assessment and provision of a report to the Minister.

Dr Paul Vogel
Chairman

8 September 2014

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Assessment No. 2005

Summary and recommendations

This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for Environment on the Western Australian Shark Hazard Mitigation Drum Line Program 2014-2017 (the proposal).

The proposal, by the Director General, Department of the Premier and Cabinet (DPC) on behalf of the State of Western Australia, involves the deployment of temporary and static drum lines within marine monitored areas (MMAs) between 15 November and 30 April each year for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017. The proposal also includes the temporary deployment of drum lines in response to an identified shark threat or incident anywhere in State waters at any time of the year until 30 April 2017.

The proposal involves the capture of target sharks with a total length of three metres (m) or greater, and aims to provide additional protection from the risk of shark interactions with water users at selected swimming beaches and surf spots in the metropolitan and south-west regions of the state.

Section 44 of the *Environmental Protection Act 1986* (EP Act) requires the EPA to report to the Minister for Environment on the outcome of its assessment of a proposal. The report must set out:

- the key environmental factors identified in the course of the assessment; and

- the EPA's recommendations as to whether or not the proposal may be implemented and, if the EPA recommends that implementation be allowed, the conditions and procedures to which implementation should be subject.

The EPA may include in the report any other advice and recommendations as it sees fit.

The EPA is also required to have regard for the principles set out in Section 4A of the EP Act.

Key environmental factors and principles

The EPA decided that the following key environmental factor relevant to the proposal required detailed evaluation in the report:

(a) Marine Fauna.

There were a number of other factors which were relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

The following principles were considered by the EPA in relation to the proposal:

(a) the precautionary principle;
(b) the principle of intergenerational equity; and
(c) the principle of the conservation of biological diversity and ecological integrity.

Conclusion

The EPA has considered the potential environmental impacts of the proposal against its environmental objective for Marine Fauna, which is *to maintain the diversity, geographic distribution and viability of fauna at the species and population levels.*

The EPA's assessment has had particular regard to the white shark, because it is listed as a migratory species and 'Vulnerable' under both the Commonwealth *Environment Protection and Biodiversity Protection Act 1999* (EPBC Act) and the State *Wildlife Conservation Act 1950* (WC Act).

The proponent has assessed the impacts of the proposal on the viability of the south-western population of white sharks. The proponent's assessment is based substantially on the considerable work undertaken by the Department of Fisheries (DoF) to obtain all available information from various sources to make best estimates of the white shark population. The proponent's assessment concludes that the proposed take limit of up to 25 white sharks over the three-year drum line program would have a minor level of consequence on population numbers and, based on its risk assessment, represents a negligible risk to the south-western white shark population, and therefore viability, of the population.

As part of the assessment the EPA engaged the CSIRO to undertake an assessment peer review of the proponent's investigations and conclusions and report directly to the EPA. Both assessment Peer Review Reports have been made available in Appendix 6 (6.6 and 6.7) to the EPA's report.

As recognised by the Peer Reviewer, the DoF's assessment is very dependent on the underlying assumptions used and most of these assumptions have yet to be supported by empirical data. The Peer Reviewer identifies that this does not necessarily mean that the conclusion of negligible risk is incorrect, but that the information provided is inadequate to judge the level of risk.

Despite the proponent's best efforts to make conservative and plausible estimates, there currently remains scientific uncertainty surrounding the available information and evidence about the south-western white shark population, population trends, and the catch of white sharks from commercial fisheries. Therefore, at this stage, and based on available information, it is the EPA's opinion that there remains a high degree of scientific uncertainty as to whether the proposal can meet the EPA's environmental objective for Marine

Fauna (i.e. to maintain the viability of fauna at the population level) and there is a risk that, if the proposal is implemented, it may compromise the viability of white sharks at the population level (for the south-western white shark population).

In view of that high degree of scientific uncertainty, the EPA considers that a cautious approach should be adopted and that the proposal should not be implemented.

The EPA's recommendation is based only on the assessment of the environmental factor of Marine Fauna, which was the only key environmental factor identified during the assessment of the proposal.

The EPA has provided other advice to the Minister for Environment in the event that the proposal proceeds. This includes a recommendation that any statement of implementation should require the proponent to have an environmental management plan in place to apply to the proposal, and set catch limits for target sharks, to minimise impacts on marine fauna.

Recommendations

That the Minister for Environment:

1. considers the report on the key environmental factor of Marine Fauna, as set out in Section 3;

2. notes that the EPA has concluded that there is a high degree of scientific uncertainty about whether the proposal can meet the EPA's environmental objective for Marine Fauna, and therefore that the proposal should not be implemented;

3. notes that the EPA has not included in this report conditions and procedures to which the proposal should be subject, if implemented, because the EPA has concluded that the proposal should not be implemented; and

4. notes the EPA's other advice presented in Section 4 about recommended requirements in the event that the State Government determines that the proposal may proceed.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for Environment on the key environmental factors and principles for the proposal by the Director General, Department of the Premier and Cabinet (DPC) on behalf of the State of Western Australia, for the Western Australian Shark Hazard Mitigation Drum Line Program 2014–2017 (the proposal).

The proposal involves the deployment of temporary and static drum lines within marine monitored areas (MMAs) (Figure 1) between 15 November and 30 April each year for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017. The proposal also includes the temporary deployment of drum lines in response to an identified shark threat or incident anywhere in State waters at any time of the year until 30 April 2017. The proposal involves the capture of target sharks with a total length of three metres or greater, and aims to provide additional protection from the risk of shark interactions with water users at selected swimming beaches and surf spots in the metropolitan and south west regions of the state.

The DPC referred the proposal to the EPA on 7 April 2014. The proposal was assessed at the level of Public Environmental Review (PER). It is also being assessed under the Bilateral Agreement between the State and the Commonwealth for likely significant impacts to the white shark, which is a listed threatened and migratory species. The Environmental Scoping Document (ESD) for the proposal was approved on 16 May 2014 and the PER was released for a four-week public comment period from 9 June 2014 to 7 July 2014.

The EPA previously considered a third party referral for a similar proposal by the proponent which involved the setting of static and temporary drum lines within MMAs from January 2014 until 30 April 2014. On 12 March 2014 the EPA determined that, given the proposal's limited duration and small scale, a formal environmental impact assessment was not warranted because it was unlikely to have a significant effect on the environment. The EPA issued public advice on the proposal and recommended that, should there be a new proposal to deploy baited drum lines to catch sharks beyond 30 April 2014, it would need to be referred to the EPA for a decision on whether the proposal should be formally assessed under Part IV of the EP Act. The current proposal is the subject of this assessment.

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the key environmental factors and principles for the proposal. Section 4 provides other advice from the EPA. Section 5 provides an overview of the Matters of National Environmental Significance and Section 6 presents the EPA's recommendations. Appendix 6 contains a summary of submissions and the proponent's response to submissions (6.1) and is included as a matter of information only. It does not form part of the EPA's report and recommendations.

2. The proposal

The DPC proposes to deploy up to 60 static baited drum lines approximately one kilometre offshore of selected high-use beaches and surf breaks within designated MMAs in the metropolitan and south-west coastal regions of Western Australia (Figures 1, 2 and 3). Up to 12 additional drum lines may be temporarily deployed in response to an identified shark threat or incident within the geographical and temporal extent of the MMAs.

The static drum lines are proposed to be deployed 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.

The proposal involves the capture of white sharks (*Carcharodon carcharias*), tiger sharks (*Galeocerdo cuvier*) and bull sharks (*Carcharhinus leucas*) with a total length of three metres or greater (target sharks) within MMAs during the drum line deployment period.

The proposal also includes the temporary deployment of drum lines, and the attempted capture of threatening sharks, in response to an identified shark threat or incident anywhere in State waters at any time of the year until 30 April 2017. This is to be implemented in accordance with the DoF *Guidelines for sharks posing an imminent threat to public safety* (the Guidelines) (Appendix 6.4).

The proponent proposes an acceptable catch level of up to 25 white sharks, 900 tiger sharks and 10 bull sharks as a result of the implementation of the proposal.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 2 of the PER document (DPC, June 2014). The locations and dimensions of the MMAs are shown in Figures 2 and 3, and detailed in the Clarification of the PER Key Characteristics Table (DPC[3], August 2014) (Appendix 6.3).

Table 1: Summary of the Proposal

Proposal Title	Western Australian Shark Hazard Mitigation Drum Line Program 2014–2017
Short Description	Marine Monitored Areas (MMAs): Metropolitan MMA from Ocean Reef to Port Beach and to approximately 1 km offshore. See Figure 2. South-west MMA from Quindalup to Prevelly and to approximately 1 km offshore. See Figure 3. Static drum lines: Up to 60 static baited drum lines approximately 1 km offshore within MMAs, but not within any marine recreational or sanctuary zones or Fish Habitat Protection Areas, set between 15 November and 30 April each year for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017. Temporary drum lines: Up to 12 temporary drum lines deployed in response to an identified shark threat or incident within the MMAs between 15 November and 30 April each year for a period of three years, commencing 15 November 2014 and ceasing 30 April 2017. Outside of the geographic and temporal extent of the MMAs temporary deployment of drum lines in accordance with DoF Guidelines[1] to 30 April 2017.

[1]The Department of Fisheries "Guidelines for fishing for sharks posing an imminent threat to public safety".

Table 1 incorporates modifications to the proposal made by the proponent following release of the PER document.

Since the release of the PER, the proponent has clarified that the DoF has jurisdiction for implementing the deployment of temporary drum lines in response to an identified shark threat or incident outside of the geographic and temporal extent of the MMAs in accordance with the Guidelines. The implementation of temporary and static drum lines within the spatial and temporal extent of the MMAs would occur in accordance with the draft Operational Environmental Management Plan (Appendix 6.2).

The details of these clarifications by the proponent are provided in Appendix 6.3 of this report. This includes: a revised Key Characteristics Table; clarification of the potential impacts as a result of temporary drum line deployment and, in relation to the proposed draft management plan, updated criteria for temporary drum line deployment within the geographic and temporal extent of the MMA; and clarification of trigger points.

The EPA notes that this means the DoF would continue to implement the Guidelines in accordance with the State Government's Imminent Threat Policy, which has been in place since 2012.

A draft management plan for the proposal was provided in Appendix 2 of the PER. This has been substantially further developed by the proponent, and the draft Operational Environmental Management Plan (DPC[3], August 2014), provided in Appendix 6.2 of this report, now proposes acceptable catch levels for target species, anticipated catch levels for non-target species, trigger points and associated contingency measures, and further detail, in particular with regard to animal handling protocols, biological sampling, record-keeping and research to be undertaken as part of any implementation of the proposal.

The potential impacts of the proposal initially predicted by the proponent in the PER document (DPC, June 2014) and their proposed management are summarised in Table ES 3 (Executive Summary) in the proponent's PER document.

A total of 6,751 public submissions and two petitions with a combined total of approximately 25,000 signatures were received during the public review period. The key issues raised relate to:

- the justification for the proposal;
- evaluation of non-lethal methods for hazard reduction including early detection, alarm systems, tag-and-release, and community awareness/education;
- predicted impacts to target and non-target species and ecosystems;
- potential impacts to marine sanctuary zones and World Heritage Areas;
- proposed management measures;
- potential risks to public safety; and
- extent of stakeholder consultation.

In addition to the above issues, the EPA notes that a considerable number of submissions on the PER raised issues in relation to the effectiveness of the proposal from a public safety perspective. The matter of the efficacy of the proposal, that is, will it make beaches safer, is not a matter which the EPA is required or empowered to address in its assessment report. This is because the EPA's assessment report can only deal with the environmental factors relevant to the proposal, being the potential significant impacts on the environment, should the proposal proceed.

Issues raised were addressed in the Response to Submissions document received on 13 August 2014 (Appendix 6.1).

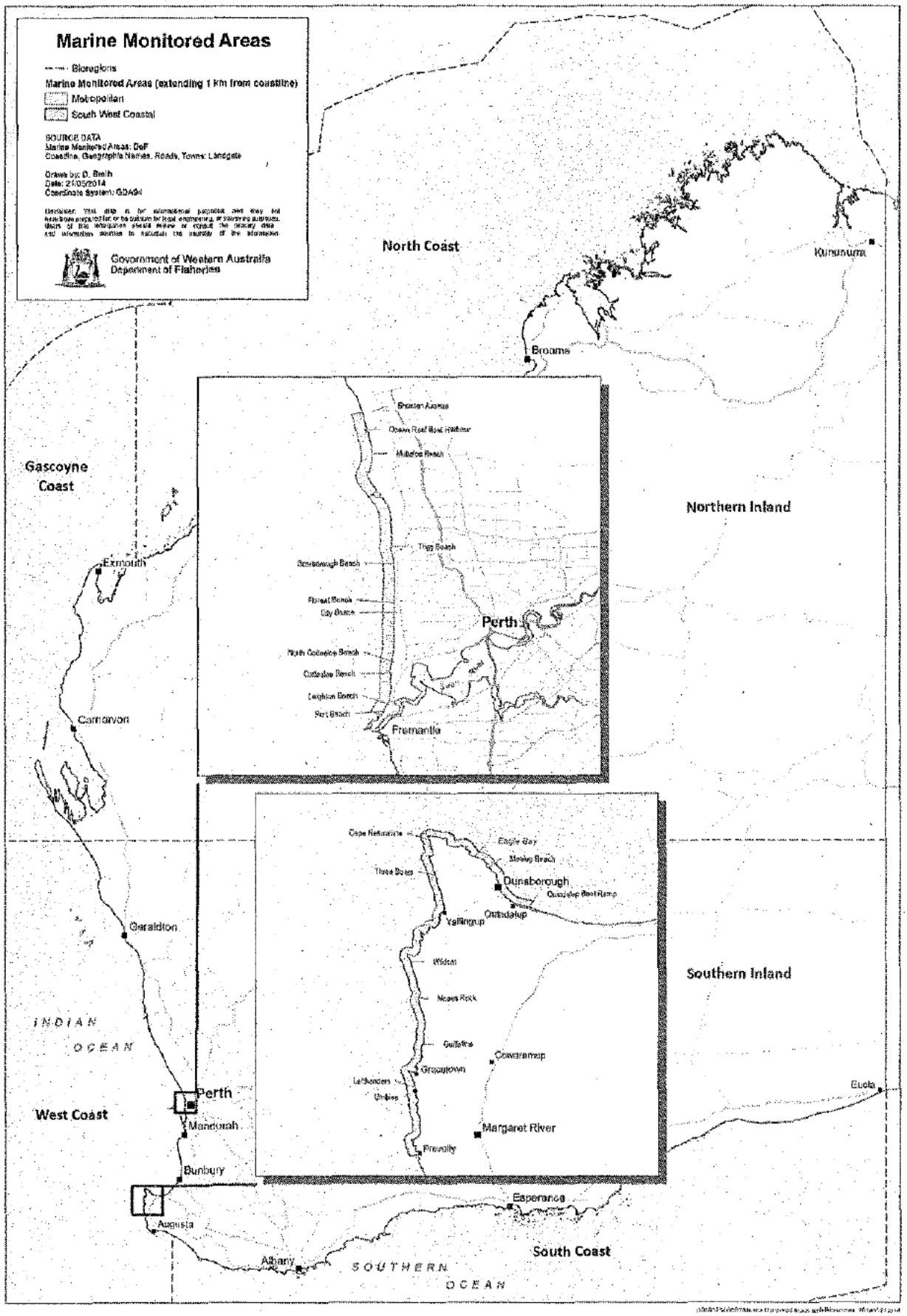

Figure 1: Location of the proposal indicating regional context

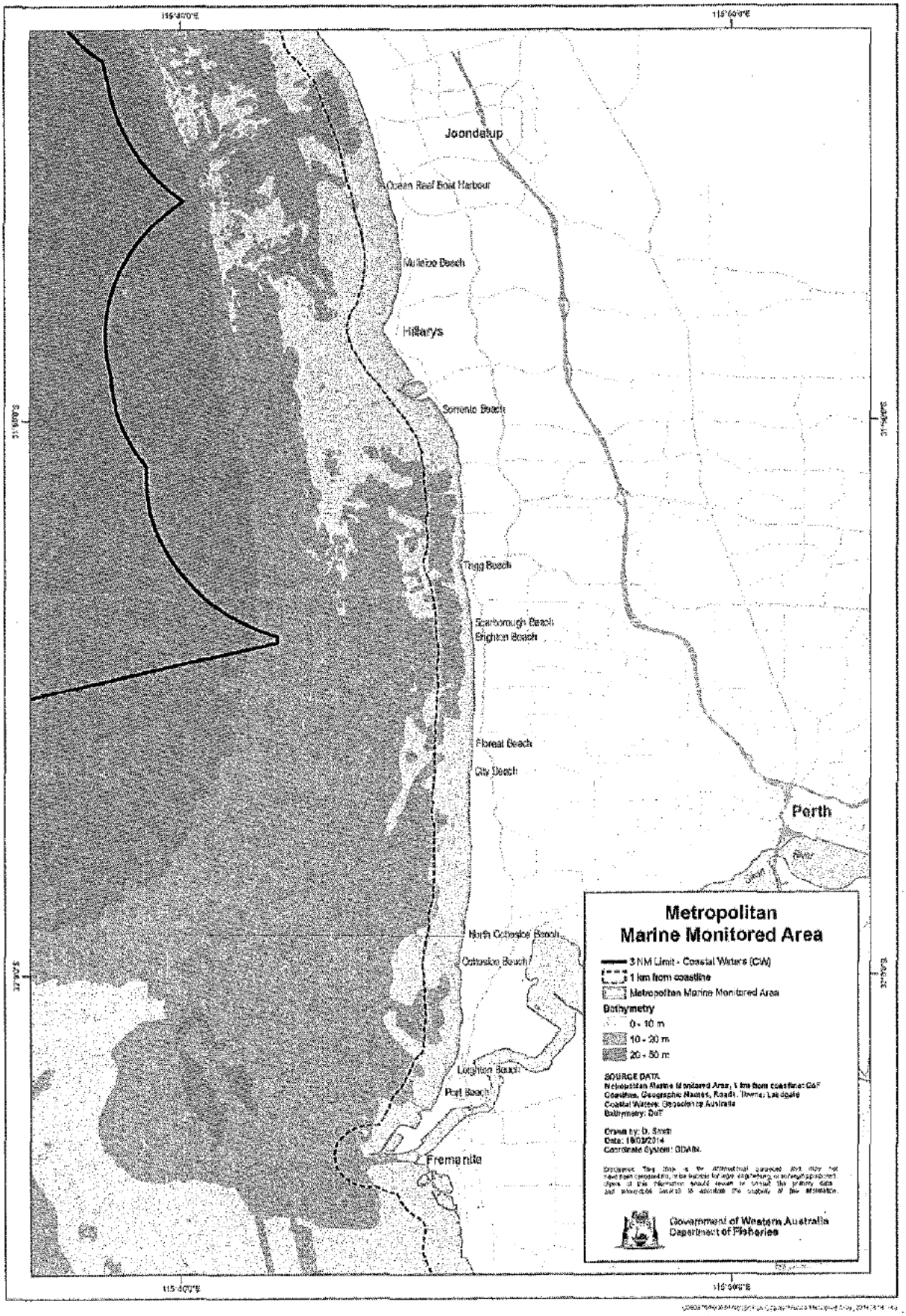

Figure 2: Metropolitan Marine Monitored Area

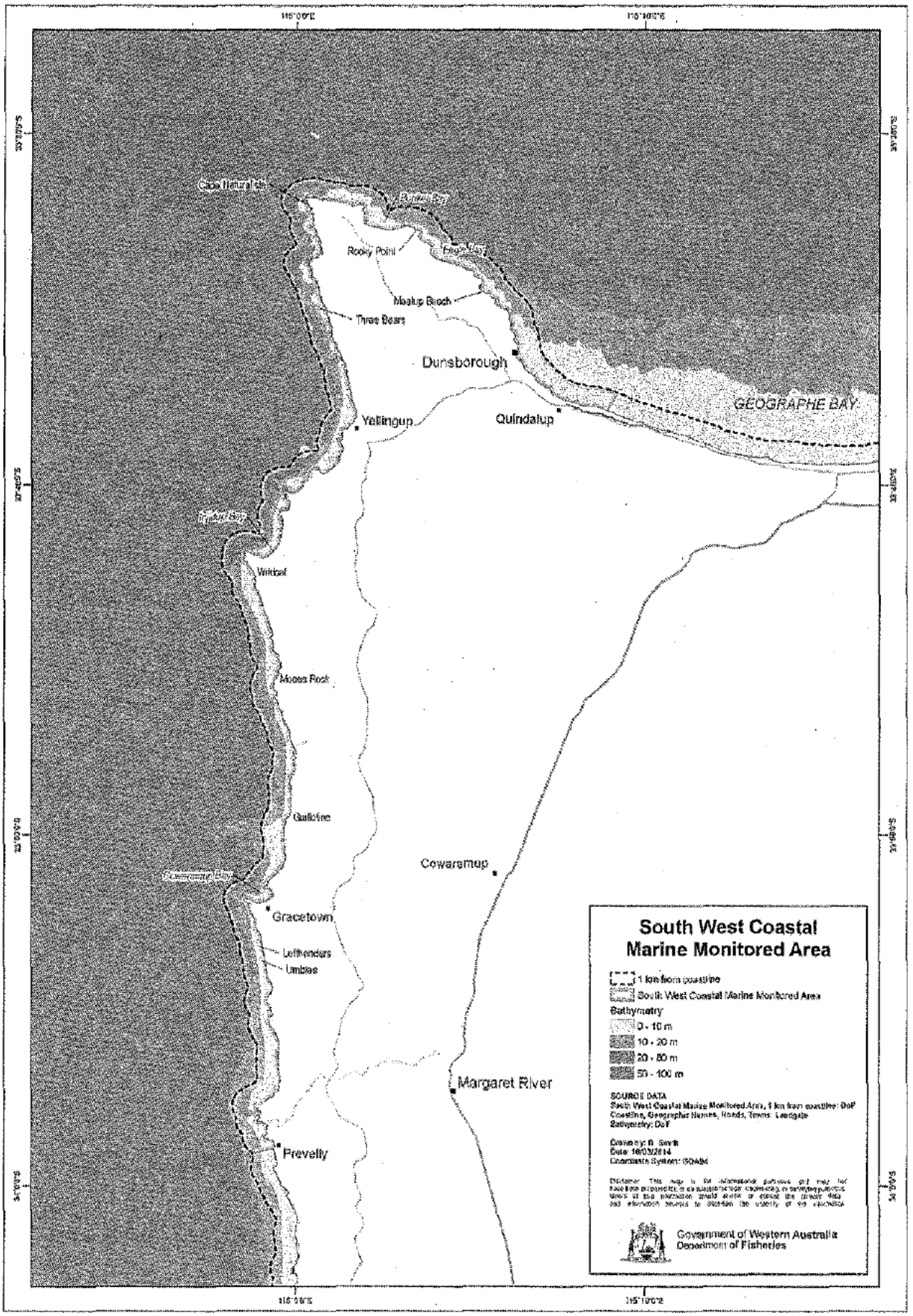

Figure 3: South West Coastal Marine Monitored Area

3. Key environmental factors and principles

Section 44 of the EP Act requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the key factors selected for detailed evaluation in this report is summarised in Appendix 3.

It is the EPA's opinion that the following key environmental factor for the proposal requires detailed evaluation in this report:

(a) Marine Fauna.

The above key factor was identified from the EPA's consideration and review of all environmental factors generated from the PER document and the submissions received, in conjunction with the proposal characteristics set out in Table 1.

Details on the key environmental factor and its assessment are contained in Section 3.1. The description of the factor shows why it is relevant to the proposal and how it will be affected by the proposal, taking into consideration environmental impact management by the proponent. The assessment of the factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

The following principles were considered by the EPA in relation to the proposal:

(a) the precautionary principle;

(b) the principle of intergenerational equity; and

(c) the principle of the conservation of biological diversity and ecological integrity.

3.1 Marine Fauna

Objective

The EPA's objective for Marine Fauna is *to maintain the diversity, geographic distribution and viability of fauna at the species and population levels.*

In deciding which components of the EPA's objective are relevant to this assessment, the EPA has had regard to the following:

- the proposal is largely limited in its extent to the two proposed MMAs, hence it is unlikely to affect the geographic distribution of the potentially affected species of marine fauna, at the species and population levels;
- the proposal is targeting three shark species (white, tiger and bull) with a total length of three metres or greater and aims to avoid and minimise impacts to other marine fauna and hence it is unlikely to affect the diversity of non-target species and populations; and
- the proposal is designed to reduce the local abundance of target sharks near selected beaches and therefore has potential to impact on the viability of target sharks at the population level.

Therefore, to meet the EPA's environmental objective, the assessment needs to demonstrate, with a high degree of confidence, that the proposal maintains the viability of marine fauna at the population level.

The evaluation of the proposal against the EPA's environmental objective in respect of maintaining the viability of species at the population level is set out below with respect to the white shark and other marine fauna.

Potential impacts of the proposal

The proposal will affect marine fauna species by the capture of target shark species (white sharks, tiger sharks and bull sharks) and the incidental capture or entanglement of other marine fauna species (non-target marine fauna).

Target sharks, which would be euthanized, are white sharks, tiger sharks and bull sharks with a total length of three metres or greater. Target sharks with a total length less than three metres that are caught would be released alive, unless they were considered not to be in a condition to survive.

Non-target marine fauna

Non-target marine fauna in the context of this assessment comprise all other marine fauna species unintentionally caught as a result of the proposal, including all non-target shark species, all non-shark fish species, marine mammals, reptiles and seabirds.

Tiger and bull sharks

With respect to the tiger and bull sharks, the EPA notes that they are not listed as a threatened species in the EPBC Act or the *Wildlife Conservation Act 1950* (WC Act).

White shark

The white shark (*Carcharodon carcharias*) is a migratory and threatened species and is listed as follows.

- Internationally it is listed on the *Convention on the Conservation of Migratory Species of Wild Animals 2002*. Australia has international obligations to protect migratory species listed in schedules to this convention. The proponent is required to address how the proposal is consistent with these obligations.

- Nationally it is listed as a 'Vulnerable' and 'Migratory' species under the Commonwealth EPBC Act. The species was listed as vulnerable because of evidence of a declining population, its life history characteristics (long lived and low levels of reproduction) and, at the time of listing, significant ongoing pressures from the commercial fishing industry (DSEWPAC, 2013). This listing occurred before it was identified that there are two distinct Australian populations of the white shark.
- Under State legislation, the species is protected and also listed as 'Vulnerable' under the WC Act. Being listed as vulnerable under the WC Act means it is considered to be facing a high risk of extinction in the wild.
- The white shark is also protected under the *Fish Resources Management Act 1994*. This means that the species is totally protected from fishing.

In 2013 the Commonwealth Government issued a National Recovery Plan for the white shark. The overarching objective of the Recovery Plan for the white shark is to assist the recovery of the white shark in the wild, throughout its range in Australian waters with a view to:

- improving the population status, leading to future removal of the white shark from the threatened species list of the EPBC Act; and
- ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future.

The Recovery Plan identifies the principal threats to the lack of white shark recovery in Australia as mortality resulting from accidental capture by commercial and recreational fishers, and shark control activities.

Recent research based on genetic analysis and tracking data suggests that there are two Australian populations of the white shark: the south-western white shark population, which occurs along the Western Australian coast to waters west of Bass Strait; and an east coast white shark population, from east of Bass Strait and up the Queensland coast (Blower et al., 2012).

Proponent's environmental review

Non-target marine fauna

The proponent has designed the proposal to avoid and minimise impacts to non-target marine fauna through measures such as the use of drum lines as opposed to nets or net meshing, drum line configuration, large hook size, limited temporal and spatial extent of the proposal which avoids whale migration, marine sanctuary and recreation zones, and fish habitat protection areas, monitoring and maintenance of the drum lines, and use of preferential bait.

The proponent's risk based assessment concludes that the proposal represents no or negligible risk, or negligible risk to non-target marine fauna.

Tiger and bull sharks

As the proposal does not coincide with the preferred habitat of the bull shark (which is the Swan/Canning estuary system), the proponent does not expect to catch large numbers of this shark.

Tiger sharks are a relatively abundant, tropical and subtropical shark species. In relation to tiger sharks, the proponent has predicted that if the levels of capture of tiger sharks remain within the anticipated levels (approximately 300 sharks per year), combined with high levels of release mortality rates, it would be possible for the program to generate a minor consequence risk rating. The proponent concludes that this would mean a potentially measurable but relatively small decrease in the total abundance of the tiger shark population as a result of a three-year drum line program. This is also noting the minimal levels of mortality to tiger sharks in other areas of Western Australia because their inadvertent capture is also low due to prohibition on the use of commercial shark fishing gear off large areas of the north-west since 1993 and a cessation of commercial shark fishing in northern Australia (DPC[1], 2014).

White sharks

The proponent has assessed the impacts of the proposal on the viability of the south-western white shark population. The proponent's assessment of the potential impacts of the proposal on Marine Fauna is based largely on information and expertise provided by the DoF. The DoF has undertaken considerable work to obtain all available information from various sources to make best estimates of the white shark population. This required the DoF to undertake the necessary scientific analysis and make available the relevant reports to support the conclusions in the PER document.

A fundamental component of this work is the DoF's risk assessment as set out in Appendix 9 of the PER: *A risk based, weight-of-evidence approach to determine the range of plausible estimates for the south-western Australian population of white sharks*.

As part of its assessment, the DoF developed a demographic model to calculate a range of scenarios based on potential population sizes and trajectories based on a number of conservative parameters for white shark life histories and estimated catch numbers from fishing. This was then combined with a risk-based, 'weight-of-evidence' approach where the scenarios were examined against other available data and observations to ascertain the range of most plausible scenarios.

In summary, the DoF has assessed the removal of up to 25 white sharks over a three-year period and concluded that *"...the additional removal of a relatively small number of white sharks (less than 10/year – which is less than 10 per cent of current capture rates) for public safety purposes was found to have no material effect on the population numbers and therefore the viability/status of the south-western population of white sharks."* This assessment is based principally on:

1. weight-of-evidence analysis of available information, giving an estimated current (2012) population size of 3,400-5,400;
2. an assessment that "the current population levels....are at least 70% or above their pre-exploitation levels" (pre-1940 levels);
3. an estimated current commercial by-catch of around 100 sharks per year from the population; and
4. the proposed catch limit on white sharks being limited to 25 or less for the three-year drum line program.

Key issues from public submissions

As mentioned above, a considerable number of submissions were received on the PER.

Submissions raised matters regarding non-target marine fauna, tiger and bull sharks including:

- impacts to other sharks in particular tiger sharks, bull sharks, shortfin mako and dusky sharks;
- contingency measures for other marine fauna; and
- ecosystem impacts as a result of the removal of apex predators.

A significant proportion of the matters raised were on the white sharks, particularly in relation to the:

- conservation status of the white shark;
- Australia's international obligations regarding the protection of the white shark;
- existing threats and pressures on the white shark population;
- need to examine alternative non-lethal methods of shark control to minimise impacts;
- scientific uncertainties in the DoF's population estimates and historical and existing catch data;
- availability of the papers and information which was used to support the estimations and conclusions in Appendix 9; and
- a published paper by Blower (et al., 2012) which estimates an 'effective population size' for the south-western white shark population to be 700 breeding individuals.

These matters were responded to by the proponent in the Response to Submissions on the Public Environmental Review (DPC[1], August 2014) which is attached for information in Appendix 6.

Blower et al. (2012) investigated the population genetics of Australian white sharks to estimate the 'effective population sizes' for the south-western white shark population and the east coast white shark population. The effective population is not a measure of total population size. While the DoF did not use

Blower's 'effective population size' in its assessment, it has responded to this issue in the response to submissions. The DoF has suggested that if the proportion of this population that would be of breeding size/age is likely to be in the order of 15-30 per cent (based on modelled population structures), then using the estimated 700 breeding individuals would generate a range of 2,500-4,600 individuals for the south-western white shark population.

Assessment Peer Review comments

As mentioned above, the EPA engaged the CSIRO to undertake an assessment peer review of the proponent's PER against the work required in the approved ESD, reporting directly to the EPA.

Tiger and bull sharks

The Peer Reviewer has advised that the proposal has the capacity to create a measurable change in the tiger shark population, with 900 anticipated to be caught over the three-year program, and that upper limits, effective monitoring, trigger points, decision rules and agreed actions in response to the trigger points, linked to management objectives, are required and may provide a mechanism to reassess the risk to the population should the catch be higher than expected.

The CSIRO[2] (July 2014) has advised that the proponent's assessment that the risk to community structure as a result of removing apex predators is likely to be negligible is not contested.

White sharks

In relation to the DoF's work on the risk-based, weight-of-evidence approach to estimating population size (Appendix 9, DPC, June 2014), the Peer Review has advised that (CSIRO[1], July 2014):

"Appendix 9 provides few details on how key parameters were estimated. Two of the significant parameters that dictate the predicted trajectories and current population estimates are the initial population size from which the model is run and the catch history of white sharks across the population. Modelling minimum viable population levels and population trajectories for white sharks via demographic models as used by the proponent are scientifically useful exploratory exercises but highlight the critical uncertainties and lack of information available to adequately assess current population size, population status and hence the likely impacts of any additional removals from the population. The outcomes of such modelling are heavily dependent on underlying assumptions relating to: biological parameters, initial population size (which is unknown), current/historical catches across the populations range (which are poorly documented) and either explicitly or implicitly assuming that some catches or trajectories are sustainable or more plausible compared to others (for which there are few data to adjudicate). It is important to note that such exercises are not stock assessments and they do not provide estimates of actual population size."

The proponent has responded to this issue by recognising that some of the biological parameter values are not well known and therefore a range of different scenarios were generated. Because the proponent considered there was not sufficient quantitative data to apply to its assessment, a more qualitative approach was used that generated ranges of more plausible values which, collectively, were used to describe the confidence levels.

In relation to the proponent's estimated catch numbers from fishing, which is necessary to estimate the combined pressures from the proposal and commercial fishing at the population level, the Peer Reviewer (CSIRO[2], July 2014) advised as follows:

"The most significant uncertainties are the initial population size and the cumulative annual mortality [total anthropomorphic catch + natural mortality (= total mortality)] applied to the modelled population... Captures of white sharks are poorly and unreliably recorded in commercial fishery logbooks; efforts to validate catch history are fraught with difficulty and white shark bycatch/fishing effort relationships are not necessarily comparable between regions or over time due to regional differences in abundance and catchability of sharks, variations in the configuration of gear, management changes impacting fishing behaviour and variability in the motivation to report captures over time."

Assessment against the EPA's Environmental Objective

Non-target marine fauna

In relation to the potential impacts on non-target marine fauna, the EPA notes that the proponent has designed the proposal to avoid and minimise impacts on non-target marine fauna species, as demonstrated in the draft Operational Environmental Management Plan (Appendix 6.2), which details the configuration of the drum lines and the measures to release captured animals.

Tiger and bull sharks

The EPA notes that the proposal does not coincide with the preferred habitat of the bull shark. With regard to tiger sharks the EPA notes that they are a relatively abundant tropical and subtropical shark species. The EPA notes that the draft Operational Environmental Management Plan (Appendix 6.2) provides for limits, trigger points and contingency measures which would apply in relation to tiger sharks.

The EPA is satisfied that the proponent has sufficiently demonstrated avoidance and minimisation measures through the proposal design and the Draft Operational Environmental Management Plan, and therefore considers that the proposal presents a low risk to the viability of populations for other target sharks and non-target marine fauna.

White sharks

The proponent's assessment, which is based substantially on the work undertaken by the DoF, indicates that the proposed take of white sharks by the drum line program would have a minor level of consequence on population numbers and, based on its risk assessment, represents a

negligible risk to the south-western white shark population, and therefore viability, of white sharks.

However, as recognised by the assessment peer review, the DoF's assessment is very dependent on the underlying assumptions used, and most of these assumptions have yet to be supported by empirical data. The Peer Review identifies that this does not necessarily mean that the conclusion of negligible risk is incorrect but that the information provided is inadequate to judge the level of risk.

Appendix 9 of the PER, which formed the basis of the DoF's investigations is considered a 'working draft'. The DoF advised that this paper would be subject to both internal and an external review process prior to publication as a DoF Report. This review process for the paper presented in Appendix 9 (DPC June 2014), and the other papers which were referenced but are still in preparation, may add confidence as to whether the EPA's environmental objective may be met.

The only other significant piece of information which gives an indication of the population size of the south-western white shark population is the 'effective population size' of 700 breeding individuals estimated by *Blower et al.*, 2012. There is no standard relationship between 'effective population size' and 'total population size' and this will vary between species and is dependent on a number of factors. The DoF's estimate of 'total population size' of between 3,400 and 5,400 is not, however, necessarily inconsistent with the 'effective population size' estimated by *Blower et al.*, 2012. The EPA notes, however, that there is also considerable scientific uncertainty regarding the estimate of *Blower et al.,* 2012 being based on limited data and subject to wide confidence limits.

For the EPA to find the proposal to be environmentally acceptable, the available information and evidence, particularly in relation to population size, trends, and by-catch rates from fishing (as the largest source of mortality for the south-western white shark population), should demonstrate with a high degree of confidence, that the EPA's environmental objective for Marine Fauna will be achieved (i.e. the viability of the south-western white shark population will be maintained).

At this stage, the scientific uncertainty surrounding the available information, evidence and analysis about the white shark population, population trends and by-catch of white sharks from commercial fisheries, cumulatively leads to a high degree of scientific uncertainty about whether the EPA's environmental objective for marine fauna can be met.

Summary

Having particular regard to the:

(a) white shark being listed as 'Vulnerable' under both the WC Act and the EPBC Act;

(b) environmental issues raised in the public submissions;

(c) proponent's assessment of the potential impacts of the proposal using best available information and using most conservative plausible estimate of population size;

(d) proponent's preparation of a draft Operational Environmental Management Plan which proposes a limit of up to 25 white sharks in the MMAs over three years; and

(e) advice and conclusions in the assessment Peer Review Reports (CSIRO[1], July 2014, August 2014) and in response to questions put to the Peer Reviewer by the EPA (CSIRO[2], July 2014),

it is the EPA's opinion that there remains a high degree of scientific uncertainty as to whether the proposal can meet the EPA's environmental objective for Marine Fauna (i.e. to maintain the viability of fauna at the population level) and there is a risk that, if the proposal is implemented, it may compromise the viability of white sharks at the population level.

Having carefully evaluated the information available, and in view of the high degree of scientific uncertainty, the EPA considers that a cautious approach should be adopted and that the proposal should not be implemented.

3.2 Environmental principles

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the EP Act. Appendix 3 contains a summary of the EPA's consideration of the principles.

4. Other advice

The EPA notes that the Minister for Environment, in consultation with other decision-making authorities for this proposal, will decide whether this proposal may be implemented and, if so, under what conditions. In doing so, the Minister may consider broader economic, social or other matters.

The EPA provides the following advice and recommendations to the Minister in the event that the proposal proceeds. In doing so, the EPA notes that the final Peer Review Close Out Report (CSIRO, August 2014) highlights that *"Continuing to look at existing data will not improve the advice and is of less importance than how to manage the risk and impact going forward (to both the public and the white shark population)."*

The EPA recommends that any statement of implementation should require the proponent to have an environmental management plan to apply to the proposal and set catch limits for target sharks.

Environmental Management Plan

The proponent has developed a draft Operational Environmental Management Plan (Appendix 6.2), which includes the core elements recommended by the Peer Review. The EPA recommends that the draft Operational Environmental Management Plan fully incorporate the advice in the Peer Review Close Out Report (CSIRO, August 2014) (Appendix 6.7), particularly in the following areas:

- limits and triggers;
- biological sampling;
- contingency measures; and
- research on post-release mortality.

In relation to the proposed limits and triggers, the EPA recommends that these apply to all aspects of the proposal, i.e. sharks caught within both the spatial and temporal extent of the MMAs as a result of the deployment of static and temporary drum lines, and the temporary deployment of drum lines outside the temporal and geographical extent of the MMAs in response to an identified threat or incident in accordance with the DoF Guidelines (DoF, 2012) (Appendix 6).

Government should also consider the following actions to better understand the current threats and pressures on the white shark and to minimise impacts.

Cumulative threats and pressures

An increased understanding of by-catch numbers of the white shark from commercial fishing, and further efforts towards minimising by-catch, is a focus of the National Recovery Plan, and consistent with recommendations in the Peer Review Close Out Report (CSIRO, August 2014) (Appendix 6.7).

The EPA recommends that Government enhance efforts being undertaken to improve information capture on by-catch, and improve knowledge on both by-catch and population dynamics.

Investigation into alternatives

Consistent with the National Recovery Plan (DSEWPAC, 2013), the EPA supports the continuation and further research into shark behaviour and investigations and implementation of non-lethal alternatives in order to minimise the potential environmental impacts to marine fauna.

5. Matters of National Environmental Significance

The Commonwealth Minister for the Environment has determined that the proposal is a controlled action under the EPBC Act as it is likely to have a significant impact on one or more Matters of National Environmental Significance (MNES).

It has been determined that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- listed threatened species and communities (sections 18 and 18A)
- listed migratory species (sections 20 and 20A).

The Commonwealth Minister further advised the proposed action is likely to have a significant impact because it targets the listed vulnerable and migratory white shark (*Carcharodon carcharias*).

This proposal is being assessed by way of an accredited process with the EPA under the bilateral agreement with the Commonwealth Government made under section 45 of the EPBC Act. The bilateral agreement allows the Commonwealth Minister for the Environment to rely on the PER process of the State of Western Australia in assessing the action under the EPBC Act.

The proposed action has been assessed by the EPA in a manner consistent with Schedule 1 of that bilateral agreement and this assessment report satisfies clause 7.3 of Schedule 1. Appendix 5 provides a table of the EPA's assessment report's achievement of the matters in clause 7.3 of Schedule 1.

As mentioned in Section 2 of the report, a considerable number of public submissions raised issues about non-lethal alternatives to the action to avoid impacts to MNES including early detection, alarm systems, underwater deterrents and repellents, tag-and-release, and community awareness/education. Some submitters made specific reference to the tag and release program undertaken in Brazil and the Shark Spotters Program in Cape Town, South Africa, and the use of shark barriers. The proponent has provided a response to all the suggested alternatives from the public submissions (Appendix 6.1).

As mentioned in Section 4 of this report, the EPA supports continued and further research into shark behaviour, and investigations and implementation of non-lethal alternatives, in order to minimise the potential environmental impacts to marine fauna, consistent with the White Shark National Recovery Plan (DSEWPAC, 2013).

The PER document contained a separate section identifying MNES and EPBC Act requirements, discussing how these matters have been addressed

consistent with the requirements of the EPA's Environmental Scoping Document.

Marine fauna listed as threatened or migratory under the EPBC Act that are likely to be present in the proposal areas and potentially impacted by the proposal through incidental capture or entanglement include:

- sharks including the Grey nurse shark, shortfin mako, porbeagle, white shark and the giant manta ray,
- marine mammals including various species of whales and dolphins, and the Australian sea lion;
- seabirds including various species of albatross and petrel; and
- various species of sea turtles.

The proponent has assessed the risk to marine fauna based on the temporal and spatial extent of the proposal, the proponent's proposed measures to avoid and minimise impacts, and the distribution, migration patterns, biology and diet of the potentially affected marine fauna. The proponent has subsequently concluded that the risk of the action impacting on the above marine fauna to be negligible.

Based on the information provided in the PER, the response to submissions and the draft Operational Environmental Management Plan, which contains measures to avoid and minimise impacts on non-target marine fauna, the EPA considers that the proponent has adequately demonstrated that the action is unlikely to significantly impact on the populations of the listed threatened and migratory species, except for the white shark.

In relation to white sharks, based on the assessment set out in Section 3.1 (Marine Fauna) of this report, it is uncertain whether the proposal is expected to result in an acceptable or sustainable impact.

Should the Commonwealth Minister for the Environment consider approving the action then the recommended requirements on the proponent are included in Section 4 of this report.

The EPA's assessment report to the Western Australian Minister for Environment on the proposed action is also forwarded to the Commonwealth Minister for the Environment, who will then make a decision as to whether or not the action should be approved under the EPBC Act. This is separate from any Western Australian Government approval that may be required.

6. Recommendations

The EPA submits the following recommendations to the Minister for Environment. That the Minister:

1. considers the report on the key environmental factor of Marine Fauna, as set out in Section 3;

2. notes that the EPA has concluded that there is a high degree of scientific uncertainty about whether the proposal can meet the EPA's environmental objective for Marine Fauna, and therefore that the proposal should not be implemented;

3. notes that the EPA has not included in this report conditions and procedures to which the proposal should be subject, if implemented, because the EPA has concluded that the proposal should not be implemented; and

4. notes the EPA's other advice presented in Section 4 about recommended requirements in the event that the State Government determines that the proposal may proceed.

Appendix 1

List of Submitters

Organisations:

Australian Marine Conservation Society Inc.
Australian Marine Science Association
Change.org
Conservation Council of South Australia
Conservation Council of Western Australia
Department of Parks and Wildlife
Department of Sport and Recreation
Dyer Island Trust
Greenpeace Australia Pacific
Marine Parks and Reserves Authority
Margaret River Regional Environment Centre Inc.
Monterey Audobon Society
Rottnest Channel Swim Association
Sentient
The Global Shark Conservation Initiative
The Law Society of NSW
The Wilderness Society
Trigg Island Surf Life Saving Club Inc.
WWF Australia

Individuals:

A Connan
Aaron Bement
Aaron Cole
Aaron Cox
Aaron Godden
Aaron Gove
Aaron Martin
Aaron Myers
Abaddon
Adam
Adam Coombs
Adam Lippiatt
Adam Miller
Adam Nelson
Adam Phillips
Adam S
Addison West
Adele
Adrian
Adrian Beard
Adrian Candey
Adrian Hansen
Adrian Kavunenko
Adrian Zuccon
Adrienne deBrincat
Affie Nuzum
Ahmad Ghananim
Aida Rodriguez- Esquire
Ailed Rivera
Ailsa Glazebrook
Aimee
Aimee Samuelson
Ainhoa Quinto
Al Williams
Alan Barnsley
Alan Burgess
Alan Charlton
Alan Henderson
Alan Hill
Alan Selby
Alan Stewart
Alan Storen
Alan Wilson
Alana
Alec Connah
Alessandra Arnfield
Aleta Pitstock
Alex
Alex Abrahams
Alex Bouman
Alex Czajka
Alex Gard
Alex Gaut
Alex Hayes
Alex Jimenez
Alex Petrosino
Alex Robinson
Alex Ross
Alex Straschko
Alex Suslin
Alex Tinson
Alex Willis
Alex Wright
Alexander Brown
Alexander Bueb
Alexander Buess
Alexander Robinson
Alexander Webster
Alexandra
Alexandra Gibb
Alexandra Crist
Alexandra Nolan
Alexandra Stevens
Alexandre Rose
Alexia Echeagaray
Alexis Maxwell
Alhay Aguirre
Ali Edmonds
Alice Stevenson
Alicia
Alicia Brooks
Alicia Keizer
Alicia Strous
Alicia Sutton
Alisa Schwartz
Alisha Mercer
Alison
Alison Dorn
Alison Loxton
Alison Mulholland
Alison Sadler
Alison Spong
Alison Towner
Allan Baker
Allan Svendsen
Allegra Giagu
Allegra R.
Allison
Allison Archibald
Alwyn
Alyce
Alyssa Cass
Amanda Cafearo
Amanda Fleming
Amanda Fussell
Amanda Harris
Amanda Jarvis
Amanda Penrose

Amanda Reddell
Amanda Richman
Amar
Amba
Amber
Amber Dear
Amber Gane
Amber Lundt
Amber Marienthal
Amelia Bridges
Amelia Graham
Amy
Amy Browne
Amy Buettner
Amy Burke
Amy Calhoun
Amy Dozier
Amy Gray
Amy Hollingsworth
Amy Lloyd
Amy Mulder
Amy Slender
Amy Smith
Amy Summerford
Ana Garcia
Anah Reichenbach
Ananda Dickman
Anastasia Bulavina
Anastasia Skamarauskas
Anderson Batista de Aguiar
Andrea
Andrea
Andrea Barr
Andrea Bridge
Andrea Brown
Andrea Earle
Andrea Smith
Andrea Sreiber
Andrea Woodhams
Andrea Yovorsky
Andreas Dalman
Andrew
Andrew
Andrew
Andrew Barrs
Andrew Christie
Andrew Corbe
Andrew d'Archy
Andrew Douglas
Andrew Frondorf
Andrew Fyfe
Andrew Hayes
Andrew Ksander
Andrew Laird
Andrew Lindsay
Andrew Minehan
Andrew Nieuwenhof
Andrew Page
Andrew Peirce
Andrew Smith
Andrew Thrift
Andrew Trevor-Jones
Andrew Walker
Andy
Andy Barton
Andy Blackburn
Andy Coles
Andy Duke
Andy Lees
Andy Thomson
Andy Wright
Angela
Angela Ayers
Angela Bellew
Angela Knable
Angela McClelland
Angela Oldfield
Angela Wang
Angela Wang
Angela Whyte
Angelika Erpic
Angeline Conron
Angus McCarl
AniMaeChi drabic
Anita
Anita Hanekom
Anita Marchesani
Anja Gramueller-Southon
Anja Schlegel
Anjali Badloe
Ann
Ann Dib
Ann Gallacher
Anna
Anna Cameron
Anna Courtney
Anna Jurs
Anna Kalyan
Anna Pethen
Anna Prince
Anna Treloar-Tanner
Annabel Southcombe
Annalie Prinsloo
Annamaria
Anne Dennehy
Anne Fitzpatrick
Anne Johnston
Anne Kobayashi
Anne Saw
Anne Streeter
Anne-Helen Wickizer
Annelise
Anne-Maree Newman
Annemarie Norton-Taylor
Annemiek Selter
Annette McNamara
Annette Smith
Annie
Annie Franklin
Anoosha Ezzat Yazdi
Anthony Colliver
Anthony Frankfort
Anthony Henderson
Anthony Hicks
Anthony Juchnevicius
Anthony Limon
Anthony McColl
Antonio Carlos
Anu Taskinen
Appin Williamson
Aresha Quaass
Ari Salo
Arlee Bryant
Arnaud Chilo
Ash Kane
Ashlee Hermsen
Ashleigh Dark
Ashleigh Nelson
Ashley
Ashley Albrecht
Ashley Crookes
Ashley Densham
Ashley Dillon
Ashley Washburn
Ashley Watkins
Ashly Green
Ashtyn McMaster
Asia Armstrong
Asia Rattenbury
Ati Brookes
Jo-anne McCrea
Audra Johnson
Audra Louise Walsh
Austin Monson
Axel Passeck
B. Lewenza
Baird Williams
Baljeet Degun
Bambi Harrison
Baratan Knaga
Barb Werner
Barbara Babula
Barbara campos
Barbara Cattunar
Barbara Maloit
Barnaby Smith
Barry
Barry Carbon
Barry Kennedy
Barton Hardie
Bayden Thomas
Beate Bär
Beate Strube
Beatrice Lucas
Beatrice Marot
Bec Cross
Becky
Bekki Hull
Bel Armand
Belinda

Belinda Doust
Belinda Holdsworth
Belinda Hosking
Belinda J Clark
Bella Lipson
Bella Quinn
Ben
Ben Beverley
Ben Byrne
Ben Davis
Ben English
Ben Haddock
Ben Hembrow
Ben Kevin Jones
Ben Leunig
Ben Mackney
Ben Peach
Ben Ryan
Ben Sharpe
Ben Wootton
Benjamin Christensen
Benjamin Dennis Rieger
Benjamin Gibb
Benjamin Thomas
Benjamin Uddin
Benjamin Zarb
Berenice Sieber
Bernadette George
Bernadette Peirce
Bernard Jean
Bernard Macdonald
Bernard Walton
Beryl Gillard
Beryl Lesmond
Beth
Beth Meades
Bethany
Bethany Domanis
Bettina Ann Jones
Betty Elwin
Beverly Oh
Bianca
Bianca Edmed
Bidda Jones
Bill Dominguez
Bill Gannon
Bill Van Hassel
Billy Grayson
Binnie Shaw
Birgit
Blair Hardman
Blair Ranford
Blanche
Bob
Bob MacLean
Bonnie Parker
Brad
Brad O'Young
Brad Trenwith
Bradley Abrahams
Bradley Alexander
Bradley Giles
Brandi Fairbee
Brandi Heller
Brasa Suhonik
Breanna Holden
Breck Curtis
Bree Gardner
Bree plater
Bree Ritchie
Brendan Donohoe
Brendan Mosdell
Brendan Pitt
Brendan Rangitaawa
Brendan Yong
Brenden Robinson
Brenton Tidow
Brett Mayberry
Brett Blackwell
Brett Mulder
Brett N Brown
Brett Newmarch
Brett Restemeyer
Brian
Brian Armer
Brian Collins
Brian Halberg
Brian Spinner
Brian Versey
Brianna
Bridget
Bridgette Wilson
Brigit Jager
Briony Coleman
Brittany Clarke
Brittany Michell
Brodie Betts
Bron kormpy
Bronte Anderson
Bronte Doneman
Bronwen fletcher
Bronwyn
Brooke Cannings
Brooke D'Alberto
Brooke Koolman
Brooke Waites
Bruce Rook
Bruno Tiaki Thomson-Baker
Bryan Field
Btjryan
Caitlin
Caitlin Fearnside
Caitlin Fox
Caitlin Race
Caleb Sigley
Calin Flora
Callan Hart
Calli Hicks
Callie Manwaring
Callum
Callum Burgess
Callum McMahon
Callum Thompson
Calum MacLeod
Camberley Sheffield
Cameron Clark
Cameron Gross
Camilla Giardini
Camilla Johansson-Merrick
Campbell Chalmers
Campbell Rae
Candace Parkyn
Candice
Candy Campbell
Cara
Cara Griesberg
Carey Heyden
Carissa McBead
Carlee
Carly Crane
Carly Gladwell
Carly Taylor
Carmen Allan-Petale
Carol Goldson
Carol Ingold
Carol James
Carol Leandro
Carol Moysey
Carol Neist
Carol Turner
Carole Migalka
Carole Vandal
Caroline Drogue
Caroline McGregor
Caroline Murphy
Caroline Perks
Carolyn Dearing
Carolyn Vinton
Carrianne Graham
Carsten Orlt
Cas Renooij
Casey
Casey Charlesworth
Cassanah Heal
Cassandra
Cassidy Reay
Cat Silver
Catharine Cameron
Catherine
Catherine Chandler
Catherine Hocking
Catherine Jeffries
Catherine Little
Catherine M Bain
Catherine O'Neill
Cathy Gilmore
Cathy Gilmore
Caz Kerbyson
Cecilia Pascelli
Chantal Buslot

Chantelle Larkin
Charlee Shea
Charles Day
Charles de Chelard
Charlie
Charlie Bicknell
Charlotte
Charlotte Johansen
Charlotte Roberts-Clarke
Chase Rawnsley
Chasta Schneider
Chay Kyme
Chelsea Jolly-Strudwick
Chelsea McNelliey
Cherie Dodd
Cherity Kean
Cheryl Anderson
Cheryl Lee
Cheryl Valenzuela
Chey Godfrey
Chloe Green
Chloe Wagenknecht-Reid
Chris
Chris Andrews
Chris Ashley
Chris Brett
Chris Byrnes
Chris Chalmers
Chris Chominsky
Chris Conroy
Chris Hall
Chris Harder
Chris Hartzell
Chris Hastie
Chris Helps
Chris Lee
Chris Macaskill-Hants
Chris Maddeford
Chris Martin
Chris Miquel
Chris Page
Chris Parker
Chris Pine
Chris Ruffell
Chris Searle
Chris Smith
Chris Thomas
Chris Yuill
Christa Aldridge
Christel Platt
Christian Taylor
Christian Pulham
Christian Truter
Christian Willis
Christiane Schmitz
Christie Dean
Christina Bodilly
Christina Dindinger
Christina Lauritzen
Christina Samarin
Christine
Christine Wanless
Christine Askew
Christine Bassett
Christine Bennett
Christine Farley
Christine Hanson
Christine Kershaw
Christine Litzgus
Christine McKay
Christine PukkLocke
Christine Shaw
Christine Storgeoff
Christine Young
Christopher Morrison
Christopher Murphy
Christopher O'Leary
Christy Marsh-Trombelli
Christy Reeves
Chula Murray
Cian Byrne
Ciara
Ciaran Hudson
Ciaran Millward
Ciaran Morris
Cindy Allen
Cindy Czabania
Cindy Lee
Cindy Rymer
Claire
Claire Black
Claire Coulson
Claire Gallagher
Claire Gold
Claire Greenwell
Claire Marston
Claire McGregor
Claire Murphy
Claire Ramsey
Claire Toole
Claire Tucker
Claire Vervaart
Claire Walker
Clancy Malcolm
Clare Francey
Clare Moynihan
Clarissa Human
Clark
Claudette Rechtorik
Claudia
Claudia Flaxman
Cle Breitinger
Clifford Morgan
Clint Williams
Clinton Rosewarne
Colette Whitton
Colin
Colin Cross
Colin Fairclough
Colin Hamilton
Colin Mitchell
Colin Ryan
Colleen Fagan
Collet
Colm MacGowan
Connor Acosta
Connor Barnes
Connor Butterfield
Connor Nolan
Connor Smyth
Connor Woodward
Conor Forsyth
Conrad Norton-Taylor
Constanze Hartmann
Coralie Carter
Corina Ravenscraft
Corinne Lecormu
Corner
Cottia Meadowcroft
Courtney Crowley
Courtney Harvey
Craig
Craig Barlow
Craig Fisher
Craig Hey
Craig Mirkin
Crimson Hite
Cristina Cilla
Cynthia Sherwell
D K
Dale
Dale Parry-Iles
Damian
Damian Bishop
Damian J. Davies
Damian Ucich
Damien
Damien Kennedy
Damon Brown
Dan Coker
Dan Fogarty
Dan Kljaic
Dana Fowler
Dana Roth
Danica Delaporte
Danie Buene Nilsen
Daniel Bertino
Daniel Boase-Jelinek
Daniel Bryer
Daniel Elder
Daniel Guthrie
Daniel Hall
Daniel Hornby
Daniel Hughes
Daniel Hulström-Allen
Daniel Hurley
Daniel Kinasz
Daniel Kowald
Daniel Langridge
Daniel McKenzie

Daniel O Brien
Daniel Panickar
Daniel Ramshaw
Daniel T Lees
Daniel Tham
Daniel Thirkell
Daniel Thompson
Daniel Vandervaere
Daniel Williamson
Daniela
Daniela Honorato
Daniele Halle
Danielle
Danielle Darwent
Danielle Findlater
Danielle Hines
Danielle Mcdill
Danielle Napier
Danielle Smith
Danielle Stocks
Danielle Taylor
Danni Williams
Danny
Dany George
Darcy
Darran Taylor
Darren Collins
Darren Fenton
Darron Richet
Darryl Leniuk
Daryl Cummings
Dave
Dave Blackburn
Dave Kelly Mla
Dave Nicholson
Dave Sharp
Dave Williams
David A. Trescuri
David Andrews
David Bunyan
David Fergusson
David Ferreira
David G. Dyke
David Gregory
David Hallett
David Hunt
David Iskra
David Kane
David Le Cornu
David Lemberg
David Lockhart
David Perry
David Ritz
David Ross
David Rowen
David S Farrar
David Spyby
David Szatkowski
David Terner
David Tickler
David Walsh
David Whittaker
David Woltschenko
Davis Koorey
Dawn Bailey
Dawn Kresan
Dawn Stock
Dawn Trakman
Dawn Zegledi
Dayna Surlan
Deaglan Harney
Dean
Dean Smith
Dean Smith
Dean Thompson
Deanna Torge
Deanna Wilson
Deanne Mcgrouther
Deb Roberts
Deb Turney
Debbie
Debbie Broomfield
Debbie Burnup
Debbie Diggins
Debbie Monks
Debbie Williams
Deborah
Deborah Besim
Deborah Blott
Deborah Bushell
Deborah Pergolotti
Deborah Stackpole
Deborah-Rose Reivers-Gillard
Debra Moncrieff
Debra Price
Debrah Coote
Declan Mcaleenan
Declan Munoz
Dee Newell
Dee Selby
Deejah Ross
Della Grallert
Della Grunwald
Delvina Gorton
Demi
Denise Bridges
Denise Cobb
Denise Fletcher
Denise Kuijlaars
Denise Tierney
Denise Wilson
Dennis Power
Denny Chen
Derek Gibb
Desmond Prout-Jones
Devin Sewell
Dhani Riehl
Di Courtney
Di Foster
Diamond Jim Legend
Diana Nymand
Diana Pendlebury
Diana Sima
Diana Tomkins
Diana Trent
Diane Pennycott
Diane Tait
Dianne
Dianne Drake
Dianne Maslin
Dianne Procopio
Digby Hildreth
Dilys E Dicks
Dina A Ely
Dina Bacvic
Dion Bradstreet
Dirt Bryant
Dominic
Dominic Burchnall
Dominic Harper
Dominic Jeanes
Dominic Stone
Donna Carresi
Donna Chapman
Donna Lock
Donna Ogston
Donna Palravan
Donna Reed
Donna Troisi
Donna-Jo Fryers
Donya Beaton
Dorian Moro
Doris Potter
Dorothy Kaluzny
Doug Collins
Doug Landau
Douglas Egan
Douglas Stetner
Dr Alicia Lloyd
Dr Ben Diggles
Dr Bill Bailey
Dr Brian Mc Erlean
Dr Brian W Darvell
Dr Debora Brown
Dr Dianne Evans
Dr Illo Streimann
Dr Jane Newsome
Dr Karen Payne
Dr Kristy Winn
Dr Michelle Morgan
Dr Rosemary Elliott
Dr Rosemary Sandford
Dr Sharon Burden
Dr Sheree Krass
Dr Stefanie Roth
Dr Stephen Bedding
Dr Susan Quinnell
Dr William Robbins
Dr. Caine Delacy
Dr. Christopher Neff

Dr. Rachel Grahamr
Drew Hui Tong
Drew Mcpherson
Drew Murphy
Drew Scanlan
Duncan Reilly
Dupré Simon
Dylan
Dylan Arnold
Dylan Mccallum
Dylan Perkins
Dylan Reilly-Pick
E Ross
Earl Digby
Ebony Mcpherson
Edith Coleman
Eduardo Garza Gisholt
Edward Dorson
Edward Khoury
Edward Mortimer
Edward Wickham
Eileen Mcdonald
Eirik Ahlsen Grimstad
Ekim Toraman
Elaine Alaia
Elaine Chong
Eleni Jaworski
Eleni Martakis
Elisa
Elisabeth Bechmann
Elise Clark
Elise De Villiers
Eliza
Elizabeth
Elizabeth Anne Melling
Elizabeth Duke
Elizabeth Heptinstall
Elizabeth Holland
Elizabeth Hutchinson
Elizabeth Kane
Elizabeth Lugg
Elizabeth Manson
Elizabeth Pottinger
Elizabeth Salkeld
Elizabeth Torres
Elizabeth Tregenza
Ella Binks
Ella Mikkonen
Ella Sweeney
Ellen
Ellen Bevan
Ellen Paynter
Ellen Sima
Ellena Marshall
Ellie Rivers
Elliott Kitson
Elly Jones
Eloise Dortch
Eloise Goudie
Eloise Rimon
Elspeth Stewart
Elvira
Elyse Cripps
Emanuel Burgos
Emelia Jones
Emily
Emily Cowell
Emily Jones
Emily Marks
Emily Ritchie
Emily Sellens
Emily Shaw
Emily Snape
Emily Sutton
Emma
Emma Arangio
Emma Azzopardi
Emma Bailey
Emma Browne
Emma Carmichael
Emma Clark
Emma Dart
Emma Davis
Emma Dunphy
Emma Higgs
Emma Johnson
Emma Kindregan
Emma Ridgway
Emma Schranz
Emma Thompson
Emma Wright
Emmali Pagan
Emmali Pagan
Emmanouil Lempidakis
Enno Stiller
Enri V. Bravo
Eric Clements
Eric Dean
Eric Lundberg
Eric William Bowyer
Erica Froistad
Erica Stecher
Erika
Erika Delemarre
Erin
Erin Brown
Erin Hall
Erin Healey
Erin Hughes
Erin Langton
Erin Lucas
Erin Sonego
Ernest Antos
Ernst G Brinkmann
Esme Clarke
Estelle Lavender
Ethan
Ethan Thornborough
Eugene Renehan
Eugenia Hall
Eva Redman
Evan Litis
Evan Peirce
Eve Clark
Eve Crawford
Evelin Hegyesi
Evie Fetherston Miller
Evie Ward
Ezra Crittenden
Ezra Ortinez
Fabienne Hill Faskel
Fallon Morfee
Family Macrae
Federico
Felicity Ahern
Felicity Caporn
Felix
Felix Junker
Fern Robinson
Fernando Reis
Fiona
Fiona Chong
Fiona Comerford
Fiona Johnston
Fiona Mayberry
Fiona Mcmullin
Fiona Robinson
Fiona Spence
Fletcher Tautkus
Florence Lignon
Frances Evans
Frances Mclean
Frances Sokel
Franck Jung
François
Frank Ayles
Frank Howard
Frank Lee
Frank Violi Jr
Frank Wehner
Frederick
Frederik Endres
Gabbi Mcguire
Gabe Mettam
Gabi Duigu
Gabriel Vianna
Gabriella
Gabrielle Doolan
Gabrielle Papeix
Gabrielle Raz-Liebman
Gabrielle Ryan
Gael Hilditch
Gail Bruce
Gail Lock
Gail Wyatt
Galang Trieu
Gandeleg Ganbaater
Gareth Hoole
Garrick Burgess
Garry Dyer

Garry Estreich
Garry Ford
Garry Smith
Garth Edwards
Gary Brooker
Gary John Ennis
Gary Warren
Gavin
Gavin Mcauliffe
Gavin Mctaggart
Gavin Saunders
Gaye Foster
Gayle
Ged
Gem Murray
Gemma
Gemma Cloutman
Gemma Day
Gemma Johnston
Gemma Machray
Gemma Whelbourn
Genevieve Hayes
Geoff Magee
Geoff Mcinnes
Geoff Munday
Geoff Stedman
Geoffrey Colino
George Stacey
Georgia Ovenden
Georgia Reynolds
Georgina
Georgina Dicks
Georgina Jones
Gerald Goeden
Gerald Henderson
Gerald Millington
Geraldene Dalby-Ball
Gerard Galbraith
Gerard Smith
Geri Son
Giada
Gigi Flux
Gill Ainsworth
Gill Duke
Gill Fahey
Gill Kennett
Gillian Campbell
Gillian Devine
Gillian Lanigan
Gillian Read
Gillian Stroud
Gina Southern
Gina Southern
Giorgia Doglioni
Giovanni Mussini
Gisela Mörtl
Giulia Pierce
Glen Browne
Glen Morrow
Glen Shaw
Glenn Watson
Glenys Davey
Glenys Davey
Glenys Robertson
Glynis Moland
Gönül Atay
Gordon New
Grace
Grace Carter
Graeme Agnew
Graeme Andrews
Graeme Ford
Graham Brimage
Graham Cassidy
Graham Zemunik
Grainne Bennett
Grant Brooks
Grant Corso
Grant Mallett
Grant Potter
Grant Stephen Buller
Greg Harper
Greg Johnstone
Greg Meggs
Greg Ralph
Greg Thomas
Gustavo E Moser
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Richelle Fraser
Richie Vinci
Rick Knable
Rick Mead
Ricky Manu Tumata
Riki Kellogg
Riley
Rin Tsubasa
Rita Uljee
Rita Van Miltenburg
Roanna Horbelt
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Rob Charles Boyce
Rob Embury
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Rob Morgan Grenville
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Robert Blackmore
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Robyn Baker
Robyn Broad
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Rochelle Meyrick
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Ronald Ian Creed
Ronan Harvey
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Rory Mack
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Rossier
Rosslyn Elliott
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Ruan Van Niekerk
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Russ Barclay
Russell Johnson
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Ruth Curtis
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Ruth McCotter
Ruth Timmiss
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Ryan Hucklebridge
Ryan M. Darragh
Ryan Mcgrath
Ryan Parkinson
Ryan Sculley
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Sahvanna Kochetkova
Sally Alvarez
Sally Battersby
Sally Campbell
Sally Clegg
Sally Gelle
Sally Osborne
Sally Purbrick-Illek
Sally Riddle
Salomeh Dastyari
Sam Bates
Sam Dolling
Sam Edmonds
Sam Khalaf
Sam Kool
Sam Mead
Sam White
Sam Wilson
Samanta Lestavel
Samantha

Samantha Brewin
Samantha Fernandez
Samantha Hill
Samantha Kent
Samantha Leivers
Samantha Matons
Samantha Ryder
Samantha Sherman
Samantha Webb
Samantha Wright
Sammy Clayden
Samuel
Samuel Bailey
Samuel Herren
Samuel Palmer
Samuel Wallrock
Sandra
Sandra Achleitner
Sandra Chung
Sandra Laight
Sandra Materi
Sandra Moroney
Sandra Samson
Sandra Speare
Sandra Thompson
Sandrine Erwin
Sandy
Sandy Aston
Sandy Moore
Sandy Taylor
Sanjeev Prasad
Santosh
Sara
Sara Miller
Sara Williams
Sarah
Sarah B Irvine Phd
Sarah Belton
Sarah Boggio
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Sarah Buckley
Sarah Calcio
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Sarah Decatania
Sarah Green
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Sarah Wallcook
Sarah Whitau
Sarah Woodhouse
Sarina Moser
Sarrah Corner
Saskia
Save Buckton
Scott Dawe
Scott L. Kreger
Scott Lawler
Scott Rettig
Scott Strachan
Scott Wood
Sean
Sean Browne
Sean Kavanagh
Sean Sharks
Sean Vermeulen
Sean Wilson
Sebastian White
Seema Raghav
Selina Chan
Seren Wickson
Serena
Serena Weatherall
Sergio Grez
Sergio Lopez
Shan
Shanda Robinson
Shane Flemming
Shane Gross
Shane Kavanagh
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Shani
Shannan Kimberley
Shannen Twine
Shannon
Shannon Ball
Shannon Bodlovich
Shannon De Melo
Shannon Edwards
Shannon Hurley
Shannon Karrer
Shannon Kurt Brincat
Shannon McInville
Shara Bidois
Sharee Shepherd
Shari
Sharna Rainer
Sharon
Sharon Deleske
Sharon Mclay
Sharon Peake
Sharon Pilayo
Sharon Wadwell
Shashank Srinivasan
Shaun Sprunt
Shaun Terblanche
Shelby
Shelby Wale
Shelley Browne
Shellie
Sheree Morris
Sherene Fuldagli
Sherisse Viray
Sherry Jones
Sherry-Lee Smith
Sheryn Pitman
Shevaun Mercer
Shimona Lisa Marie
Shreya Sinha
Si Free
Sian Mills
Siege Linsley
Sierra Jones
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Sim Huber
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Simon Blears
Simon Day
Simon Free
Simon Gartenstein
Simon Hart
Simon James
Simon Lee
Simon McLernon
Simon Newrick
Simon O'Hana
Simon Robins
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Simon Weyers
Simon Woodley
Simone Rupp
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Siobhan Paget
Sita Balshaw
Skyler Thomas
Sofie Bammer
Solange Williams
Sonia Urgel Miranda
Sonya Holmes
Sonya Jones
Sophia Cowdry
Sophie Ashford
Sophie Dentrinos
Sophie Guthrie
Sophie Jones
Sophie Neubauer
Sophie Smith
Sophie Teede
Sosdia Solofoni
Spencer Moncrieff
Stacey
Stacey Blake
Stacey Collerone
Stacey Lucas
Stacie Scattergood
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Stacy Blane
Stäheli Lechner Yvonne
Stefan
Stefan Augustin
Stefan Kiefer

Stefanie Habel
Steffi Selle
Stella Glennon
Stephan Liljedahl
Stephanie
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Stephanie Bove
Stephanie Di Battista
Stephanie Jones
Stephanie Morley
Stephanie Wehner
Stephen
Stephen Allen
Stephen Amore
Stephen Chapman
Stephen J. Burchall
Stephen Kimber
Stephen Meyer
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Stephi Von Kanel
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Steve Drew
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Sue Steele
Susan Foster
Susan Harvey
Susan Krumbein
Susan Lane
Susan Lesmond
Susan M Chulyk
Susan Murrey
Susan Pedersen
Susan R Upright Rn
Susan Shephard
Susana
Susana Kubu
Susanna Druce
Susanna Minacheili
Susanna Peters
Susannah Bell
Susannah Thompson
Susanne Sprungala
Sush Goureeve
Suzanne Ingelbrecht
Suzanne Rabey
Suzanne Wolfe
Suzette Perich
Sven Taapken
Swantje
Switzer
Sydney Brown
Sydney Lester
Sylvia Hebrob
Sylvia Van Der Does
Sylvie C
Szilard Balogh
T C Chapman
Tahlia Robinson
Tahlia Watts
Talei Owen
Talia
Talulah Gaunt
Tam Smith
Tamara Juricic
Tammy Gibbs
Tammy Stone
Tamsin Kelly
Tania Giles
Tania Martin
Tania Mullis
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Tanya Denman
Tanya Harrison
Tanya Hui Tong
Tanya Traish
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Taryn Haynes
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Taya Nielsen
Taylor Bawden
Taylor Drew
Tayne
Teagan Elliott
Teena Cordwell
Tegan
Tegan Goodey
Tegan Redinbaugh
Tegan Thiele
Teja Lipold
Tenille Cozamanis
Teresia Lindberg
Terra Lalirra
Terry Corr
Terry Farr
Terry John William Savidis
Terry Williams
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Tess Middleton
Tess Sharp
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Theodore Box
Theresa Schmidt
Theresa Bridle
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Thomas Beneth
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Thomas Williams
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Tiffany Pusker
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Tim Grohmann
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Tim Potter
Tim Somers
Timothy Mullen
Timothy Treglown
Tina Cook

Tina Maddison
Tito Lozada
Toby Roe
Toby Stringer
Todd Burton
Todd Stuart
To-Kim Hoang-Le
Tom
Tom Bellamy
Tom Pegram
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Tommy Leitch
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Toni Markette
Toni Pennicott
Tony
Tony Batchelor
Tony Bennett
Tony Higgs
Tony Mosman
Tony Roche
Tony Stevens
Tonya
Tori Lock
Torsten
Tracey McArthur
Tracey Rodwell
Tracy Bartram
Tracy Brown
Tracy Harris
Tracy Raby
Tracy Skippings
Tracy Yuen
Travis Zee
Treena Bron
Trent Ende
Trent Marchment
Trent Sterling
Trent Van Zanten
Trevor Beer
Trevor McDonald
Tricia Maguire
Trish Durlacher
Trisha Stevens
Troels Nielsen
Troy
Troy Deephouse
Troy Whitmarsh
Trudi Shearer
Trudy Lucas
Ty Beh
Tyler
Tyson
Ulla Werner
Ushma Joshi
Ute Owen-Jones
Val Turbine
Valarie Meltzer
Valerie Burgess
Valerie May Taylor Am
Valerie Reed
Valerie Wong
Valery Wittstein
Vanessa
Vanessa Baker
Vanessa Botero
Vanessa Leevers
Vanessa Nemeth
Veerle Roelandt
Veerle Vanderplasschen
Venkatesh Velayutham
Verena Homberger
Veronica Abela
Vic Bovis
Vic Cherikoff B.App.Sc.
Vicki Chapman
Vicki Jamieson
Vicki Petersen
Vicki Trevor-Jones
Vicky Thomson
Victor Guerin
Victoria Basteed
Victoria Bird
Victoria Bowen
Victoria Fraser
Victoria Graham
Victoria Greentree
Victoria Manning
Victoria Rimbos
Victoria Von Bernard
Vincent Grillo
Vincent Mauro
Vincent Vandervaere
Vincenzo Cascioli
Virginia Anscombe
Viv Coburn
Viviana Sepulveda Flores
Vivien Lightfoot
Volker Kukla
Walt Brown
Wan Ting
Warren Crawford
Warren Naseby
Wayne Merchel
Wendy Ball
Wendy Brooks
Wendy Chapman
Wendy King
Wendy Lamb
Wendy Shaw
Wendy Woods
Wiebke Eggers
Wiebke Wessels
Wiliam O'Connor
Will Brownlee
Will Faulkner
William C Cromwick
William Hawke
William Solomon
Wilma Goodyear
Xavier De Blocq
Ximena Arango
Ximena Sanchez
Yana
Yani Armbruster
Yara Halabi
Yasmin Paten
Yhaness
Yianni Anagnostis
Yolanda Schultes
Yolande Brown
Yvette Pitt
Zac Boyce
Zac Jenkins
Zac Munoz
Zach Folan
Zach Whalen
Zachary Gallagher
Zachary Ostroff
Zainab Tahir
Zaya
Zenon Samuels
Zinnia Manchanda
Zoe
Zoë
Zoe Chester
Zoe Hewett
Zoe Huxtable
Zoe Jones
Zoe Maynard
Zoe Moffat
Zoe Myers
Zoe Sharratt
Zoe Squires
Zoe-Marie Arnold
Zusje De Pool

Appendix 2

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CSIRO[2] (July 2014) *CSIRO answers to questions from EPA/OEPA to Peer Reviewer*

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DPC[3] (August 2014) Clarification on the temporary drum line deployment aspect of the Western Australian Shark Hazard Mitigation Drum Line Program 2014-17.

DSEWPAC (2013) Recovery plan for the White Shark (*Caracharodon carcharias*). http://www.environment.gov.au/resource/white-shark-carcharodon-carcharias-recovery-plan

Appendix 3

Summary of Identification of Key Environmental Factors and Principles

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
Marine Fauna	**Target marine fauna:** The proposal involves the capture of white sharks (*Carcharodon carcharias*), tiger sharks (*Galeocerdo cuvier*) and bull sharks (*Carcharhinus leucas*) three metres in total length or greater (target sharks) within the temporal and geographical extent of the MMAs during the drum line deployment period, and sharks considered to pose an imminent threat outside of the temporal and geographical extent of the MMAs **Non-target marine fauna:** The proposal has potential to alter community structure through the removal of apex predators, and result in the unintentional capture of non-target marine fauna.	Public and non-government organisations • Noted that there is considerable uncertainty in the predicted catch rates for the white shark. • Unclear as to whether the proponent has considered demographics such as sex ratios of white sharks expected to be caught. • The cumulative impact to the south-western Australian population of white sharks has not been fully considered. • Considers that there is a high level of uncertainty regarding population estimates of the south-western Australian white shark. • Considers that the tiger shark is being unduly targeted and should not be considered a 'target shark'. • Considered that the 'low risk' rating assigned to the tiger shark is not justified. • Considers that the PER did not evaluate the survival rate of released tiger sharks (and other released animals) from the trial. • Noted that the PER contained no information to assess the likely impacts on Bull Sharks. • The posited absence of ecological impacts in the past merely reflects a lack of research on this topic and is not grounds for dismissing the issue in the present day. • Considers that the proponent has not sufficiently assessed the environmental impacts of the temporary drum line component of the program because it was reliant on the results and data collected from the trial. • Considers that the proponent is dismissing the potential impacts of the annual removal of upward of 40 tonnes of tiger sharks on World Heritage Areas. • Considers that the proponent has not adequately addressed	Considered to be a key environmental factor and is discussed in Section 3.1

		the requirements of Table 1, section 2 of Work and Output required, detailed in the ESD. • The likelihood of mortality to undersized sharks, whether on the drum line or shortly after their release is likely to be greater than estimated. • The allowable catch rates should be provided based on the proponents risk assessment to ensure that the viability of the population is maintained. • Submissions note that triggers and contingency actions have not been developed for the proposal. <u>Department of Parks and Wildlife (DPaW)</u> • Recommends that the Department is consulted regarding those aspects of the management framework that have the potential to affect species that are specially protected under the WC Act. • Considers that opportunities for fauna research associated with the drum line program are maximised and prioritised on the basis of research needs identified in the nationally endorsed recovery plans for potentially affected species. <u>Marine Parks and Reserve Authority (MPRA)</u> • Noted the efforts to minimise by-catch, and small numbers involved. • Considers that the proposal may offer opportunity to increase scientific knowledge of the ecological role of sharks and their behavior in our local waters. • Support increased efforts to extend the development of other methods to deter shark attacks. • Identified that it would be preferable if the baited lines were kept outside the offshore boundaries for Ngari Capes Marine Park special purpose zones. • Identified that there is a risk that DoF resources that are currently used to assist in the achievement of MPRA and DPaW management objectives will be redirected to the	

		metropolitan component of the shark drum line program at a cost to their wider contribution efforts in managing marine ecosystems.	
Human Health		<u>Public and non-government organisations</u> • Contend that the proposal cannot be justified if the proponent cannot demonstrate that the proposal will enhance public safety. • Consider that the baited drum lines present a serious public safety hazard as they may actually draw sharks into areas where they are deployed.	The EPA notes that the issue of efficacy of the proposal, that is, will it make beaches safer, is outside of the scope of the *Environmental Protection Act 1986*, and therefore cannot be considered by the EPA. This is discussed further in Section 2. - The proposal. With regard to the matter of an increase in shark populations near beaches as a result of the implementation of the proposal, the EPA notes that the proposal is designed to reduce the abundance of sharks that are in the local area. The EPA also notes information provided in the proponents Response to Submissions (DPC[2], August 2014) in which the proponent has reviewed the information collected from shark control programs in other jurisdictions and also research about shark biology and attractants. This together with a review of the trial program in 2014 has led the proponent to advise that drum lines do not necessarily attract sharks. Having regard to the issues raised in submissions, the design of the proposal and the information

			provided by the proponent, the EPA considers that it is unlikely that the implementation of the proposal will increase the abundance of sharks in the area and therefore does not consider Human Health to be a key environmental factor.

PRINCIPLES		
Principle	**Relevant Yes/No**	**If yes, Consideration**
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In application of this precautionary principle, decisions should be guided by –* *(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *(b) an assessment of the risk-weighted consequences of various options.*		
	Yes	The EPA has considered this principle insofar as the proposal impacts on marine fauna and has therefore assessed the proposal against the EPA's objective for Marine Fauna which is *to maintain the diversity, geographic distribution and viability of fauna at the species and population levels.*
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*		
	Yes	The EPA has considered this principle insofar as the proposal impacts on marine fauna and has therefore assessed the proposal against the EPA's objective for Marine Fauna which is *to maintain the diversity, geographic distribution and viability of fauna at the species and population levels.*
3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*		
	Yes	The EPA has considered this principle insofar as the proposal impacts on marine fauna and has therefore assessed the proposal against the EPA's objective for Marine Fauna which is *to maintain the diversity, geographic distribution and viability of fauna at the species and population levels.*

4. Principles relating to improved valuation, pricing and incentive mechanisms *(1) Environmental factors should be included in the valuation of assets and services.* *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *(4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximize benefits and/or minimize costs to develop their own solution and responses to environmental problems.*		
	No	
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimize the generation of waste and its discharge into the environment.*		
	No	

Appendix 4

Identified Decision-making Authorities

Identified Decision-making Authorities

Section 45(1) requires the Minister for Environment to consult with decision-making authorities, and if possible, agree on whether or not the proposal may be implemented.

The following decision-making authorities have been identified for this consultation:

Decision-making Authority	Approval
1. Minister for Environment	*Wildlife Conservation Act 1950* *Conservation and Land Management Act 1984*
2. Minister for Fisheries	*Fish Resources Management Act 1994*
3. Department of Transport	*Western Australian Marine Act 1982* *Navigable Waters Regulations 1958*

Note: In this instance, agreement is only required with DMAs 1 and 2, as these DMAs are Ministers.

Appendix 5

Information required by clause 7.3 in schedule 1 of the Bilateral Agreement relating to environmental impact assessment

Table of information about relevant impacts of the action as required by clause 7.3 in schedule 1 of the Bilateral Agreement relating to environmental impact assessment between the Commonwealth of Australia and the State of Western Australia.

Clause 7.3 in schedule 1 - Information about the relevant impacts of the action	**Relevant section(s) of the EPA Assessment Report**
(a) A description of: (i) the action; and (ii) the places affected by the action; and (iii) any matters of national environmental significance that are likely to be affected by the action; and	Section 2 of the Assessment Report includes a description of the proposal and places affected by the proposal. Section 5 describes the Matters of National Environmental Significance that are likely to be affected.
(b) a summary of the relevant impacts of the action; and	Sections 3 and 5 of the Assessment Report include a summary of the relevant impacts.
(c) a description of feasible mitigation measures, changes to the action or procedures to prevent or minimise environmental impacts on relevant matters of national environmental significance proposed by the proponent or suggested in public submissions;	Section 3 of the Assessment Report discusses the proponent's mitigation measures to minimise environmental impacts. Appendix 6 of the EPA Assessment Report contains the summary of public submissions which contains suggested mitigation measures to prevent or minimise environmental impacts on relevant matters of national environmental significance.
(d) to the extent practicable, a description of any feasible alternatives to the action that have been identified through the assessment process, and their likely impact on matters of national environmental significance;	Included in Sections 2 and 5 of the EPA Assessment Report.
(e) a statement of recommended conditions for approval of the action that may be imposed to address identified impacts on matters of national environmental significance; and	In the event the action proceeds, Section 4 of the Assessment Report recommends requirements that should be included as conditions. This includes the implementation of the proponent's Operational Environmental Management Plan to minimise impacts to marine fauna and setting catch limits for target sharks.
(f) a statement of State or Territory approval requirements and conditions that apply, or are proposed to apply, to the action when the report is prepared, including a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	Section 6 of the Assessment Report recommends the State Minister note that conditions and procedures have not been included because the EPA has concluded that the proposal should not be implemented.

Appendix 6

Further Proponent and Peer Review Information (CD)

6.1 DPC Response to Submissions

6.2 DPC draft Operational Environmental Management Plan

6.3 DPC Clarification of the temporary deployment aspect of the drum line program WA

6.4 DoF Guidelines for fishing for sharks posing an imminent threat

6.5 Peer Review Terms of Reference

6.6 CSIRO Peer Review report

6.7 CSIRO Peer Review Close Out Report

6.8 CSIRO answers to questions from EPA/OEPA to Peer Reviewer