ATTACHMENT 5F

Mr John Riley
Environmental Officer
Department of Biodiversity,
Conservation and Attractions (DBAC)
Locked Bag 104, Bentley Delivery Centre
WA 6983
Phone (08) 9278 0925
Email john.riley@dbca.wa.gov.au
Web www.dbca.wa.gov.au

Australian Sailing Limited
ABN 26 602 997 562

Yachting Western Australia Inc.
ABN 80 549 302 900

Australia II Drive
Inside the grounds of Royal Perth
Yacht Club
Crawley WA 6009
Australia

Box 3073, P.O. Broadway
Nedlands WA 6009

T +61 8 9386 2438
E wa@sailing.org.au

Re: Part 5 – 2021 – 2616 The Nature Conservancy Limited – Blue Mussel Reef Construction Project;
https://www.dbca.wa.gov.au/node/473

Reference #2021/2616

Dear John,

Yachting Western Australia and Australian Sailing have safety concerns around the subject Blue Mussel Reef Project in the Swan River Park.

Our member clubs have several yachts that have drafts exceeding three meters. The proposed project includes indicated depths which include:

- Proposed Attadale Reef at -4.0 meters LAT
- Proposed Freshwater Bay 1 Reef at -3.6 meters LAT
- Proposed Freshwater Bay 2 Reef at -3.6 meters LAT
- Proposed Point Walter Reef at -3.2 meters LAT

It is the view of YWA and AS that these are not sufficiently deep to allow safe navigation in the proposed areas of the Swan River, given the current and future boating requirements and event hosting considerations. It is also important to note that LAT (Lowest Astronomical Tide) does not represent extreme levels and certain meteorological conditions can cause a lower level than LAT.

Also of concern is the proposed sites given they are directly in the "usual" racing courses areas of most of the River-based clubs in the following locations:

- Proposed Attadale Reef in the vicinity of racing markers Smith and Lucky Bay Buoys
- Proposed Freshwater Bay 1 Reef in the vicinity of Claremont Yacht Club Dinghy Starting line
- Proposed Freshwater Bay 2 Reef in the vicinity of Middle Spit and Parker Buoy
- Proposed Point Walter Reef in the vicinity of Tasker Spit

We have requested of Mr Andrew Bossie, from the Nature Conservancy Oceans, Project Coordinator a map overlaying the locations with a Nautical Chart for greater clarity and to distribute to our member clubs before the end of the notification period ending on the 26th of November.

We have also voiced our concerns with the Department of Transport Marine Safety via Mr Mark Briant who has requested he be copied on this correspondence.

Our member yacht clubs are cognisant of the intended environmental purpose of this project but are vehemently opposed to any encroaching on existing racing considerations and are generally opposed to anything that increases obstacles in an already narrow waterway.

Please take this letter as a formal recommendation to reconsider the parameters and locations of the proposed, on behalf of our eleven river-based member clubs and our 22,000 members in WA and 120,000 members nationally.

Mark Nicholas BE, MBA, CPEng, FIEAust, GAICD
President, Yachting Western Australia

CC: Mark Briant Department of Transport Marine Safety mark.briant@transport.wa.gov.au
CC: Andrew Bossie The Nature Conservancy andrew.bossie@tnc.org

Blue Mussel Reef Project

Introduction

Australian Sailing (AS) and Yachting Western Australia (YWA) are the governing body for the recreation of Sailing in Australia and Western Australia. Our purpose is to support the administration, promotion, and development of sailing. We are a member-based organisation that represents the interests of over 360 clubs, 130,000 members and 30,000 junior participants across Australia. AS / YWA has 11 of its 41 WA affiliated member yacht clubs located in the Swan and Canning Riverparks, with a combined membership of 13,741. In partnership with our clubs, we help to facilitate thousands of additional temporary-member participants on the water each year via access through these facilities.

AS and YWA's revenue is sourced via a combination of funding from;

- State and Federal Governments,
- Club and Class Association Memberships,
- Training Programs for Coaches, Officials, and Instructors,
- Patrons and Sponsorships, and
- The delivery of Recreational Skippers Tickets, the largest provider in WA with 3800 RST's issued in 20/21 FY.

Terms

Yachting Western Australia	YWA
Australian Sailing	AS
The Nature Conservancy	TNC
Department of Transport	DoT
Aquatic Council Inc	AC
Royal Freshwater Bay Yacht Club	RFBYC
Royal Perth Yacht Club	RPYC
South of Perth Yacht Club	SoPYC
Mounts Bay Yacht Club	MBSC
Claremont Yacht Club	CYC
Perth Flying Squadron Yacht Club	PFSYC
Nedlands Yacht Club	NYC
Perth Dinghy Sailing Club	PDSC
East Fremantle Yacht Club	EFYC
Shelley Sailing Club	SYC
Maylands Yacht Club	MYC
Blackwall Reach	BW
Canning River	CR
Freshwater Bay	FB
Karrakatta Bank	KB
Maylands	M
Matilda Bay	MB
Mosman Bay	MosB
Melville Water East	MWE
Melville Water West	MWW

Industry Consultation

The Nature Conservancy (TNC) as per the recommendation of Department of Transport (DoT) have declined a consultant meeting with yachting groups until 2022, even after stating in the project application that there would be meeting with yachting groups, late in 2021 to incorporate their feedback into the proposed locations of the full-scale reefs. The request for a specific meeting between TNC, YWA, AS and our Swan River-based affiliated Yacht Clubs so our community could speak to TNC about the proposed project, prior to the pending approval application #2021/2616 submitted to the Department of Biodiversity, Conservation and Attractions, deadline of 26 November was declined.

*See attachment HERE

We note that the Aquatic Council (AC) has also not received appropriate Industry Consultation on a reasonable timeline.

**See attached constitution HERE*

Common Interest and Safety

Of greatest concern to AS / YWA and its member clubs is the potential safety concerns which comes with this project. TNC have been unable to provide clarity on some of the following important questions from a Risk Management and Safety perspective for our on-water users;

- Can or will these proposed reefs be dived on?
- Will these proposed reefs attract additional boating in recreational fishing and diving vessels to the locations and create conflict of water use?
- Will these proposed reefs in due course then want to have an exclusion zone?
- Will these proposed reefs attract dangerous wildlife (e.g., Sharks)?
- Will these proposed reefs have impact on the wave state around the sites?
- Why does the large and small navigation channels diagram used for the application exclude ordinary yachting vessel movement, when yachting is currently the largest daily user of the Swan Riverpark?

  **See attached map HERE from application #2021/2616*
- Will Lowest Astronomical Tide (LAT) remain constant or is there a possibility for the tide to increase/decrease, beyond average meteorological conditions?
- If the proposed project is unsuccessful and needs to be closer to the water surface, will TNC request to decrease the LAT at these locations which have been said as the only places TNC can do these based on their research?
- Who will remain responsible for the removal or rectification of the proposed structures in the future?
- How were the proposed locations chosen, and have the existing marina and future marina structures been considered in the study?
- Data appears inconsistent throughout the report, stating that the proposed project is 3.5m-8m LAT, but that the proposed 4 sites range in water depth from 3.3m – 8m followed by the Point Walter Reef Site plan shows a LAT of 3.2m LAT. Which is the correct LAT that TNC are proposing at these locations?

All the questions above remain unclear from the perspective of the yachting community and we require greater clarity on the project prior to being in a position to support the proposed application #2021/2616.

World, State, and Club Events

AS / YWA member clubs were due to hold 21, World or Australian Championships during the 2021/22 summer period prior to travel restrictions. The Swan River Calendar, a YWA approval mechanism for the DoT with its interim step via the AC captures all the sailing and power-based aquatic event applications on behalf of the member clubs for the shared usage of the Swan River. Currently, there are 95 recurring events and 495 special events applications.

Note: the AC could provide additional water usage information.

The Swan River Racing Committee (and its calendar), a subcommittee here in WA is tasked to manage all the Swan River Calendar applications and have split the river into sections. Currently the 590 event applications, reside over the following areas;

- Blackwall Reach (BW) 8,
- Canning River (CR) 82,
- Freshwater Bay (FB) 163,
- Karrakatta Bank (KB) 15,
- Maylands (M) 4,
- Matilda Bay (MB) 113,
- Mosman Bay (MosB) 31,
- Melville Water East (MWE) 283, and
- Melville Water West (MWW) 267.

Due to the nature of sailing, yachts do not stay on the rhumb line (straight line from the previous mark to the next turning mark). Boats are required to tack or gybe multiple times, based on the ever-changing wind conditions, performance, or strategy. Due to this, yachts will vary by approximately up to + or - 60 degrees when heading towards a mark from the "rhumb line". This results in all the turning marks in MWW of Miller (28), Bricklanding (33A), Bricklanding (33B), Smith (35A), Lucky (51), Lucky Bay (35B) and Attadale (45) all being in the imminent sailing vicinity of the proposed Attadale reef build area for example.

Note: Similar results can be achieved when looking at the Freshwater Bay #1 and #2 proposed sites.

As seen in the image attached HERE (blue arrows), all of the above 7 marks and piles are used commonly as turning marks at the west end of MWW for the following reasons;

(1) All clubs east of the 7 turning marks (RPYC/SoPYC/PFSYC/NYC) use these as turning marks to come back into MWE and towards the club for the end of a race,
(2) All clubs west of the 7 turning marks (EFYC/CYC/RFBYC) use these marks to either,
(3) On the way out to MWE to turn into the middle of the river or (B) To come back into Freshwater Bay and towards the club for the end of a race.

The same concept happens the other way, with RFBYC, EFYC and CYC all going out through Point Walter/Freshwater Bay and using MWW as turning marks (in specific these 7 marks) to head into MWE area, as seen in the image attached HERE (green arrows). They will head into MWE, before

turning around at some point at a turning mark, to come back to one of the 7 marks in MWW and used to turn back into Freshwater Bay/Point Walter.

Another issue is that the proposed locations can also be in the sailing area from one mark to the next even though those marks are not in the imminent vicinity of the proposed location. Key examples of where this occurs is: from a mark inside Freshwater Bay to either Squadron, Dee Road, Bond or Sanders or vice versa (Example can be seen HERE).

After collecting data from affiliated yacht clubs, it shows that currently of the relevant 276 different courses which are in the 20/21 course books of our clubs, 226 are affected in some manner by the proposed project.

Note: this study excludes the regular "championship" style of racing courses that would regularly involve an anchored start boats and set markers in the vicinity of the proposed Attadale Reef and the proposed Freshwater Bay Reefs #1 and #2 in both the common prevailing Easterly and or South Westerly conditions. There are 52 affiliated class associations in Western Australia that would use the course areas for Club, State, National and International competitions.

Club	Affiliation Band	Membership	Total # of Pens / Hardstands / Moorings	Occupancy Rate	Total # of Sailing Boats	Total # of Power Boats	Total Sailing Courses***	Sailing courses affected by project	Courses
RPYC	2	2455	473	95.3%	292*	266*	28	18	HERE
SoPYC	2	3867	504	100%	211	293	40	18	HERE
RFBYC	2	3798	334	95% +	138	196	112	101	HERE
EFYC	8	899	138	N/A	N/A	N/A	32	32	HERE
PFSYC	10	1255	210	89%	N/A	N/A	23	21	HERE
CYC	11	458	229	N/A	N/A	N/A	21	21	HERE
MBSC	12	254	80	N/A	N/A	N/A	N/A**	N/A**	
NYC	12	376	10	100%	N/A	N/A	20	15	HERE
PDSC	13	234	N/A	N/A	N/A	N/A	N/A**	N/A**	
MYC	18	84	N/A	N/A	N/A	N/A	N/A	N/A	
SSC	21	61	N/A	N/A	N/A	N/A	N/A	N/A	
Total		***13,741***	*1990*				**276**	***226***	

** Boats on club register*
*** Club courses do not sail into Melville Water West or Freshwater Bay, but clubs are due to host both Nationals and Worlds in locations.*
**** Does not include Junior/Dinghy Sailing courses*

Draft

Lowest Astronomical Tide (LAT) is defined as;

"The lowest tide level that can be predicted to occur under average meteorological conditions."

It is important to note that this means the tide can be lower. Below find a table of typical recreational performance yachts that can and will be sailing in the Swan River. Further studies in fact show when we look at Sailboat Data there are 144 yachts listed with a draft over 10 feet.

Boat Name	Length	Beam	Draft	Link
Beneteau - Oceanis 60	18.97m	4.99m	2.70m	HERE
GP 52	12.80m	3.90m	2.60m	HERE
TP 52	15.85m	4.42m	3.35m	HERE
Ker 40	12.20m	4.20m	2.90m	HERE
Botin 40	12.15m	4.20m	2.90m	HERE
40 One Design	12.19m	4.50m	3.00m	HERE

Note: There are 144 boats which have a Draft over 10ftin the database https://sailboatdata.com/

Table 1 of the TNC project application (page 8), states that 4 = most suitable and 0 = less suitable. They have stated that a depth anywhere in the range of 3.5m – 9m is most suitable due to logistics constructing below 9m and risk of boats in less than 3m depth.

The yachting and boating community is advising, that the minimum safe LAT would be 5m and that the proposed reef locations are of great safety concern to us, for keel strikes.

It is a good moment to consider the horrific double fatality that occurred in the Bunbury and Return Ocean Race in 2018 where a yachts keel fell off. Many river-based yachts regularly participate in this event, whilst it is unclear why the keel fell off, keel strikes are taken very seriously in Yachting and within our own AS Special Regulations at categories level 1, 2 and 3 all keels and rudders must be periodically inspected by industry specialist for this very reason. Further information can be read (HERE).

We would support any reef that is below 5m LAT and is outside of our yachting boundaries. We would be willing to provide TNC based on their ideal locations data (HERE) recommendations of places which we would support their proposal.

Member Alignment

Letters from AS / YWA and Affiliated Yacht Club opposing pending approval application #2021/2616 are received from.

- Royal Freshwater Bay Yacht Club
- Royal Perth Yacht Club
- South of Perth Yacht Club
- Claremont Yacht Club
- AS and YWA

And found attached in Appendix A to D

Summary

As mentioned in the letter sent to Mr John Riley on the 1 November 2021 and attached as Appendix E, AS and YWA are fundamentally opposed to;

- Any decrease in safety by an introduced conflict of water users,
- Any reasonable reduction of existing available sailing water space,
- Any restriction of draft considerations that have unreasonable safety margins, given the gravity of the risk, and
- Science that is hasty, impatient, supportive of an introduced species and not giving our members time to appropriately be in the conversation.

Please apply our concerns to this pending approval process #2021/2616.

Yours sincericely,

Mark Nicholas
BE, MBA, CPEng, FIEAust, GAICD

President
Yachting Western Australia Inc.

Australian Sailing

YACHTING WESTERN AUSTRALIA

Appendix A

TELEPHONE:
+61 (8) 9286 8200

EMAIL: rfbyc@rfbyc.asn.au

WEBSITE: www.rfbyc.asn.au

KEANE'S POINT
PEPPERMINT GROVE
WESTERN AUSTRALIA 6011

POSTAL ADDRESS
P.O. BOX 373,
COTTESLOE, WA 6911

ABN: 82 671 754 734

Thursday, 25 November 2021

Mr John Riley
Environmental Officer
Department of Biodiversity, Conservation and Attractions (DBCA)
Locked Bag 104, Bentley Delivery Centre
WA 6983

Ref: Part 5 – 2021 – 2616 The Nature Conservancy Limited – Blue Mussel Reef Construction Project

Dear John,

On behalf of the 2,300 members of Royal Freshwater Bay Yacht Club, our guests, visiting competitors and participants we wish to register our safety and operational concerns about the proposed Blue Mussel Reef Project in the Swan River Park.

Proposals and projected plots onto charts of the river indicate the proposed locations for these artificial reefs to be in the direct pathway for race courses used by most of the yacht clubs on the river including RFBYC and are therefore subject to regular high levels of boating traffic on and around these areas.

Of greatest concern is the shallow depth clearances proposed, with depths below LAT of as little as 3.2m. With yachts of up to 50 feet and draughts of up to 3m, the indicated depths are not sufficient to give a safety factor or allow for other meteorological effects such as high pressure and offshore winds.

Similarly, we also have concerns about the sudden change in wave-state that these reefs might cause and the impact that these might have on yachts racing around course markers. It is noted that all of the proposed sites are close or adjacent to highly trafficked course markers.

We respectfully submit that the reef locations be reviewed to move to parts of the river where they will not impact existing, regular and long-standing yachting activities, or that they be located such that water depths above the reef are no higher than 5m below LAT.

Given the extent of our concerns and those expressed by our peak body YWA / Australian Sailing, we would appreciate further opportunities for consultation prior to any approvals being considered.

Thank you for your consideration in this important matter.

Kind regards

Rob Parker
Commodore

CC: Mark Nicholas, Yachting Western Australia
CC: Andy Fethers, Australian Sailing WA
CC: Mark Briant, Department of Transport Marine Safety
CC: Andrew Bossie, The Nature Conservancy

Appendix B

Dear John

Having studied the proposal for the Blue Mussel Reef project, we wish to voice our concerns with respect to the impact such a project would have on the sport of sailing.

We have read the submission sent to you by the Royal Freshwater Bay Yacht Club which reflects our concerns precisely. Given that we share the same view which has also been expressed by our peak body, Australian Sailing, we see little point in repeating what they have submitted.

We request that this project be stopped until a suitable design is prepared following consultation with the many organizations that use the river for recreational and competitive purposes.

Regards
Stuart

Stuart N Walton
General Manager
Royal Perth Yacht Club

Appendix C

1st December 2021

Mr John Riley
Environmental Officer
Department of Biodiversity, Conservation and Attractions
Locked Bag 104, Bentley Delivery Centre
BENTLEY WA 6983

Dear John,

Re: Blue Mussel Reef Construction Project

Having reviewed the contents of the proposed Blue Mussel Reef Project, the South of Perth Yacht Club has some concerns regarding the location of the proposed reefs and in regard to the potential impacts on our club's sailing operation.

While acknowledging and supporting the environmental benefits of such a project we share concerns raised in the attached communication from Australian Sailing / Yachting Western Australia and we would like to see additional consultation with clubs on the matter to ensure our boats do not impact on the proposed reefs.

Yours sincerely,

Keith McLuckie
General Manager

Appendix D

Mr John Riley

Environmental Officer

Department of Biodiversity, Conservation and Attractions (DBCA)

Locked Bag 104

Bentley Delivery Centre WA 6983

Ref: Blue Mussel Reef Construction Project – Freshwater Bay

Dear John,

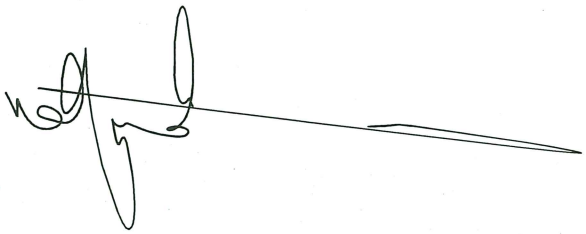
We have reviewed the proposal for Freshwater Bay – and we wish to advise you that we are opposed to the location of the reefs.

Whilst we are in favour of the environmental benefits, the locations of the reefs near Karrakatta Spit and Middle Spit in particular – would make our on-water competitions dangerous for our members, volunteers and visiting competitors. These are high-traffic areas.

We have plotted the proposed locations of the reefs in freshwater bay. They are in the direct path of our navigation courses. We feel that the depths below LAT of 3.2m are extremely dangerous for yachts – not to mention the crowded water the reefs could create with fishers and crabbers all vying for the same water space once the reefs are established.

With respect, we submit that the reef locations be reviewed and moved to areas that will not impact regular and long-standing yachting activities and at depths below 5m below LAT. Should you wish to discuss this further please do not hesitate to make contact with our club.

Yours sincerely,



Darren Chatfield

COMMODORE

Claremont Yacht Club

Thursday, 2 December 2021

Australian Sailing

YACHTING WESTERN AUSTRALIA

Appendix E

Mr John Riley

Environmental Officer

Department of Biodiversity,

Conservation and Attractions (DBAC)

Locked Bag 104, Bentley Delivery Centre

WA 6983

Phone (08) 9278 0925

Email john.riley@dbca.wa.gov.au

Web www.dbca.wa.gov.au

Re: Part 5 – 2021 – 2616 The Nature Conservancy Limited – Blue Mussel Reef Construction Project; https://www.dbca.wa.gov.au/node/473

Reference #2021/2616

Dear John,

Yachting Western Australia and Australian Sailing have safety concerns around the subject Blue Mussel Reef Project in the Swan River Park.

Our member clubs have several yachts that have drafts exceeding three meters. The proposed project includes indicated depths which include:

- Proposed Attadale Reef at -4.0 meters LAT
- Proposed Freshwater Bay 1 Reef at -3.6 meters LAT
- Proposed Freshwater Bay 2 Reef at -3.6 meters LAT
- Proposed Point Walter Reef at -3.2 meters LAT

It is the view of YWA and AS that these are not sufficiently deep to allow safe navigation in the proposed areas of the Swan River, given the current and future boating requirements and event hosting considerations. It is also important to note that LAT (Lowest Astronomical Tide) does not represent extreme levels and certain meteorological conditions can cause a lower level than LAT.

Also of concern is the proposed sites given they are directly in the "usual" racing courses areas of most of the River-based clubs in the following locations:

- Proposed Attadale Reef in the vicinity of racing markers Smith and Lucky Bay Buoys
- Proposed Freshwater Bay 1 Reef in the vicinity of Dinghy Starting line Claremont Yacht Club
- Proposed Freshwater Bay 2 Reef in the vicinity of Middle Spit and Parker Buoy
- Proposed Point Walter Reef in the vicinity of Tasker Spit

We have requested of Mr Andrew Bossie, from the Nature Conservancy Oceans, Project Coordinator a map overlaying the locations with a Nautical Chart for greater clarity and to distribute to our member clubs before the end of the notification period ending on the 26th of November.

We have also voiced our concerns with the Department of Transport Marine Safety via Mr Mark Briant who has requested he be copied on this correspondence.

Our member yacht clubs are cognisant of the intended environmental purpose of this project but are vehemently opposed to any encroaching on existing racing considerations and are generally opposed to anything that increases obstacles in an already narrow waterway.

Please take this letter as a formal recommendation to reconsider the parameters and locations of the proposed, on behalf of our eleven river-based member clubs and our 22,000 members in WA and 120,000 members nationally.

Mark Nicholas BE, MBA, CPEng, FIEAust, GAICD

President, Yachting Western Australia

CC: Mark Briant	Department of Transport Marine Safety	mark.briant@transport.wa.gov.au
CC: Andrew Bossie	The Nature Conservancy	andrew.bossie@tnc.org

ATTACHMENT 5H

From:	tern@iinet.net.au
To:	John Riley
Cc:	Claire Greenwell
Subject:	Re: Part 5 - 2021/2616 - Swan River - Point Walter, Freshwater Bay and Attadale - Blue mussel reef construction project - The Nature Conservancy Limited
Date:	Saturday, 13 November 2021 11:38:06 AM
Attachments:	Greenwell et al. 2021. Feeding ecology of Australian Fairy Terns.pdf

Hi John

The Conservation Council (and WA Fairy Tern Conservation) have a number of comments and concerns.

1. The Blue Mussel is not to our knowledge a native species?
2. The Point Walter structures may alter sediment erosion / accretion and change the shape of the sandbar. Fairy Tern breeding habitat may be lost from the island.
3. The reefs may provide attachment for invasive sessile species (eg. Sabella).
4. The proposed structures are located within the the 'prey-field' area that supports Fairy Tern colonies on the island. This may alter foraging patterns positively / or negatively? Would need to be monitored.
5. Construction should not occur between October and February to avoid disturbance to foraging.
6. If recreation fishing is permitted on the reefs it may increase pressures on large mobile target species. Recommend that the reefs be closed to fishing.

Regards

Dr Nic Dunlop
Citizen Science Program Coordinator
Conservation Council WA

----- Original Message -----
From:
"John Riley" <john.riley@dbca.wa.gov.au>

To:
"tern@iinet.net.au" <tern@iinet.net.au>
Cc:
"Rivers Planning" <rivers.planning@dbca.wa.gov.au>
Sent:
Fri, 12 Nov 2021 06:56:30 +0000
Subject:
Part 5 - 2021/2616 - Swan River - Point Walter, Freshwater Bay and Attadale - Blue mussel reef construction project - The Nature Conservancy Limited

Good afternoon,

PART 5 – SWAN RIVER – POINT WALTER, FRESHWATER BAY AND ATTADALE – BLUE MUSSEL REEF CONSTRUCTION PROJECT – THE NATURE CONSERVANCY LIMITED

The Department of Biodiversity, Conservation and Attractions (DBCA) has received an application for the above mentioned development. The application can be downloaded from DBCA's website here https://www.dbca.wa.gov.au/node/473. Your organisation is invited to provide comments relevant to this proposal.

Prior to the report being prepared, the application has been referred to other relevant agencies for comments and advice. Accordingly, could you please provide a response to this office by 26 November 2021 (or earlier). Should you not be able to respond within this time, please notify the department as soon as possible, outlining the reasons for the delay and a date when a response may be available.

In preparing your response, please be aware that it may be made available for viewing by the public, unless otherwise requested.

Please forward your response via email to rivers.planning@dbcawa.gov.au. Should there be any queries regarding this matter, please contact John Riley, Environmental Officer, on 9278 0900. In all correspondence please quote the reference number **2021/2616**.

Yours sincerely

John Riley

Environmental Officer | Statutory Assessments | Rivers and Estuaries Branch (**Wed-Fri only**)

Department of Biodiversity, Conservation and Attractions

Locked Bag 104, Bentley Delivery Centre WA 6983

Phone: (08) 9278 0925

Email: john.riley@dbca.wa.gov.au Web: www.dbca.wa.gov.au

We acknowledge the Whadjuk people as the Traditional Owners of this land.

From: [redacted]
To: John Riley; Briant, Mark; YWApresident@sailing.org.au; andrew.bossie@TNC.ORG; "Andy Fethers"
Subject: Swan-Canning Reef Builder Project - as prepared by Andrew Bossie of The Nature Conservancy.
Date: Friday, 26 November 2021 7:14:09 PM

All,

I comment on this project as a long-time sailor on the river having started in the late 1960's.

Whilst I have no scientific environmental qualifications I spent 33 years of my working life as a cartographic/GIS consultant specialising in projects requiring environmental assessment. I worked directly with Government agencies, private industry and consultants.

I have several concerns regarding this proposal:

- Page 19 states that "The precinct is also significant for the Whadjuk Noongar people who recognise several sites of importance as part of the Mooro district. No individual culturally significant sites are impacted by the reef location." Is this the full extent of any input from the research involving the indigenous traditional owners ? Given the Swan River plays such a large part of the lives of the indigenous traditional owners of the land, I will be interested to see what this proposal means to them given it is likely to cause at least some accretion/erosion to the riverbed and subsequent disturbance to the tidal flow as well.
- From a sailing/boating perspective:
    - The modelling is flawed by the lack of any criteria that truly reflects the area used for sailing/boating. The true areas that sailors/boaters use and enjoy are extremely different to what are modelled. The terms "main boating tracks" and "small boating channels", as used and modelled, are incongruous in their use in the document. The sailing/boating area is hard to define, let alone put a physical boundary to, apart from it being logically wherever the water is sufficient to float a particular boat. I note you use the terms "large/small navigation channel" in the legend of the map for Conflicting Estuarine Uses (page 20) and agree with that terminology because it may be defined. I assume this is what was chosen to be modelled.
    - All forms of competitive sailing (from dinghies to keelboats to foiling windsurfers) operate in an area of the river that is only bounded by water depth (sometimes defaulting to established channel markers).
    - The first common point in any of these competitive forms of sailing is the fixed position marks that are part of established yacht racing courses. These should have been assigned a criteria value and modelled. As an aside, please note that a yacht at racing speed can cover the 50m and 100m criteria for shipping channel avoidance in 5 and 10 seconds respectively. Smaller foiling dinghies could be more like 3 and 7 seconds respectively.
    - The second common point in any of these competitive forms of sailing is the variable positions of temporary "day" marks that are used and removed often but not always in the same place. Wind direction and depth are the factors that determine their placement. Modelling of the "day" marks would be almost impossible but a pattern is possible.
    - None of these marks apply to the sailors/boaters who are enjoying a recreational day out and those marks have no meaning, nor represent any boundaries, for them

To try to model a recreational sailing parameter and assign a criteria is a challenge to say the least but would be likely to include anything that was deep enough to float a particular boat.
    - It appears that the channel markers and fixed racing marks are not modelled at all apart from 50m either side of a shipping channel/small craft channels.
    - It appears that recreational boating/sailing (apart from close to navigation channels) is not modelled at all. This is a very major oversight.
- One trend in sailing is towards deeper keeled, faster yachts. I'd suggest that a more realistic criteria is 4m or preferably 5m as opposed to the current "No shallower the 3.5m and maintain at least 3m over the highest point". Whilst I recognise the desire to nominate 3.5m deep as a minimum I am also aware that that may not be guaranteed because some of the rocks may be 1m in size and sit atop the reef at less than that unless physically inspected. In a case of a boat hitting a reef at a modest 10knots the personal injuries to crew and damage to the boat can be severe.
- This does take into consideration that a boat will be anything other than upright when passing over the reefs. Capsized dinghies may draw 6 to 7m for their inverted masts.
- The Freshwater Bay sites and the Attadale site are planned for two of the busiest localities on the river because of your modelling criteria not reflecting the amount of traffic and hence they increase the amount of exposure to risk.
- If this project fails due to any circumstance what mechanism is in place to remove/rehabilitate the reefs ?

Regards,

[redacted]

Dear John Riley and Hamish Beck

I have just become aware of the Swan Canning Reef Builder Project and would like to make some quick comments on it.

First, my background is that I was [redacted] research assistant over three years investigating benthic fauna in the Swan River and other estuaries of SW WA in the early 1970s, then spent three years researching marine fouling growth at Garden Island where blue mussels were a major part of the ecological community. This was followed by a couple of decades researching marine fouling on offshore oil and gas structures where mussel-like organisms were also a significant part of the ecological community. I also conducted extensive marine habitat and biota surveys along the WA coast.

In relation to mussels at Garden Island, I found that predators were extremely important in determining where and when mussels could survive. I did numerous protective caging experiments, exposure experiments, fish gut analysis and aquarium predation trials on different size mussels and a range of fish species. Mussels and mussel-like species were "fugitives in space and time". They colonised new environments rapidly in large numbers before predators existed in those environments. Then as predators also became established in those habitats, they disappeared and did not persist there. They only continued to persist in areas where predators could not survive such as intertidal zones. At Garden Island ten of the most common 12 fish species ate mussels. Juvenile mussels were highly vulnerable to fish predation and a size of 20mm was necessary to start to become safe from fish. However other predators such as carnivorous molluscs and starfish were able to successfully prey on larger mussels.

As the Stirling Naval base was established, I watched mussels colonise the limestone breakwaters, rapidly achieving 100% cover. Over the next couple of years, fish predation reduced the numbers of small mussels and predators such as the muricid gastropod Bedeva and the starfish Cosnosterias became established and the larger subtidal mussels gradually disappeared. At the end of three years, most of the mussels had disappeared from subtidal areas where the predators could access them, and only persisted in the intertidal zone. Similarly, I also recorded mussel-like organism disappear from offshore oil and gas structures as predatory species became established.

Mussels are able to persist on some physically isolated habitats such as jetty piles or mussel farms where predators have difficulty accessing them or where the predators have limited protection themselves.

Several of the fish species that I recorded eating mussels at Garden Island do, or could occur, in the Swan River. Black bream and pink snapper are also likely to eat Blue mussels. Similarly, the gastropod mollusc Bedeva is also known to occur throughout the lower and middle Swan River zones. Blue swimmer crabs and Xanthid Crabs are also likely to be predators of Blue mussels in the

Swan River. The Reef Builder report also notes that Blue Mussels at present only occur 'naturally' in the Swan River in intertidal zones. This should be a warning that Blue mussels are unlikely to persist and maintain colonies on artificial reefs in subtidal areas of the Swan River.

Another comment that I would like to refers to Page 11 of the report where it states that Blue Mussels are "native to the Swan Canning Estuary". When I was talking to the Assistant Curator of Molluscs at the WA Museum in 1980 about exotic species in the Swan River (and I discovered a couple of newly introduced species), she stated that aboriginal middens of the Swan River did NOT contain Blue Mussels and at that time, she considered that Blue mussels were an introduced exotic species. In WA, Blue Mussels only occur in high nutrient or eutrophic environments that are man-modified where they can escape predation, in river mouths, estuaries, marinas or ports. I have never seen Blue Mussels in natural environments where nutrients are lower and predators abound. Blue Mussels are fouling species that commonly colonise ships, particularly wooden ships, and are known to have been transported around the world.

In conclusion:

- The artificial limestone reefs will increase biological diversity of the area by introducing a new habitat into soft sediment estuary flora.
- There is likely to be a halo effect of predatory fish on the soft sediment biota in the area surrounding the reefs.
- The report has NOT established that Blue Mussels can survive outside cages in the long term.
- The report has NOT considered the effects of non-fish predators such gastropod molluscs and crabs which are known predators of Blue mussels and which may take a couple of years to build up in numbers on the artificial reefs.
- The report has NOT shown that Blue Mussels will naturally recruit onto these reefs, and survive, in the future so that there is an ongoing recruitment process without the need to artificially replace mussels on the reef from farmed stocks on a yearly basis.
- The report has ignored its own information where it states that Blue Mussels currently only occur intertidally on rocky structures in the Swan River. This is critical information because if Blue mussels do not occur in subtidal areas in the Swan River at present, they will not do so in the future.
- If Blue Mussel survival, recruitment and persistance are not successful on these artificial reefs, what are the plans to remove the reefs and who is going to fund it.
- Recommendation: Survey subtidal limestone features in the Swan River to detect whether Blue Mussels can persist there in large numbers before proceeding with this project. If they cannot exist on naturally occurring subtidal habitats in the Swan River at present, it is not worth proceeding with this project.

I would be happy to talk further about this topic in detail if required.

ATTACHMENT 5K

Mr John Riley

Environmental Officer

Department of Biodiversity, Conservation and Attractions (DBCA)

Locked Bag 104

Bentley Delivery Centre WA 6983

Ref: Blue Mussel Reef Construction Project – Freshwater Bay

Dear John,

We have reviewed the proposal for Freshwater Bay – and we wish to advise you that we are opposed to the location of the reefs.

Whilst we are in favour of the environmental benefits, the locations of the reefs near Karrakatta Spit and Middle Spit in particular – would make our on-water competitions dangerous for our members, volunteers and visiting competitors. These are high-traffic areas.

We have plotted the proposed locations of the reefs in freshwater bay. They are in the direct path of our navigation courses. We feel that the depths below LAT of 3.2m are extremely dangerous for yachts – not to mention the crowded water the reefs could create with fishers and crabbers all vying for the same water space once the reefs are established.

With respect, we submit that the reef locations be reviewed and moved to areas that will not impact regular and long-standing yachting activities and at depths below 5m below LAT. Should you wish to discuss this further please do not hesitate to make contact with our club.

Yours sincerely,

Darren Chatfield

COMMODORE

Claremont Yacht Club

East Fremantle
Yacht Club
ESTD. 1933

26th November 2021

Mr John Riley
Environmental Officer
Department of Biodiversity, Conservation and Attractions
Locked Bag 104
BENTLEY DC WA 6983

Dear John

Re: Part 5 -2021 - 2616 The Nature Conservancy Ltd – Blue Mussel Reef Construction Project

It has been brought to our attention that Yachting Western Australia has submitted correspondence to the Department of Biodiversity, Conversation and Attractions (DBCA) regarding the Blue Mussel Reef Construction Project. In support of this correspondence, the East Fremantle Yacht Club believes the proposed reef locations as per the letter submitted by Mark Nicholas, has the potential to impact our sailing and boating activities in the following manner.

1) the sheer volume of rock they are proposing to deposit in the river is going to have significant impacts on the way the river flows, potentially changing the course of the river. The reef proposed near Tasker will dramatically affect flow on both an incoming and outgoing tide potentially scouring out Point Walter sand spit.

2) the proposed locations of the other artificial reefs are not in any way benign, impacting substantially on RFBYC and CYC start/ finish lines and dinghy courses. The reef in the vicinity of Bricklanding A & B will affect every yacht club downstream of the Narrows and Canning Bridges. Regardless of the proposed depth at low tide, any sailing dinghy capsizing and turning turtle will foul on the rocks.

Additionally, over time we have seen a gradual increase in the size of keelboats in the river-with corresponding deeper keels, this is unlikely to change. Obviously, owners of such boats accept that the natural contours of the river bed will limit the navigable part of the river but putting artificial impediments in place around some of the most used turning marks on the river currently accessible to larger vessels is restrictive and unwarranted.
3) Australia has a questionable history of intervention in nature to rectify perceived environmental problems.
The change to the coastline at/ around Hillary's due to the imperfect modelling of the changes to water flow resulting from the construction of Hillary's Boat Harbour or Port Geographe marina are two examples. The introduction of the cane toad another. These examples of unintended consequences have cost millions to rectify with negligible effect. Who knows what will result from this well-meaning project?

Overall, the individual size of the test sites on which the proposal is based are so small that data collected cannot possibly be used to determine the impacts of the large-scale installations that are proposed.

To the best of my knowledge, with the possible exception of the Tasker site near Blackwell reach, the areas proposed for the installation of these reefs are not areas where limestone has been a feature of the riverbed since well before white settlement, so the changes proposed are substantially changing the geological makeup of the riverbed.

Instead, perhaps they should be installing such reefs in areas where a limestone structure is already a featured such as between the low water mark and the spit post at Pt Resolution where boating activity is already precluded due to hazards. I am sure there are other places suitable also that are not going to alter the original composition of the riverbed or impact on the activities water users, particularly those with some of the lowest environmental impact.

We would welcome further consultation on the proposal, given the immense impact it will have on our Club

Yours sincerely

Mrs. Margaret Shiner
Commodore

TELEPHONE:
+61 (8) 9286 8200

EMAIL: rfbyc@rfbyc.asn.au

WEBSITE: www.rfbyc.asn.au

KEANE'S POINT
PEPPERMINT GROVE
WESTERN AUSTRALIA 6011

POSTAL ADDRESS
P.O. BOX 373,
COTTESLOE, WA 6911

ABN: 82 671 754 734

Thursday, 25 November 2021

Mr John Riley
Environmental Officer
Department of Biodiversity, Conservation and Attractions (DBCA)
Locked Bag 104, Bentley Delivery Centre
WA 6983

Ref: Part 5 – 2021 – 2616 The Nature Conservancy Limited – Blue Mussel Reef Construction Project

Dear John,

On behalf of the 2,300 members of Royal Freshwater Bay Yacht Club, our guests, visiting competitors and participants we wish to register our safety and operational concerns about the proposed Blue Mussel Reef Project in the Swan River Park.

Proposals and projected plots onto charts of the river indicate the proposed locations for these artificial reefs to be in the direct pathway for race courses used by most of the yacht clubs on the river including RFBYC and are therefore subject to regular high levels of boating traffic on and around these areas.

Of greatest concern is the shallow depth clearances proposed, with depths below LAT of as little as 3.2m. With yachts of up to 50 feet and draughts of up to 3m, the indicated depths are not sufficient to give a safety factor or allow for other meteorological effects such as high pressure and offshore winds.

Similarly, we also have concerns about the sudden change in wave-state that these reefs might cause and the impact that these might have on yachts racing around course markers. It is noted that all of the proposed sites are close or adjacent to highly trafficked course markers.

We respectfully submit that the reef locations be reviewed to move to parts of the river where they will not impact existing, regular and long-standing yachting activities, or that they be located such that water depths above the reef are no higher than 5m below LAT.

Given the extent of our concerns and those expressed by our peak body YWA / Australian Sailing, we would appreciate further opportunities for consultation prior to any approvals being considered.

Thank you for your consideration in this important matter.

Kind regards

Rob Parker
Commodore

CC: Mark Nicholas, Yachting Western Australia
CC: Andy Fethers, Australian Sailing WA
CC: Mark Briant, Department of Transport Marine Safety
CC: Andrew Bossie, The Nature Conservancy

From:	Stuart Walton
To:	John Riley
Cc:	Andy Fethers; scott.johnston@sailing.org.au
Subject:	Blue Mussel Reef Construction Project
Date:	Friday, 26 November 2021 2:11:24 PM

[External Email] This email was sent from outside the department – be cautious, particularly with links and attachments.

Dear John, having studied the proposal for the Blue Mussel Reef project, we wish to voice our concerns with respect to the impact such a project would have on the sport of sailing.
We have read the submission sent to you by the Royal Freshwater Bay Yacht Club which reflects our concerns precisely. Given that we share the same view which has also been expressed by our peak body, Australian Sailing, we see little point in repeating what they have submitted.
We request that this project be stopped until a suitable design is prepared following consultation with the many organizations that use the river for recreational and competitive purposes.
Regards
Stuart

Stuart N Walton
General Manager
Royal Perth Yacht Club

Rivers and Estuaries Branch
Department of Biodiversity, Conservation and Attractions
17 Dick Perry Avenue, Kensington WA 6151

Re: Blue Mussel Reef Construction Project - The Nature Conservancy Limited (2021/2616).

OzFish Unlimited is a not-for-profit charity that is well established nationwide. We facilitate recreational fishers taking action for river, lake, estuarine and ocean health, primarily through habitat restoration. OzFish does this by partnering with community groups, Councils, Universities and Government agencies to invest time, knowledge, and money to protect and restore our waterways, counteracting decades of degradation.

One organisation we are proud to partner with is The Nature Conservancy (TNC) in habitat restoration projects across the country and particularly in Western Australia. In our dealings with the Perth TNC branch, we have found them to be knowledgeable, trustworthy, and able to deliver project outcomes in a timely and professional manner. We are confident they have the skills and resources to deliver the Blue Mussel Reef Construction Project successfully.

This project is a positive move towards improving the health of local waterways by enhancing existing habitats. By providing hard substrate and encouraging mussels and reef building organisms, the project will increase local biodiversity and abundance of fish and invertebrate species. The Blue Mussel Reef will have positive environmental outcomes such as nutrient removal by filter feeders and community outcomes such as improved recreational fishing in the vicinity.

After review of the draft project report, it is obvious that this project has been carefully designed and researched in close consultation with relevant stakeholders and authorities. The considerate and flexible approach demonstrated by TNC is commendable. OzFish Unlimited supports the proposed Blue Mussel Reef Project and we look forward to seeing it completed successfully.

Kind Regards

Steve Pursell
OzFish Program Manager - Western Australia

From: Shenaye Hummerston
To: Rivers Planning
Subject: comment on draft report 2021/2616
Date: Wednesday, 8 June 2022 3:35:41 PM
Attachments: image001.png

To: the Department of Biodiversity, Conservation and Attractions

Re: **PART 5 - DRAFT REPORT - 2021/2616 - BLUE MUSSEL REEF CONSTRUCTION PROJECT - THE NATURE CONSERVANCY LIMITED**

Perth NRM is in full support of the Nature Conservacy's application for Part 5 approval for the Blue Mussel Reef Construction Project. The Swan River Estuary is subject to significant degradation due to the impacts of sediment and nutrient pollution and habitat removal. This project represents a great opportunity to improve water quality through increased biofiltration and improve biodiversity and ecosystem resilience through increasing habitat availability for a range of estuarine species.

The project aligns with Perth NRM's values and aims in building on natural systems and processes to maximise environmental outcomes and community benefits through habitat augmentation in our urbanised areas. The project compliments the work Perth NRM is supporting through TNC on the Black Pygmy Mussel in the middle Swan and Canning Rivers as well as the 21 projects Perth NRM is supporting in the community through our Swan Canning River Recovery Project.

Kind Regards,
Shenaye

Please note: I am part-time working Tuesdays, Wednesdays and Thurdays

Logo

Shenaye Hummerston | Conservation Program Manager

Perth NRM | Whadjuk Noongar Boodja
Suite 3, 11 Brodie-Hall Drive | Bentley, WA, 6102
e: shenaye.hummerston@perthnrm.com | **w:** www.perthnrm.com/
p: (08) 9374 3324

Perth NRM acknowledges the traditional custodians throughout Australia and their continuing connection to the land, waters and community. We pay our respects to all members of the Aboriginal communities and their cultures; and to Elders past and present.

recfishwest

Mr John Riley
Environmental Officer
Department of Biodiversity, Conservation and Attractions (DBCA)
Locked Bag 104, Bentley Delivery Centre
BENTLEY WA 6983

Dear John

BLUE MUSSEL REEF CONSTRUCTION PROJECT - SWAN RIVER - POINT WALTER, FRESHWATER BAY AND ATTADALE

As the recognised peak body representing the interests of more than 740,000 recreational fishers in Western Australia Recfishwest place the highest priority on preserving the marine environment and safeguarding the future of recreational fishing experiences which rely on access, healthy habitats, and abundant fish stocks.

Recfishwest fully supports the rehabilitation of shellfish reefs throughout Western Australia and have been actively involved in promoting such projects to the recreational fishing community. Recfishwest recognises the importance of rehabilitating in water habitat and are actively involved in several projects designed to improve habitat in freshwater, estuarine and oceanic waters. Increasing the volume and complexity of mussel habitat within the Swan-Canning estuary will provide long and short term benefits for fish populations and abundances as well as providing broader societal benefits.

Recfishwest has worked with The Nature Conservancy on other shellfish reef projects in Western Australia and is a member of the Technical Advisory Group for this project. As a member on this group Recfishwest can provide relevant, informed information to aid TNC's design and scope as well as aid engagement with the recreational fishing community, arguabley the largest on water stakeholder group affected by this this project.

The Swan-Canning estuary is a significant recreational fishery and improving habitat while maintaining recreational access is a primary concern for Recfishwest. Recfishwest fully supports The Nature Conservancy's proposed mussel reef project and are committed to contributing towards this project to help make it a success. Should you require any further information in this regard, please do not hesitate to contact me on 9246 3366.

Yours sincerely

J Dempsey

John Dempsey
Recfishwest Operations Team

7 June 2022

Suite 3, 45 Northside Drive, Hillarys WA 6025
Tel: (08) 9246 3366 Email: info@recfishwest.org.au Web: recfishwest.org.au facebook.com/recfishwest
Western Australian Recreational and Sportfishing Council trading as Recfishwest ABN: 77 922 817 608

From: Susan Haste
To: Rivers Planning
Subject: Fwd: Shellfish Reefs Rivers Planning
Date: Thursday, 9 June 2022 2:20:15 PM

[External Email] This email was sent from outside the department – be cautious, particularly with links and attachments.

Sent from my iPhone

> To whom it concerns
>
> Thank you for an opportunity to comment on the Swan Shellfish Reef Development .
> It has been very impressive the amount of research and consultation that has been achieved .The work done has identified best possible locations for the reefs success and close consultation with such users of the areas such has the Sailing Clubs will enhance its success.
> Club members are frequently diving the river and the new reefs would provide a potential brilliant new area for photography .
> We would anticipate using a dive flag in the vicinity for safety as it will also be considered a fishing area.
>
> We have been involved in the Rottnest Reef Life Survey yearly providing a vessel .This may be something that could be considered for any monitoring.Members of the club have show in the past to be happy to engage with community activities and as experienced divers and photographers may be another help for future monitoring.
> Thank you again for the opportunity for comment

> Susan Haste
> Environment Officer
> Underwater Explorers Club
0438918481
>>
>>
>>
>>

East Fremantle
Yacht Club
ESTD. 1933

Thursday 9th June 2022

Mr John Riley
Environment Officer
Department of Biodiversity, Conversation and Attractions
Locked Bag 104
BENTLEY DC WA 6983

Dear John

Re: Part 5 2021/2616 The Nature Conservancy Ltd – Blue Mussel Reef Construction Project

Further to our correspondence submitted 26th November 2021, East Fremantle Yacht Club still believes the proposed reef locations will impact our sailing and boating activities.

Our reasons from our first submission haven't changed and submit further details that we would like to be considered. We fully support the objections submitted by Mark Nicholas, President of Yachting Western Australian on behalf of Australian Sailing.

At a meeting on 28th January 2022, which YWA attended it was raised the relevant areas of concern were only to Freshwater Bay 1 and Attadale reef locations. As our club is located South of the reefs our biggest impact will be the reef location at Point Walter. Due to the width of the river we use Tasker & Point Walter marks in our sailing courses to stay clear of the river water due to the busy boating traffic heading to & from Fremantle. The other reef locations do impact our sailing courses as well.

In point 3.4 YWA was appreciative of the revised four metre vertical separation taking into account only Keelboat sailing. Our Centreboard classes of boats have masts that would be impacted if they capsized in any of the areas eg: Sharpies have a mast of 6.14m, Skates 7.2m, National 125 5.65m and Sabre mast is 5.3m. We also have concerns the same as YWA the reefs will attract additional fishing to the area(s) that would impact during racing events.

The amount of limestone going to be used in the construction will have an impact on Point Walter bank. Strong currents impact our club and we feel the increase to the Point Walter reef will upset the flow of current which will have an impact on the sandbank at Point Walter.

You haven't indicated the time frame when construction would commence due to the draft report only been released for public comment. It should be noted that the sailing season for 2022-2023 begins in October 2022 and finishes April 2023. Then clubs hold winter sailing as well.

Given the immense impact it will have on our Yacht club please take the above into consideration.

Yours sincerely

Margaret Shiner
Commodore

From:	Melissa Davis
To:	Rivers Planning
Subject:	RE: Draft Report - Part 5 - 2021/2616 - Blue mussel reef construction project - Swan River - Point Walter, Freshwater Bay and Attadale - The Nature Conservancy
Date:	Monday, 30 May 2022 10:09:01 AM
Attachments:	image003.png image001.jpg

[External Email] This email was sent from outside the department – be cautious, particularly with links and attachments.

Good morning,

Thank you for notifying us of the draft report that has now been made available for public comment. We have already made comments on this report and have nothing further to add.

Kind regards,
Melissa

Melissa Davis | Assistant Manager, Aboriginal Heritage Conservation | Heritage and Property Services
140 William Street, Perth WA 6000
6552 4080 | 0448 970 519
www.dplh.wa.gov.au | Please note that I'm unavailable on Thursdays.

Keep WA COVID safe

Get tested if you are unwell, get vaccinated including a booster, wash hands, wear masks when required, social distance, carry your vaccination certificate and check-in at locations.

The Department acknowledges the Aboriginal people of Western Australia as the traditional custodians of this land and we pay our respects to their Elders, past and present.

From: Rivers Planning <rivers.planning@dbca.wa.gov.au>
Sent: Friday, 27 May 2022 1:15 PM
To: Melissa Davis <Melissa.Davis@dplh.wa.gov.au>
Subject: Draft Report - Part 5 - 2021/2616 - Blue mussel reef construction project - Swan River - Point Walter, Freshwater Bay and Attadale - The Nature Conservancy

Good afternoon,

PART 5 - DRAFT REPORT - 2021/2616 - BLUE MUSSEL REEF CONSTRUCTION PROJECT - THE NATURE CONSERVANCY LIMITED

The draft report on the above mentioned proposal has been prepared and released for public comment for a period of 14 days in accordance with Section 75(4) of the *Swan and Canning Rivers Management Act 2006*.

The report is available here: https://www.dbca.wa.gov.au/node/569

Should you wish to comment on the draft report, please forward your submission to the Department of Biodiversity, Conservation and Attractions prior to 10 June 2022 at

rivers.planning@dbca.wa.gov.au. Submissions received outside this time may not be accepted.

Submissions made will be considered by the Director General of the department before the report is finalised and a recommendation made to the Minister for Environment.

If you have any queries regarding this matter, please contact John Riley, Environmental Officer, on 9278 0900. In all correspondence please quote the reference number 2021/2616.

Yours sincerely

Statutory Assessments
Rivers and Estuaries Branch
Department of Biodiversity, Conservation and Attractions
17 Dick Perry Avenue, Kensington WA 6151
Locked Bag 104, Bentley Delivery Centre WA 6983
Email: rivers.planning@dbca.wa.gov.au Web: www.dbca.wa.gov.au

We acknowledge the Whadjuk people as the Traditional Owners of this land

The Nature Conservancy
Australia

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Rivers Planning
The Department of Biodiversity, Conservation and Attractions

9th June 2022

RE: Public comment 4.2 Attachment 3J, Part 5: Development Application 2021/2616

Dear Rivers Planning

As the proponent of Part 5: Development Application 2021/2616, The Nature Conservancy Australia (TNC) has prepared the attached response to the public comment '4.2 Attachment 3J' that was provided in the Draft Report prepared by DBCA.

We request that TNC's response be considered in DBCA's Final Report regarding this Development Application.

Please reach out if you have any queries regarding this response.

Best regards,

Andy Bossie
Oceans Project Coordinator, The Nature Conservancy

T: (+61) 421756271
E: andrew.bossie@tnc.org
Our people (natureaustralia.org.au)

Response to public comment 4.2 Attachment 3J (Part 5: Development Application 2021/2616), prepared by The Nature Conservancy Australia

Firstly, we thank the author of the above Attachment, prepared in response to The Nature Conservancy Australia's (TNC's) Development Application to rebuild shellfish reef ecosystems in the lower Swan-Canning Estuary.

The author has provided some compelling arguments, and we welcome insights from their research experience in the estuary and Cockburn Sound in the 1970s. While we agree on some of the points raised, the collective experience of members of our scientific and restoration team that have worked in shellfish reef restoration (and more particularly Blue Mussel reef restoration) Australia-wide, and/or the benthic ecology of the estuary and Cockburn Sound over many decades, yields important evidence that counters other key points raised by the author.

We provide our responses below to each of the main points raised in the Attachment.

Predation

We agree with the author that there are various predators of Blue Mussels (*Mytilus galloprovincialis*) that occur in the lower estuary and that juvenile mussels are especially vulnerable to predation. Our own mussel predation experiments undertaken in the Swan-Canning and Peel-Harvey estuaries indicate that mussels <20 mm in size are heavily susceptible to predation, while those >40 mm were far less vulnerable. These findings have since guided the minimum size mussels need to attain before they are seeded to the reef substrate in our restoration work. Some of our other learnings regarding predation during the pilot phase of our Swan-Canning reef restoration project include the following:

1. Mussels seeded to flat coir-mesh substrates, which were trialled as mussel 'beds' in the shallows, were highly vulnerable to predation as they provided no refuge, unlike the rocky/rubble substrate trialled in the deeper waters which provided considerably more protection due to abundant crevices. This has focussed our work in the subtidal zones where rocky substrates can be deployed with no navigational risk to watercraft, as well as influenced the design of the full-scale reefs to incorporate considerable heterogeneity with regard to rock size, undulation of the reef surface, and a diversity of reef unit dimensions.
2. Providing newly-seeded mussels with the opportunity to firmly attach themselves to the substrate and form dense aggregations affords them with far greater resilience from predation. This can be achieved through (i) ensuring seeding happens at a time of year when the abundance of key predators in the lower estuary is typically lower (i.e. during winter); (ii) ensuring seeding is undertaken before large quantities of other colonising plants and animals have become established on the substrate, and; (iii) installing protective netting over sections of the reef during the initial months following seeding (which is later removed following mussel establishment).

The above learnings have helped shape improvements in our mussel restoration approach for the proposed full-scale reef build in the Swan-Canning Estuary. It should also be noted that some of these learnings were in fact a consequence of 2020 being one of the poorest mussel recruitment years on record on the Cockburn Sound shellfish aquaculture lease (which supplies the Blue Mussel stock for this project). This exceptionally-poor mussel spatfall season led to the mussels initially being seeded onto the pilot reef substrate at a far smaller size and ~5 months later than planned (i.e. during summer as opposed to winter). In contrast, the 2021 mussel spatfall season (i.e. that producing the mussels to be seeded onto the proposed full-scale reefs in 2022) has been far stronger and typical of that expected, with mussel growth on track to attain minimum seeding size by winter as planned. As identified above, exploiting this winter time window for reef construction followed by timely seeding is imperative to bolster the establishment of the seeded mussels and subsequent reef development.

We differ, however, on some of the other points raised by the author regarding predation of mussels and subsequent impacts on their distribution. For example, we disagree that mussels only survive in the intertidal zone because predators cannot survive there. Fish are able to exploit intertidal zones at high tide to feed, and there is a wealth of information to support this (e.g. Anderson & Connell, 1999; Rivlov & Schiel, 2006). We instead propose

that a key reason *M. galloprovincialis* is at present largely found in the intertidal zone of the Swan-Canning Estuary is that the deeper subtidal waters lack appropriate hard structure for mussel settlement. The lack of hard substrate in waters >1.5 m deep across the entirety of Melville Water and the upper channel of the estuary was demonstrated by a systematic benthic survey during the trial phase of the project, in which footage was collected by drop-camera at >2,000 sites across the study area. This survey revealed the current substrate is almost entirely soft mud and sand that offers little in the way of complexity, and does not provide a viable substrate for the establishment of Blue Mussels. The intertidal zone and the numerous hard substrates that occur within it in the Swan-Canning Estuary (e.g. rocky outcrops, buoys, jetty pylons), also provides 'real-estate' that mussels can exploit, but which inhibits the survival of many other organisms. Additionally, a one-year study undertaken by Murdoch University researchers, in which 300 jarrah stakes seeded with *M. galloprovincialis* were deployed in Melville Water at depths of ~4m, showed that not only did mussels survive and grow well, but that new recruits also became established on the stakes (Maus, 2020).

Further evidence of the ability of Blue Mussels to persist sub-tidally in the presence of a range of predators is provided by the situation in Cockburn Sound during the 1970s. Extensive subtidal beds of *M. galloprovincialis* dominated much of the shallow 'flats' north of the causeway, which were harvested by commercial fishing until the late 1990s. The staff at CSIRO Fisheries at Marmion and from the Fisheries Research Labs at Waterman Bay (including one of the contributors to this response) regularly collected 20kg bags of mussels from the beds at the grain jetty to feed experimental animals in the aquaria at the Waterman's lab. These extensive mussel beds were dense aggregations containing a number of size classes, and co-existed with a number of the predators identified by the author, i.e. fish, crabs and gastropods of the *Bedeva* genus. These predators did not eliminate the large and well-established mussel beds. Rather, overfishing was likely a key factor in the collapse of these beds as mussels became a fishery focus in the 1980's.

Introduced species

Although *M. galloprovincialis* was once considered to be an introduced species to the Swan-Canning Estuary as identified by the author, the evidence is clear that a distinct southern genetic variant is native to the temperate waters of coastal Australia (Gerard et al. 2008; Dias et al. 2014).

The writer also states that Blue Mussels only occur in eutrophic waters. Blue mussels are some of the worlds' most abundant and widespread bivalves. They are a resilient group that can withstand a broad range of environmental conditions. As filter feeders that consume phytoplankton, mussels can benefit from the increased phytoplankton production that results from eutrophication, but they are not restricted to eutrophic waters.

We now address each of the authors conclusions (copied below in italics).

The artificial limestone reefs will increase biological diversity of the area by introducing a new habitat into soft sediment estuary flora.

We agree that an additional and intended benefit of restoring shellfish reefs in the lower estuary will be to enhance its biological diversity and provide flow-on benefits for the local community, e.g. recreational fishing and wildlife watching opportunities. Despite the small scale of the existing pilot reefs in the estuary, diver surveys have confirmed the significantly greater diversity of biota on the reefs (e.g. macroalgae, sessile invertebrates such as fan worms and scallops and important recreational fish species such as Snapper and Cobbler) compared to control sites with bare substrate. This concurs with the findings from TNC's established Blue Mussel and/or Flat Oyster reefs that have been restored at various sites in Victoria and South Australia to date. Additionally, the reef restoration method being undertaken in the Swan-Canning Estuary and elsewhere as part of TNC's national *Reef Builder* program is consistent with the standards and principles of the *Society of Ecological Restoration* and in line with international best practice (Fitzsimons et al., 2019). We also highlight that the reefs being developed will mimic the foundations of natural reefs, rather than being 'artificial reefs' (e.g. concrete reef balls or similar).
There is likely to be a halo effect of predatory fish on the soft sediment biota in the area surrounding the reefs.

As other ecological studies around reef structures have shown, a 'halo' of fish foraging activity may develop around the restored reefs (e.g. Reeds et al, 2018). However, those studies have also shown that such effects are highly localised. Additionally, there are substantial areas of soft sediment environments in the lower Swan-Canning Estuary that support the type of infauna that may be targeted by benthic fish species in any potential reef halo.

The report has NOT established that Blue Mussels can survive outside cages in the long term.

Such long-term evidence can only be provided once the reefs have been developed at scale, the seeded mussels have become fully established on the substrate, and ideally after they have had the opportunity to spawn and develop a range of size classes. As with all habitat restoration processes, and especially those in challenging environments such as estuaries, this will take time and the target species may require a helping hand to properly establish. It is common practice in shellfish reef restoration to allow for a considerable level of mortality (often up to 90%), with the target species then becoming self-sustaining after a period of time. This is reflective of the slow but steady gains with TNC's Port Philip Bay mussel reef restoration efforts, where predation by native Eleven-armed sea stars (*Coscinasterias muricata*) is a factor after seeding. However, sufficient proportions of mussels do survive and reach maturity, and have produced successful, self-sustaining reefs. Additionally, as outlined further below, TNC will undertake re-seeding of the Swan-Canning reefs if necessary to help support their ability to form resilient mussel populations.

The report has NOT considered the effects of non-fish predators such gastropod molluscs and crabs which are known predators of Blue mussels and which may take a couple of years to build up in numbers on the artificial reefs.

As identified above, there are various potential predators of Blue Mussels that could occur in the lower Swan-Canning Estuary, and there was no objective by TNC or our project partners to focus on one species over another. As in any estuarine environment, it is anticipated that the abundance of any one predator type (as for all biota) will undergo natural seasonal and interannual variability. The resulting impacts on mussels, both negative and positive, are part of the natural development and adaptation expected of the reefs.

TNC will be monitoring the reefs annually post-construction to assess (i) mussel survival, growth and recruitment, and (ii) the abundance of a comprehensive suite of other biota via Reef Life Surveys, both on the reefs and at nearby control sites. These surveys will provide a sound basis for detecting whether any one predator type is having a particularly large impact on the reefs, and therefore which type of adaptive management approach is most appropriate.

The report has NOT shown that Blue Mussels will naturally recruit onto these reefs, and survive, in the future so that there is an ongoing recruitment process without the need to artificially replace mussels on the reef from farmed stocks on a yearly basis.

We will not know whether mussels will naturally recruit onto the reefs until the reefs have become established (see above). Mussel larvae, however, are abundant throughout the water column in the lower estuary, as demonstrated by Maus (2020).

The report has ignored its own information where it states that Blue Mussels currently only occur intertidally on rocky structures in the Swan River. This is critical information because if Blue mussels do not occur in subtidal areas in the Swan River at present, they will not do so in the future.

As outlined above, the lack of hard benthic structure in the subtidal waters of the lower Swan-Canning Estuary would preclude the ability of Blue Mussel spat to settle and establish subtidal aggregations under current conditions. However, evidence collected both during the pilot reef trials and by Maus (2020), shows that when appropriate hard substrate is provided, Blue Mussels are able to survive and grow subtidally, even under challenging environmental conditions. These findings are also consistent with those in Port Phillip Bay, Victoria, where the lack of hard substrate has been shown to be a limiting factor in the natural recovery of mussel reefs that were once abundant in that system. To date, TNC has successfully restored 12 ha of Blue Mussel and Flat Oyster reefs in Port Phillip Bay, providing a comparable model of what could be achieved in the lower Swan-Canning Estuary.

If Blue Mussel survival, recruitment and persistence are not successful on these artificial reefs, what are the plans to remove the reefs and who is going to fund it.

As shown during the pilot reef trials, abundant plant and animal life naturally settled onto the reef substrate, in turn providing complex habitat for a range of mobile epifauna and fish. The diversity of life supported by even these small and shallow-profile reef patches was significantly greater than on nearby bare sediment, providing a snapshot of what could be achieved by the far larger and more complex full-scale reefs. These biodiversity enhancements provide clear environmental and social benefits for the Swan-Canning Estuary, distinct from the degree of mussel survival on the reefs.

As mentioned above, all habitat restoration approaches require support and ongoing management to establish and persist. To help support this process, TNC have budgeted for a re-seeding of the full-scale reefs, should it be required following the initial seeding event. TNC is also working closely with the staff at DBCA to ensure the approaches for both re-seeding and monitoring the reefs in future years are shared.

Recommendation: Survey subtidal limestone features in the Swan River to detect whether Blue Mussels can persist there in large numbers before proceeding with this project. If they cannot exist on naturally occurring subtidal habitats in the Swan River at present, it is not worth proceeding with this project.

As we have outlined above, the lack of subtidal benthic limestone features throughout the lower Swan-Canning Estuary means that the above recommendation is a not a practical basis for determining the viability of this project.

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3.1.5 Model Validation – Pilot Reefs

Sixteen pilot rocky reefs and eight coir mesh beds were constructed in the lower estuary in the second half of 2020, with their locations guided by the preliminary RSM framework. At each of the four pilot areas (Applecross, Attadale, Freshwater Bay and Point Walter; Fig. 1), two replicate reefs were built in both the deeper waters (~8-9 m) and moderately deep waters (~3-4 m), while two replicate coir mesh beds were built in the shallows (~1-2 m) (see Fig. 6).

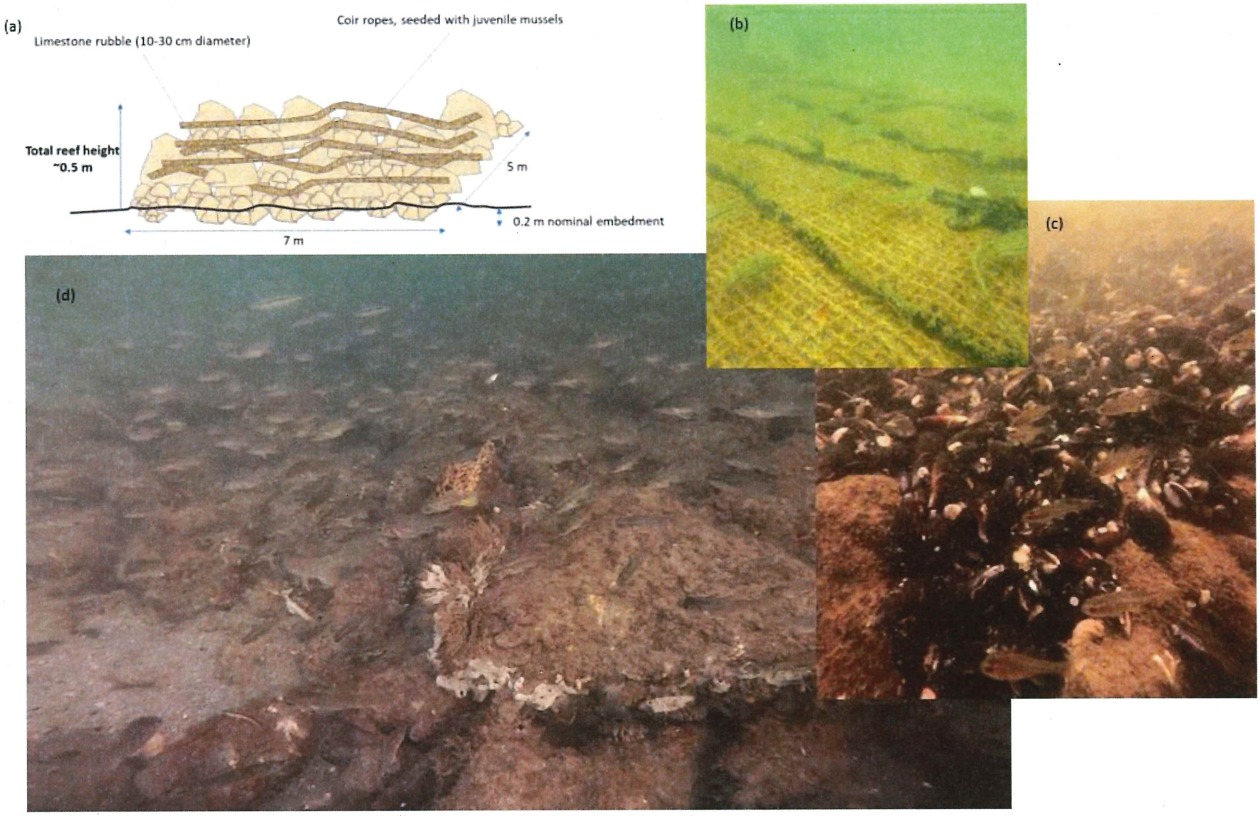

Figure 6. Pilot reef and bed images. **(a)** Original rocky reef pilot designs. **(b)** Coir aggregated mussel on shallow beds post-deployment in December 2021. **(c)** Loose seeded mussels on a rocky reef in March 2021. **(d)** Point Walter medium depth reef, prior to mussel deployment in June 2021, showing the large number of varied reef inhabitants.

Mussels were seeded on to these reefs/beds over three separate events. The first mussel seeding event, originally planned for August 2020, occurred in December 2020 due to an exceptionally late and patchy settlement of mussel spat on the aquaculture lease in Cockburn Sound. This reflected a very poor recruitment season in 2020, and the mussels (which were attached to biodegradable coir rope) were extremely small (~5-10 mm in size). This made them vulnerable to predation by the Common Blowfish and resulted in significant and rapid mortality, especially in the shallows. A second seeding event in March/April 2021, with larger sub-adult mussels (35-55 mm) deployed loose, resulted in high mortality due to Blue Swimmer Crab predation. Blowfish and crabs are particularly abundant in the estuary in the summer/autumn months, reiterating that mussel seeding should be avoided at these times. Seeding during winter is anticipated to reduce these predation pressures.

For the final seeding event in mid-June 2021, during which a mixture of sub-adult mussels (~25-40 mm) were deployed, temporary predator exclusion measures were installed over the mussels for two months to allow them to re-aggregate, attach to the reef/bed base and build their natural protection strategies over time (see section 3.1.6 for details). These mesh-based predator exclusion structures provided excellent protection, enabling the mussels to sustain high survival and secure attachment to the reef base in the weeks following seeding. Over the following months, however, the Perth region experienced the wettest winter in 26 years, resulting in significant and prolonged freshwater flows throughout the estuary. Water quality thresholds for salinity and oxygen availability eventually exceeded mussel thresholds and persisted for substantial periods, with salinity stress (fresh conditions) being particularly prevalent at the shallow and moderately deep sites in the upstream areas (Applecross and Attadale).

Even under these exceptionally stressful water quality conditions, however, mussel survival was better than anticipated. Live mussel densities were highest and coverage most consistent at the Point Walter medium and deep sites (1,200 – 7,400 mussels m^{-2} reef), followed by the Freshwater Bay deep reefs (1,125 – 4,700 mussels m^{-2}) and medium reefs (75 – 2,900 mussels m^{-2}), and lastly by the Attadale deep reefs (325 – 2,900 mussels m^{-2}). Patchy survival was recorded at the Attadale medium reefs (up to 125 mussels m^{-2}) and Applecross deep reefs (up to 1,450 mussels m^{-2}). It is approximated that fewer than 400 mussels survived at the Applecross medium site (Fig. 7). This trend of declining mussel survival from the upstream to downstream sites was expected based on the HSI modelling (section 3.1.3).

Mussel growth rates, based on the difference between size range at deployment and the average size of ~20 mussels measured from 16 quadrats at each site, indicated a consistent increase over time at Attadale, Freshwater Bay and Point Walter regardless of depth (10-20mm increase in shell height). Slower growth rates were recorded at Applecross (8-9 mm increase in shell height; Fig. 8).

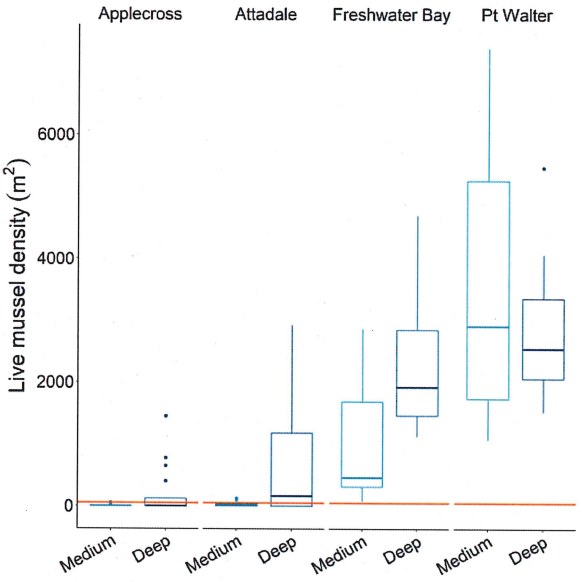

Figure 7. Box plot of live mussel densities at the moderately-deep (medium) and deep pilot reef sites in September 2021.

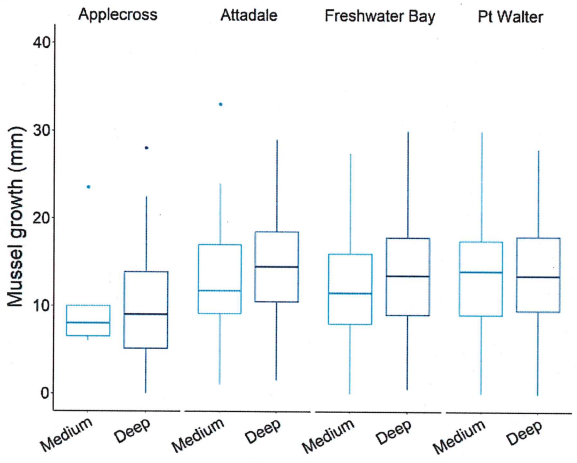

Figure 8. Box plot of mussel shell height growth (mm) at the moderately-deep (medium) and deep pilot reef sites in September 2021.

3.1.7 Filtration Capacity

Blue mussel filtration experiments were undertaken in both winter (August 2020) and summer (February 2021) to ascertain the volume of water filtered per mussel over time (clearance rate) and the mass of particles filtered and consumed over time (filtration rate). This was achieved using a specially designed 'flow-through chamber' built by Murdoch University, into which individual mussels were placed in chamber trays, water collected from the estuary was pumped though the head chamber, and the capacity of mussels to clear the water of particles was measured via their feces and pseudofeces.

Estuary water used in the filtration experiments captured the range of conditions likely to be experienced across the mussel reefs, i.e. collected within 0.5m of the estuary bed from six sites adjacent to the pilot reefs in both summer and winter conditions. Individual mussels (~50mm in size) cleared an average of ~1 L of water per hour in winter and ~0.58 L of water per hour in summer, with respective filtration rates of 8.1 mg L^{-1} and 4.5 mg L^{-1}. These seasonal differences most likely reflect greater environmental stress on the mussels in summer (i.e. higher temperatures and salinities) than winter. Despite significant water quality pressures, these shellfish have the potential to filter an enormous volume of water if the reefs are built at the proposed ecosystem-scale. At aggregations of ~1,500 mussels per m^2 of reef, and assuming a reef footprint of 30% over a 10-ha bottom area, this **shellfish reef ecosystem would potentially filter ~50 gigalitres, the approximate volume of the entire Swan-Canning Estuary, every year**.

3.1.7 Ecological Impact of Pilot Reefs – General

Reef Life Surveys (RLS) were carried out on pilot reef and bed sites, as well their respective control sites (bare sediment), both prior to reef construction in May 2020 ('baseline') and one year after reef construction in May 2021, i.e. a Before-After-Control-Impact (BACI) monitoring design. The RLS's systematically capture data on key biota visible to the naked eye, including seagrass, macroalgae, sessile (attached) invertebrates, mobile invertebrates (e.g. crabs), fish and megafauna such as dolphins.

The RLS results show that the diversity (richness) of mobile and semi-mobile species was greater on all medium and deep reefs than at those sites before the reefs were constructed, as well as being greater than at the sediment control sites (Fig. 10). Importantly, there was also a shift from sediment-associated species (e.g. gobies and tube anemones) to reef-associated species (e.g. colonising red algae, sea squirts, fan worms). It is also noteworthy that reefs had natural settlement of other shellfish species. Both Flat oysters and Rock oysters were observed at multiple reef sites, albeit in low numbers. Settlement of Doughboy scallops occurred in relatively high densities (up to 35 scallops m^{-2}) on reefs at Point Walter and Freshwater Bay.

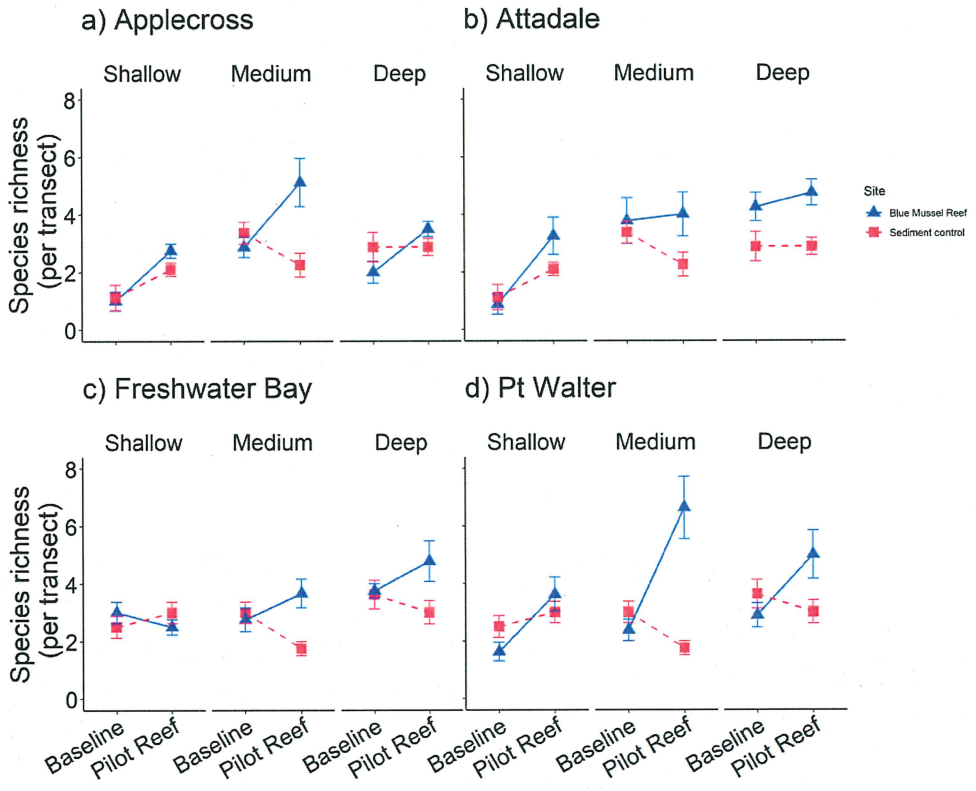

Figure 10. Mean (+/- SE) species richness of mobile and semi-mobile species at all reef/bed sites and on sediment controls, both before (baseline) and after pilot reef construction.

3.1.8 Ecological Impact of Pilot Reefs – Fish

Remote Underwater Video samples, collected using a similar BACI monitoring design as outlined in section 3.1.7, showed that fish species richness was almost always higher at the built reef sites than before construction and at the sediment control sites (Fig. 11). As for the other non-fish species described above, there was a significant increase in reef-associated species post-construction at all sites. Two species of note, amongst other important fishery species, include various schools of juvenile Pink Snapper at the Point Walter at Freshwater Bay sites. These Snapper were observed foraging on the reefs, highlighting the potential of these new habitats as fish nurseries. The iconic Estuarine Cobbler was also been observed on the reefs on multiple occasions.

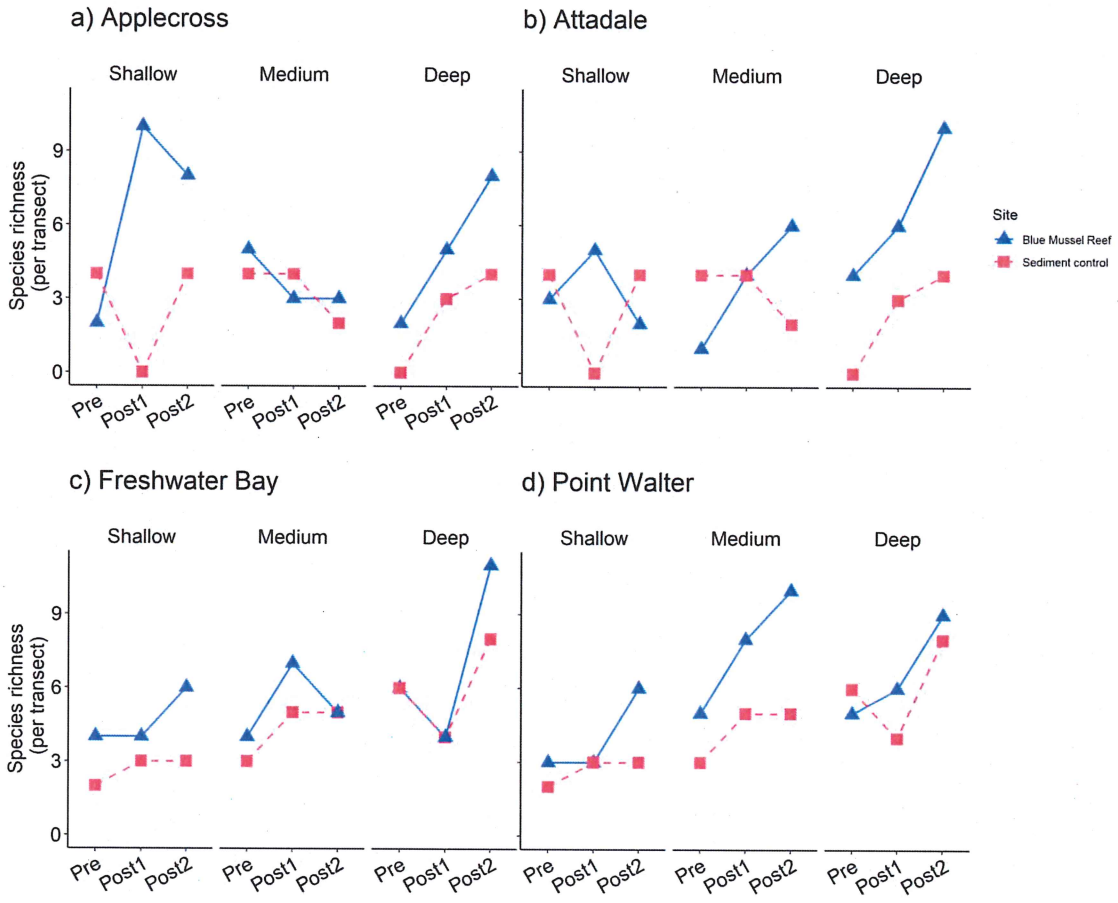

Figure 11. Fish species richness per 90-minute Remote Underwater Video (RUV) at pilot reef/bed sites and sediment controls. Monitoring was carried in May 2020 (pre-construction), December 2020 (post 1) and May 2021 (post 2).

The Nature Conservancy Australia

SWAN-CANNING SHELLFISH REEF RESTORATION RISK ASSESSMENT

The following report documents an ecologically sustainable development (ESD) risk assessment and an additional project-wide risk assessment by The Nature Conservancy Australia (TNC). These assessments relate to the development of a native shellfish reef (Blue Mussel) to enhance habitat and help improve the ecosystem health of the Swan-Canning Estuary, WA.

Contents

Project Scope

This project has an overarching aim of building a native Blue Mussel (*Mytilus galloprovincialis*) reef array interspersed over a total bottom area of ~10 hectares in the lower Swan-Canning Estuary, WA. In accordance with the global standards on marine habitat restoration, the total footprint of all hard reef units will cover 15-30% of that bottom area (i.e. 1.5-3 ha). The project is being led by The Nature Conservancy Australia and funded by Lotterywest, the Minderoo Foundation, Department of Biodiversity, Conservation and Attractions (DBCA), the Australian Government and various philanthropists.

This risk assessment accompanies a Development Application that has been submitted to DBCA for construction of the reef array. Other detailed Project Plans are available on request.

Ecologically Sustainable Development Risk Assessment

1.1 Method and Interpretation

The aim of the **Ecologically Sustainable Development** (ESD risk assessment is to evaluate the major environmental and ecological risks to the Swan-Canning Estuary that may arise from the construction and development of the proposed Blue Mussel reefs in the lower Swan-Canning Estuary.

The risk assessment method is based on a National ESD Reporting Framework [1], developed initially for the fisheries and aquaculture sectors in Australia, and is based on the Australia and New Zealand standard for risk management AS/NZS ISO 31000:2009 [2]. Each identified issue is assigned a risk ranking based on two factors: (i) the potential **consequence** arising from a particular event, and (ii) the **likelihood** that this particular event will occur (Tables 1 and 2). The combination of consequence and likelihood produces a **risk value**, which in turn is used to determine the **overall risk ranking** associated with a particular issue (Tables 3 and 4).

Table 1: Standard likelihood levels

Level	Descriptor
Remote - 1	Not heard of, but not impossible
Rare - 2	May occur in exceptional circumstances
Unlikely - 3	Uncommon
Possible - 4	Some evidence to suggest this is possible
Occasional - 5	May occur
Likely - 6	Is likely to occur

Table 2: Standard consequence levels

Level	Descriptor
Negligible - 0	Very insignificant impacts. Impacts unlikely to be measurable at the scale of the stock/ecosystem/community level against background variability.
Minor - 1	Possibly detectable but minimal impact on structure/function or dynamics.
Moderate - 2	Maximum appropriate/acceptable level of impact.
Severe - 3	Wider, longer-term impacts detectable at the stock/ecosystem/community level.
Major - 4	Very serious impacts with relatively long time-frame likely to be needed to restore to an acceptable level.
Catastrophic - 5	Widespread and permanent/irreversible damage or loss will occur

Table 3: Risk Matrix

		Consequence					
Likelihood		Negligible	Minor	Moderate	Severe	Major	Catastrophic
		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30

The numbers in cells of the above matrix are risk values, which are calculated by multiplying the likelihood value by the consequence value; the colours/shades correspond to risk rankings (see Table 4).

Table 4: Risk rankings and associated required levels of management

Risk Rankings	Risk Values	Explanation & Likely Management Response
Negligible	0	Nil
Low	1 – 6	No specific additional management is needed, but low-level monitoring of the issue may be required. Any current management should continue, as the risk ranking is based on the current management in place
Moderate	7 – 12	Additional information may be needed or the issue may require monitoring. Immediate management is required, but the issue should be the subject of continuous improvement with the aim of achieving a low risk ranking in the future
High	13 – 18	Possible increases to management activities in addition to those already being applied. Needs to be monitored and any information deficiencies should be addressed
Extreme	> 19	Increases in management activities in addition to those already being applied are strongly recommended

1.2 Table 5: ESD Risk Assessment for the Blue Mussel Reef in the Swan-Canning Estuary

Risk event	Likelihood x Consequence	Risk ranking	Explanation and management response
1. Reef construction (i.e. building phase)			
1.1 Water quality	Likely (6) x Minor (1)	Low (6)	The main water quality concern to be monitored and managed throughout the works is turbidity impacts at the reef building sites. It is expected that deployment of limestone spalls will create a sediment plume in the immediate area of operation due to the nature of the material being deployed. To help mitigate the plume, a range of measures will be undertaken. i. Limestone delivered will be checked to ensure it meets the appropriate specification. ii. A rake bucket will be fitted to the excavator to minimise the quantity of fines transferred into the water. iii. Upon returning to the load-out site, the barge platform will be cleared of fines remaining from the previous rock load and disposed of at an appropriate land-based site. iv. Prior to reef construction at any site, surface buoys will be anchored a fixed distance (e.g. 200 m; to be agreed with DBCA) from the mid-point of the site in the main direction of water flow. After rock deployment commences, crew will continuously visually inspect the extent of any plume and determine if they exceed the limits of the surface buoys for more than a set time (e.g. two hours; to be agreed with DBCA). If so, works are required to cease to let sediments settle, with operations continuing only once the plume is less than the agreed distance. Plume extent and the time required for the plume to disperse will also be recorded. This information will be compiled in written daily reports by the contractor, and provided to TNC on a weekly basis. In the event that a plume exceeds the above trigger criteria and works are stopped, TNC will be notified immediately and revisions to the construction approach will be discussed (including with DBCA).
1.2 Benthic habitat effects	Unlikely (3) x Moderate (2)	Low (6)	Placement of the limestone rubble on the estuary bed will result in localised, short-term impacts to the benthic environment, including temporary sediment suspension and disturbance to soft-bottom fauna. All of the reef building areas have a predominantly bare sand/silt substrate, which was one of their criteria for selection during the Restoration Suitability Modelling work that has underpinned this project. Extensive bottom habitat mapping was also undertaken during the first phase of this project to verify the nature of the estuary bed across the entirety of Melville Water. During construction, sediment suspension that is visible from the water surface will be monitored and managed using the same regime as outlined in section 1.1.

			1. *Mobile benthic-associated fauna* Larger mobile benthic-associated fauna (e.g. crabs, fish) are likely to experience temporary disturbance during construction due the physical placement of rubble on the estuary bed, sediment suspension and/or noise. These fauna are likely to quickly disperse from the site during construction, then return to the area in the hours or days following completion of the works. Smaller mobile benthic-associated fauna (e.g. zooplankton, polychaetes, small crustaceans and gastropods) may also disperse or be displaced upon disturbance (then quickly resettle in adjacent areas),but may also experience some crushing impacts during placement of the limestone. Given the highly abundant and ubiquitous nature of these fauna throughout the lower to middle estuary, combined with the small footprint of the reef substrate relative to the wider available habitat, impacts on the broader populations of these fauna will be negligible. 2. *Sessile benthic-associated fauna* Placement of the reef substrate on the estuary floor will impact sessile and less mobile infauna species (e.g. burrowing polychaetes, fanworms, sea squirts etc) through crushing. Given the highly abundant and ubiquitous nature of these fauna throughout the lower to middle estuary, combined with the small footprint of the reef substrate relative to the wider available habitat, impacts on the broader populations of these fauna will be negligible. 3. *Seagrass and macroalgae* There are no seagrass areas within the reef building envelope, and a minimum buffer of 10m from seagrass (as stipulated by DBCA) was one of the criteria underpinning the Restoration Suitability Modelling upon which reef site selection was based. It should be noted that all proposed build areas are situated beyond mapped seagrass areas. Sediment plumes arising from the reef construction could potentially impact adjacent seagrass and/or macroalgae through smothering and/or turbidity (light reduction) effects. These impacts will be mitigated through the plume monitoring and management approaches outlined in section 1.1. The overall risk of negative habitat effects as a result of reef deployment are considered low, given the above described conditions and mitigation measures. Furthermore, in time, it is predicted that the mussel reefs will improve environmental conditions for seagrass growth (through increasing water clarity) and increase the presence of resident invertebrates and fish species (as has been demonstrated in the pilot reef phase) .

1.3 Proximity to sensitive regions	Possible (4) x Severe (3)	Moderate (12)	*1. Marine Protected Areas* All proposed reef building areas lie beyond a 200m buffer from the gazetted edge of any boundary of the Swan Estuary Marine Park (as agreed with DBCA). The proposed reef site at Attadale is the only site in relative proximity to a Marine Protection Area (MPA), Alfred Cove, which is a high-quality bird conservation area. Potential impacts of reef construction on the Alfred Cove are mitigated by (i) the proposed reef building area being more than 200m from the gazetted edge of the MPA (ii) site-specific engineering work that has underpinned the reef design at Attadale has demonstrated that the likelihood of any disturbance to the estuary bed within the MPA itself or adjoining foreshores is minimal. *2. Other known bird nesting sites* Point Walter is a Fairy Tern nesting, mating and foraging habitat with the riverward half of the spit fenced off from the public. The proposed reef site is offshore (200m+) from the more landward portion of the spit. Site-specific engineering work that has underpinned the reef design at Point Walter has demonstrated that the likelihood of any disturbance to the adjoining foreshores is minimal. During reef construction at Point Walter, none of the building activity will access the spit. Noise disturbance from plant equipment (boat, excavator) is also expected to be minimal, temporary and not exceed typical levels generated by other estuary uses (e.g. general boating activity). Reef construction will only occur outside of the Fairy Terns residency at Point Walter from October to March. This will alleviate any chance of direct impacts to the colony from the construction process. A significant piece of engineering work has formulated reef designs to ensure the reefs do not impact on natural erosion and accretion process affecting the size and shape of the sand spit at Point Walter. Reefs are suitably far from the shoreline as to preclude fishing from the sand spit at Point Walter, as such additional human - tern interactions should not occur as a result of the shellfish reefs. Potential longer-term indirect impacts on the Fairy Tern population are addressed in the following section 3.5. *3. Aboriginal heritage sites* It is recognised that the entirety of the Swan-Canning Estuary is an Aboriginal heritage site of significance and as such processes as outlined by the *Department of Lands and Heritage* are informing necessary approvals. A search of the *Aboriginal Heritage Inquiry System* (AHIS) shows that none of the proposed build areas impact on specific notable sites within the waterway.
2. Local impacts of the established reef (i.e. months/years post-construction)			
2.1 Erosion	Remote (2) x Minor (1)	Low (2)	Detailed, site-specific modelling and coastal engineering analysis has demonstrated that, under the known wave conditions experienced across Melville Water (i.e. maximum wave heights of 0.7m), the proposed reef structures (all of which are situated below 3m of water at low tide) will have negligible interactions with wave

			driven currents (which are likely to have the strongest impact on shore-based erosion and accretion processes). The engineering analysis has also shown that some scouring effects are possible under increasing current strength conditions, but these will occur close to the base of reef units. At sites where this is more likely to occur, reef units have been aligned with the dominant current direction to reduce any impacts. This will allow tidal movement and natural sediment movement processes (e.g. longshore drift) without compromising the reef structures. Coupled with the distance from the shoreline, reef design considerations and use of appropriate materials, this ensures that the risk of erosion has been minimised and is consequently considered low risk.
2.2 Water flow	Minor (1) x Possible (4)	Low (4)	Water depth at the proposed sites vary from 3.5 - 8m and reef structures will be built to a maximum height of 2m (peaked areas) where water depth allows (i.e. where the required 3 m water clearance over the reefs can be maintained). The reefs have been designed with consideration to water flow (i.e. organised as a series of reef units or 'patches' interspersed over the build area, as opposed to a solid reef mass), and the location and placement of the reef units is informed by hydrodynamic modelling, bathymetric sampling and sediment sampling. The reef patches have been aligned to dominant current where deemed necessary by the coastal engineers, allowing tidal and natural sediment movement processes to occur. Accordingly, the consequence of impacts to the natural flow of water attributed to the presence of the reef structures is considered minor and the overall risk to water flow is expected to be low.
2.3 Shading	Negligible (0) x Possible (4)	Negligible (0)	The reef structure will be built to a maximum height of 2 m (in occasional peaks) and maintain a minimum of 3 m water clearance over the top of the reef. While sunlight can penetrate to these depths, it will scatter, refract and absorb through the denser water above, so shading of the adjacent benthos by the reef structures is unlikely. On the reef structure itself, it is possible that overhangs created by the rock placement with result in localised shading effects. These are likely to create habitat for additional cryptic species, which would not otherwise inhabit the area.
2.4 Escape	Likely (6) x Minor (1)	Low (6)	The likelihood of escape of Blue Mussel (*M.galloprovincialis*) from the site is possible post-seeding of the constructed reefs and is, in fact, an objective of the project to encourage wider establishment of native mussel reefs. Competition with other native filter feeders may occur,but is not deemed as a significant risk due to naturally occurring populations within the region and isolated populations still existing. Refer to section 2.7 Disease Management for further information regarding the safe release of *M. galloprovincialis* onto the reef substrates.
2.5 Interactions	Remote (1) x Severe (3)	Low (3)	Mussels are not considered a highly attractive food source for species such as sea lions, dolphins or sharks. The substrates will be located underwater on the seafloor with a maximum height of 2m in >3 metres of water. Therefore, the likelihood of adverse interactions with seabirds, large marine vertebrates and protected species is remote.

			It should be noted that Temporary Protection mesh will be used to reduce predation on a small scale during the deployment and initial settlement phase. These structure were deployed successfully during the pilot reef phase (Phase 1) of the project and were subject to strict design, deployment and monitoring guidelines, which were devised in consultation with and under the regulation of DBCA and the Department of Primary Industries and Resources (DPIRD). All 16 structures that were deployed during Phase 1, for a period of 3.5 months, had no security or entanglement issues. Although the consequence relating to interactions with seabirds and marine vertebrates can be severe (e.g. in the event of an entanglement or adverse interaction occurs), the nature of the proposed mussel reef structures and layout in this application pose a low risk of negative interaction with marine animals. Because of the anticipated flow on effects of creating reef habitat and foraging opportunities in the area some interactions with megafauna is anticipated but this will be considered a positive interaction rather than a negative.
2.6 Habitat effects	Possible (5) x Minor (1)	Low (5)	An increase in shellfish abundance can divert food resources from planktonic to benthic food webs. However, given the majority (~80%) of fish species in the Swan-Canning are demersal or benthic associated effects should be localised and generally beneficial. The likelihood that the natural habitat will be disturbed from the reef construction is possible given the anticipated frequency of site visitation by recreational fishers and the impacts during reef deployment. The greatest risk to habitat is anchoring, rubbish (such as fishing gear) and general pollution. There may be other impacts from activities such as monitoring work and the on-going impact of structures on the riverbed. Furthermore, no artificial feeding will take place on the site, and no processing or cleaning will be undertaken. The mussel reef design will minimise the consequence of structural impacts and is anticipated to assist in providing habitat for fish, increase water filtration and increase seagrass growth. Changes to the habitat are generally localised, and unlikely to occur outside the reef site area. By placing all reef substrate on the estuary bed in a way that has minimal potential impact on natural reef habitat and seagrass, will reduce the overall risk associated with habitat effects. As a result of increased fishing in the area, The Nature Conservancy will work with relevant State and Local Government authorities to ensure responsible use of the reef through community engagement and education. Signage at boat ramps may be considered as part of the consultation process.
2.7 Disease Management	Remote (1) x Severe (3)	Low (3)	To date, no notifiable diseases have been found in Australian mussels. Possible mussel disease agents include the protazoan *Perkinsus olseni* and *Martelia sydneyi* that naturally occur along the east coast of Australia. With the exception of *Perkinsus*, most Australian notifiable bivalve diseases are believed to be highly species specific, and have typically impacted commercial oyster production, e.g. Queensland unknown disease caused by *Marteilia sydneyi*, infecting the oyster species *Saccostrea glomerata* and *Ostrea angasi* [12]. The international literature shows that some species of *Marteilia* can infect mussels. However, in Western Australia, to avoid this, albeit low, risk, it is compulsory for a number of mussels to be

			tested histopathologically by the Department of Primary Industries and Regional Development Diagnostic Laboratory Services (DDLS) prior to any translocation. This process also alleviates the potential of inadvertently moving any toxic algae or bacterial species between the supply and translocation sites. This process occurred throughout Phase 1 of the project with 2-week translocation windows approved following testing. The same process will be adhered to during the full-scale reef construction phase (Phase 2). It is worth noting that during one testing period the gill parasite *Turbellaria sp.* was identified in the Cockburn Sound mussel stock. A comparison with mussels taken from the Swan-Canning showed that the parasite already infects the estuary population with significantly higher frequency.
2.8 Sedimentation	Possible (4) x Minor (1)	Low (4)	The likelihood of sedimentation occurring on site as a result of shellfish reef establishment is possible, as reef structures will locally slow water movement, and the mussels and other filter feeders will deposit faeces and pseudo-faeces on and round the reef. Reefs have been designed to decrease the likelihood of estuarine sedimentation processes impacting the ecology of the reef (i.e via burial). It should be noted that sedimentation processes within the lower Swan-Canning are generally not well understood
2.9 Invasive Species (Biofouling)	Likely (6) x Minor (1)	Low (6)	Due to the nature of this project, settlement of other reef species to the deployed rock substrate is expected to occur. This would technically not be considered biofouling in a restoration project, but it could include invasive species (e.g. European Fan Worm, Didemnum – colonial ascidian). No manual cleaning of rock will occur. Through on-going species abundance and distribution monitoring of the site The Nature Conservancy will be able to identify any issues associated with invasive species and consider options to adaptively manage any impacts to the site that occur. To reduce the potential for movement of non-native 'hitch-hikers' between the supply site in Cockburn Sound and the translocation site in the Swan-Canning, mussels are tumbled and washed, as a key stage in the harvesting process, prior to transportation.
3. System-wide impacts of the established reef			
3.1 Nutrients/ Nutrient Removal	Likely (6) x Negligible (0)	Negligible (0)	Mussels are filter feeders removing natural phytoplankton (microscopic algae or plant cells) and organic particles from sea water as it passes over the gills. As oyster reefs provide the important ecosystem service of water filtration and no manufactured feeds will be applied to the site, the removal of nutrients is likely, with a high likelihood of positive effects in a highly modified estuarine system such as the Swan-Canning. Some nutrients could be added to the site from the use of burley and cleaning of catches within the reef area, but consequences are also considered negligible given the suitable water movement in the area to facilitate this level of nutrient dispersal. See section 4.5 'Phytoplankton' for matters relating to nutrient removal by *M. galloprovincialis*. Taking these factors into consideration, the overall consequence and risk of the reef impacting the water quality of the region is considered to be negligible.
3.2 Sedimentation	Possible (4) x Negligible (0)		The reef will be deployed at a water depth of >3 metres, which provides low residence time for water circulation when compared to shallower waters. This indicates that there will be minimal sediment accretion issues around the proposed reef structures. As a result, the likelihood of sedimentation and bio-depositions

		Negligible (0)	from the mussel reef to impact the surrounding marine environment is expected to be possible, however the low loads expected would result in negligible consequence, thereby giving a negligible risk rating.
3.4 Flow	Remote (1) x Negligible (0)	Negligible (0)	It is anticipated that the fully developed reef structures will occupy relatively minimal water volume compared to the broader basin region. The reef structure and layout are designed to ensure optimal location and placement of the reef, where necessary along bathymetric contour (in line with the dominant direction of currents). The likelihood that reef substrates and structures will change flow is considered to be remote. Therefore, the consequence and overall risk to changing local water flow patterns from the reef is negligible.
3.5 Listed migratory and threatened species	Possible (4) x Severe (3)	Moderate (12)	Potential direct impacts on the Fairy Tern, *S. nereis nereis* (currently listed as 'vulnerable') have been addressed in *1.3 Proximity to sensitive regions*. Changes to habitat within a 2km radius of the Fairy Tern colony have the potential to impact (positively or negatively) the food availability and feeding behaviour of the birds. The Point Walter site and both Freshwater Bay sites fall within a 2km radius of the colony. There is no literature which adequately addresses the impact of reef restoration on pelagic food availability. However CCWA, who are experts on Fairy Terns, and Murdoch University, who undertook the original ecological risk assessment for this project, are in agreeance that impact is likely to be limited. It should be noted that during the breeding season of 2021/2022, monitoring indicates that Terns are feeding on the highly abundant white bait that are inhabiting the system. A prey source which usually only makes up a small proportion of the Point Walter colony diet. This suggests that environmental extremes, such as the 2021 winter freshwater flows, are likely to have a stronger impact on food availability than reef restoration. CCWA have requested that monitoring of the Fairy Terns post-reef construction be considered as part of the ongoing monitoring and evaluation regime.
3.6 Sensitive habitats	Unlikely (3) x Minor (1)	Low (4)	See *Section 1.1.1 Habitat Effects* for detail on actions which mitigate any negative impacts on seagrass beds and MPA's. Reefs are expected to have negligible or positive impacts on seagrass growth. No negative impacts are expected for invertebrate fauna associated with seagrass beds.
3.7 Behavioural changes to species	Remote (1) x Moderate (2)	Low (2)	The mussel reefs will provide food and refuge for many prey invertebrate and fish species, enhancing their overall growth and survival. Accordingly, it is possible that other larger fish species and vertebrates may change their foraging behaviour to include visitation or increase residence time at the reef. As naturally occurring mussel aggregations occur within the Swan-Canning, no artificial feed or other attractants will be used, these potential changes in behaviour are considered positive and accordingly present a low risk of negatively affecting species behaviour.
3.8 Translocations between regions	Rare (2) x Minor (1)	Low (2)	One of the objectives of shellfish reef deployment is to encourage further dispersal of native Blue mussels (refer 2.2 Escape). Mussels will be sourced locally from Cockburn Sound via wild spat collection. Any translocations must be consistent with relevant policies and regulations. See *Section 2.5 Disease Management* (above) for detail on biosecurity protocols for translocation in Western Australia.

3.9 Phytoplankton	Likely (6) x Negligible (0)	Negligible (0)	Phytoplankton essentially underpin the autotrophic food chain in marine ecosystems, and fluctuations in nutrients may be beneficial to the ecosystem (i.e. drive an increase in phytoplankton biomass with a resultant increase in food web productivity), but they can also be detrimental (e.g. an increase in abundance of harmful algal blooms) that can cause widespread problems for the ecology of the environment. Mussels are filter-feeders that strain microscopic algae (phytoplankton) and grow suspended in surrounding waters. Addition of nutrients can result in positive and negative impacts on phytoplankton communities but given that no feed will be used at the site, and larger numbers of *M. galloprovincials* were previously occurring in the region the overall risk of impacting phytoplankton negatively from reef deployment is considered negligible.
3.10 Benthic communities	Unlikely (3) x Moderate (2)	Low (6)	See explanation and management response as per *1.2 Habitat Effects* (above).
3.11 Scavengers	Unlikely (3) x Moderate (2)	Low (6)	The likelihood of the reef to result in a significant increase in the regional density or overall abundance of a scavenger species is considered unlikely. As feed will not be used at the site, and no additional nutrients to assist the growth of mussels it is unlikely that the mussels will result in an unbalanced environmental response as a result of an influx of scavenger species. Ongoing monitoring of the site will provide feedback regarding species diversity and abundances including presence of scavengers. The consequence of scavenger presence within the site is considered moderate and therefore the overall risk from scavengers is low.

Project-wide risk assessment

In addition to ecological risk it is vital to assess and address reputational, operational, statutory, environmental and risk to personnel, as these have these hold significant potential to hinder project success.

2.1 Table 6: Project-wide Risk Assessment

Risk event	Likelihood x Consequence	Risk ranking	Explanation and management response
1. Stakeholders and Traditional Owners			
1.1 Stakeholders not supportive of project	Unlikely (2) x Moderate (3)	Low (6)	Project Lead fails to sufficiently engage stakeholders throughout duration of project, leading to poor stakeholder support, negative media, political intervention and potentially, project delays. *Management* 1. Key stakeholders mapped and identified during early planning phase of project. 2. Open community forums held regularly throughout project. Listen and respond to community views and perspectives. 3. Where possible, include methods of co-design and/or consider community advisory groups. 4. Provide regular and transparent updates to general public at key stages of the process (e.g. through website, social media, presentations, forums, media releases). 5. Provide targeted forums to specific user groups (e.g. Yachting WA, Natural Resource Management groups, commercial and recreational fishers) where necessary. 6. Provide opportunities for community to participate in the project (e.g. citizen science/volunteer activities, monitoring support, workshops).
1.2 Traditional Owners not supportive of project	Rare (2) x Severe (3)	Low (6)	Project Lead fails to sufficiently engage Traditional Owners in co-design practices or seek advice on culturally sensitive issues leading to alienation, negative media, political intervention and potentially, project delays. *Management* 1. Identify Traditional Owners and elders who can speak for Country through Indigenous advisory groups, prescribed body corporates, or other government registers. 2. Identify cultural/environmental aspirations and consider opportunities for incorporating into planning and design (e.g. cultural mapping included in habitat suitability models, consideration of Traditional Ecological Knowledge into project planning, ranger programs). 3. Establish process for regular engagement with Traditional Owners, based on *their* preferred method. 4. Budget appropriately for Traditional Owner salaries and engagement fees. 5. Consider Welcome to Country, Indigenous names for new reefs and support for other cultural ceremonies/practices. *The following advice on required process has been provided by DPLH to TNC regarding the proposed full-scale reef construction. Evidence is required to be emailed to DPLH's Registrar.*

			1. The Development Application, highlighting the positive impacts of reefs and evidence of the negligible anticipated impacts on the estuarine environment. *2. The Scope of Works required to install and maintain the reefs.* *3. Documentation outlining consultation with SWALSC and a summary of discussions from a Project Briefing with local Knowledge Holder families (family names have been provide by DPLH).* *This will allow construction to proceed for a designated 3-month window under Regulation 7 & 10 permits*
1.3 Poor performance of stakeholders, partners or sub-contractors	Unlikely (2) x Moderate (3)	Low (6)	Threat or danger to the good name or standing of a business or entity as the result of actions by the project partner organizations, due to the actions of an employee, or through other peripheral parties and subcontractors. *Management* 1. Undertake due diligence on all third-party subcontractors and avoid working with those with compromising or non-aligned values. 2. Listen to and consider opinions of stakeholders on subcontractors and an individual's reputation. 3. Suspected concerns to be mitigated through prompt damage control measures such as direct communications with relevant individuals, or businesses and terminating working relationships early. 4. Prepare key messages for any media response as part of an agreed communications protocols with project partners.
2. Long-term success of restored shellfish community			
2.1 Sporadic events (e.g. unseasonal rainfall) affect success of mussel reef development	Possible (4) x Moderate (2)	Moderate (8)	Low mussel recruitment, survival and/or growth or the establishment of non-intended community assemblages on the reefs due to improper site selection and reef development methods. *Management* 1. Use science and habitat suitability models to inform the site selection process (e.g. water quality, topography, hydrodynamic, sediment analysis, benthic habitat type, historic shellfish reef locations). 2. Establish TAG review process and provide opportunities for workshops to peer review the data and process. 3. Consult with key experts and relevant authorities and draw upon experience gained from other projects and processes. 4. Develop full ecological sustainable development risk assessment for mussel reef construction (*see Table 5 above*)

			5. Develop an MOU between TNC and DBCA for ongoing habitat restoration activities in the Swan Canning Estuary. 6. Develop a monitoring and maintenance plan in collaboration with DBCA to ensure reef resilience beyond the life of this funded project. 7. Characterise the various other ecological benefits of the reefs beyond mussel populations, e.g. biodiversity gains, filtration gains from other filtering organisms, nutrient cycling capacity etc.
2.2 Long-term climate change patterns affect ongoing reef success	Possible (4) x Moderate (2)	Moderate (8)	Mussels become a less viable candidate for reef building as the climate changes in the long-term. *Management* 1. Model the anticipated future water quality changes in the Swan-Canning Estuary in the context of *M. galloprovincialis*. 2. Collaborate with DBCA and other interested stakeholders to formulate adaptive management plans regarding likely changes to other key ecosystem components of the estuary (e.g. seagrass beds, fish and invertebrate assemblages etc). 3. Identify other shellfish species that could become more viable candidates for seeding the reef structures in the future. 4. Characterise the various other ecological benefits of the reefs beyond mussel populations, e.g. biodiversity gains, filtration gains from other filtering organisms, nutrient cycling capacity etc.
3. Statutory/Operational			
3.1 Misalignment of project with funding or partners organisation	Rare (1) x Moderate (3)	Low (3)	Governance issues relating to poor communication, and conflict within partner organization resulting in misaligned objectives, breakdown of relationship and potential legal action. *Management* 1. Clearly define partner roles and discuss preferred ways funding or partner organisations want to be involved. 2. Establish deliverables-based project plan and agreed timelines. 3. Establish regular communication and feedback opportunities with key stakeholders. 4. Submit reports and communication materials that are high quality and on time. 5. Outline an agreed communications plan with project partners.
3.2 Contract deliverables not met	Unlikely (2) x Moderate (3)	Low (6)	Project Lead and/or third party vendors not delivering on time or as agreed, potentially leading to project delays and potential legal action. *Management* 1. Prepare contracts one month in advance according to TNC standard operating procedures and relevant funder policy. 2. Establish deliverables-based project plan and agreed timelines. 3. Establish regular communication and feedback opportunities with key stakeholders.

			4. Where possible, ensure flexibility around timing of works is built into contracts to compensate for unforeseen events (e.g. adverse weather, supply delays). 5. Regular communication with contractors with clearly defined timelines to ensure that due dates for deliverables are met. 6. Identify alternative options that can be used to undertake the works if contractor fails to deliver.
3.3 Project delays	Possible (4) x Minor (1)	Low (4)	The risk that activities will take longer than expected. *Management* 1. Regularly communicate with project partners the key dates and deliverables required to advance the project schedule. 2. Provide generous timing where possible for contingency. 3. Where necessary, any required changes to the project timeline are negotiated with partners as soon as is feasible.
3.4 Legal risks	Unlikely (2) x Moderate (3)	Low (6)	Arising from legal and regulatory obligations, including contract risks and litigation brought against TNC. *Management* 1. Contract Terms and Conditions and Terms of Reference be reviewed by TNC's legal team in accordance with Standard Operating Procedures and policies. 2. All communications between principal and contractors will be recorded and filed. 3. Any conflicts or disputes with contractors are first discussed informally to try and resolve issues prior to legal intervention. 4. Discuss legal proceedings with TNC's Legal Team and Leadership team if conflict cannot be resolved.
3.5 Poor implementation	Unlikely (2) x Moderate (3)	Low (6)	Includes risks from process problems such as materials, procurement and delivery. *Management* 1. Develop implementation plans based on lessons learnt from other projects and peer reviewed by colleagues and project partners. 2. Project Manager to draw upon the wider resources and support expertise across the organization.
3.6 River user conflicts	Likely (6) x Moderate (2)	Moderate (12)	Direct issues relating to estuary-user groups, such as reefs at inappropriate depths causing navigational risk issues, commercial fishing gear becoming entangled in reef, anchorage issues etc *Management* 1. Reefs to be built to all relevant requirements/conditions, as supplied by relevant regulatory/government departments, e.g. Department of Transport (DOT), DBCA, DPIRD etc.

			2. Post-construction multi-beam surveys to be undertaken by TNC and supplied to relevant regulators for incorporation into navigational charts, departmental plans/operational procedures etc. 3. Consult with relevant user groups to build awareness of reef locations and, where necessary and possible, negotiate a mutually-agreeable outcome.
3.7 Inappropriate monitoring and maintenance	Unlikely (2) x Moderate (3)	Low (6)	Post-construction monitoring of reef structures reveals reefs do not conform to agreed specifications. *Management* 1. Reef-building contractor required to rectify the build to specifications outlined in the Contract Terms and Conditions and Terms of Reference between contractor and TNC.
4. Financial			
4.1 Over Budget	Unlikely (2) x Moderate (3)	Low (6)	Escalation of project costs due to poor cost estimation, scope creep and fluctuations in materials costs. *Management* 1. Align scope to the contract agreement. 2. Base costs on previous comparable projects, known costs and quotes from contractors. 3. Closely monitor the budget and review frequently. 4. Explore opportunities to advance the project with further fundraising where necessary.
5. Personnel			
5.1 Injury or death to project staff or subcontractors	Remote (1) x Catastrophic (5)	Low (6)	Activities that involve field work, diving, use of heavy machinery or marine works may result in personal harm, injury or death. *Management* 1. Identify all hazards and risks at early stages of planning and complete activity-based risk assessment. 2. All TNC staff to follow TNCs Standard Operating Procedures and relevant work health safety policies. 3. Conduct due diligence on all subcontractors undertaking construction works and ensure WHS is addressed in all relevant contracts to TNC requirements and standards. Additional on-ground checks of contractor JSEAs to ensure quality WHS is adhered to in practice.

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Part 5: Development Application – Swan-Canning Shellfish Reef Restoration Project

Swan River Trust request for further information on:

1. The financial implications of a potential 12-month deferment of implementation of the project, to allow for further monitoring and evaluation of the pilot reefs

This will have significant, detrimental implications for the financial viability of the project, donor relationships and the on-ground outcomes able to be delivered with the remaining budget. At best, it will lead to an estimated 60% reduction in the quantity of reef constructed (i.e. from ~8 ha to 3 ha), reflecting the costs and consequences outlined below. It will also lead to additional risks to project delivery, as identified in the following.

i. Ongoing salary and administration support for Project staff (full-time Project Coordinator and proportional time allocations for the Oceans Director, Restoration Scientist and Communications Manager) for an additional 24 months (note that this includes the proposed 12 month deferment, plus an additional year to regrow sufficient adult mussel seeding stock – see point iv below). Alternatively, if the Project Coordinator was allocated part-time to this project to only undertake further monitoring and evaluation (e.g. 0.5 FTE), then either (i) TNC would be required to supplement the remaining FTE proportion of that role with work on another comparable project (and likely based in the Perth metropolitan region), which it does not currently have available; or (ii) the Project Coordinator would seek alternative full-time employment elsewhere. The latter scenario would lead to a significant loss of knowledge and expertise that has been built by the current Project Coordinator over the last year (and indeed longer given their previous 2-year role as a Research Assistant working on the science underpinning this project). In the event that a new and suitably-qualified Project Coordinator could be recruited into a 0.5 FTE role, it is envisaged that project progress would be delayed by ~4-6 months to accommodate time required for recruitment, onboarding and traction.

   It should also be noted that TNC has already extended the Project by one year (in late 2020/early 2021) - at no additional cost to the Project funders - to enhance learning from pilot reefs. This extension was driven by an exceptionally-poor mussel recruitment season on the Cockburn Sound shellfish aquaculture farm in 2020, which led to poor mussel seed stock for the pilot reefs. Considerable extra work was undertaken by TNC staff, mussel aquaculture experts and researchers during this period to adapt and trial different mussel seeding approaches, quantify the susceptibility of mussels to predation based on both size and seeding substrate (rocky reefs or coir beds), develop a predation-exclusion approach to enable mussels to establish following seeding, and monitor the pilot reefs.

ii. Loss of the $1M funding allocation to the Swan-Canning project from the Australian Governments' Reef Builder initiative. The timeline for delivery of all reef building, seeding and post-construction monitoring under this initiative is June 2023, which could not be achieved with a further one-year delay on this project. The existing funds would instead be reallocated to one of the other 12 reef-building projects being supported by this national initiative.

iii. Risk of other funders terminating existing Collaborative Agreements, given further project delays. This risk, combined with the loss of the $1M Reef Builder funding, could trigger further losses in project funding by devaluing the $2M match-funding contribution provided by The Minderoo Foundation. The implications of a one-year

delay for the $2M funding contribution committed by the WA Government in 2021 is unknown.

iv. Dumping of ~90 tonnes of adult mussels, currently being grown on the Cockburn Sound aquaculture lease specifically for this project, at a cost of ~$150,000. There is no alternative to use this stock on another reef building project or on-sell the stock commercially. It should also be noted that, if the project were delayed by one year (commencing within the next month), the soonest that more adult mussel stock could be made available for the full-scale reefs would be July/August 2024. This would in turn delay the commencement of full-scale reef building until May/June 2024.

v. Additional costs of further re-seeding and monitoring of existing pilot reefs (x2 monitoring events) under the proposed one-year deferment scenario (~$100,000), which will further reduce funds available for the full-scale reef build.

vi. Risk to the potential of TNC being able to re-contract the same preferred reef construction contractor (selected after an extensive Request for Quote and assessment process) due to retraction of the contract that is currently being negotiated.

2. Further justification for the proposed locations and depth of the reefs, to minimise potential navigation impacts.

The proposed locations and depths of the full-scale reefs with regards to navigational safety are the culmination of extensive (i) Restoration Suitability Modelling (RSM) and (ii) consultation with key regulators (Department of Transport [DoT] and Department of Biodiversity, Conservation and Attractions [DBCA]) and the yachting community (represented by Australian Sailing and Yachting WA) since 2019/20.

i. Reef locations have been chosen after detailed RSM assessments, which combine spatial data layers and suitability thresholds for (a) environmental preferences of mussels (validated with the in-field mussel survival and growth data); (b) avoidance of sensitive habitats (e.g. seagrass, Marine Protected Areas) and (c) estuary-user conflicts (e.g. navigational safety risk, existing infrastructure, water ski zones etc) and (d) reef construction constraints (e.g. water depth, slope of substrate etc).

In reference to component (c) above, navigational safety is accounted for by excluding all waters surrounding navigational channels (i.e. a 100 m buffer around all sides of main navigational channels and a 50 m buffer around all sides of smaller navigational channels), and maintaining a required water clearance (as stipulated by the DoT) above the highest point of all reefs at Lowest Astronomical Tide (LAT). During 2019/20, DoT stipulated the required water clearance was 2.5 m, which was complied with in all RSM assessments. Following further consultation with the yachting community and key regulators in 2021/2022 (see point ii below), this water clearance was increased to 4 m at LAT, which has been adjusted for in the RSM and proposed reef building locations.

ii. Significant consultation has occurred between TNC, Australian Sailing, Yachting WA, DoT and DBCA with regards to the navigational safety of the proposed reefs for the yachting community in the estuary. Yachters do not limit their activities to the marked navigation channels in the estuary, but use all available navigable space in order to maintain competitive advantage. To alleviate yachters' concerns that a 2.5 m water clearance at LAT would be insufficient for deeper-keeled yachts, TNC

agreed to increase the water clearance to 4 m at LAT. The Director of Waterways Safety Management at DoT further stated during consultation with the above representatives that, in his view, this water clearance posed no navigational risk of concern for either the power-boating community or the yachting community. TNC further proposed that, within the boundaries of the proposed reef building areas at each site, the locations of individual reef units could potentially be adjusted to accommodate preferred anchoring locations at the start/finish points of yacht races. This latter option was not found to be feasible, given that the areas requested by yachting representatives were considerably larger than could be reasonably accommodated within the reef building envelopes.