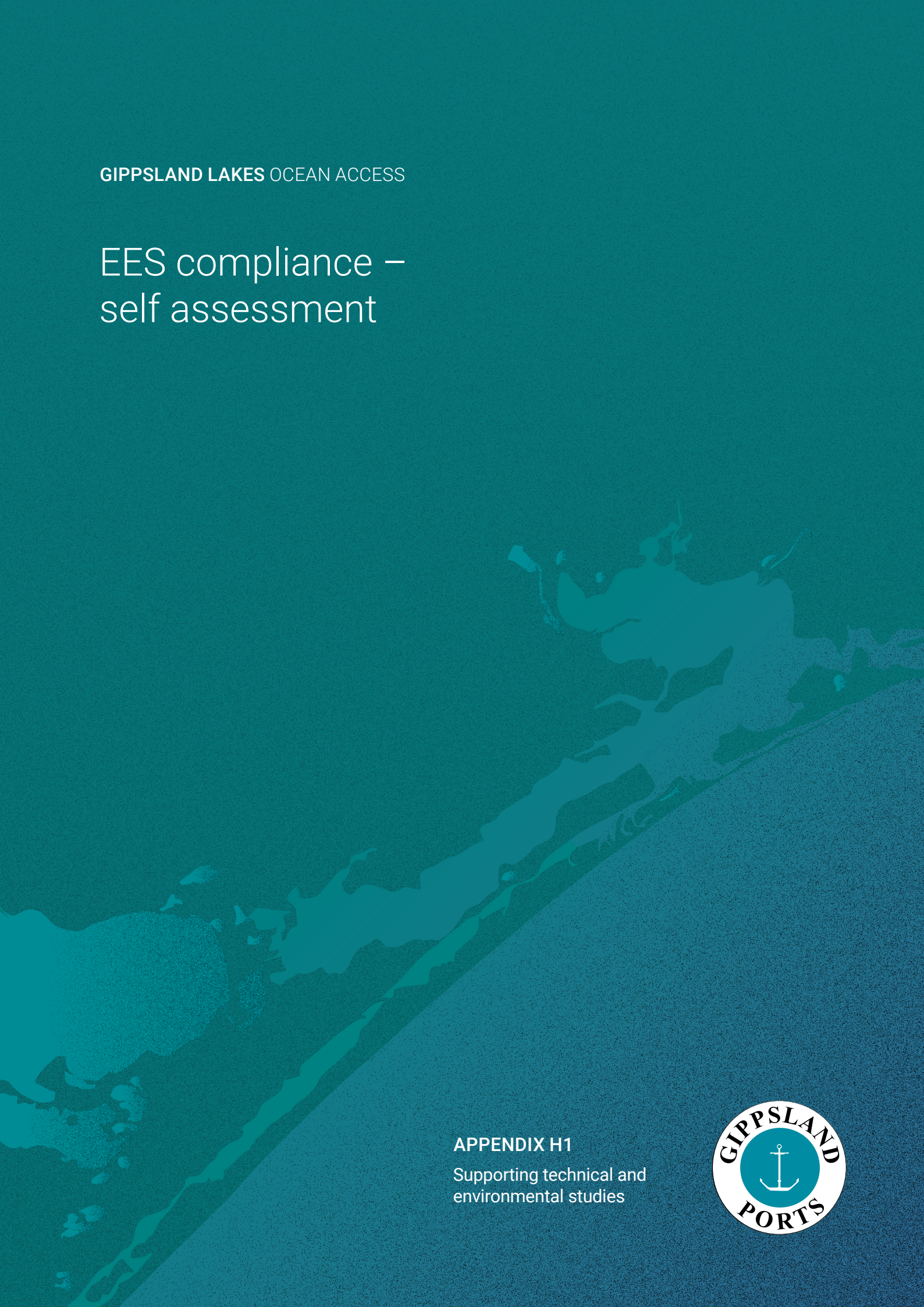
GIPPSLAND LAKES OCEAN ACCESS

EES compliance – self assessment



APPENDIX H1

Supporting technical and environmental studies

GIPPSLAND PORTS

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

MEMO

To: **Damian Snell / Swash Project Delivery Pty Ltd**

David Holding / Gippsland Ports

From: **Cam Tiller/ Ethos NRM**

Date: **11/07/2022**

RE: **Assessment of requirement of an Environment Effects Statement (EES) under the *Environment Effects Act 1978* for the Gippsland Lakes Ocean Access (GLOA) program.**

INTRODUCTION

The *Environment Effects Act 1978* provides that where proposed works may have a significant effect on the environment, either a proponent or a decision-maker may refer these works (or project) to the Minister for Planning for advice as to whether an Environment Effects Statement (EES) is required.

Ethos NRM Pty Ltd have been engaged to provide an assessment for the requirement of an EES for the Gippsland Lakes Ocean Access program based on the criteria for referral provided in the *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978* (DSE, 2006).

BACKGROUND INFORMATION

The Gippsland Lakes Ocean Access (GLOA) program maintains reliable navigational access between the Gippsland Lakes and Bass Strait for commercial and recreational vessels. The main component of the GLOA program is dredging of the Entrance and Inner Channels (**Figure 1**) with the Trailing Suction Hopper Dredge (TSHD) *Tommy Norton* and placing dredged material nearshore in allocated Dredged Material Grounds (DMGs) (**Figure 2**). A smaller Cutter Suction Dredge (CSD), *Kalimna*, is also used to relocate sand from the Inner Channels via a sand transfer system and two very nearshore outfalls for direct beach nourishment (**Figure 3**).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

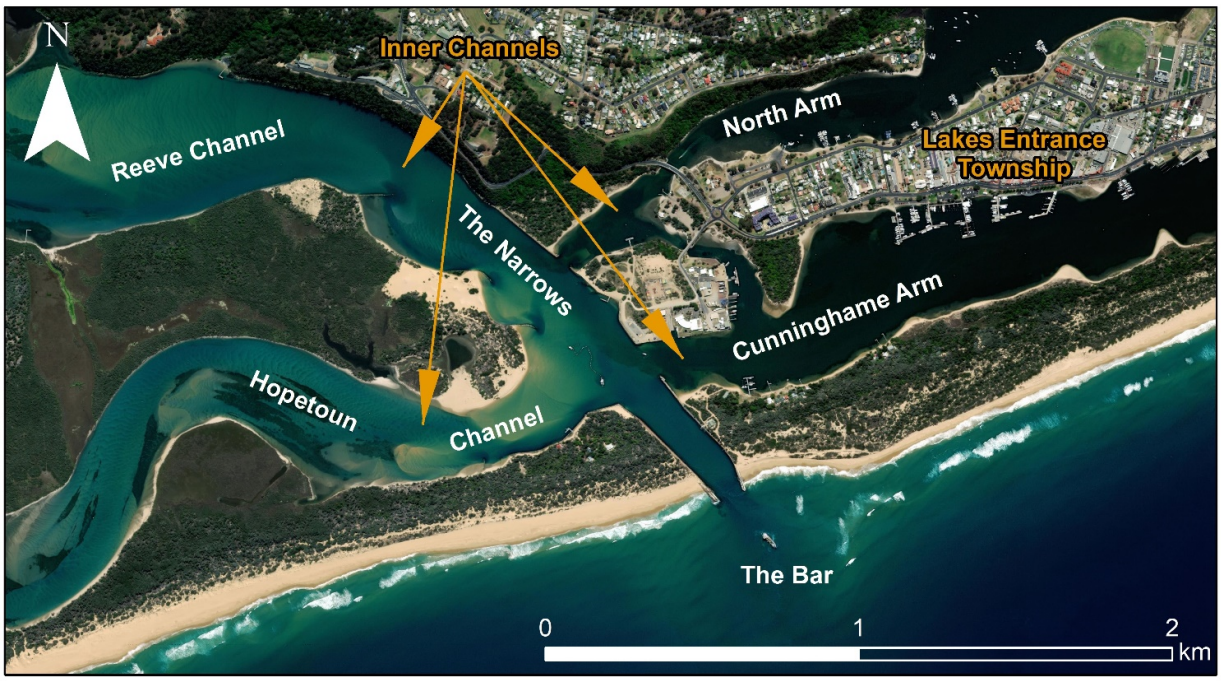
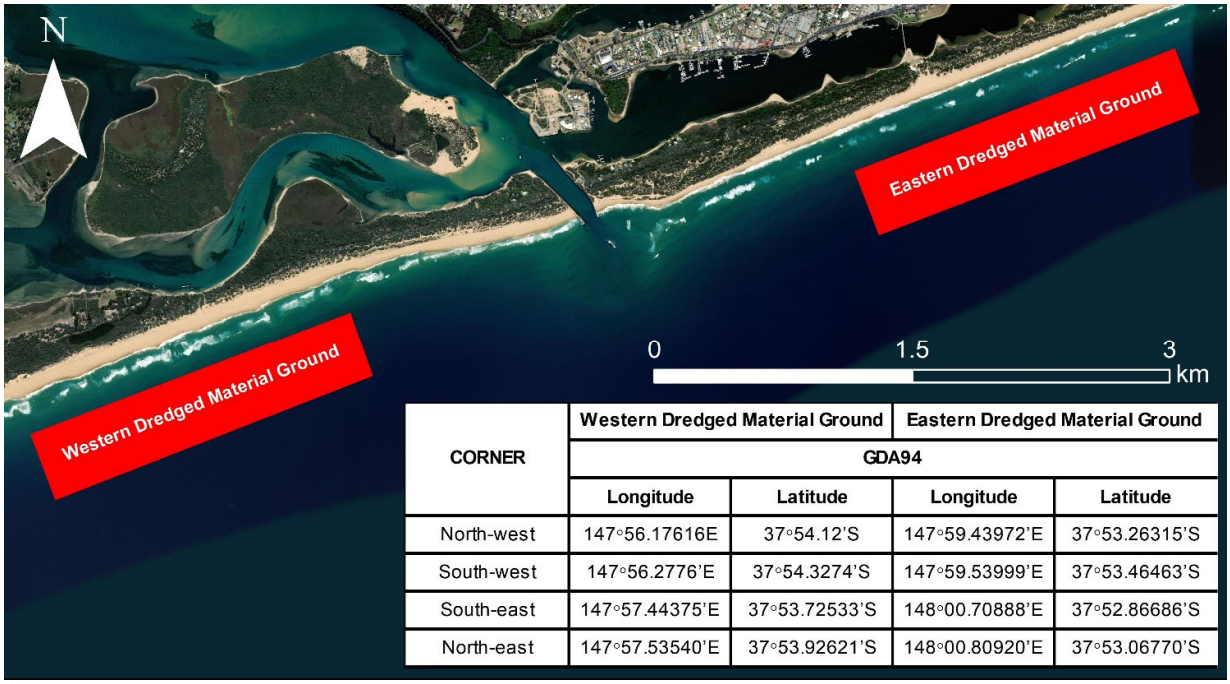


Figure 1. Location of GLOA Activities



CORNER	Western Dredged Material Ground		Eastern Dredged Material Ground	
	GDA94			
	Longitude	Latitude	Longitude	Latitude
North-west	147°56.17616E	37°54.12'S	147°59.43972'E	37°53.26315'S
South-west	147°56.2776'E	37°54.3274'S	147°59.53999'E	37°53.46463'S
South-east	147°57.44375'E	37°53.72533'S	148°00.70888'E	37°52.86686'S
North-east	147°57.53540'E	37°53.92621'S	148°00.80920'E	37°53.06770'S

Figure 2. Location of Dredged Material Grounds.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

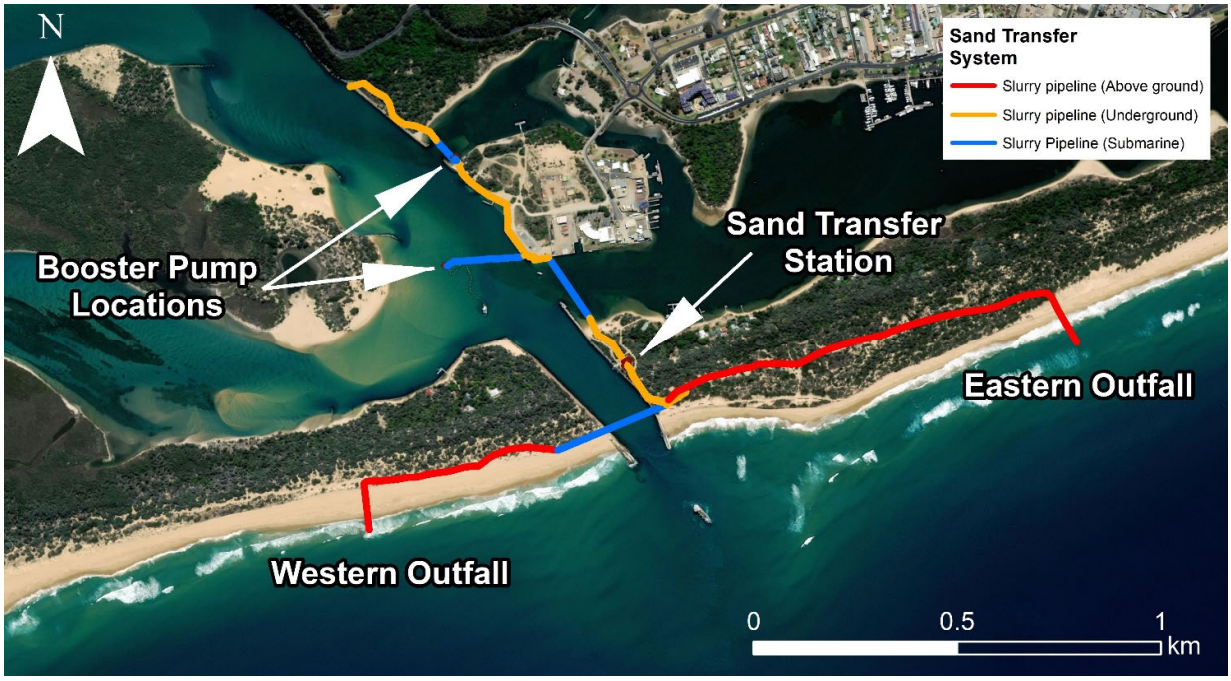


Figure 3. Location of the Sand Transfer System and nearshore outfalls.

The location of GLOA dredging activities are largely confined to areas that have been subject to regular maintenance dredging to keep the artificial entrance open since its creation in 1889 (see **Table 1**).

ETHOSNRM

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Table 1: Summary of historic dredging activities at Lakes Entrance

DREDGE NAME	PERIOD OF USE	TYPE OF DREDGE
Wombat	1879 to 1928	Bucket Dredge
Pioneer	1906 to unknown	Suction Dredge
Priestman	Pre 1908 to 1963	Grab Dredge
W.H. Edgar	1922 to 1936	Side Suction Dredge
Paynesville	1936 to 1963	Suction Dredge
Sandpiper	1963 to 2005	Cutter Suction Dredge
Mathew Flinders	Circa 1970	Trailing Suction Hopper Dredge
April Hamer	1979 to 2011	Side-casting Dredge
Melbourne	2006 to 2007	Cutter Suction Dredge
Kalimna	2007 to present	Cutter Suction Dredge
Pelican	2008 to 2016	Trailing Suction Hopper Dredge
Tommy Norton	2017 to present	Trailing Suction Hopper Dredge

During 2008 – 2016, the TSHD *Pelican* operated for typically 6 to 8 weeks on a 24/7 basis for the annual GLOA program as required throughout the year. Since the delivery of the Gippsland Ports' owned TSHD *Tommy Norton*, operations for the GLOA program are conducted during daylight hours on a 76-hour, 9-day fortnight, ongoing throughout the year, except where constrained by operational issues (i.e. maintenance), weather conditions, or restrictions imposed by the GLOA Environmental Management Plan (EMP) and/or approvals/legislation.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

During 2008-2019, the 'Total Dredged Volume' from the TSHD programs averaged almost 230,000m^3 per annum (Swash, 2019) to maintain a channel design depth of 4 – 5.5 metres (**Figure 4**). Bathymetric surveys (Port and Coastal Solutions, 2021) indicate that sedimentation above design depths for GLOA dredge areas is in the order of:

- Bar Channel: **20,000 to 80,000 m^3 / year**
- Bar Wedge: **70,000 to 160,000 m^3 / year**
- Entrance Channel: **3,000 to 7,000 m^3 / year**
- Swing Basin: **20,000 to 30,000 m^3 / year**
- Inner Channels: **140,000 to 170,000 m^3/year**

Figure 4. Channel design depths for the Entrance, Bar, Wedge, Swing Basin and Inner Channels.

Table 2 provides records of the total volume of material dredged from the Bar, Entrance and Inner Channels and the volume of dredged material placed within each DMG during 2008 – 2020.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Table 2. Volume of dredge and placement of dredged material during 2008 – 2020.

Year	Volume (m^3)[1]			DMG Placement	
	Bar	Entrance[2]	Inner Channels	West	East
2008	Unknown	Unknown	Unknown	215,280[3]	143,520[3]
2009	Unknown	Unknown	Unknown	150,268	90,273
2010	Unknown	Unknown	Unknown	97,593	67,146
2011	355,579	23,179	Unknown	379,175	0
2012	228,910	1,356	132,194	214,251	30,315
2013	162,539	10,141	135,182	173,892	0
2014	160,786	16,269	118,562	179,774	1,158
2015	149,735	4,063	158,824	96,330	60,459
2016	198,435	2,333	176,330	198,911	1,857
2017	43,585	2,013	165,233	0	45,598
2018	132,966	45,668	135,585	0	184,401
2019	108,909	49,551	102,432	0	172,271
2020	152,600	34,667	132,962	0	210,787
Total	1,694,044	189,240	1,257,304[4]	1,705,474	1,007,785

[1] the volume shown represents the volume reported by the dredge vessel as the transported volumes. Based on previous comparison by GPs it was estimated that the in-hopper volume for the TSHD is approximately 16% more than the in-situ volume due to bulking and sand infill into the dredged areas prior to post dredge survey.
[2] this includes the Entrance Channel and the Swing Basin.
[3] the exact breakdown of the placement between the east and west DMGs in 2008 is unknown but has been estimated based on the relative increase at volume following the placement at the two sites.
[4] the majority of the sediment dredged from the Inner Channels region was pumped to the nearshore beach discharge points using the STS.

Current seasonal restrictions apply to TSHD dredging operations, including the Rigby Island Buffer Zone which preclude dredging activities during shorebird breeding and migration periods (i.e. between October and March inclusive) and turbidity restrictions during the Australian Grayling migration (i.e. September to January). Also, cetacean proximity protocols and restrictions are permanently in place.

An annual external audit of the GLOA EMP is conducted to ensure compliance (Ethos NRM, 2020) with these buffer zones and restrictions.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

REFERRAL CRITERIA: INDIVIDUAL POTENTIAL ENVIRONMENTAL EFFECTS

Individual types of potential effects on the environment that might be of regional or State significance, and therefore warrant referral of a project, are:

Potential clearing of 10 ha or more of native vegetation from an area that:

– is of an Ecological Vegetation Class identified as endangered by the Department of Sustainability and Environment (in accordance with Appendix 2 of Victoria's Native Vegetation Management Framework)

– is, or is likely to be, of very high conservation significance (as defined in accordance with Appendix 3 of Victoria's Native Vegetation Management Framework)

– is not authorised under an approved Forest Management Plan or Fire Protection Plan

The GLOA program will not clear 10 ha or more of native vegetation. Seagrass mapping during 2007-12 (AME, 2007, 2008, 2009, 2012) and 2017-21 (Brooks & Hale, 2021) indicated that there is ***no*** seagrass within the channel areas that are continuously dredged (**Figure 5**).

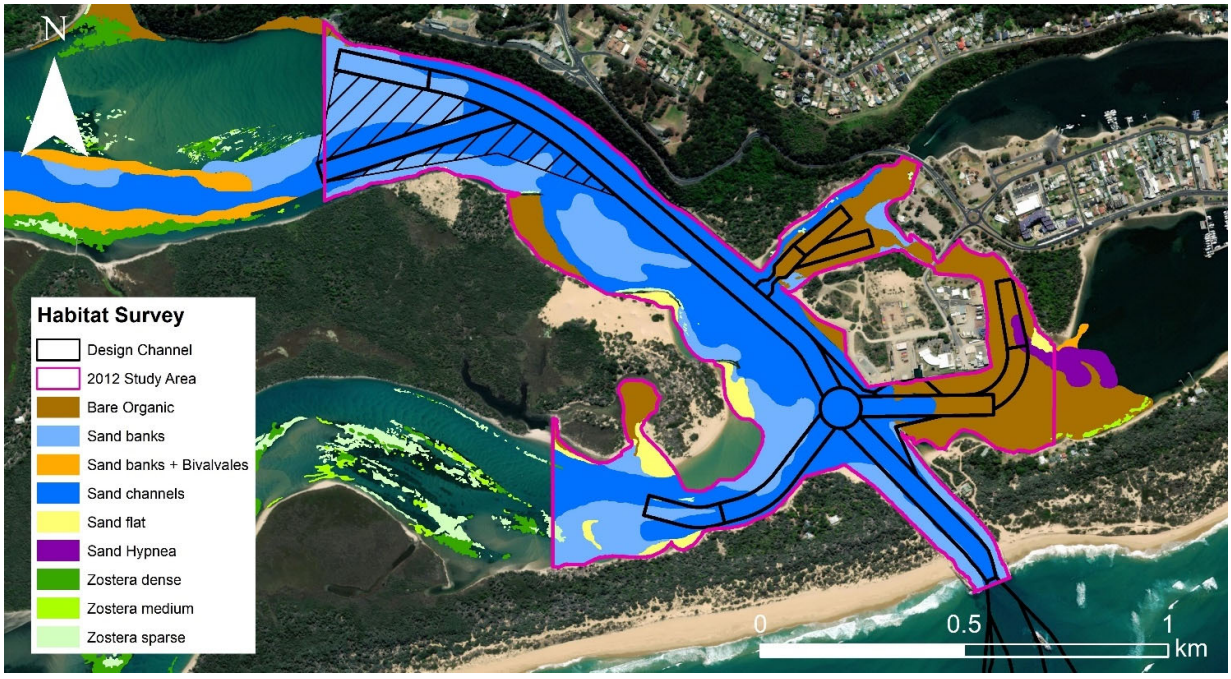


Figure 5. Results from the 2012 Marine Habitat survey.

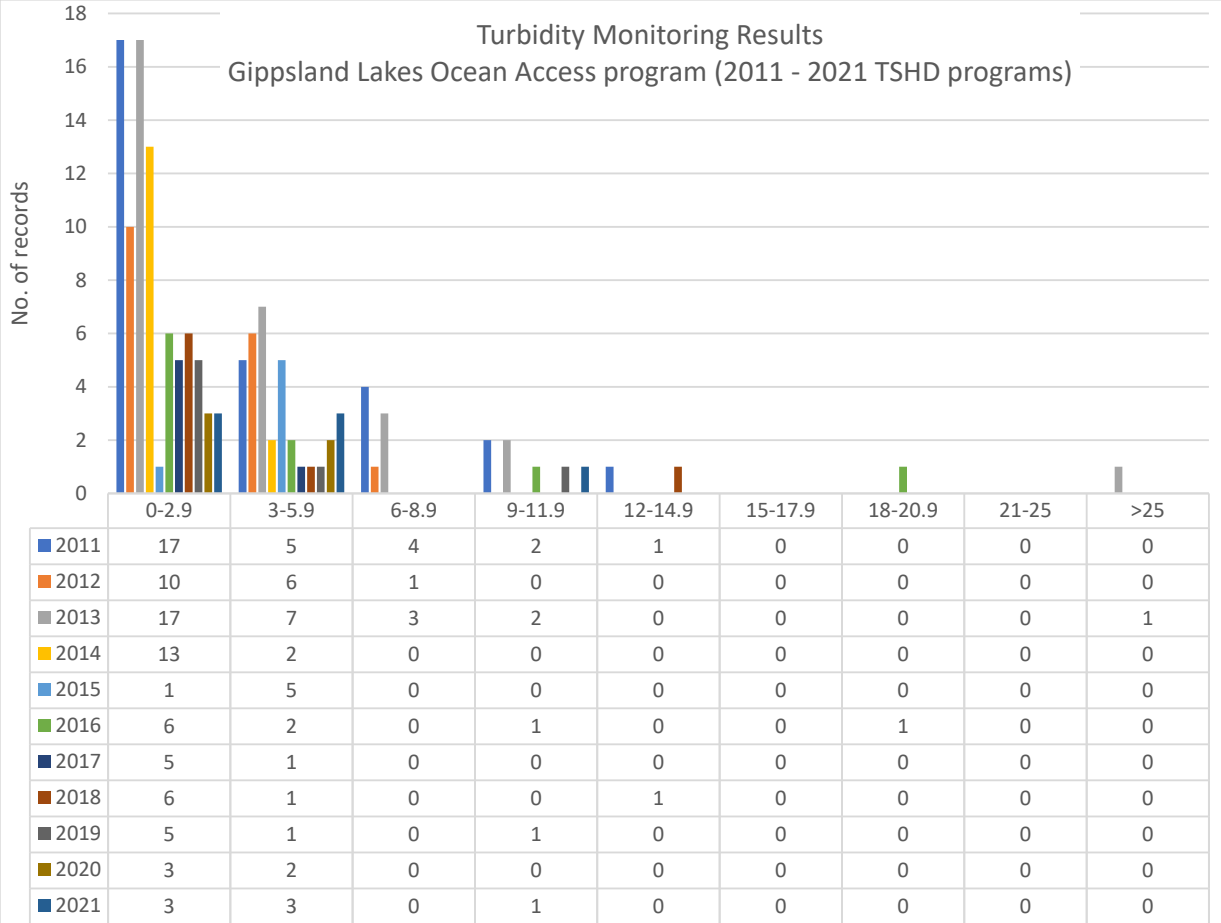
PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

The GLOA Environmental Risk Register notes that a small (<100 metre) plume is expected to occur in the area immediately surrounding the vessel for a period of 50 minutes each 3-hour cycle. Seagrass mapping during 2017-21 (Brooks & Hale, 2021) indicates high annual variability in the distribution of seagrass within 100 m of the GLOA dredging footprint, with this buffer containing an annual average of 0.70 ha, or 0.027% of the total area of seagrass within the Gippsland Lakes system, during this period. This is considerably less than the 10 ha of potential native vegetation clearing specified by this referral criteria.

The dredging plume created by the TSHD is localised and expected to occur only in the area immediately surrounding the vessel. As such, settled sediment from the plume will also be localised in distribution. Long-term monitoring of turbidity levels (**Figure 6**) demonstrate that dredging activities have remained well within the turbidity compliance limit of 25 NTU (measured at 50 m from the vessel) suggesting minimal, localised increases in suspended sediments. Therefore, seagrass habitats are considered to be at low residual risk of significant impact. AME (2007, 2008, 2009 and 2012) also indicates that benthic organism density is low, and that there are no threatened aquatic species in the area to be dredged.

The Eastern and Western Dredge Material Zones (DMGs) consist only of sediment habitats, primarily medium sand fractions (AME, 2007), similar to the Inner Channel areas subject to dredging (Gippsland Ports, draft 2022). There was no subtidal reef located during surveys of the area subject to GLOA activities (AME, 2007).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528



	0-2.9	3-5.9	6-8.9	9-11.9	12-14.9	15-17.9	18-20.9	21-25	>25
2011	17	5	4	2	1	0	0	0	0
2012	10	6	1	0	0	0	0	0	0
2013	17	7	3	2	0	0	0	0	1
2014	13	2	0	0	0	0	0	0	0
2015	1	5	0	0	0	0	0	0	0
2016	6	2	0	1	0	0	1	0	0
2017	5	1	0	0	0	0	0	0	0
2018	6	1	0	0	1	0	0	0	0
2019	5	1	0	1	0	0	0	0	0
2020	3	2	0	0	0	0	0	0	0
2021	3	3	0	1	0	0	0	0	0

Figure 6: GLOA turbidity monitoring results (2011 – 2021).

Note: *The 2013 high reading (>25NTU) was due to an anomalous outlier from 10 test readings measured across the channel. Event occurred just inside training walls and on upslope from natural scour hole. Reading of 40.1 NTUs was transient and localised with readings of 5.3 and 10.8 NTUs taken one minute either side of this result. The "Dredge effect" calculation gave a 'false positive' (38.9 NTUs) by subtracting the minimum reference reading (1.8) from this maximum test reading (40.1). If the "Dredge effect" was calculated based on 10 readings measured across the channel then the results would have been 3.7 NTUs (based on averages) or 1.6 NTUs (medians).*

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Potential long-term loss of a significant proportion (e.g. 1 to 5 percent depending on the conservation status of the species) of known remaining habitat or population of a threatened species within Victoria

Impact to species

There are a number of FFG-listed threatened species that are known or are likely to occur in the area affected by GLOA dredging activities. However, there is no residual risk for the potential loss of a population of a threatened species or their critical habitat that is not mitigated by the seasonal restrictions currently applied to GLOA dredging operations. These restrictions include the Rigby Island Buffer Zone which preclude dredging activities during shorebird breeding and migration periods (i.e. between October and March inclusive), turbidity restrictions during the Australian Grayling migration (i.e. September to January), and the ongoing cetacean proximity protocols and restrictions.

Impact on habitat

The GLOA program will not clear 10 ha or more of native vegetation. Seagrass mapping during 2007-12 (AME, 2007, 2008, 2009, 2012) and 2017-21 (Brooks & Hale, 2021) indicated that there is ***no*** seagrass within the channel areas to be dredged (**Figure 5**).

The GLOA Environmental Risk Register notes that a small (<100 metre) plume is expected to occur in the area immediately surrounding the vessel for a period of 50 minutes each 3-hour cycle. Seagrass mapping during 2017-21 (Brooks & Hale, 2021) indicates high annual variability in the distribution of seagrass within 100 m of the GLOA dredging footprint, with this buffer containing an annual average of 0.70 ha, or 0.027% of the total area of seagrass within the Gippsland Lakes system, during this period. This is considerably less than the 1 – 5% of potential long-term loss of known remaining habitat specified by this referral criteria.

The Eastern and Western Dredged Material Zones (DMGs) consist only of sediment habitats, primarily medium sand fractions (AME, 2007), similar to the Inner Channel areas subject to dredging (Gippsland Ports, draft 2022). That is, source and deposition sites consist of very similar sediments. There was no subtidal reef located during surveys of the area subject to GLOA activities (AME, 2007).

Seagrass is known to provide particularly important habitat for syngnathid fish. Although the distribution of seagrass displays high annual variability, mapping of seagrass beds in the Narrows, Hopetoun Channel, North and Cunningham Arms, adjacent to GLOA actions, have

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

shown little long-term change between mapping periods 2007 – 2012 (AME, 2007) and 2017 – 2021 (Brooks & Hale, 2021).

The dredging plume created by the TSHD is localised and expected to occur only in the area immediately surrounding the vessel. As such, settled sediment from the plume will also be localised in distribution. Long-term monitoring of turbidity levels (**Figure 6**) demonstrate that dredging activities have remained well within the turbidity compliance limit of 25 NTU (measured at 50 m from the vessel) suggesting minimal, localised increases in suspended sediments. Therefore, seagrass habitats are considered to be at low residual risk of significant impact. AME (2007, 2008, 2009 and 2012) also indicates that benthic organism density is low, and that there are no threatened aquatic species in the area to be dredged.

Potential long-term change to the ecological character of a wetland listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'

Following the methodology set out in the National Ecological Character Description Framework (DEWHA, 2008), the "Ecological Character Description of the Gippsland Lakes Ramsar Site" (BMT WBM, 2011) has identified, described and where possible quantified critical components, processes and services of the site. To address this referral criteria, the critical components, processes and services potentially affected by GLOA dredging activities are addressed below.

Critical Component 1 – Marine Subtidal Aquatic Beds

Seagrass cover within the Gippsland Lakes displays a high inter-annual variability with Roob and Ball (1997) showing that there had been continual fluctuation in seagrass cover during 1959 – 1997 at their five sampling sites.

More recent seagrass mapping during 2007-12 (AME, 2007, 2008, 2009, 2012) and 2017-21 (Brooks & Hale, 2021) has indicated that there is ***no*** seagrass within the channel areas that are continuously dredged (**Figure 5**).

The GLOA Environmental Risk Register notes that a small (<100 metre) plume is expected to occur in the area immediately surrounding the vessel for a period of 50 minutes each 3-hour cycle. Seagrass mapping during 2017-21 (Brooks & Hale, 2021) supports earlier evidence (Roob & Ball, 1997) of high annual variability in the distribution of seagrass within 100 m of the GLOA dredging footprint, with this buffer containing an annual average of 0.70

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

ha, or 0.027% of the total area of seagrass within the Gippsland Lakes system, during this period.

Critical Component 2 – Coastal Brackish or Saline Lagoons

The ecology of the main lakes (King, Victoria and Wellington) is supported by a combination of freshwater inflows, marine inflows, ambient water quality and nutrient cycling processes associated with bed sediments. Salinity levels, water temperature and levels, dissolved oxygen concentrations, growth of aquatic vegetation and turbidity levels vary substantially over time in response to these underlying ecosystem processes (BMT WBM, 2011).

The depth of the dredged channel and bar does not influence tidal exchange. Instead, the flow of water into the lakes is controlled by the cross-sectional shape at the entrance (CES, 2010). Expert professional opinion sought by Gippsland Ports from consultants GHD and Coastal Engineering Solutions advised that "the Entrance is the primary "choke" to flow rates in and out of the lakes and conditions in the Entrance have not materially changed. Although dredging of the bar and creation of the wedge has further opened up the *ocean* channel, the Entrance remains the primary limitation on tidal flows, and additionally, the tidal prism within the Lakes has not changed (GHD 31 January 2011).

The above was reconfirmed by Water Technology entitled *"Review of Hydrodynamic and Salinity Effects Associated with TSHD on the Gippsland Lakes*" in 2013 (Water Technology, 2013) and 2022 (Water Technology, 2022).

Even if hydrodynamic processes were to change, they would be unlikely to significantly increase the salinity of the Lakes or to alter their ecological character. For example, modelling by Webster *et al*. (2001) indicated that even an increase of 150% or decrease of 60% in the channel capacity outside the Entrance would cause a negligible change in salinity in the main basins of the Lakes.

The mixing of fresh and saline water is primarily influenced by the flow of fresh water from the catchments which, during floods, can push the saltwater out of the system or, during droughts, can result in saltwater intrusion far deeper into the lakes and estuaries (Water Technology, 2022).

Critical Component 6 – Abundance and Diversity of Waterbirds

Shorebird habitat on Rigby Island, adjacent to GLOA dredging activities, is protected by seasonal restrictions on dredging operations, including a 100m buffer zone, to prevent disturbance during breeding and migration periods.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

In 2010, Coastal Engineering Solutions determined that a deeper channel through the bar created by dredging does not increase the total flow of water into the lakes because it is the restriction of the cross-sectional shape at the entrance that controls this flow (CES, 2010). Ecological communities and threatened species habitat (including migratory shorebirds) at sites in the Gippsland Lakes system further from the entrance (i.e. Crescent Island and surrounding areas) will not be affected by dredging at the entrance.

A self-assessment for EPBC referral has recently been conducted for the GLOA program and concluded that there was no residual risk of impact to any threatened species or their habitat that were not mitigated by the seasonal restrictions currently applied to TSHD dredging operations, including the Rigby Island Buffer Zone which preclude dredging activities during shorebird breeding and migration periods (i.e. between October and March inclusive).

Critical Process 1 – Hydrological Regime

The Gippsland Lakes Ramsar site's hydrological regime can be separated into surface freshwater inflows, groundwater inflows and influences, and marine in-flows (from Bass Strait at Lakes Entrance) (BMT WBM, 2011). GLOA dredging activities potentially affect the latter.

Dredging has not had any significant effects on hydrodynamic processes at the Entrance. Expert professional opinion sought by Gippsland Ports from consultants GHD and Coastal Engineering Solutions advised that "the Entrance is the primary "choke" to flow rates in and out of the lakes and conditions in the Entrance have not materially changed. Although dredging of the bar and creation of the wedge has further opened up the *ocean* channel, the Entrance remains the primary limitation on tidal flows, and additionally, the tidal prism within the Lakes has not changed (GHD 31 January 2011)." Creating a deeper channel through the bar by dredging does not increase the total flow of water into the lakes because it is the restriction of the cross-sectional shape at the entrance controls this flow (CES, 2010).

The above was reconfirmed by Water Technology entitled *"Review of Hydrodynamic and Salinity Effects Associated with TSHD on the Gippsland Lakes*" in 2013 (Water Technology, 2013) and 2022 (Water Technology, 2022).

Critical Process 2 – Waterbird Breeding Sites

The Gippsland Lakes supports habitat and conditions that are important for a variety of waterbird species at critical stages in their life cycles (for example, breeding, overwintering, moulting), such that if interrupted or prevented from occurring, may threaten long-term conservation of those species (BMT WBM, 2011). Of these life cycle functions, breeding is considered to be the most prominent and therefore critical.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Shorebird habitat on Rigby Island, adjacent to GLOA dredging activities, is protected by seasonal restrictions on dredging operations, including a 100m buffer zone, to prevent disturbance during breeding and migration periods.

In 2010, Coastal Engineering Solutions determined that a deeper channel through the bar created by dredging does not increase the total flow of water into the lakes because it is the restriction of the cross-sectional shape at the entrance that controls this flow (CES, 2010). Waterbird breeding sites in the Gippsland Lakes system further from the entrance (i.e. Bunga Arm and Crescent Island) will not be affected by dredging at the entrance.

Critical Service 1 – Maintaining Threatened Species

The Gippsland Lakes Ramsar Site ECD (BMT WBM, 2011) identified the following nationally EPBC-listed threatened species as the key wetland dependent species of the Gippsland Lakes: Green and Golden Bell Frog (*Litoria aurea*), Growling Grass Frog (*Litoria raniformis*), Australian Grayling (*Prototroctes maraena*), Australian Painted Snipe (*Rostratula australis*), and the Australasian Bittern (*Botaurus poiciloptilus*).

Maintaining the populations of these species (and the other threatened species) over time is most dependent on the following:

- Hydrology - Maintenance of natural patterns of freshwater inundation and prevention of increases in saline intrusion.
- Biological/Biophysical Processes - Maintenance of natural vegetation patterns, extent, condition, and habitat interconnectivity. Maintenance of key biological processes occurring at the site such as growth, reproduction, recruitment, feeding and predation.
- Water Quality - Maintenance of water quality in key habitats (nutrients, dissolved oxygen, salinity).

Coastal Engineering Solutions (CES, 2010) identified that the restriction created by the cross-sectional shape at the entrance controls the total flow of water into the Gippsland Lakes and is not controlled by a deeper channel created by dredging (CES, 2010). Even if hydrodynamic processes were to change, they would be unlikely to significantly increase the salinity of the Lakes or to alter their ecological character. Modelling by Webster *et al*. (2001) indicated that even an increase of 150% or decrease of 60% in the channel capacity outside the Entrance would cause a negligible change in salinity in the main basins of the Lakes.

The mixing of fresh and saline water is mostly influenced by the flow of fresh water from the catchments which, during floods, can push the saltwater out of the system or, during

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

droughts, can result in saltwater intrusion far deeper into the lakes and estuaries (Water Technology, 2022). GLOA dredging activities do not affect these processes.

Current seasonal restrictions apply to GLOA dredging operations to promote the maintenance of key biological processes at the site, including the Rigby Island Buffer Zone which preclude dredging activities during shorebird breeding and migration periods (i.e. between October and March inclusive), turbidity restrictions during the Australian Grayling migration (i.e. September to January), and permanent cetacean proximity are in place. GLOA dredging activities do not have any impact on the habitat of terrestrial species.

Turbidity restrictions (i.e. dredge operating in overflow mode between the training walls) are in place to mitigate potential disturbance during the Australian Grayling migration period. Long-term monitoring undertaken by Gippsland Ports (2011 – 2021) has clearly demonstrated that dredging activities have a very minor, localised and transient impact on turbidity which is well within the compliance 'dredge effect' limit of 25 NTU. From 2011 – 2018, the 'dredge effect' was less than 6 NTUs for 86% of the time with only one false positive reading greater than 25 NTUs during this period. It is also noted that natural river discharges cause comparatively greater turbidity and visual impact (Swash, 2019).

The maintenance of biological/biophysical processes that are potentially affected by dredging activities involve seagrass habitats and are addressed under **Critical Component 1**.

Potential extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems, over the long term

Maintaining ocean access by dredging does not exceed the natural range of conditions at the entrance caused through natural scouring and accretion events (i.e. flood, wave and storm events). Expert professional opinion sought by Gippsland Ports from consultants GHD and Coastal Engineering Solutions advised that "the Entrance is the primary "choke" to flow rates in and out of the lakes and conditions in the Entrance have not materially changed. Although dredging of the bar and creation of the wedge has further opened up the *ocean* channel, the Entrance remains the primary limitation on tidal flows, and additionally, the tidal prism within the Lakes has not changed (GHD 31 January 2011)." Creating a deeper channel through the bar by dredging does not increase the total flow of water into the lakes because it is the restriction of the cross-sectional shape at the entrance controls this flow (CES, 2010).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

The above was reconfirmed by Water Technology entitled *"Review of Hydrodynamic and Salinity Effects Associated with TSHD on the Gippsland Lakes*" in 2013 (Water Technology, 2013) and 2022 (Water Technology, 2022).

Dredging activities at Lakes Entrance have occurred since before the permanent entrance was established in 1889 (see **Table 1**). Apart from the continual removal of accreted sands from within the GLOA dredging footprint, the placement of dredged material within the DMGs, and the very minor, localised and transient impact on turbidity, GLOA dredging activities create few changes to the physical environment of the Gippsland Lakes. Therefore, the potential for extensive or major effects on the long-term health or biodiversity of aquatic, estuarine or marine ecosystems from changes to the physical environment caused by dredging is considered a very low residual risk.

Other impact pathways (i.e. noise, toxicants, lighting at night) with the potential to effect the health or biodiversity of these ecosystems are all minor and/or within the levels already experienced in the area by commercial and/or recreational boating activities.

Lakes Entrance is a working regional port and airborne noise measures from commensurate port areas are typically 40-50 decibels during the day, and fishing vessels in the order of 55 decibels at 100m distance (SVT Engineering 2004).

In November 2021, 34 core samples were collected in accordance with National Assessment Guidelines for Dredging (NAGD 2009) and followed the methodologies set out in the project Sediment Sampling and Analysis Plan approved by DAWE. The results of contaminant testing of these samples were similar to that of historical sediment testing, showing that the dredge material in the Inner Channels is comprised of **clean oceanic sand** that is **devoid of any contaminants at notable levels** (Gippsland Ports, draft 2022)**.**

The Gippsland Ports-owned TSHD Tommy Norton only operates during daylight hours and, hence, is not expected to impact species such as marine and wading birds (including migratory shorebirds) that may be attracted to artificial lights.

Potential extensive or major effects on the health, safety or well-being of a human community, due to emissions to air or water or chemical hazards or displacement of residences

The GLOA program facilitates reliable navigational access between Bass Strait and the Port of Gippsland Lakes for commercial and recreational vessels supporting social and economic well-being for the region.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

An independent audit of the Environmental Management Plan for maintenance dredging for the GLOA program is conducted annually to assess compliance with waste and chemical hazards. Since 2015, the GLOA program has achieved 100% compliance.

During 2007, investigations were undertaken to characterize potential contamination of the sediments proposed for dredging within the Narrows, Hopetoun Channel, Cunninghame Arm and North Arm. 40 samples were collected from these sites with all sediments classified as "acceptable for unconfined ocean disposal" under the NODG Phase II assessment (DEH, 2002).

Exemption for the testing of sediment in the Swing Basin, the Entrance Channel and the Bar was given due to existing information that >95% of sediment in these areas is sand which makes sediment contamination unlikely.

In November 2021, an additional 34 core samples were collected in accordance with National Assessment Guidelines for Dredging (NAGD 2009) and followed the methodologies set out in the project Sediment Sampling and Analysis Plan approved by DAWE. The results of contaminant testing of these samples were similar to that of historical sediment testing, showing that the dredge material in the Inner Channels is comprised of **clean oceanic sand** that is **devoid of any contaminants at notable levels** (Gippsland Ports, draft 2022)**.**

Lakes Entrance is a working regional port and airborne noise measures from commensurate port areas are typically 40-50 decibels during the day, and fishing vessels in the order of 55 decibels at 100m distance (SVT Engineering 2004).

Annual independent auditing investigates airborne noise as a project delivery standard (PDS) of the GLOA Environmental Management Plan, using stakeholder and resident's feedback as criteria for compliance. No complaints have been received from residents during the 2008 - 2021 dredging programs using the TSHD *Pelican* or the TSHD *Tommy Norton* (Gippsland Ports, pers. comm.).

Potential greenhouse gas emissions exceeding 200,000 tonnes of carbon dioxide equivalent per annum, directly attributable to the operation of the facility.

Fuel usage for the two dredges – TSHD *Tommy Norton* and CSD *Kalimna* is summarised in **Table 3**. These fuel volumes have been used to determined greenhouse gas emissions along with emissions noted on associated Sand Transfer Station electricity bills. Allowing for an additional estimate of 100 tonnes of CO_2 per year for the CSD Kalimna (2018-20) an estimate

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

of around 600 tonnes of CO_2 per year is directly attributed to the GLOA program, well below the 200,000 tonne per annum criteria.

Table 3. Fuel volumes and CO_2 emissions from the TSHD Tommy Norton, CSD Kalimna and the Sand Transfer Station.

year	Kalimna		Tommy Norton		STS	Dredging Total
	fuel (L)	GHG as CO_2 (T)	fuel (L)	GHG as CO_2 (T)	CO_2 (T)	CO_2 (T)
2018			73,520	201.34	291.1	**492.44**
2019			80,203	219.65	164.5	**384.15**
2020			76,027	208.21	275.4	**483.61**
2021	33,576	91.95	137,066	375.37	153.9	**621.22**

Note: these figures are based on 2.7kg of CO_2 being emitted per litre of fuel

ETHOSNRM

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

REFERRAL CRITERIA: A COMBINATION OF POTENTIAL ENVIRONMENTAL EFFECTS

A combination of two or more of the following types of potential effects on the environment that might be of regional or State significance, and therefore warrant referral of a project. **Table 4** presents the potential environmental effects and summary of the potential impact caused by GLOA dredging activities. Further detail is provided in the relevant sections below.

Table 4. Potential Environmental Effects and their potential impacts

Potential Environmental Effect	Potential Impact
Potential clearing of 10 ha or more of native vegetation, unless authorised under an approved Forest Management Plan or Fire Protection Plan	Nil. Seagrass mapping during 2017-2021 revealed an annual average of 0.7 ha of native vegetation within 100 m of GLOA dredging activities.
Matters listed under the Flora and Fauna Guarantee Act 1988: - potential loss of a significant area of a listed ecological community; or - *potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or* - *potential loss of critical habitat; or* - *potential significant effects on habitat values of a wetland supporting migratory bird species*	Negligible. Existing mitigation measures ameliorate potential impact of GLOA dredging activities on FFG-listed species.
Potential extensive or major effects on landscape values of regional importance, especially where recognised by a planning scheme overlay or within or adjoining land reserved under the National Parks Act 1975	Unlikely. Dredging at the site has been ongoing for over 140 years without causing extensive or major effects on landscape values of regional importance.
Potential extensive or major effects on land stability, acid sulphate soils or highly erodible soils over the short or long term.	Nil. All sediments sampled from these sites are classified as “acceptable for unconfined ocean disposal” under the NODG Phase II assessment (DEH, 2002).
Potential extensive or major effects on beneficial uses of waterbodies over the long term due to changes in water quality, streamflows or regional groundwater levels	Negligible. Dredging activities have a very minor, localised and transient impact on turbidity which is well within the compliance ‘dredge effect’ limit of 25 NTU.
Potential extensive or major effects on social or economic well-being due to direct or indirect displacement of non-residential land use activities	Nil. The GLOA program facilitates permanent ocean access for commercial and recreational vessels supporting social and economic well-being for the region.
Potential for extensive displacement of residences or severance of residential access to community resources due to infrastructure development	Nil. GLOA activities are predominantly water-based with no impact to residences or access to community resources due to infrastructure development.
Potential significant effects on the amenity of a substantial number of residents, due to extensive or major, long-term changes in visual, noise and traffic conditions	Unlikely. Dredging at the site has been ongoing for over 140 years.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Potential Environmental Effect	Potential Impact
Potential exposure of a human community to severe or chronic health or safety hazards over the short or long term, due to emissions to air or water or noise or chemical hazards or associated transport	Nil. All sediments sampled from these sites were classified as "acceptable for unconfined ocean disposal" under the NODG Phase II assessment (DEH, 2002).
Potential extensive or major effects on Aboriginal cultural heritage	Nil. All Aboriginal cultural heritage sensitive area/zones identified are terrestrial and outside the dredge footprint.
Potential extensive or major effects on cultural heritage places listed on the Heritage Register or the Archaeological Inventory under the Heritage Act 1995.	Nil. No heritage sites were identified within the area of GLOA dredging activities.

Potential clearing of 10 ha or more of native vegetation, unless authorised under an approved Forest Management Plan or Fire Protection Plan

The GLOA program will not clear 10 ha or more of native vegetation. Seagrass mapping during 2007-12 (AME, 2007, 2008, 2009, 2012) and 2017-21 (Brooks & Hale, 2021) indicated that there is ***no*** seagrass within the channel areas to be dredged (**Figure 3**).

The GLOA Environmental Risk Register notes that a small (<100 m) plume is expected to occur in the area immediately surrounding the vessel for a period of 50 minutes each 3-hour cycle. Seagrass mapping during 2017-21 (Brooks & Hale, 2021) indicates high annual variability in the distribution of seagrass within 100 m of the GLOA dredging footprint, with this buffer containing an annual average of 0.70 ha, or 0.027% of the total area of seagrass within the Gippsland Lakes system, during this period. This is considerably less than the 10 ha of potential native vegetation clearing specified by this referral criteria.

The Eastern and Western Dredge Material Zones (DMGs) consist only of sediment habitats, primarily medium sand fractions (AME, 2007), similar to the Inner Channel areas subject to dredging (Gippsland Ports, draft 2022). There was no subtidal reef located during surveys of the area subject to GLOA activities (AME, 2007).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Matters listed under the Flora and Fauna Guarantee Act 1988: - potential loss of a significant area of a listed ecological community; or

- potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or

- potential loss of critical habitat; or

- potential significant effects on habitat values of a wetland supporting migratory bird species

There are a number of FFG-listed threatened species that are known or are likely to occur in the area affected by GLOA dredging activities. However, there is no residual risk for the potential loss of a significant area of a listed ecological community, threatened species or their critical habitat that is not mitigated by the seasonal restrictions currently applied to GLOA dredging operations. These restrictions include the Rigby Island Buffer Zone which preclude dredging activities during shorebird breeding and migration periods (i.e. between October and March inclusive), turbidity restrictions during the Australian Grayling migration (i.e. September to January), and the ongoing cetacean proximity protocols and restrictions.

Victorian Biodiversity Atlas (VBA) recorded FFG-listed species from within 1 km of GLOA dredging activities, and an assessment of residual risk to these species are included in **Table 5.** Records of these species indicate the existence of potential habitat for a wider range of species which are discussed in further detail below.

Avian Species

The majority of avian species recorded within 1 km of GLOA dredging activities are wetland (including migratory) or shorebird species, with habitat located on Rigby Island potentially affected. The area of habitat potentially affected by GLOA dredging activities is small in comparison to similar available habitat nearby.

Wetland species (including migratory species) are considered unlikely to be affected as there is no critical habitat located adjacent to GLOA dredging activities. As previously discussed, dredging activities are unlikely to have a significant effect on the hydrodynamic or salinity regime, suggesting little to no impact on wetland species or their habitat throughout the Gippsland Lakes system. Significant impact to any vagrant migratory species on Rigby Island is mitigated by seasonal restrictions on dredging operations, including a 100m buffer zone, to prevent disturbance throughout the migration period. Therefore, these species and their critical habitats are not likely to be at risk of significant impact.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Shorebird species such as terns and plovers, that are known to utilise (and breed in) habitat adjacent to GLOA dredging activities (i.e. Rigby Island), may potentially be affected by altered hydrodynamic processes and airborne noise.

As previously discussed, the change in the volume capacity due to dredging is very small in the context of the overall channel and is much smaller than the natural change experienced in response to changes in catchment flows. In 2010, Coastal Engineering Solutions determined that a deeper channel through the bar created by dredging does not increase the total flow of water into the lakes because it is the restriction of the cross-sectional shape at the entrance that controls this flow (CES, 2010). Ecological communities and threatened species habitat (including migratory shorebirds) at sites in the Gippsland Lakes system further from the entrance (i.e. Crescent Island and surrounding areas) will not be affected by dredging at the entrance.

To minimize disturbance from airborne noise, the Rigby Island buffer zone has been established during the shorebird breeding season (i.e. October – March inclusive) within which GLOA actions are prohibited. Annual audits of the GLOA Environmental Management Plan between 2011 and 2021 (excluding 2017 when there was no audit conducted) confirm that the Rigby Island buffer zone has not been breached by GLOA actions during the breeding season. Therefore, these species are considered to be at low residual risk of significant impact.

Fish

Turbidity restrictions (i.e. dredge operating in overflow mode between the training walls) are in place to mitigate potential disturbance during the Australian Grayling (Endangered) migration period. Long-term monitoring undertaken by Gippsland Ports (2011 – 2021) has clearly demonstrated that dredging activities have a very minor, localised and transient impact on turbidity which is well within the compliance 'dredge effect' limit of 25 NTU. From 2011 – 2018, the 'dredge effect' was less than 6 NTUs for 86% of the time with only one false positive reading greater than 25 NTUs during this period. It is also noted that natural river discharges cause comparatively greater turbidity and visual impact (Swash, 2019).

Cetaceans and marine mammals

Only a few species of whales are likely to frequent the area and potentially be affected by the placement of dredged material at the DMGs. The Humpback Whale and the Southern Right Whale are likely to occur seasonally near this coast and the Blue Whale may occasionally occur. To minimize the impact on these species, cetacean monitoring protocols are in place including the cessation of some GLOA TSHD actions when sighted within monitoring zones.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Annual audits of the GLOA EMP between 2011 and 2021 (excluding 2017 when there was no audit conducted) confirm that these protocols have been adhered to. Therefore, these species are considered to be at low residual risk of significant impact.

Dolphins are known to inhabit areas affected by GLOA dredging activities, particularly Bottle-nosed Dolphin, Common Dolphin, Risso's Dolphin and Burrunan Dolphin (this species is not currently EPBC-listed). Similar to the whales, to minimize the impact on these species, cetacean monitoring protocols are in place including the cessation of some GLOA TSHD actions when sighted within monitoring zones. Therefore, these species are considered to be at low residual risk of significant impact The CSD Kalimna is a non-propelled, stationary dredge and is considered a low risk even when operating.

During 2013 – 2019, there were a total of 196 dolphin sightings with an average of 5.7 individuals per sighting and a total of 17 whale sightings with an average of 2.1 individuals per sighting. During this period, there were no known incidents of injury or death to cetaceans associated with dredging activities (Swash, 2019). In fact, dredging has been undertaken at Lakes Entrance since 1889 with no reported collisions with any cetaceans (Swash, 2019).

The Australian Fur-seal has also been recorded infrequently within areas adjacent to GLOA actions. This species is considered to be potentially affected by underwater noise but at low residual risk of significant impact due to their continued records despite noise from GLOA activities, and commercial and recreational vessels.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Table 5. FFG-listed species recorded within 1 km of GLOA dredging activities and the residual risk of potential impact.

Scientific Name	Common Name	FFG Status	Residual Risk	Potential Impact	Comments
Ardea alba modesta	Eastern Great Egret	Vulnerable	Nil	No plausible impact pathway	Wide range of wetland habitats, usually frequenting shallow waters.
Ardea intermedia plumifera	Plumed Egret	Critically Endangered	Nil	No plausible impact pathway	Prefers shallow waters in terrestrial wetlands including freshwater swamps, billabongs, floodplains and wet grasslands with dense aquatic vegetation. Only occasionally seen in estuarine or intertidal habitats.
Arenaria interpres	Ruddy Turnstone	Endangered	Low	Altered hydrodynamic processes result in increased tides and salinity	Found singly or in small groups along coastline, often on exposed rocks or reefs with shallow pools, and on beaches. The change in the volume capacity due to dredging is very small in the context of the overall channel and is much smaller than the natural change experienced in response to changes in catchment flows. Hence, dredging has little effect on the tidal volume passing through the channels. Furthermore, the mixing and salinity regime is mostly influenced by "longer ocean level changes, such as due to storm effects over several days" and " catchment flows, which during floods can push the salt water out of the system, or during droughts can experience salt-water intrusion far deeper into the lakes and estuaries" (Water Technology, 2022).
Egretta garzetta	Little Egret	Endangered	Nil	No plausible impact pathway	Frequents tidal mudflats, saltwater and freshwater wetlands and mangroves.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Scientific Name	Common Name	FFG Status	Residual Risk	Potential Impact	Comments
Eubalaena australis	Southern Right Whale	Endangered	Nil	No plausible impact pathway	Species may occur along the coast of the Ninety Mile Beach. Cetacean monitoring and protocols are in place to minimise impact to all cetaceans, including cessation of works when sighted.
Haliaeetus leucogaster	White-bellied Sea-Eagle	Endangered	Nil	No plausible impact pathway	Found in coastal habitats and around terrestrial wetlands characterised by large areas of open water. Unlikely to be affected by short-term, localised disturbance such as proposed dredging/placement activities.
Hirundapus caudacutus	White-throated Needletail	Vulnerable	Nil	No plausible impact pathway	Primarily an aerial species., occurring over most types of habitat.
Hydroprogne caspia	Caspian Tern	Vulnerable	Low	Altered hydrodynamic processes result in increased tides and salinity	Mostly found in sheltered coastal habitats, preferring sandy or muddy margins. The change in volume capacity due to dredging is very small in the context of the overall channel and is much smaller than the natural change experienced in response to changes in catchment flows. Hence, dredging has little effect on the tidal volume passing through the channels. Furthermore, the mixing and salinity regime is mostly influenced by “longer ocean level changes, such as due to storm effects over several days” and “ catchment flows, which during floods can push the salt water out of the system, or during droughts can experience salt-water intrusion far deeper into the lakes and estuaries” (Water Technology, 2022).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Scientific Name	Common Name	FFG Status	Residual Risk	Potential Impact	Comments
Limosa lapponica	Bar-tailed Godwit	Vulnerable	Nil	No plausible impact pathway	Migratory shorebird found mainly in coastal habitats including intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Often found around beds of seagrass and, sometimes, in nearby saltmarsh.
Numenius phaeopus	Whimbrel	Endangered	Nil	No plausible impact pathway	Migratory shorebird often found on the intertidal mudflats of sheltered coasts, in harbours, lagoons, estuaries and river deltas. Rigby Island buffer zone protects species during seasonal migration.
Oxyura australis	Blue-billed Duck	Vulnerable	Nil	No plausible impact pathway	Prefer stable, deep, fresh, well vegetated wetlands often containing rushes or sedges.
Sternula albifrons	Little Tern	Critically Endangered	Low	Altered hydrodynamic processes result in increased scour and erosion	The Little Tern inhabits sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches. Despite ongoing dredging extending several channel areas and potentially increasing total volume, change in volume is very small in the context of the overall channel and is much smaller than the natural change in channel volumes experienced by scouring or deposition of sediments in response to changes in catchment flows (Water Technology, 2022). Airborne noise has the potential to impact on nesting and migratory shorebirds and studies have
			Low	Airborne noise	

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Scientific Name	Common Name	FFG Status	Residual Risk	Potential Impact	Comments
					shown that an average "flight" response occurs in shorebirds exposed to 85 decibels (Brown, 1990). A study by Burger et al. (1998) indicated that a 100m buffer from operating vessels would protect shorebird values. At 100m, measurements from commensurate port areas are typically 45-55 decibels and fishing boats 55 decibels. The Rigby Island Buffer Zone provides a 100m buffer from the tern nesting area at the south-eastern corner of Rigby Island.
Sternula nereis	Fairy Tern	Critically Endangered	Low	Altered hydrodynamic processes result in increased scour and erosion	The Australian Fairy Tern utilises a variety of habitats including offshore, estuarine or lake islands, wetlands, beaches and spits. Nests in small colonies on sandy islands and beaches inside estuaries and on open sandy beaches. Known to nest on Rigby Island, adjacent to the Entrance. This area is subject to a buffer during breeding season Despite ongoing dredging extending several channel areas and potentially increasing total volume, change in volume is very small in the context of the overall channel and is much smaller than the natural change in channel volumes experienced by scouring or deposition of sediments in response to changes in catchment flows (Water Technology, 2022).
			Low	Airborne noise	

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Scientific Name	Common Name	FFG Status	Residual Risk	Potential Impact	Comments
					Airborne noise has the potential to impact on nesting and migratory shorebirds and studies have shown that an average "flight" response occurs in shorebirds exposed to 85 decibels (Brown, 1990). A study by Burger et al. (1998) indicated that a 100m buffer from operating vessels would protect shorebird values. At 100m, measurements from commensurate port areas are typically 45-55 decibels and fishing boats 55 decibels. The Rigby Island Buffer Zone provides a 100m buffer from the tern nesting area at the south-eastern corner of Rigby Island.
Thinornis cucullatus	Hooded Plover	Vulnerable	Low	Altered hydrodynamic processes result in increased tides and salinity	Generally inhabits wide ocean beaches. It may also occur on near-coastal saline and freshwater lakes and lagoons, tidal bays and estuaries, rock platforms, or on rocky or sandy reefs close to shore. The change in the volume capacity due to dredging is very small in the context of the overall channel and is much smaller than the natural change experienced in response to changes in catchment flows. Hence, dredging has little effect on the tidal volume passing through the channels. Furthermore, the mixing and salinity regime is mostly influenced by "longer ocean level changes, such as due to storm effects over several days" and " catchment flows, which during floods can push the salt water

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Scientific Name	Common Name	FFG Status	Residual Risk	Potential Impact	Comments
					out of the system, or during droughts can experience salt-water intrusion far deeper into the lakes and estuaries" (Water Technology, 2022).
Tursiops australis	Burrunan Dolphin	Critically Endangered	Low	Underwater noise.	Species known to occur within the Gippsland Lakes. Noise monitoring and modelling conducted for the Port of Melbourne Channel Deepening Project for a much larger TSHD (i.e. 35,000m^3 compared to TSHD Tommy Norton 650m^3) indicated that underwater noise from dredging operations would have no impact on marine fauna in Port Phillip Bay (PoMC 2008). Although not tested, it is expected that underwater noise levels of the smaller TSHD Tommy Norton will be less and potentially not detectable above background noise levels.
Tyto tenebricosa	Sooty Owl	Endangered	Nil	No plausible impact pathway	Terrestrial species that will not be affected by GLOA dredging activities.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Potential extensive or major effects on landscape values of regional importance, especially where recognised by a planning scheme overlay or within or adjoining land reserved under the National Parks Act 1975

By the date of designation as a Ramsar site in 1982, the Gippsland Lakes had been operating as an estuarine system for more than 90 years. Dredging activities at Lakes Entrance has occurred since before the permanent entrance was established in 1889 (see **Table 1**). It is unlikely that the GLOA program will result in extensive or major effects on landscape values of regional importance.

Potential extensive or major effects on land stability, acid sulphate soils or highly erodible soils over the short or long term.

During 2007, investigations were undertaken to characterize potential contamination of the sediments proposed for dredging within the Narrows, Hopetoun Channel, Cunninghame Arm and North Arm. 40 samples were collected from these sites with all sediments classified as “acceptable for unconfined ocean disposal” under the NODG Phase II assessment (DEH, 2002).

Exemption for the testing of sediment in the Swing Basin, the Entrance Channel and the Bar was given due to existing information that >95% of sediment in these areas is sand which makes sediment contamination unlikely.

In November 2021, an additional 34 core samples were collected in accordance with National Assessment Guidelines for Dredging (NAGD 2009) and followed the methodologies set out in the project Sediment Sampling and Analysis Plan approved by DAWE. The results of contaminant testing of these samples were similar to that of historical sediment testing, showing that the dredge material in the Inner Channels is comprised of **clean oceanic sand** that is **devoid of any contaminants at notable levels** (Gippsland Ports, draft 2022)**.**

Acid sulphate testing shows some potential acidic components of the materials, but a large acid-neutralising capacity and a resulting low net acidity. There is minimal risk of acidic leachate due to the disturbance of this dredging material.

Following the NAGD procedures, the material sampled is deemed suitable for unconfined disposal at the DMG, and as a beneficial reuse in circulating natural sediments into the nearshore system” (Water Technology, February 2022).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

The volume capacity of Reeve Channel relative to the tidal prism is a key factor in determining the extent of tidal influence in the Gippsland Lakes. Although ongoing dredging does slightly extend several channel areas, potentially increasing total volume, it is very small in context of the overall channel and much smaller than the natural change in channel volumes caused by the scouring or deposition of sediments in response to natural catchment flows. Hence, shorebird nesting habitat at Crescent Island, some distance from the dredging channel, is not expected to be impacted by scour or erosion caused by dredging. It is also noted that Gippsland Ports supports other agencies (EGCMA, DELWP, Parks Victoria) with sand nourishment of these islands for bird habitat improvement.

Potential extensive or major effects on beneficial uses of waterbodies over the long term due to changes in water quality, streamflows or regional groundwater levels

Long-term monitoring undertaken by Gippsland Ports (2011 – 2021) has clearly demonstrated that dredging activities have a very minor, localised and transient impact on turbidity which is well within the compliance 'dredge effect' limit of 25 NTU. From 2011 – 2018, the 'dredge effect' was less than 6 NTUs for 86% of the time with only one false positive reading greater than 25 NTUs during this period. It is also noted that natural river discharges cause comparatively greater turbidity and visual impact (Swash, 2019).

In any event, the impact of any plume is likely to be minimal as AME (2007, 2008, 2009 and 2012) indicates that there are few benthic organisms in the area and no threatened species. Furthermore, most species of fish can actively move from the dredge area during dredge operations.

The mixing of fresh and saline water is mostly influenced by the flow of fresh water from the catchments which, during floods, can push the saltwater out of the system or, during droughts, can result in saltwater intrusion far deeper into the lakes and estuaries (Water Technology, 2022). Modelling by Webster *et al*. (2001) indicated that even an increase of 150% or decrease of 60% in the channel capacity outside the Entrance would cause a negligible change in salinity in the main basins of the Lakes.

There is no plausible impact pathway from the GLOA program on streamflows or regional groundwater levels.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Potential extensive or major effects on social or economic well-being due to direct or indirect displacement of non-residential land use activities

Lakes Entrance is a working regional port. In 2005, the $30m Lakes Entrance Sand Management Program (LESMP) was announced by the Victorian Government to install a system designed to keep the Port of Gippsland Lakes (Lakes Entrance) open for vessel traffic.

The GLOA program facilitates permanent ocean access for commercial and recreational vessels supporting social and economic well-being for the region. Almost 7,300 tonnes of seafood was landed in Lakes Entrance during 2012/13, with a value of approximately $27.5 million. Employment in the East Gippsland region as a result of the commercial fishing and related processing and food service sectors is estimated to be 278 FTE jobs (EconSearch & Roberts Evaluation, 2014).

Where practicable, dredging activities are planned with a particular awareness and regard for high recreational use periods (i.e. Easter, summer holidays, long weekends) as stipulated by Project Delivery Standard (PDS) 15(a) in the GLOA Environmental Management Plan. Since 2015, Gippsland Ports have achieved 100% compliance with the EMP as assessed by annual independent audit.

Potential for extensive displacement of residences or severance of residential access to community resources due to infrastructure development

GLOA activities are predominantly water-based with no impact to residences or access to community resources due to infrastructure development. The objective of the GLOA program is to provide reliable navigational access between the Gippsland Lakes and Bass Strait for recreational and commercial vessels which provides social and economic benefit to the local community.

Potential significant effects on the amenity of a substantial number of residents, due to extensive or major, long-term changes in visual, noise and traffic conditions

Sand management activities at Lakes Entrance have occurred since before the permanent entrance was established in 1889 (see **Table** 1). The GLOA program is predominantly water-

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

based and the results of dredging are not visible as dredged material is placed underwater at nearshore DMGs.

Annual independent auditing investigates airborne noise as a project delivery standard (PDS) of the GLOA Environmental Management Plan, using stakeholder and resident's feedback as criteria for compliance (Ethos NRM, 2021). No complaints have been received from residents during the 2008 - 2021 dredging programs using the TSHD *Pelican* or the TSHD *Tommy Norton*.

The GLOA program provides reliable navigational access between the Gippsland Lakes and Bass Strait for commercial and recreational vessels and does not impact terrestrial motor vehicle traffic conditions.

Hence, the GLOA program will not result **in extensive or major, long-term changes** in visual, noise and traffic conditions.

Potential exposure of a human community to severe or chronic health or safety hazards over the short or long term, due to emissions to air or water or noise or chemical hazards or associated transport

Lakes Entrance is a working regional port and airborne noise measures from commensurate port areas are typically 40-50 decibels during the day, and fishing vessels in the order of 55 decibels at 100m distance (SVT Engineering 2004).

Annual independent auditing investigates airborne noise as a project delivery standard (PDS) of the GLOA Environmental Management Plan, using stakeholder and resident's feedback as criteria for compliance. No complaints have been received from residents during the 2008 - 2021 dredging programs using the TSHD *Pelican* or the TSHD *Tommy Norton* (Gippsland Ports pers. comm.).

Potential extensive or major effects on Aboriginal cultural heritage

Gippsland Ports undertook an archaeological heritage (aboriginal values) impact assessment for sand redistribution works as part of the Lakes Entrance Sand Management Program (Volume 1, Perspectives Heritage Solutions, 2007). Three sensitive area/zones were identified in the vicinity of GLOA activities (**Table 6** & **Figure 7**) however these are unlikely to be impacted as they are all terrestrial and outside the footprint for both the dredging and placement of dredged material.

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Table 6. Aboriginal sensitive areas (Perspectives Heritage Solutions, 2007)

Sensitive Area/Zone	Sensitivity	Potential sites	Potential impact
Site AAV 8422-0083 (Lakes Entrance Cranium)	High	Further human remains	Low to undisturbed if 50m buffer and observer present.
Older sands	High	Shell midden sites, artefacts, scatters, human remains	Low to undisturbed; observer to be present.
New sands area	Very low	n/a	Very low

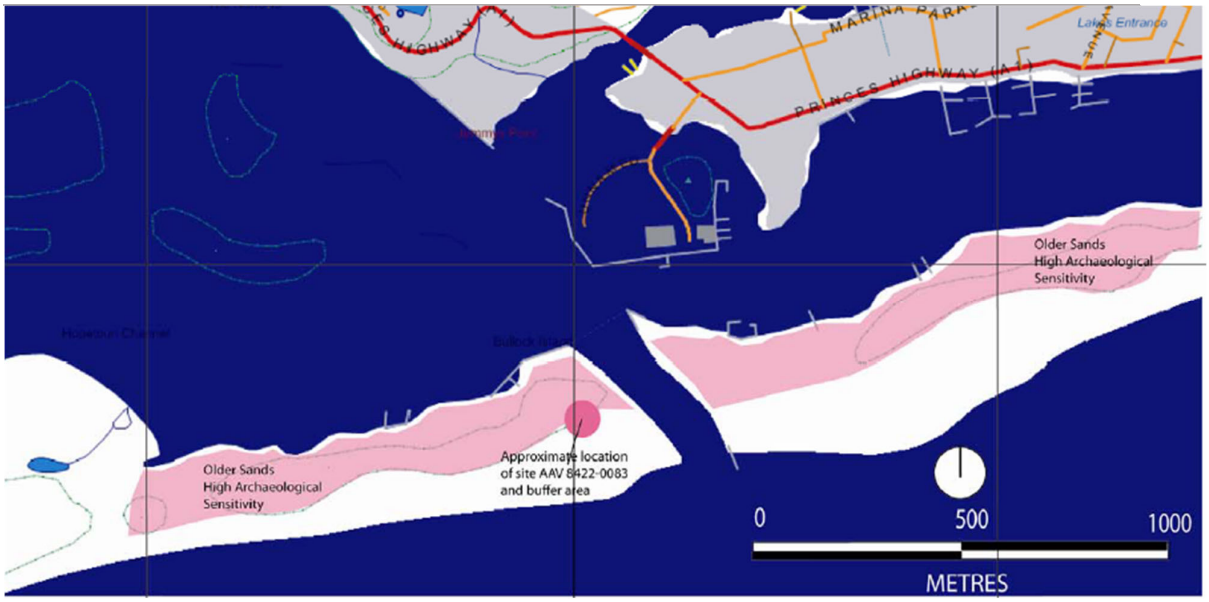


Figure 7. Areas of potential archaeological sensitivity for Aboriginal sites (Perspectives Heritage Solutions, 2007).

PO Box 204, Bairnsdale VIC 3875
Phone: (03) 5153 0037
Email: info@ethosnrm.com.au
Website: www.ethosnrm.com.au
ABN: 44 104 999 528

Potential extensive or major effects on cultural heritage places listed on the Heritage Register or the Archaeological Inventory under the Heritage Act 1995.

Williams and Dudley (2007) and Helms (2007) did not identify any heritage sites in the channel area (channel has been dredged since 1977 making it almost impossible for heritage items to remain).

CONCLUSION

TSHD dredging and placement of dredged material for the GLOA program does not meet any of the criteria, as established in the *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978* (DSE, 2006), for individual or a combination of potential environmental effects that might be of regional or state significance.

Furthermore, environmental regulation through the provisions of the Victorian *Coastal Management Act 1995*, the Commonwealth *Environment Protection (Sea Dumping) Act 1981*, and the annual independent audit of compliance with the GLOA Environmental Management Plan provide sufficient assurance that the GLOA program will continue to be undertaken in an environmentally sensitive manner.