Tamar Lake Inc.

Further Ecological Assessment of Threatened Species and Potential Ecosystem Impacts – Tamar Lake Proposal

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15 June 2012

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Document History and Status

Revision	Date Issued	Reviewed By	Approved By	Date Approved	Revision Type
1		Mark Breitfuss	Mark Breitfuss	18/06/12	

Distribution of Copies

Version	Date Issued	Quantity	Electronic	Issued To
Final	25/06/12		1	Robin Frith

Printed:	25 June 2012
Last Saved:	25 June 2012 04:09 PM
File Name:	Tamar Lake Inc 180612
Author:	Craig Miller and Mark Breitfuss
Project Manager:	Craig Miller
Client:	Tamar Lake Inc.
Document Title:	Further Ecological Assessment of Threatened Species
Document Version:	Final
Project Number:	B12728.01

1 Introduction

Tamar Lake Inc. is proposing to create a freshwater lake on a major portion of the Tamar River through the construction of a tidal barrage. The strategic vision is to reduce siltation and flooding in the Tamar River, and to enable the transformation of tourism, agriculture, aquaculture, and other economic enterprises in the region (Frith, 2012).

The intention is that the gated spillways of the barrage would enable the level of the lake to be varied between the current high and mid tide levels, with the normal level being approximately one metre below high tide in Launceston.

The spillway gates in the barrage will be designed to accommodate the normal freshwater flows into the lake from the North and South Esk rivers, and to pass floodwaters from an Average Recurrence Interval (ARI) 200 year flood without affecting flood levels in the Launceston area.

This proposal would change the state of the ecosystem from a largely estuarine state to a purely freshwater state and will therefore require a comprehensive environmental impact assessment before being granted development permission. The environmental impact assessment would require consideration of the measures taken to avoid or mitigate adverse effects on key environmental values.

BMT WBM has conducted a desktop review to identify and characterise the ecological values of the Tamar Estuary and provide a preliminary understanding of the likely effects of the Concept to these values (the Assessment) (Costen, 2012). E3 Consult (to be known as CDM Smith Australia after 1st July 2012) provided an external review of the initial Assessment for Tamar Lake Inc. and recommended a further level of ecological analysis to identify key threatened species or guilds that may be referred, for example, under the *Environment Protection and Biodiversity Conservation Act 1999*.

1.1 Objectives

This report seeks to assist Tamar Lake Inc. through:

- Providing a provisional assessment of potential threats and impacts of the proposed lake to key threatened species and guilds
- Identifying current threatened species management plans, their relevance to the Tamar Lake concept, and potential Environmental Impact Assessment implications
- Identifying a range of ecological issues associated with changing the state of an ecosystem from saline or brackish to freshwater.

2 Provisional assessment of potential impacts

2.1 Threatened species identified by desktop analysis

The Assessment (Costen, 2012) identified a range of species that have been or may be found in the area of the proposed Tamar Lake. We have further assessed the ecological requirements of these species, and their likely use of habitat affected by the Project, to determine whether the project will potentially impact them (Table 1).

There is uncertainty about the current presence of a number of these species, and whether the impacts of the Project would be positive or negative. Field surveys will be required as part of any Environmental Impact Assessment process and consideration will have to be given to mitigating adverse impacts.

For example, the Dwarf Galaxias (*Galaxiella pusilla*) prefers still or slow moving fresh water with abundant aquatic vegetation. It may be present in the rivers feeding the proposed Tamar Lake and would be affected by any loss of aquatic vegetation due to changed water levels. In this instance a mitigation measure may be to progressively establish new areas of aquatic vegetation to offset the loss. The same may be said for the Australasian bittern (*Botaurus poiciloptilus*) and great-crested grebe (*Podiceps cristatus*). It may also be the case that the new freshwater conditions will improve the population status of these species in the longer term if associated with aquatic and emergent vegetation enhancement. Confirmation of this benefit would require monitoring and possibly research.

Conversely, marine species such as the humpback whale (*Megaptera novaeangliae*) will not be affected because their main habitat is coastal areas and open ocean, although they may visit bays and inlets to rest on their migration routes. Similarly, the widespread fairy prion (*Pachyptila turtur subantarctica*) (ranked as Least Concern on the IUCN Red List of Threatened Species) is unlikely to be affected because they do not rely on these areas as part of their habitat, while the white-bellied sea-eagle (*Haliaeetus leucogaster*) will forage equally as well in large bodies of freshwater as in the ocean.

Habitat modification in the surrounding landscape will have had a greater impact on the populations and ongoing conservation status of threatened species such as the spotted tailed quoll (*Dasyurus maculatus maculatus*) and the Swift parrot (*Lathamus discolour*). Tamar Lake Inc. may consider enhancement or restoration of terrestrial habitat as part of a comprehensive environmental approach to the Project, but this should not be considered to mitigate any other effects of changing the ecosystem state of the Tamar River.

We have identified a number of threatened species that will require further research and field surveys, and these are discussed below.

Table 1: Threatened species occurring in the region, their conservation status, and assessment of potential project impact

Species name	Common name	Conservation status		Occurrence, habitat, and potential impact
		EPBC Act	TSP Act	
Likely to be impacted				
Prototroctes maraena	Australian Grayling	V	V	EPBC Protected Matters search tool and habitat mapped in study area by Natural Values Atlas. Species migrates between fresh and salt water during life cycle. This species will be impacted by project if present.
Potentially impacted				
Galaxiella pusilla	Dwarf Galaxias	V	V	Habitat mapped in study area by Natural Values Atlas. Species is known to occur well to the east of the project area. Prefers still or slow-moving water with abundant aquatic vegetation. Some potential to be impacted if present, if habitat degradation occurs.
Litoria raniformis	Green and Golden Frog	V	V	Habitat mapped in study area by Natural Values Atlas, EPBC Protected Matters search tool and database records. Prefers still or slow-moving water bodies with abundant aquatic vegetation. Populations have potential to be impacted by project if habitat degradation occurs.

Botaurus poiciloptilus	Australasian Bittern	E		EPBC Protected Matters search tool and two old (>30 yrs) database records. Generally a solitary species that occurs in densely vegetated freshwater wetlands. Only rarely in tidal wetlands. If present, impacts resulting from the project are considered likely to be minor and potentially positive.
Numenius madagascariensis	Eastern Curlew	M	E	EPBC Protected Matters search tool and database records. Large wader species that prefers saline habitats (particularly mudflats, mangroves and estuaries). Impacts associated with project uncertain and may be negative or positive.
Sternula nereis nereis	Fairy Tern	V	V	EPBC Protected Matters search tool and database records. This species nests/roosts in sheltered beaches, spits and banks above the high tide mark. Also occurs in inlets and saline or brackish lakes. Impacts associated with project uncertain and may be negative or positive.

Migratory Waders *Actitis hypoleucos* *Arenaria interpres* *Calidris acuminata* *Calidris canutus* *Calidris ferruginea* *Calidris ruficollis* *Charadrius bicinctus* *Charadrius mongolus* *Gallinago hardwickii* *Heteroscelus brevipes* *Limosa lapponica* *Numenius phaeopus* *Pluvialis fulva* *Pluvialis squatarola* *Xenus cinereus*	 Common Sandpiper Ruddy Turnstone Sharp-tailed Sandpiper Red Knot Curlew Sandpiper Red-necked Stint Double-banded Plover Lesser Sand Plover Latham's Snipe Grey-tailed Tattler Bar-tailed Godwit Whimbrel Pacific Golden Plover Grey Plover Terek Sandpiper	M		EPBC Protected Matters search tool. No database records available but some species at least will forage and roost in the project area and surrounds. Impacts uncertain and may be negative if intertidal mudflats are lost, or positive if new areas created.
Unlikely to be impacted				

Pseudemoia rawlinsoni	Glossy Grass Skink		R	Habitat mapped in study area by Natural Values Atlas. Occurs in dense vegetation adjacent to lakes, swamps, salt marsh and creeks. May occur but considered unlikely to be impacted by project.
Podiceps cristatus	Great-crested Grebe		V	Database search records. Occurs on a variety of large open water bodies. Unlikely to be impacted by project.
Diomedea cauta cauta	Shy Albatross	V	V	EPBC Protected Matters search tool and database records. Marine species that is unlikely to be impacted by the project.
Pachyptila turtur subantarctica	Fairy Prion (southern subspecies)	V	E	Database search records. Marine species that is unlikely to be impacted by the project.
Macronectes giganteus	Southern Giant-petrel	E	V	EPBC Protected Matters search tool and database records. Marine species that is unlikely to be impacted by the project.
Haliaeetus leucogaster	White-bellied Sea-eagle	M	V	Habitat mapped in study area by Natural Values Atlas, EPBC Protected Matters search tool and database records. Large fish-eating species that occurs over large fresh or saltwater water bodies. Considered unlikely to be impacted by project.

Aquila audax fleayi	Wedge-tailed Eagle (Tasmanian)	E	E	EPBC Protected Matters search tool and habitat mapped in study area by Natural Values Atlas. Iconic species that mainly nests in old-growth forest and forages over a range of habitats including cleared areas. Considered unlikely to be impacted by project.
Accipiter novaehollandiae	Grey Goshawk		E	Habitat mapped in study area by Natural Values Atlas and a single database record. Occurs in forest with a dense canopy. Considered unlikely to be impacted by project.
Tyto novaehollandiae castanops	Masked Owl (Tasmanian)	V	E	Habitat mapped in study area by Natural Values Atlas. Large owl that nests in hollows and forages over a range of habitats. Considered unlikely to be impacted by project.
Lathamus discolor	Swift Parrot	E	E	Habitat mapped in study area by Natural Values Atlas, EPBC Protected Matters search tool and database records. Nectar-feeding species that nests in tree hollows. Considered unlikely to be impacted by project.
Ceyx azureus diemenensis	Azure Kingfisher (Tasmanian)	E	E	EPBC Protected Matters search tool. Prefers forested rivers of the west and north-west of Tasmania. Given lack of records and disturbed habitat in project area species is considered unlikely to occur.

Dasyurus naculatus maculatus	Spotted-tail Quoll (Tasmanian)	V	R	EPBC Protected Matters search tool and database records. Terrestrial species that is unlikely to be impacted by the project.
Perameles gunnii gunnii	Eastern Barred Bandicoot (Tasmanian)	V		Habitat mapped in study area by Natural Values Atlas, EPBC Protected Matters search tool and database records. Terrestrial species that is unlikely to be impacted by the project.
Sarcophilus harrisii	Tasmanian Devil	E	E	EPBC Protected Matters search tool and database records. Terrestrial species that is unlikely to be impacted by the project.
Pseudomys novehollandiae	New Holland Mouse	V	E	Habitat mapped study area by Natural Values Atlas. Prefers heath lands or vegetated dunes. If present, considered unlikely to be impacted by project.
Balaenoptera musculus	Blue Whale	E		EPBC Protected Matters search tool. Marine species that is unlikely to be impacted by the project.
Eubalaena australis	Southern Right Whale	E		EPBC Protected Matters search tool. Marine species that is unlikely to be impacted by the project.
Megaptera novaeangliae	Humpback Whale	V		EPBC Protected Matters search tool. Marine species that is unlikely to be impacted by the project.

Note: Conservation status abbreviations: EPBC Act – Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*; TSP ACT – Tasmania's *Threatened Species Protection Act 1995*; E – Endangered; V – Vulnerable; R – Rare; M – Migratory.

2.2 Key threatened species potentially affected by the Project

2.2.1 *Protroctes maraena* Australian Grayling

Conservation significance

Vulnerable; (*EPBC Act 1999* and *TSP Act 1995*).

Occurrence within project area

The Australian Grayling is predicted to occur in the project area by DPIPWE habitat mapping and EPBC Search Matters Online database. There are no verified records of the species from the Natural Values Atlas database; however the project area is within the species range and the species is known to occur in the Tamar Estuary (Davies, 2003).

Ecology and threats

The Australian Grayling is a small-medium size fish that is endemic to south-east Australia. The species migrates from freshwater streams to coastal seas. They inhabit coastal areas and estuaries in the larval and juvenile stages. Adults inhabit freshwater rivers and streams preferring clear water with a coarse substrate (Backhouse, Jackson, & O'Connor, 2008). Spawning occurs in freshwater where it is thought the freshly hatched larvae are swept downstream into estuaries or coastal waters where they stay for approximately six months. They feed on small invertebrates, crustaceans and algae (SEWPaC, 2012).

Threats to the species include river regulation, reduction in water quality, river siltation, introduced fish species and changes in rainfall regimes due to climate change. Barriers are recognised as a major threatening process affecting the movement of migratory fish species (Backhouse, Jackson, & O'Connor, 2008; Bryant & Jackson, Tasmania's threatened fauna handbook: what, where, and how to protect Tasmania's threatened animals, 1999).

Potential threats from the project

The installation of the barrage is likely to affect the movement of Australian Grayling through the Tamar Estuary should a population exist there. Other negative impacts from the project that may affect the species include changing water chemistry in the estuary upstream of the barrage, exposure to the effects of acid sulphate soils and siltation of suitable habitat resulting from changed siltation regimes. Introduced Brown trout (*Salmo trutta*) are a known predator of Grayling and are likely to increase in abundance in the freshwater lake.

Potential benefits from the project

There may be no benefits to the Grayling through the establishment of a freshwater lake. However, it may trigger associated landcare activities in the catchment to improve water quality and instream condition that will be of benefit to the fish.

Environmental Impact Assessment

Surveys will be required upstream to determine whether Australian Grayling are present and to identify when they spawn, the larvae descend downstream to the estuary, and when the juveniles return from the sea. Identification of spawning areas and habitat conditions will be important for possible mitigation activities.

Possible mitigation

Barriers such as the proposed barrage are a threat to the survival of populations of this species, as they impede the life cycle. It will be an engineering design challenge to enable larvae and fish to move to and from the marine environment.

The stocking of Brown trout in the lake should be discouraged, although their population may increase naturally under the new conditions if they currently exist in the rivers. Encouraging fisheries based around the husbandry of native fish would be a better option.

Encouraging improved land management upstream, e.g. through riparian revegetation, will be important generally for the health of the proposed lake, and will be of benefit to native fish such as the Grayling.

2.2.2 *Litoria raniformis* Green and Golden Frog

Conservation Significance

Vulnerable; (*EPBC Act 1999* and *TSP Act 1995*).

Occurrence within project area

Project area is stated as a 'breeding hotspot' for this species with a substantial population located within the Tamar Island Wetland Reserve (Bryant & Jackson, Tasmania's threatened fauna handbook: what, where, and how to protect Tasmania's threatened animals, 1999). There are a number of verified Natural Values Atlas database records from the project area.

Ecology and threats

This species was once widespread across the north and east of Tasmania as well as south-east Australia. Its range has now substantially contracted and the population in and around Launceston has declined from being abundant to scarce (Tyler, 1997). Green and Golden Frogs prefer still or slow-moving waters where there is abundant emergent aquatic vegetation. They largely feed on a variety of terrestrial invertebrates but may also feed on small vertebrates such as other frogs, lizards and small fish. In warm weather this species can be active during the day and is known to bask in filtered sunlight. Breeding success depends on freshwater lagoons with a complex vegetation structure including submerged vegetation which provides food and shelter for tadpoles (SEWPaC, 2012).

Threats to the species include habitat loss and degradation, changed flooding regimes, chemical pollution, salinisation of water bodies, drought, predation from introduced species, and increased exposure to ultraviolet-B radiation due to anthropogenic impacts (Bryant & Jackson, Tasmania's threatened fauna handbook: what, where, and how to protect Tasmania's threatened animals, 1999).

Potential threats from the project

It is possible that changes to the existing hydrological regime and water levels may negatively impact on existing frog habitat, reducing the immediate availability of aquatic and emergent vegetation. Changes to flood regimes, sedimentation patterns, and the accumulation of chemical pollutants upstream of the barrage may also be issues.

Potential benefits of the project

A freshwater lake would increase the potential extent of suitable habitat, over the current saline-brackish conditions.

Environmental impact assessment

Conduct surveys to establish the extent and size of Green and Golden Frog population/s around the Tamar River.

Map and model the population distribution and habitat areas against the proposed lake level under normal and flood conditions. Determine whether existing habitat will be affected by changed water levels, changed sedimentation patterns, or chemical accumulation.

Possible mitigation

It is likely that the creation of a freshwater lake will be of long term benefit for frog populations as long as habitat is retained or enhanced, e.g. through revegetation, in the short term.

2.2.3 Migratory wader species.

Conservation significance

Migratory; (EPBC Act) in accordance with international agreements including the Japan-Australia Migratory Bird Agreement and China-Australia Migratory Bird Agreement. The Eastern Curlew *Numenius madagascariensis* is also listed as Endangered in Tasmania (*TSP* Act).

Occurrence within project area

There are a number of verified Natural Values Atlas database records of Eastern Curlew from the project area. Sites located downstream of the proposed barrage (Kelso and George Town Reserve) are known sites for migrant waders and are subject to regular

wader monitoring/count events. George Town reserve was identified as having a very high diversity of shorebirds, including migratory species (Bryant, 2002). Species encountered during surveys carried out from 1992-99 include substantial numbers of Eastern Curlew, Curlew Sandpiper *Calidris ferruginea*, Red-necked Stint *Calidris ruficollis* and Ruddy Turnstone *Arenaria interpres.* A total of 15 wader species listed as Migratory are known to occur in the area and it is likely the Tamar Estuary is an important site for Eastern Curlew in Tasmania (Brett Lane & Associates, 2006).

Ecology and threats

These species breed in the northern hemisphere and migrate to the southern hemisphere in the summer, arriving from late September and leaving again by April. Several species may forage for invertebrates along the edges of a variety of freshwater and saline habitats and substrates (e.g. Red-necked Stint and Common Greenshank *Tringa nebularia*). However species including Eastern Curlew, Ruddy Turnstone and Red Knot *Calidris canutus* generally prefer to forage on saline tidal flats. A range of invertebrates are taken including snails, crustaceans, bivalves, clams, limpets, and worms. Wader species roost together in areas just above the high tide line (Bryant, 2002).

Threats include: disturbance from recreational activities; disturbance and predation from feral and domestic animals; pollution from urban, agricultural and industrial runoff and encroachment on habitat by human development (Garnett & Crowley, 2000). The construction of barrages across estuaries can negatively affect foraging areas (Close & Newman, 1984). Flood barriers and dams on coastal rivers increase downstream salinity which may decrease the viability of benthic invertebrate communities potentially impacting on foraging potential for wader species (Kingsford & Hankins, 2010).

Potential threats from the project

The most significant issue for migratory waders is the loss of inter tidal feeding grounds. Changes in water chemistry both upstream (converted to freshwater) and downstream (increased salinity) of the barrage will also cause changes in mudflat invertebrate communities, possibly decreasing the foraging potential of these areas for wader species, particularly downstream. The barrage also has the potential to change siltation regimes in the estuary affecting the sustainability of the present tidal flat system. This may have both a positive or negative effect by increasing or decreasing available foraging habitat for wader species.

Possible benefits from the project

Changed siltation patterns upstream and downstream of the barrage may increase the potential foraging area for wading species.

Environmental Impact Assessment

The current use of available habitat upstream of proposed barrage by migratory wader species is unknown. Surveys will be required to identify whether wading species use all

possible areas for feeding, and how important these areas are. Mapping habitat areas and modelling the effect of changed sedimentation patterns and salinity on feeding areas and invertebrate communities will be required.

Possible mitigation

Monitoring and research will be required to ensure that the changed conditions do not adversely affect migratory wading species, and to determine whether in fact populations are benefited in some way. Conservation activities in key foraging and resting areas could include control of exotic predators, fencing and public awareness campaigns to protect birds from recreational vehicles, and general public awareness of the value of these birds, could be considered.

2.3 Ecological impacts from ecosystem state change

The Tamar Lake proposal will result in a significant shift in ecosystem state from a largely brackish estuary to a freshwater lake. The speed of ecosystem response will depend on the rate of inflow of freshwater and the dilution of saltwater. Estuarine ecosystems and their biological communities tend to be adapted to a wide range of salinities; however a gradient from largely saline adapted communities to near-freshwater adapted communities occurs along the length of the Tamar River system.

2.3.1 Unintended consequences and alternate stable states

The ecological effects of the change will be dynamic, with a range of new feedback loops and trophic relationships establishing, and the resulting freshwater ecosystem may occur in one of a number of possible alternative stable states (Beisner, Haydon, & Cuddington, 2003). There may be a range of unintended consequences that occur as the water becomes fresh, including the possibility of a eutrophic lake developing.

As the salinity decreases following the establishment of a barrage, all communities and organisms that require saltwater conditions will die. Mobile fish species may have the opportunity to escape before the barrage is fully closed, but sessile organisms such as shellfish and sea grass will die and decompose. This will include the invasive non-native saltmarsh species *Spartina anglica*. The mass dieback and decomposition will be unsightly and will smell, and may also cause anoxic conditions in the lower levels of the lake. The extent and duration of this will depend on the rate and volume of water that is able to pass the barrage, and any mixing or layering of anoxic and oxygenated water.

The reduced turbidity that will result from changes in tidal mixing and sediment movement will increase light penetration and may increase the growth of phytoplankton. This enhanced primary production will raise oxygen concentration in surface waters, which can be positive for some organisms. However, dense blooms of unpalatable phytoplankton may also occur, and cause an anoxic bottom layer as they die, sink, and decompose. Similarly, depending on the level of nutrients in the water, toxic algal blooms may also occur.

Under anoxic conditions, sediments release phosphorus (Niirnberg, 1994) and this phosphorus contributes to the ongoing algal blooms. These sorts of ecological dynamics cause the unintended consequences, and the solution is not always obvious. Reducing the

inflows of nutrients is important to the long term health and maintenance of clear lakes; however this will not change the lake ecosystem to a clear state. It will probably be necessary to ensure that there is adequate mixing of the water and flushing of the lake following impoundment until a clear freshwater lake is achieved.

Alternatively, as the water desalinates, the soils containing iron sulphides will oxidize leading to the production of sulphuric acid and the release of toxic quantities of iron, aluminium, and heavy metals. Sulphuric acid affects the capacity of fish to take up oxygen and maintain the balance of salts and minerals in their tissues, while aluminium for example burns the gills and accumulates in body tissue causing organ damage (Poleo, 1995). Sub lethal toxic loadings in fish can then build up in other animals that eat the fish, and this includes humans. The scale and impact of such acidification in the proposed lake is unknown, and will require particular study.

2.3.2 Human health

As a receiving environment, the lake will concentrate pollutants and nutrients from the catchment. Some of these will be concentrated and largely bound in sediments while others may affect primary productivity and the growth of algae in the water column and/or enter the food chain, potentially causing health issues for animals and humans. The levels of *E. coli* in the water from wastewater treatment and disposal, storm water, and agriculture will be a human health issue that requires a catchment scale focus and mitigation. Salt water and exposure to sunlight kills *E. coli*, but it can persist in freshwater and accumulate in some species, e.g. freshwater shellfish.

2.3.3 Greenhouse gas emission and sequestration

Estuarine wetlands are net sequesters of carbon from the atmosphere, storing this in the soils, and releasing only a small amount of methane (Choi & Wang, 2004). Conversely the organic sediments and decomposing organic matter of freshwater wetlands and lakes are often significant sources of atmospheric methane, a significant greenhouse gas (Bastviken, Tranvik, Downing, Crill, & Enrich-Prast, 2011). The decomposition of sea grasses, phytoplankton, and other organisms, as the water changes from saline to fresh is likely to result in a pulse of emitted methane. The project proponents may be required to measure, account for, and/or offset these emissions, and for the loss of sequestration by the estuary.

3 Conclusion

The Tamar Lake proposal would see a largely brackish estuarine river ecosystem converted into a freshwater lake. This will result in changed habitat conditions for a number of species, and there will be some species that will benefit and some species that will possibly be detrimentally affected. The presence of threatened species in the region does not automatically mean that they will be affected by this proposal, and such species can be largely summarily dealt with in a future development application.

The Environmental Impact Assessment (EIA) process will require a range of surveys and modelling to determine whether there will be an impact and to what extent this impact will occur. The EIA process will also require consideration of the types of mitigation that will occur to reduce or offset impacts. We have identified some of the information requirements and mitigation measures that would be required for two threatened species (Australian Grayling; Green and Golden frogs) and one guild of protected species (migratory wading birds).

There is the potential for a range of unintended ecological, human health, and greenhouse gas emission consequences associated with the project. The information provided in this report is intended to assist Tamar Lake Inc. in understanding the range of possible ecosystem level impacts that may need to be considered and mitigated through the EIA process. This will help Tamar Lake Inc. in scoping the studies that should be conducted, and in thinking about the wider implications and opportunities of the proposal. For example, activities in the wider catchment will play a greater role in the ongoing condition of a future lake, and the design of any barrage should include the capacity for flushing anoxic water.

5 Limitations

This report has been prepared for the sole purpose of providing Tamar Lake Inc. with supplementary ecological information in accordance with generally accepted consulting practice. No other warranty or guarantee, expressed or implied is made as to the advice indicated in this report.

This report should not be used for any other purpose without our prior written consent. Accordingly, neither E3 nor any member or employee of E3 accepts responsibility or liability in any way whatsoever for the use of this report for any purpose other than that for which it has been prepared.

This report should not be released to any other party, in whole or in part, without the express written consent of E3. E3 accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

E3 has relied upon and presumed accurate information provided by Tamar Lake Inc. and/or any third party (or absence thereof) in making the assumptions made in this report. Nothing in this report should be taken to imply that E3 has verified or audited any of the information supplied to us other than as expressly stated in this report. We have assumed this information to be both adequate and accurate for the purposes of this report.

Where findings, observations and conclusions are based solely upon information provided by Tamar Lake Inc. and/or a third party and E3 do not accept, to the maximum extent permitted by law, any liability for any losses, claims, costs, expenses, damages (whether in statute, in contract or tort for negligence or otherwise) suffered or incurred by Tamar Lake Inc. or any third party as a result of or in connection with E3's reliance on any such the information to the extent that such information is false, misleading or incomplete and E3 give no warranty or guarantee, express or implied as to such findings, observations and conclusions.

If further information becomes available, or additional assumptions need to be made, E3 reserves its right to amend any statements or opinions made in this report

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