Hunter Community Environment Centre

Thermal pollution impacts on the Lake Macquarie ecosystem

July 2021

Lake Macquarie is almost surrounded by a fringe of Zostera of greater or less width, interrupted where the cliffs drop steeply into deep water...

In general, growth was more dense in the southern part of the lake than in the north.

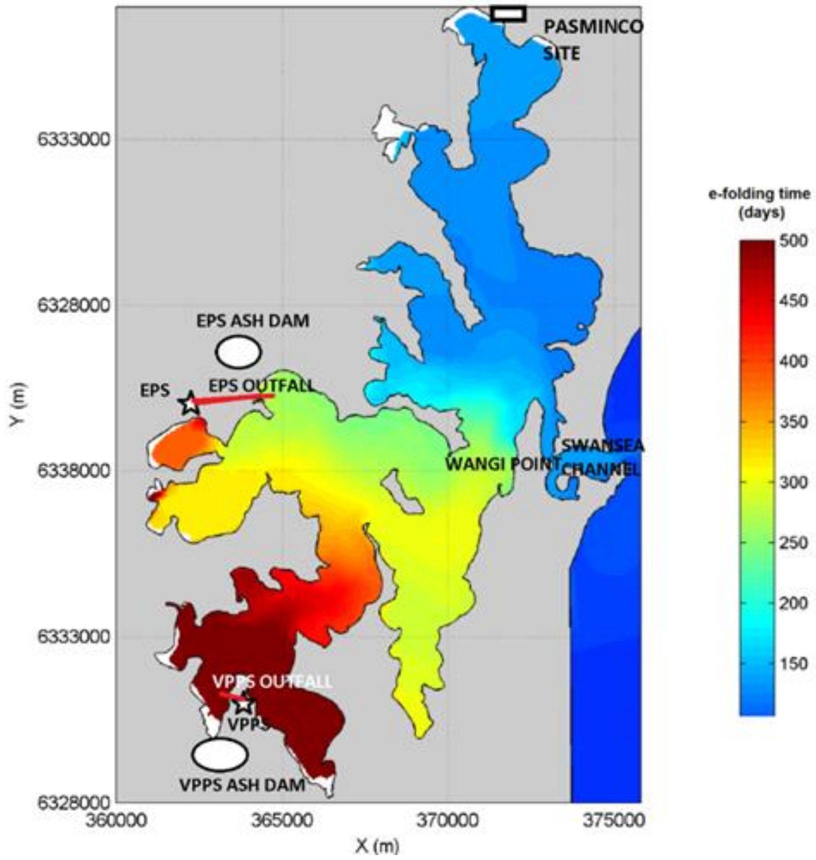
Woods, 1959

Overview

- Seagrasses of Lake Macquarie
- Seagrass loss from thermal discharges
- Eraring & Vales Points thermal pollution
  Mapping, plumes, intake impacts
- Seagrass, fish & phytoplankton impacts
- Q&A + Discussion
- What can we do to reduce thermal pollution?
  Proposed tactics & actions we can take

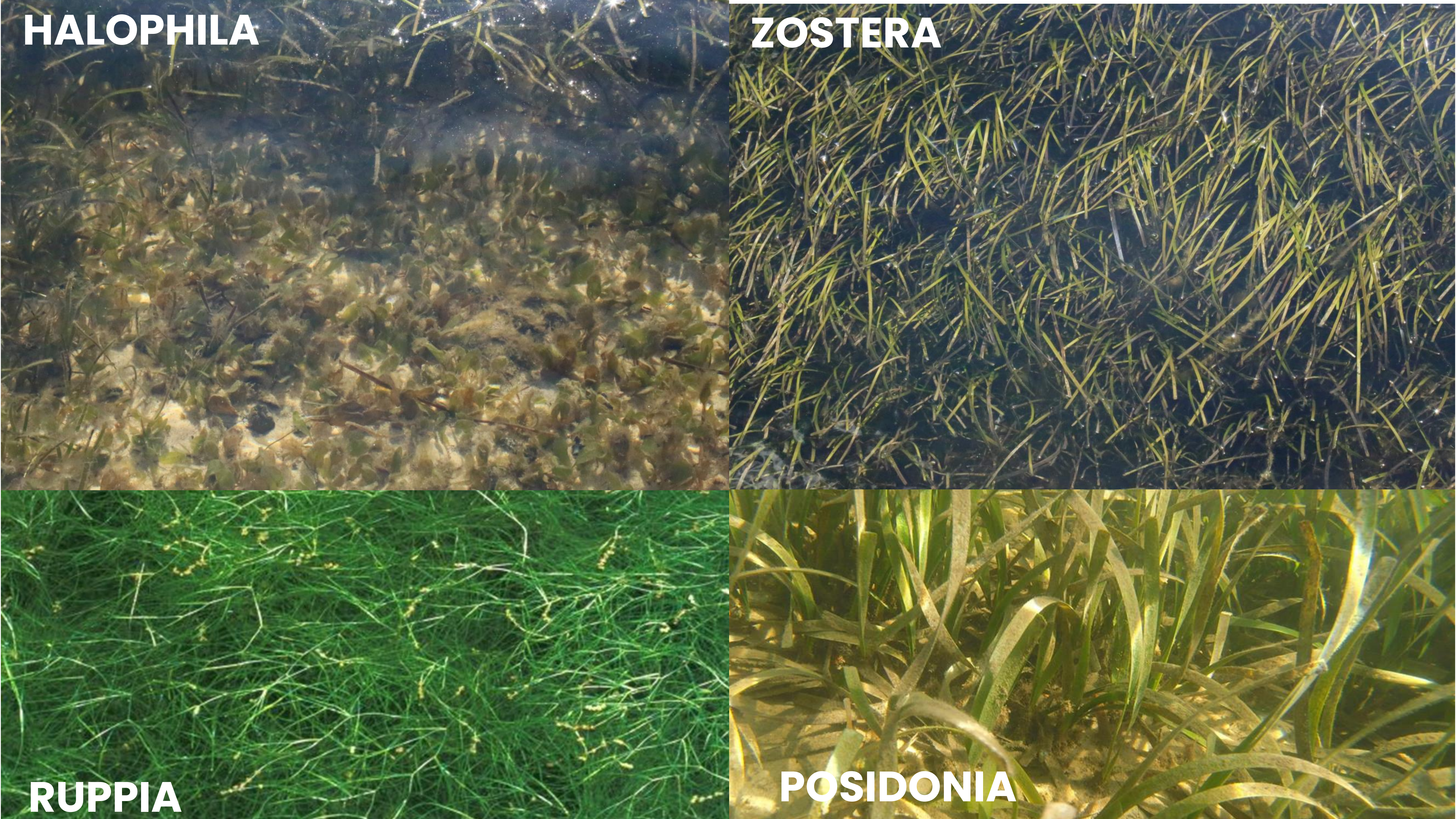
Lake Macquarie & seagrass

- Largest saltwater estuary in the country
- 1% of the Lake's volume exchanges with ocean waters during an average tide ¬ 277 days for the Lake to flush –southern end 500 days
- 232 species of fish recorded.
- 430 tonnes of commercial fish a year, the second highest estuary catch in NSW.
- Recreational fishing catches ¬ 200 tonnes a year ¬500,000 individual fish, crab, octopus and squid.
- seagrass underpins much of the Lake's abundant ecosystem.



Values of seagrass

- Stabilizes shorelines and prevent coastal erosion
- Key role in nutrient cycling worth $30,000 ha/yr.
- Enhances commercial fishery production in southern Australia by $230 000 ha/year
- Supports ~50% of the world's fisheries nursery habitat.
- Provides one of the most powerful carbon sinks on the planet.


HALOPHILA
ZOSTERA
RUPPIA
POSIDONIA

Seagrass 1953 & 2017

‘In general, [seagrass] growth was more dense in the southern part of the lake than in the north.’
Woods, 1959

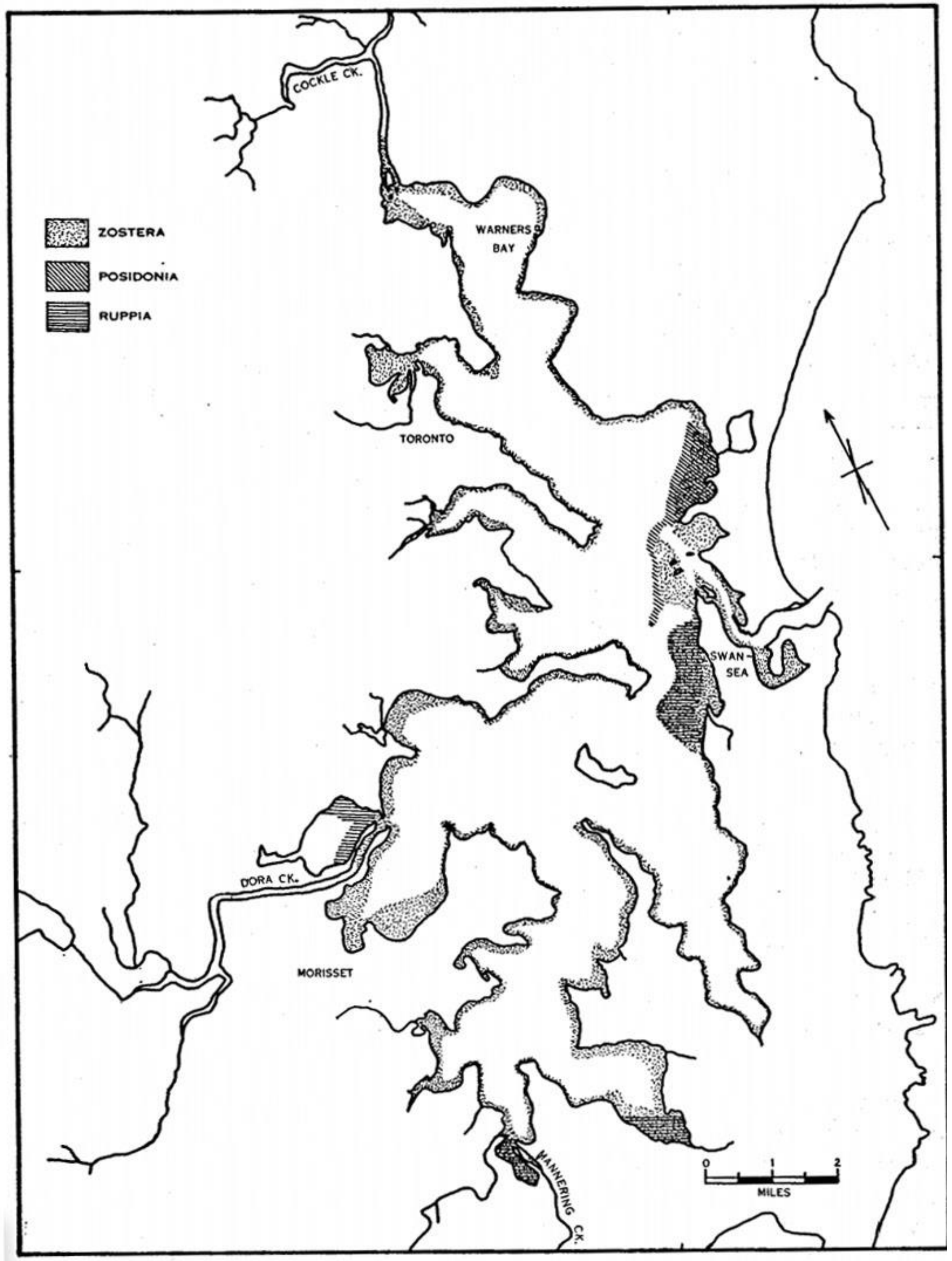
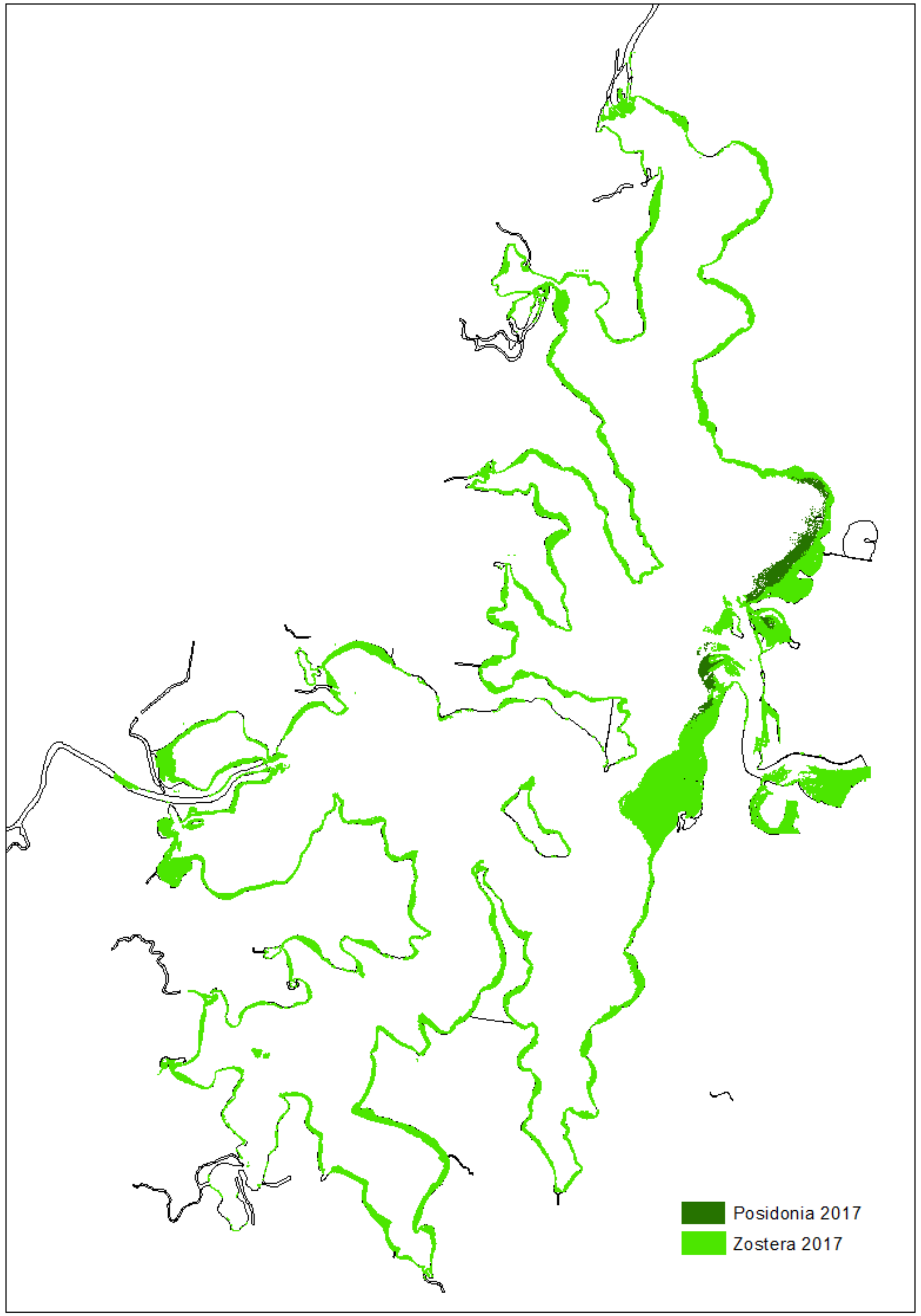


Fig. 1.—Lake Macquarie, showing the distribution of the sea-grasses.



Lake Macquarie seagrass loss

800 ha of seagrass (38%) since 1953

Seagrass	1953 (ha)	2000 (ha)	2008 (ha)	2012 (ha)	2017 (ha)	lost since 1953 (ha)	lost since 1953 (%)
Posidonia	207	87.6	98.8	97.7	91.9	115.1	**55.6**
Posidonia/Zostera		1	0.3	0.5			
Halophila	0	15.7	116.7	2.9			
Halophilla/Ruppia			21.7				
Halophylla dominant							
Zostera	1399	1153.4	1051	1042.2	1187.2	211.8	**15.1**
Zostera/Halophila		63.4	223.2	51.2			
Zostera/Ruppia		57.9					
Zostera dominant	1399	1274.7	1274.2	1093.4	1187.2		
Ruppia	466	85.4	18.8			466	**100%**
Total	**2072**	**1464.4**	**1530.5**	**1194.5**	**1279.1**	**792.9**	**38.3**

Seagrass loss 2001, 2008, and 2012

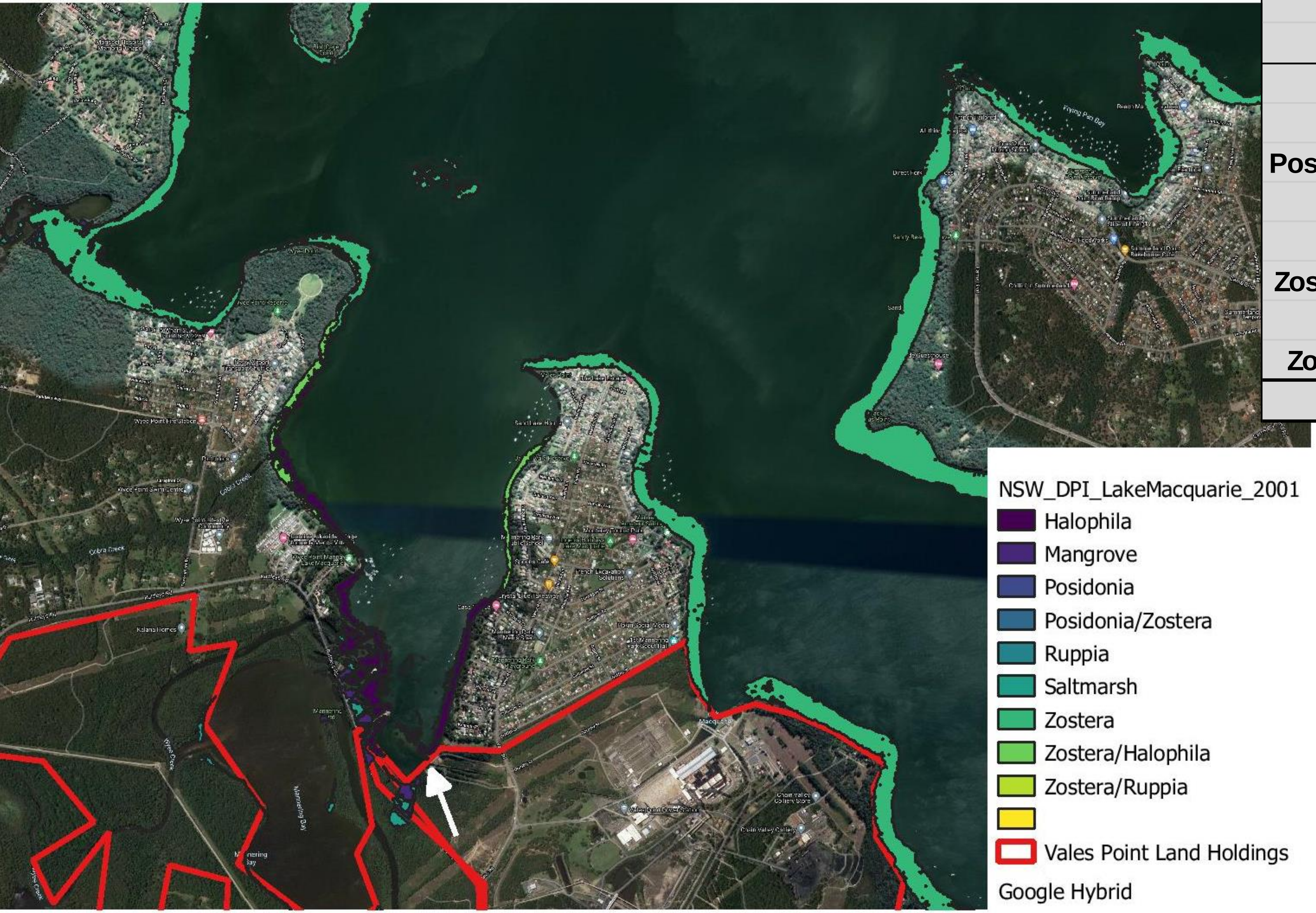
Lake Macquarie	North				South			
Year	2001	2008	2012	change	2001	2008	2012	change
Halophila	0	0	0		15.6	15.6	2.9	-12.7
Posidonia	87	87	97.7	10.7	0.6	0.6	0	-0.6
Posidonia/Zostera	0.9	0.9	0.5	-0.4	0.1	0.1	0	-0.1
Ruppia	7.9	7.9	0	-7.9	77.4	77.5	0	-77.5
Zostera	**432**	**432**	**495**	**63**	**721**	**721**	**547**	**-174**
Zostera/Halophila	35.5	35.5	29.2	-6.3	28	28	21.9	-6.1
Zostera/Ruppia	0	0	0	0	57.9	57.9	0	-57.9
TOTAL	**563.3**	**563.3**	**622.5**	**59.2**	**900.7**	**900.8**	**571.8**	**-329**

Seagrass loss between 2001 and 2012

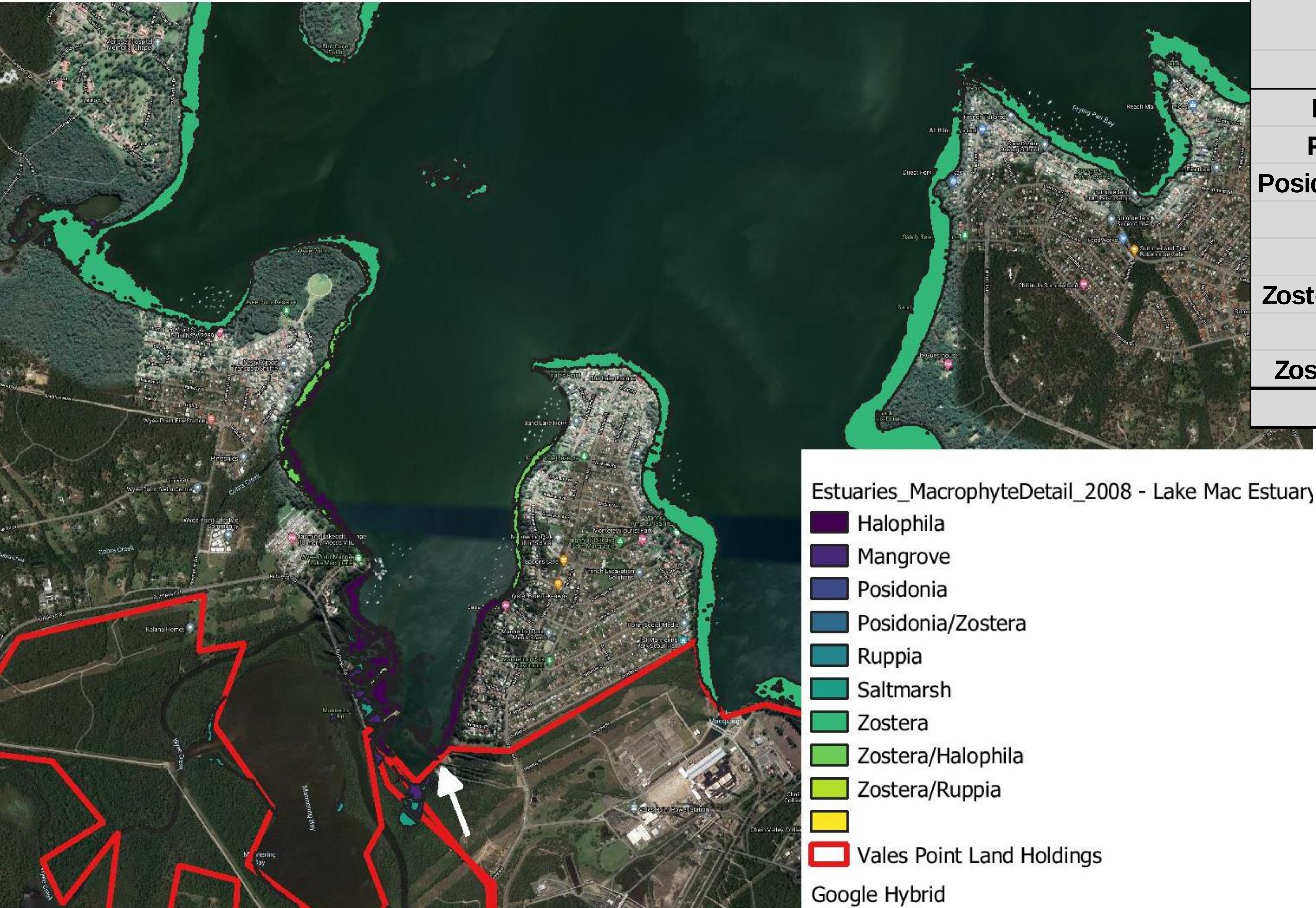
	Lake Macquarie			Change	Vales (Wyee Point to Vales Point inc.			Change	Eraring (Rocky Point to Goonda Point			Change
	2001	2008	2012	%	2001	2008	2012	%	2001	2008	2012	%
Halophila	15.6	15.7	2.9	81	11.5	11.6	0.2	98	0	0	1.1	
Posidonia	87.5	87.6	97.7	-12	0	0	0		0	0	0	
Posidonia/Zostera	1	1	0.5	50	0	0	0		0	0	0	
Ruppia	85.3	85.4	0	100	0	0	0		0	0	0	
Zostera	*1152.6*	*1153.4*	*1042.2*	*10*	*37.5*	*37.5*	*21.7*	*42*	*30*	*30.1*	*21.8*	*27*
Zostera/Halophila	*63.3*	*63.4*	*51.2*	*19*	*5.7*	*5.7*	*0*	*100*	*3.6*	*3.6*	*4.4*	*-22*
Zostera/Ruppia	57.9	57.9	0	100	0	0	0		0	0	0	
TOTAL	1463.3	1464.3	1194.5	18	54.8	54.8	21.8	60	33.6	33.6	27.3	19

Vales Point Power Station 2001

	Vales (Wyee Point to Vales Point inc.			Change
	2001	2008	2012	%
Halophila	11.5	11.6	0.2	98
Posidonia	0	0	0	
Posidonia/Zostera	0	0	0	
Ruppia	0	0	0	
Zostera	***37.5***	***37.5***	***21.7***	***42***
Zostera/Halophila	***5.7***	***5.7***	***0***	***100***
Zostera/Ruppia	0	0	0	
TOTAL	**54.8**	**54.8**	**21.8**	**60**

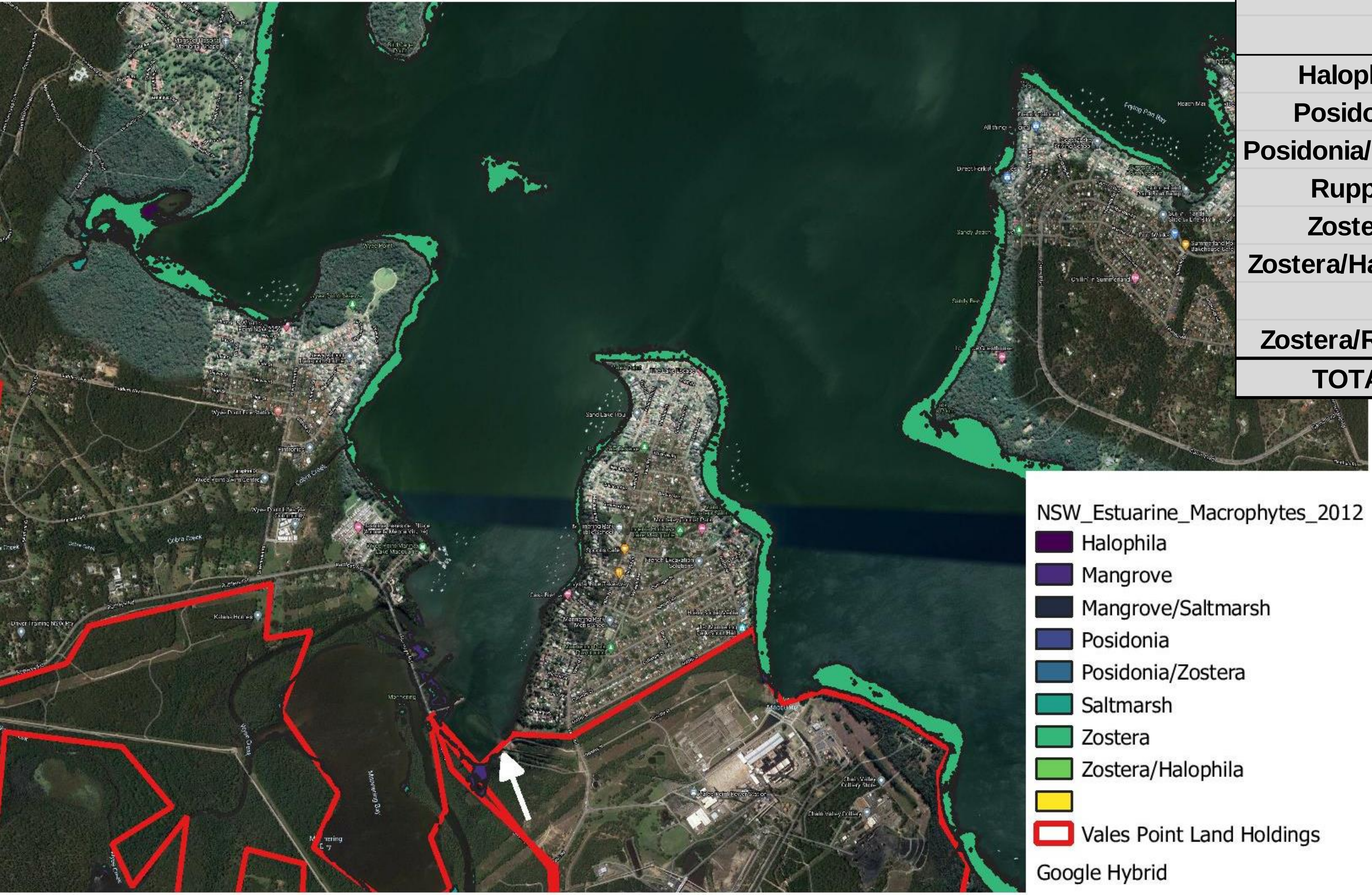


Vales Point Power Station 2008



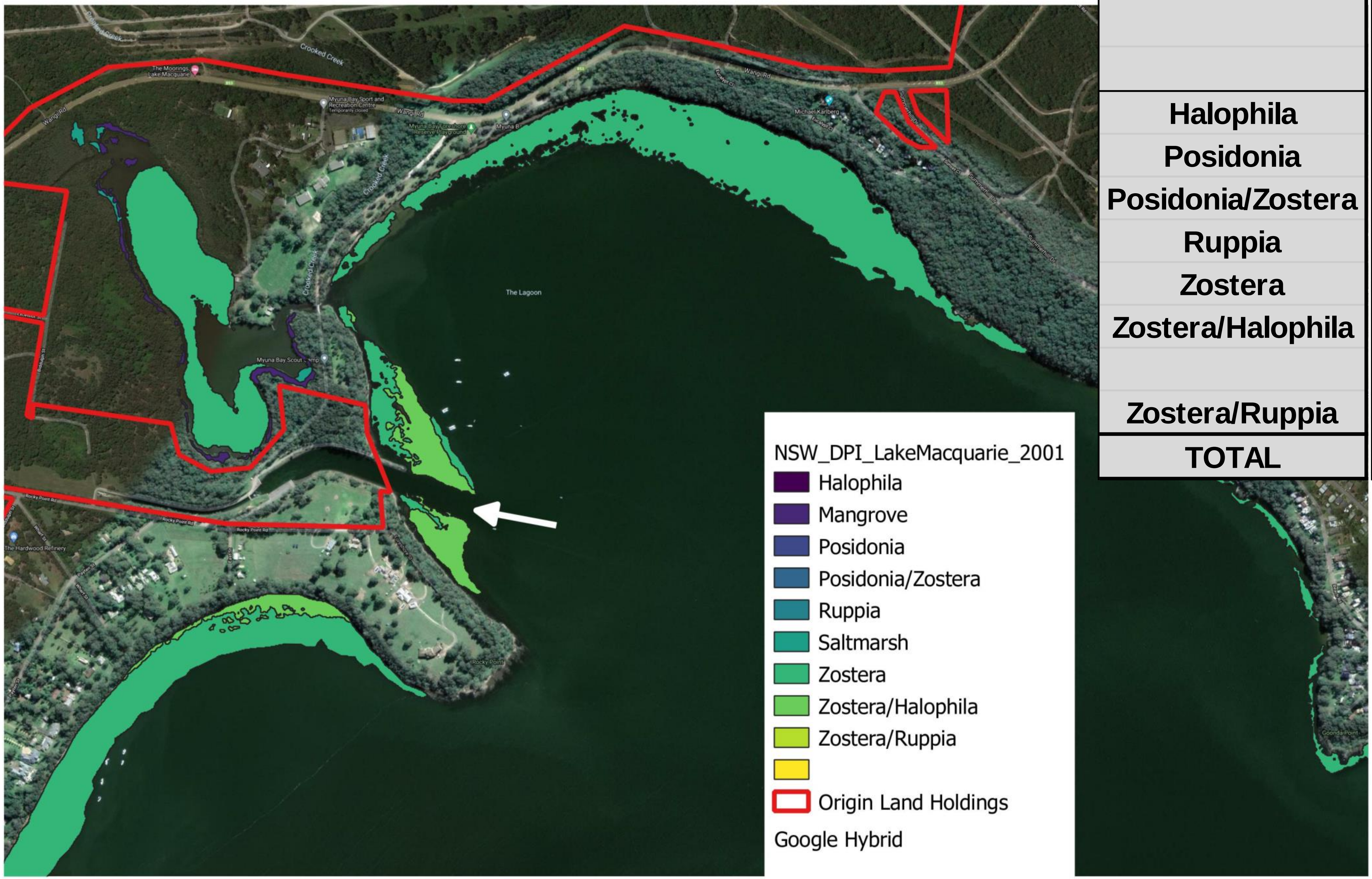
	Vales (Wyee Point to Vales Point inc.			Chang
	2001	2008	2012	%
Halophila	11.5	11.6	0.2	98
Posidonia	0	0	0	
Posidonia/Zostera	0	0	0	
Ruppia	0	0	0	
Zostera	***37.5***	***37.5***	***21.7***	***42***
Zostera/Halophila	***5.7***	***5.7***	***0***	***100***
Zostera/Ruppia	0	0	0	
TOTAL	**54.8**	**54.8**	**21.8**	**60**

Vales Point Power Station 2012



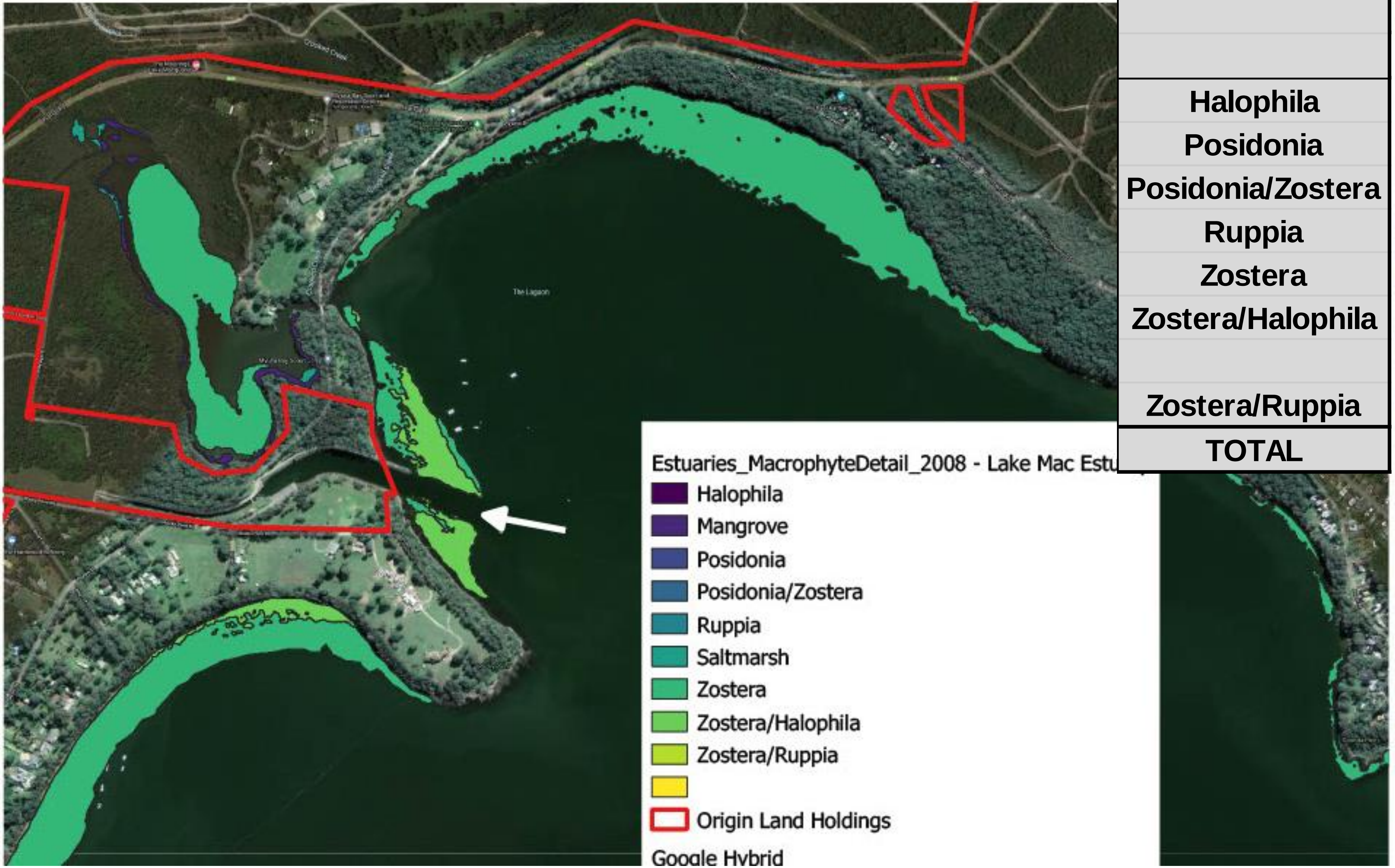
	Vales (Wyee Point to Vales Point inc.			Change
	2001	2008	2012	%
Halophila	11.5	11.6	0.2	98
Posidonia	0	0	0	
Posidonia/Zostera	0	0	0	
Ruppia	0	0	0	
Zostera	***37.5***	***37.5***	***21.7***	***42***
Zostera/Halophila	***5.7***	***5.7***	***0***	***100***
Zostera/Ruppia	0	0	0	
TOTAL	**54.8**	**54.8**	**21.8**	**60**

Eraring Power Station 2001



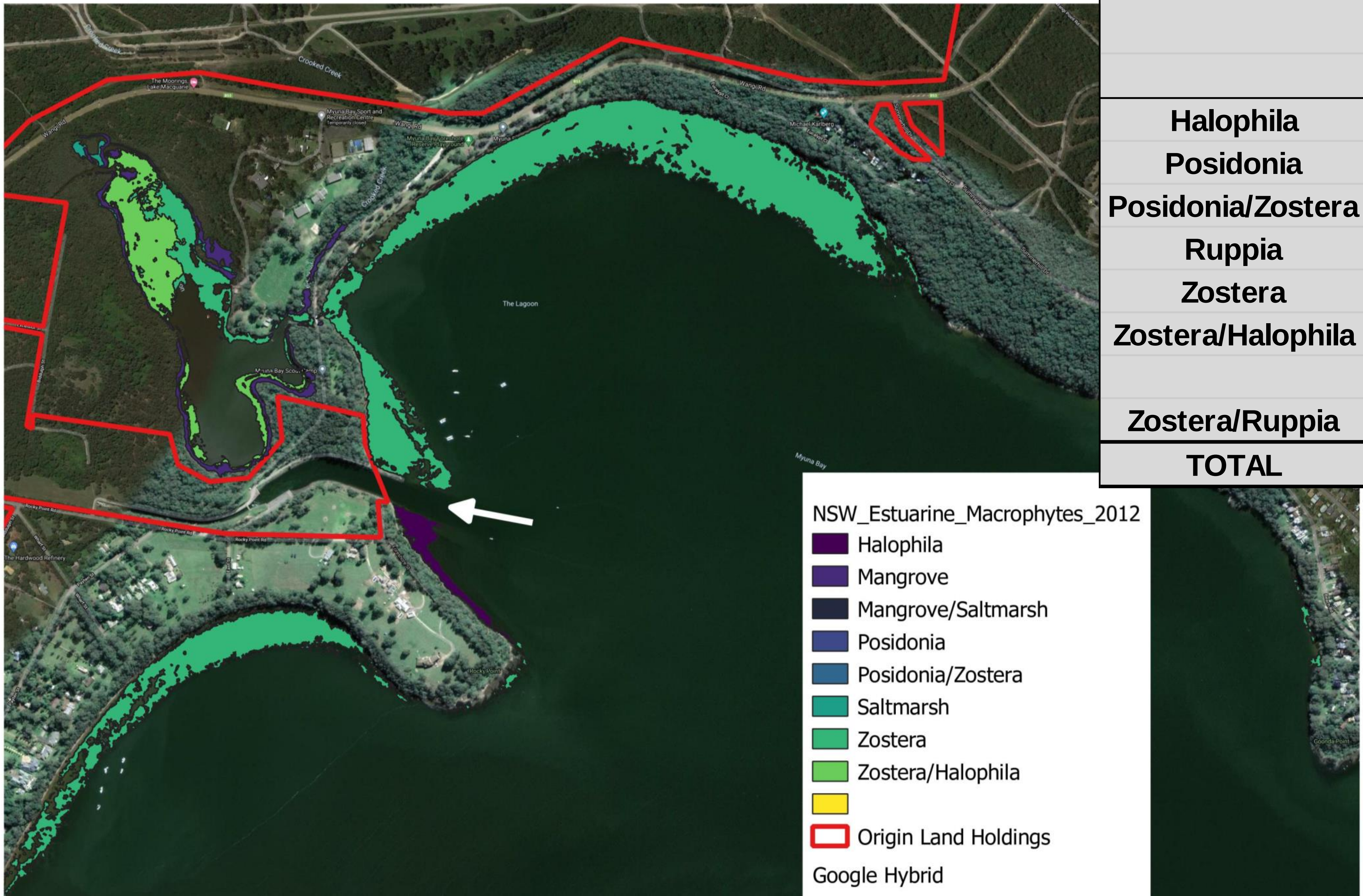
	Eraring (Rocky Point to Goonda Point			Change
	2001	**2008**	**2012**	%
Halophila	0	0	1.1	
Posidonia	0	0	0	
Posidonia/Zostera	0	0	0	
Ruppia	0	0	0	
Zostera	***30***	***30.1***	***21.8***	***27***
Zostera/Halophila	***3.6***	***3.6***	***4.4***	***-22***
Zostera/Ruppia	0	0	0	
TOTAL	**33.6**	**33.6**	**27.3**	**19**

Earing Power Station 2008



	Eraring (Rocky Point to Goonda Point			Change
	2001	2008	2012	%
Halophila	0	0	1.1	
Posidonia	0	0	0	
Posidonia/Zostera	0	0	0	
Ruppia	0	0	0	
Zostera	*30*	*30.1*	*21.8*	*27*
Zostera/Halophila	*3.6*	*3.6*	*4.4*	*-22*
Zostera/Ruppia	0	0	0	
TOTAL	33.6	33.6	27.3	19

Eraring Power Station 2012



	Eraring (Rocky Point to Goonda Point			Change
	2001	2008	2012	%
Halophila	0	0	1.1	
Posidonia	0	0	0	
Posidonia/Zostera	0	0	0	
Ruppia	0	0	0	
Zostera	***30***	***30.1***	***21.8***	***27***
Zostera/Halophila	***3.6***	***3.6***	***4.4***	***-22***
Zostera/Ruppia	0	0	0	
TOTAL	**33.6**	**33.6**	**27.3**	**19**

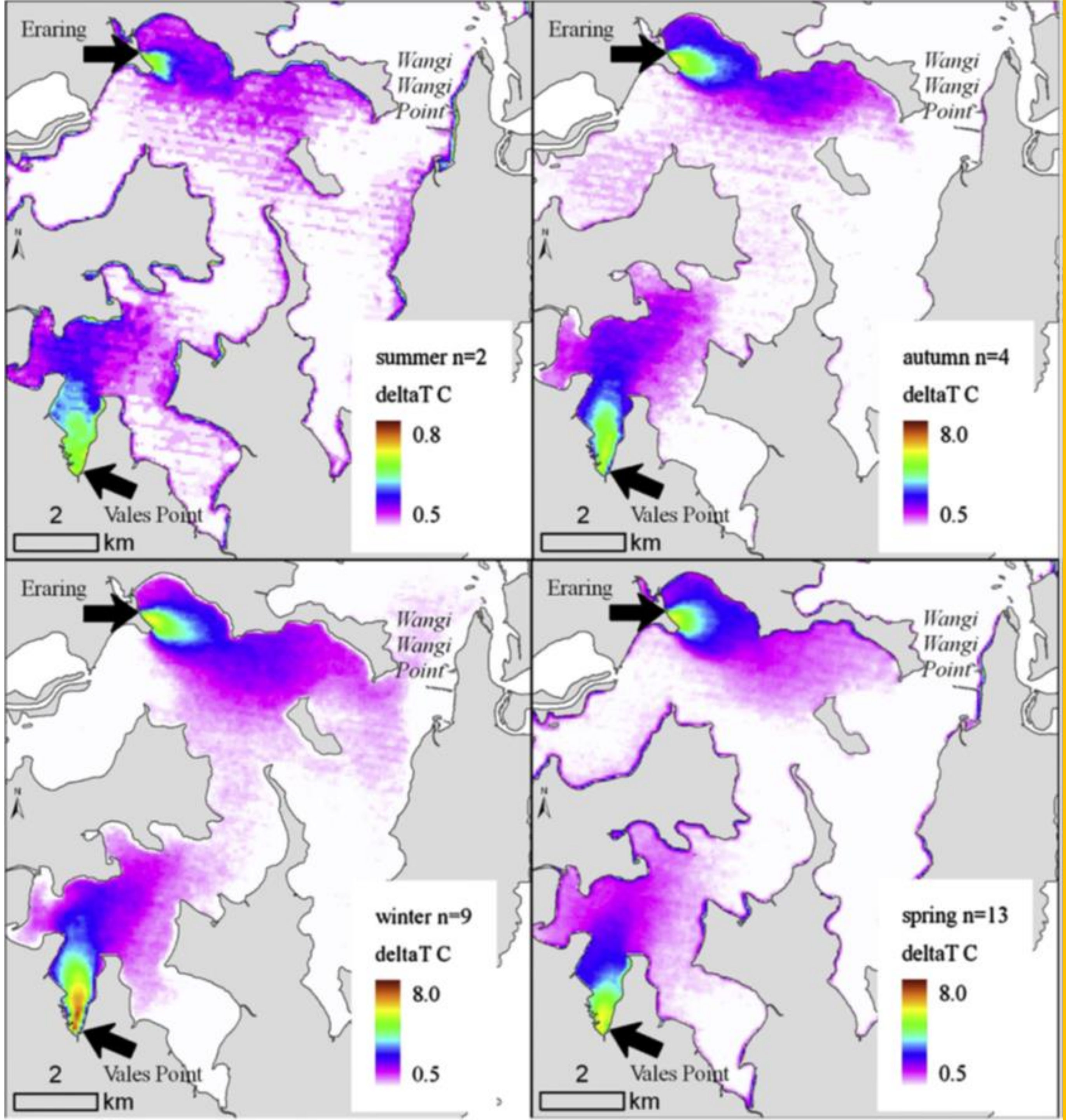
Thermal pollution

- It is generally accepted that the initial rise in temperature at the outlet point of the thermal discharge should be less than 5 °C, in order to avoid impact on aquatic ecosystems.
- Water temperatures 4 to 10ºC higher at the power station outflows at Myuna Bay and Wyee Bay than the rest of the lake.
- *Guidelines for Thermal Power Plants* for an International Finance Corporation loan requires power plants to limit thermal pollution by "no more than 3°C at the edge of a scientifically established mixing zone.
- Under special EPL conditions, Vales Point and Eraring discharge to a maximum of 38.8C.

Thermal pollution

- The aquatic ecological impacts of the increased water temperature near the power station discharge points includes;
  - Loss of seagrass in the vicinity of cooling water outlets;
  - Replacement of zostera beds by halophila in Wyee Bay;
  - Changes in fish distribution ;
    - snapper, squid, tailor, mullet, leather jackets, cardinal fish, glassy perchlets, goatfish, and toadfish less abundant,
    - tarwhine, silver biddy, bream and southern butterfish more abundant ;
- Since Munmorah power station decommissioned in 2012, seagrass has re-established close to the cooling water outlet.

Power station thermal plumes



ERARING COOLING WATER DISCHARGE

- Up to 11.8 billion litres (GL) a day into Myuna Bay.
- Must be below 35.5ºC for 98.5% of time.
- For 307 hours a year can discharge up to 37.5ºC.
- From 2018 an additional 18 hours up to a maximum of 38.5ºC.
- The conditions applies until 31 August 2021.

Eraring cooling-water intake is estimated in a year to:

- Capture about 100,000 fish
- Kill about 7,000
- Damage about 26,000
    - loss of spines, scales, skin and or fins and swim bladder damage

19 species killed or damaged including;

- silver bellies,
- leatherjackets,
- glassfish,
- herring,
- trumpeters,
- batfish,
- garfish,
- octopus,
- squid , and
- tailor

2012

2021

VALES POINT COOLING WATER DISCHARGE

- up to 6.5 billion litres (GL) a day into Wyee Bay.
- Must be below 35 C for 97% time
- 2000, 131 hours a year up to 37.5 C
- 2016, 262 hours up to 37.5 C .
- Additional 69 hours up to 37.5 during high electricity demand
- 2017 withdrew an application to increase temperatures to 38.5 C
- In force until 31 August 2021

Loss of seagrass in Wyee Bay due to Vales Point discharge

Zostera grows optimally at 27°C with the upper thermal limit close to 30 ºC

Halophila has a wider thermal tolerance to 37.5'C, with the optimum growth up to 30°C

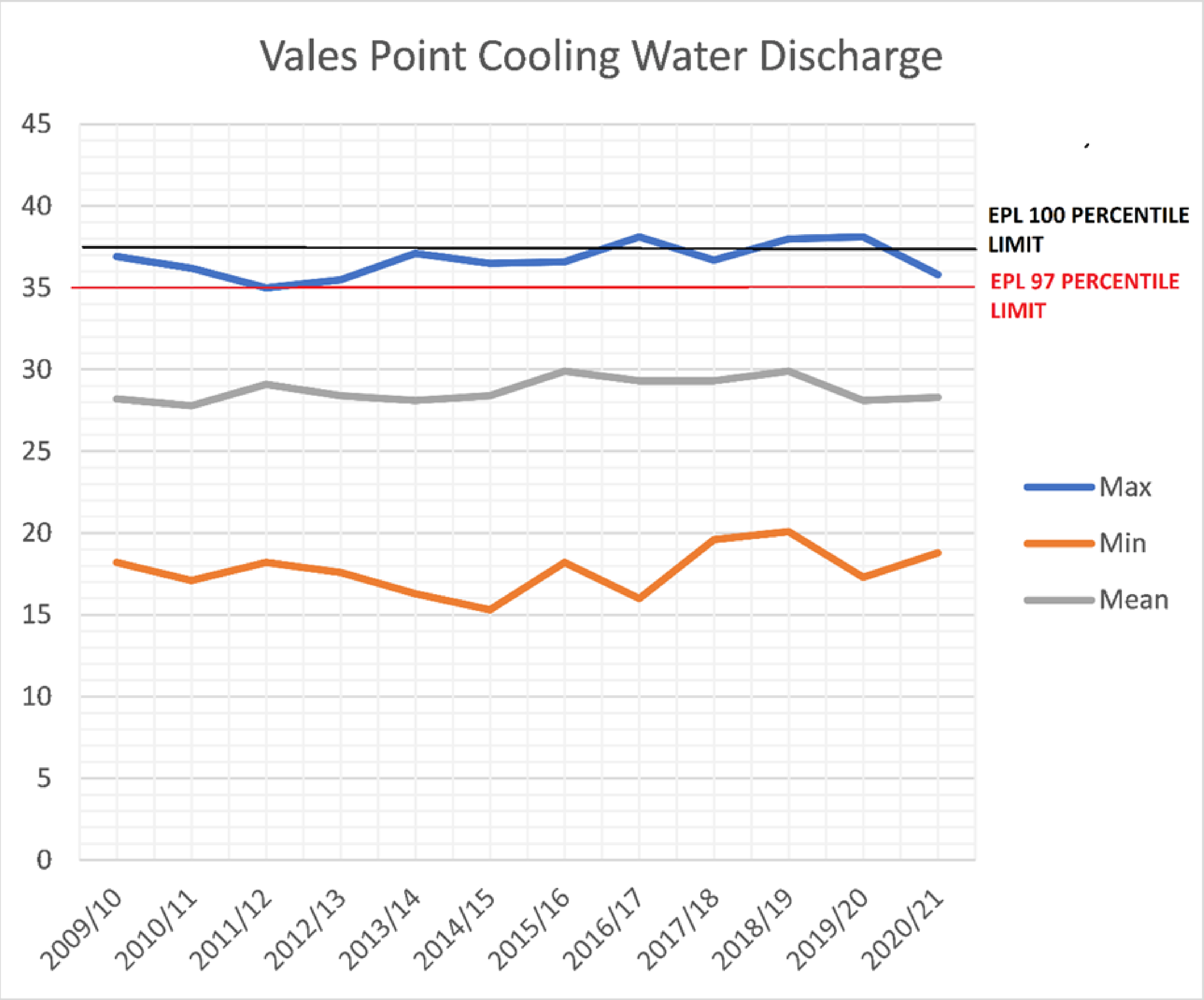
In 2016 Temperatures in Wyee Bay exceeded 30C for 1,520hours.

In 2016 Zostera in Wyee Bay was almost absent.

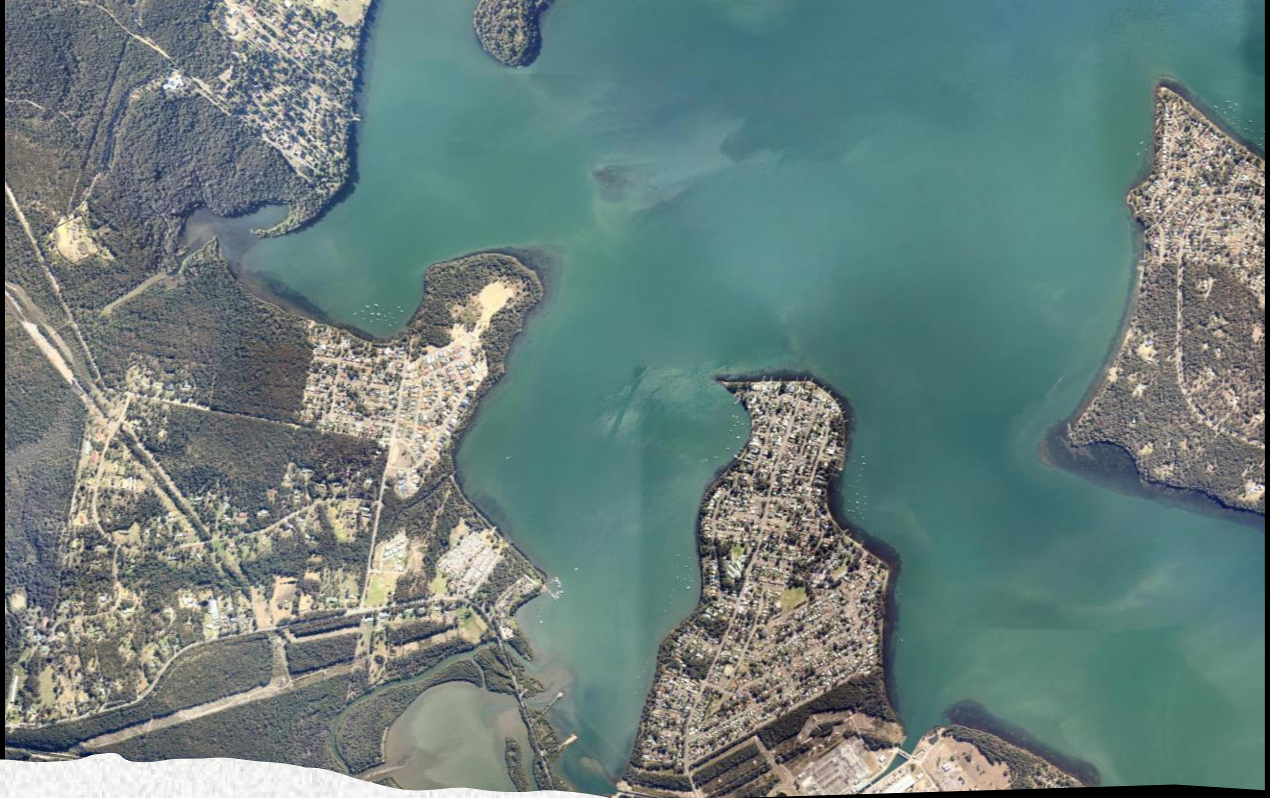
In 2018 just 25 ha of Halophilla and mixed beds of Hallophilla/Zostera in the north of the bay.

2019 seagrass further reduced to 19 ha with other areas of Lake Macquarie seagrass increasing.

Vales Point thermal discharge 2009 – 2021



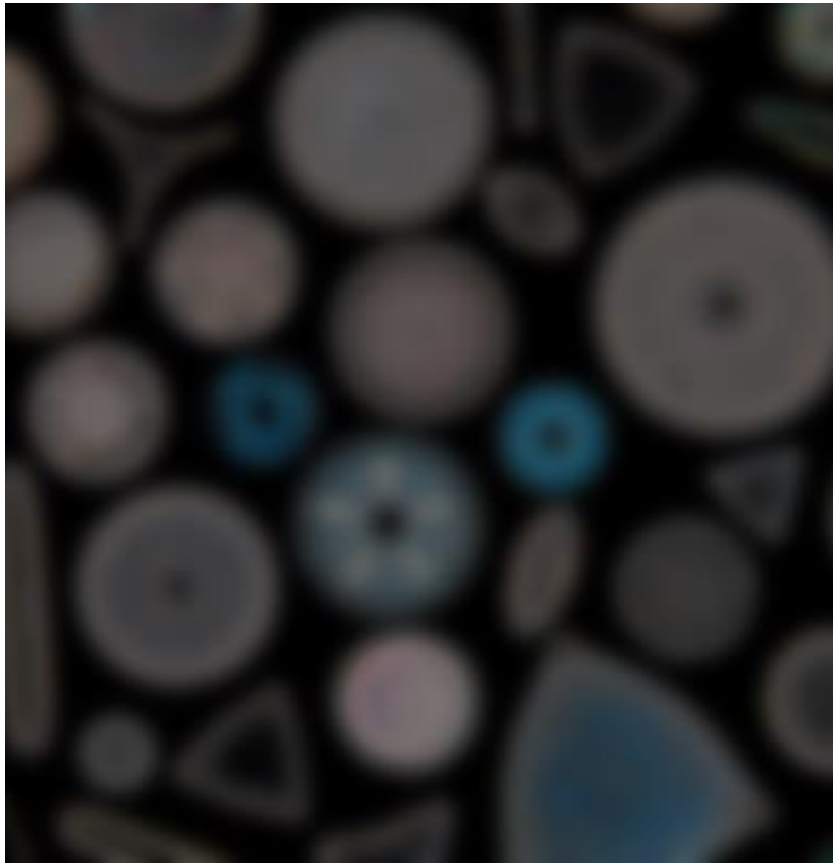
2012



2021

Phytoplankton impacts

- Diatoms contribute up to 50% of primary production within estuaries,
- Diatom assemblages are sensitive to as little as 1-2 degrees and the area of affect sustained by diatoms is greater than that of seagrass.
- thermal plumes in Lake Macquarie affected benthic assemblages to about 4.7m, depth **beyond the immediate confines of Wyee Bay."**
- the increase in the depth the thermal plume effects may have broader implications for the lake's microphytobenthos and primary production.




Q&A

Thankyou!

Hunter Community
Environment Centre