PENRITH LAKES
ENVIRONMENTAL EDUCATION CENTRE
EDUCATION FOR A SUSTAINABLE FUTURE

Year 11 Earth and Environmental Science
Human Impacts @ Penrith Lakes
(Water Management/Introduced Species)

Key inquiry questions :

How can water be managed for use by humans and ecosystems?

Students:

- represent the distribution of the Earth's water, including the amount available to plants and animals
- investigate the treatment and potential reuse of **stormwater**
- Describe ways in which human activity can influence the availability and quality of water indirectly eg algal blooms

How do introduced species affect the Australian environment and ecosystem?

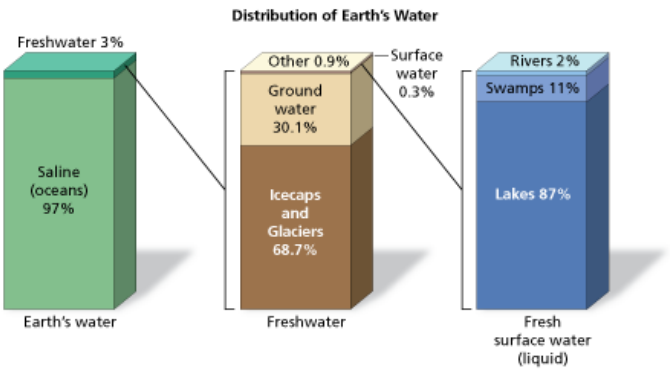
Students:

- outline the biotic and abiotic effects of introduced species
- conduct an investigation into a local introduced species, including:
  - reason for introducing the species
  - biotic and abiotic effects of the species
  - area affected by the species
  - human impacts that favour the introduced species
  - control or mitigation methods
  - economic impact of the species
  - different views about the value of and /or harm caused by the introduced species
- analyse ways in which human activity can upset the balance of ecosystems and favour introduced species
- describe ways in which introduce species contribute to the decline or extinction of native Australian species

Student Name: _____

Preamble: Water Management

The amount of water available to plants and animals is extremely scarce resource (see diagram below). Humans need to manage, treat and reuse available freshwater for life as we know it today.



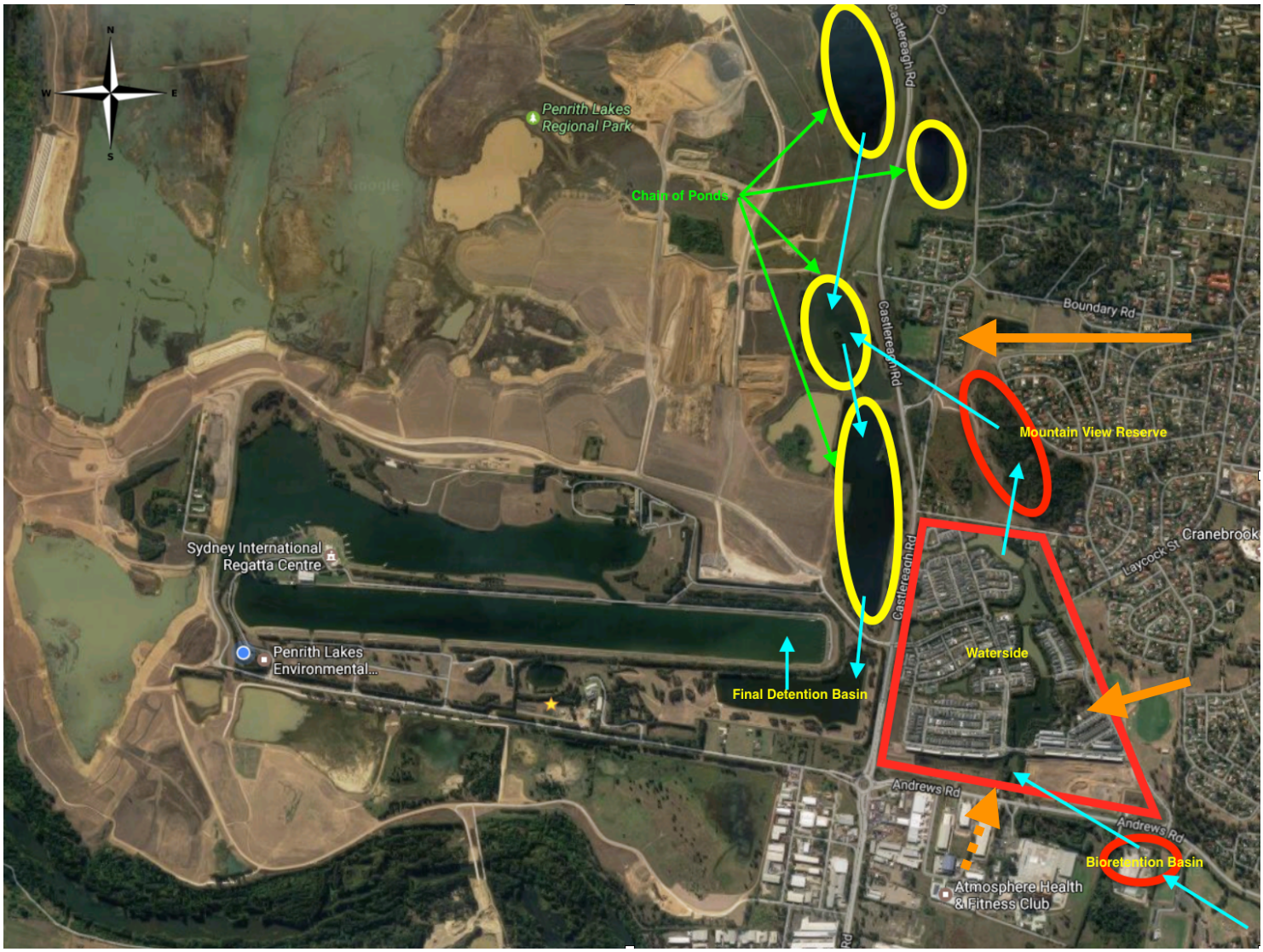
Preamble: Introduced species

Australia's native plants and animals adapted to life on an isolated continent over millions of years. Since European settlement they have had to compete with a range of introduced animals for habitat, food and shelter. Some have also had to face new predators. These new pressures have also caused a major impact on our country's soil and waterways and on its native plants and animals.

Investigation inquiry question:

How is stormwater reused for recreation at Penrith Lakes?

1. Where does the stormwater come from? (Introduction to the Penrith Lakes Scheme)



Introduction to stormwater at Penrith Lakes

1. Use the following places/features to complete the flow of Farrell's Creek stormwater to Penrith Lakes:

Middle detention basins	Regatta Lake,	Waterside,	Final detention basin
Andrews Rd Bioretention Basin	Chain of ponds	Mount View Reserve	

FLOW: Northeast Penrith urban area ⇨ _____ ⇨ _____

⇨ _____ ⇨ _____ ⇨ _____

⇨ _____ ⇨ _____

2. The 'chain of ponds' is made up of Cranebrook Lake, Duralia Lake and the _____.

3. Treated stormwater is used at Penrith Lakes for rowing, canoeing, kayaking, whitewater rafting, jet packing, triathlons, long distance swimming, model boat racing, _____ and other approved activities.

4. Stormwater also enters from the _____ Creek catchment (large orange arrow), the _____ urban area (small orange arrow) and the Penrith North _____ area (small dotted orange arrow).

Working Scientifically - Is water management working? (Water Testing)

Water Test	Instrument	Units	Directions
Phosphate	Test Tablet Kit	ppm	
pH	Universal Indicator	Number	
Turbidity	Turbidity Tube	ntu	
Temperature	Thermonmeter	°C	
Conductivity (Salts)	TDS Scan	ppm	

Waterside				**Final Detention Basin**			
Phosphate (nutrients): _____ ppm				Phosphate (nutrients): _____ ppm			
0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0
pH: _____				pH: _____			
6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	6	4	0	8	6	4	0
Turbidity (clarity): _____ ntu				Turbidity (clarity): _____ ntu			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu
8	4	2	0	8	4	2	0
Temperature: _____ °C				Temperature: _____ °C			
Summer	20 - 30 °C	Summer	>30 °C	Summer	20 - 30 °C	Summer	>30 °C
Autumn/ Spring	15 - 25 °C	Autumn/ Spring	<15 or >25 °C	Autumn/ Spring	15 - 25 °C	Autumn/ Spring	<15 or >25 °C
Winter	10 - 20 °C	Winter	>20 °C	Winter	10 - 20 °C	Winter	>20 °C
8		4		8		4	
Conductivity (salts): _____ ppm				Conductivity (salts): _____ ppm			
<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	6	4	0	8	6	4	0
Appearance							
Clear	Cloudy/some colour	Muddy/murky	Oily/scummy and/or smelly	Clear	Cloudy/some colour	Muddy/murky	Oily/scummy and/or smelly
8	6	2	0	8	6	2	0
Overall Score Waterside: _____				Overall Score Final Detention Basin: _____			

Overall Rating	Excellent	Very Good	Good	Fair	Poor	Very Poor
Waterside	42+	37 - 41	32 - 36	25 - 31	20 - 24	<20
Final Detention Basin	42+	37 - 41	32 - 36	25 - 31	20 - 24	<20

What water management methods are being used on-site at Penrith Lakes?

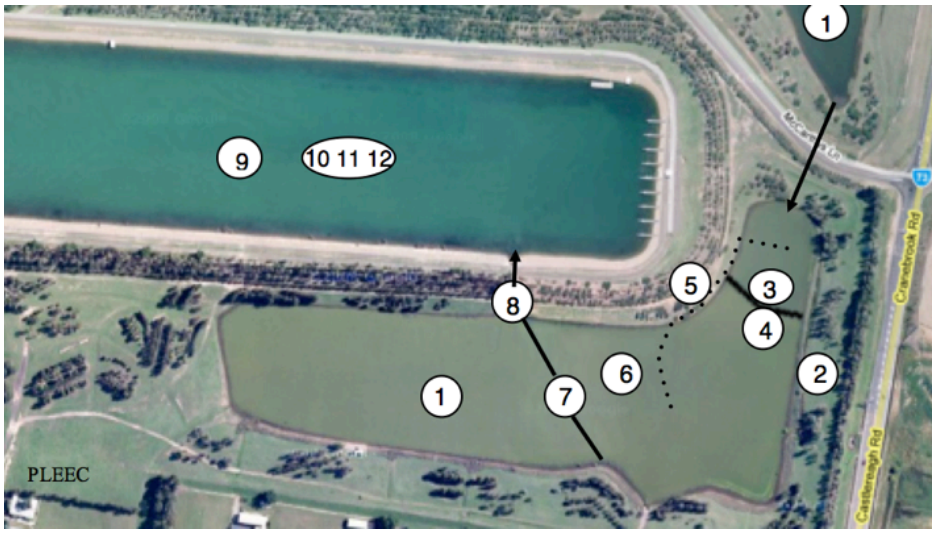
Final Detention Basin

Before reaching the Final _____ Basin, stormwater has been treated at a number of sites and slowed down by the _____ of ponds. Within the Final Detention Basin there are some further water management practices in place to ensure the stormwater is clean enough for recreational use. For sustainable recreational water a well balanced native _____ needs to be in place.

Word List

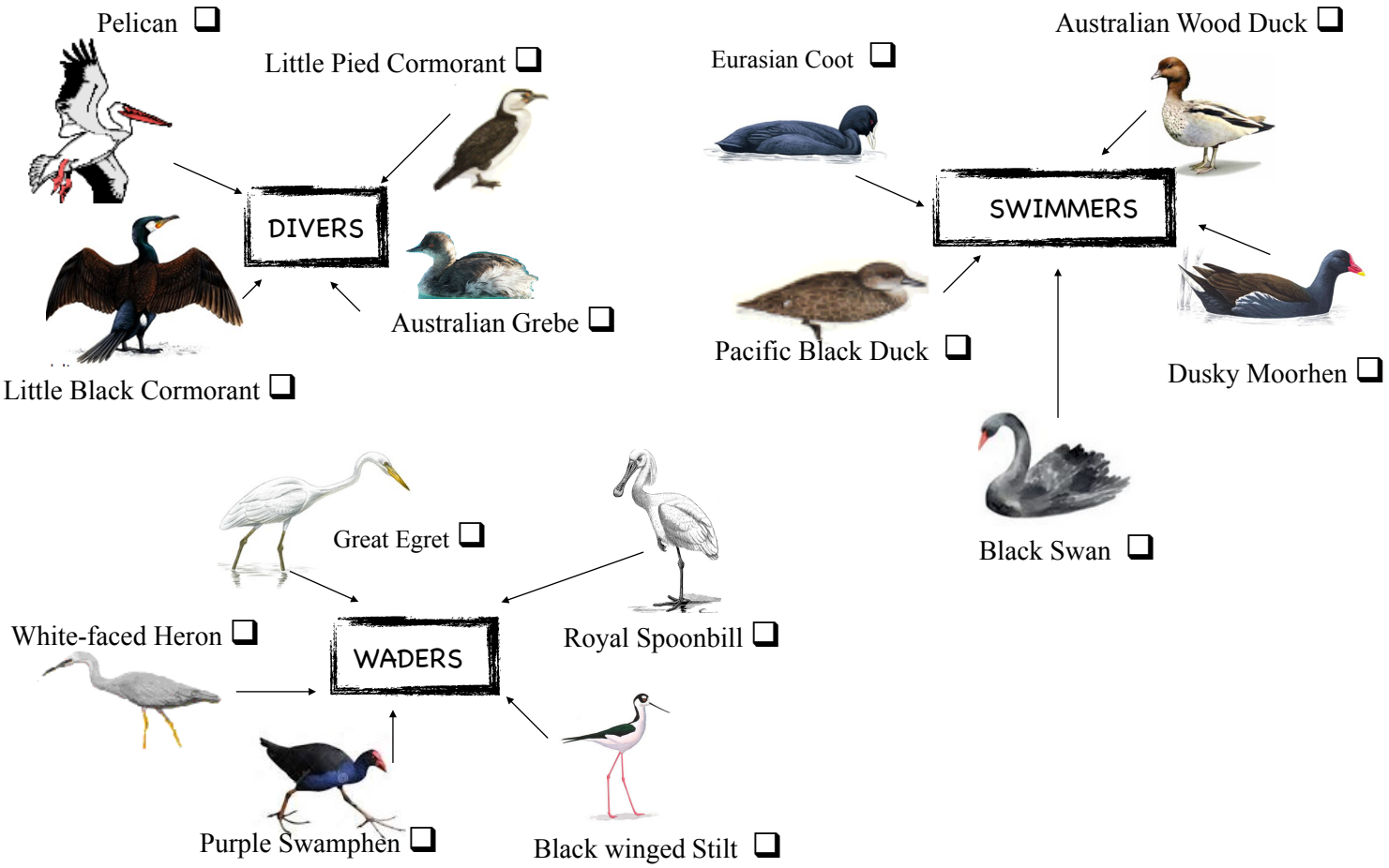
sluice; chain; harvesting; air pump; detention; stratification; nutrients; turbidity; boom; carp; blue-green; perched; bass; wetlands; submerged; screen; ecosystem; spraying

	Problem	Effects on water quality	Water Management
A	High nutrient run off	Encourages _____. _____ algal blooms.	(2) _____ wetlands (use up nutrients) (3) Floating Treatment _____ .
B	Excessive sediment from land clearing and non sealed areas	Causes turbid (brown) water which raises water temperature and lower O2 by blocking sunlight.	(4) A silt _____ (filters sediment). (2) _____ wetlands (slows inflow). (1) Detention basin system and sluice gate.
C	_____ (high water surface temperatures and low bottom temperatures)	Stratified water (low O2 at bottom level) releases _____ from "floor" sediment. Warm top layer encourages algal blooms.	(5) An _____ and hoses create currents to mix water. (6) Remote temperature sensor (yellow floating instrument with solar panels) triggers the air pump.
D	Petrochemicals (e.g. oil) and litter	Harmful impacts on ecosystem life. Blocks sunlight (low O2).	(7) A trash _____ holds back oil and litter.
E	Polluted storm water/ storm events	First flush run-off brings pollutants. Large flows can exceed basin capacity.	(8) _____ gate can be closed for pollutants or opened during flooding/storms.
F	European _____ (introduced fauna)	High _____ - stirs up sediments and rips out water plants which leads to lower O2 and higher nutrients.	Electro-fishing (in the past). (9) Stocking the lakes with _____ (biological control)
G	Hydrilla (native flora)	Hydrilla canopies lower)2 by blocking sunlight. Chokes out _____ plants.	(10) Weed _____ . (11) Selective _____ . (12) Covering with mats.



Working Scientifically - Is water management working? (Bird Observation)

1. *On your walk - Look at the bird pictures. Once you and the teacher have ID the bird, tick the box.*
2. *Use this to work out a habitat/food supply point score.*



Waterbirds observed today	Circle points for birds seen today
Bird Species	
1. Australian Grebe	4
2. Australian Wood Duck	2
3. Black Swan	5
4. Blackwinged Stilt	5
5. Dusky Moorhen	3
6..Eurasian Coot	3
7. Great Egret	5
8. Little Black Cormorant	4
9. Little Pied Cormorant	4
10 Pacific Black Duck	3
11.Pelican	5
12 Purple Swamphen	4
13. Royal Spoonbill	5
14.White-faced Heron	5
15. Other:_____	5
Total point score today	

Habitat total bird score?	
0-10	Poor
11-18	Fair
19 - 25	Good
>25	Excellent

Wrap Up - Water Management

1. Are stormwater management practices working at Penrith Lakes?

- Assessment of abiotic indicators
- Did you notice any biotic indicators during the day?

2. How can human activity influence the availability and quality of recreational water at Penrith Lakes? (Discussion)

- Read the algal alert bulletin below
- What factors cause a blue green algal outbreak?
- What are the effects of such an outbreak?
- How has this outbreak impacted on the availability and quality of recreational water at Penrith Lakes?
- What human activity could have been responsible for this outbreak?

ALGAL ALERT BULLETIN

Metropolitan and South Coast Regional Algal Coordinating Committee

23 March 2016

Blue-green algae red alert for Sydney International Regatta Centre - Penrith

The Metropolitan and South Coast Regional Algal Coordinating Committee today issued a red alert warning for blue-green algae covering the Sydney International Regatta Centre at Penrith.

This red alert level warning indicates that people should not undertake recreational activities where they may come into direct contact with the water such as swimming, as well as domestic uses such as drinking, showering and washing.

Contact with the water may also pose a threat to pets and livestock.

Blue-green algae are potentially toxic and may cause gastroenteritis in humans if consumed and skin and eye irritations after contact. Boiling the water does not inactivate algal toxins.

Blue-green algae usually appear as green paint-like scums on the water, near the edges, or as greenish clumps throughout the water. It makes the water appear dirty, green or discoloured and generally has a strong musty or earthy odour.

People should not eat mussels or crayfish from red alert level warning areas. Any fish caught should be cleaned and washed thoroughly in uncontaminated water and any internal organs disposed of before consumption.

Regular monitoring will continue and the alert will be lifted as soon as the high levels of algae dissipate.

Information on health impacts can be found here:

http://www.health.nsw.gov.au/environment/water/Pages/water-recreational.aspx

Information updates about blue-green algae blooms and red level warning areas can be obtained from the Regional Algal Coordinating Committee freecall Algal Information Hotline on **1800 999 457** or visit – **www.water.nsw.gov.au**

Wrap up - Introduced Species

1. Did you catch any of the water bugs pictured below? Tick the box if found.

1. Damselfly Nymph ☐

2. Gambusia ☐

3. Freshwater Shrimp ☐

4. Caddisfly Larve ☐

5. Backswimmer ☐

6. Water Spider ☐

7. Dragonfly Nymph ☐

8. Water Beetle ☐

9. Tadpole ☐

10. Water Boatman ☐

One of the above water bugs was introduced by humans to control mosquitos in Australia. This vertebrate eats a large range of invertebrates. It can live in poor quality water e.g. low oxygen. It breeds quickly with 'live births' (not eggs). A female can produced up to 100 young at a time. The babies can swim. It is higher order consumer. In relatively shallow water it has very few predators.

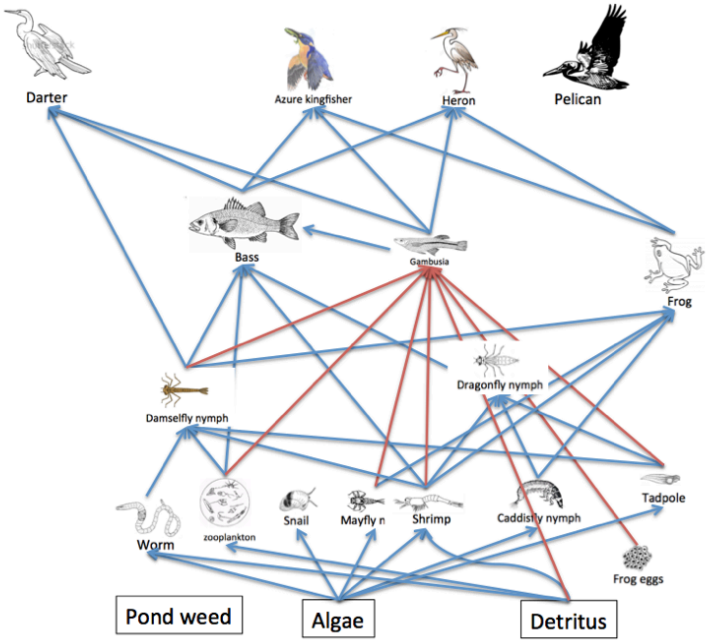
2. Which water bug do you think was introduced? _____

3. How could this vertebrate upset the balance of the Penrith Lakes freshwater ecosystem?

_____

_____

_____



A Local Extinction Event

The introduced species above had a preference for feeding on frog spawn and tadpoles in Australia. It is believed to be responsible for the decline or extinction of many frog species in local areas where it is found.

Around Penrith Lakes it is believed to be responsible for extinction of the Green and Gold Bell Frog (pictured).

Mosquito Fish Secondary Data Sheet (Note: there is a lot more research that can be explored as follow up)

Category	Explain, and/or, give an example from the information below
1. Reason/s for introducing Mosquito Fish	
2. Biotic and abiotic effects of Mosquito Fish	
3. Area affected by Mosquito Fish	
4. Human impacts that favour Mosquito Fish	
5. Control or mitigation methods for Mosquito Fish	
6. Economic impact of Mosquito Fish	
7. Positive views about the value of Mosquito Fish	

The native range of the mosquitofish is from southern parts of Illinois and Indiana, throughout the Mississippi River and its tributary waters, to as far south as the Gulf Coast in the northeastern parts of Mexico. They are found most abundantly in shallow water protected from larger fish.
Source: https://en.wikipedia.org/wiki/Mosquitofish

The lifespan of a mosquitofish averages less than a year and the maximum is about 1.5 years. However, mosquitofish kept as pets can live much longer, with owners reporting lifespans of over three years. Male mosquitofish lifespans are considerably shorter than the hardier females.
Source: https://en.wikipedia.org/wiki/Mosquitofish

The virtues of the mosquito fish have been extolled by many mosquito control organisations. However, the species can be a major pest when introduced outside their natural range.

Mosquitofish are extremely hardy, and can tolerate a wide range of temperatures. During the winter months these fish move to the bottom of the pond, become inactive, and do not feed. In most cases they will survive the winter and become active again in the spring when the temperatures rise.
Source: www.msmosquito.com/sites/default/files/brochures/MSM-

Mosquito fish can tolerate water temperatures between 33°F (0.5°C) and 104°F (40°C), but like temperatures around 80°F (26°C). They like water with a pH between 6.5 and 8.0.
Source: https://www.sandiegocounty.gov/content/sdc/deh/pests/.../chd_wnv_mosquito_fish.html

A large female can eat 100-200+ mosquito larvae in a day! More often mosquito fish will eat other tasty insect larvae and fish fry. Source: www.fishpondinfo.com/mosq.htm

General information: Gambusia were first introduced into Australia from North America as a biological control for mosquitoes; however, this was unsuccessful. Instead, they have had a detrimental effect on native fish through competition for resources and their aggressive behaviour. They have a habit of nipping the fins of other fish, regardless of size differences. They also prey on the eggs and larvae of native fish and frogs.

Habitat: They inhabit fresh and brackish waters at low elevations. They can withstand environmental conditions that native fish cannot, such as high temperatures and low oxygen but they are sensitive to high salinity.

Distribution in Australia: Introduced to eastern Australia in 1929 as a mosquito control agent because they thrive in calm, shallow, vegetated waters where mosquitoes lay their eggs.

Life cycle: Females mature at about 18-20mm, which is 4-6 weeks of age. They can produce up to 315 young per season. Live-bearing fish.
Produce small broods at frequent intervals, thereby increasing reproductive output and survival of the young

Environmental impacts: Have the potential to rapidly outnumber native fish and dominate aquatic communities.
Can survive a range of environmental conditions which native fish find difficult to cope with.
Have many traits which make them a good invader such as high reproductive potential, flexible diet, broad environmental tolerances and low vulnerability to predation due to burrowing habit.
Are aggressive and nip the fins of other fish species as well as eat their eggs.
Highly successful as they mature early, have a high survival rate of fry and a large annual number of broods.
Also able to gulp air from the surface when there is low oxygen in the water.

Social impacts: Loss of favourite fishing locations due to invasion.

Control: Biosecurity Queensland advocates the ethical euthanasia protocols recommended by the 2001 ANZCCART publication.
Intensive fishing may have the potential to reduce pest fish numbers in small enclosed waterbodies, but it is very unlikely that fishing alone is an effective long-term control measure.
Poisons have been used to eradicate pest fish in ponds and small dams, but are not practical for rivers and streams as these poisons also kill native fish.

Source: https://www.daf.qld.gov.au