PENRITH LAKES
ENVIRONMENTAL EDUCATION CENTRE
EDUCATION FOR A SUSTAINABLE FUTURE

Stage 4 Geography

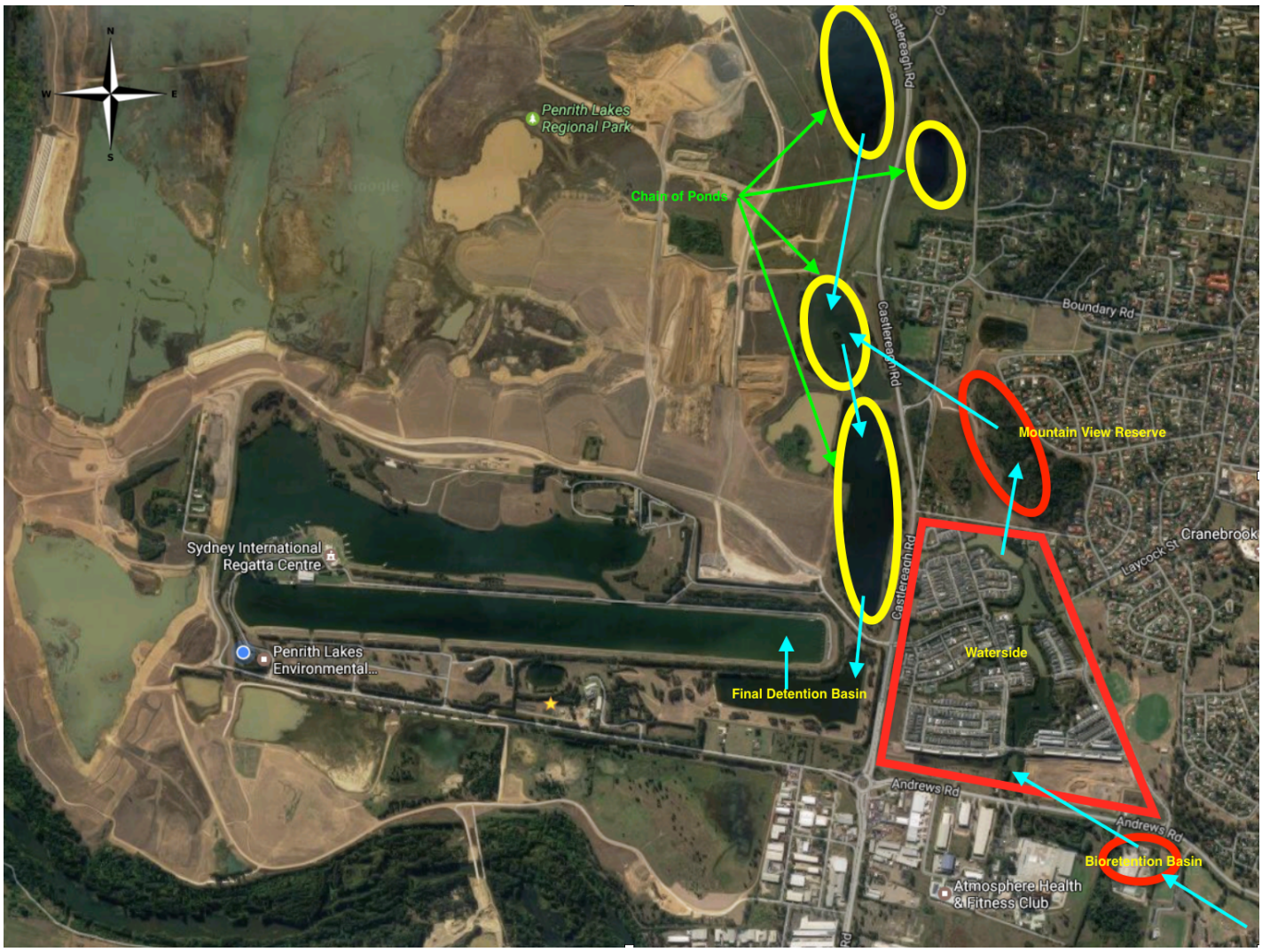
Water in the World - **Full Day**

Outcomes:

1. **GE4-1** Locates and describes the diverse features and characteristics of a range of places and environments.
2. **GE4-2** Describes processes and influences that form and transform places and environments.
3. **GE4-3** Explains how interactions and connections between people, places and environments result in change.
4. **GE4-5** Discusses management of places and environments for their sustainability.
5. **GE4-7** Acquires and processes geographical information by selecting and using geographical tools for inquiry.

Student Name: _____

Case Study: Water Management at Penrith Lakes



Stop 1: Introduction to Penrith Lakes

Bus tour of the Penrith Lakes Scheme.

Stop 2: Andrews Road **Bioretention Basin**

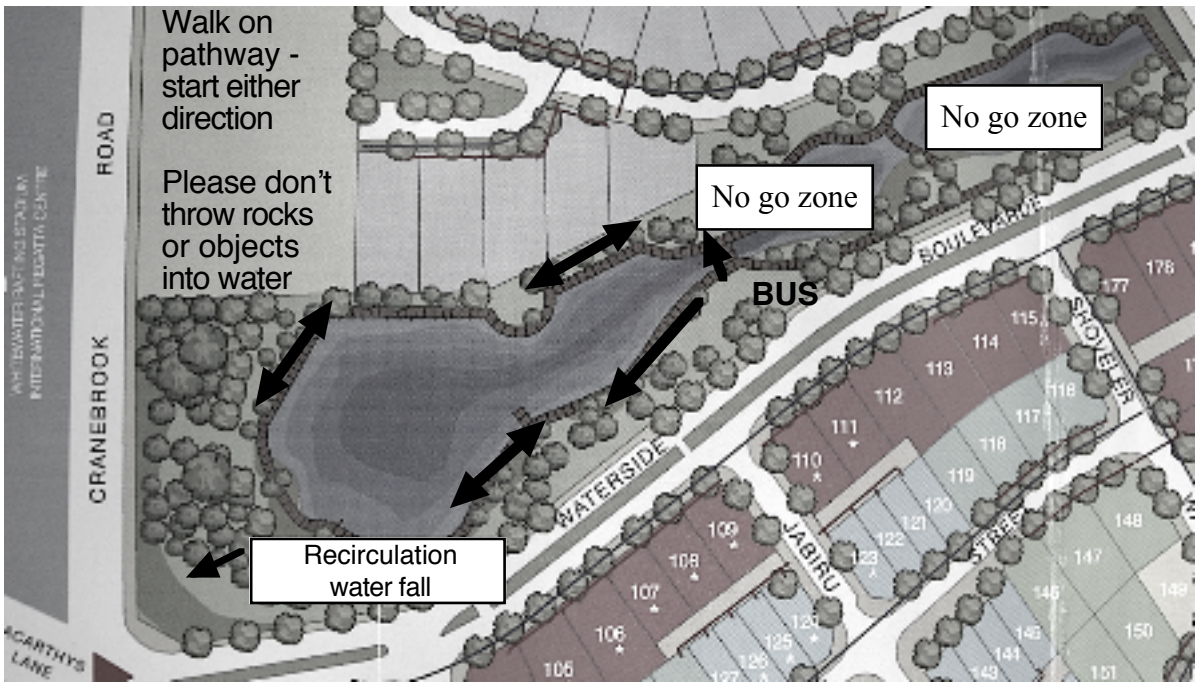
Aim: To track the flow of stormwater through Penrith Lakes to it's primary contact for recreational use.

Picture 1: Andrews Road Bioretention Basin Location Map and Conceptual Design

The Andrews Road Bioretention Basin System involves:

- Diverting stormwater from an urban catchment upstream of the site. The catchment area is approximately 70ha.
- Stormwater is pre-treated in a gross pollutant trap, which removes litter, organic debris and some coarse sediment.
- Stormwater flows into a sediment basin for settling of coarse sediment.
- Stormwater is then treated in a bioretention system, which removes suspended solids, nutrients, heavy metals, hydrocarbons, pathogens and other pollutants.
- At the base of the biorention system, treated stormwater is captured in subsoil drains and directed to the existing drainage channel to **Waterside**.

Stop 3: **Waterside** - A case study of "Water Sensitive Urban Design"



Picture 2: Waterside Location Map and Pathways

The "Waterside" development is being built by Stockland and is made up of two areas - Corporate (Employment) and Residential. Waterside Corporate covers 12.5ha of developable land providing valuable employment. The residential area of Waterside covers 54ha. There will be 686 lots available. The estimated population is 2,150 persons. The public open space will cover 11 ha and the lakes another 11 ha.

Waterside has been planned around a series of lakes that are designed to provide amenity to the estate as well as water quality improvements.

Central to Waterside is the practice of "Water Sensitive Urban Design" (WSUD). This involves the management and protection of stormwater.

Key principles of WSUD (fill in the blank spaces below):

1. Protect _____ systems
2. Protect _____ quality (e.g. chain of ponds to begin water filtration)
3. Integrate _____ treatment into the landscape
4. Reduce _____ and peak flows
5. Add value while _____ development costs (e.g. water drains to centre of road)
6. Reduce _____ water demand (e.g. rainwater tanks for gardening)

From Waterside the water flows to **Mountain View Reserve**.

Water Testing

Water Test	Instrument
Phosphate	
pH	
Turbidity	
Temperature	
Conductivity	

Waterside				Final Detention Basin/Regatta Lake			
Appearance				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
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
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/Regatta Lake	42+	37 - 41	32 - 36	25 - 31	20 - 24	<20

Notes on water quality:

- **High/low water temperatures** mean more stress on organisms, lowering their resistance to pollutants and diseases.
- **High turbidity** (water clarity) increases water temperature and reduces sunlight penetration, which reduces the ability of submerged plants to grow and produce oxygen.
- **Small changes in pH** can endanger many types of plants and animals.
- **High TDS readings** (mainly salt) make conditions uncomfortable for freshwater animals and plants. It can also have an impact on pH levels. E.g. higher TDS reading, the higher pH number.
- **High phosphate levels** (nutrients) can lead to overgrowth of plants, decreased oxygen levels and increased algal blooms.

Stop 4: **Mountain View Reserve**, Cranebrook

Picture 3: Mountain View Reserve, Cranebrook, Location Map

Key points about Mountain View Reserve:

- Receives water from Waterside and surrounding catchment hills.
- This water is then redirected to the restored wetlands.
- The wetlands naturally filter the water by taking out pollutants and excess nutrients.
- This water then flows in to the chain of ponds and the **Final Detention Basin**.
- So the restoration works will improve water quality entering Penrith Lakes and the Hawkesbury-Nepean River System.

Stop 5: **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.

	Problem	**Effects on water quality**	**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 O2 by blocking sunlight. Chokes out _____ plants.	(10) Weed _____ . (11) Selective _____ . (12) Covering with mats.

Word List

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

Comparison of Water Testing Results

Once you have recorded your results from water testing at Waterside and the Final Detention Basin/Regatta Lake, answer the following questions:

1. Identify **one** difference in the results between Waterside Estate and the Final Detention Basin/Regatta Lake.

   _____

   _____

   _____

   _____

2. Provide at least **two** reasons that explain this difference.

   _____

   _____

   _____

   _____

   _____

   _____

Some further questions for you to consider after your excursion:

1. How has the construction of Penrith Lakes altered the local water cycle?

   _____

   _____

   _____

   _____

   _____

   _____

2. What employment opportunities are related to the Penrith Lakes Scheme?

   _____

   _____

   _____

   _____