

# Macrophyte zonation and sustainability in stormwater wetlands in subtropical eastern Australia: design and function.



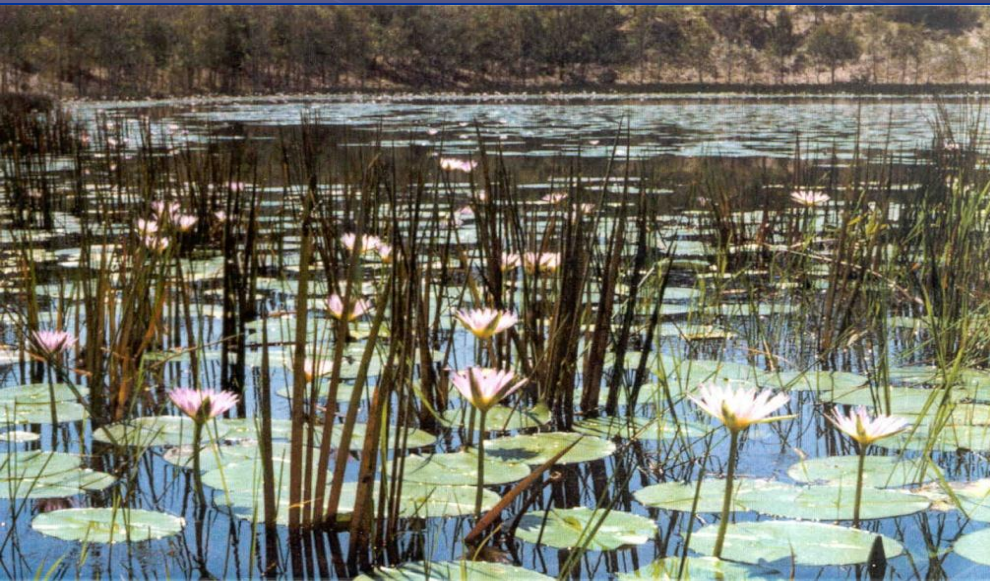
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“Hydrology is probably the most important determinant of the establishment and maintenance of specific types of wetlands and wetland processes” (Mitsch and Gosselink, 2009)





Hydrologic conditions are responsible for the maintenance of a wetland's structure and function.

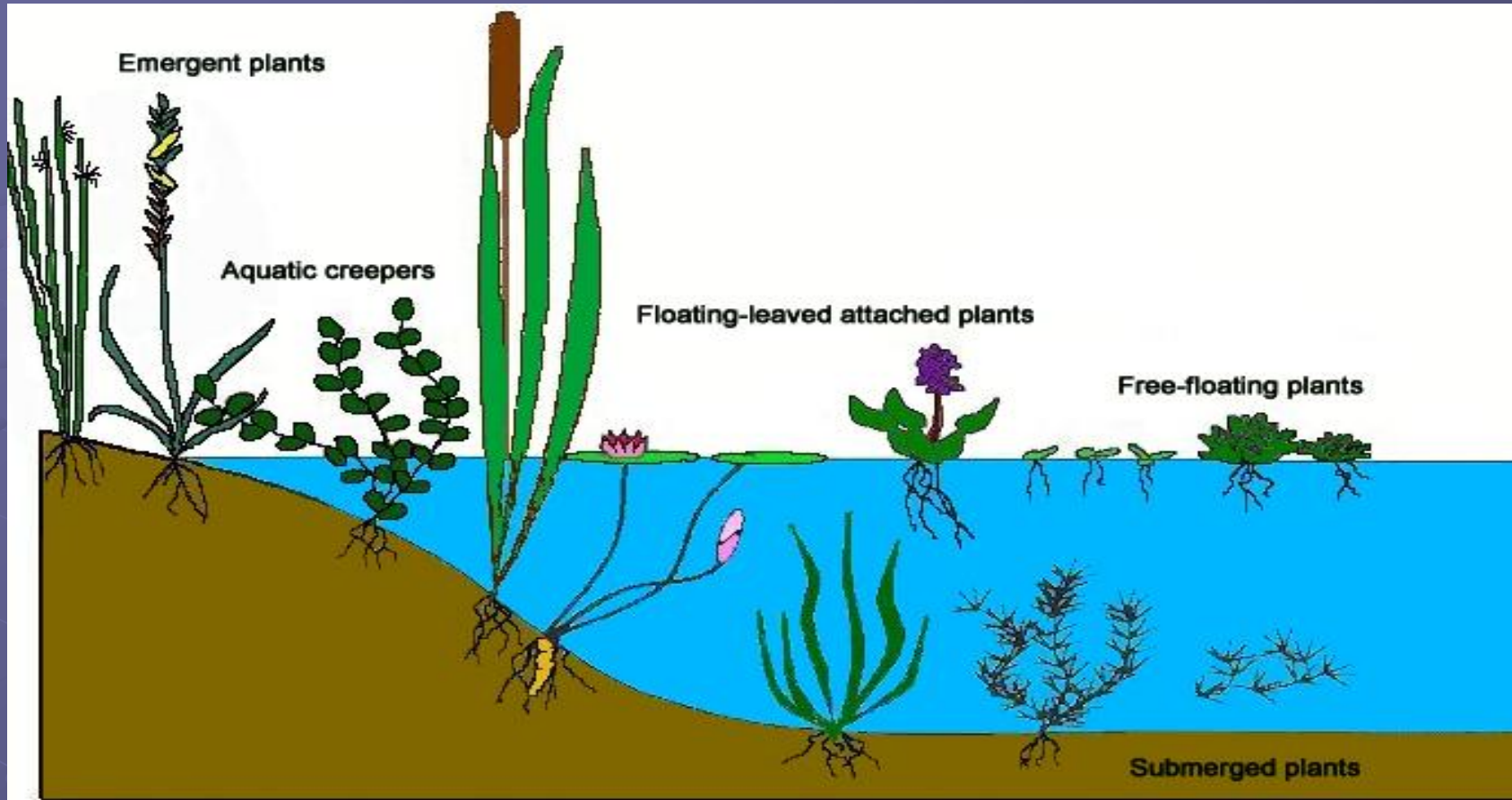
Hydrology modifies and determines the abiotic physicochemical environment i.e. soil and water chemistry.

Hydrology in turn affects the biotic environment i.e. plants, animals and microorganisms.

Hydrology determines macrophytes zonation

**Ultimately it is the hydrology that governs the performance efficiency of stormwater wetlands**

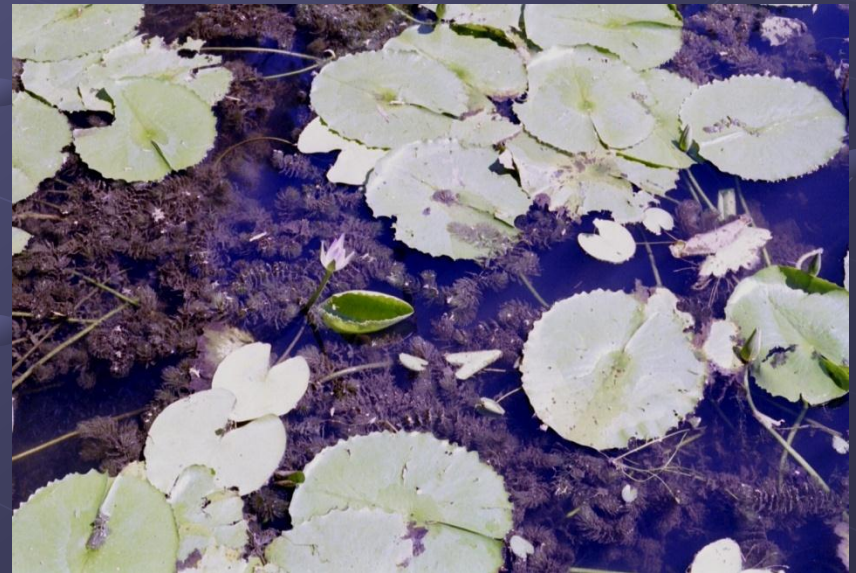
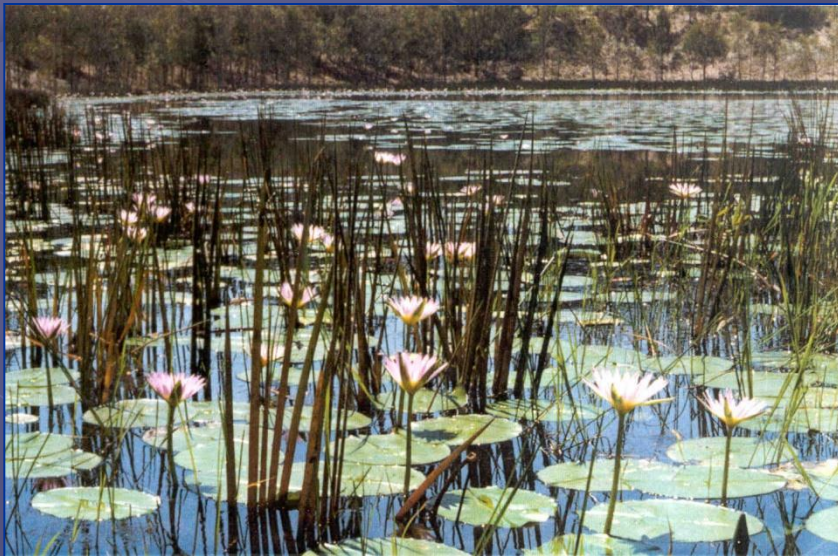
# Water depth determines macrophyte type & species and Wetland Zonation



1. Emergent - sedges, reeds, rushes
2. Creepers/vines- water primrose
3. Floating leaved-attached- water lilies
4. Free floating – duckweed, Pistia
5. Submerged – Ceratophyllum, Potamogeton



# Surface Flow Wetlands support the greatest diversity of aquatic plants





The hydroperiod i.e. extent of inundation, is the hydrologic signature of a wetland.

It is the balance between inflows and outflows of water from the wetland basin.

The hydroperiod determines the zonation of macrophytes.





# Stormwater Wetland Zones

- Deep marsh (30-50cm)
- Marsh (20-40 cm)
- Shallow marsh (5-20 cm)
- Ephemeral (dries out)





# Macrophyte establishment and growth are affected by:

- Water depth
- Hydroperiod ( extent and duration of inundation or substrate saturation)
- Depth and duration of flooding
- Season and frequency of flooding
- Water velocity
- Water quality- nutrients and turbidity





# What Can Go wrong?

## Causes of Lack of Plant Establishment and Loss

- Water levels too deep
- Extent of inundation too long
- Wrong species recommended/planted
- Inappropriate planting media
- Scouring and erosion
  
- Lack of / or inappropriate maintenance



# Case Study – Golden Pond Wetland

Wetland was a retrofit concrete stream channel-with no bypass channel



12 months after planting



18 months after planting



24 months after planting



**THEN:** Major storm event ( 100mm in 30 mins)- Scouring and uprooting of submerged macrophytes, aquatic creepers, and some waterlilies ( Note No Bypass Channel)

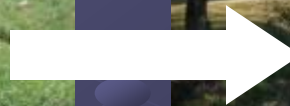
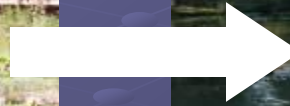




5 years after planting vegetation loss by maintenance workers!!

“Getting rid of the weeds”

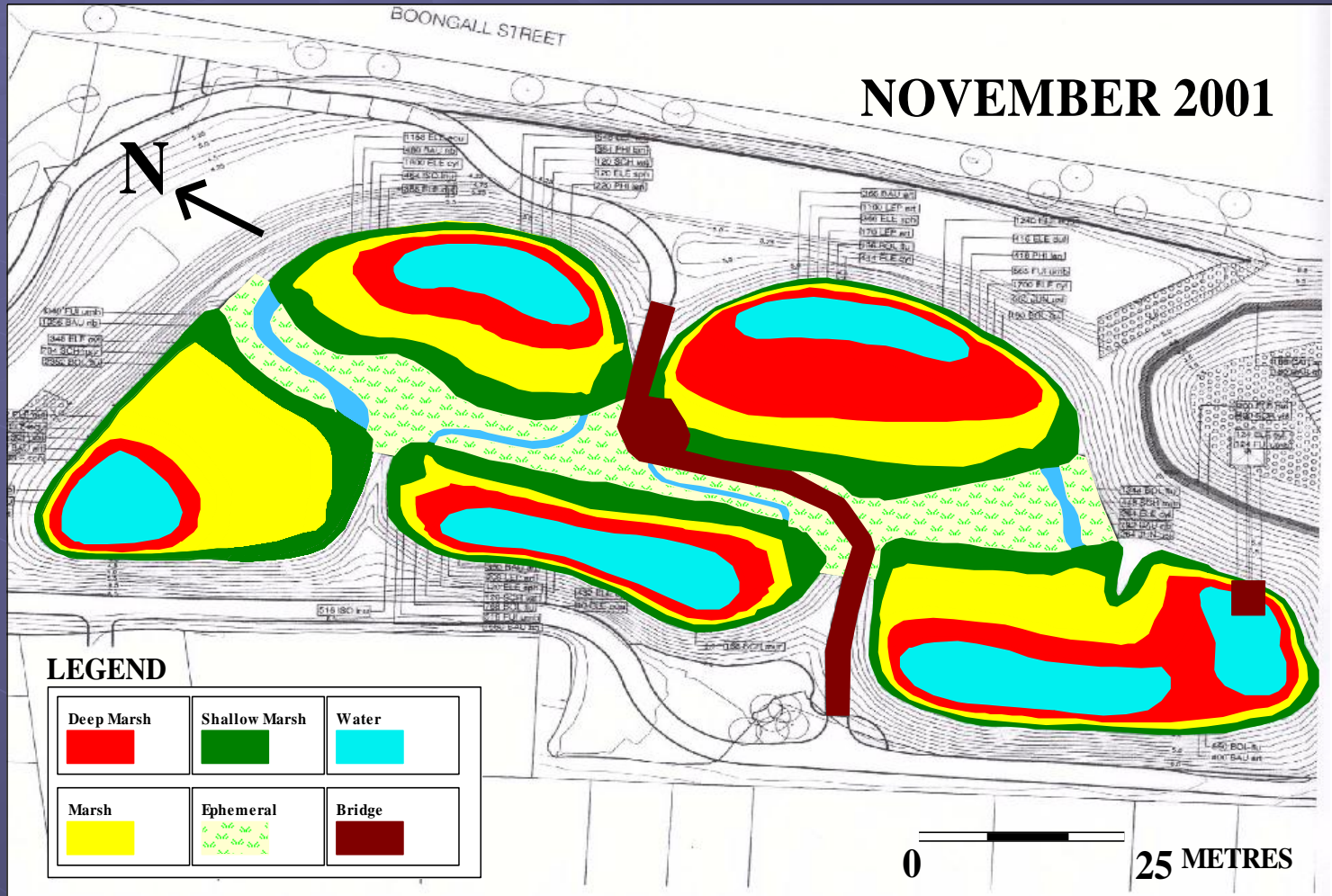
**Note Asset Management and Education Essential**





# Case Study Bridgewater Creek Wetland- Scheme of Original Macrophyte Planting Zones

Ephemeral 14%; Shallow Marsh 23%; Marsh 24%; Deep Marsh 20%; Open Water 19%

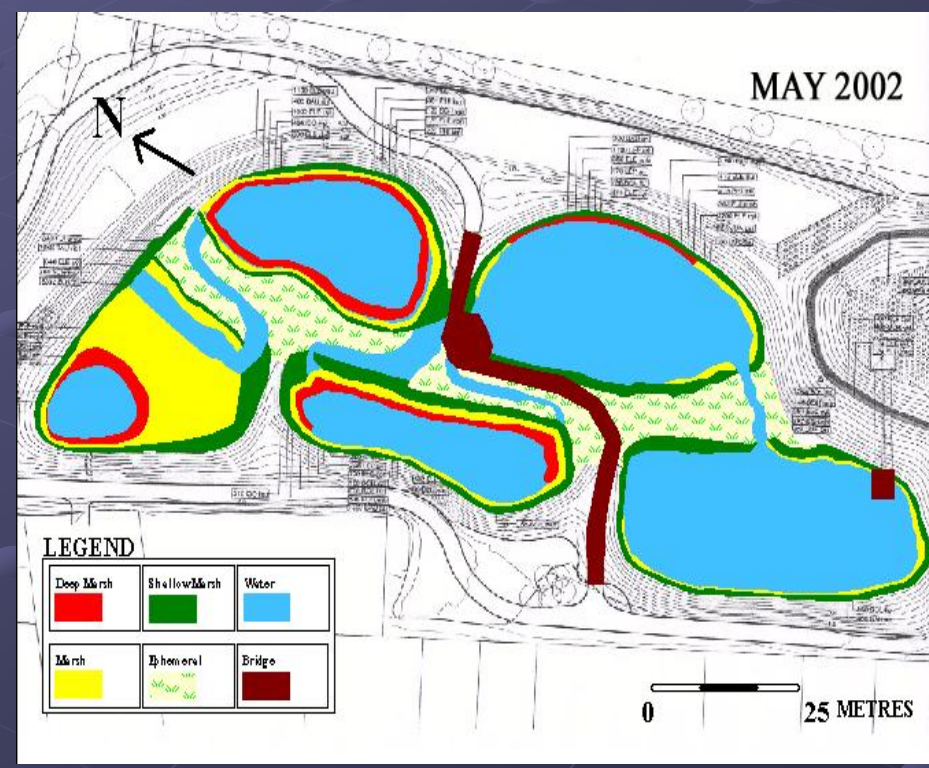
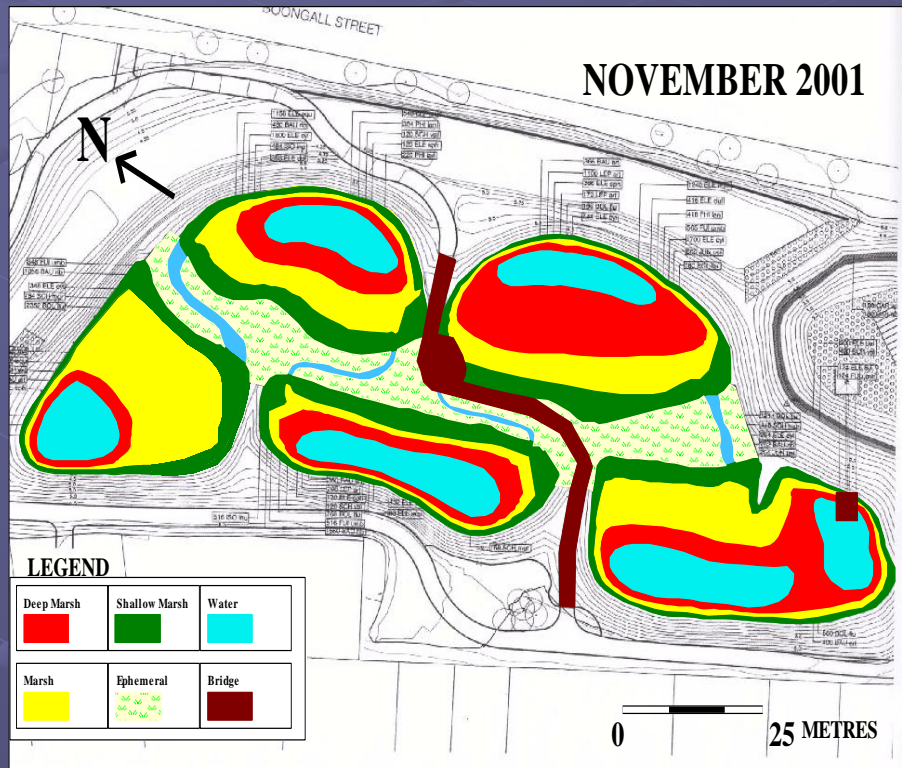




# Macrophyte Zones –6 months after planting

- Very poor establishment of **deep marsh** & **marsh** species
- **Open water dominates** - 56%

What went wrong: water too deep; extended inundation





# Vegetation loss due to extended inundation caused by poor design of outlet structure



**Schoenoplectus**

**Carex**





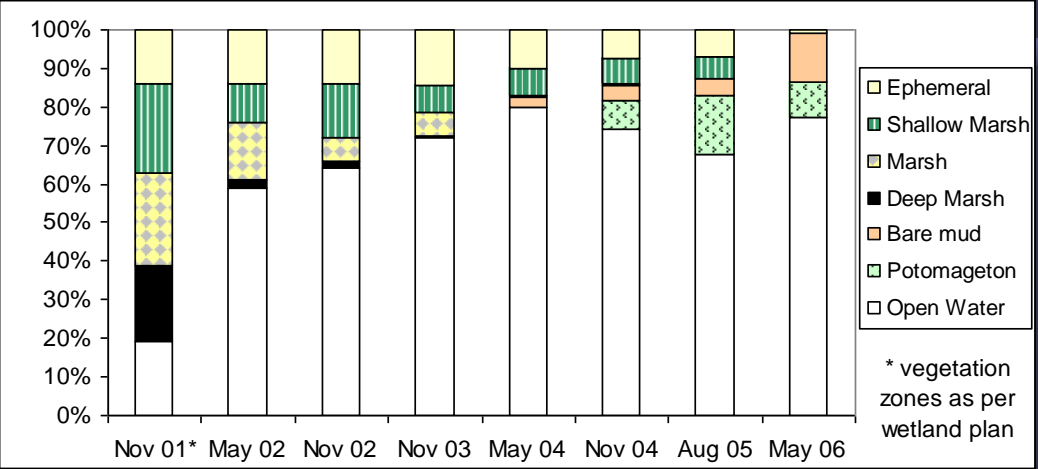
### 3 – 5 years after planting:

- ❖ Landward colonisation of *Bolboschoenus*
- ❖ Colonisation of open water by *Potamogeton javanicus*





# Vegetation Loss due to Extended Inundation- poor design and poor maintenance



Clogging of wetland outlet structure

Macrophyte loss over 5 years



# What can we do to ensure good urban wetland design?

- Hydrology: Water levels must be controlled
- Species selection: the right species with the appropriate “flooding” tolerance, for the right wetland zones
- More consultation needed with wetland plant specialists
- Design to minimise short-circuiting which may cause scouring and erosion
- Planting media: Ensure there is sufficient substrate depth of sand/gravel or loam for root growth
- Maintenance crew must be educated