Restoring Estuaries– Linking Planning, Science and On-ground Considerations

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Restore/Recreate/Rehab/Remediate

>$100M/a spent with limited understanding of:

- Ecohydraulics
- Hydrology vs Vegetation Linkages
- Geomorphology and carbon cycles
- System values (what is important and why)
- Climate Change impact
- System Feedback Loops
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Saltmarsh Acid Sulphate Soils Mangroves Frogs Freshwater Flora Fish Migratory Birds Neighbours Snipe/Grass Owl Mosquitos Catchment Impact Buffer Zone

Very Good

Good

No Change

Bad

Very Bad
# MANGROVE Scenario

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- **Very Good**: Minimal impact or positive influence on the ecosystem.
- **Good**: Slight impact with some mitigation measures required.
- **No Change**: Impact remains consistent with current state.
- **Bad**: Significant negative impact requiring urgent action.
- **Very Bad**: Severe negative impact necessitating immediate intervention.

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The Dream...

CLIMATE CHANGE Scenarios

- Saltmarsh
- Acid Sulphate Soils
- Mangroves
- Frogs
- Freshwater Flora
- Fish
- Migratory Birds
- Neighbours
- Snipe/Grass Owl
- Mosquitos
- Catchment Impact
- Buffer Zone

Very Good

Good

No Change

Bad

Very Bad

Rate of Change?

Boundary Influences?
Typical Wetland Projects

CONCEPTUAL UNDERSTANDING
Understanding existing site constraints and forcing functions (numerical modelling)

DESIGN/PLANNING
Applying conceptual design against site limitations and project restraints (floodgate design criteria)
Typical Wetland Projects

(c)
ON-GROUND WORKS
Implements project plan
(modified gate design)

(d)
MONITORING
BACI programme
(importance of mass flux and imaging techniques)
Concept Stage: Lessons

- Move beyond singular outcomes by understanding entire estuary.
- Plan within resilience timeframes.
- Objectively determine the highest priorities.
DRY Conditions

Dry Periods
- Saline dominant
- Limited acid discharge
- Limited upland inflow
- Highly buffered
Flood Conditions

**Wet Periods**
- Freshwater dominant
- Acid flow high, low concentration
- Limited tidal prism
- Highly diluted

**Acid Water:**
- Strong flow, low concentration

**Restricted tidal prism**
- Freshwater
- Tidal (salt) water
- Freshwater, high dilution
Draining Conditions (Acidic)

Acid Periods
- Acid water dominant
- Highly concentrated acid
- Limited upland inflow (low dilution)
- Limited tidal intrusion (low buffering)

Low dilution, low salt, high acid

Acid Water: Moderate flow, high concentration
Risk Based Priority Method

- **Drainage**: Long, deep, wide drainage network, Low lying land — High drain invert narrow, short, High topography.
- **Hydrology**: Large catchment — Small catchment.
- **Asset condition**: Poor condition — Good condition.
- **Groundwater**: High hydraulic conductivity — Low hydraulic conductivity.
- **Water quality**: Low pH <4 (history of acid) — Near neutral pH >6 (no acid history).
- **Sensitive receivers**: Nearby oysters — Far from.
- **Acidic soils**: Shallow acidic layer (above drain invert and MSL) — Deeper acid layer (below drain invert and low tide elevation).

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Planning/Design Lessons

• Overseas methods largely not valid.

• On-ground engineering reduces initial risk but not a long-term solution.

• Pick winnable stages (but avoid zoos).
Case Study: Tomago Wetlands

Restoration of large coastal wetland for habitat offset project.

- Design
- Planning
- On-ground works
- Monitoring
Wetland Creation
On-ground Controls
On-ground Works Lessons

• Trial by error is no longer acceptable.

• Trial periods don’t work.
Remediation Options: Tidal Wetland Creation
Monitoring Lessons

- Concentration is only $\frac{1}{2}$ the story.
- Rehabilitation occurs in spurts.
- Link site results to impacts.
>200 mm of rainfall was recorded at the site in 3 days in late Jan 2013
Wet Conditions: Jan-Feb 2013
On-ground Impacts
Response to Restoration
Things to note...

- Lets not wait for a catastrophe, its already bad enough (death by 1000 cuts).
- Existing scientific method is flawed.
- CC impact is caused by rate of change.
Climate Change

• System dynamics are in balance.
• SLR Rate is not linear!
• When SLR exceeds deposition system failure occurs.
• Rate of change is key
But then...

- Scientific method has to be adjusted to integrate various rate changes...
- BACI to b-FAcI?
  - Where is the site headed towards?
  - Are there any controls?
Thanks...

- WRL Staff
- OEH’s Parks and Wildlife Division
- Councils (Shoalhaven, GTCC)
- Students (Lisa Granqvist)
- NSW DPI - Fisheries
- Habitat Action Grants
- Various LLS
- Commonwealth
- Plus many others...
But...

- Animation Link