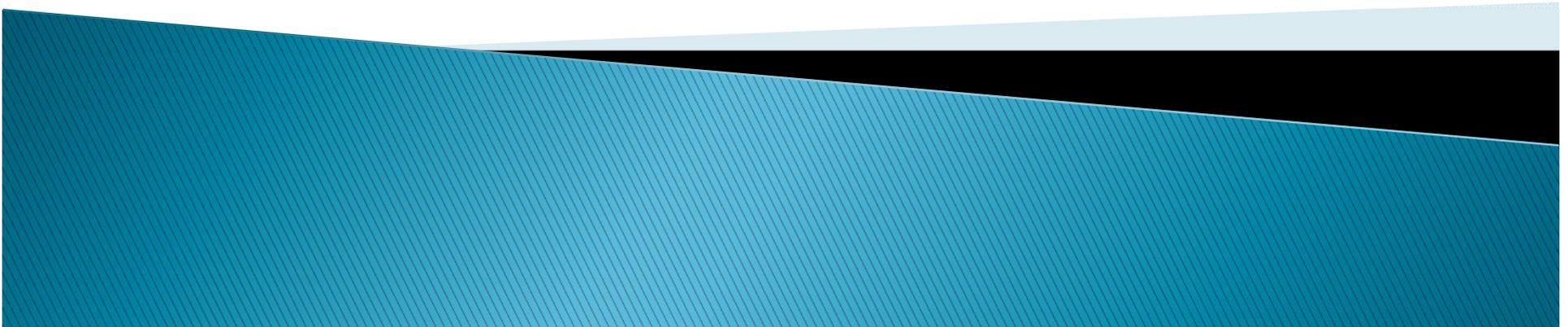




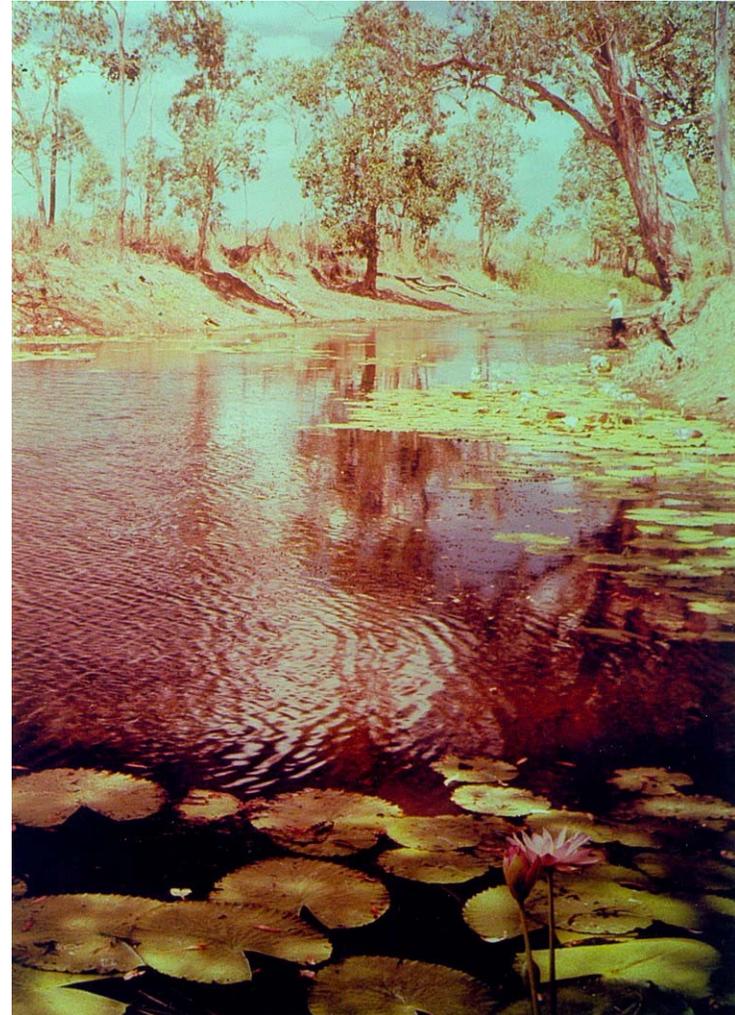
Provision of Coastal Ecosystem Services to the Great Barrier Reef World Heritage Area (GBRWHA)

Lower Burdekin Floodplain Case Study
Jim Tait of Econcern



Introduction – Jim Tait

- ▶ Originate Lower Burdekin (Tait's Rd Maidavale)
- ▶ 30 + years environmental science
- ▶ Fish Biologist / aquatic ecologist – specialise in floodplains esp. tropical Australia and PNG
- ▶ Trade as **E**concern
 - NRM, R&D
 - Biodiversity conservation
 - Impact assessment
 - Catchment & regional planning
 - Freshwater fisheries & wetland management
- ▶ Worked on Burdekin floodplain since late 80's – Conceived BBIFMAC 1998



Presentation Overview

- ▶ Background Lower Burdekin Floodplain Case Study
- ▶ Floodplain Coastal Ecosystems and Linkages (Services) to Health and Resilience GBRWHA
- ▶ History of Floodplain Land and Water Resource Use
- ▶ Natural Resource Management Tools and Practices
- ▶ Status of Floodplain Coastal Ecosystems and Service Provision
- ▶ Opportunities and Ways Forward to Improve Coastal Ecosystem Services to the GBRWHA



Background Lower Burdekin Floodplain Case Study

- ▶ *GBR Outlook Report (2009)* many threats to GBRWHA result from actions beyond Marine Park boundaries incl. development, land use and climate change.
- ▶ Reduction in the condition and/or extent of coastal ecosystems biophysically linked to the ecological health and resilience of the GBRWHA
- ▶ Aust & Qld Govt Response undertake strategic assessments under the EPBC Act in key coastal areas adjacent to the Great Barrier Reef support development of regional sustainability plans
- ▶ Studies need to be stratified across a broad suite of bioregional, land use and development pressure contexts
- ▶ Lower Burdekin a case study of coastal ecosystem management challenges on a floodplain dominated by irrigated agriculture.
- ▶ Study conducted 2013 – reviewed literature sources, mapped and remote sensed data sets, targeted stakeholder consultation, field and personal experience author
- ▶ Reviewed coastal ecosystem status and land use activities, practices and management arrangements that influence their functions linked to the health and resilience of the GBRWHA



Background Lower Burdekin Floodplain Case Study

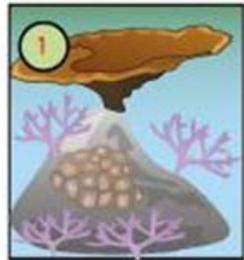
Why interested in coastal ecosystem services at a water management forum?

- ▶ In the water resource management field much focus is on the outcomes generated by individual & industry water use practices and patterns
- ▶ Examining the status of coastal ecosystems and their services recognises that the **landscape is also a 'water manager'** and that all water management operates within a landscape context!

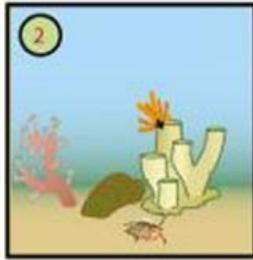




GBRWHA Coastal Ecosystems



CORAL REEFS



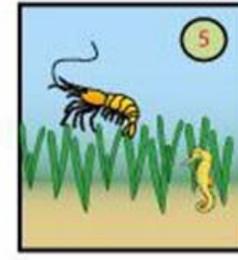
LAGOON FLOOR



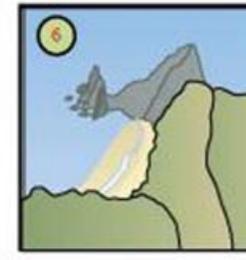
ISLANDS



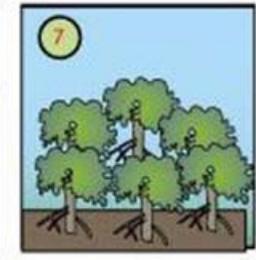
OPEN WATER



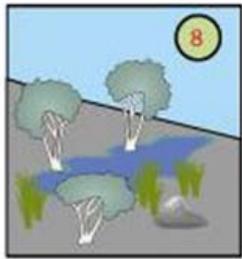
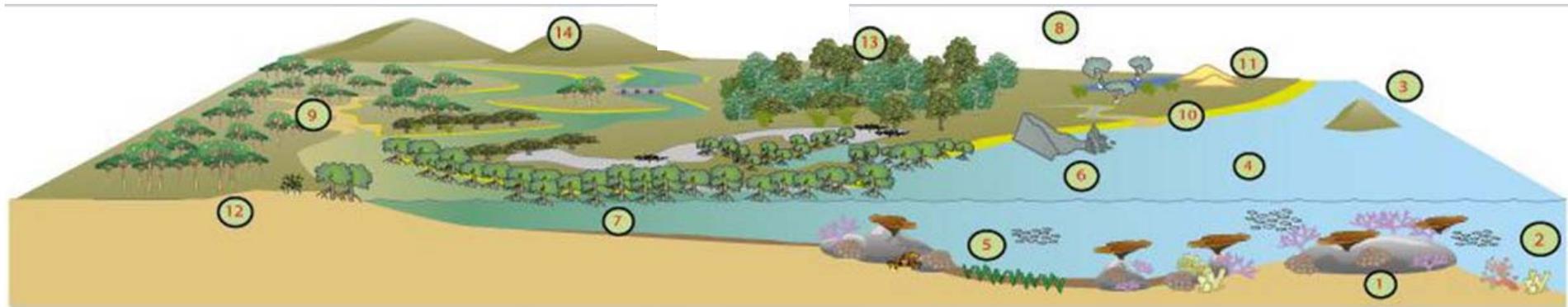
SEAGRASSES



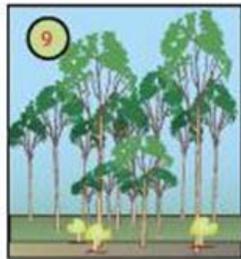
COASTLINE



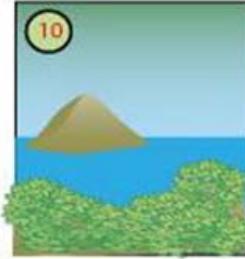
ESTUARIES



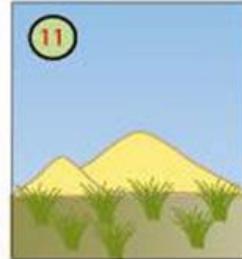
FRESHWATER WETLANDS



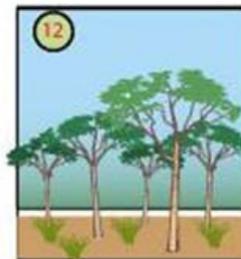
FOREST FLOODPLAIN



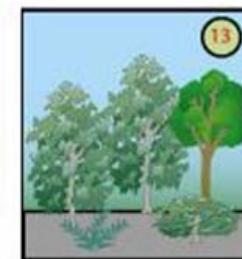
HEATH & SHRUBLANDS



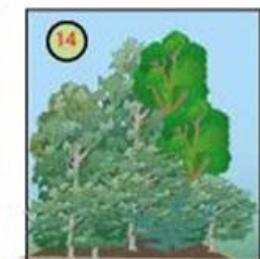
GRASS & SEDGELANDS



WOODLANDS



FORESTS



RAINFORESTS

Floodplain Coastal Ecosystems

Coastal ecosystems Lower Burdekin Floodplain Study Area are six major types including:

- ▶ *Floodplain forests and Woodlands;*
- ▶ *Freshwater Wetlands;*
- ▶ *Rainforests;*
- ▶ *Grasslands and sedgeland;*
- ▶ *Estuaries; and*
- ▶ *Coastlines.*

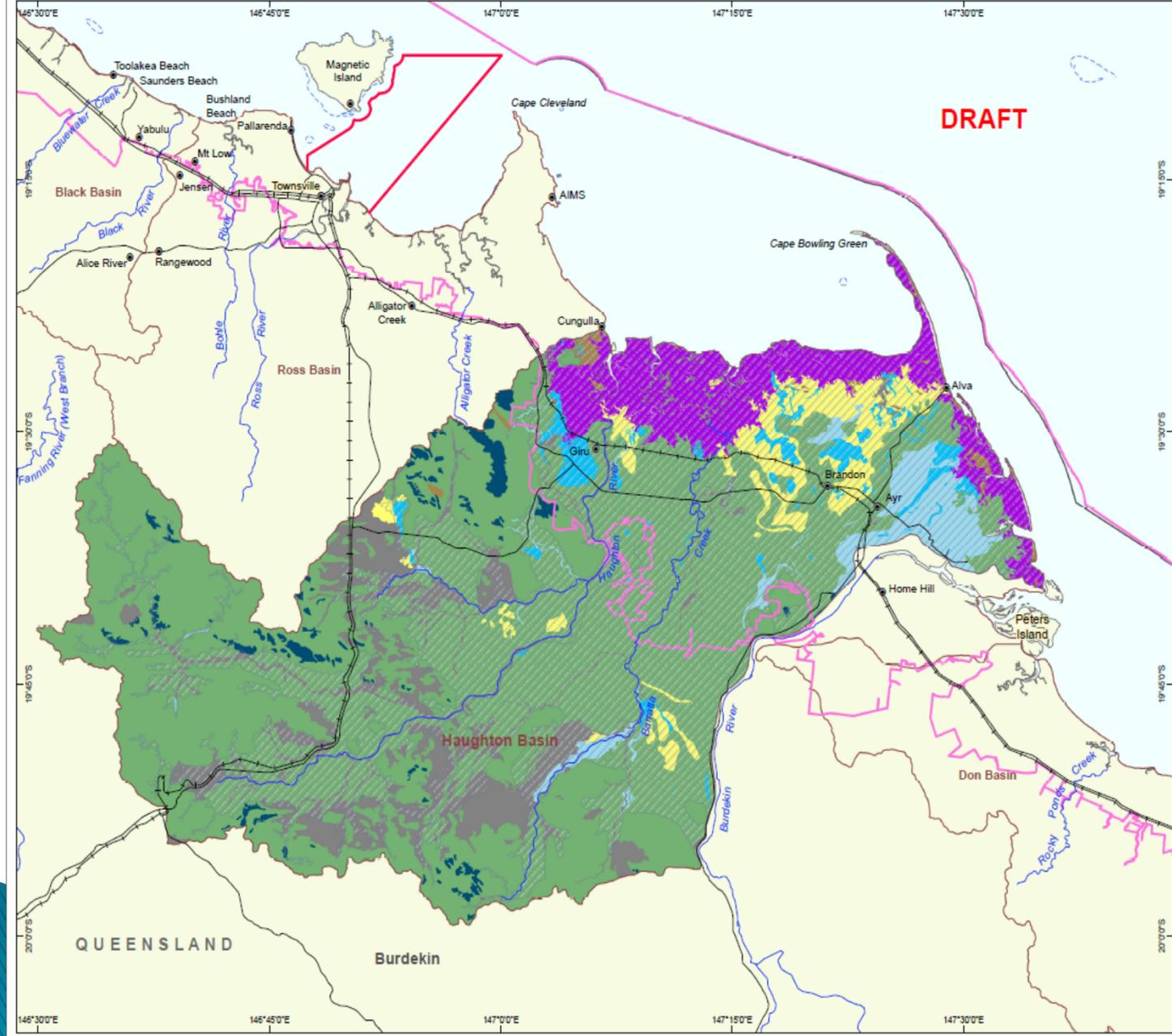


Floodplain Coastal Ecosystems



Houghton Basin Pre-clear Coastal Ecosystems

DRAFT



- LEGEND**
- Great Barrier Reef Marine Park boundary
 - Queensland Coastal Zone
 - Natural Resource Management Region boundary (NRM)
 - Basin boundary
 - Indicative Reef boundary
 - Town or City
 - Road
 - Railway Line
 - River
 - Mainland and Islands
 - QRA Floodplain
- Pre-clear Coastal Ecosystem**
- Rainforests
 - Forests
 - Woodlands
 - Forest floodplain
 - Grass and sedgelands
 - Heath and shrublands
 - Freshwater wetlands
 - Estuaries



Map Projection: Unprojected Geographic
 Horizontal Datum: Geocentric Datum of Australia 1984
 Data Source: DEEM - Queensland Herbarium
 10 September 2012
 QRA - Queensland Reconstruction Authority
 August 2012
 © State of Queensland (DEEM) 2012
 Geoscience Australia (GA)
 SDC120716a1 November 2012



Floodplain Coastal Ecosystem Services to GBRWHA

Physical processes

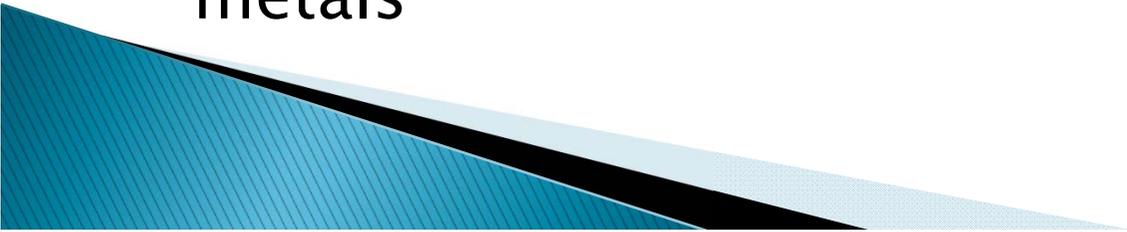
(NB facilitate secondary and integrated physical, geochemical and biological processes)

- ▶ Detention of water and floodplain run off
- ▶ Providing hydrological connectivity between ecosystems
- ▶ Regulating overland flow (velocity) and groundwater (levels) and surface expressions
- ▶ Stabilise, trap, assimilate and provide source sediment
- ▶ Particulate deposition and transport (sed/nutr/chem etc.)
- ▶ Material deposition and transport



Floodplain Coastal Ecosystem Services to GBRWHA

Biogeochemical processes

- ▶ Primary and Secondary production
 - ▶ Cycle, uptake and regulate flow of nutrients
 - ▶ Provides a carbon source, cycles and sequesters carbon
 - ▶ Source of Nitrogen / Phosphorus
 - ▶ Source of dissolved organic matter
 - ▶ Regulation water, salinity, hardness, pH, temperature
 - ▶ PASS management
 - ▶ Oxygenate water & sediments
 - ▶ Bio geochemically modifies chemicals/heavy metals
- 

Floodplain Coastal Ecosystem Services to GBRWHA

Biological Processes

- ▶ Provide habitat refugia for aquatic species with reef connections
 - ▶ Habitat for terrestrial species with reef connections
 - ▶ Food source
 - ▶ Habitat for ecologically important animals
 - ▶ Source/sink for ecosystem colonization/replenishment
 - ▶ Pathway for migratory fish
 - ▶ Habitat contributes significantly to population recruitment
- 

Floodplain Coastal Ecosystem Services to GBRWHA

In a nut shell:

- ▶ Quality, quantity and timing of water discharged
- ▶ Quality habitat and productivity food chains downstream ecosystems
- ▶ Population size and recruitment levels of organisms with dependent life cycle linkages
- ▶ Geomorphology and stability of coastal / nearshore landforms
- ▶ Climatic stability



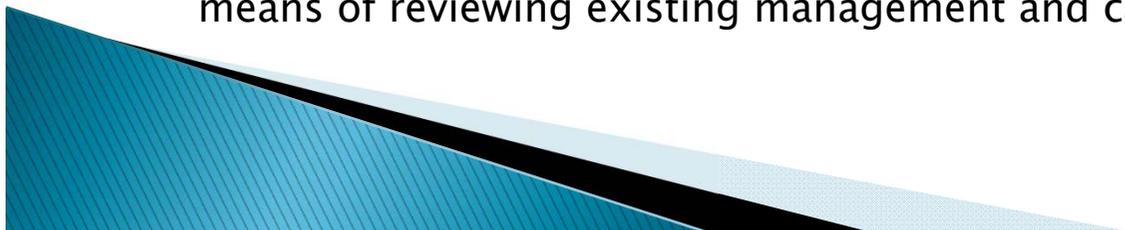
History of Floodplain Land and Water Resource Use (potted history)

- ▶ Develop the best (delta) loamy soils first using accessible surface water (lagoons)
- ▶ Extend farmable area by accessing (via spears) shallow groundwater
- ▶ Increase security of shallow groundwater supplies by recharging aquifers with river water pumped to recharge pits and floodplain distributary channels and preventing tidal incursion in coastal margins by bunding
- ▶ Increase the perenniality of seasonal Burdekin River water supplies by construction of the Burdekin Falls Dam
- ▶ Develop the more clayey older floodplain soils via surface water irrigation scheme development (BHWSS)
- ▶ Develop more marginal delta soils by extending the aquifer recharge scheme beyond natural floodplain distributaries via constructed channel network
- ▶ Implement aquatic weed control, riparian revegetation, fire regime management, remnant habitat protection, groundwater management, water use efficiency and on-farm practice initiatives to address emerging sustainability issues (in progress?)
- ▶ Key Point – Seasonally Dry Forested Floodplain – Perennially Wet Grassy one!!



Floodplain Coastal Ecosystem Management Tools

- ▶ Condition, extent and functioning of coastal ecosystems strongly linked to management of land and water resources.
- ▶ Factors governing land and water resource outcomes represent direct or indirect management mechanisms for coastal ecosystems.
- ▶ There is a hierarchy of such factors:
 - *societal and individual values*
 - *economic considerations*
 - *information and data gaps*
 - *available resources*
 - *organisational vehicles*
 - *stakeholder capacity*
 - *legislative and planning frameworks*
- ▶ Study focused primarily on statutory tools provided by:
 - *Government legislation*
 - *Planning frameworks and programs*
 - *voluntary initiatives by industry*
- ▶ Sought to identify key management mechanisms for coastal ecosystems as a means of reviewing existing management and capacity for improved management



Floodplain Coastal Ecosystem Management Tools

- ▶ Commonwealth Environmental Legislation

- *Marine Parks Act 1975*
- *Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999*

Qld State Natural Resource Legislation & Planning Frameworks

- *Vegetation Management Act 1999+*
- *Water Resources Act 2000*
- *Fisheries Act 1994*
- *Nature Conservation Act 1992 (NCA)*
- *Environmental Protection Act 1994*
- *Environmental Protection (Water) Policy 2009*
- *Land Protection (Pest and Stock Route Management) Act 2002*
- *Fire and Rescue Service Act 1990*
- *Sustainable Planning Act 2009 (SPA)*

- ▶ Protected Areas

- ▶ Local Government Planning

- ▶ Industry Best Management Practice (BMP) Guidelines



Management Practices Affecting Floodplain Coastal Ecosystems

Water Resource Use

After extensive – intensive land use pattern single largest driver of coastal ecosystem impact.

Aseasonal inputs of water to coastal ecosystems from:

- ▶ aquifer recharge,
- ▶ irrigation scheme and farm losses
- ▶ elevated and rising groundwater levels
- ▶ Irrigation tailwater flows in the dry season found to be primary driver of nutrient and pesticide losses to downstream environments

Perverse Incentives associated with water pricing arrangements

- ▶ Most commonly nominated priority amongst industry for improving water resource management
- ▶ End result is an incentive to use the full allocation entitlement that has, “already been paid for” regardless of variability in actual needs
- ▶ Superfluous delivery of water to farms and aquifer recharge systems results waterlogged floodplain and coastal ecosystems

Conjunctive Use and Efficiency (not enough of either)

- ▶ Levels of on farm water use remains at the crux of factors increasing the potential for off farm impacts to receiving coastal ecosystems.
 - ▶ Conjunctive groundwater / surface water use has long been nominated as a potential management tool for reducing the rate of groundwater rise (BHWSS)
 - ▶ perverse pricing incentives, regulatory framework impediments, complicated by established cultural practices /aversions, diverse range of farm and soil conditions
 - ▶ Changes to irrigation practices and methods can deliver WUE improvements but cultural, economic and agronomic factors impediments).
- 

Management Practices Affecting Floodplain Coastal Ecosystems

Water Resource Use

Organisational Vehicle and Lead Responsibility

- ▶ Lower Burdekin Floodplain is functionally one hydrological system, water management has been fractious and divided across multiple organisations covering separate irrigation areas
- ▶ Distrust between sectors, association of community NRM organisations with 'green' interests, the attribution of 'self-interests' to industry groups, and concern that regulatory agencies will seek to deal with admissions of management problems with greater regulatory intervention.
- ▶ Findings from coordinated studies have highlighted the potential benefits of having a single management body for what is ultimately one holistic ground and surface water system.

Flow regulating in-stream infrastructure

Another major source of water resource management impacts on coastal ecosystems including

- ▶ weirs on major rivers
- ▶ flow gates, drop boards and tidal exclusion dams on regulated distributary streams
- ▶ bunds on coastal inter tidal areas



Management Practices Affecting Floodplain Coastal Ecosystems

Land Use Pattern



The Lower Burdekin Floodplain has a very intensive pattern of agricultural land use

- ▶ All soils with 'some' suitability for agriculture within the economic reach of irrigation infrastructure have been developed to irrigated sugar cane cultivation and lesser areas to horticulture.

Landscape can be conceptualised as large levelled sugar cane field fringed on its coastal margin by a relatively narrow band of coastal estuarine ecosystems.

It is perennially watered, periodically inundated and drained by a combination of high capacity constructed earthen drains, grassy distributary stream channels with isolated small stands of riparian vegetation and the higher integrity Barratta Creek channel which retains broad bands of riparian and floodplain forest assemblages.

Management Practices Affecting Floodplain Coastal Ecosystems

Land Use Pattern

- ▶ Significant volumes of water also leave the landscape via accessions to shallow groundwater aquifers and consequent discharges via surface flows to streams and river channels or via submarine discharges to near shore area via old alluvial fan conduits.
- ▶ Within this landscape capacity for the relatively limited retained extent of coastal ecosystems to be resilient and perform ecological process services for downstream receiving areas including the GBRWHA is not high
- ▶ Physical and biogeochemical processing capability of the remaining, downstream located coastal ecosystems is prone to being overwhelmed by the larger contributing catchment area of 'leaky' agriculture production system
- ▶ Downstream 'dysfunction' is generated in the form of sustained aseasonal flows of water often characterised by low dissolved oxygen levels and elevated loads of inorganic nutrients, suspended sediment and agri-chemical residues.
- ▶ Cleared, levelled and drained landscape also delivers peakier wet season flows which have relatively diluted concentrations of most contaminate loads except for sediment. The consequent poor condition of these receiving remnant coastal ecosystems further undermines their biological processing capability.



Management Practices Affecting Floodplain Coastal Ecosystems

Weeds

- ▶ Exotic plants invade and establish best in disturbed ecosystems.
- ▶ Lower Burdekin Floodplain is a highly disturbed ecosystem.
- ▶ Loss of hydrological seasonality and replacement with perennial and often nutrient enriched water availability have created weed nirvana
- ▶ Removal of grazing pressure which historically mitigated the invasive potential of naturalised exotic pasture species
- ▶ Clearing and/or disturbance of woody overstorey vegetation,
- ▶ Altered fire regimes and other forms of regular land disturbance and weed dispersal associated with agricultural all contributed to the dominance of weeds
- ▶ Beyond the loss of floristic integrity, the most significant weed issues from a coastal ecosystem management viewpoint are those that drive a loss of ecosystem structure and function.
- ▶ Two such issues in the study area are:
 1. **aquatic weed infestations** related to modified hydrology the impacts of which can exacerbate in-stream ecological degradation to the point of ecosystem collapse, and
 2. **invasive pyrophytic and ponded pasture grasses** that dominate the understorey of most smaller ungrazed habitat remnants in agricultural landscapes. **Ungrazed pasture grasses operate synergistically with uncontrolled fire regime** to destroy the structure and functional capacity of riverine and palustrine riparian vegetation communities.



Management Practices Affecting Floodplain Coastal Ecosystems



Fire Regime

- ▶ Fire is an integral component of seasonal dry tropics coastal floodplain ecosystems.
- ▶ However fire in concert with invasive grass species that have altered fuel loads is one of the major drivers of impact on remnant vegetation assemblages.
- ▶ The highly simplified wetland riparian and floodplain vegetation that result from the unmanaged, predominantly hot and often frequent fires that occur within the agriculture dominated areas of the LBF have a much lower capacity for delivering the physical and biogeochemical process functions normally associated with these coastal ecosystem types

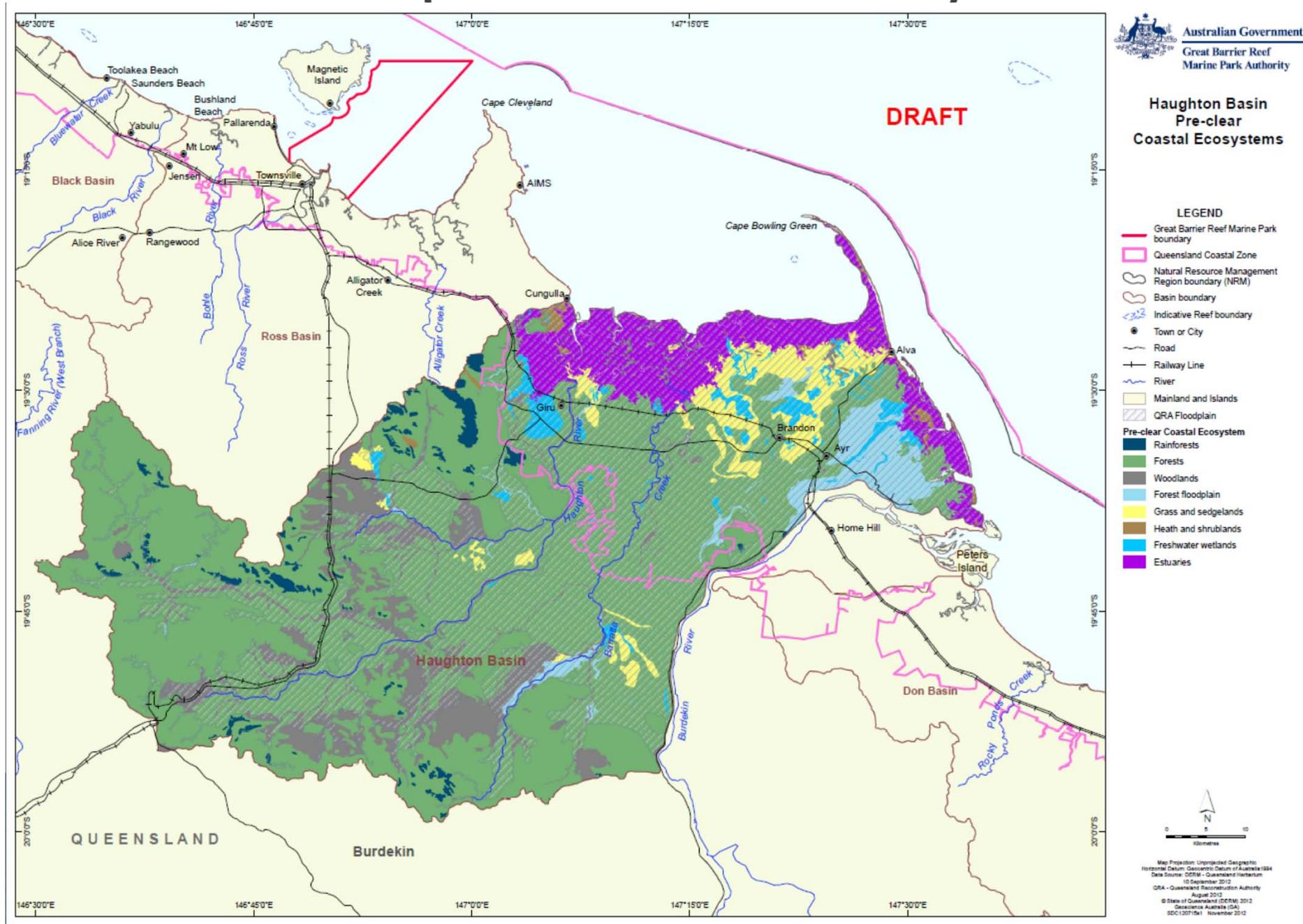
Management Practices Affecting Floodplain Coastal Ecosystems

On Farm Practices

- ▶ The majority of the LBF is private freehold cane farmland.
- ▶ Management practices that individuals pursue on their 'farm' including for non-production areas such as remnant habitat have a major cumulative impact on the status and functioning of the LBF system as a whole.
- ▶ Off-farm losses of water, nutrients and pesticides continue to be a major source of coastal ecosystems impact and condition decline. Evidence includes farm and sub catchment irrigation tailwater flow volumes and deep drainage losses to aquifers, wetlands and estuaries, and recorded nutrient and pesticide residue levels including some above ANZEC water quality guidelines in farm tailwater, aquifers, streams, estuaries and near shore areas of the lower Burdekin
- ▶ The contemporary pattern of land use on the floodplain comprised of a subdominant extent of remnant coastal ecosystems and their capacity to physically and bio-geochemically process nutrient and other contaminant loads from the larger area of agricultural production systems is likely to be continually overwhelmed unless these losses are minimised to the greatest extent possible.
- ▶ On farm practice issues are not only concerned with cane production but also non production areas.
- ▶ Non-production areas of farms include natural drainage lines and remnant riparian, wetland and floodplain habitats. Management practice issues in these areas concern native vegetation and biodiversity, fire regime, weeds and run off management.



Status Floodplain Coastal Ecosystems



Status Floodplain Coastal Ecosystems



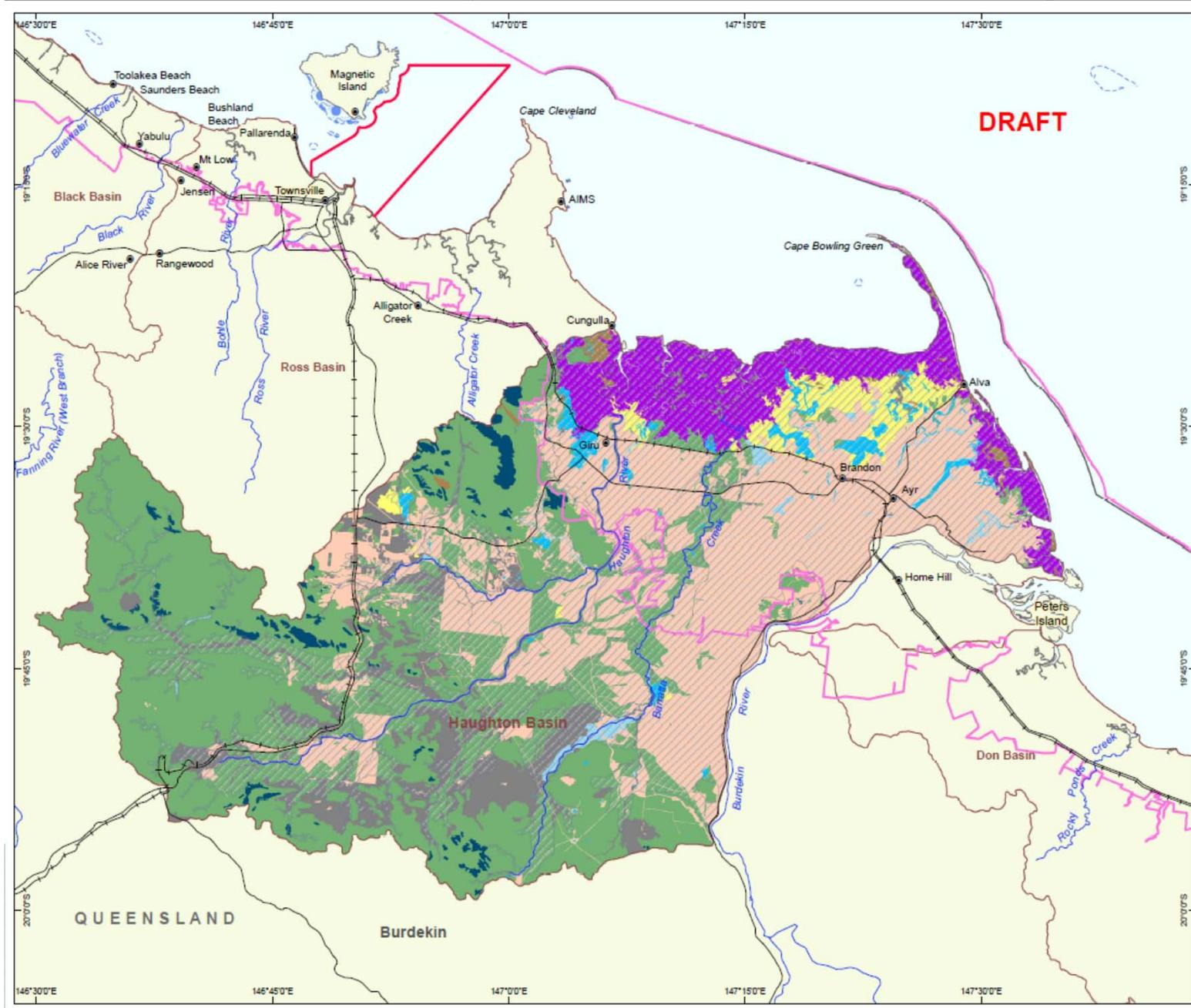
Haughton Basin Coastal Ecosystems 2006

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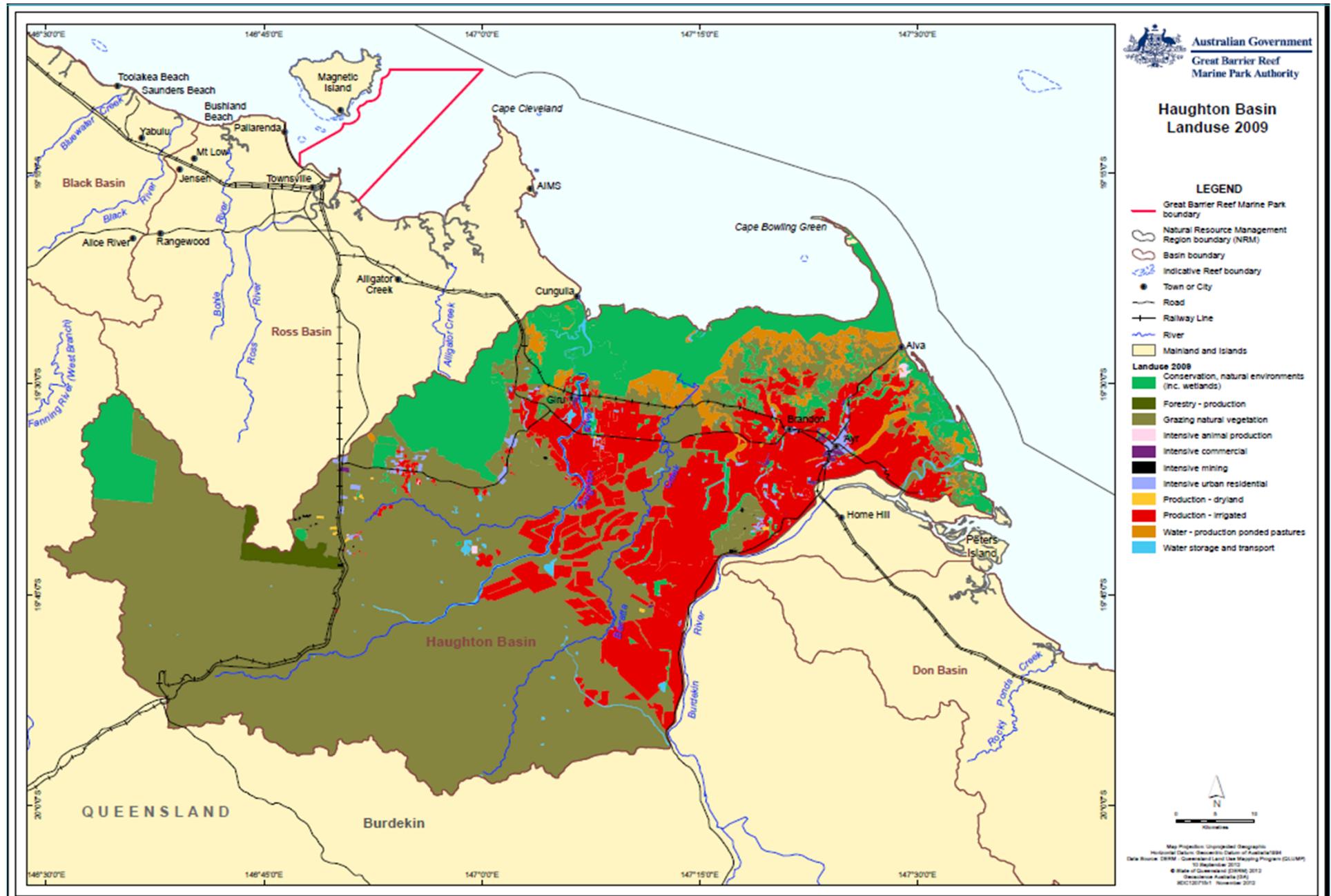
- LEGEND**
- Great Barrier Reef Marine Park boundary
 - Queensland Coastal Zone
 - Natural Resource Management Region boundary (NRM)
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 - Road
 - + Railway Line
 - River
 - Mainland and Islands
 - QRA Floodplain
- Coastal Ecosystems 2006**
- Rainforests
 - Forests
 - Woodlands
 - Forest floodplain
 - Grass and sedgelands
 - Heath and shrublands
 - Freshwater wetlands
 - Estuaries
 - Non-Remnant



Map Projection: Unprojected Geographic
 Horizontal Datum: Geocentric Datum of Australia 1984
 Data Source: 2006 - Queensland Herbarium
 QRA - Queensland Reconstruction Authority
 August 2012
 © State of Queensland (QRM) 2012
 Queensland Australia (QA)
 SC11207161 September 2012



Status Floodplain Coastal Ecosystems



Status of Floodplain Coastal Ecosystems and Service Provision

- ▶ Remnant coastal ecosystems retain important physical, biogeochemical and biological functional values
- ▶ Under a high level of stress due to the dominating influence of the larger extent of irrigated production system = **NOW THE DOMINANT 'COASTAL ECOSYSTEM'**
- ▶ Systemic alteration of floodplain hydrology
 - large aseasonal flows of irrigation scheme tailwater
 - aquifer recharge operations
 - rising groundwater levels
 - areal drainage schemes
- ▶ High export of nutrients, pesticides and sediment occur in association with water movement from production systems to receiving coastal ecosystems
- ▶ Pervasive threats posed by weeds (terrestrial and aquatic) and a hot fire regime.



Status of Floodplain Coastal Ecosystems and Service Provision

Freshwater wetlands

- ▶ *water logged,*
 - ▶ *lost seasonality*
 - ▶ *Ecosystem structure /function changing*
weed infestations and fire regimes
 - ▶ *contaminant loading*
 - ▶ *poor reach condition associated water*
quality decline
 - ▶ *Loss of physical, biological and*
biogeochemical process function
- 

Status of Floodplain Coastal Ecosystems and Service Provision

Estuarine wetlands

- ▶ *subject to elevated and perennial versus historically seasonal freshwater inflows*
- ▶ *weed infestation and water quality decline in upper reaches – connectivity barriers*
- ▶ *nutrient and agric-chemical contaminant loading*
- ▶ *Loss of physical, biological and biogeochemical process function*



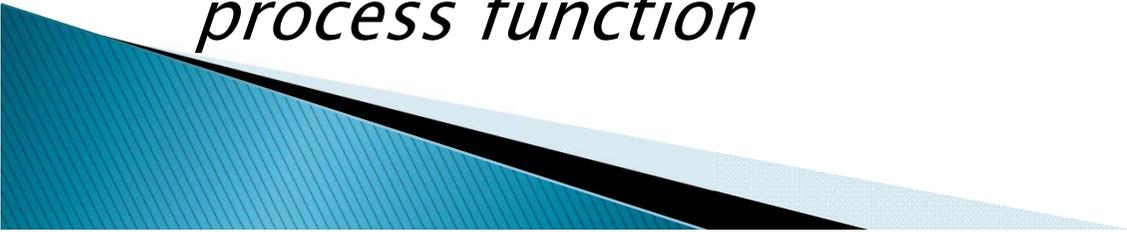
Status of Floodplain Coastal Ecosystems and Service Provision

Grasslands & Sedgeland (e.g. bulkuru)

- ▶ *Tidal sedgeland areas banded, anoxic, subject to elevated and perennial versus historically seasonal freshwater flows /hydrology*
 - ▶ *Grassland floodplains circumvented by areal drainage networks, invaded by exotic species*
 - ▶ *Loss of physical, biological and biogeochemical process function*
- 

Status of Floodplain Coastal Ecosystems and Service Provision

Woodlands and Forests

- ▶ *Extensively cleared developed to agriculture, isolated remnants subject to pests, edge effects*
 - ▶ *Floodplain forests circumvented by areal drainage networks, invaded by exotic species*
 - ▶ *Exotic grass understorey, high fuel load hot fires leading to simplified structure*
 - ▶ *Tailwater and groundwater rise driven water logging*
 - ▶ *Loss of physical, biological and biogeochemical process function*
- 

Status of Floodplain Coastal Ecosystems and Service Provision

Groundwater Systems

- ▶ *Sustained rise through significant areas BHWSS and some Delta areas threaten to extinguish the non-saturated soil zone*
 - ▶ *thousands of hectares potentially subject to waterlogging and/or salinity degradation*
 - ▶ *affected floodplain could include significant areas of remnant woodland and wetland habitat*
 - ▶ *Loss of physical, biological and biogeochemical process function*
- 

Ways Forward to Improve Coastal Ecosystem Services

A review of management arrangements across the entire GBR catchment conducted for the GBRMPA Outlook Report found development and land use impacts to coastal ecosystems resulted primarily from a lack of:

- ▶ integrated planning;
- ▶ resources;
- ▶ enforcement; and,
- ▶ failure to adequately address cumulative impacts.

The review of management arrangements on the Lower Burdekin Floodplain reiterated these findings.

Aliments confronting LBF coastal ecosystem health are also linked to other systemic and compounding origins that include:

- ▶ conflicted roles of Government in the history of lower Burdekin floodplain and irrigation management including as irrigation scheme developer, corporate water seller and environmental regulator / natural resource manager;
 - ▶ absence of management arrangements at a floodplain system scale and an appropriate management body with broad stakeholder support, authority and lead responsibility for ensuring floodplain ecosystem sustainability; and
 - ▶ lack of a collective vision across stakeholders as to what constitutes an integrated management blueprint for a sustainable Lower Burdekin Floodplain ecosystem.
- 

Ways Forward to Improve Coastal Ecosystem Services

Addressing Water Management Needs

Floodplain is 'awash' in too much water!!

- ▶ Removing Perverse Incentives
- ▶ Increasing Conjunctive Use and Efficiency
- ▶ Utilising Environmental Management Capacity of Regulatory Framework
 - ecosystem monitoring and triggers in ROPS
 - Catchment /farm /soil type specific WUE targets
 - Groundwater behaviour linked surface water managment
- ▶ Appropriate Management Organisational Vehicle with Lead Responsibility – Floodplain is holistic system – needs holistic integrated management



Ways Forward to Improve Coastal Ecosystem Services

Information Sharing and Capacity Building

- ▶ Information Brokering – so much study, information rich but stakeholder access hard... need a BRIC?
- ▶ Information Driven Management Mechanisms – actions supposedly controlled by legislation need to have access to ecosystem/species information – underpin development planning
- ▶ Local Stakeholder Access to Monitoring Data and Modelling Tools – out of agency and into individual stakeholder/industry hands!!
- ▶ Extension Services – reinvest, build capacity



Ways Forward to Improve Coastal Ecosystem Services

Protecting Assets, Managing Threats and Restoring Ecosystems and Processes

Protection of Assets

1. *Woodhouse – BRIA/BHWSS – Jerona – Barratta Creek Habitat*
2. *Majors – Double Creek riparian corridor – High integrity linkage to Mt Elliot National Park*
3. *St Margaret's to Palm Creek Riparian corridors and alluvial remnants.*
4. *Burdekin Delta Coastal Margins*
5. *Cassidy Creek and Stokes Creek corridors between Stokes Range and Burdekin River (southern margin southern floodplain)*
6. *Floodplain Distributary Stream Remnant Habitats – Collinsons Lagoon, Kalamia, Sheep Station, Plantation, Ana-Branch, Iyah and Saltwater Creek catchments.*
7. *Floodplain periphery Lagoons Inkerman Station, 8-Mile Creek Dalbeg, Swans Lagoon Millaroo*
8. *Floodplain periphery river levee forests, woodlands and drainage lines*
9. *Mt Kelly node*
10. *Mt Inkerman–Mt Alma to Grouper Creek Corridors*
11. *Alva Beach to Lochinvar Coastal Swamps*



Ways Forward to Improve Coastal Ecosystem Services



Protecting Assets, Managing Threats and Restoring Ecosystems and Processes Threat Management

- ▶ *African understorey Australian Overstorey*
- ▶ *Improving On farm practices to reduce Off farm impacts – role for local subcatchment monitoring and peer review*

Ways Forward to Improve Coastal Ecosystem Services

Protecting Assets, Managing Threats and Restoring Ecosystems and Processes

Restoration of Ecosystems

- ▶ Revegetation of functional landscape elements – wetland detention basins, riparian systems including farm drainage systems
- ▶ Re-instating tidal Ingress and seasonality to bunded Coastal Wetlands
- ▶ Addressing Fish Passage Barriers. There are four generalised classes of fish passage barrier identified on the Lower Burdekin Floodplain:
 - Poor stream reach conditions defined by weed infestation / low dissolved oxygen;
 - Road and rail bridge infrastructure;
 - Small scale water infrastructure i.e. Burdekin Water Board – flow gates, drop boards, sand dams; and
 - Large water infrastructure i.e. Sunwater – weirs and dams.



Ways Forward to Improve Coastal Ecosystem Services

Managing for Ecosystem Function and Values in the Modified Landscape

- ▶ **Irrigated Agriculture the Dominant ‘Coastal Ecosystem’**
 - Needs to provide bigger share of ecosystems services originally provided by coastal ecosystems – reduced leakiness of nutrients, water, sed
 - pattern of drainage – vegetation interception – detention – drainage – vegetation interception–detention could be established on the LBF at primary, secondary and tertiary scales
- ▶ **Aquatic Weeds – Addressing Symptoms in Lieu on the Cure – maintain control programs**
 - – maintenance cost for industrial landscape
- ▶ **Setting Functional cf. Historical Ecosystem Restoration Targets**
 - Make the ecosystem work not necessarily with ‘original parts’
- ▶ **Finding Connectivity ‘*Short Cuts*’**
 - Bypass the cesspools – can make access for water, do the same for fish!
- ▶ **Restoring Hydrological Variability and Function to wetlands**
 - Pumped Flood Flow
 - Hydrological Isolation

Resourcing ‘On Country’ Management

- Fire Management a Burning Need
- Weeding the Burdekin Floodplain



Ways Forward to Improve Coastal Ecosystem Services

An Implementable Integrated Management Vision a 'Floodplain Landscape Blueprint'

- Lower Burdekin Floodplain is ultimately one integrated system
- Changes to one component of the system affect other components of the system through material and energetic linkages
- An integrated management strategy needs to be developed and owned by the community
- Need a visioning exercise that goes beyond motherhood statements to an actual model or 'blueprint' of landscape geography and management systems
- must also not be static consider land use and environmental changes over decadal time scales, potential changes in land use pattern, responses to varying sustainability challenges, production goals and coastal ecosystem responses to emerging threats posed by climate change and sea level rise
- Imbed and support via statutory planning processes – local, state commonwealth
- Identifying an appropriate organisational vehicle to lead the development of an implementable vision is the first challenge

