



Department of
Environment and Conservation

Contemporary Pressures and Science Gaps in the Pilbara region

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Current development pressures

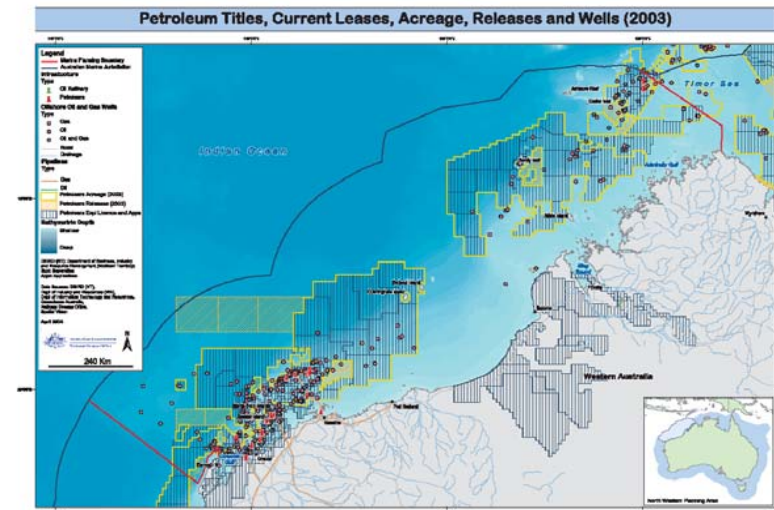
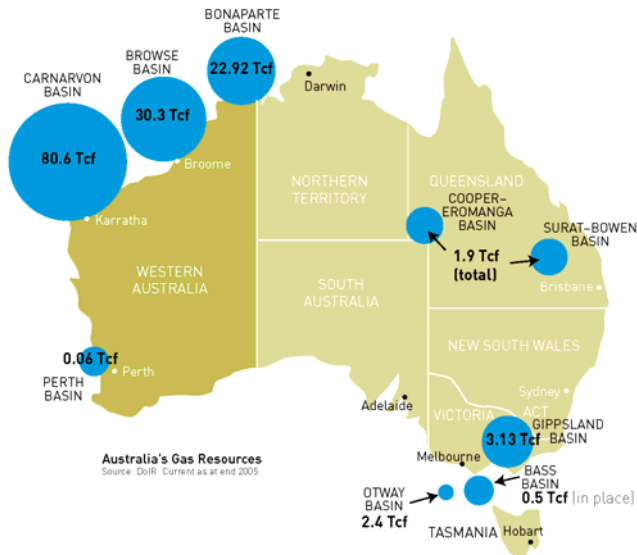
- Port development/expansion for minerals
- LNG processing & export facilities
- Salt works





Petroleum

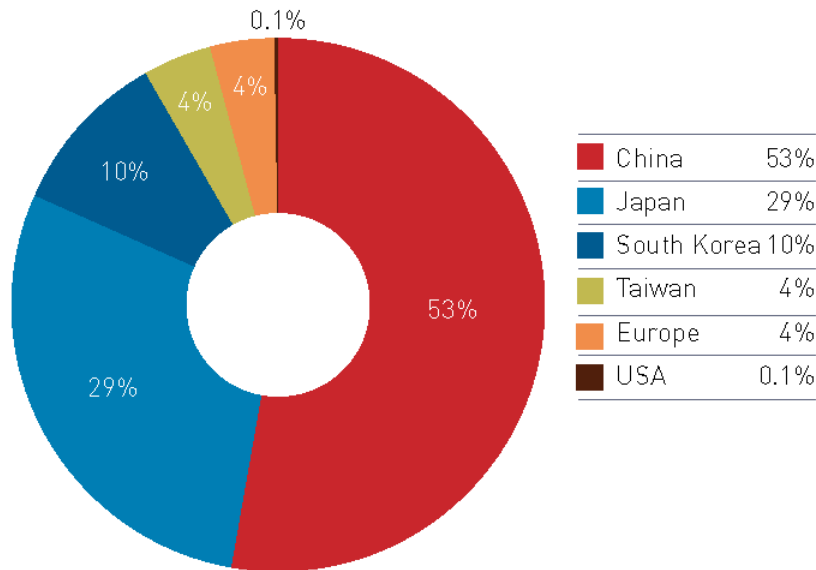
\$35.4 billion of marine related projects in the oil, gas and condensate sector alone.





Iron Ore

A projected a shortfall in port capacity of 300 Mt pa.



Iron Ore Exports. Total value \$12.73 billion



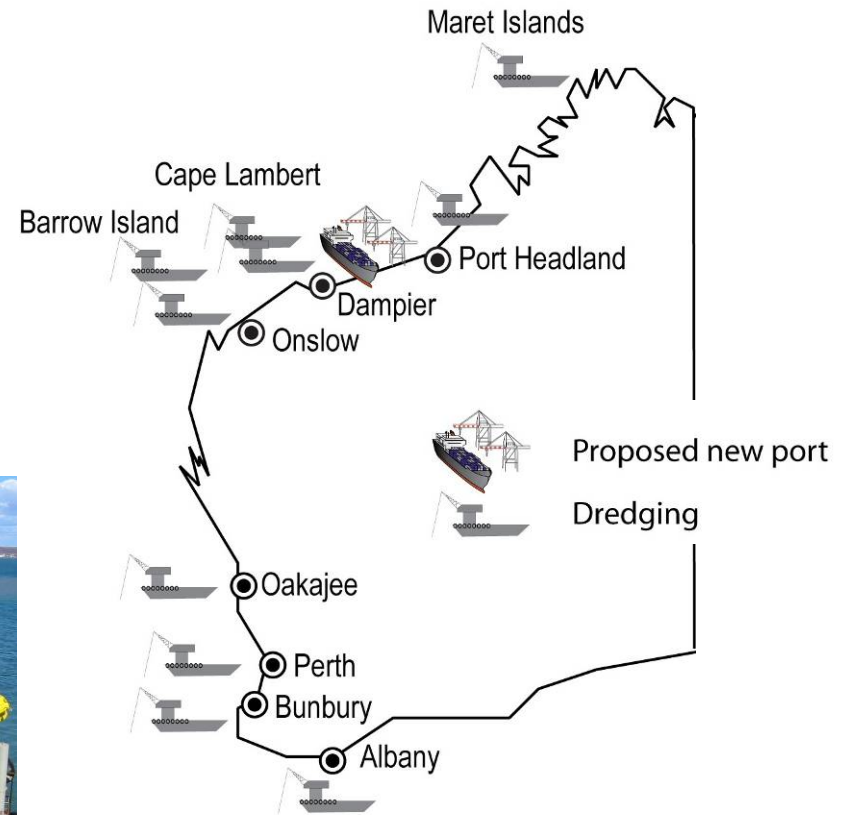
Figure 23 | Iron Ore Price A\$/Fe unit
Source: Tex Report, High Grade Fine Ore Prices





Key Issues

- Infrastructure development
- Dredging & filling (reclamation)
- Wastewater discharges

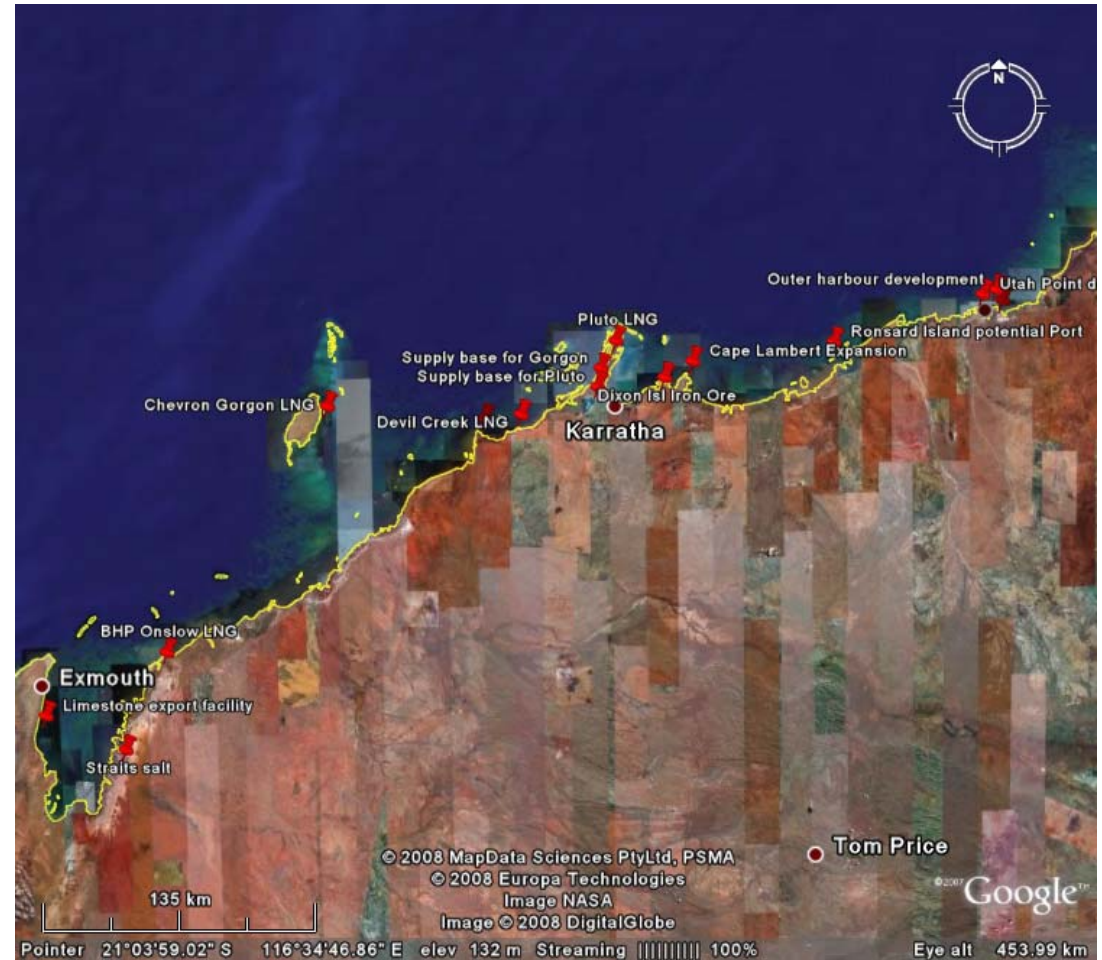




Projects

- Exmouth Gulf Straits salt
- Exmouth Limestone loadout
- Onslow BHP LNG
- Barrow Is. Chevron Gorgon LNG
- Cape Preston Iron Ore Port
- Apache Devil Creek LNG
- Gorgon Supply base
- Pluto Supply base
- Woodside Pluto LNG
- Dixon Island Iron Ore Port
- Cape Lambert Iron Ore Port
- Ronsard Island Iron Ore Port
- Port Hedland Outer harbour
- Utah Point Mineral export
- Offshore seismic, drilling, upstream processing, Oil/gas/condensate

Mm³
 ~0.15
 ?
 10-20?
 12
 8-14?
 n/a
 <0.1?
 <0.1
 12
 10-20?
 8-12
 10
 30-60



Range: approx **100-160** million m³ of dredging and spoil disposal





Marine Environmental Impact Assessment and Management

- EIA and management relies on predictions of environmental impacts
 - What will be impacted?
 - What won't?
- Considerations
 - Where are the sources of predictive uncertainty?
 - What is the level of confidence in predictions?
 - What are the implications for the environment, and the proponent, of getting it wrong?
- Predictions and management should be informed by robust targeted science





Marine Environmental Impact Assessment and Management

- Scope to manage the direct construction-related impacts of a large scale development is limited
- Different to adaptive management of activities like fishing
- Emphasis on
 - iterative design
 - reducing predictive uncertainty, and
 - identifying and applying early warning indicators to trigger management





Basis of Predictions

- Cause-effect pathways
- Link activity to potential environmental impacts
- Understand the activity
- Understand the environmental setting
- Understand response of biota





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- Example - large scale capital dredging





Approach to Impact Prediction

A 3-step approach

- hydrodynamic modelling
- transport modelling
- ecological impact modelling



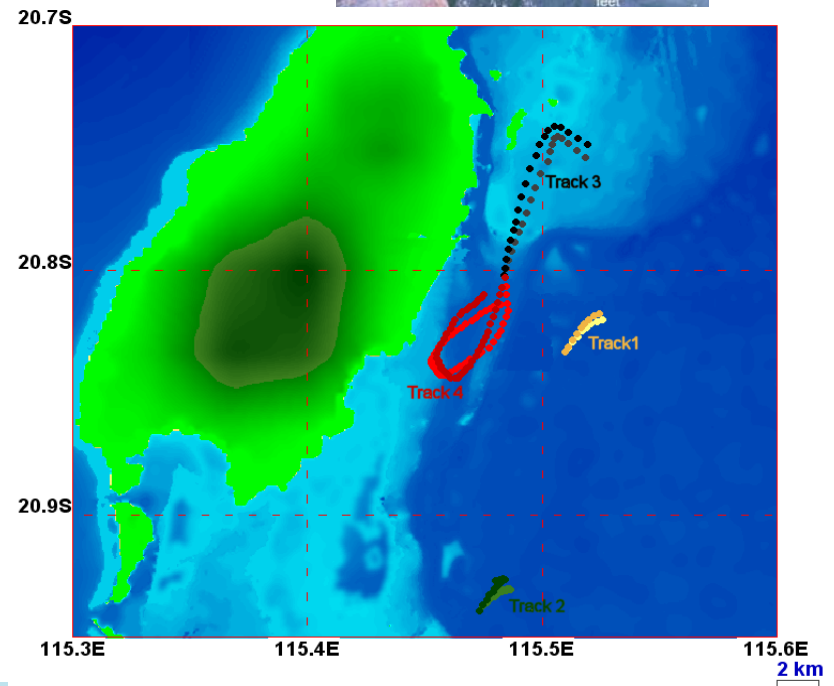


Hydrodynamic modelling

- Models **well developed**
 - require site-specific forcing data
 - good quality bathymetry at appropriate resolution
- Boundary conditions
 - waves, regional currents
- Current meter data from the site
 - for calibration to tune model
 - for validation to appraise 'confidence'



U.S. Geological Survey





Transport modelling

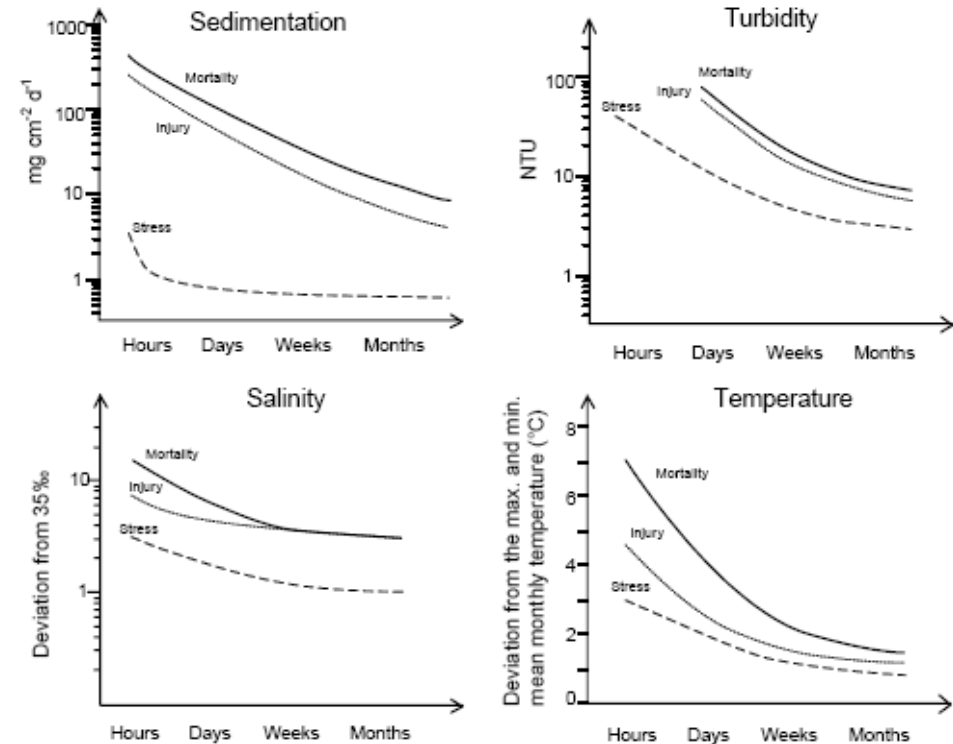
- Models **less well developed**
- Rely on sediment source characterisation
 - Geotechnical data for material to be dredged
 - Type of dredge plant
 - Mode of operation
- Sediment deposition and re-suspension
 - Particle behaviour
 - Aggregation
 - Waves and tidal currents





Ecological impact prediction

- Models **poorly developed**
- Rely on stress thresholds for key biota
- Many variables
 - Seasonality of impact
 - Severity and intensity
 - Vulnerability/resilience
 - Life stage(s)
- Corals?



From Gilmour *et al.*, (2006)



Considerations

- Differential susceptibility/resilience
 - *Porites*, *Acropora*, turf algae
 - intensity and duration of impact
 - timing of impact
- Species vs communities
 - population and community structure
 - K vs r - strategists
- Recovery potential
 - recovery pathways
 - life cycle processes/inter-species competition
 - alternative state?





Information gaps

Environmental Modelling

- composition and distribution of benthic communities
- physiological requirements
- environmental tolerances
- sediment in water column
 - PAR availability
 - Clogging/abrasion
- deposited sediment
 - survival and growth
 - recruitment

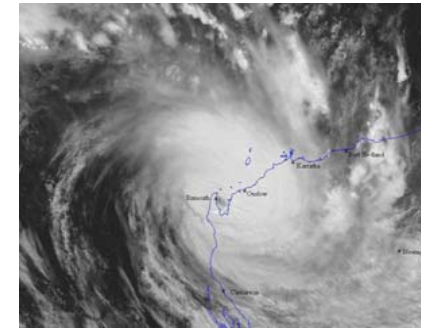




Information gaps

Project design and Impact prediction

- susceptibility of dominant benthic communities (which are most sensitive and should be avoided)
- resilience of the dominant benthic communities (which are least sensitive and can withstand greater levels of pressure than others)
- Does resilience/susceptibility vary with season, reproductive status, age (used to time dredging to minimize impact)





Information gaps

Impact management

- primary and secondary indicators of sub-lethal stress
 - (for monitoring and management program design)
- levels/duration of pressure associated with the primary and secondary indicators of stress
 - (useful for establishing alert and action criteria)



Information gaps

Impact management (cont.)

- What is the duration of pressure that is tolerable before the primary and secondary indicators of stress are exceeded
 - (temporal component of alert and action management regimes and criteria to recommence dredging after management intervention)
- What are the pathways of recovery and how long does it take
 - (post development monitoring and project closure plans)

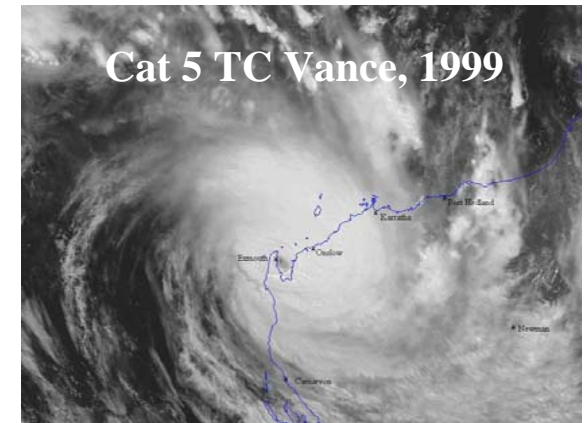




Information gaps

What is there now and why?

- Environmental requirements
- Natural tolerances
- Natural variability
- Natural disturbance
- Environmental windows
- Trophic linkages





Information gaps

How will the biota respond to anthropogenic pressures such as turbidity, sediment deposition, thermal and saline discharges?

- Cause-effect pathways
- Sub-lethal stress indicators
- Metrics for those indicators
- Criteria - alert and action triggers
- Standard procedures - effort / surety
- Chronic/repeated impact?
- In a changing climate?

