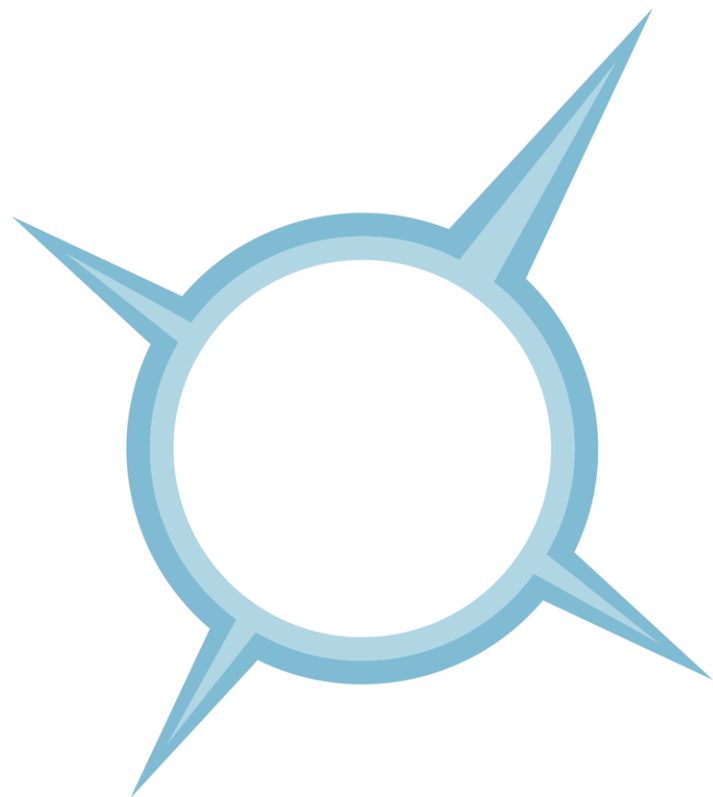




# Proteus Annual Meeting

28<sup>th</sup> - 29<sup>th</sup> June 2016

David Attenborough Building, Cambridge, UK



ExxonMobil



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# An integrated approach to operational resilience – trends, drivers and opportunities

A role for EbA?

John Firth, CEO, Acclimatise Group Ltd

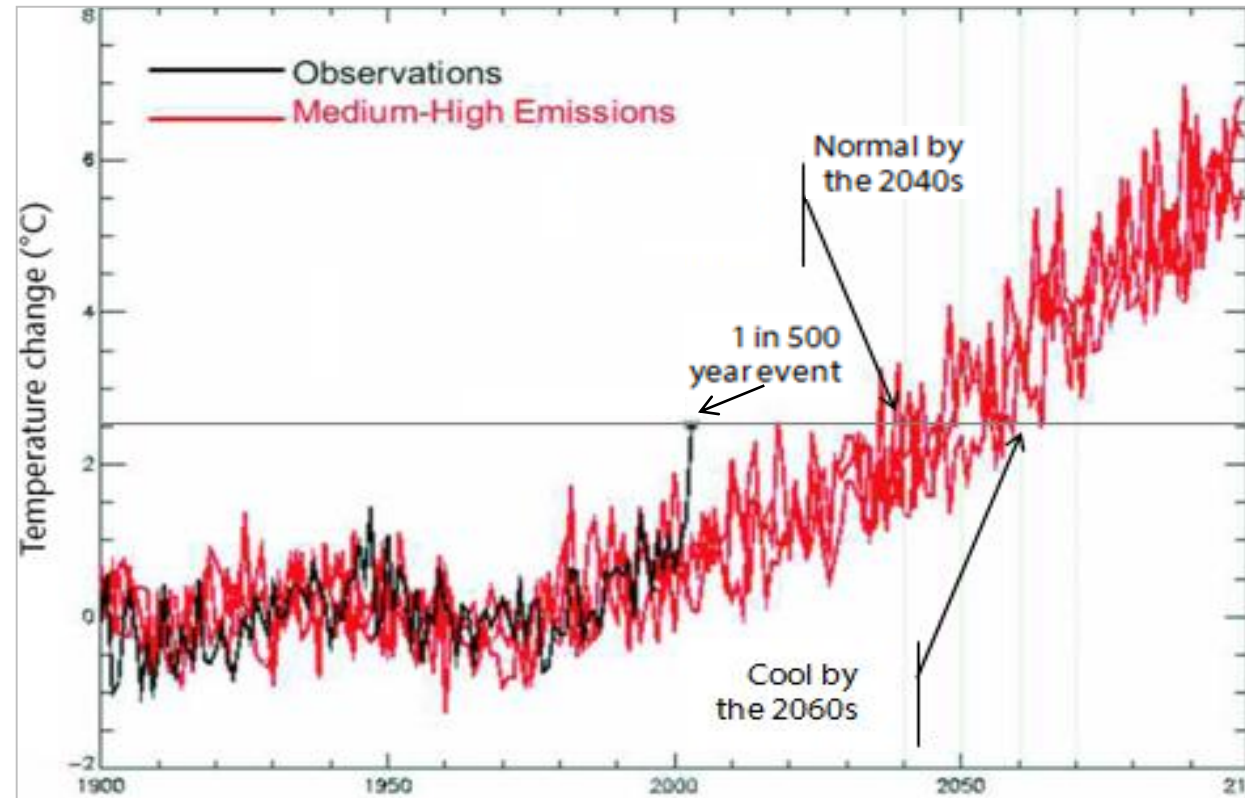
29 June 2016

# Impact of slow-onset/incremental and extreme events from a changing climate

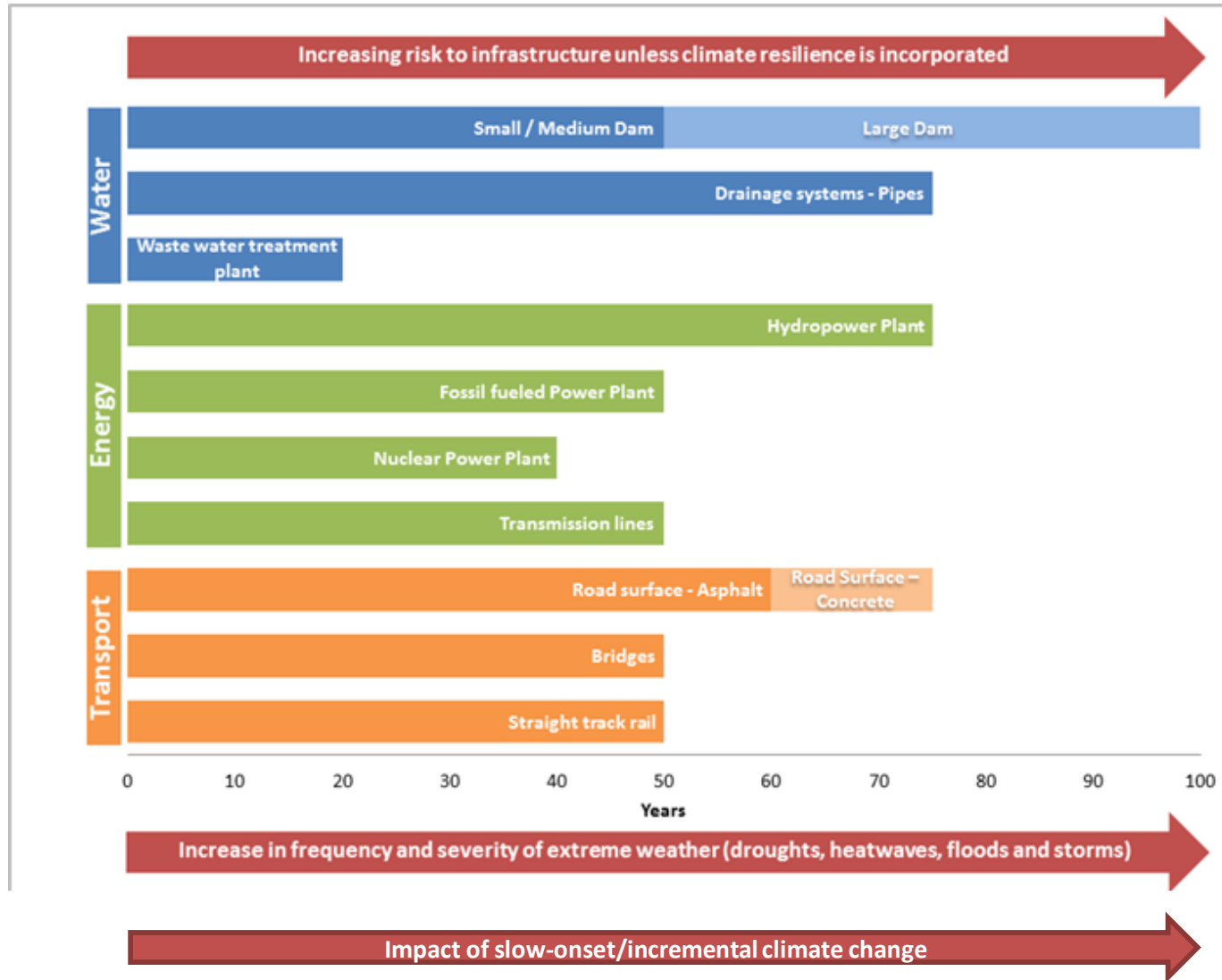


## Europe summer 2003 heatwave

- Unforeseen risks categorized under **“force majeure”**
- Today’s extreme weather events tomorrow’s **new normal**
- Force majeure clauses **do not adequately capture** changing climate risks



# Infrastructure lifespans and climate change timescales



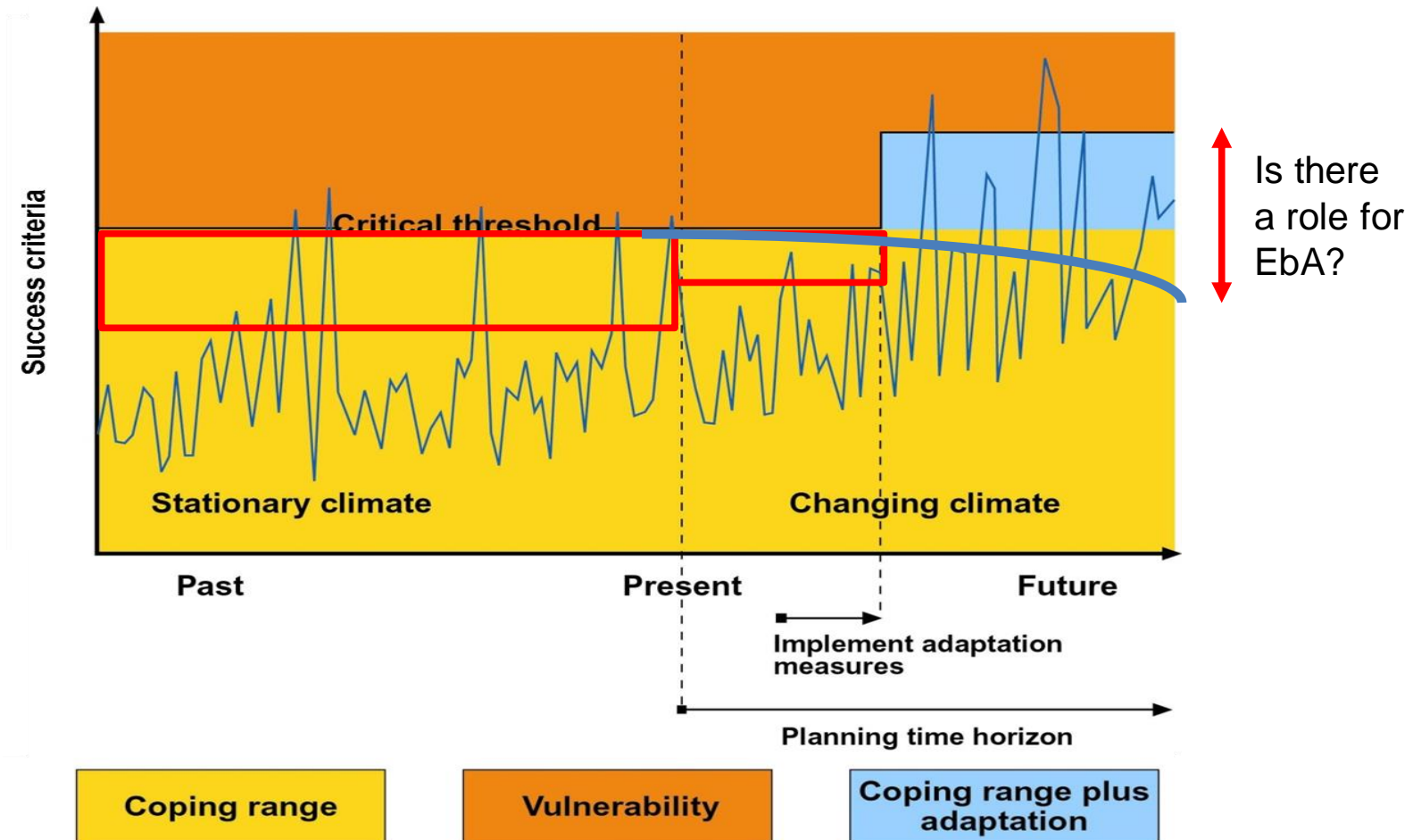
# Climate change impacts on infrastructure



- Affects supply of, and demand for infrastructure services
  - **Asset damage** and deterioration; **reduced asset life**
  - Increased **OPEX** and **CAPEX**
  - **Disruption** to service provision
  - **Loss of income**
  - Increased risks of **environmental damage** and litigation
  - **Reputational damage**
  - **Changes in market demand** for services
  - **Increased insurance costs** or **lack of insurance availability**



# Thresholds



Adapted from Willows, R.I. and Connell, R.K. (Eds.). (2003). *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report. UKCIP, Oxford.

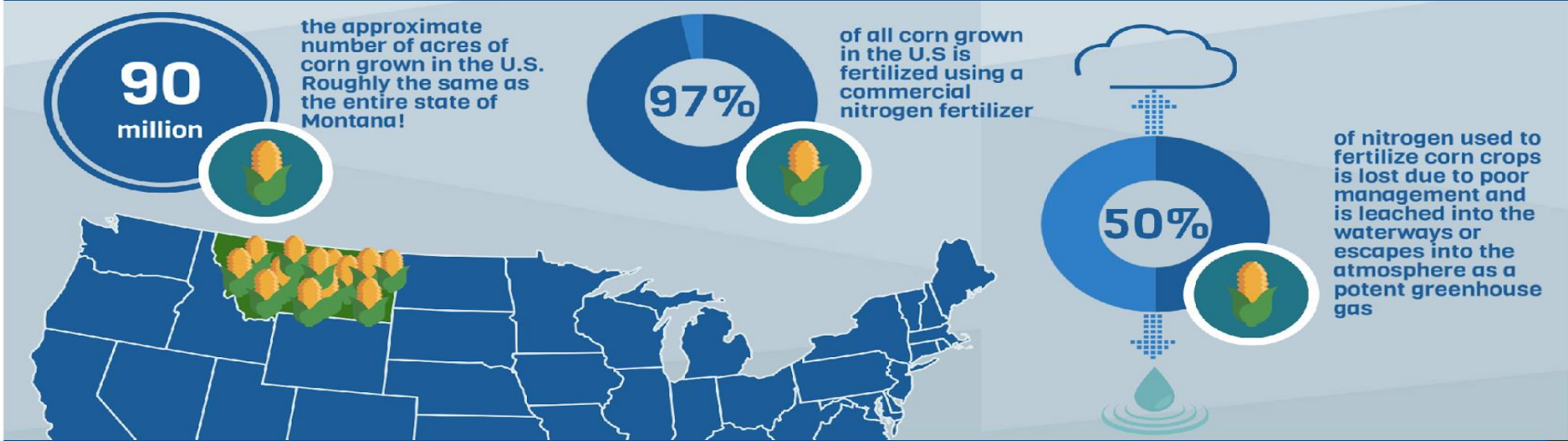
# Decommissioning and contingent liabilities



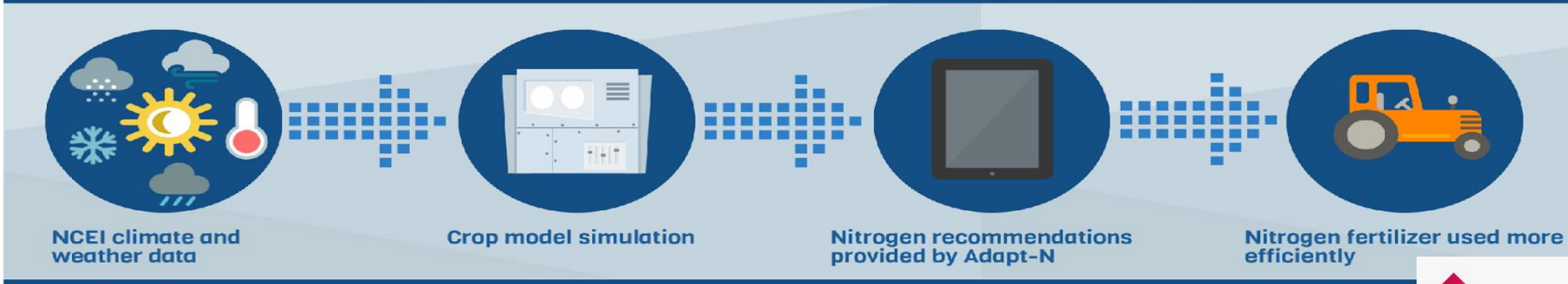
- Decommissioning provisions equate to about 45% of the debt burden for oil and gas companies.
  - A significant financial risk because the majority of cash flows occur at the end of a project's life.
- IFRS (IAS 37) requires a company to recognise a liability as soon as the decommissioning obligation is created, which is normally at the time facility is constructed.
- Limited evidence that companies are assessing and reporting the impacts of changing climatic conditions on the decommissioning costs for their existing and planned assets.
  - If this is correct then companies may be underestimating their future debt liabilities and failing to meet reporting obligations.
- Environmental site protection and reinstatement plans agreed during the licensing and consenting process may not be appropriate in view of the changes in species and habitats during the life of the project.
- Legally binding obligations (supported by bonds and insurance policies) may have been given regarding the decommissioning and restoration of a site and its future use, which may not be achievable. These obligations may need to be re-negotiated.
- Is there a role for EbA (lower CAPEX and OPEX):
  - Reviewing existing decommissioning plans to make up the 'coping range'?
  - Designing new reinstatement plans using EbA to enable plans to respond to a changing climate
  - Meeting corporate governance credentials, fiduciary responsibilities to shareholders, and compliance with IAS37 and regulatory commitments



**NCEI climate and weather data is being used to strengthen America's economy**  
 Here is how it helps corn growers increase profits while decreasing environmental impacts by optimizing nitrogen fertilizer use



**NCEI climate and weather data powers the ADAPT-N tool to help farmers apply just the right amount of fertilizer...**



## ADAPT-N saves farmers money and helps reduce the impact on the environment...



On average ADAPT-N saves farmers \$30 per acre



on average can be saved by a 1000 acre farm each year.

28% of corn production comes from farms larger than 1000 acres



**\$2.7 Billion** could be saved if ADAPT-N was used for all corn in the U.S.

That's enough dollar bills to cover 6400 acres!



Over 2 years of strip-trial testing, Adapt-N reduced fertilizer use 90% of the time



56%



of agricultural green house gas emissions come from Nitrous Oxide. One ton of nitrous oxide is 298 times as potent as one ton of carbon dioxide

Fertilizer is the leading source of water quality degradation to U.S rivers and lakes and the second biggest to wetlands



**\$1.7 Billion**

Current annual cost of removing nitrates due to fertilizer pollution from U.S drinking water supply



# Thank you

Contact details:

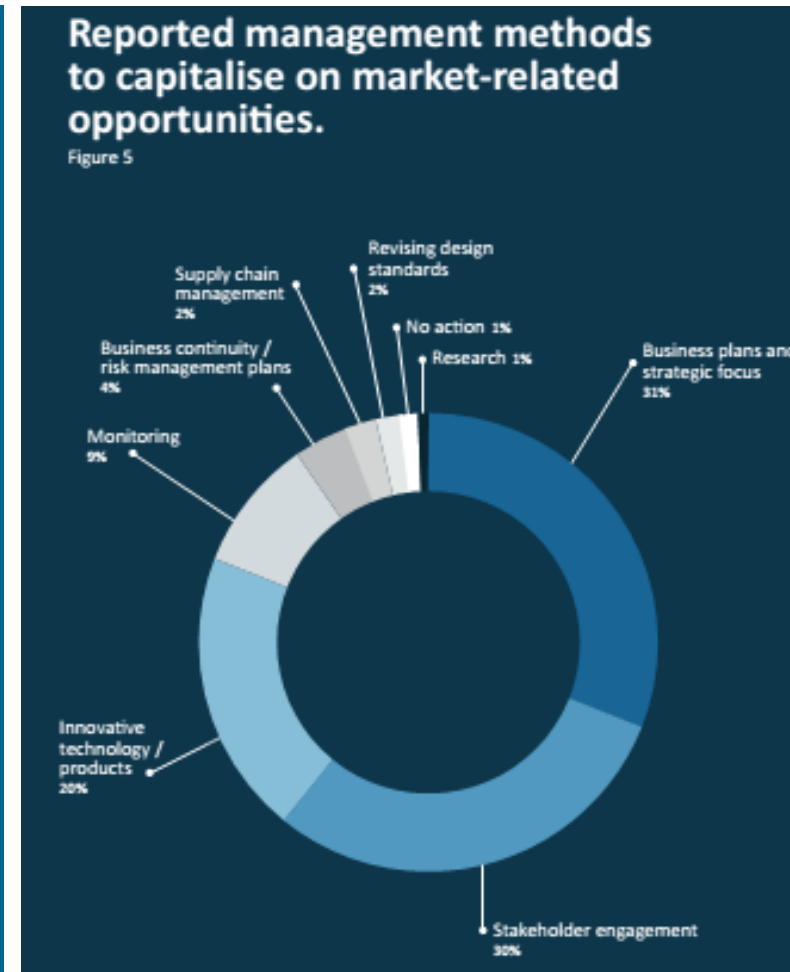
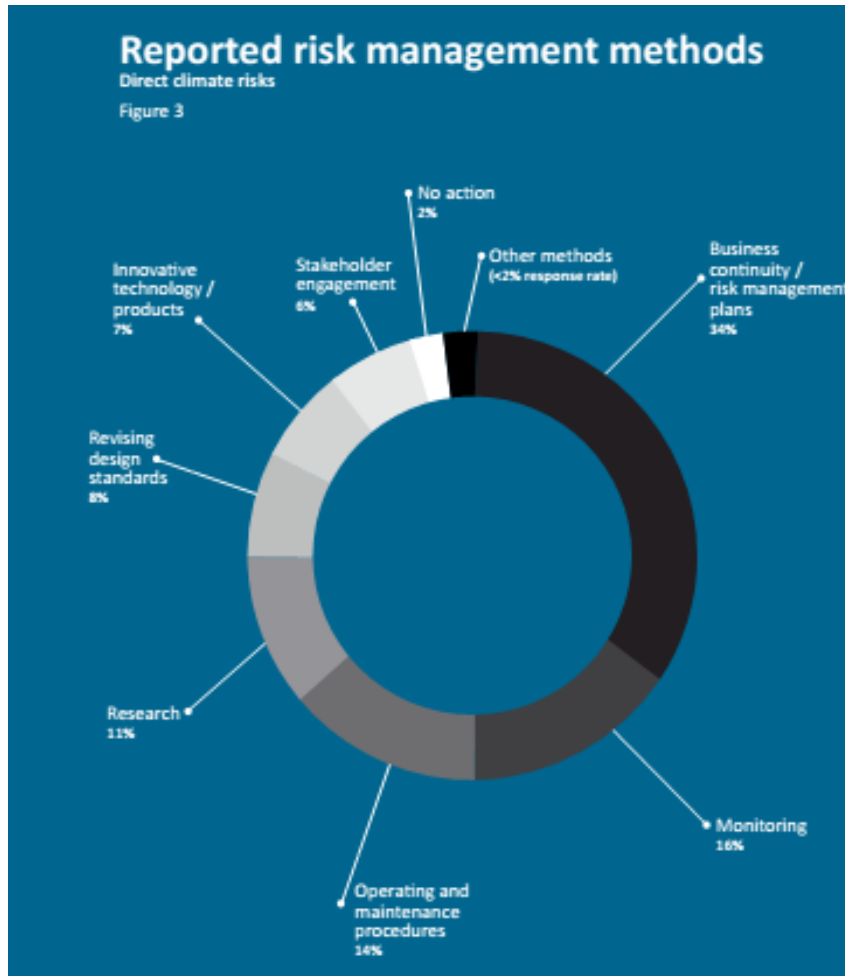
John Firth CEO Acclimatise Group Ltd

[www.acclimatise.uk.com](http://www.acclimatise.uk.com)

[j.firth@acclimatise.uk.com](mailto:j.firth@acclimatise.uk.com)

+44 (0) 7769 706184

# Risk = opportunity

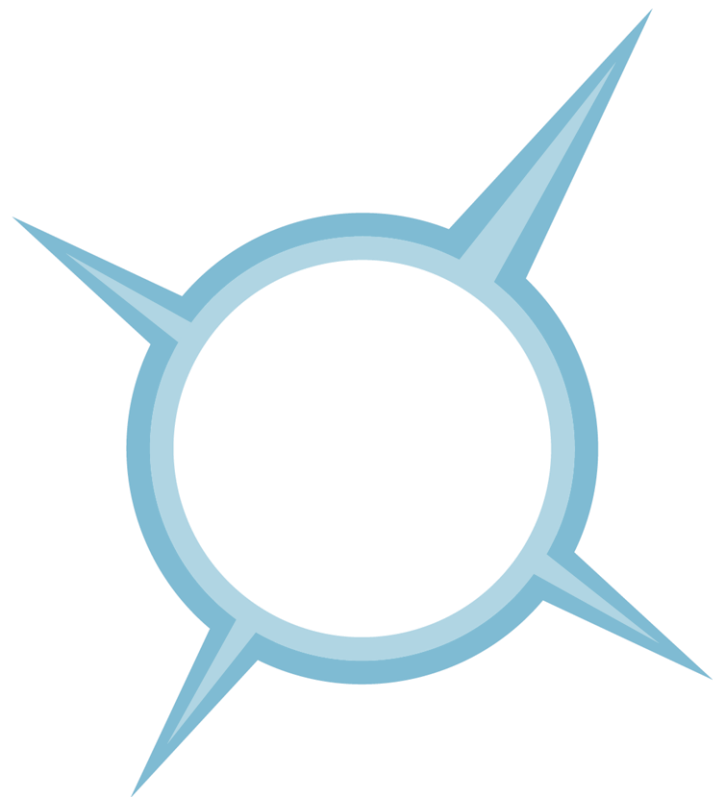




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# Biodiversity data for spill response planning: how much pre-planning is enough?

**Anthony McMullen | 29<sup>th</sup> June 2016**

**Proteus Annual Meeting 2016**



# Disclaimer and important notice



This presentation contains forward looking statements that are subject to risk factors associated with oil and gas businesses. It is believed that the expectations reflected in these statements are reasonable but they may be affected by a variety of variables and changes in underlying assumptions which could cause actual results or trends to differ materially, including but not limited to: price fluctuations, actual demand, currency fluctuations, drilling and production results, reserve estimates, loss of market, industry competition, environmental risks, physical risks, legislative, fiscal and regulatory developments, economic and financial market conditions in various countries and regions, political risks, project delay or advancement, approvals and cost estimates.

All references to dollars, cents or \$ in this presentation are to US currency, unless otherwise stated.

References to “Woodside” may be references to Woodside Petroleum Ltd. or its applicable subsidiaries.

- Use of biodiversity data in planning for spill response
- Driven by external incidents
  - Macondo
  - Montara
- Resulted in substantial change of expectations and perceptions
  - Regulators
  - Government
  - Other stakeholders
- View of likelihood of a spill incident and preparedness of operators
  - Response
  - Determining impacts post spill



Credit: WA Museum

# Our approach – environmental management

## Systematic and risk based approach

- Consistently address and manage any potential environmental impacts and risks associated with our activities and developments
- Focus efforts and resources following an assessment of the likelihood and risk of potential consequences
- Based on solid science

## Seek to understand before we act

- Regulatory regime
- Spatial and temporal environmental sensitivities

## Stakeholder identification and engagement

- Addressing local concerns and issues
- Local expertise input
- Partnerships and transparency



- Montara incident of August 2009
- Findings of the Final Montara Commission Enquiry (2011) led to Government expectations for oil spill environmental monitoring programs.

Broad expectations:

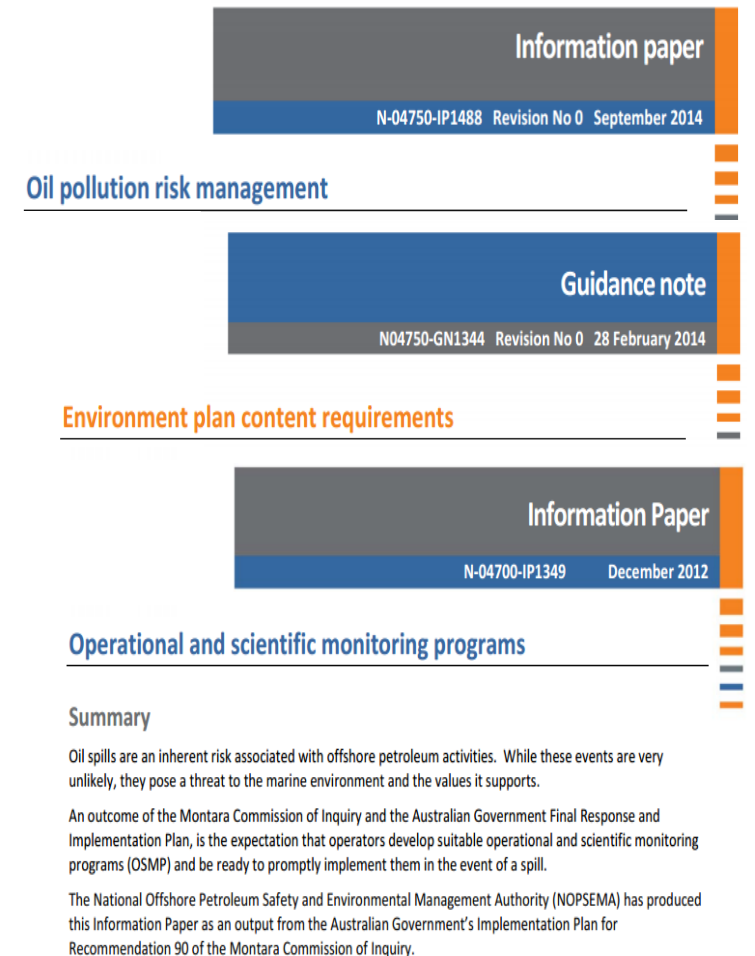
*'...recognises the importance of the prompt implementation of Scientific Monitoring to facilitate the assessment of the environmental impacts of an incident'*

*'... 'off the shelf' monitoring programs should be developed that can be speedily implemented following incidents in Commonwealth waters'*

- Spill response planning under remit of NOPSEMA for petroleum activities
- Introduced requirements for operational and scientific monitoring
  - Operational and Scientific Monitoring Plan (OSMP)



- Prior to any E&P activity, an Environment Plan must be accepted by NOPSEMA, and must include:
  - An Oil Pollution Emergency Plan (OPEP)
  - An Operational and Scientific Monitoring Plan (OSMP)
  - Spill modelling
- Balance between expense associated with groundtruthing all potentially impacted areas and being able to meaningfully respond
  - Right areas
  - Right type of equipment
  - Timely deployment



Information paper

N-04750-IP1488 Revision No 0 September 2014

Oil pollution risk management

Guidance note

N04750-GN1344 Revision No 0 28 February 2014

Environment plan content requirements

Information Paper

N-04700-IP1349 December 2012

Operational and scientific monitoring programs

Summary

Oil spills are an inherent risk associated with offshore petroleum activities. While these events are very unlikely, they pose a threat to the marine environment and the values it supports.

An outcome of the Montara Commission of Inquiry and the Australian Government Final Response and Implementation Plan, is the expectation that operators develop suitable operational and scientific monitoring programs (OSMP) and be ready to promptly implement them in the event of a spill.

The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) has produced this Information Paper as an output from the Australian Government's Implementation Plan for Recommendation 90 of the Montara Commission of Inquiry.

# Environmental setting

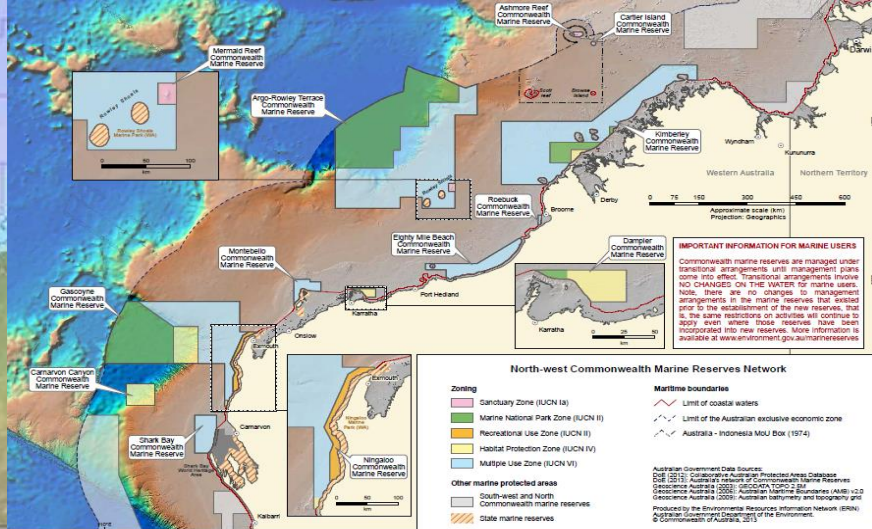
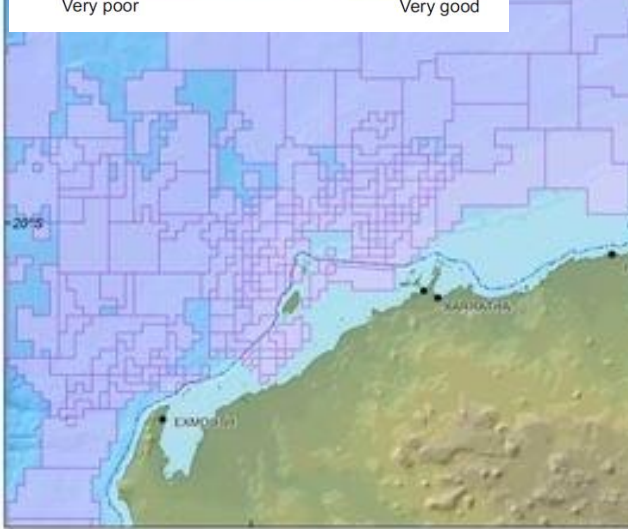
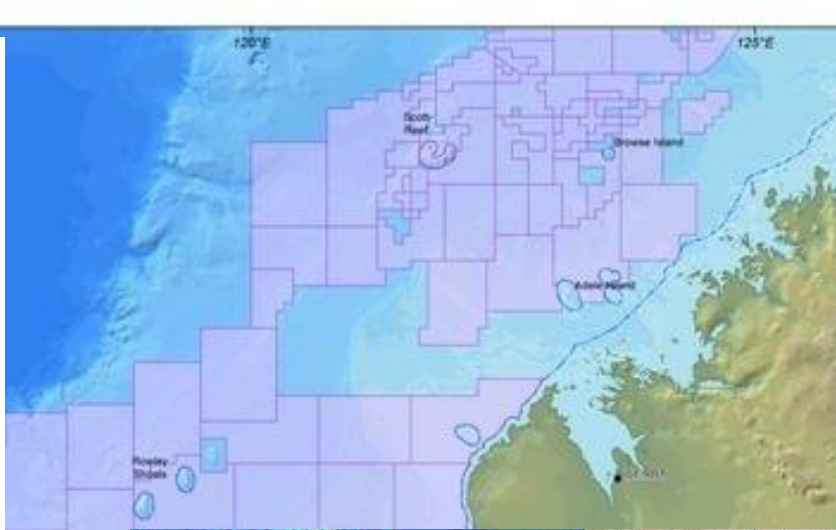
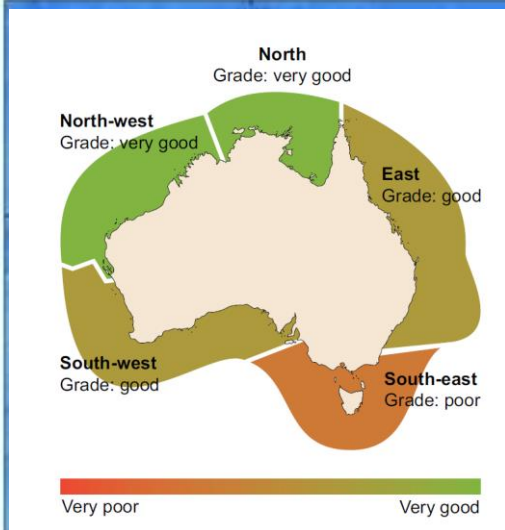


Photo credits:  
Blue Planet  
WA Museum  
Jim Eu



- Focus on better identification of potential zone of impact and potential effect
- Spill modelling
  - Standardisation of modelling software, type and runs
    - Surface expression
    - Entrained and dissolved hydrocarbon
  - Metocean conditions and hydrodynamics
  - Deterministic and stochastic runs
    - Aggregated data to determine potential zone of effect, volume and time to contact
- Impact thresholds
  - Ecotoxicity testing
  - Published data – acute, sublethal
  - Aligned to hydrocarbon type
- Overlay modelling results with known sensitive receptors and habitats and identify priority areas for response
  - Existing data sets

# Why is there a need for monitoring?

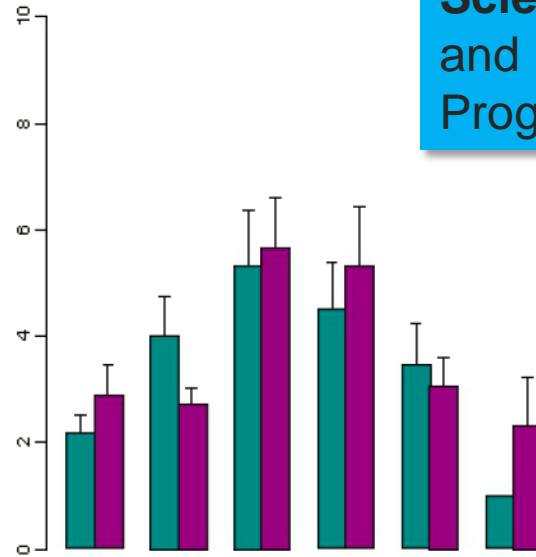
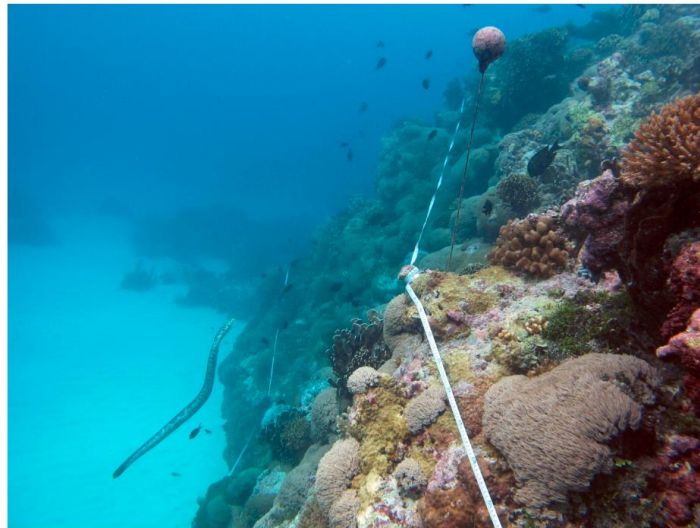
- Satisfy our regulatory requirements
- Maintain social licence to operate
- Need to know the environmental and socio-economic impacts – primary and wider effects
- Communicate the impacts to internal and external stakeholders
- Effective and unambiguous reporting on impacts
- Evaluate and restore damaged natural resources
- Identify timelines and cost of recovery
- Scientific evidence base for discussion on compensation and liability



# What is Operational and Scientific Monitoring



**Operational Oil Pollution Monitoring:** monitoring oil pollution to inform response activities and their effectiveness (Operational Monitoring Programs (OMPs)/environmental monitoring)



**Scientific Monitoring:** monitoring for oil pollution impacts and to inform remediation activities (Scientific Monitoring Programs (SMPs)/ environmental monitoring)

A Heyward et al. 2011; Monitoring Study S6B Corals Reefs, Montara: 2011 Shallow Reef Surveys at Ashmore, Cartier and Seringapatam Reefs. Final Report for PTTEP Australasia (Ashmore Cartier) Pty. Ltd. Australian Institute of Marine Science, Townsville. (163pp.).

What are the challenges to setting up and maintaining oil spill scientific monitoring capability?

- What to monitor?
- How to monitor?
- When to monitor – are baseline data needed?
- Where to monitor?
- Reporting monitoring results



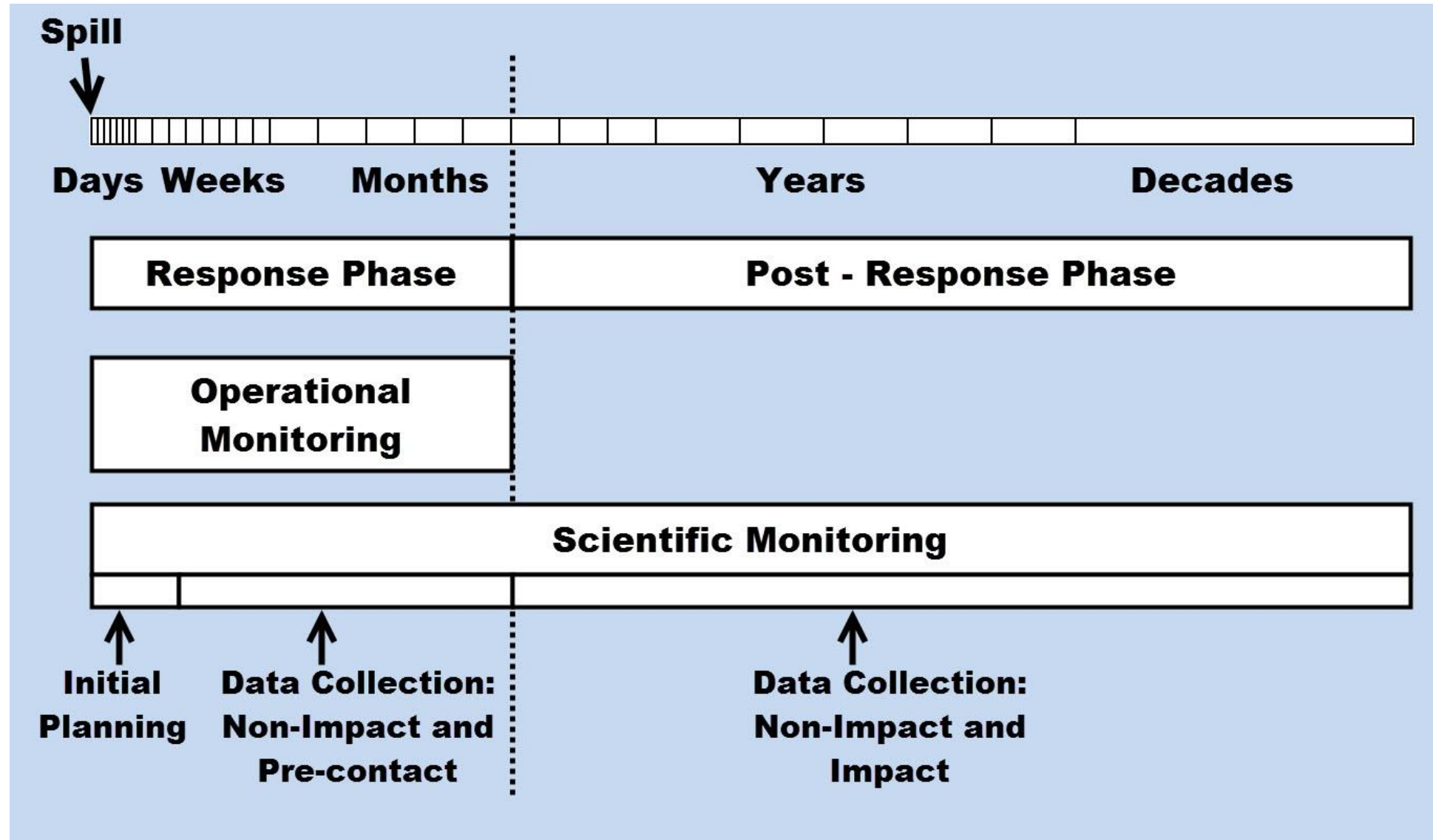
Credit: NOAA's Office of Response and Restoration

# Our approach – what and how



Receptor type	Suitable for IA	Receptor type	Suitable for IA	Receptor type	Suitable for IA

# Our approach – when and where



# Our approach – existing baseline

- Access to environmental knowledge and datasets applicable to oil spill impact assessment
  - IGEM – metadata
  - Proteus and other public domain source
- Regional and habitat level mapping
  - Field based
  - Remote sensing
- Data sharing/ swapping with other operators



# Our approach – obtaining baseline



Baseline acquisition programs carried out at targeted locations based on:

- Existing or planned activities
- Proximity (10's km) to high environmental value receptors with no existing baseline data or the need for an update
- Remote locations with short timeframes to hydrocarbon contact based on oil spill modelling and risk assessments
- Co-funded research where fits with scientific institutions

## Long-term monitoring of shallow water coral and fish communities at Scott Reef 2014

Report prepared by the Australian Institute of Marine Science for  
**Woodside Energy Ltd**  
AS OPERATOR OF THE  
 BROWSE LNG DEVELOPMENT

Authors James Gilmour, Mark Case, Kylie Cook, Marcial Depczynski, Rebecca Fisher, Rachelle Ninio, Marji Puotinen, Ben Radford, Conrad Speed, Paul Tinkler



## NINGALOO & OUTER SHARK BAY BASELINE SURVEY 2014 AIMS FIELD REPORT

AIMS Cruise Nos. 6082 & 6122



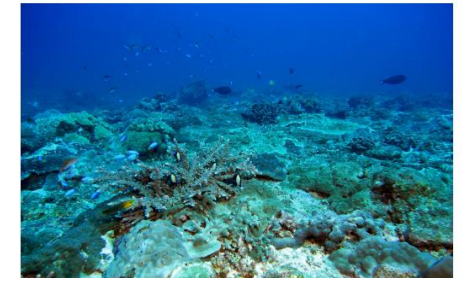
PRODUCED FOR  
**WOODSIDE ENERGY LTD**  
 PURCHASE ORDER NO. 4510321048



December 2014

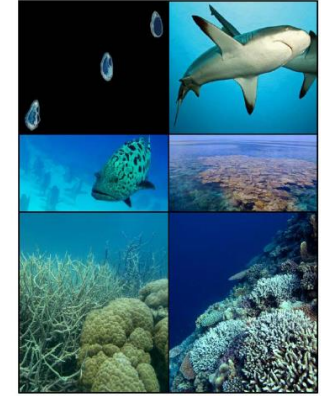
Document Details			
Prepared by:	Karen Miller, Marcial Depczynski, Paul Tinkler	Authorised by:	Steve Rogers
Issue No.	0	Date of Issue	23 December, 2014

## GLOMAR SHOAL & RANKIN BANK ENVIRONMENTAL SURVEY 2013



Long-term monitoring of benthic and fish communities at Rowley Shoals:  
 AIMS/WOODSIDE RESEARCH PROGRAM 2013

Authors: Gilmour JP, Cappel M, Case M, Cook K, Depczynski M, Fisher R, Ninio R, Radford B, Speed CW, and Tinkler P



REPORT PRODUCED FOR  
**WOODSIDE ENERGY LTD**  
 AS OPERATOR OF THE  
 OUTER CANNING JOINT VENTURES  
 WOODSIDE ENERGY LTD PURCHASE ORDER NO 4510262589



PERTH  
 2014

# Our approach – reporting



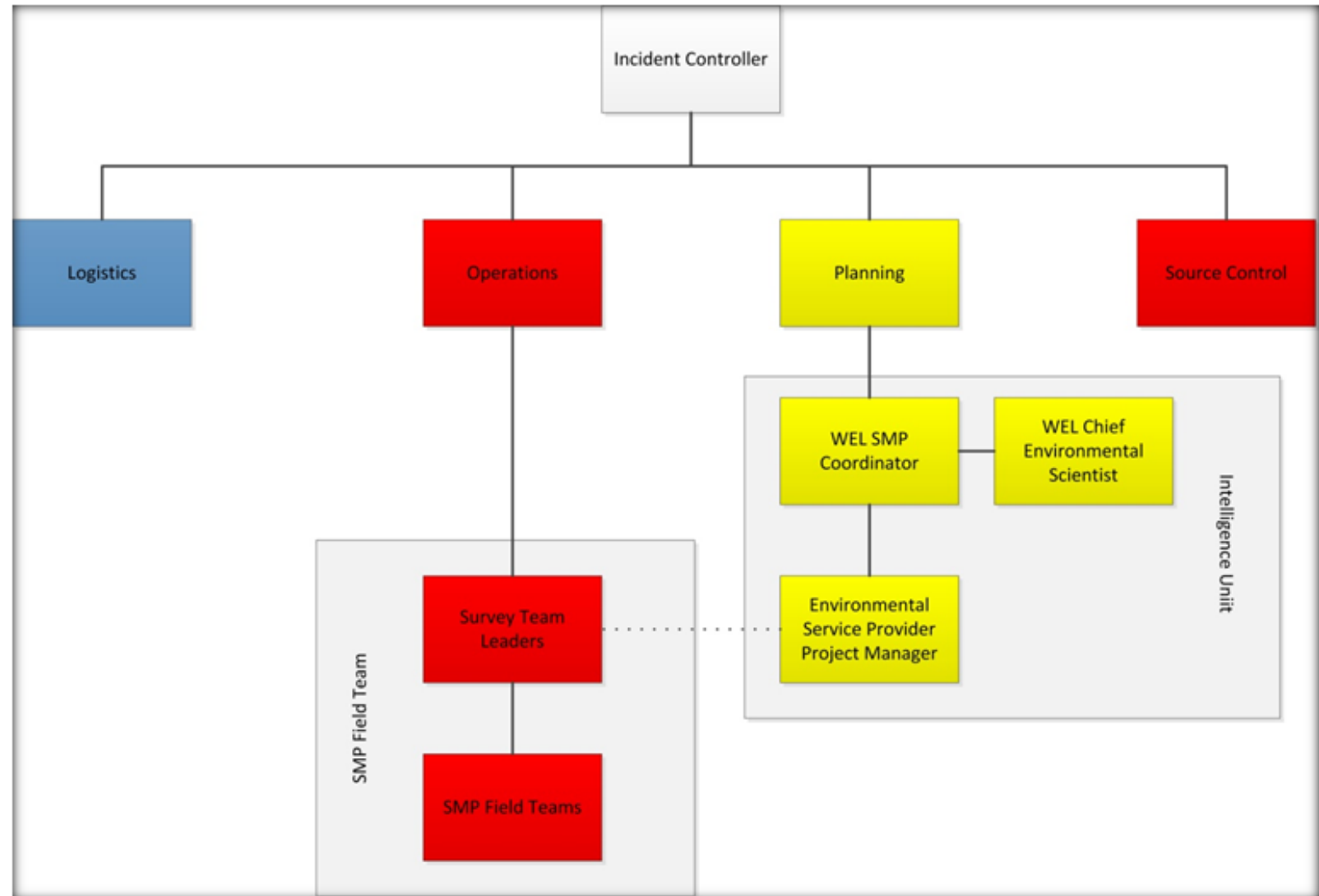
- Environmental Report Cards
- Summarise complex data
- Readily interpretable
- Support adaptive management decisions

Component	Summary	Assessment grade				Confidence	
		Very poor	Poor	Good	Very good	In grade	In trend
Gulfs, bays, estuaries, lagoons	South-east, south-west and east regions heavily degraded in many places; north region in very good condition						
Beaches	South-west and north regions in very good condition						
Fringing reefs— corals, intertidal and subtidal, of coast and islands	East region in very poor condition						
Seabed inner shelf (0–50 m)	South-east and east regions in poor condition						

State of the Environment Report (2011): Marine

# Our approach – preparedness

- Integration of scientific monitoring into oil spill response Incident Management
- Post-incident framework for Impact Assessment and monitoring that provides flexibility and scalability
- Operational systems and processes
- Resources – people and equipment
- Targeted baseline data acquisition



# Our approach – readiness

- Regular updates on monitoring resourcing – people and equipment
- Training and exercises in oil spill response
- Capacity building in the key processes and roles of the monitoring programs



# Our approach – key learnings and challenges

- Operational and scientific monitoring are an integral component of oil spill response
- Capacity building – monitoring processes and procedures
- Shared vision for industry, the regulators and stakeholders on scientific monitoring for oil pollution
- Aligned understanding across industry, the regulators and government response agencies on scientific monitoring for oil pollution
- Standardise methodologies for data collection
- Callout contracts
- Commitment of costs to maintain readiness
- Maintain social licence to operate

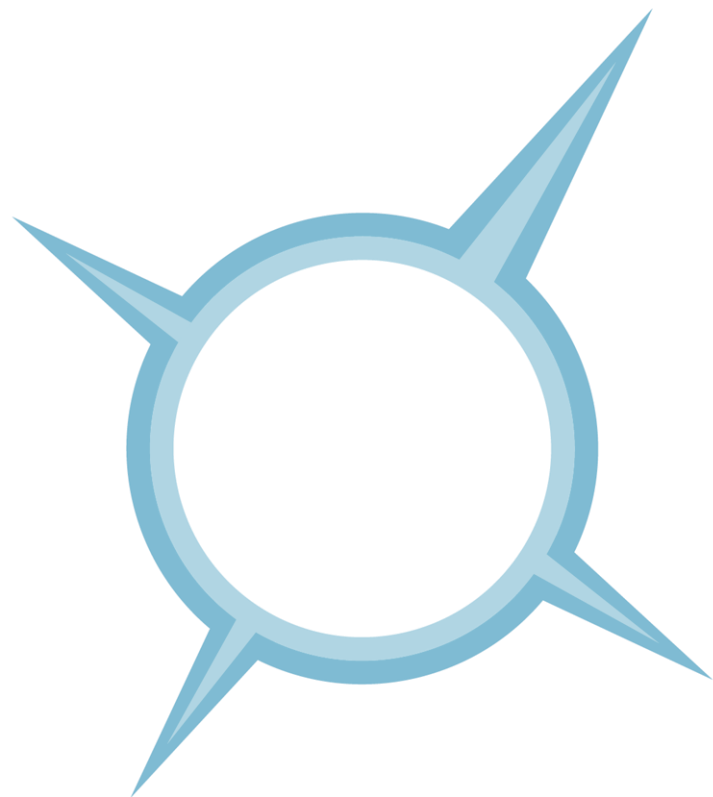




# Proteus Annual Meeting

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ExxonMobil



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UNEP



WCMC

# United Nations Environment Programme World Conservation Monitoring Centre



## **ENHANCING OPERATIONAL RESILIENCE TO CLIMATE CHANGE THROUGH ECOSYSTEM CONSERVATION** - Robert Munroe

# BUILDING RESILIENCE TO CLIMATE RISK – RELEVANCE TO OIL/GAS OPERATIONS

## Changes in climate



Changes in temperature



Changes in precipitation



Global and local sea level rise



Regional changes in ice/snow/permafrost

## Potential risks

### Exploration



- Subsidence
- Wave loading
- Loss of surface water access
- Delays due to species migration

### Production



- Early season delays
- Pad damage
- Loss of surface water access
- Production interruptions
- Ice road—decreased tundra travel

### Transport and terminals



- Ice-load variation
- Damage to coastal facilities
- Shipment interruptions
- Improved or reduced shipping lanes or seasons

### Pipelines



- Thaw subsidence and frost jacking
- Wildfires

### Refining and processing



- Loss of access to water
- Flooding
- Loss of peak cooling capacity

### Neighbouring communities

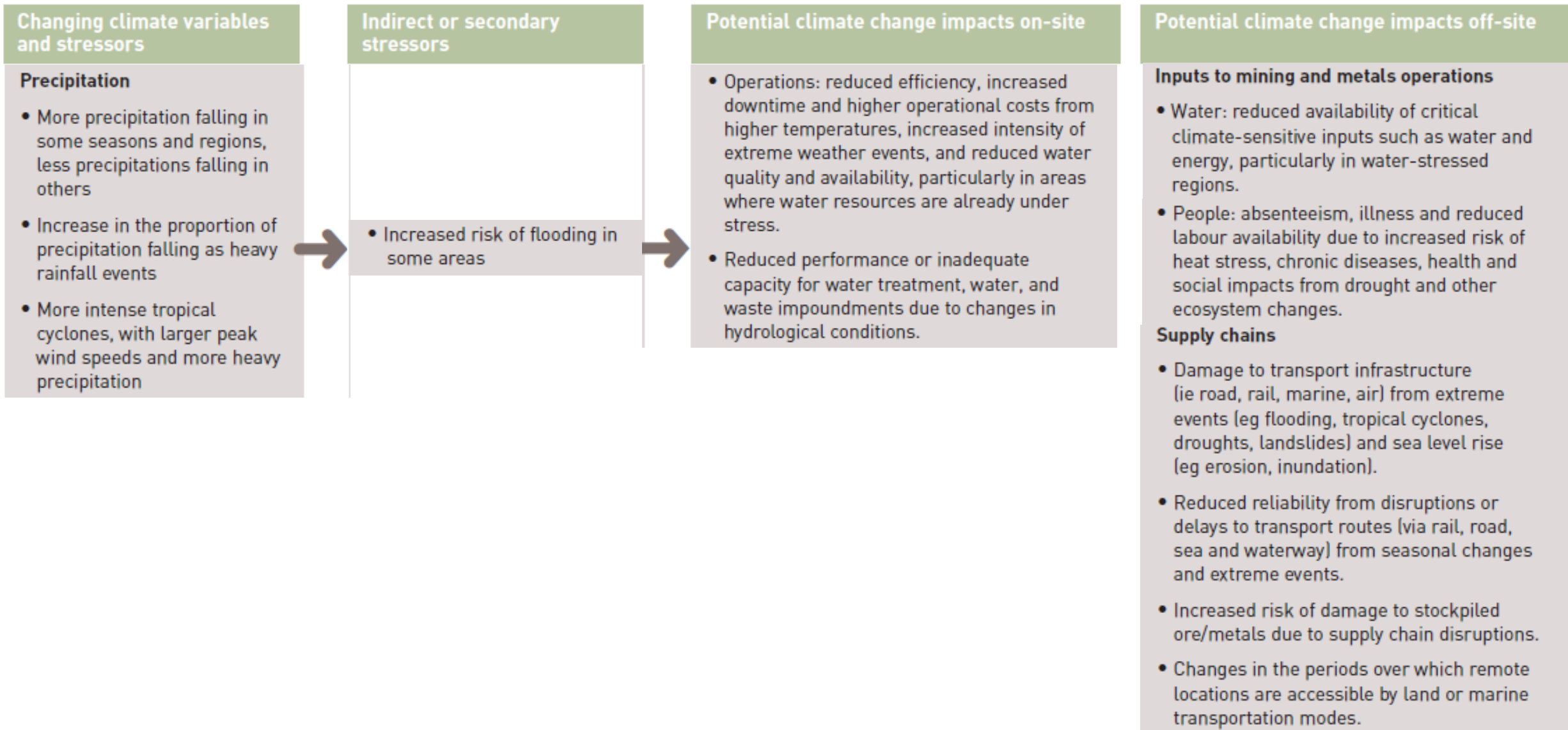


- Loss of species and habitat
- Water
- Storm impacts on key infrastructure

Source: adapted from Jan Dell's presentation



FIGURE 3, PAGE 5



# WHAT ARE THE OPTIONS FOR ENHANCING RESILIENCE?

## **PORTFOLIO OF SOLUTIONS**

## **NEED TO BE CONTEXT SPECIFIC**

**ECOSYSTEM-BASED ADAPTATION TO CLIMATE CHANGE** – the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change

**NATURE-BASED SOLUTIONS, NATURAL/GREEN INFRASTRUCTURE SOLUTIONS** that increase resilience to climatic risk

# RECOGNITION

“We welcome the implementation of biodiversity conservation actions applying these approaches [nature-based solutions including ecosystem-based adaptation to climate change...] in various countries, not only through central government, but also through...private sector activities...”

**(G7 ENVIRONMENT MINISTERS’ MEETING, TOYAMA, JAPAN, MAY 2016)**

“...The United states conference of mayors encourages its members to prioritize natural infrastructure...to protect freshwater supplies, defend the nation’s coastline...”

**(US CONFERENCE OF MAYORS, JUNE 2014)**



# ECOSYSTEM-BASED ADAPTATION

- MANGROVES AND SALT-MARSHES** as buffers against damage to coastal infrastructure
- CO-BENEFITS:** biodiversity, fish nurseries, carbon sequestration value (**IPCC**)
- PERFORMANCE FACTORS MANGROVES**
  - Space behind to track sea level rise; Density; Width of belt
- PERFORMANCE FACTORS SALT-MARSHES**
  - Elevation; Continuity; Vegetation type/density

# **CASE STUDY – BREAKING THE WAVES, MANGROVE REFORESTATION IN VIET NAM**

## **□ TYPHOONS AND COASTAL FLOODING**

## **□ PROTECT 100KM SEA DIKE AND PROPERTY/INFRASTRUCTURE BEHIND**

## **□ RESTORED AND PLANTED 8,961HA MANGROVES**

## **□ COST: \$8.88 MILLION**

## **□ RESULTS (BY 2010):**

**□ Benefit-cost ratios: 3:1 to 28:1**

**□ Less flooding and sea dike damage, avoided damages to dike: \$80,000-295,000**

[http://www.preventionweb.net/files/globalplatform/entry\\_bg\\_paper~mangroveimpactreportfinalallowapril2011.pdf](http://www.preventionweb.net/files/globalplatform/entry_bg_paper~mangroveimpactreportfinalallowapril2011.pdf)

# HYBRID SOLUTIONS



□ **ECOSYSTEM MANAGEMENT**  
combined with **BUILT INFRASTRUCTURE**

□ **NATURAL DEFENCES IN FRONT**  
of these structures can greatly **REDUCE EXPOSURE**

TABLE 1, PAGE 6

Evaluation criteria	Green infrastructure	Gray infrastructure
<b>Stakeholder involvement</b>	Extended stakeholders are often required to support the project and may have an active and ongoing role in the project design and operation	Stakeholders are often engaged with the aim to create local support for the project, but without active involvement in the project design and operation
<b>Engineering approach</b>	GI solutions require a custom-made, location-specific design and do not lend themselves to standardization and replication	Traditional engineering solutions enable standardization and replication which can significantly reduce project costs and delivery times
<b>Physical footprint</b>	A large physical footprint is often required due to low energy density	Usually, only a small physical footprint is required due to high energy density
<b>Environmental footprint</b>	Often reduced environmental footprint due to GI solutions being nature-based and self-regenerating	Often increased environmental footprint due to material and energy intensive processes (manufacturing, distribution, operation)
<b>Speed of delivering the functionality</b>	GI solutions may take time (years) to grow to provide a certain service and capacity	Traditional engineering solutions provide a certain service and capacity from day 1 of operation
<b>Susceptibility to external factors</b>	GI solutions are susceptible to extreme weather conditions, seasonal changes in temperature or rainfall and disease.	Gray infrastructure is susceptible to power loss, mechanical failure of industrial equipment and price volatility.
<b>Operational and maintenance costs</b>	Operating and maintenance costs are often significantly lower (only monitoring and feedback is required)	Operating costs are often significantly higher due to power consumption, operational and maintenance requirements
<b>Risk of price volatility</b>	GI solutions are relatively insensitive to fluctuations in the cost of raw materials, oil, gas and power	Traditional engineering solutions are sensitive to fluctuations in the cost of raw materials, oil, gas and power
<b>Approach to system monitoring and control</b>	GI solutions are living and complex systems that can be monitored and effectively managed by a deep understanding of the key control variables	Traditional engineering solutions are man-made systems that are typically designed with established monitoring techniques to effectively manage and control system performance
<b>Required operating personnel</b>	No need for 24/7 operational supervision	Complex control and safeguarding systems typically require 24/7 operational supervision
<b>Expenses for increasing capacity of system</b>	Relatively inexpensive to extend the capacity of the GI solution, provided there is physical footprint available	Extension of capacity could be relatively inexpensive as long as significant modification or redesign is not required
<b>Need for recapitalization</b>	Recapitalization during the life of the GI solution is usually not significant. The end of life replacement/ decommissioning will vary greatly depending on the GI technology selected but is usually not necessary as GI solutions are self-sustaining and do not depreciate	Gray solutions are depreciating assets with a finite performance capacity and usually require significant replacement/decommissioning at end of life

TABLE 1: EVALUATION OF GREEN VERSUS GRAY INFRASTRUCTURE

# SECTOR CASE STUDY – COASTAL PIPELINE EROSION CONTROL USING OYSTER REEFS

**SHELL PIPELINE COMPANY LP, SHELL GLOBAL SOLUTIONS  
INTERNATIONAL, THE NATURE CONSERVANCY, CH2M**



- GULF OF MEXICO, EXTREME WEATHER EVENTS**
- HARD INFRASTRUCTURE – COSTLY MAINTENANCE AND HABITAT LOSS**
- HYBRID APPROACH: LIVING BREAKWATERS**
- COST: \$1 MILLION** per mile versus **\$1.5-3 MILLION** per mile for rock barriers
- DYNAMIC CAPACITY**
- CO-BENEFITS:** preserve/create habitat, improve local water quality
- PERFORMANCE FACTORS**
  - Depth of structure; Width and position relative to shore; Roughness of ‘reef’;  
Currents, wave actions and tidal height

[http://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2015/11/Shell\\_NI4BizCaseStudy\\_CoastalPipeline.pdf](http://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2015/11/Shell_NI4BizCaseStudy_CoastalPipeline.pdf)

## **EVIDENCE-BASE**

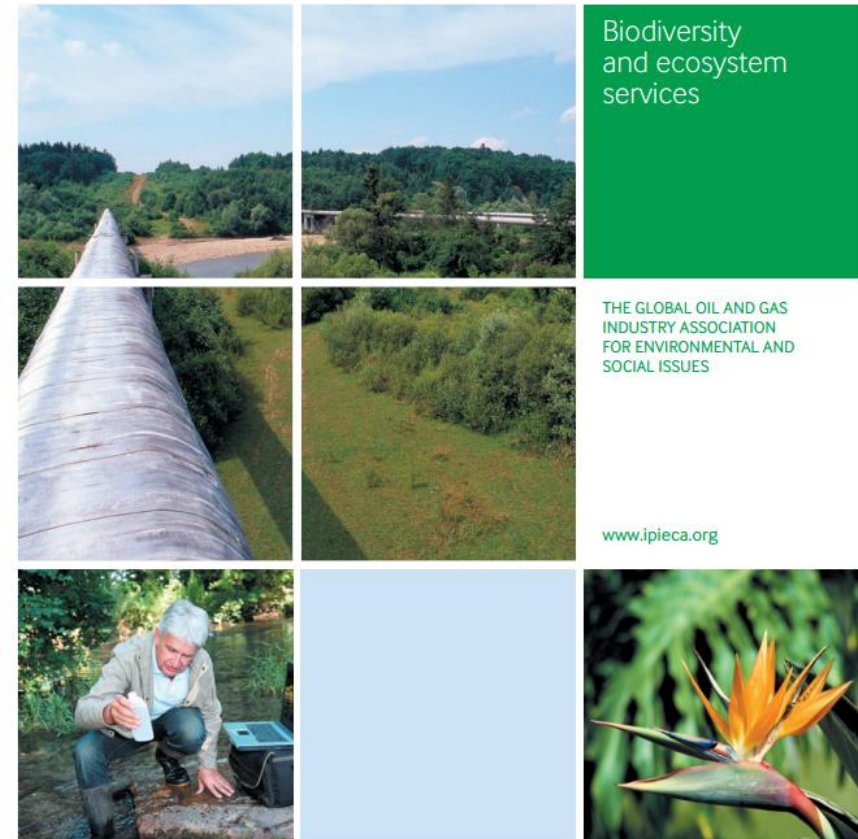
- LOTS OF EBA-RELEVANT LITERATURE** – often not called EbA and widespread across disciplines
- ADDRESS BROAD RANGE OF CLIMATIC RISK**
- MORE ON TEMPORAL AND SPATIAL ASPECTS OF EFFECTIVENESS**
- MORE COMPARISONS BETWEEN OPTIONS**
- MORE INFORMATION ON COSTS**

# ROLE OF THOSE WORKING ON BIODIVERSITY IN EXTRACTIVES

- MANAGE CLIMATE RISK IN BIODIVERSITY MANAGEMENT ACTIVITIES, MAINTAINING ECOSYSTEMS THAT CAN PROVIDE OPERATIONAL RESILIENCE**
- INTEGRATE CLIMATE CHANGE IMPACT ON ECOSYSTEMS IN PHYSICAL RISK ASSESSMENTS**
  - Are biodiversity impact mitigation plans factoring in climate change?

## Biodiversity and ecosystem services fundamentals

Guidance document for the oil and gas industry



# WHAT THE EXTRACTIVES SECTOR NEEDS TO CONSIDER SUCH APPROACHES?

- COMPARABLE STANDARDS AND METHODOLOGIES**
- ECONOMIC AND ENVIRONMENTAL FOOTPRINT ANALYSES**
- CLEARER EVIDENCE-BASE, PARTICULARLY COSTS-BENEFITS**
- SPECIFIC BUSINESS CASE FOR SECTOR**
- CASE STUDIES**
- SECTOR-CHAMPIONS**
- SPECIFIC GUIDANCE/TOOLS FOR SECTOR ON EBA IMPLEMENTATION**
- GUIDANCE ON ASSESSING CLIMATE CHANGE IMPACTS ON ECOSYSTEMS**
- SPATIAL ASSESSMENTS OF EBA POTENTIAL**
- ENGAGEMENT ON RELEVANT NATIONAL STRATEGIES**
- DOWNSCALED CLIMATE DATA FOR APPROPRIATE PLANNING TIMEFRAMES**
- COMMUNICATE IN SECTOR TERMS**

# Managing ecosystems for operational resilience

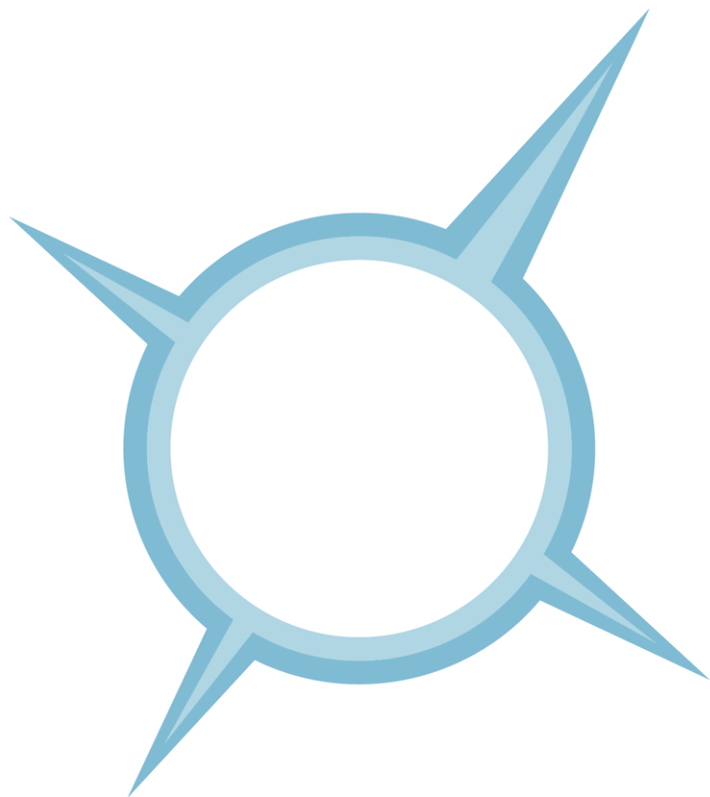
- 1. What are the strongest drivers to manage ecosystems for climate adaptation in the private sector?**
- 2. What's stopping a more integrated approach to climate and ecosystems management?**
- 3. What do you need from Proteus (or through other means) to overcome these barriers?**



# Proteus Annual Meeting

28<sup>th</sup> - 29<sup>th</sup> June 2016

David Attenborough Building, Cambridge, UK



ExxonMobil



RioTinto

