

# ‘Bottlenecks, Showstoppers and Train-wrecks’ – How Can We Manage Estuaries?

*“To develop a holistic management planning framework for estuaries & coasts using a multi-manager sectoral framework. But: not to re-invent the wheel or alienate legitimate sectoral planning bodies. Instead, to build on existing expertise and linkages and have an inclusive system involving stakeholder expertise and understanding.”*

Professor Mike Elliott  
Institute of Estuarine and Coastal Studies, University of  
Hull, Hull HU6 7RX, UK

With acknowledgements to  
all TIDE partners



# Challenges for science & management:



*'There is only one big idea in estuarine environmental management - to protect and enhance ecological functioning and ecosystem services while at the same time delivering societal benefits'*

- Recovery/coping with historical legacy
- Endangered coastal and marine ecosystem functions
- Legal & administrative framework
- Economic prosperity and delivery of societal benefits
- Coping with climate change & moving baselines



# 'Bottlenecks, Showstoppers & Trainwrecks': UNIVERSITY OF Hull

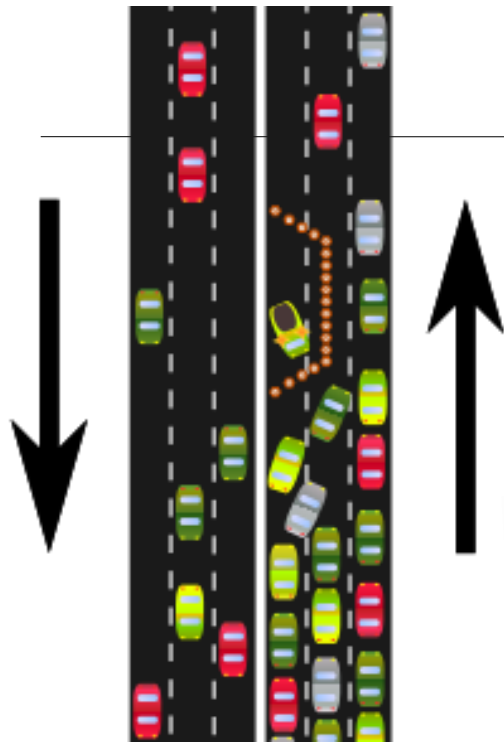
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**'Bottleneck'**: anything obstructing an even flow of production; where the performance or capacity of an entire system is limited by a single or limited number of components or resources; a point of congestion in a system that occurs when workloads arrive at a given point more quickly than can be handled; creates a longer overall cycle time; easily overcome with good forward planning or eventually eases.

**'Showstopper'**: (originally, a performance that gets a positive audience reaction big enough to pause the production); a hardware or software bug of extreme severity which requires an immediate fix; action, condition, event or problem that is serious enough to halt an activity, programme or process until it is resolved; something that draws attention away from others or brings a course of action to a halt; resolved eventually.

**'Train-wreck'**: a disaster - not the "act of God" type of disaster, but just a horrible mess, nothing is going anywhere, requires a major response if at all!

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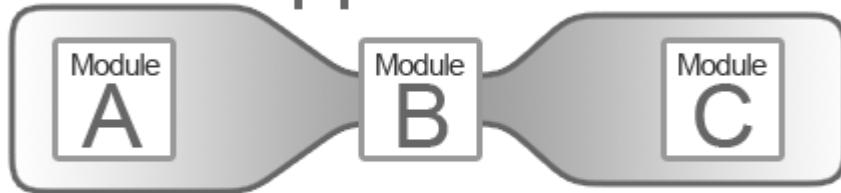


search ID: jmo1433

"A word to the wise, Harry. At this morning's meeting you were referred to as 'the bottleneck!'"



# Application



Optimizing features in module "A" or "C" will not produce a change in the performance of the application until the performance problems in module "B" are addressed.

# Pressures, Valuing, Valuation and Management

- *Paradigm 7: Estuaries have more human-induced pressures than other systems and these include both exogenic unmanaged pressures and endogenic managed pressures. Consequently their management has to not only accommodate the causes and consequences of pressures within the system but, more than other ecosystems, they need to respond to the consequences of external natural and anthropogenic influences.*

Estuarine, Coastal and Shelf Science 94 (2011) 306–314

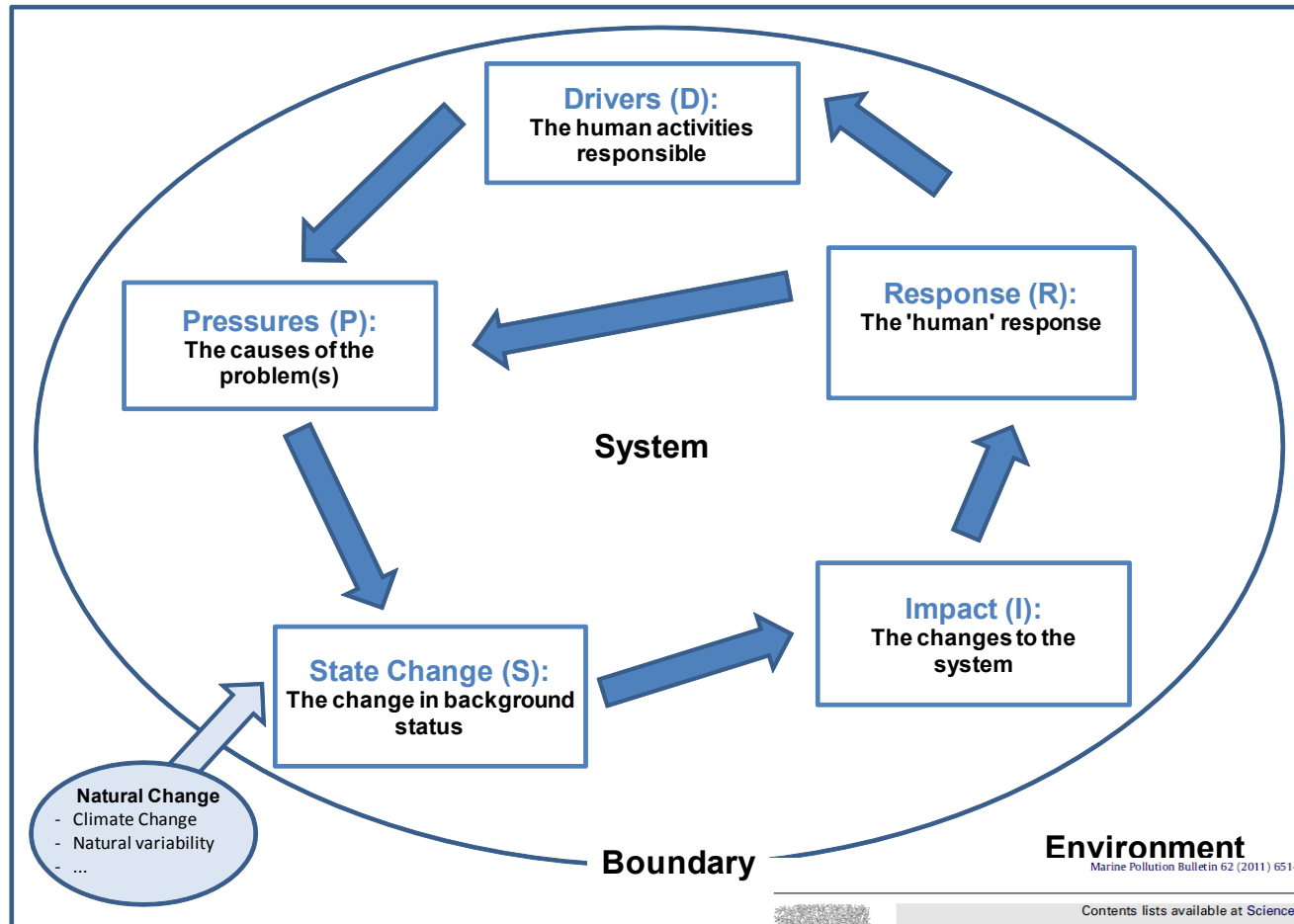


Challenging paradigms in estuarine ecology and management

M. Elliott<sup>a,\*</sup>, A.K. Whitfield<sup>b</sup>



# DPSIR modelling framework (Also \* DPSWR, DPSEEAC)



\*  
**Drivers**  
**Pressures**  
**State change**  
**Welfare**  
**Response;**

**Drivers**  
**Pressures**  
**State change**  
**Exposure**  
**Effects**  
**Action**  
**Context**



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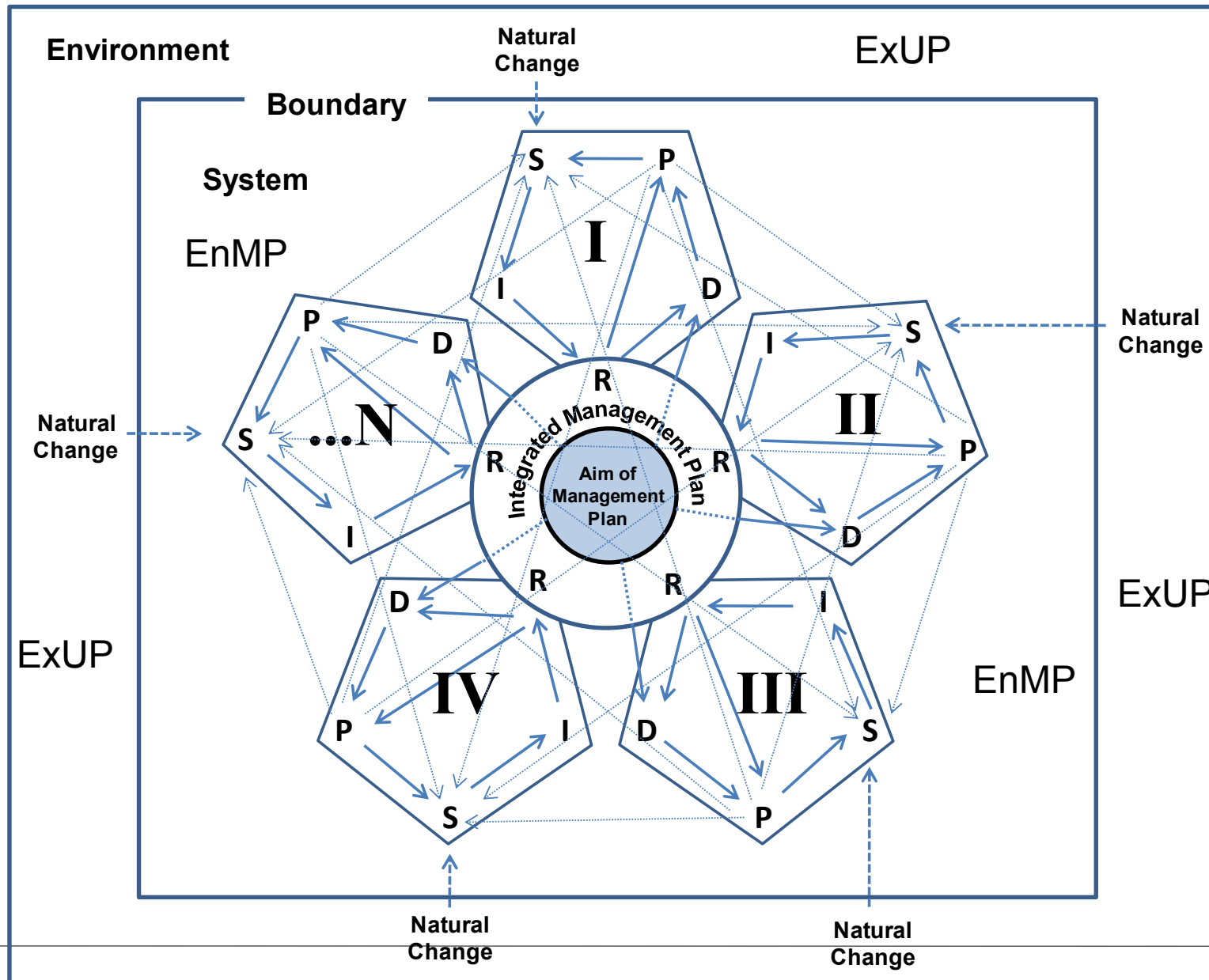
Marine Pollution Bulletin

journal homepage: [www.elsevier.com/locate/marpolbul](http://www.elsevier.com/locate/marpolbul)

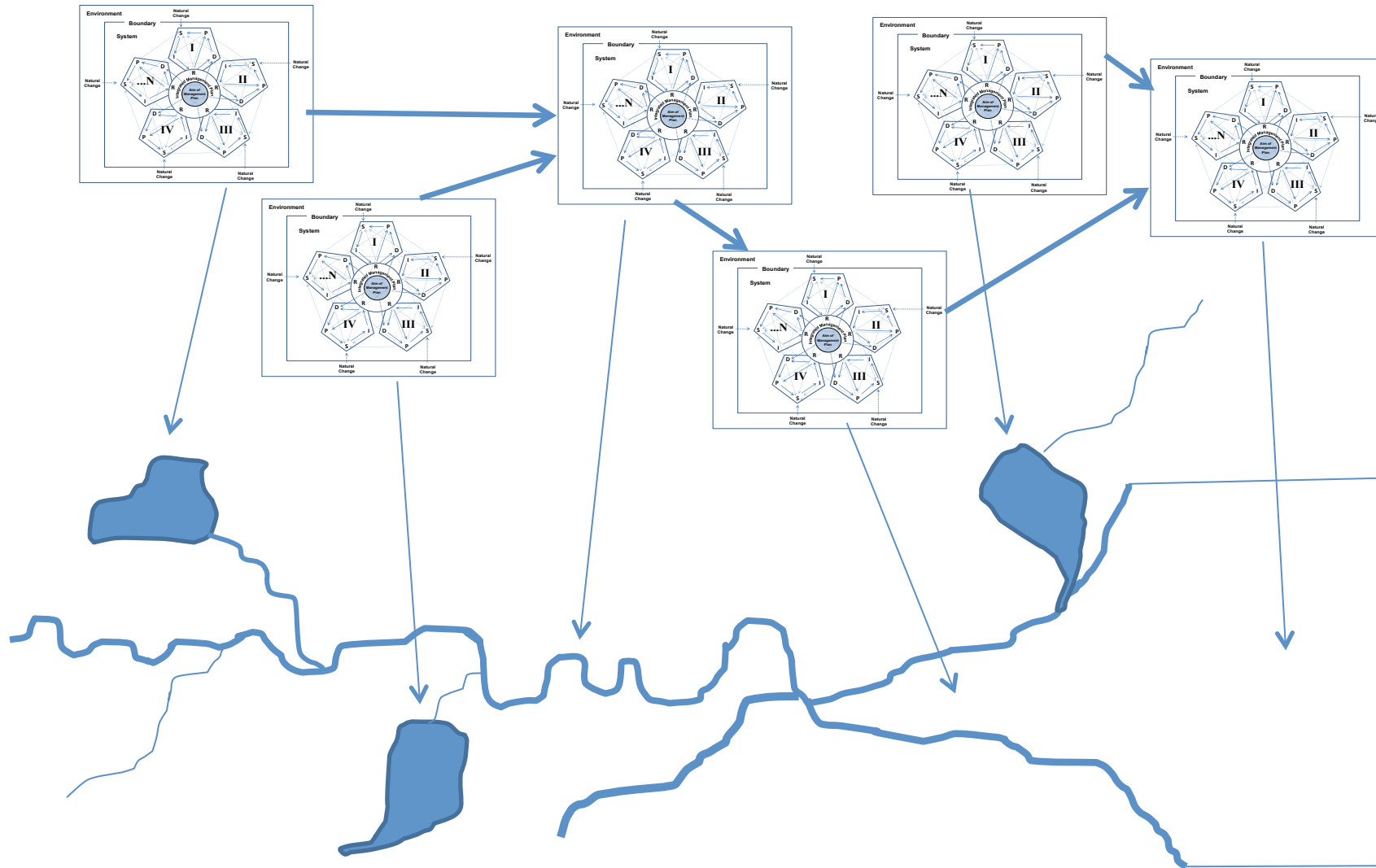


Editorial

Marine science and management means tackling exogenic unmanaged pressures and endogenic managed pressures – A numbered guide



<b>VECTORS of Change – From Drivers through Impacts to Policy Responses - Examples</b>				
<b>Driver</b>	<b>Pressure</b>	<b>State Change</b>	<b>Impact</b>	<b>Response</b>
Increasing urbanisation, agriculture and industrialisation	Changes in temperature regimes and weather patterns (storminess)	Climate change and related impacts (natural and anthropogenic; effects on structure and functioning and on Ecosystem Services)		Local adaptation, compensation; policy, economic & legal mechanisms
	Increased CO <sub>2</sub> and decreased pH	Ocean acidification	Reduced ecosystem services, ability for waste removal	Global agreements
	Diffuse and point source land-based pollution	Polluted components; HAB formation	Environmental and food quality reduction, reduced ES	Diffuse and point-source discharge controls
	Space removal	Loss of carrying capacity	Loss (& gain) of ecosystem services	Planning controls, MSP
Demand for food	Capture fisheries	Changes to local populations, spawning sustainability, by-catch and habitat damage	Stock viability, ecosystem services reduction	Economic and legal instruments
	Aquaculture	Changes to local ecology	Ecosystem services (+ and -)	
Maritime transport (demand for movement of goods, etc)	AIS introduction, infrastructure demands, pollution, dredging	Community change, habitat alteration	Pest introduction, invasive and nuisance species; effects on ecosystem services	Introduction of new ballast water technologies and practices
Energy demands	Infrastructure demands	Habitat loss and gain, energy/hydrodynamic change	Effects on ecosystem services (+ and -)	Marine spatial planning, economic and legislative constraints
Tourism & recreation demands		Loss of natural habitats, reduction in resilience		Planning controls, coastal spatial planning
Total societal demands	Interactions between multiple users & sectors	Cumulative effects on natural structure and functioning	Effects on ecosystem services	Changes in policy



# Hazard & Risk Typology:

## Hazard leading to Risk (depending on assets)

A) Surface hydrological hazards

B) Surface physiographic removal by natural processes - chronic/long-term

C) Surface physiographic removal by human actions - chronic/long-term

D) Surface physiographic removal - acute/short-term

E) Climatological hazards - acute/short term

F) Climatological hazards - chronic/long term

G) Tectonic hazards - acute/short term

H) Tectonic hazards - chronic/ long term

I) Anthropogenic microbial biohazards

J) Anthropogenic macrobial biohazards

K) Anthropogenic introduced technological hazards

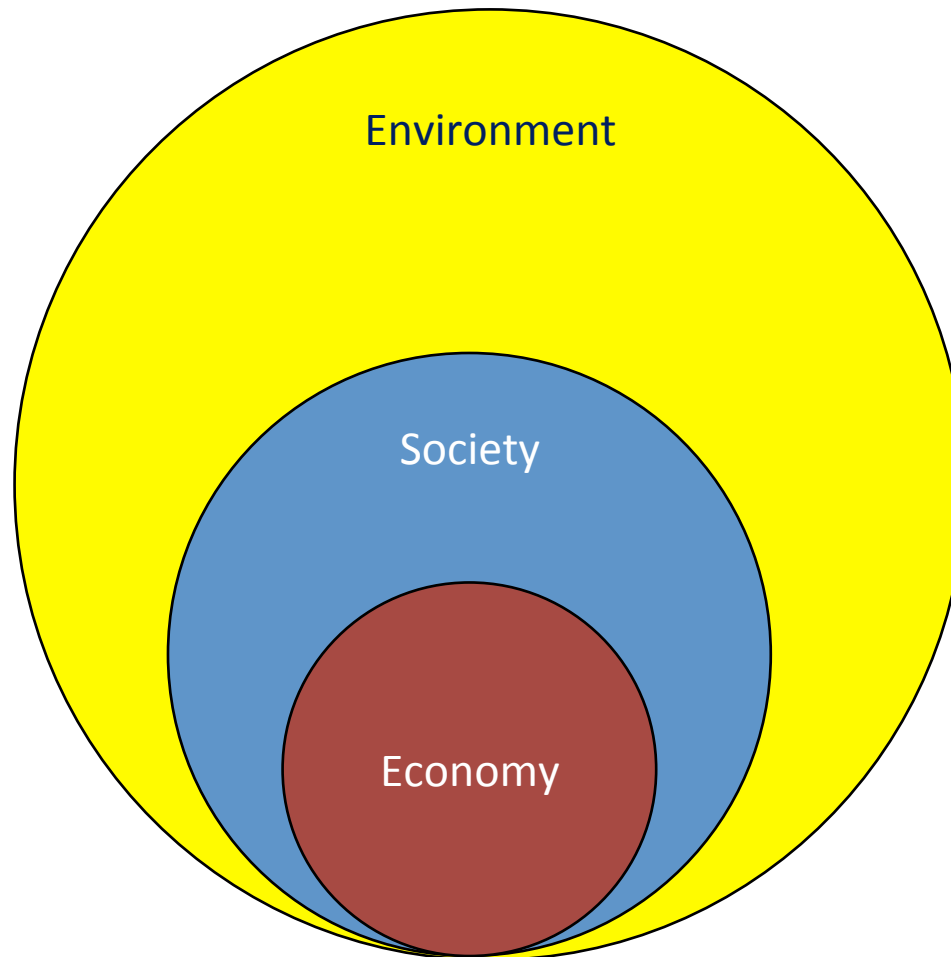
L) Anthropogenic extractive technological hazards

M) Anthropogenic acute chemical hazards

N) Anthropogenic chronic chemical hazards

(Elliott, Cutts and Trono, submitted.; expanded from: Elliott, M, A Trono & ND Cutts (2010) Chapter 17 Coastal Hazards and Risk. In: DR Green (Ed.) Coastal Zone Management. Thomas Telford Publ. London, p396-432.)

# The overarching (accepted) sustainable development framework



The 'three-legged stool',  
the 'three pillars of  
sustainability'

But (and there is always a  
'but!):

- (a) Are there only 3 'legs'?
- (b) Are all 'legs' equal?
- (c) Do the 'legs' differ in length according to the current economical climate?
- (d) Does the system fall over if a 'leg' is missing?
- (e) Do you need a 10-legged stool?

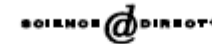
# The ~~ten~~ tenets

To be successful, management measures or responses to changes resulting from human activities should be:

- Ecologically sustainable
- Technologically feasible
- Economically viable
- Socially desirable/tolerable
- Legally permissible
- Administratively achievable
- Politically expedient
- Ethically defensible (morally correct)
- Culturally inclusive
- Effectively communicable



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Marine Pollution Bulletin 49 (2004) 671–674

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Editorial

Marine habitats: loss and gain, mitigation and compensation

Michael Elliott <sup>a,\*</sup>, Daryl Burdon <sup>a</sup>, Krystal L. Hemingway <sup>a</sup>, Sabine E. Apitz <sup>b</sup>

Marine Pollution Bulletin 62 (2011) 651–655



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Editorial

Marine science and management means tackling exogenic unmanaged pressures and endogenic managed pressures – A numbered guide

(from Elliott, Cutts and Trono, submitted; Elliott & Barnard, in prep.)

‘The ten tenets’: levels of applicability within the SD framework (‘estuarine economic futures’):

	Sustainability principle		
Tenets' applicability	Environment	Society	Economy
Overarching (activity) level		<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Politically expedient</li> <li><input checked="" type="checkbox"/> Socially desirable/ tolerable</li> <li><input checked="" type="checkbox"/> Ethically defensible (morally correct)</li> <li><input checked="" type="checkbox"/> Culturally inclusive</li> <li><input checked="" type="checkbox"/> Effectively communicable</li> </ul>	
Overarching level (but need information on likely measures)		<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Legally permissible</li> <li><input checked="" type="checkbox"/> Administratively achievable</li> </ul>	
Specific measures	<input checked="" type="checkbox"/> Ecologically sustainable	<input checked="" type="checkbox"/> Technologically feasible	<input checked="" type="checkbox"/> Economically viable

# 1<sup>st</sup> Tenet: Environmentally/ecologically sustainable

- maintain the natural system, ecological carrying capacity; protect ecosystem services for ecosystem benefit, maintenance of ecosystem health;
- functioning, structure, problems of focussing on structure;
- look after the physics and chemistry and ecology will follow; ecological/habitat compensation; ecological significance of change (cf. statistical);
- e.g. for eutrophication - not creating the 'symptoms of ecosystem pathology'.

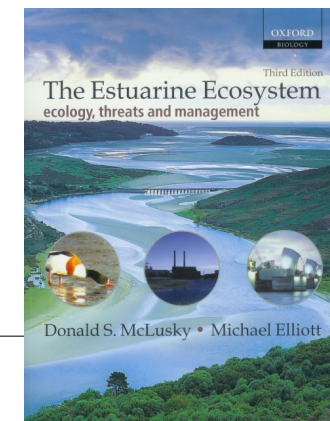


# Science & Types of Monitoring:

- Surveillance monitoring
- Condition monitoring
- Operational monitoring
- Compliance monitoring
- Check monitoring
- Self-monitoring
- Toxicity testing
- Investigative monitoring
- Diagnostic monitoring
- Feedback monitoring




(Elliott, Mar Poll Bull, 2011; See also Elliott & de Jonge (1996) The need for monitoring the monitors and their monitoring. Mar. Poll. Bull. 32(3): 428-9)



## 2<sup>nd</sup> Tenet: Economically viable

- funding to do recovery/prevention/restoration; economic compensation and mitigation costs of schemes, maintenance of wealth creation;
- societal benefits, employment prospects (or at least not averse), economic carrying capacity; monitoring costs;
- e.g. for eutrophication - cost of removing nutrients (in 3ry treatment) or of not applying them (in lost agricultural production) is acceptable.



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Marine Pollution Bulletin 53 (2006) 195–204

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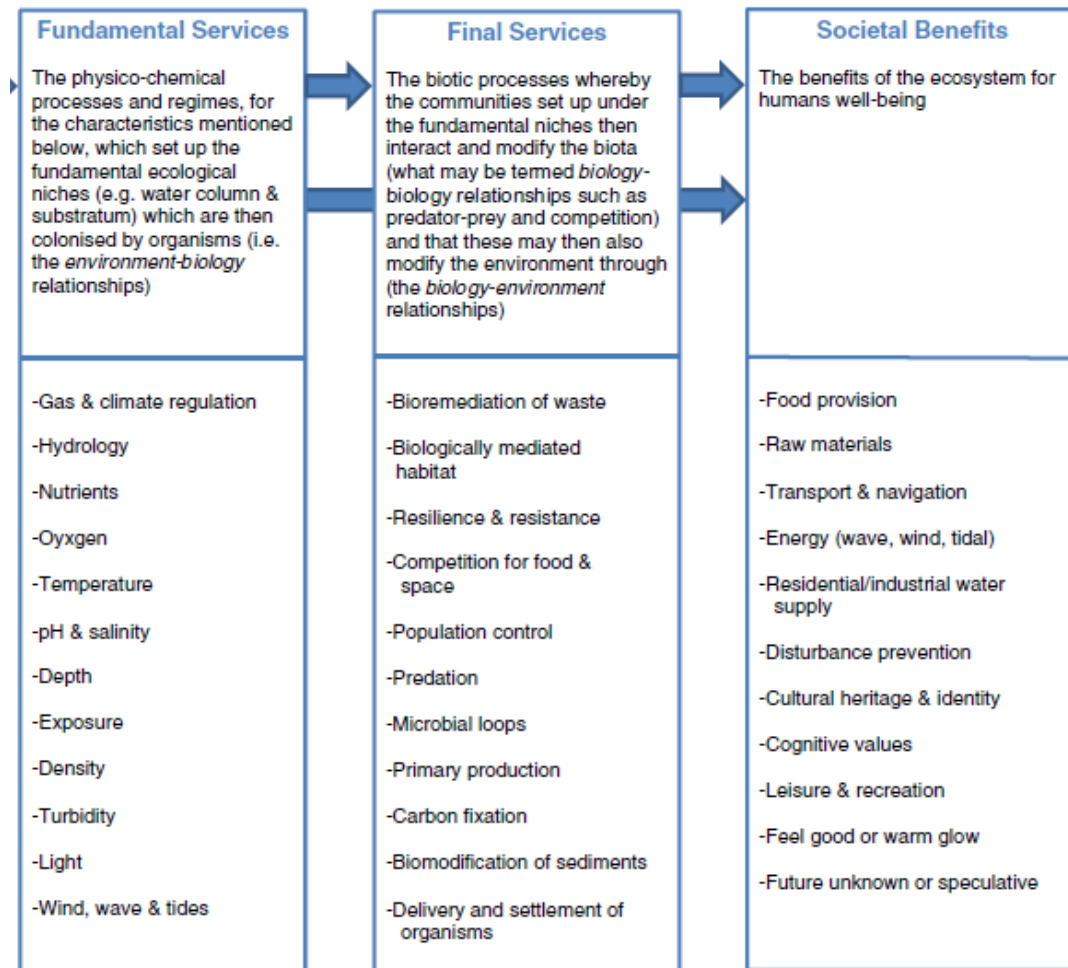
An initial economic evaluation of water quality improvements  
in the Randers Fjord, Denmark

Jonathan P. Atkins <sup>a</sup>, Daryl Burdon <sup>b,\*</sup>

<sup>a</sup> Centre for Economic Policy, The Business School, University of Hull, Hull HU6 7RX, UK  
<sup>b</sup> Institute of Estuarine and Coastal Studies (IECS), University of Hull, Hull HU6 7RX, UK


# Delivery and Protection of Ecosystem Services & Societal Benefits

- Paradigm 8: *Estuaries provide a wider variety of ecosystem services and an increased delivery of societal benefits than many other ecosystems. Hence estuaries are one of the most valuable aquatic ecosystems serving human needs but for this to occur they require functional links with the adjoining terrestrial, freshwater and marine systems.*




# Total economic value of water quality improvements


Use Values		Non-Use Values	
Direct Use Values	Indirect Use Values	Option Values	Existence Values
Recreation	Recreation	Future uses as per direct and indirect use values	Estuary and coastal zone as an object of intrinsic value, as a gift to others, and as a responsibility (stewardship)
Commercial fishing	Landscape		
Agriculture/Industry	Biodiversity value		
Drinking purposes	Aesthetic value		
Biodiversity value	Tourism/Ecotourism		
Landscape	Research/Education		
Research/Education	Human health		
Tourism/Ecotourism			
Human health			



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Marine Pollution Bulletin 55 (2007) 591–602



[www.elsevier.com/locate/marpolbul](http://www.elsevier.com/locate/marpolbul)

An application of contingent valuation and decision tree analysis to water quality improvements

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<sup>a</sup> Centre for Economic Policy, The Business School, University of Hull, Hull HU6 7RX, UK  
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WATER RESEARCH 46 (2012) 205–217



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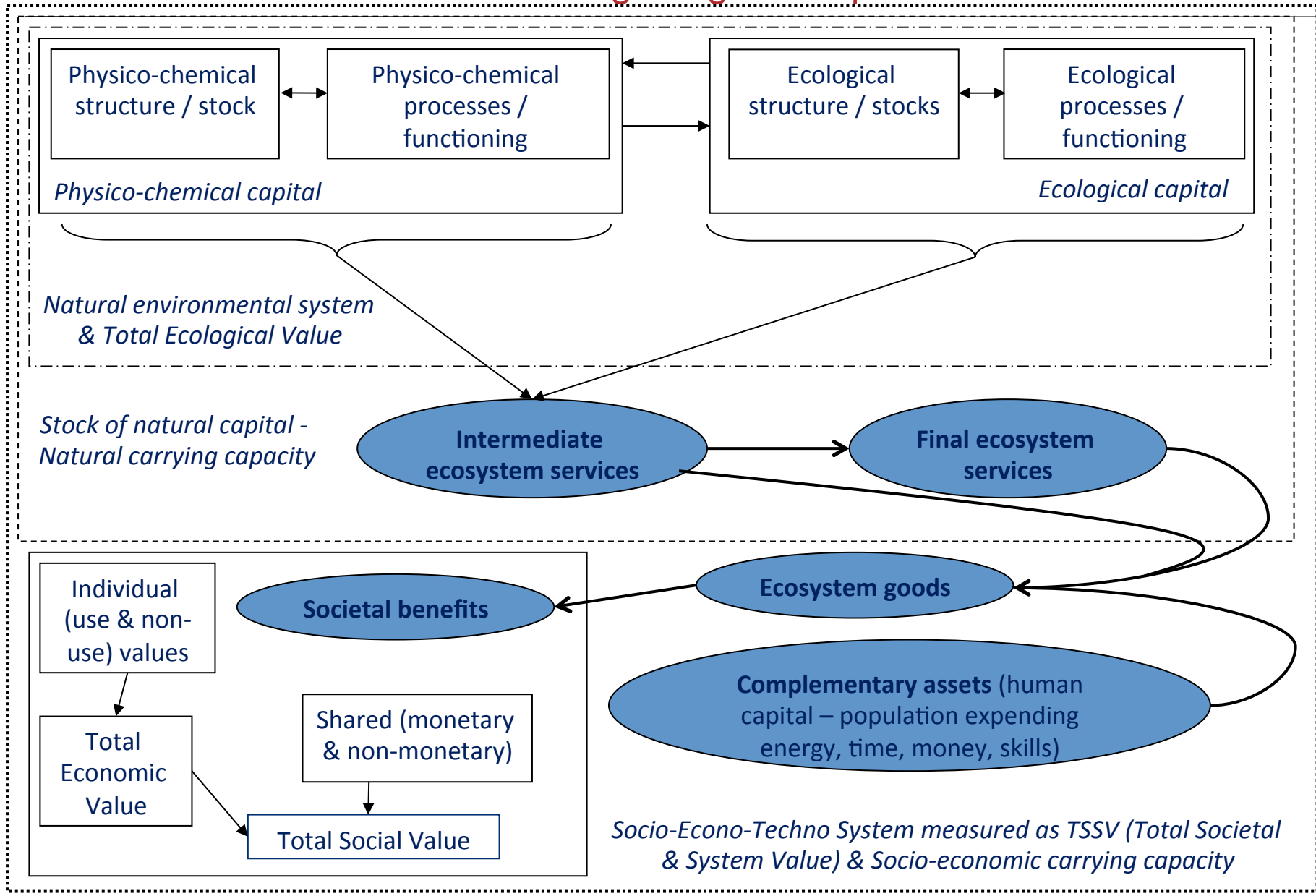
journal homepage: [www.elsevier.com/locate/watres](http://www.elsevier.com/locate/watres)



**What are the costs and benefits of biodiversity recovery in a highly polluted estuary?**

M. Pascual <sup>a,b,\*</sup>, A. Borja <sup>a,\*</sup>, J. Franco <sup>a</sup>, D. Burdon <sup>b</sup>, J.P. Atkins <sup>c</sup>, M. Elliott <sup>b</sup>

# Natural and Social Science - Integrating Concepts:



## 3<sup>rd</sup> Tenet: Technologically feasible

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- equipment for treatment, coastal defences/protection schemes, BAT (or BATNEEC or even 'CATNIP'), fishing gear to protect stocks;
  - technologies for mitigation and habitat/resource compensation schemes;
  - monitoring methodologies; scientific methods e.g. indices;
  - e.g. for eutrophication - that nutrients can be removed in treatment works (e.g. by nutrient stripping) or that agricultural technologies are developed that don't require them.
-

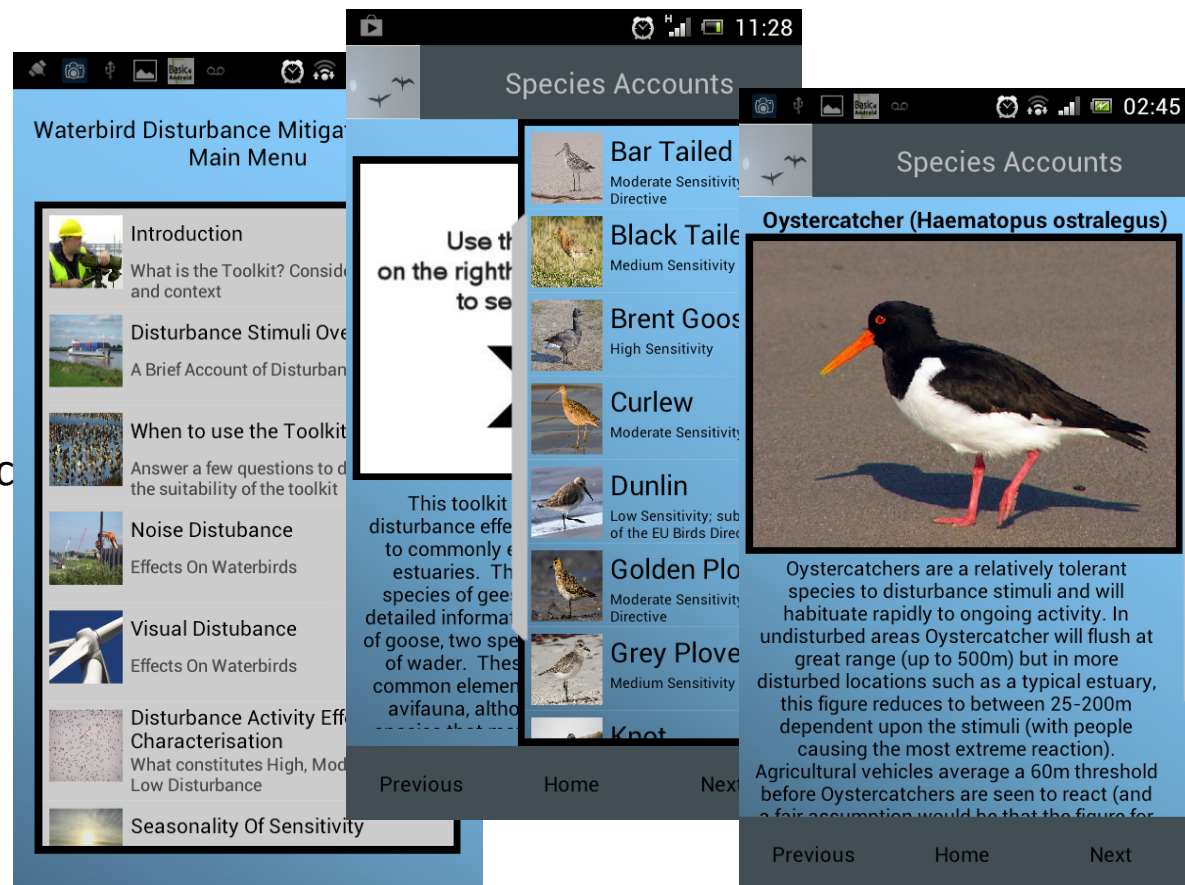
# Waterbird Disturbance & Mitigation Toolkit UNIVERSITY OF Hull

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- Developed by IECS with Environment Agency match-funding.
  - Designed as a high-level assessment tool for planners, construction managers and statutory agencies, to assess likely disturbance impacts of a plan or project & potential mitigation.
  - Identifies likely disturbance impacts and their severity on waterbird assemblages on estuaries e.g. Natura 2000 sites.
  - These include visual and noise stimuli from a range of sources.
  - Criteria provided to characterise disturbance potential based on species sensitivity, activity type, distance, habitat etc.
  - Guidance on threshold distances for visual (key activities) and noise (dB(A) at receptor) sources & mitigation measures.
-

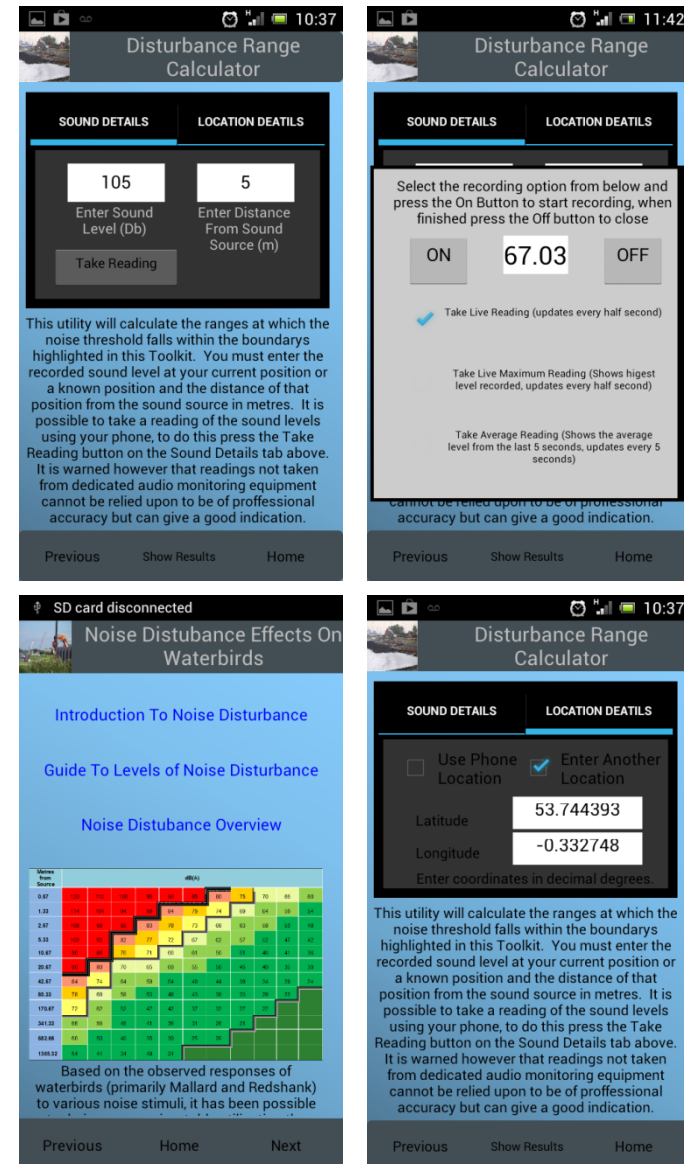
# General Content (App Screens Shown)

- Menu driven by hyperlinks
- Information included: when and how to use the Toolkit; disturbance causal factors; activity effects; thresholds of effect and severity; species accounts and mitigation measure application.
- Common species are described.
- Species accounts provide basic information on identification, ecology and disturbance resilience.



# Noise Assessment (App Screens Shown)

- Noise thresholds established by monitoring a range of construction and third party activities and the responses of a number of waterbird species to these stimuli;
- This has allowed a Noise Threshold Effect matrix to be developed. Currently this is a generic tool for ‘waterbirds’ but it is planned to derive similar for key species when data can be collected;
- Noise level, distance from source & duration of recording (dB(A)max) can be manually input or sampled in real-time using on-phone devices. This allows theoretical calculations to be made ‘in office’ as well as real-time measurements ‘in field’;
- Similarly, location details can be manually input or taken real-time using phone utilities.



# Noise Assessment (App Screens Shown)

- Output of the noise:distance:sensitivity calculations are displayed on Google Maps as a 'bull's eye' of critical, high, medium and low effects radii.
- There is also an option to look at radii of differing threshold effects.
- The App is available free of charge and the PC-based Toolkit (without interactive components) can be downloaded from the TIDE Toolbox web site.
- The tool will continue to be developed as data allow.

(See Nick Cutts N.D.Cutts@hull.ac.uk)

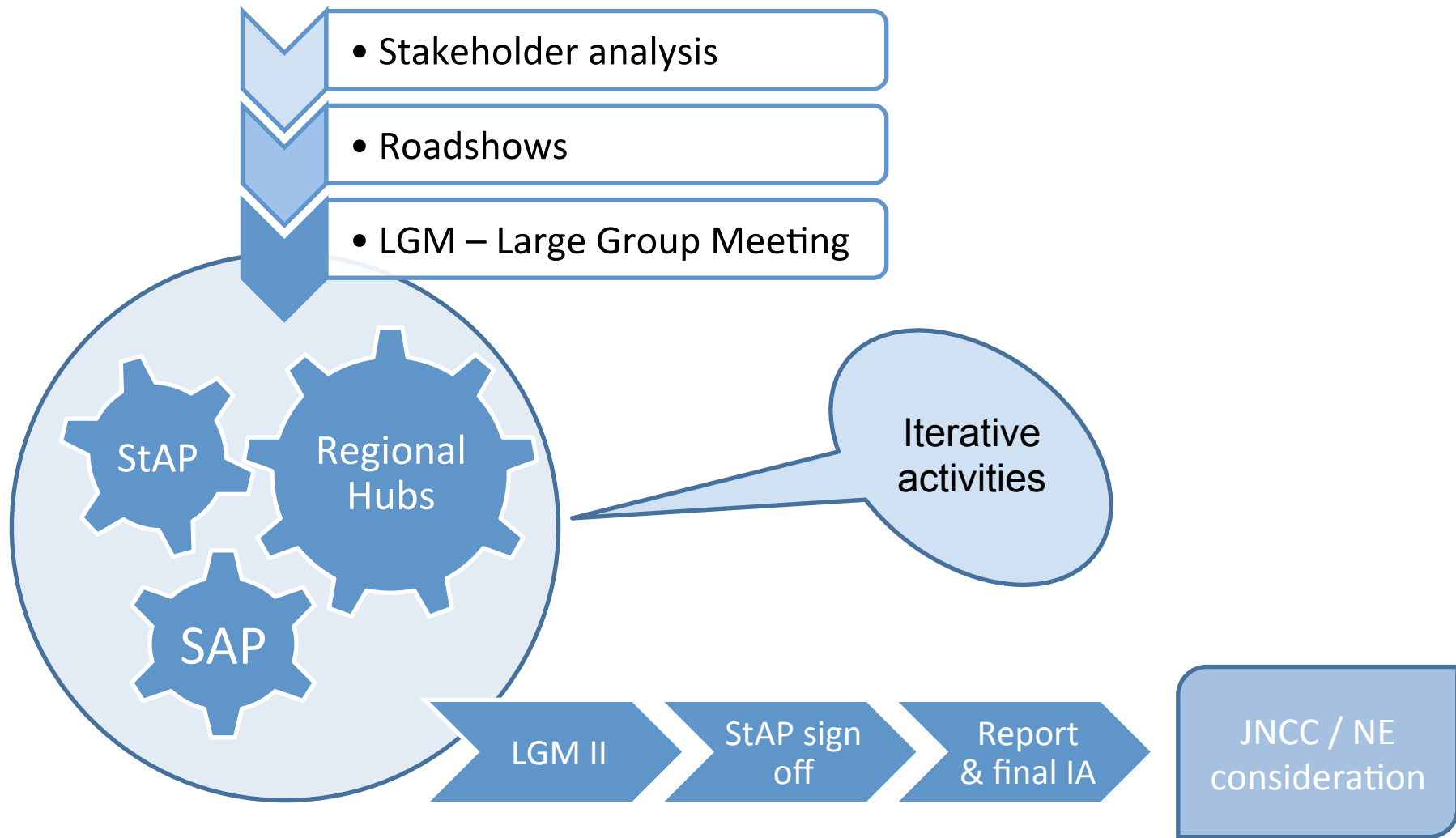


## 4<sup>th</sup> Tenet: Socially desirable/tolerable

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- societal benefits, societal carrying capacity; maintenance of societal health and quality of life; feel-good factor, cute-and-cuddly approach; societal significance of change cf. ecological or statistical significance;
  - tree-huggers vs. industrial warriors; cost-effective approaches;
  - consultation with public, NGOs, etc.; stakeholder engagement, public participation but possibility of agreeing to 'lowest-common-denominator'
  - e.g. for eutrophication - that society is willing to fund the technological and economic aspects, desires high quality or tolerates poor environmental quality, and any other socio-economic repercussions if nutrients are discharged.
-

# Net Gain MCZ Project roadmap



## Success (1):

1. Be prepared - know your objectives, players, 'environment', limitations.
  2. The human touch - constant and personal contact, act early and be open.
  3. Use the right amount and type of explanation (ideas, rationale and plans) (KISS)
  4. Emphasise 'joint wins' (synergies, partnerships and benefits).
  5. Focus on the primary stakeholders and leading players ('opinion leaders') but don't ignore the wider base.
  6. Openly acknowledge concerns and balancing of interests.
  7. Maintain contact and flow of information (events, individual contact) even if little happening (to avoid cynicism in stakeholders).
-

# Stakeholder Communication - Recipe for Success (2):

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8. Don't avoid the contentious issues - discuss, explain, acknowledge, accept/reject.
  9. Understand the objections and even 'the hidden agendas' and competing interests.
  10. Involve different stakeholder groups, look for joint and mutual solutions.
  11. Be aware of 'he who shouts loudest' and of the weighting of interests and concerns.
  12. Acknowledge problems of 'lowest common denominator' acceptance.
  13. Acknowledge the importance of 'the medium' and 'the message' (display, dissemination, take the problem to the stakeholders not vice-versa) re. venue, time).
-

## 5<sup>th</sup> Tenet: Legally Permissible

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- international treaties, agreements, regional seas approaches, bloc legislations (e.g. EU), national laws, enabling legislation;
  - e.g. for eutrophication - by having Nitrates and UWWT Directives leading to WFD and MSFD to give Good Ecological and Environmental status;
  - that if nutrients are discharged and in danger of affecting conservation objectives/features to reduce Favourable Conservation Status then an Appropriate Assessment is done;
  - that an EIA is done for the proposed methods/ infrastructure, even that an AA is done for the removal.
-

Basis in adopting several internationally recognised principles:

- ecologically sustainable development and the principle of intergenerational equity;
- the precautionary principle;
- conservation of biological diversity and ecological integrity;
- economic valuation of environmental factors and the polluter pays principle;
- waste minimisation, and
- public participation.

‘The principles are not binding in themselves on developers or government, but government may be required to give them proper consideration when it is making a decision affected by these principles. This is especially the case when a principle is stated to be an objective of a statute, or if the statute states the principle has to be taken into account.’



## Legislative Drivers and Sectoral Plan Review – including SWOT analysis - Recipe:

- Assess the environmental drivers (EU legislation) affecting sectoral management plans of estuaries.
- Document the key organisations with management responsibilities.
- Assess management plans for each estuary for their internal strengths and weaknesses, and the external opportunities and threats (SWOT).
- Plans assessed include those addressing: water quality; nature conservation; flood protection and coastal protection; ICZM; navigation, ports & pollution prevention; and economic development.

Schelde Estuary Management Plans



Figure 4a  
European  
Marine Sites  
(SAC & SPA) in  
the  
International  
River Basin  
District Schelde

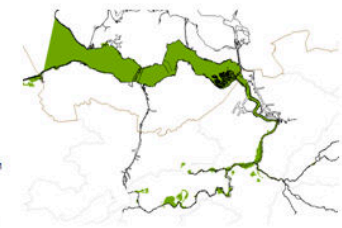


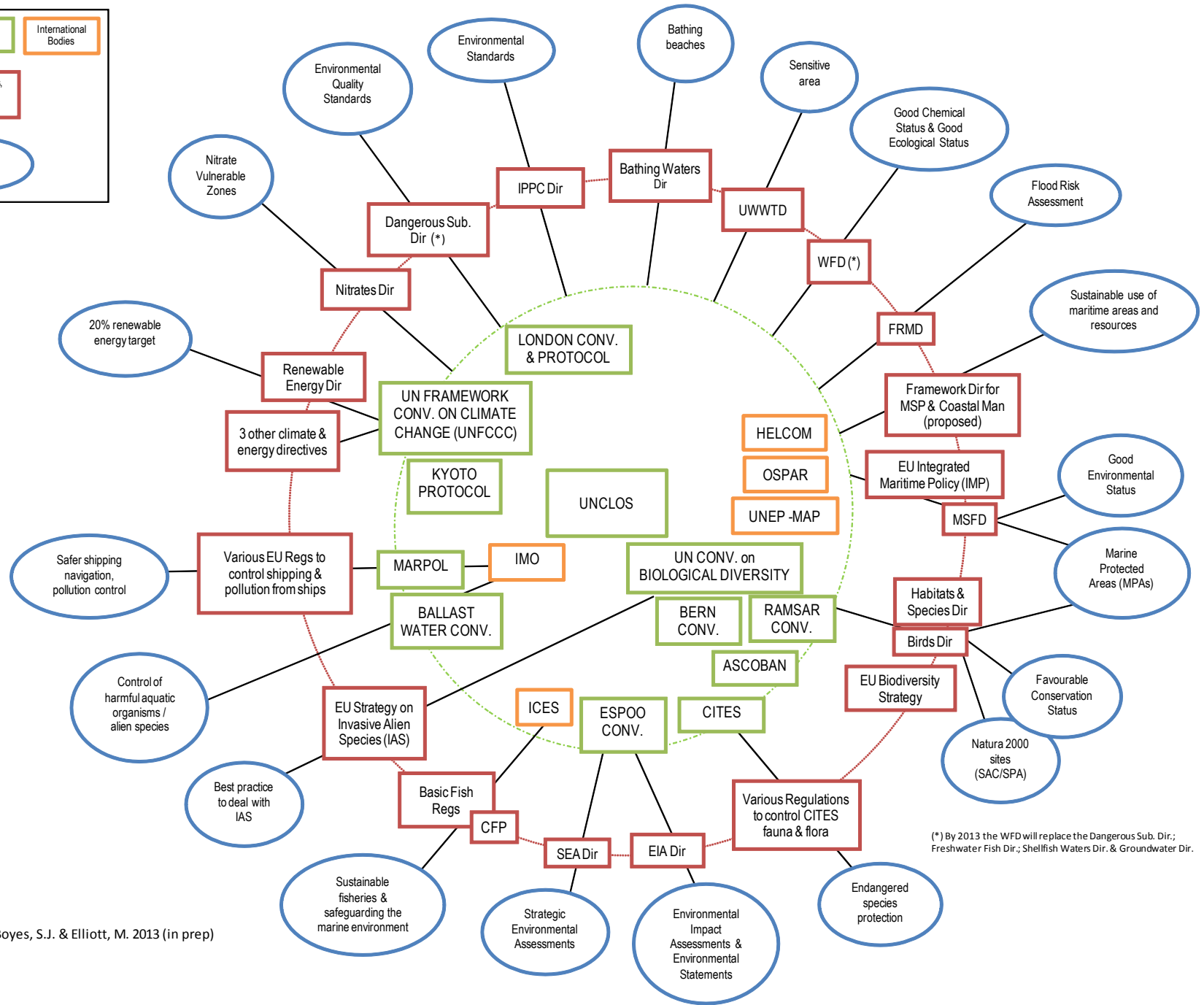
Figure 4b  
Schelde  
Estuary  
European  
Marine Site



Figure 4c  
Implementation  
of the Water  
Framework  
Directive and the  
Floods Directive  
in Flanders



Figure 4d  
International  
river basin  
district of the  
Schelde



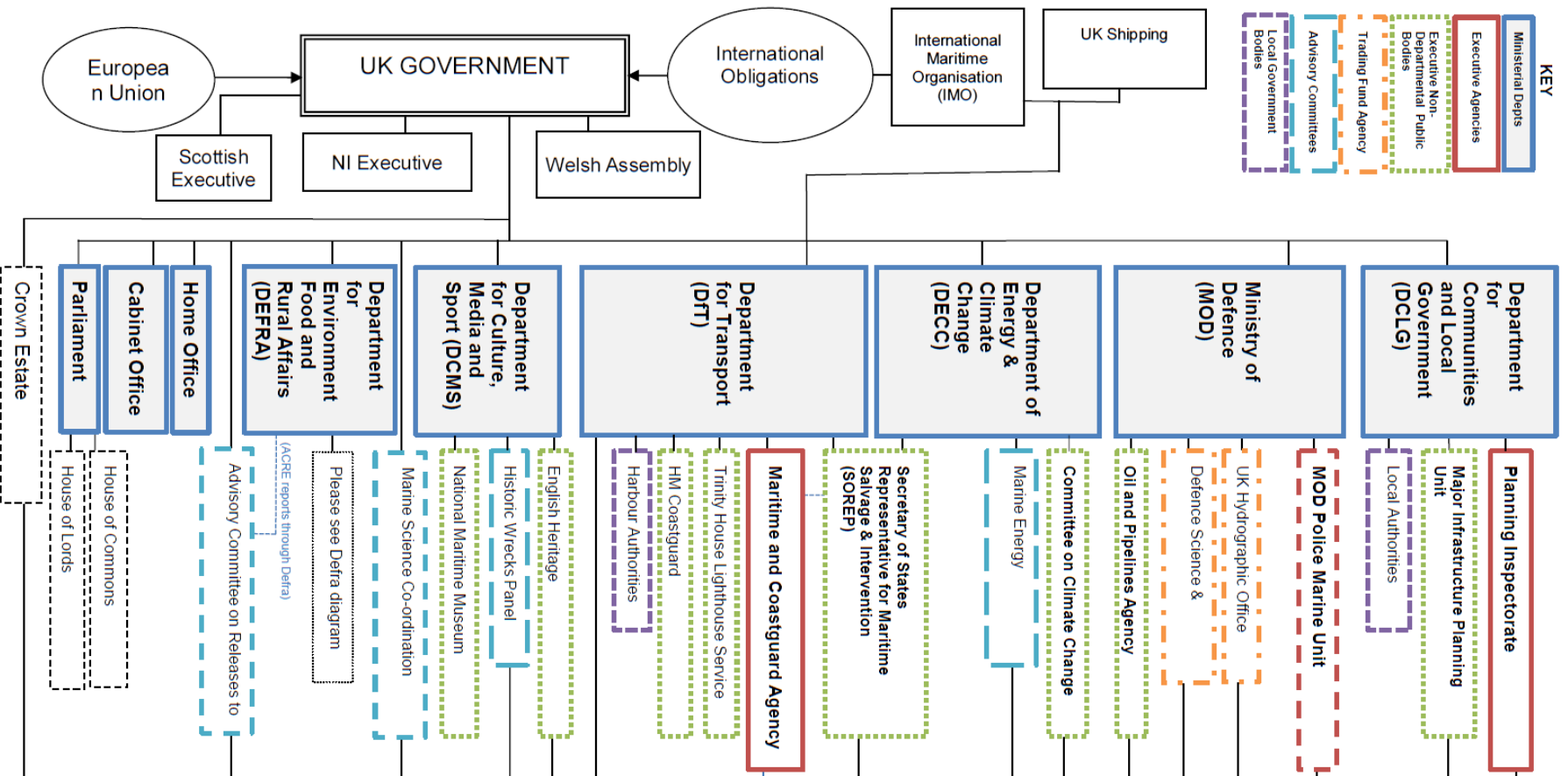
(\*) By 2013 the WFD will replace the Dangerous Sub. Dir., Freshwater Fish Dir.; Shellfish Waters Dir. & Groundwater Dir.



## 6<sup>th</sup> Tenet: Administratively achievable

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- ministries, departments, agencies, statutory bodies, interlinked bodies at international/regional/national levels;
  - horizontal and vertical coordination; across/between sectors;
  - integration easier if more bodies adopt The Ecosystem Approach;
  - e.g. for eutrophication - availability of EPA, NFU, planning body, municipal water body (treatment works, trade effluent), Ministries of agriculture/ environment, nature conservation bodies; ability and willingness to create NVZ.
-



## 7<sup>th</sup> Tenet: Politically expedient

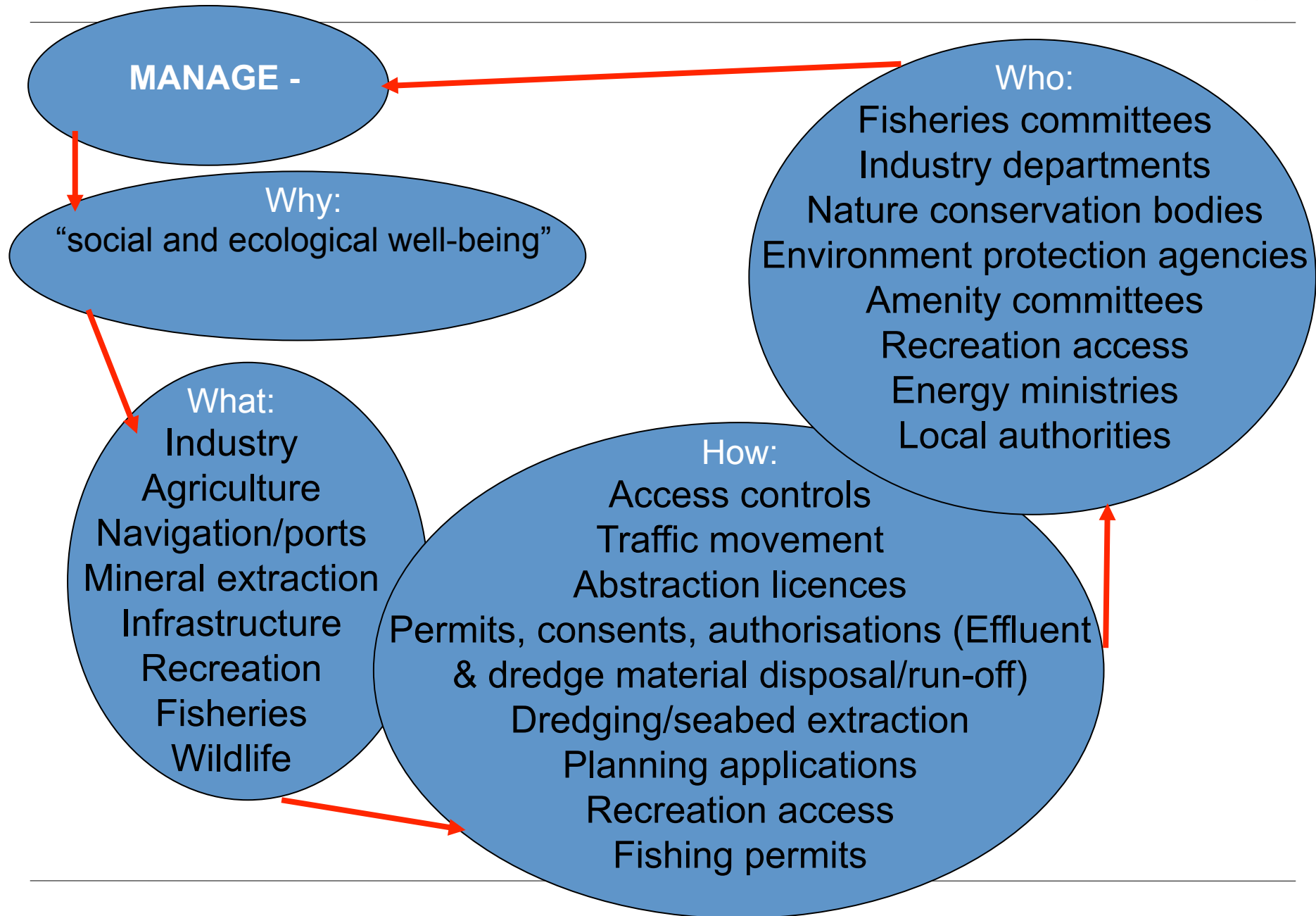
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- leading or following society; fundamental philosophy – centre left/centre right political spectrum;
  - business/economic imperative; economic prosperity vs. big idea;
  - cf. debate that ecosystem services only for society or for own sake;
  - pragmatic scenarios;
  - e.g. for eutrophication - awareness of environmental quality, treat HAB as an oil spill, aware of votes in clean environment but aware of agriculture/farming lobby and jobs versus costs of treatment
-

## 8<sup>th</sup> - 10<sup>th</sup> Tenets:

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- **Ethically defensible (morally correct)** - e.g. economic discounting, forward loading of costs of remedial actions on to future generations
  - **Culturally inclusive** - e.g. First Nation status considerations
  - **Effectively Communicable** - e.g. not only doing the sustainable management actions but being seen to do them.
-



## Things to be managed (and by whom):

- Habitats (nature conservation agencies)
  - Environmental quality (EPA-type organisations)
  - Water space usage (port authorities)
  - Navigation (port authorities)
  - Infrastructure (municipalities/federal state)
  - Energy extraction (private companies)
  - Biological extractions (fisheries bodies)
  - Estuarine water extraction (private energy companies)
  - Upstream water abstraction (water supply companies)
  - Land space usage (municipalities/federal state)
  - Erosion and flooding control (EPA, municipalities etc)
  - Industry (EPA and private companies)
  - Recreation and tourism (agencies)
-

# Analysis of management plans and management drivers

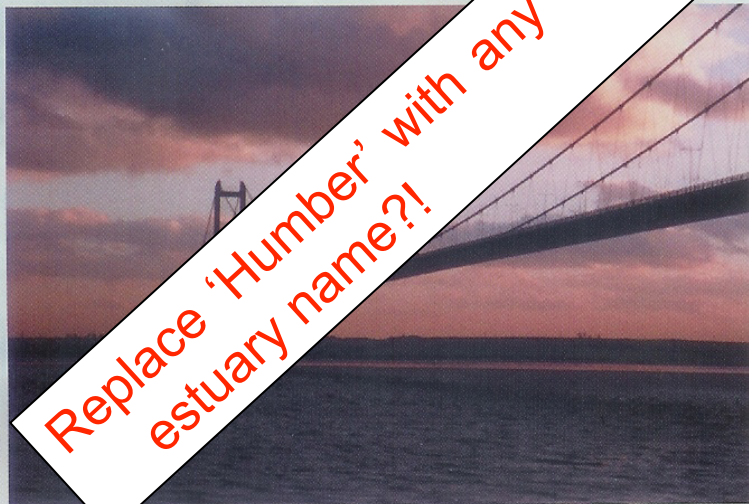
The following management drivers were identified across the four TIDE estuaries, under which all sectoral management plans have been collated and assessed.

- water quality (WFD & UWWTD)
  - nature conservation (Habitats & Species Directive & Wild Birds Directive)
  - flood protection and coastal protection (Flood Risk Management Directive)
  - integrated coastal zone management (MSP&CMD)
  - navigation, ports and pollution prevention
  - economic development (including agriculture, forestry, tourism)
-

# Types of Estuary and Coastal Plan:

- Shoreline Management Plan
- Estuary Management Plan
- Structure Plan
- Port Development Plan
- CHaMPS – Habitat Management Plans
- European Marine Sites Management Plan
- Fish and Shellfisheries Management

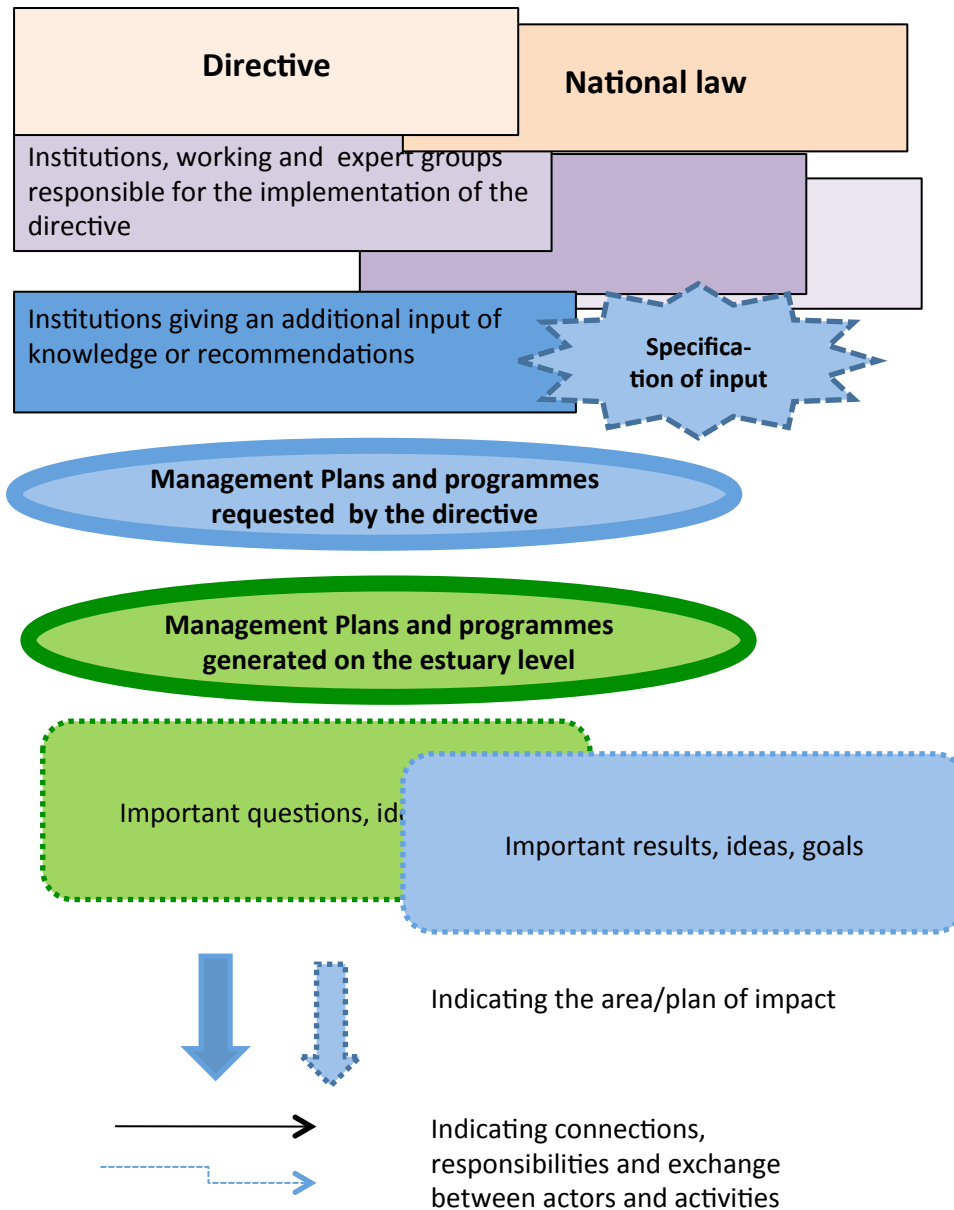
## *Our Vision for the Humber*

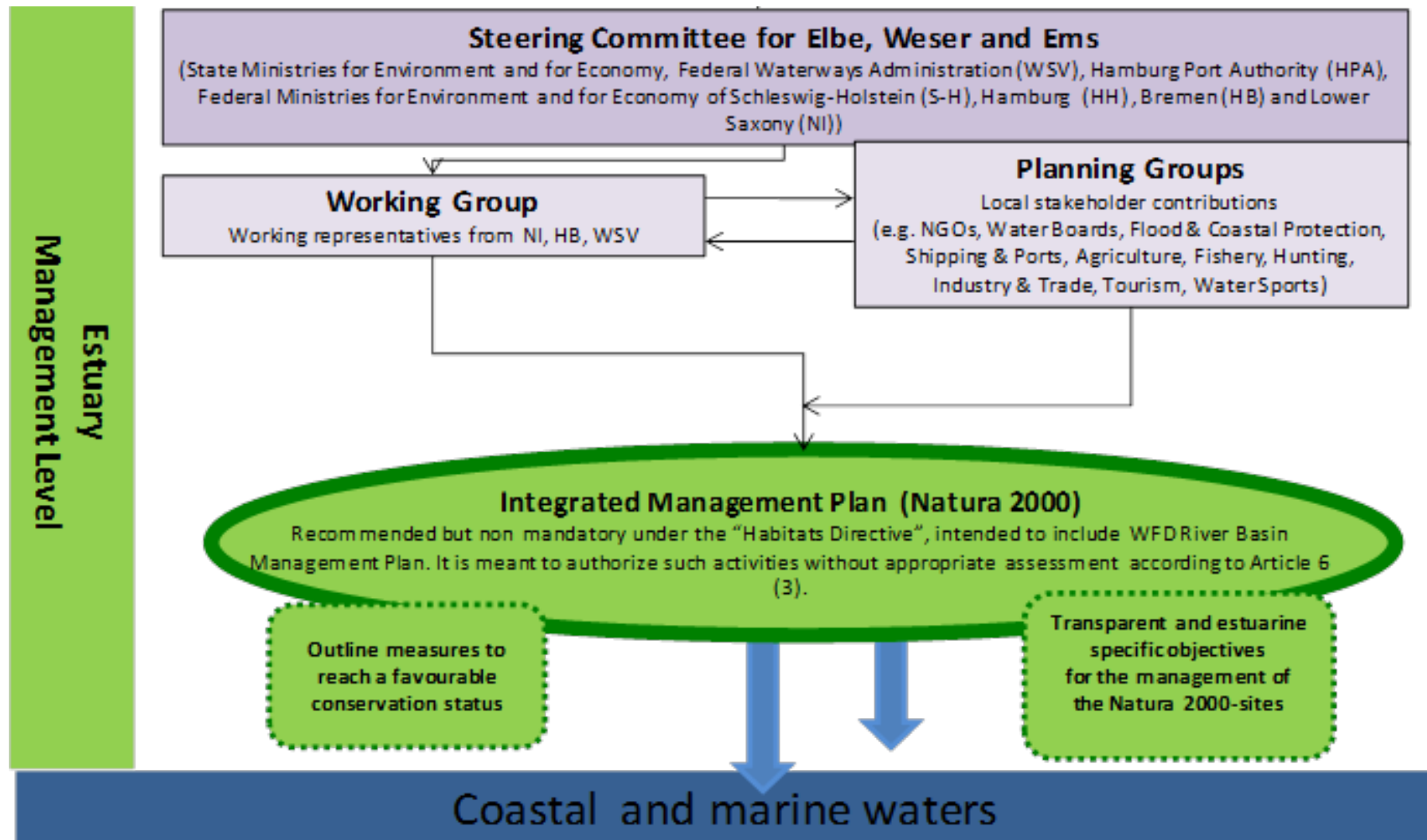


*On a clear day you will see from the top of the Humber Bridge's towers:*

- An unpolluted estuary
- A healthy fishery
- Thriving wildlife with an expanded inter-tidal habitat
- Flood defences that provide an assured level of protection in harmony with the estuary's natural processes
- Prosperous ports, industry and agriculture, which have minimised their environmental impacts and benefit from the diverse and healthy Humber
- A landscape with outstanding archaeological and historic features enhanced by the Environment Agency's activities
- A tourist economy that benefits from the Humber but is sensitive to its wildlife and historic riches
- A vibrant community that understands, cares for and enjoys the Humber.

## Legend





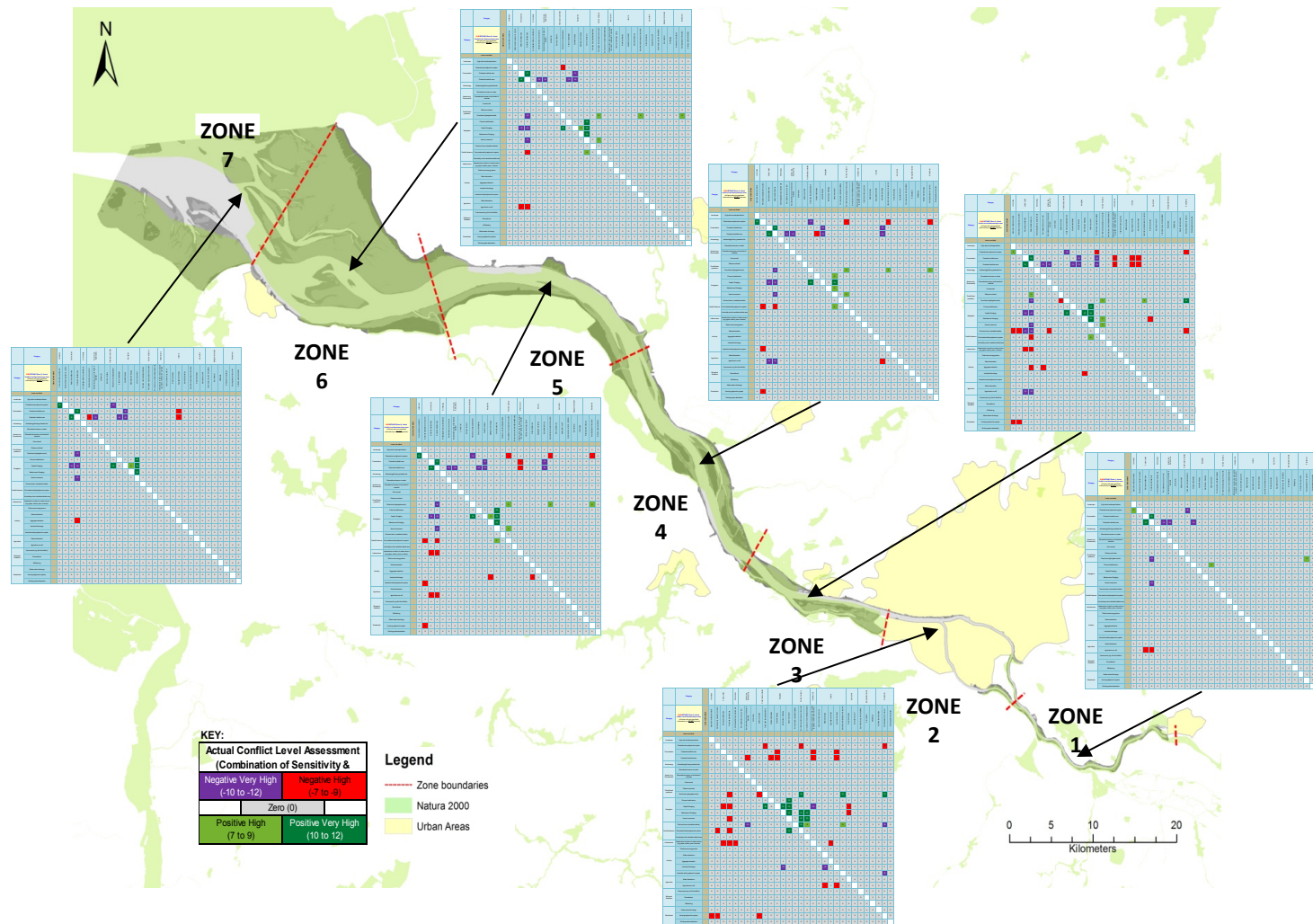
The SWOT analysis was used for each sectoral management plan to create the following table, e.g. water quality:

Estuary	Good/Best Practice	Issue
Weser	Stakeholder groups (Regional Cooperation Groups) were founded in Lower Saxony and Bremen on a regional level. They are supposed to contribute to a successful WFD implementation and set up a list of non-binding measures referring to the tidal section of the river Weser and plans to be updated every six years.	No extended focus on the tidal sections of the rivers within each estuary RBMP. WFD offers a solid basis (see column “Opportunities”) for appropriate implementation.
Elbe	Stakeholder working groups have written non-legally binding lists of measures for the tidal section of the Elbe. This practice has allowed the further integration of other issues like ports, shipping and agriculture into the implementation of the WFD. This plan lists the non-binding list of measures for the Elbe and is planned to be updated every six years.	Continuous control of the accomplishment of the WFD targets is necessary.
Schelde	The RBMPs give greater awareness to nature conservation, recreation, ICZM, shipping and ports than plans for the other three estuaries.	
Humber	A good network of advisory and stakeholder groups for the Humber feeding into the RBMP for the estuary.	

# Conflict Matrix Approach

Key conflict areas identified for each zone for each estuary

This is for the Elbe (and green shading indicates Natura 2000 extent, yellow the urban zones)





## Typology of 'Conflict' based on all estuaries (-/+)

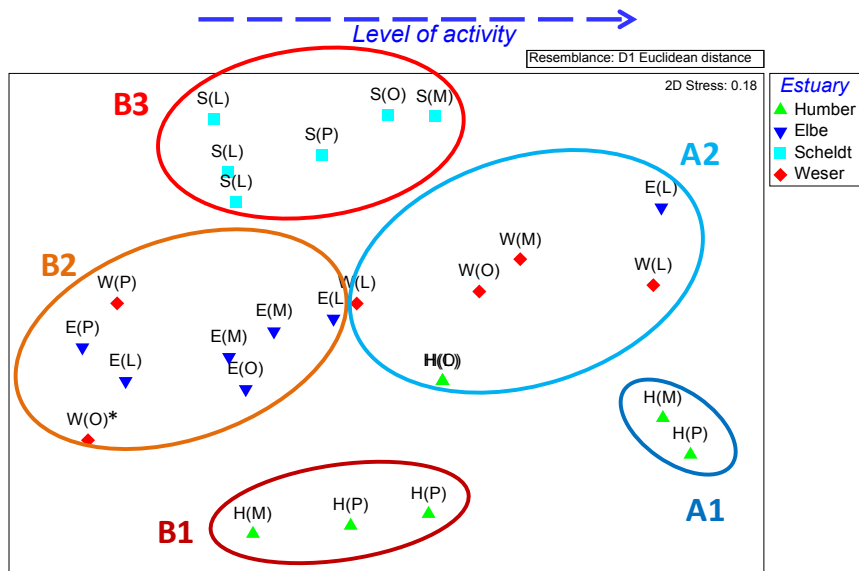
CONFLICTS

Impact of		Impact On		Score
Category	Activity	Category	Activity	
Conservation	Protected subtidal area	Navigation	Capital dredging	-7
Conservation	Protected subtidal area	Navigation	Maintenance dredging	-7
Conservation	Protected intertidal area	Access (e.g. disturbance)	Recreational access on the banks & intertidal	-9
Access (e.g. disturbance)	Recreational access on the banks & intertidal	Conservation	Protected intertidal area	-8
Flood/Coast protection	Flood bank (dyke/gabion/wall)	Conservation	Protected intertidal area	-8
Navigation	Capital dredging	Conservation	Protected subtidal area	-7
Navigation	Capital dredging	Conservation	Protected intertidal area	-7
Navigation	Maintenance dredging	Conservation	Protected subtidal area	-7

SYNERGISMS

Impact of		Impact On		Score
Category	Activity	Category	Activity	
Conservation	Protected subtidal area	Conservation	Protected intertidal area	9
Conservation	Protected intertidal area	Conservation	Protected subtidal area	10
Flood/coast protection	Flood bank (dyke/gabion/wall)	Ports & Harbours	Port related activity adjacent to system	7
Flood/coast protection	Flood bank (dyke/gabion/wall)	Industry	Industrial activity adjacent to system	7
Flood/coast protection	Flood bank (dyke/gabion/wall)	Residential	Housing adjacent to system	8
Navigation	Channel stabilisation	Navigation	Vessel movement	8
Navigation	Capital dredging	Navigation	Vessel movement	7
Navigation	Maintenance dredging	Navigation	Vessel movement	9

## *MDS ordination & cluster analysis based on activity scores by management zone*



Whilst a typology of key estuary user interactions can be established, issue composition is site specific – no ‘one size fits all’ plan may be possible, but requires targeted approach focussing on pinch-points. TIDE Measures & Tools provide guidance to assist this process.

**A groups** show higher activities level overall, in particular related to Port & Harbour (port activities, land claim, port related activities in adjacent areas) and Industry (discharge, water abstraction) compared to B groups

**A1 (Zone 3 & 4, Humber)** shows highest activities level overall, in particular **high** Port & Harbour activities, Infrastructure on Bed or in Water Column and Tidal/current Energy Device (Industry), but **no** Channel Stabilisation

**A2 (mostly Weser): Higher** Water Abstraction for Agriculture and Industry & presence of Drinking Water Abstraction (absent in all other groups)

**B1 (Humber, Zones 2, 5, 6): Low** Channel Stabilisation (Nav.), Recreational Access on Water, Landscape feature and **No** Port land claim, Industrial discharge and Water abstraction (Industry)

**B2 (mostly Elbe):** lowest activity level overall, **no** Port Activities, **low** Recreational Access to banks/intertidal, Infrastructure on Bed & Residential Housing, but **high** value Landscape Feature provision.

**B3 (Scheldt): High** Commercial Access, Aggregate Extraction (Industry) & Channel Stabilisation (Navigation), but **low** Capital Dredging (Navigation) and **No** Archaeology/ Historical Protected Site

## Estuary Use & Planning

- The Weser estuary has a relatively large number of moderate to high severity conflicts (29), however only 4 (or 14%) of these are potentially severe.
  - The Humber has a marginally lower number of moderate to high conflicts (24) but a considerably greater number of severe interactions (9) or 38%.
  - The Elbe, whilst having considerably less moderate to high conflicts (12) has 5 of them rating as severe (42%).
  - The Scheldt analysis indicates that there are very few moderate to severe conflicts and a low proportion of these are actually severe.
  - The Weser issues although more numerous are generally less severe than other estuaries, and the Elbe, whilst having relatively few issues, faces a larger proportion of these being severe.
  - Whilst there are synergisms identified for all estuaries, the Scheldt has many more and these tend to be more positive.
-

As such, according to the Regional Working Groups:

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- although the Weser has the highest number of ‘issues’, the Humber has the greatest number of ‘issues’ ranked as *severe*.
- the Elbe has a reduced number of conflicts, but the highest percentage of those ranked as severe.
- the Scheldt features both the lowest number of conflicts, but also the highest number of user interactions considered to be synergistic.

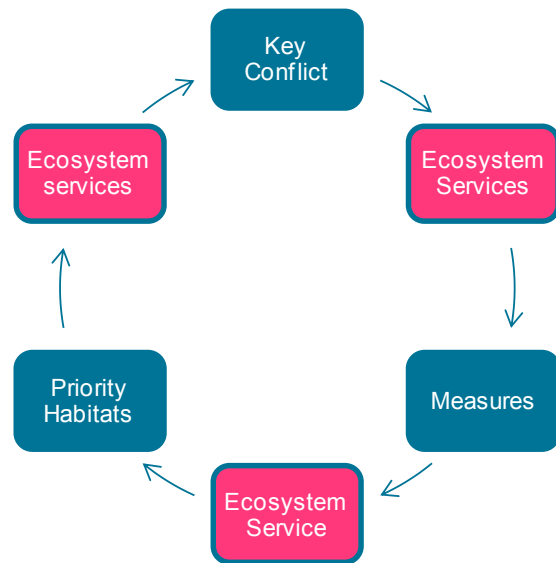
Is the Scheldt subject to better management – it has a history of integrated management e.g. ‘Long term vision Westerscheldt’ plan and a necessity for trans-national co-ordination?

Reduced conflict between Natura 2000 requirements and navigation related activity on the Humber is primarily due to the ports industry being towards the estuary mouth. However, the recent development of a dredging strategy for the Humber for a Habitat Regulations Assessment is considered to have assisted in the reduction of conflict potential (e.g. by the ports authority in conjunction with statutory agencies charged with environmental protection.)

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# Conflict Matrix Findings:

## Measures Implementation via Ecosystem Services



Hence: the conflict matrix approach is of value, particularly when used with the measures tools developed under TIDE and with the Ecosystem Services approach.

This allows Ecosystem Services to provide a common currency to help determine the relative values of management options once the areas of key conflict are determined,

Hence leading to appropriate management measure delivery.

**Conflict Matrix proforma and user guide provided as a TIDE Tool for download**

- Understanding the legal, political, economic and social constraints to adaption to, and mitigation of the effects of climate change;
  - to determine the impacts of changes in marine life on governance structures (PESTLE);
  - use the synthesis and modelled outputs to identify mitigation/compensation/adaptation options;
  - to determine how political systems and environmental solution differ across the EU;
  - to consider how best to integrate RSC requirements within EU level;
  - to use the synthesis to determine recovery/restoration scenario differences across EU re. PESTLE;
  - to link outputs to give a spatial analysis of dominant pressures in regional seas & link to future change projections [scenarios?];
  - to define societal tolerances/preferences and make recommendations
-

## What are the main challenges (spelt p.r.o.b.l.e.m.s) facing our estuaries?

### Climatic and ecological deterioration

- Climate change including sea level rises
- Bank erosion
- Reducing rainfall and reduced water flow
- Loss of vegetation
- Eutrophication and nutrient enrichment from diverse sources
- Acid sulphate sediments
- Hydrocarbons
- Catchment drainage management needs to be coordinated
- Agricultural applications and fertilisers
- Poor water quality

Which of these are within or outside our control?

### **Increasing development pressures**

- Rapid urban development and human pressures
- Increased industry
- Non nutrient pollution
- Inappropriate development
- Huge population growth and overcrowding
- Multiple, competing uses
- Managing recreational areas for increased population
- Increased boat traffic and pollution
- Illegal hunting and invasive species
- Overfishing
- No long-term sustainable focus





**Which of these are 'train wrecks', showstoppers' and 'bottlenecks'?**

# What is your vision for an/our estuary/ies?

Ecologically restored habitat	
<input type="checkbox"/> Maintained biodiversity and an abundance of wildlife	
<input type="checkbox"/> Clean water and healthy flora and fauna	
<input type="checkbox"/> The intrinsic ecological values of the system preserved	<p>How to measure the end point? How do you know you've reached it? What indices can you use? Are the objectives SMART (specific, measurable, achievable, realistic, time-bounded) ?</p>
<input type="checkbox"/> Whole ecosystem functioning well to provide ecological services	
<input type="checkbox"/> Preserved connectivity	
<input type="checkbox"/> Adaptable system which can accommodate future pressures	

Effectively managed human development and impacts	
<input type="checkbox"/> Urban and population impacts managed	
<input type="checkbox"/> Restricted residential and industrial development	
<input type="checkbox"/> Opportunities for built environment and industry to exist sustainably	<p>How to measure the end point?            How do you know you've reached it?            What indices can you use?            Are the objectives SMART (specific, measurable, achievable, realistic, time-bounded) ?</p>
<input type="checkbox"/> Restricted ecological areas and reduced recreation areas	
<input type="checkbox"/> Developments to have nil impact on estuarine systems	
<input type="checkbox"/> Incorporate urban, industrial and agricultural values into management	
<input type="checkbox"/> Sustainable agriculture with more effective systems to reduce impacts	

## Healthy functioning ecosystem that serves the community

 Healthy waters for community recreation, safe to swim in	
 An alive estuary that people can use not just look at	
 Provides access for recreation & tourism	
 Safe, resilient and accessible facilities and opportunities for the community to recognise cultural and social values	

How to measure the end point?  
 How do you know you've reached it?  
 What indices can you use?  
 Are the objectives SMART (specific, measurable, achievable, realistic, time-bounded) ?

## Improved environmental management across the catchment

Effective management to cope with industrial and urban development

Nutrients reduced and no eutrophication symptoms

Eliminate human effects

Estuaries managed and reshaped to cope with future impacts such as sea level rise

How to measure the end point?

How do you know you've reached it?

What indices can you use?

Are the objectives SMART (specific, measurable, achievable, realistic, time-bounded) ?

**Better governance of estuarine systems**

- ☒ Simplified, effective, holistic management systems with clear roles and responsibilities
- ☒ Community, government and stakeholders collaborating
- ☒ Indigenous management and experience recognised

How to measure the end point?  
 How do you know you've reached it?  
 What indices can you use?  
 Are the objectives SMART (specific, measurable, achievable, realistic, time-bounded) ?

**Recognition and awareness of the value of healthy ecosystems**

- ☒ Create community awareness and support action
- ☒ Opportunities for learning, education and awareness

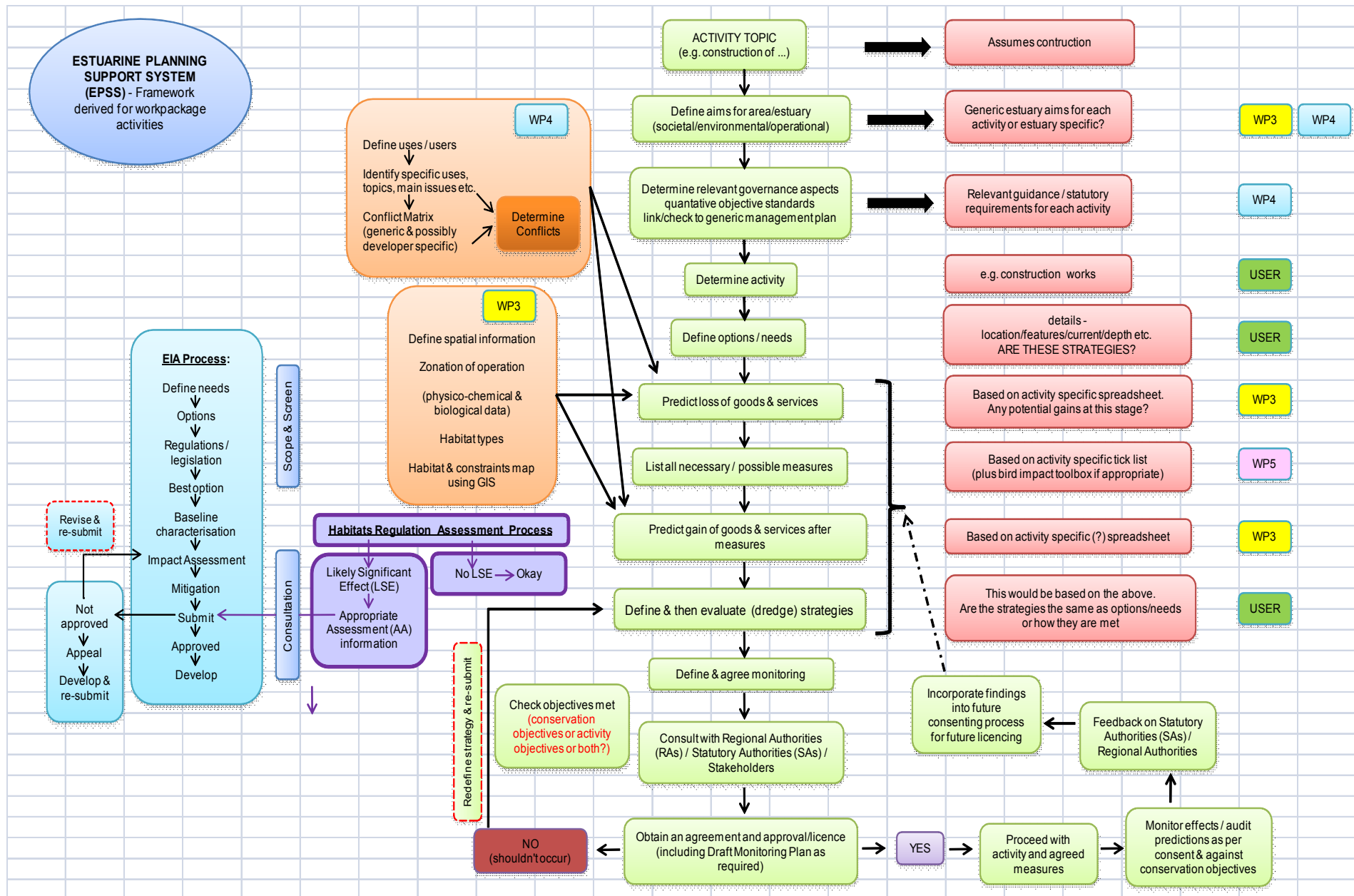
The last 7 slides from TIDE-on-Tour to Perth, Australia!

Bottlenecks	Showstoppers	Trainwrecks
Lack of clear objectives No stakeholder forum Poor scientific understanding Poor advice Confusing planning system Manageable hazards Poor communication	Complex regulation Poor knowledge Poor training Overlapping designation Conflicting designation Sectoral management Poor administration Economic prerogative Lack of technologies Lack of tools Increasing governance Slow planning system Non-integrated planning system Manageable hazards	Intransigence Lack of funding Legal challenges Political will Unwillingness to adopt joint aims/vision Inflexible planning system Unmanageable hazards Lack of permissions Cultural conflicts Iconic ecology Ethically immoral

## Recipe Leading to Integrated Management

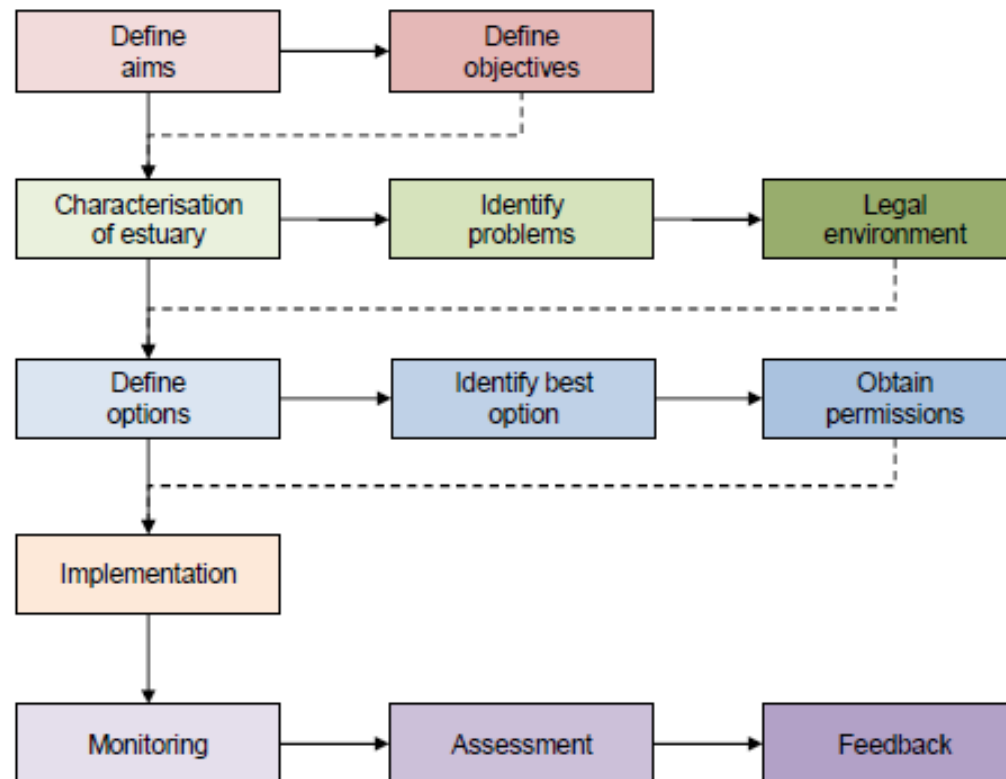
- Needing an understanding of: Ecological structure and functioning
- Leading to describing: Ecosystem services
- Leading to providing: Societal benefits
- Defined by: Historical evolution and estuarine comparisons
- To show how: Ecosystem services are delivered
- Requiring: Management initiatives and governance to ensure how societal benefits are obtained
- Within a multiuser system: What occurs where amongst estuarine users
- Leading to: Conflicts amongst users
- Requiring: Resolution of conflicts
- Requiring: Management measures
- Communicated by: Dissemination and information

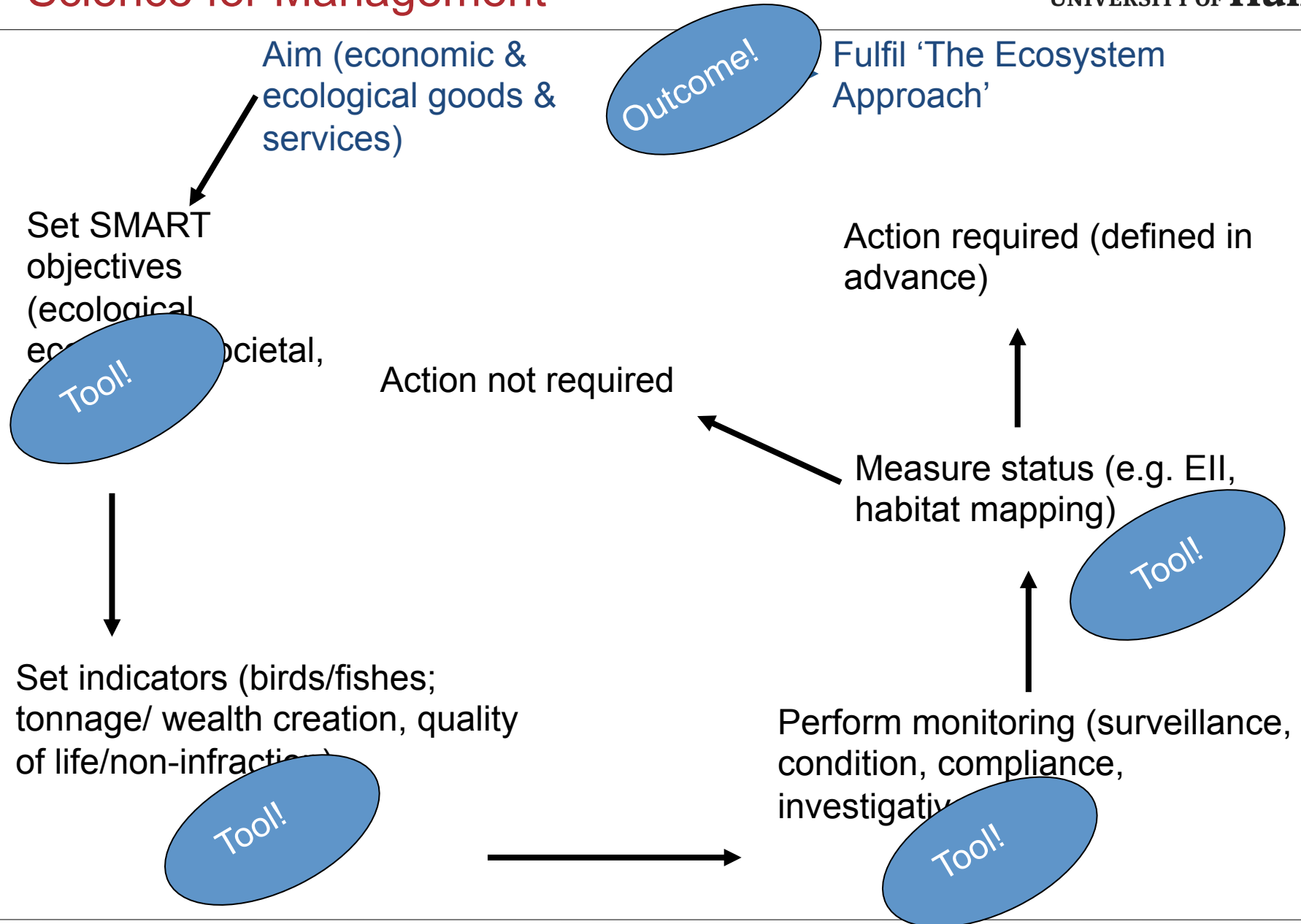
# EPSS – generic tool for set up of plans



# Estuarine Planning Support System, EPSS (v1.0)

- The EPSS is a representation of a generic integrated estuarine management process.
- Five main stages are linked through a series of steps to guide a user through the process of estuarine management.
- Throughout the process links are available to take the user to specific tools and outputs from the TIDE project .
- Further information on each stage of the EPSS is available by clicking on the boxes in the flowchart.





## Conclusions (and there is always a 'but!'):

- All estuaries are different for management (*but* all estuaries have similar features/paradigms);
- All approaches to management are similar (*but* need to be modified for site-specificity);
- All management requires data, knowledge and expertise (*but* manage in the absence of these);
- All sectors have different constraints and perspectives (*but* prevailing governance requires integration);
- The underlying governance is the same (*but* has been implemented differently at local/regional/national levels);
- All areas have conflicts (*but* conflict resolution requires compromise)
- Tools are available and/or can be created (*but* need 'road testing' for other estuaries);
- All estuaries have similar economic and societal constraints (*but* not all players are aware of this).

## Main Messages (1):

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- Clear objectives in fulfilling The Ecosystem Approach, 'triple wins' for ecology, society and economy.
  - Determine problems (footprint) and then address/solve/ mitigate/ compensate;
  - Don't assume activities automatically lead to pressures to impacts (negates mitigation and compensation);
  - Good business relies on good ecology/biology/husbandry;
  - Essence is connectivity (good water conditions, ecological well-being, conditions fit-for-purpose);
  - Vertical and horizontal integration, across sectors and states with harmonised governance and feedback mechanisms;
  - Ability to agree future scenarios & manage to moving baselines;
  - Monitoring/modelling/management - adaptive systems;
-

## Main messages (2):

- From ExUP and EnMP to achieve ecological and socio-economic carrying capacity;
- To protect and enhance ecosystem services and deliver societal benefits;
- To achieve and manage ecological and socio-economic connectivity via a nested DPSIR/DPSWR/DPSEEC approach;
- To use ecological and economic valuation for communication and management decisions;
- Within a sustainable management framework (10-tenets, using governance ‘as a servant not a master’);
- To separate (and use properly) Environmental and Regulatory Impact Assessment;
- Ensure sustainability - but for what/who/how/when?

