



Cardiff Bay Barrage

EIA EVALUATION

Introduction - EIA

- ▶ **Environmental Impact Assessment (EIA)** - process which identifies, predicts, evaluates and mitigates the biophysical and social effects of intended developments before significant decisions are taken and commitments made (Senécal, Goldsmith and Conover 1999).
- ▶ **Legal Definition?** Art 1(2) revised EU Directive on EIA (2011/92/EU) [UK transposition by spring 2017] (Fothergill 2014).
- ▶ **Environmental Statement (ES)**
 - ▶ key output of the EIA process
 - ▶ considered, when deciding whether to grant consent for a development, by the competent authority (Wood, Dipper and Jones 2000).
- ▶ ES for the Cardiff Bay Barrage development (1991) was compiled by the Environmental Advisory Unit (EAU).

Cardiff Bay Barrage - Location



Source: www.hydrokit.co.uk



Source: www.activecardiff.com

Introduction – Cardiff Bay Barrage

- ▶ Why construct a Barrage at Cardiff Bay?
 - ▶ improve the aesthetic appearance of Cardiff Docks
 - ▶ hide a large area of mudflats (perceived unsightly)
 - ▶ attract development
- ▶ However...
 - ▶ Cardiff Bay mudflats/salt marshes designated a site of Special Scientific interest (SSSI) in 1980 (bird species in nationally important numbers)
 - ▶ Severn Estuary designated a Special Protection area (SPA) under the EC Directive on the Conservation of Wild Birds
 - ▶ Wetland of International Importance under the Ramsar Conventions
- ▶ SSSI was permanently submerged by a two-hundred hectare freshwater reservoir upon Barrage closure

Ecology – Waders and Wildfowl

- ▶ Nationally important numbers of Dunlin and Redshank in Cardiff Bay (studies conducted in 1980s and 1990s)
- ▶ Loss of 190ha of feeding ground habitat
- ▶ Relocation of displaced birds in Severn Estuary's neighbouring mudflats expected
 - ▶ Newport Wetland Reserve (NWR) compensation habitat would not support species dependent on mudflat feeding ground
 - ▶ ES estimated Dunlin and Redshank populations would increase by 10.7% and 36.1% respectively in neighbouring mudflats- similar to what was observed.
 - ▶ Goss-Custard et al. (2006) observed a 40% increase in Redshanks at Rhymney
- ▶ Increase in mortality rate of birds in the remaining estuaries expected, but no research was conducted as to the extent
 - ▶ Goss-Custard et al. (2006) observed a 3.17% increase in mortality of the combined population of birds at Rhymney - an increased rate of food depletion?
- ▶ Unknown effect on Shelduck population
 - ▶ Breeding season territoriality limits available habitat
 - ▶ Regrettable this was not investigated as the population of Shelduck in Cardiff Bay plummeted by 89% (Ferns and Reed 2009) post Barrage completion
 - ▶ Uncertain if displaced population was accommodated elsewhere.
 - ▶ Significance? - Despite Cardiff Bay not holding nationally important numbers, 10-15% of the Severn's Shelduck population were resident at Cardiff Bay

Ecology – Birds and Construction

- ▶ Very little consideration of barrage construction as a source of disturbance for bird species.
 - ▶ Only briefly mentioned - ES stated numbers of Green Winged Teal, Pochard and Mallard may reduce as a result
- ▶ No detail provided on proximity of the major construction to the species' habitat or details of what the construction will entail
 - ▶ In addition, housing, a hotel, a peripheral distributor road (PDR) and divided highway were under construction (Burton, Rehfish and Clark 2002).
- ▶ No consideration is made for other bird species that may be affected
 - ▶ Eurasian Oyster Catcher, Dunlin, Common Redshank and Eurasian Curlew
 - ▶ Construction disturbance significantly reduced populations of the four aforementioned species over eleven years in addition to the Green Winged Teal (Burton, Rehfish and Clark (2002)
- ▶ The ES expected Mallard numbers to reduce during construction
 - ▶ The opposite was found possibly as this species often experiences anthropogenic activities Burton, Rehfish and Clark (2002)
- ▶ Unclear if decline in species numbers during construction is solely due to disruption
 - ▶ During the study period, a decline in numbers was noted in South Wales generally (Austin, Peachel and Rehfish 2000).
- ▶ Regardless, the impact should have been considered fully in order to take steps to mitigate impacts
 - ▶ Carrying out the most disruptive work during the summer months when the most affected species are not resident
- ▶ Also on construction: revised EIA Directive (Annex IV) – requirement to report in the ES the expected types/quantities of waste that will result from the project.

Ecology – Mitigation (1)

- ▶ Cardiff Bay Development Corporation was required to provide ~ 400ha of compensatory wetland habitat (NWR) for the damage caused to bird species by the barrage development (Murata and Feest 2015).
- ▶ Varied feedback as to the success of the reserve as an alternative to the Cardiff Bay SSSI habitat
 - ▶ NWR was successful in achieving its double target
 - ▶ Firstly, two water bird species have been maintained in nationally important numbers
 - ▶ Secondly, 374.2ha of the reserve was designated a SSSI in 2010 (County Council for Wales 2010).
- ▶ Murata and Feest (2015) suggest the NWR is preferable to the original habitat but acknowledge that the expected species colonisation at NWR would be different to the species displaced from Cardiff Bay.
 - ▶ ES also states that the NWR will support alternative plants and animals to those which were resident in the Bay
 - ▶ Therefore, the replacement habitat will not offer 'complete compensation' and cannot be regarded as a replacement
- ▶ ES estimated that the NWR would support 25% of the displaced Dunlin and 15% of Redshank
- ▶ However, NWR would be more hospitable than the harsh estuarine environment of Cardiff Bay, increasing biodiversity and by extension, increasing competition for food
 - ▶ ES acknowledges that gulls may be attracted from a near-by landfill site

Ecology – Mitigation (2)

- ▶ The NWR was 'highly successful' in supporting a broad range of avian species
- ▶ Remaining habitat at Cardiff Bay also became more attractive to less adapted species (Reed 2007).
 - ▶ Therefore, Redshank or Dunlin remaining at Cardiff Bay during winter had a twofold problem:
 - ▶ Firstly, the majority of their feeding ground is permanently submerged
 - ▶ Secondly, competition is increased for dwindling food supplies
- ▶ Wentloog Lagoon at the NWR would need to be maintained and dredged every five years
 - ▶ Impact upon resident invertebrate species briefly mentioned but no consideration given to the disturbance of local avian populations
 - ▶ Conduct activity when it causes the least disturbance i.e. not during times of breeding/roosting.
- ▶ NWR is fed by a reservoir whose input sources include run-off water from roads and car parks, potentially containing pollutants of a high concentration – not considered in the ES (Reed 2007)
 - ▶ This may result in a lower than average diversity of species in the reservoir (less invertebrate species for feeding).

Ecology – Mitigation (3)

▶ **NWR was not completed in time**

- ▶ Construction commenced in 1998 - completed in 2000 (Murata and Feest 2015)
 - ▶ Construction on the Barrage commenced in 1994 and the Barrage closed in 1999
 - ▶ The ES recommended Wentloog Lagoon be completed between one and three years before the closure of the Barrage – this was not achieved.
 - ▶ Developers overlooked the birds displaced during construction - the lagoon was not completed until six years after construction on the barrage had commenced. ES rightly suggested should be avoided to minimise disruption to avian species
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- ▶ Reed (2007) suggests that the NWR, if managed correctly could offer suitable direct compensation for the habitat lost
 - ▶ Arguable that this is not the case at present as the NWR has not attracted the nationally important numbers of Dunlin and Redshank who were frequent winter residents of Cardiff Bay (Murata and Feest 2015).

Ecology – Mitigation (4)

- ▶ Impact of revised EIA Directive?
- ▶ Article 8a (1) – requirement of monitoring for significant environmental effects of projects, (Fothergill 2014)
 - ▶ E.g. reduction in wader and wildfowl numbers following construction disturbance and submersion of natural habitat.
 - ▶ Fothergill (2014) - put right the existing legislation's 'biggest flaw'
 - ▶ mandatory monitoring requirement ensures feedback from completed projects drives practice in the future, leading to continuous improvement
- ▶ Encouraging, as the EIA process is less likely to be seen as a means of gaining consent for a development.
 - ▶ Throughout the EIA process, feedback should be continuous (Wood, Dipper and Jones 2000)
 - ▶ The EIA process should be cyclical (Wood 1995) allowing EIAs to become a useful tool for sustainable, sound and rational management of the environment rather than a means of obtaining planning permission (Bisset, 1980; Rosenberg et al., 1981; Bisset & Tomlinson, 1988; Sadler, 1988).
- ▶ The barrage development was a landmark example whereby, although conservation was arguably considered a secondary concern to socio-economic progress, concessions were made in the form of the allocation of the NWR (Doody 2004)
- ▶ Following the transposition of Article 8a (4), the delivery of mitigation will be a requirement

Ecology – Fish Species and Water Quality

- ▶ A fish pass was incorporated into the barrage design
 - ▶ Allows safe passage of migratory fish upstream to spawn
- ▶ Dissolved oxygen (DO) concentration of 5ml/l, used as a key indicator water quality
 - ▶ In order for the freshwater lake to be hospitable for salmon and sea trout
 - ▶ incorporated in the Cardiff Bay Barrage Bill (1993)
- ▶ Measures taken to maintain DO concentration
 - ▶ aeration system
 - ▶ deployment of an oxygen barge
- ▶ Data uploaded onto a publically-available website as of 2008 (YSI 2011)
 - ▶ Good practice - keeping stakeholders involved in continued monitoring helps to better manage a project's implementation in the community (Glasson, Therivel and Chadwick 2005).
 - ▶ Revised EIA Directive Article 8a (1) – requirement of monitoring for adverse environmental effects
 - ▶ e.g. DO monitoring following development completion (Fothergill 2014)

Hydrology - Flooding

- ▶ ES concludes:
 - ▶ the Barrage would not increase flood risk from any cause
 - ▶ the effect of the barrage regarding flooding would be beneficial
 - ▶ Extensive hydrodynamic modelling simulating an array of river and tidal conditions (Burt 2001)
- ▶ Continuous monitoring to alert to increasing water levels was recommended in the ES to allow sluice gates to be opened to alleviate surplus water.
 - ▶ Such monitoring will be required following the transposition of the amended EIA directive Article 8a (1)
 - ▶ However, monitoring failed in December 2009 when lake water flooded Mermaid Quay with an apparent 'mystery' cause (Wales Online 2009).
 - ▶ No other instances of flooding have been recorded.

Hydrology - Groundwater

- ▶ Extensive studies were carried out by various firms in order to map the groundwater conditions of the surrounding area and the effect of the Barrage thereon
 - ▶ Good practice - the EIA process should be striving for an impact estimation which is realistic (Wood 1995).
- ▶ ES concluded that the negative impact upon groundwater would be marginal and possibly beneficial - peak groundwater levels in some areas would be reduced
 - ▶ It has been found that out of sixteen-thousand homes, only one property showed negative effects following a rise in groundwater associated with the Barrage, and this was in the predicted area. (Fletcher and Spencer 2005)
 - ▶ Groundwater rises in some areas may result in health problems in elderly and young residents (Best 2004)
 - ▶ It may have been advisable to conduct a Health Impact Assessment (HIA) to assess the effects of the barrage upon local residents (HIAs to be discussed in more detail in the following slides)

Hydrology – Coastal Erosion

- ▶ ES considers the impact of the barrage upon siltation rates in the dredged channel
- ▶ No consideration of the barrage's impact upon coastal erosion
 - ▶ Significant impact - erosion related to the barrage has been detected 72km away (Phillips 2007).
- ▶ Studies, such as those carried out for groundwater impacts appear to have been necessary in the case of coastal erosion.

Society – Local Communities

- ▶ ES considers the societal implications of the construction of the barrage
 - ▶ Society has equal priority to environment and economy in models of sustainable development (Khan 1995, Giddings, Hopwood and O'Brien 2002)
- ▶ ES only briefly consider social tension between the existing residents of Butetown and the anticipated 12,000 new inhabitants
- ▶ Many positive effects of the barrage development upon the Butetown and Grangetown
 - ▶ house price rises
 - ▶ more local amenities and leisure facilities
- ▶ Also many negative effects more than trebling the population which are not/not fully considered
 - ▶ strife between different societal or racial groups
 - ▶ availability of parking
 - ▶ availability of social amenities e.g. access to doctors surgeries and dentists.
 - ▶ impact of hundreds/thousands of visitors to the developed area upon local residents
- ▶ Would have been appropriate to conduct a Social Impact Assessment (SIA) - appears to have been deemed unnecessary
 - ▶ As part of the EIA process the social dimension has often been considered the 'poor relation' (Glasson and Wood 2009)

Society – Noise Pollution

- ▶ Increased noise from Barrage construction and PDR traffic considered
- ▶ No consideration of increased noise pollution post construction and following Cardiff Bay development as a result of day visitors and an increase in nightlife
 - ▶ Residents
 - ▶ Wildlife
- ▶ Light Pollution?
 - ▶ Effect of light pollution on residents and wildlife overlooked
 - ▶ During construction
 - ▶ Post development of Cardiff Bay

Society – Traffic and Air Quality

- ▶ Issue of dust generation during the latter stages of construction identified
- ▶ However, no consideration made for potential air quality issues resulting from increased in traffic congestion associated with more visitors
 - ▶ Road traffic has been found to have an adverse effect on the human respiratory system (Wjst et al 1993) owing to emissions of airborne particles, carbon monoxide, volatile hydrocarbons and nitrogen oxides (Koenig 1988, Godlee 1991)
- ▶ Carrying out a HIA of the construction phase and wider impacts of the Barrage development on public health (relating to noise and light pollution, air quality and a potential increase in groundwater) would have been advisable
 - ▶ Allow the barrage development to be judged on its effect on the surrounding population's health and also importantly the distribution of said effects (WHO 1999)
 - ▶ Ascertain if some communities would be more affected than others and allow for development of alternatives/mitigation.
 - ▶ Post transposition of the revised EIA Directive, one of the new environmental topics to be considered is human health under Article 3 (Fothergill 2014)

Society

- ▶ Public Participation
 - ▶ Consent believed to be obtained in secretive manner (Secrett 1997; Best 2004)
 - ▶ Providing information of proposed project's potential environmental impacts is a key aim of the EIA process (Glasson, Therivel and Chadwick 2005)
 - ▶ However, no official requirement for public participation exists during Local Planning Authority decision-making process or prior to ES submission (Wood 1995)
 - ▶ Despite this, involving the public in ES preparation results in improved quality of the report or at least increased acceptability (Wood 1995)

Recommendations & Conclusions

- ▶ The ES has been found to be adequate with a breadth of issues considered
 - ▶ Guidance suggests not every aspect of a development's possible environmental impacts need consideration in great detail – just a brief mention to demonstrate they have not been overlooked (ODPM 2003).
- ▶ Despite this, impacts considered in insufficient detail:
 - ▶ light pollution
 - ▶ coastal erosion
 - ▶ effect of the barrage construction upon wildlife in close proximity (compensation environment not completed in time to accommodate displaced species)
- ▶ NWR successful in achieving its two aims
 - ▶ Unsuccessful in housing the original species displaced
- ▶ Monitoring requirement for adverse environmental impacts following Article 8a (1) transposition
- ▶ HIA and SIA useful to identify impacts upon local population
 - ▶ Article 3 – requirement to consider human health

Improvements made by Revised EIA Directive

- ▶ The revised EIA Directive will result in a number of improvements to the EIA process
 - ▶ New topics to be considered include:
 - ▶ Human health, land and disaster risk and biodiversity [Art 3]
 - ▶ Climate change and resource efficiency [Annex IV]
 - ▶ Utilisation of experts (preparation and examination of EIA reports) [Art 5 (3)]
 - ▶ Monitoring of significant adverse effects [Art 8a(1)]
 - ▶ Definition of EIA and cumulative effects [Art 1(2)], Annex IV)
 - ▶ Restrictions on developers acting as competent authorities [Art 9a]
 - ▶ Penalties for infringements [Art 10a]

How could the revised EIA Directive be improved?

The revised EIA Directive might have been improved by conducting a review of Annex I and Annex II (Fothergill 2014)

- ▶ Legal ambiguity concerning unconventional hydrocarbon activity
- ▶ Failing to serve needs of stakeholders
 - ▶ Developers determine own approach to EIA
 - ▶ Concern that community concerns will be left unconsidered
- ▶ Therefore, a full review of Annex I and Annex II should have been conducted

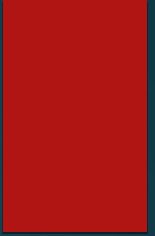
Criticism - Additional requirements:

additional bureaucracy in decision-making

greater legal challenge risk to projects (Howorth, Hardacre & Coxall 2014)

→ Improvements to process and increased protection for environment and society

Questions?



References

- ▶ **Austin, G. E., Peachel, I. and Rehfish, M. M., (2000)** Regional trends in coastal wintering waders in Britain. *Bird Study* 47: 352-371
- ▶ **Best (2004)** 'A whim set in concrete: The campaign to stop the Cardiff Bay Barrage' *Seren* 2004 p.11
- ▶ **Bisset, R. (1980)** Problems and issues in the implementation of EIA audits, *Environmental Impact Assessment Review*, 1, pp. 379 - 396.
- ▶ **Bisset, R. & Tomlinson, P. (1988)** Monitoring and auditing of impacts, in: P. Wathern (Ed) *Environmental Impact Assessment: Theory and Practice*, London, Unwin Hyman.
- ▶ **Burt, N., (2001)** *Guidelines for the Assessment and Planning of Estuarine Barrages*, Thomas Telford, London p.232
- ▶ **Burton, N., Rehfish, M. M., and Clark, A., (2002)** Impacts of disturbance from construction work on the densities and feeding behaviour of water birds using the intertidal mudflats of Cardiff Bay, UK. *Environmental Management*, Vol. 30, No.6, pp. 865-871. Springer-Verlag, New York Inc.
- ▶ **Countryside Council for Wales (2010)** Gwlyptiroedd Casnewydd/Newport Wetlands Site of Special Scientific Interest. Countryside Council for Wales, Cardiff.
- ▶ **Doody, J. P., (2004)** 'Coastal Squeeze' – a historical perspective, *Journal of Coastal Conservation* 10: 129-138. EUCC, Opulus Press Uppsala.
- ▶ **Environmental Advisory Unit (1991)** Cardiff Bay Barrage – Environmental Statement (Cardiff Bay Barrage Bill). Environmental Advisory Unit of Liverpool University Ltd. Liverpool
- ▶ **Ferns, P. N. and Reed, J. P. (2009)** Effects of the Cardiff Bay tidal barrage on the abundance, ecology and behaviour of Shelducks *Tadorna Tadorna*. *Aquatic Conservation Marine and Freshwater Ecosystems*. John Wiley & Sons Ltd, New Jersey, United States.
- ▶ **Fletcher, C. A. and Spencer, T., (2005)** *Flooding and Environmental Challenges for Venice and its Lagoon: State of Knowledge*, Cambridge University Press 2005 p.295-298.
- ▶ **Fothergill, J., (2014)** Built to assess Impacts, *The Environmentalist*, Institute of Environmental Management & Assessment, 7th April 2014 p.16-18 (online) available at: www.environmentalisonline.com/article/built-assess-impacts [accessed on 31st January 2016]
- ▶ **Giddings, B., Hopwood, B. and O'Brien, G., (2002)** Environment, economy and society: fitting them all together into sustainable development. *Sustainable Development*, Volume 10, Issue 4, p.187-196. John Wiley & Sons 2002, New Jersey, United States.
- ▶ **Glasson, J., Therivel, R., and Chadwick, A., (2005)** *Introduction to Environmental Impact Assessment*. 3rd ed. Abingdon: Routledge

References(2)

- ▶ **Glasson, J. and Wood, G., (2009)** Urban regeneration and impact assessment for social sustainability, *Impact Assessment and Project Appraisal*, 27:4, 283-290
- ▶ **Godlee, F., (1991)** Health and the environment – air pollution. II. Road traffic and modern industry. *BMJ* 1991;303:1539-43
- ▶ **Goss-Custard, J. D., Burton, N. H. K., Clark, N. A., Ferns, P. N., McGroarty, S., Reading, C. J., Rehfish, M. M., Stillman, R. A., Towend, I., West, A. D., & Worrall, D. H., (2006)** Test of a behaviour-based individual-based model: response of shorebird mortality to habitat loss. *Ecological Applications* 16: 2215–2222.
- ▶ Howorth, N., Hardacre, E. and Coxall, M. (2014) Watered-down revisions to EU EIA rules finalised. Clifford Chance Briefing Note 2014 (online) available at www.cliffordchance.com [accessed on 26th April 2016]
- ▶ **Khan, M. A., (1995)** Sustainable Development: The key concepts, issues and implications. Keynote paper given at the International Sustainable Development Research Conference, 27th to 29th March 1995, Manchester, UK. Contained in: *Sustainable Development*, Volume 3, Issue 2 p.63-69, John Wiley & Sons 1995, New Jersey, United States.
- ▶ **Koenig, J.Q., (1988)** Indoor and outdoor pollutants and the upper respiratory tract. *J Allergy Clin Immunol* 1988;81:1055-9
- ▶ **Murata, N. Feest, A. (2015)** A case study of evidence for showing 'no net loss' of bird biodiversity in a development project. *Water and Environment Journal*. Print ISSN 1747-6585
- ▶ **Office of the Deputy Prime Minister [ODPM] (2003)** Environmental impact assessment: guide to the procedures. London. HMSO.
- ▶ **Phillips, M., (2007)** Beach response to a total exclusion barrage: Cardiff Bay, South Wales, UK. *J. Coast. Res.* 794-805.
- ▶ **Pollitt, M. S., Cranswick, P. A., Musgrove, A. J., Hall, C., Hearn, R. D., Robinson, J. A., Holloway, S. J. (2000)** The Wetland Bird Survey 1998-99: wildfowl and wader counts. BTO/WWT/RSPB/JNCC, Slimbridge pp.236.
- ▶ **Reed, J. P., (2007)** Plant and animal community changes associated with the Cardiff Bay Barrage. Cardiff University, School of Biosciences. ProQuest LLC, 2013.
- ▶ **Rosenberg, D.M., Resh, V.H., Balling, S.S., Barnby, M.A., Collins, J.N., Durbin, D.V., Flynn, T.S., Hart, D.D., Lamberti, G.A., McElravy, E.P., Wood, J.R., Blank, T.E., Schultz, D.M., Marrin, D.L. and Price, D.G. (1981)** Recent trends in environmental impact assessment, *Canadian Journal of Fisheries and Aquatic Sciences*, 38, pp. 591 - 624.
- ▶ **Sadler, B. (1988)** The evaluation of assessment: post-EIS research and process development, in: P. Wathern (Ed) *Environmental Impact Assessment: Theory and Practice* London, Unwin Hyman.
- ▶ **Secrett, C., (1997)** Friends of the Earth Press release, 'Labour hypocrites over Cardiff Bay Barrage' (online) available at: www.foe.co.uk/pubsinfo/infoteam/pressrel/1997/19970707161413.html [accessed on 16th January 2016]

References (3)

Senécal, P., Goldsmith, B. and Conover, S., (1999) International Association for Impact Assessment, Principles of Environmental Impact Assessment Best Practice, (online) available at: www.iaia.org/uploads/pdf/principlesEA_1.pdf [accessed on 23rd January 2016]

- ▶ **Wales Online (2009) [No author]** Mystery about cause of flooding at Cardiff Bay, 7th Dec 2009 (online) available at: <http://www.walesonline.co.uk/news/wales-news/mystery-cause-flooding-cardiff-bay-2063856> [accessed on 25th January 2016]
- ▶ **Wjst, M., Reitmeir, P., Dold, S., Wulff, A., Nicolai, T., Freifrau von Loeffelholz-Colberg, E., von Mutius, E., (1993)** BMJ 1993; 307:596-600
- ▶ **Wood, C., (1995)** Environmental Impact Assessment: A Comparative Review. Essex: Pearson Education.
- ▶ **Wood, C., Dipper, B. and Jones, C., (2000)** Auditing the Assessment of the Environmental Impacts of Planning Projects Journal of Environmental Planning and Management, 43(1), 23-47, 2000
- ▶ **World Health Organisation (1999)** European Centre for Health Policy. Gothenburg Consensus Paper, Health Impact Assessment – main concepts and suggested approach. Brussels •
- ▶ **YSI Environmental (2011)** Water quality is key to the success of Cardiff Bay Restoration. Application note: A592 (online) available at: www.ysihydrodata.com [accessed on 14th January 2016].