Institution: University of Manchester

Unit of Assessment: UoA5

Title of case study: Remediation and development of the Manchester Ship Canal and Salford Quays

1. Summary of the impact

The 33km Manchester Ship Canal (MSC) was one of the most polluted waterways in Europe following the industrial revolution. Ecosystems were destroyed and odorous sediment rafts prevented the redevelopment and regeneration of the surrounding water front areas that had an estimated real estate value of £500m.

The research led by White established the cause and extent of water pollution in the upper MSC and Salford Quays. Critically this research allowed evidence based restoration programmes to be initiated that have rejuvenated the waterway and Salford Quays areas. This improvement in water quality was the essential first step in the long term development of Salford Quays that has seen approximately 2,000 homes being built and the arrival of 900 businesses that employ over 35,000 people.

2. Underpinning research

The impact is based on the work of University of Manchester (UoM) researchers that took place from 1993 to date. The key researchers were:

Dr Keith White (Senior Lecturer, 1981 to date; Marine Scientist and Technical Director of APEM, 1987 to date)

Dr Adrian Rees (PhD student, 1991-1994)

Dr William Bellamy (PhD student, 1994-1997)

Dr Kevin Nash (PhD student, 1999-2003)

Dr Liz Baldwin (PhD student, 2000-2004)

Mr Robert Mansfield (PhD student, 2011 to date)

The aim of the research has been to analyse the extent of pollution and ecological deterioration in the MSC and Salford Quays, with a view to informing and implementing remediation measures. The key steps were as follows:

- Determining the extent of pollution in the River Irwell whose lower reaches form the MSC. Particular attention was given to the interactions between the chemistry of the sediments and water column, the relative importance of changes in flow and the impact of the tributaries on water quality. The main conclusions were that the lower Irwell/MSC was subject to significant organic pollution from sewage during storm water overflows and the release of pollutants from smaller tributaries [1].
- Identifying the concentration of metals and other contaminants in the sediment layer before and after intervention. UoM researchers showed that the installation of Helixor mixing systems at Salford Quays successfully prevented stratification and release of pollutants from the sediments, reduced anoxia, decreased orthophosphate and ammonia concentrations and controlled algal blooms [2,3].
- Demonstrating that the homogenous conditions in the water basins restricted biodiversity [4]. A programme of habitat diversification and introduction of fish was devised and successfully created a more complex foodweb [5]. Biodiversity has increased, for example there has been an increase from 9 to 50 invertebrate taxa following the improvements in water quality and diversification programme.

On-going research is aimed at analysing ecological improvements as the upper MSC recovers from pollution, with a view to applying effective remediation measures to the entire length of the MSC.

3. References to the research

The research has been published in high quality books and journals. References 1 and 3 in particular are internationally recognised.

1. **Rees, A**., **White, K. N.** (1993) Impact of combined sewer overflows on the water quality of an urban watercourse. *Regulated Rivers: Research & Management*. 8 (1-2). 83-94. DOI:10.1002/rrr.3450080112. Journal Article.
2. Hendry, K., Webb, S. F., **White, K. N.** (1993) Water quality and urban regeneration: a case study of the central Mersey basin. In: Urban Waterside Regeneration: Problems and Prospects. (ed: White, K N, Bellinger, E G, Saul, A J Symes, M & Hendry, K) Ellis Horwood, Chichester. Chapter 31. 271-282. Book Chapter. Available on Request (AOR)
3. Williams, A. E., Waterfall, R. J., **White, K. N,** Hendry, K. (2010) Manchester Ship Canal and Salford Quays: industrial legacy and ecological restoration. In: Ecology of Industrial Pollution (ed: Batty, L C & Hallberg, K B). Cambridge University Press. 276-308. Book Chapter. AOR
4. **White, K. N.,** Hendry, K., Bellinger, E. G. (1993) Ecological change as a consequence of water quality improvements at Salford Quays. In: Urban Waterside Regeneration: Problems and Prospects. (ed: White, K N, Bellinger, E G, Saul, A J Symes, M & Hendry, K) Ellis Horwood, Chichester. Chapter 40. 366-376. Book Chapter. AOR
5. Hendry, K., **Bellamy, W. M., White, K. N.** (1997) Environmental improvements to enhance and develop freshwater fisheries – Salford Quays, a UK case study. In: Fisheries and the Environment: Beyond 2000 (eds. B. Japar Sidik, F. M. Yusoff, M.S, Mohd Zaki and T. Petr). Universiti Putra Malaysai, Serdang, Malaysia. 121-131. Book Chapter. AOR

4. Details of the impact

Context

The MSC was one of the busiest waterways in Europe during the industrial revolution. It was polluted by industrial discharges, sewage overflows, surface water runoff and tributaries. Salmon disappeared from the Irwell in the 1850s and rowing races were abandoned in the 1970s. Despite the real estate value of the disused docks being estimated at around £500m, development was prevented by unpleasant odours, bubbling gas and sediment rafts.

Pathways to impact

White's research into water pollution and biodiversity has been translated into practical solutions for the remediation of contaminated urban waterways. The mechanism for this quick and effective translation is an on-going collaboration with the spin-out company, APEM (Aquatic Pollution and Environmental Monitoring). APEM was founded at UoM in 1987 by White's former Research Associate, Hendry [A]. The annual turnover of APEM is ~£8m, making it one of the largest independent aquatic science consultancies in Europe [B]. White is a Director and Scientist at the company [A].

APEM was commissioned to monitor, manage and advise on water quality and ecology in Salford Quays and the MSC. The work started in 1987 and is continuing to have a major impact on the area today (see review in [3]) with critical input from UoM researchers.

Reach and significance of the impact

Providing an evidence base for effective water remediation strategies:

APEM's continuing commercial activities relating to water quality management are underpinned by research led by White. From 1993 to date, research conducted by White has been influential in directing APEM's research strategy and enabling the realisation of environmental and social benefits, with joint projects and co-supervised students playing a key role. Specific examples are as follows:

- Bellamy, under the supervision of White, showed that 'top down' control by planktonic and benthic biota are key factors in improving water quality in Salford Quays by filtering out algae [5], and this research was taken forward by APEM. The improvements resulted in the introduction of a successful recreational fishery. Salford Friendly Angling Society, with over 300

members, is currently bidding for the fishing rights.

- White supervised Nash, whose research on the role of water quality in determining coarse fish population dynamics was published as a report to the Environment Agency, Mersey Basin Campaign and United Utilities [C]. Nash showed that water quality in the lower River Irwell and upper MSC had profound effects on the size and health of fish stocks.
- An industrial placement student, Whitehead (Sep 2012 – Aug 2013) has produced valuable results examining metal contamination in fish populations. This data has been used by APEM to assess the level trace metal contamination in the lower River Irwell and MSC.
- Mansfield is currently working with APEM to examine past data collected by the company that have identified, quantified and modelled the key drivers ('bottom-up' control via the nutrient phosphate and 'top-down' control via filtration) of the changing aquatic community structure in Salford Quays, and has provided insights into the reasons for the current favourable water quality and ecology. These findings will be used by APEM and others to inform water quality and ecological management of similar artificial and re-engineered systems.

The long and productive collaboration between APEM and White is demonstrated by APEM having sponsored/directly funded five PhD students and co-supervised over 20 MSc projects [B]. APEM hosts up to two industrial placement students per year from UoM, where students are paid a salary and act as members of staff for 12 months.

The Chairman of the Mersey Basin Campaign states, "*We can verify that the solutions pioneered by researchers at APEM and the University of Manchester have actively led to significant improvements in water quality at Salford Quays and the ecological recovery of the area*" [D].

The Assistant Director of Planning at Salford City Council also verifies that, "*The research conducted by APEM and the University of Manchester which produced practical solutions… has* been fundamental to the area's success" [E].

Environmental improvements:

The initial Water Quarter Improvement Programme (WQIP, 1987) involved cleaning the headwaters of the MSC and was funded by North West Water (£3.5m) and English Partnerships (£0.5m), with input from the Mersey Basin Campaign, United Utilities, MG Gases and APEM [F]. A key part of the WQIP involved injecting oxygen into the MSC and monitoring resulting water quality improvements. In 2012 this was replaced with Helixor mixers (following success in Salford Quays) and APEM was commissioned to assess their efficacy in maintaining water quality improvements. This system is now being extended to the whole 33km MSC [B].

As a result of the WQIP, a thriving fish and invertebrate community developed and 22km of the MSC has been designated a cyprinid fishery under the Freshwater Fisheries Directive (FFD) (78/659/EEC). At one point, the dock basins contained the fastest growing fish population in the UK [B]. Work is on-going to achieve FFD standards further along the MSC.

Oxygen levels at Salford Quays are now sufficient to meet the European Water Framework Directive [D].

Economic and commercial impact on Salford Quays:

The cleaner waterways have been absolutely critical in attracting £185m of public investment in the Salford Quays area, levering £1,405m of private investment [E]. This includes £7m from United Utilities, over £1m from Salford City Council, £400k from the Heritage Lottery Fund and £100k from the Mersey Basin Campaign [B]. As a result of the water quality improvements, homes for 6,000 people have been built and 900 businesses have located on Salford Quays, employing over 35,000 people (in contrast to the 1,000 people employed 20 years ago) [E].

From being a polluted wasteland, Salford Quays is now a hub of culture, retail and tourism. It hosts attractions such as the Lowry Theatre, the Imperial War Museum and the Salford Watersports Centre that hosted the 2002 Commonwealth Games Triathlon [B].

MediaCityUK has recently been developed on Salford Quays and the projected public and private investment is approximately £800m for 2005-2020 [F]. MediaCityUK is designed around the specific needs of the media and creative industries and from Spring 2012 is home to the BBC, ITV,

University of Salford, Lowry Outlet Shopping and over 80 small businesses. Phase One of MediaCityUK is a 36-acre site, including 65,032 m² office space, 7,432 m² of retail and leisure space, 378 apartments, a new tram terminus and a public area for 5,000 people [G].

Social and cultural impact:

The rejuvenation of the MSC and Salford Quays has provided a high quality and pleasant living environment for residents and recreational facilities for the community. Indeed, Salford Quays attracts well over 3million visitors per year [E].

European 'Blue Flag' standards of water purity have been recorded at Salford Quays, allowing international sports events such as triathlons to take place [B]. From 2010 to date, the site hosts the annual Great Manchester Swim event which is part of the 'Great Swim' open water swim series) [H]. Also, the Water Sports Centre at Salford Quays is a well-used facility and a base for Agecroft Rowing Club which includes Olympic rowers [E].

Neighbouring socially deprived areas such as Ordsall, Langworthy and Trafford Park benefit from substantially increased levels of investment in the Salford Quays area [F].

Informing other regeneration programmes:

The successful regeneration of the waterways at Salford Quays has been mirrored on the Trafford bank of the MSC, which encompasses the football and cricket grounds of Old Trafford, which are now a distinct part of Greater Manchester. Salford City Council acknowledges that, *'APEM and the University of Manchester's role … has been vital'* [E].

It is hoped that the water remediation strategy at Salford Quays and the upper MSC will be applied to the whole 33km length of the MSC in 2015, to facilitate compliance with the Water Framework Directive [B,D].

Furthermore, the results from the Salford Quays and the MSC projects have set the precedent for the regeneration and redevelopment of other dock and urban waterways, including London Docklands, Liverpool Docks and Cardiff Bay [B].

5. Sources to corroborate the impact

A. http://www.apemltd.co.uk/about/apems-25th-anniversary---1987---2012 *Company website describing the history, current team membership, ongoing projects & locations of UK offices.*

B. Letter from Managing Director of APEM, *corroborating the relationship with the University of Manchester and the nature and impacts of the research.*

C. Nash, K. T., White K. N., Henry, I. C. The Effect of Water Quality on Coarse Fish Productivity and Movement in the Lower River Irwell and Upper Manchester Ship Canal: A watercourse recovering from historical pollution. R&D Technical Report W2-030/TR, March 2003. Commissioned by the Environment Agency. ISBN No. 1 85729 956.

D. Letter from Chair of Mersey Basin Campaign (now Healthy Waterways Trust), *corroborating the investment in Salford Quays and the improvements to water quality.*

E. Letter from Assistant Director Planning, Salford City Council, *corroborating the impact of the research on Salford Quays and investment in the area.*

F. http://www.salford.gov.uk/d/milestones_v2.pdf Salford Quays regeneration milestones, the story of the regeneration project. Councillor Antrobus, July 2008. *History of Salford Quays.*

G. http://www.mediacityuk.co.uk/about-us *Overview of facilities at MediaCityUK.*

H. http://www.greatswim.org/Events/Great-Manchester-Swim *Great Manchester Swim hosted at Salford Quays.*