Moston Brook

Summary Report for the Evidence and Measures Project

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Scope of Work

This report has been prepared to meet the proposed scope of work set out in pjHYDRO Limited's proposal ("Proposal_MostonBrook_E+M_final.docx") of 17 Sept 2012. The report contents reflect the scope, information provision by the client and third parties, time and costs and other assumptions agreed in that proposal or documented in writing as amendments to that proposal.

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Summary

Purpose of this Report

This document has been prepared to accompany a number of presentations and other outputs from the Moston Brook Evidence and Measures (E+M) Project undertaken between September 2012 and March 2013, which was commissioned by the Environment Agency. The project was undertaken to collect evidence and then help stakeholders agree the main causes of poor WFD status (primarily water quality) before moving on to identify measures to improve the water quality and amenity value of the brook. This document provides a broad overview and commentary on the approach taken and the project's findings. It is also provided to help navigate through the project outputs collated on CD.

The Problem

Moston Brook was selected for this project because it is considered to be one of the most difficult failing waterbodies under the Water Framework Directive (WFD). It is located within the River Irwell catchment, which is a pilot WFD catchment. Moston Brook's Water Framework Directive (WFD) status is given by the Ecological Quality which is Moderate Potential with the potential to achieve good ecological status by 2027. The following water quality elements fail: ammonia, phosphate and dissolved oxygen (DO). It was well-known that there were multiple suspected causes of failure associated with multiple stakeholders, but there was no agreement on the key causes of WFD failure, where these were located and who was responsible for dealing with them.

The Objective

The project objective, adapted from the Project's Statement of Requirement (Environment Agency, 2012), was to help stakeholder devise reliable measures which are based on existing evidence and that could be implemented in years 2 and 3 by the Environment Agency and its partners to help meet Water Framework Directive (WFD) requirements and community aspirations.

The Results

Between September 2012 and March 2013, 35 participants from 11 organisations took part in two half-day meetings and two one-day workshops. Data and reports were collated, lines of evidence were reviewed, plotted and analysed, and the results presented in Evidence Packs at the two workshops. At the first workshop (Causes Workshop), participants reached consensus on the main causes of WFD failure by considering the Evidence Packs. The agreed main causes of WFD failure in each sub-catchment are shown in the table below and described in more detail in Section 4.

At the second workshop (Measures Workshop), participants agreed on a list of 67 measures which target these main causes of failure for submission into partners' business plans for allocation of funding. A selection of the measures devised at the workshop is shown in the table below.

Table S1 Main Causes of WFD Failure and Selected Potential Measures in Each Sub-catchment

Sub-catchment	Main Causes[1]	Measures[2]
North Culvert	Intermittent sewage discharges, wrong connections	EA and UU work together to investigate any uncharted combined sewage overflows (CSO) and wrong connections - easy ones now, harder ones next AMP cycle. Look at Suffolk Street CSO data to ensure it only spills when it is supposed to. Check tank meets design criteria.
South Culvert	Intermittent sewage discharges, wrong connections	Display the unique ID number on each CSO to enable the public to report incidents. Surface water management plans - remove surface water system connected to foul system. See Note 3.
Wrigley Head – Broadway	None – although action may be required here on the landfill to address issues downstream	Hardman Fold: capping with suitable design, install leachate drain/interceptor & enhanced toe drain. Need full info about GMWDA infrastructure already in place. Surface water transfer from canal or surface drains to increase flow in the brook, dilute & increase resilience to pollution.
Broadway – Williams Rd	Landfill, wrong connections	Stop up and divert the drains at 2 sites; the Lancaster Club & Lower Memorial Park (ref to Groundwork report). Wrong connection awareness campaigns either by post or email. Influence planners and local authority to open up culverts. Remove weir and replace with rock ramp for aeration.
Williams Rd – Silchester Dr	Wrong connections, intermittent sewage discharges	Rationalisation of 6 CSOs into 2 in culvert between Kenyon Lane and Potters Lane. EA to attend Category 3 pollution incidents that have been identified as a risk in Moston Brook (for sewage).
Silchester Dr – River Irk	Wrong connections, intermittent sewage discharges	UU and EA BA team to develop a joint survey to identify known and unchartered combined sewage overflows (CSOs) and wrong connections (with potentially some water quality sampling).
All		Investigate having Moston Brook scorecard to demonstrate the complex WFD WQ issues in a simple way - do every year and published in libraries etc. Make use of existing groups, organisations etc. Highlight specific issues e.g. fly tipping. Have awards associated with it, could attract funding.

Notes:

1 As agreed by Stakeholders at the Causes Workshop.
2 This is a headlines summary of the measures identified at the Measures Workshop.
3 The measures developed appear to assume that current known problems with sewage discharge from the Alford St pumping station will be addressed in planned AMP5 works by 2015.

Contents

List of Figures / Drawings

List of Appendices

1. Introduction

1.1 Purpose of this Report

This document has been prepared to accompany a number of presentations and other outputs from the Moston Brook Evidence and Measures (E+M) Project undertaken between September 2012 and March 2013. The project was undertaken to collect evidence and then help stakeholders agree the main causes of poor WFD status (primarily water quality) before moving on to identify measures to improve the water quality and amenity value of the brook. This document provides a broad overview and commentary on the approach taken and the project's findings. It is also provided to help navigate through the project outputs collated on CD.

1.2 Scope of Work

This short report has been prepared by pjHYDRO Limited and Rukhydro Limited for the Environment Agency to a scope of work set out in pjHYDRO Limited proposal ("Proposal_MostonBrook_E+M_final.docx") of 17 Sept 2012. The proposal was made in response to an Environment Agency Statement of Requirement for the "Moston Brook Action Project using an Evidence and Measures Approach" provided by email on 13 July 2012.

1.3 The Project Team and Roles

Many individuals and a number of organisations were involved in this project, but the day to day delivery of the project was undertaken by:

- Danielle Soulsby, the Environment Agency's project manager, who in addition to project management, pulled together Environment Agency datasets and reports from colleagues and external organisations and organised the initial meetings and the two workshops;
- Paul Hulme of pjHYDRO to whom the contract was let; and with subcontract support from;
- Nick Rukin of Rukhydro.

Paul and Nick analysed the data and information, produced the Evidence Packs and ran the two workshops.

1.4 Layout of this Report

Following this introduction, this document follows the approach taken from identification of suspect causes in Section 2, and the collection and presentation of evidence in Section 3, to the results of the Causes Workshop where consensus on causes was gained (Section 4), and then the Measures identified at a second workshop (Section 5). Lessons learned from application of the project are discussed in Section 6 and a Summary and Recommendations are provided in Section 7.

1.5 Background to Moston Brook

1.5.1 About Moston Brook

The following background information on Moston Brook has been adapted from that provided in the Environment Agency (2012) Statement of Requirement for this project.

Moston Brook (WFD water body GB112069061080) is a relatively short tributary of the River Irk, stretching approximately 6 km (source: SD8970402168 and confluence with River Irk: SD8501200015), through an area of Oldham and north east Manchester (Figure 1.1). Its Water Framework Directive (WFD) status is given by the Ecological Quality which is currently Moderate Potential with the potential to achieve good ecological status by 2027. Moston Brook was selected for this study because it is considered to be one of the most difficult failing waterbodies under the Water Framework Directive (WFD). It is located in the River Irwell catchment, which is a WFD pilot catchment.

Figure 1.1 – Location of the Moston Brook catchment within the Irwell Pilot catchment

Note: Moston Brook is outlined in blue on the blown up map of the Irwell Pilot catchment (red area)

Moston Brook has long been known to the Environment Agency (EA) as having poor water quality. The 2011/2 GQA status for the biology and chemistry of the brook are both grade F, the lowest category available. The chemical status in particular has been stable for the last 8 years, with significant failures on BOD and ammonia.

The potential causes for poor water quality are complex, but prior to the start of the project were thought to be mainly attributed to:

- **Sewerage discharges** – the brook is located in a densely populated area with some of the surrounding wards within 20 % of the most deprived in the UK.
- **Historic land contamination** – the area suffers from a legacy of former industrial activities; leachate outbreaks along the banks of historic landfills adjacent to the brook are evident.
- **Heavily modified waterbody** - over half the brook is culverted, including the source, and numerous weirs are also present along its course.

In recent years, work has been undertaken by partners and volunteers to improve the green corridor and provide a community asset. This focus has consequently highlighted the poor water quality of the brook. The need to investigate and provide evidenced arguments for reasons for water quality failure to begin to facilitate good ecological status was therefore a priority.

There are other water courses and water bodies in the Environment Agency's (EA) Northwest Region that have poor WFD status, but Moston Brook was highlighted as an ideal candidate for WFD funding given its complexity, the EA's long involvement regarding water quality and the enthusiasm of partners and volunteers to increase its amenity value. Three years of funding were planned and it was decided that application of the Defra/EA Evidence and Measures (E+M) approach would be the best way to start the project.

1.5.2 Project objective

The objective was to devise reliable measures which are based on existing evidence and that could be implemented in years 2 and 3 by the EA and its partners to help meet WFD requirements and community aspirations.

1.6 Background to the Evidence and Measures Approach

1.6.1 Background

The Evidence and Measures project is concerned with helping the Environment Agency and others understand the causes of failure in Water Framework Directive (WFD) water bodies and then define targeted measures to address these causes for the next round of River Basin Management Planning. The potential rewards for this area of work are far greater than simply meeting EU WFD targets, and include capacity building for catchment management in the Environment Agency, and strong relations with stakeholders as actions are agreed and put in place.

The approach focuses on use of existing information in databases, archives, internal and published reports. It also seeks to take value from the testimonies and recollections of people who have known their catchments or stretches of river over time. The approach therefore aims to gain good value from existing information. New investigations are not part of the approach and, if required, will typically be identified as part of investigatory measures for future work.

Understanding the aquatic ecology and water quality aspects of rivers is scientifically challenging. River-reach and catchment scale problems are often the culmination of a number of pressures that have built up over decades and unravelling which ones are the most important is difficult. The task is made more challenging by incomplete datasets, which, due to uncertainties over what happened in the past, cannot be dealt with simply by a new field investigation or survey. Instead there is a need to use often disparate pieces of information to provide "weight of evidence" to discuss with stakeholders and form the basis of selecting measures. Categorical proof of the cause of a problem should rarely be expected.

The Evidence and Measures approach started in 2006 with an examination of what data could be available nationally and locally for catchment management investigations in the Frome-Piddle. This then led to the Petteril Trial in Environment Agency Northwest Region, which focussed on identifying the causes of poor trout numbers in the River Petteril, a tributary of the Eden, in a largely rural part of Cumbria. That project identified most likely causes of WFD failure in discussion with stakeholders and agreed a number of measures, many of which are now in the Environment Agency's and Eden Rivers Trust's business plans. With such a positive outcome, the approach was taken to an area between Preston and Lytham St Anne's in Lancashire to try and unravel a new set of possible causes for a mixed rural, urban and industrial area, use new and different information, and work with a different group of Environment Agency staff and external stakeholders. Over 100 measures were identified at a workshop in August 2012 and many of these measures are now in the Ribble Life Action Plan.

1.6.2 Summary of the Evidence and Measures Approach

The Evidence and Measures approach comprises six main stages:

- Stage 1: Identify the problem;
  - Identify WFD failures;
  - List the suspected causes of WFD failure;
  - Collect existing knowledge: current & historical data, reports, information from EA staff and partners etc.;
- Stage 2: Analyse the evidence;
  - Plot data in time and space and look for patterns;
  - Gather the lines of evidence for and against each suspected cause;
- Stage 3: Causes Workshop to agree the *most likely causes* of WFD failure based on all lines of evidence;
- Stage 4: Measures Workshop to identify measures that will address these most likely causes of failure. Consider both existing planned measures and new measures;
- Stage 5: Get the measures into partners' business plans;
  - Agency and external partners review the list of measures;
  - Partners choose actions to implement
  - In choosing, consider what funding is available, what is achievable and what is cost-effective;
- Stage 6: Make provision to record the consequences of the measures that have been implemented.

Stages 1 – 4 in the above approach were part of the scope of work of the Moston Brook Evidence and Measures project and are described in Sections 2 – 5 of this report. Stages 5 and 6 are to be carried out subsequently by the Environment Agency and its partners and the recommendations for this are described in Section 7.2.

2. Identifying the Problem

2.1 Purpose of this Section

This section of the report provides a summary of the WFD failures and the suspected causes of those WFD failures according to stakeholders at the start of the project.

2.2 Water Framework Directive Failures

As stated in Section 1, the Water Framework Directive (WFD) status for Moston Brook is given by the Ecological Quality which is currently Moderate Potential (Slides: Fig 2.1) with the potential to achieve good ecological status by 2027.

No data has been included to date in the Water Framework Directive (WFD) classification for Moston Brook, but there is information at a monitoring point on Moston Brook just before it joins the River Irk, which has currently been included in the classification for the River Irk (Moston Brook to River Irwell, GB112069061070). The results from this monitoring point indicate the following water quality failures (Slides: Fig 2.2):

- Ammoniacal nitrogen (bad in 2009 and 2011);
- Dissolved oxygen (poor in 2009, bad in 2011);
- Phosphate (poor in 2009 and 2011).

Moston Brook is a Heavily Modified Water Body which passes its flow assessment so no assessment needs to be made for invertebrates or fish. Heavily Modified Water Bodies also need to be assessed against whether a standard national set of mitigation measures is in place and for Moston Brook it is not.

The main WFD Reasons for Failure as defined by the Environment Agency are set out in Table 2.1.

Table 2.1 WFD Reasons for Failure for Moston Brook

Element	Significant Water Management Issues	Activity	Sector
Mitigation Measures Assessment	Physical modification	Urbanisation – other	Urban and transport
Expert Judgement	Diffuse source	Contaminated land	Urban
Expert Judgement	Diffuse source	Sewage discharge (diffuse)	Urban
Expert Judgement	Point source	Sewage discharge (intermittent)	Water industry
Expert Judgement	Point source	Landfill leaching	Urban and transport

Notes: Information provided by the Environment Agency. The terminology used is standard for all water bodies in England and Wales.

2.3 Suspected Causes of WFD Failure

At a site visit (half a day) and two initial meetings (half a day each), with Environment Agency staff in September 2012 and with external partners at the Moston Brook Officers' Group Meeting in November 2012, an initial list of suspected causes of WFD failure was collected from participants' local knowledge about the catchment. These were recorded in spreadsheets and displayed via a GIS layer (Slides, Figs. 2.3 and 2.4). Later other suspected causes were added including one (cemeteries) at the Causes Workshop. The final list of suspected causes of failure is given in Table 2.2.

A list of the participants at the initial meetings is provided in Appendix A.

Table 2.2 List of Suspected Causes identified by Stakeholders During the Project

Suspected Cause	Detail
Landfill leachate from historic landfills	
Intermittent sewage discharges (at high flows) from:	Combined sewage overflow (CSO)
	Pumping station overflow (PSO)
Wrong connections or continual sewage discharges from:	Domestic properties
	Sewage discharges connected to storm overflow culverts
	Blocked CSOs and PSOs
Highways	Runoff from M60
Cemeteries	
Parks and gardens	As a result of fertiliser use.
Geomorphological changes	Straightening
	Culverts
	Weirs

Notes:

3. Evidence

3.1 Purpose of this Section

This section provides a succinct overview of the sources of information examined in the search for evidence on the causes of poor water quality in Moston Brook. It includes a brief discussion regarding the processing and presentation of information in the Evidence Packs.

3.2 Sources of Information

3.2.1 Data Inventory and Timing of Data Collation

An inventory of all the information made available to the project is provided in Appendix B.

A lot of data and existing reports were collated by the Environment Agency prior to the start of the project in September 2012, but further information was identified subsequently (including up to the week before the Measures Workshop in February 2013). Additional information was identified as a result of discussions with stakeholders, being referenced in reports, or through lines of investigation not anticipated at the project planning stage.

3.2.2 Visit to the Catchment

The project team were escorted to a number of locations in Moston Brook by an Environment Agency officer on the morning of 20 September 2012. Photographs were taken and an appreciation of the size, condition and setting of the brook were gained.

3.2.3 Fruitful Datasets

Based on experience from the two previous Evidence and Measures Projects, the following Environment Agency datasets were identified as being likely to be fruitful in revealing evidence on the causes of poor water quality in Moston Brook:

- Water quality;
- Invertebrates;
- Fish data (although it transpired there are very few);
- Pollution Incidents (National Incident Reporting System, NIRS);
- Consented Discharges (location and type with subsequent information on spill rates and volumes);
- Non-mains sewerage / “septic tanks” (locations of properties >100 m from a sewer);
- Landfills (location, age, waste type etc.);
- Environment Agency Source Apportionment GIS (SAGIS) and SIMCAT outputs where available;
- Flows on Moston Brook.

These data were collated prior to the start of the project. During the project additional data were identified and collated and are listed in the Data Inventory in Appendix B. One particularly "fruitful" dataset gratefully received for use on the project was United Utilities' sewer network mapping.

3.2.4 DataShare

DataShare is the Environment Agency's data download and live feed portal, which helps provide spatial data directly to the public, Environment Agency staff, contractors, and other government organisations.

This was the first time that the Environment Agency project manager and the consultants had used the Environment Agency's new DataShare system. After some initial problems learning how to find and select datasets from the online system, the team found the use of DataShare valuable in transferring and licensing commonly used datasets.

The data transferred using DataShare included the following:

- Environment Agency WFD Data;
- Environment Agency general quality assessment (GQA) data (chemistry, nutrients, biology);
- Environment Agency easiWFD Lite;
- Landfill sites (historical and authorised);
- Ordnance Survey basemaps;
- Rainfall Data;
- River network shapefiles (detailed and statutory rivers).

3.2.5 Reports

The following reports were identified by the Environment Agency and Oldham District Council to be potentially valuable sources of information:

- APEM (March 2009), Moston Brook, Culvert Investigation;
- Atkins (August 2002), Moston Brook Pollution Prevention Project, Desk Study;
- Groundwork (March 2008a), Preliminary Risk Assessment of Moston Brook;
- Groundwork (March 2008b), Moston Brook Feasibility Study;
- Manchester City Council (April 2011), Preliminary Risk Assessment and Site Investigation on Moston Brook Sites (Williams Road, Broadway Common and Wrigley Head).

Other reports examined briefly are included in the Data Inventory. The Atkins (2002) report provides historical maps, 1990s pollution incidents and mentioned a detailed water quality survey downstream of Hardman Fold. The raw data for the 1990's water quality survey was subsequently identified in Agency archives and provided for use on the project.

Two draft internal reports (Environment Agency, 2011a, b) on water quality problems in Moston Brook, prepared by the Environment Agency's invertebrates and water quality team, were also made available.

3.2.6 Stakeholder Opinions

Project Start-up Meeting of 20 September 2012

Prior to close examination of the collated information, a meeting was held with Environment Agency staff on 20 September 2012 in Warrington. The 2 hour meeting was attended by staff from a wide range of technical disciplines (see Appendix A for list of attendees).

At the meeting, the Environment Agency project manager presented background information on the setting and geomorphology of Moston Brook and the current understanding of causes of WFD failure. The presentations on conceptualisation and geomorphology are provided on the project CD. During a group working session, participants recorded suspected causes of WFD failure and related previous work.

Moston Brook Officers' Group Meeting of 15 November 2012

Two of the project team also attended a Moston Brook Officer's Group meeting in November 2012 at Harpurhey District Officers. The meeting was attended by representatives from the local authorities, United Utilities, Greater Manchester Waste Disposal Authority, the Irwell Rivers Trust and the Environment Agency. Appendix A provides the list of attendees and their disciplines.

The meeting included presentations on evidence collated by the project and group working sessions where participant's thoughts on likely causes of poor water quality were recorded.

3.3 Project GIS

3.3.1 GIS System Used

The "open source" GIS software, QGIS version 1.8.0, was used to display and analyse vector data (shapes) and raster data (grids). Quantum GIS (QGIS) is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo).

3.3.2 GIS Layers

The GIS included layers in the following data categories:

- Participants suspected causes of WFD failure and other issues from initial meetings;
- Discharge consents with volumes;
- Pollution events: NIRS (2001-2012) and 1990s pollution incidents digitised from the Atkins (2002) report;
- Areas of historical landfill;
- Maps and grids from the EA's Source Apportionment GIS (SAGIS).
- Water body boundaries;
- Sub-catchment boundaries (see Section 3.6);
- Monitoring points;
- Rivers, flows and rainfall;
- Sewer network (with permission of United Utilities);
- Georeferenced photographs and diagrams or maps from reports.

In addition Ordnance Survey basemaps were downloaded for use under OS's Open Data licence at scales of 1:1,000,000, 1:250,000, 1:25,000 and 1:10,000. The Environment Agency also provided OS basemaps via its DataShare facility at scales of 1:50,000, 1:25,000 and 1:10,000.

3.3.3 Use

The GIS project set up in this way was used to view the locations of different monitoring points and pressures (possible causes of poor water quality) and interrogate details of specific layers. Areas of the sub-catchments to different water quality monitoring points were also calculated to allow the density of e.g. landfills or pollution incidents to be expressed by area (per km^2 of the catchment).

3.4 Interrogating Data

3.4.1 Water Quality Stats

WFD water quality status is based on the percentile or average concentrations of samples collected over a twelve month period and is defined under "*The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009*".

The raw data on concentrations of dissolved oxygen, biological oxygen demand, ammoniacal nitrogen, and orthophosphate were processed to calculate their 10%ile, 90%ile, 90%ile and annual average respectively and then compared to the thresholds in Table 3.1.

Table 3.1 WFD Water Quality Thresholds

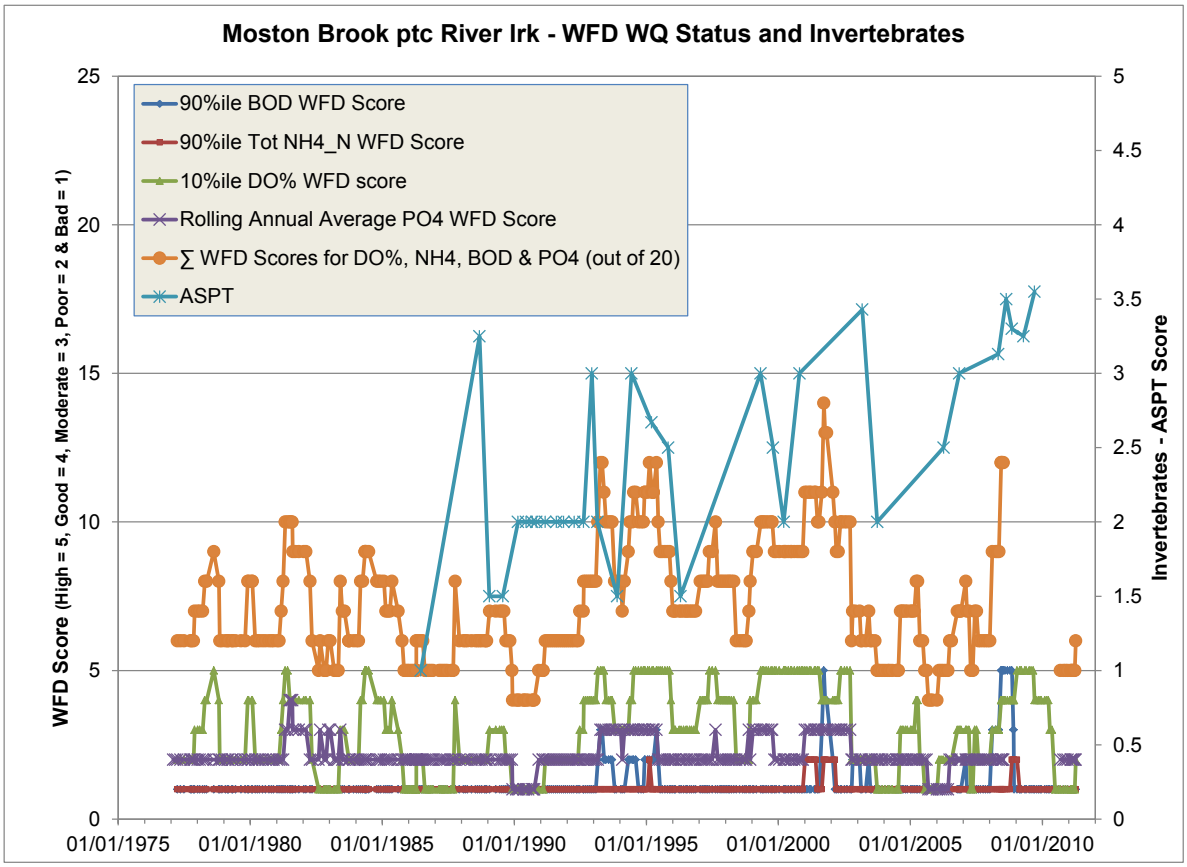
WFD Status[1]	E+M Score[2]	DO Sat% (10%ile)[1]	Tot NH_4 mg/l N (90%ile)	BOD mg/l (90%ile)[1]	PO4-P µg/l (Annual Mean)[1]	E+M All Parameters Combined Score("Orange Blobs")[2]
High	5	70	0.3	4	50	20 (4No x Score of 5)
Good	4	60	0.6	5	120	16 (4 No x Score of 4)
Moderate	3	54	1.1	6.5	250	12 (4 No x Score of 3)
Poor	2	45	2.5	9	1000	8 (4 No x Score of 2)
Bad	1					4 (4 No x Score of 1)

Notes:

1 Thresholds as in The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009.
2 This score is a simple translation of WFD Status into a number that can be plotted on a graph.
3 This score is the sum of the four individual scores of DO, BOD, NH4-N and PO4 and is used to illustrate on a single line on a chart how water quality has varied over time. It is indicative rather than being used for classification.

To make processing the raw data easier, percentiles were calculated on the previous ten samples rather than being strict on a twelve month period. Again the focus of the processing was to allow a quick visual appraisal of how water quality had changed over time in terms of WFD status. Figure 3.1 provides an example of this for the monitoring point at the downstream end Moston Brook, ptc with the Irk.

Figure 3.1 – Long Term Changes in WFD WQ Status and Invertebrates



Note: ASPT = Average Score per Taxa. See Table 3.1 for explanation of WFD Scores.

3.4.2 Invertebrate Data

Invertebrate data for Moston Brook was examined, but the Environment Agency's invertebrate specialist noted that water quality was the prime control on invertebrates (and fish) with flows and habitat being secondary. Invertebrates measured at the downstream end of Moston Brook are compared to the WFD water scores in Figure 3.1 and show a broadly similar long term variation to overall water quality (the line of "orange blobs").

Invertebrates (and fish) were not examined further, with the focus of the investigation on water quality.

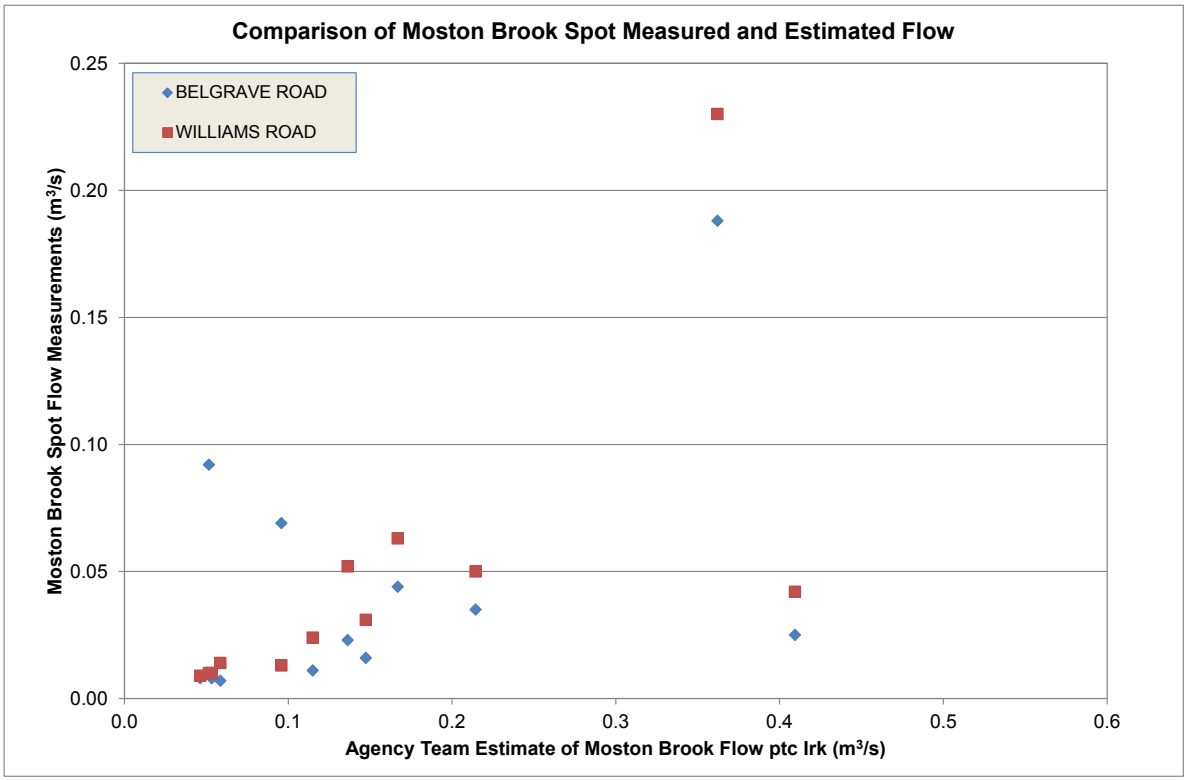
3.4.3 Spot Flows and Flow Estimates

Flow measurements in Moston Brook are limited primarily to spot measurements between 2009 and 2011 at two locations:

- Belgrave Road (near Wrigley Head at SD8966802144);
- Williams Road (at SD8803201165).

The Environment Agency's Hydrometric Team also provided flow estimates for Moston Brook prior to the confluence with the Irk (SD8593600707). The flow estimates were based on a correlation with flows in the Irk. Comparison of the flow estimates with spot measurements is generally good but there are periods where the two do not correlate (see Figure 3.2).

Figure 3.2 – Comparison of Flow Estimates and Spot Flow Measurements



Note: This is a comparison of relative flows as actual flows would differ due to the different locations in which the flows are measured / estimated.

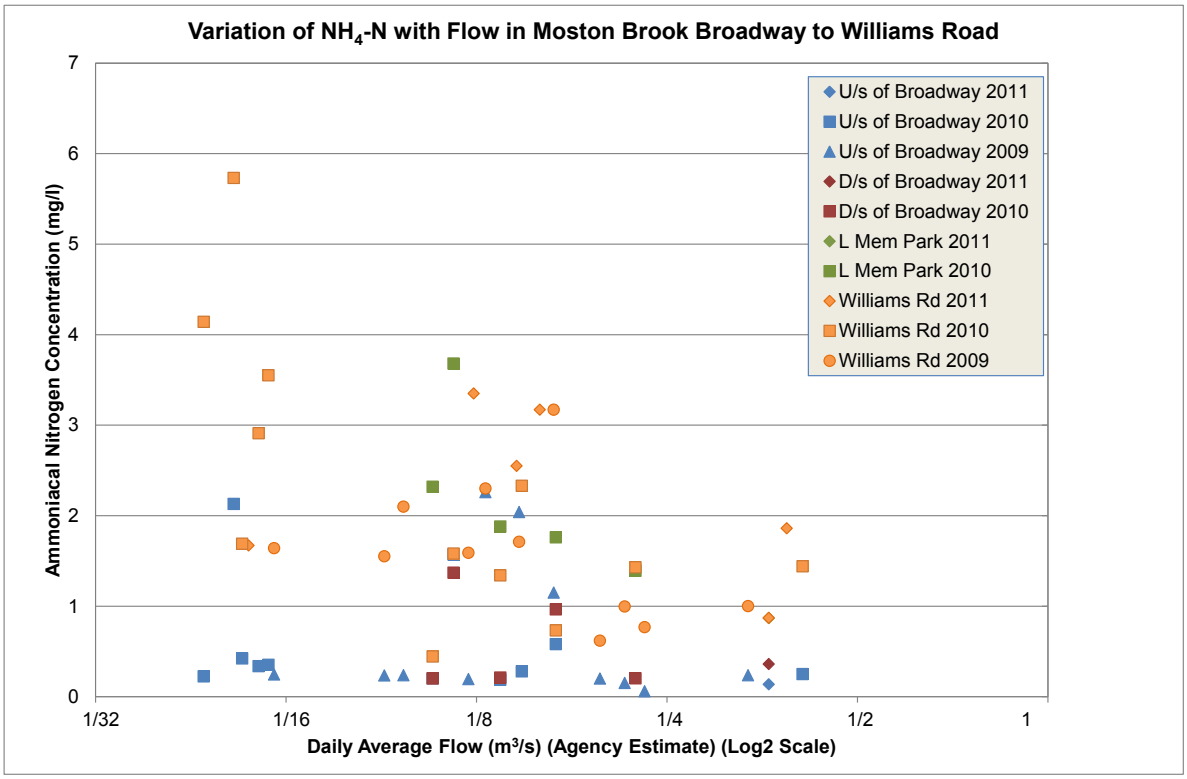
Just before the Measures Workshop of 14 February 2012, United Utilities provided data for the period May to October 2008 for temporary flow monitoring upstream of Mill Street (NGR SD8854501393). The data show good correlation with the Agency's flow estimates. During at least two periods of dry weather the flows also show signs of diurnal variation.

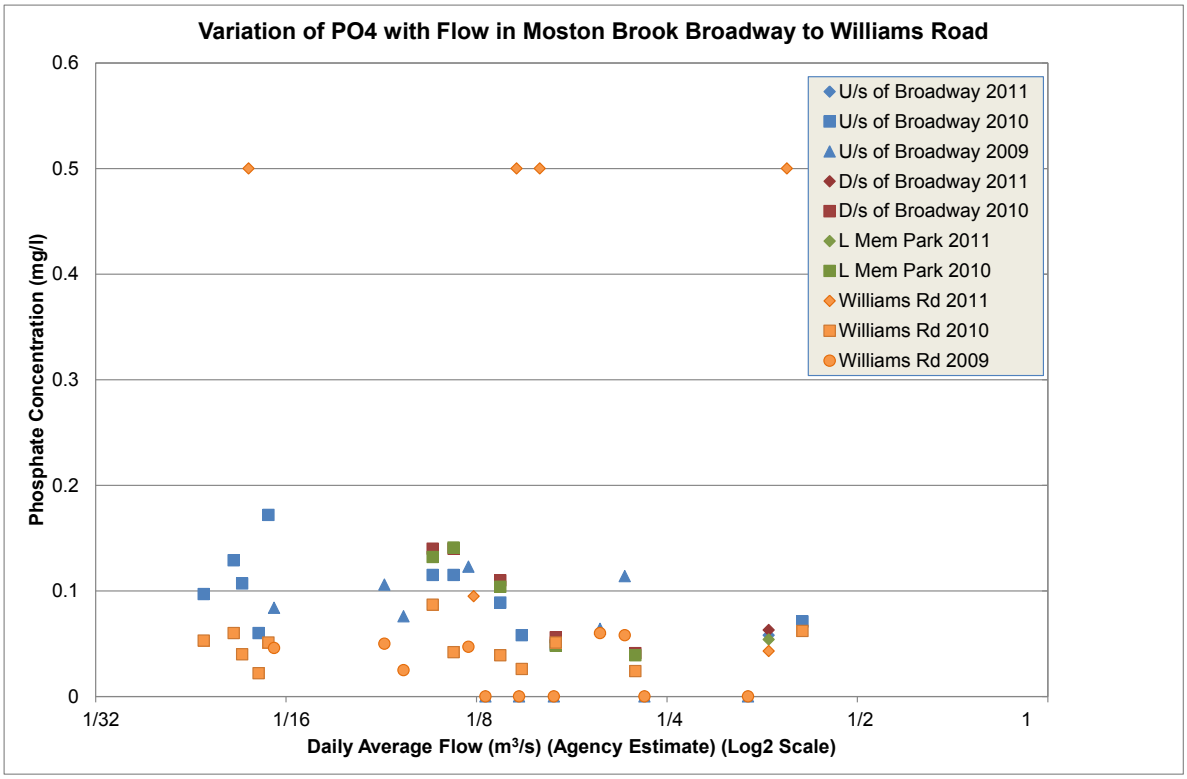
3.4.4 Changes in Water Quality with Flow

Measured water quality was compared with the flow estimates for Moston Brook to help identify the source of poor water quality. Deterioration of water quality during high flows was taken to suggest combined sewer overflow discharges or pumping station overflows whereas deterioration during lower flows suggests a background constant source such as landfill leachate or wrong connections.

Charts comparing water quality (DO, BOD, NH_4-N, PO_4, K, B, Cl) with flow were prepared for each monitoring location. Two example charts are shown in Figure 3.3, illustrating a background ammoniacal nitrogen source (without accompanying PO_4 problems, so suggestive of a landfill leachate input) is evident between Broadway and Williams Road.

Figure 3.3 – Examples of Change in Water Quality with Flow





Note: The top chart shows there is little variation of NH_4-N with flow upstream of Broadway (blue) but a marked increase in NH_4-N with decreasing flows at Williams Road (orange). This implies a background / constant source of NH_4-N between Broadway and Williams Road that is diluted as flows increase. There is also a "hint" of a slight increase in NH_4-N at Williams Road during very high flows and this could imply storm sewage discharge. PO_4 (bottom chart) shows a slight increase with flow upstream of Broadway, but little variation with flow at Williams Road, so the NH_4-N source does not have PO_4.

3.4.5 Downstream Changes

To help identify where water quality in Moston Brook deteriorated or improved, water quality was plotted against the sampling points (ordered from upstream to downstream by their National Grid Reference easting). Downstream changes in water quality (DO, BOD, NH_4-N, PO_4, K, B, Cl) were then considered for sampling dates with different flows. Two example charts are shown in Figure 3.4, where the main problem areas (high NH_4-N and PO_4) are downstream of Broadway (and Hardman Fold landfill) and between Silchester Drive and the confluence with the River Irk.

3.5 Sewer Network Interpretation

United Utilities kindly provided sewer network mapping for the Moston Brook catchment area. The sewers are mapped as:

- Surface water sewers (in theory conveying clean water);
- Foul sewers (conveying sewage including grey water);
- Combined sewers (representing the majority of sewers and conveying both clean water runoff and sewage in typically older sewers).

Areas with adjacent surface water and foul sewers were viewed as having the greatest risk of wrong connection of sewage or grey water to the surface water sewers.

3.6 Subdividing Moston Brook into Reaches

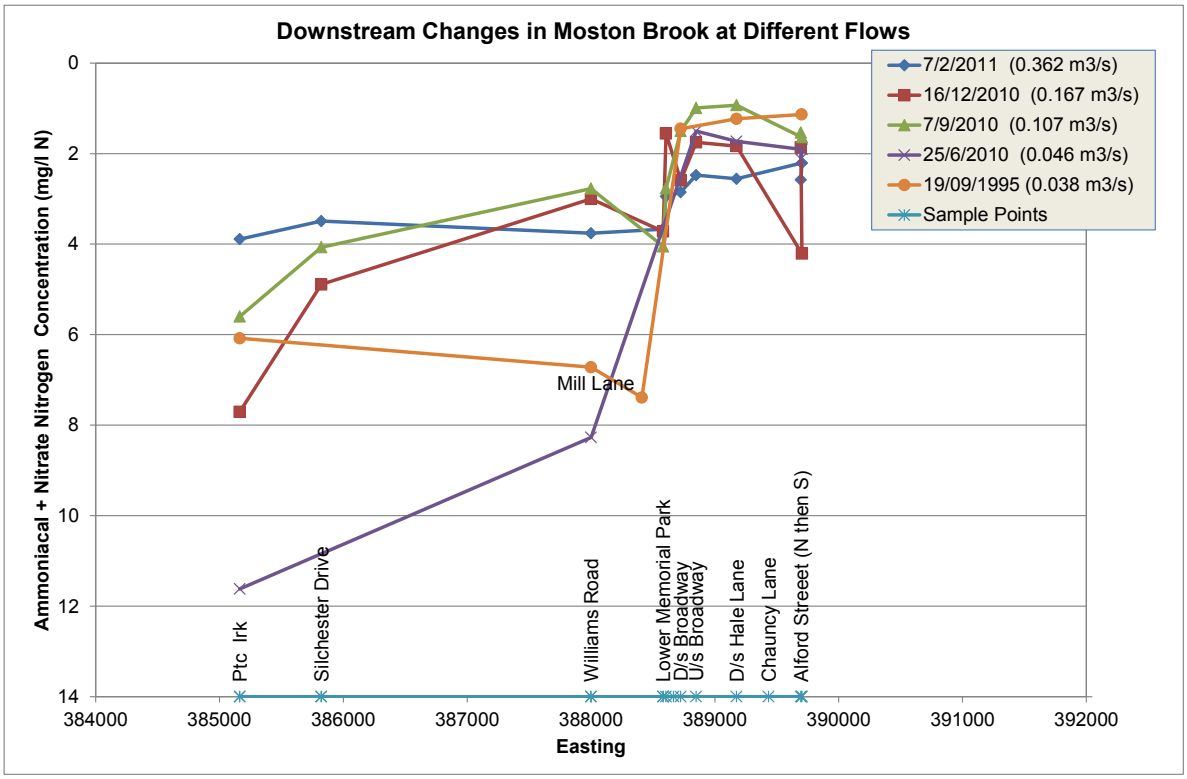
To help break down the Moston Brook water quality problem, the catchment was subdivided into reaches based on the locations of water quality monitoring points as follows:

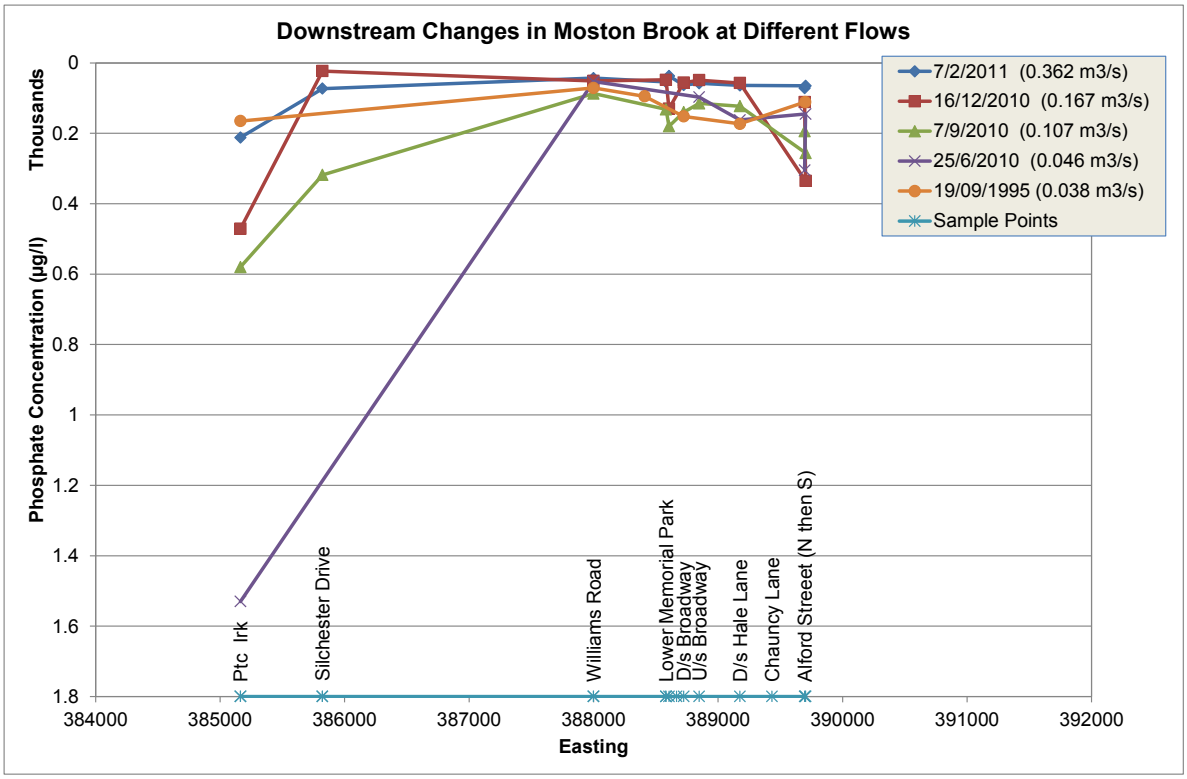
- North Culvert at Wrigley Head (also called Alford Street);
- South Culvert at Wrigley Head (also called Alford Street);
- Broadway;
- Williams Road;
- Silchester Drive
- Prior to the Confluence (“ptc”) with the River Irk.

The sub-catchment to each of these points was defined approximately in GIS using the location of the downstream monitoring point and having regard to topography. The APEM (2009) survey of North Culvert and a Highways Agency drawing (Mouchel, 1993) showing the proposed North Culvert and line of the existing (South) culvert were also used to help roughly define the sub-catchments to these points.

Besides helping to examine how Moston Brook’s water quality changed over a particular reach, the sub-catchments were used in GIS to extract the number of e.g. pollution incidents, consented discharges and landfill areas to allow comparison of pressures from one reach to the another.

Figure 3.4 – Examples of Downstream Changes in Water Quality





Note: The vertical axes are reversed showing high concentrations at the bottom. The top chart shows a marked deterioration in NH_4-N concentration (particularly at lower flows) from Broadway to Williams Road and then again by Silchester Drive and again significantly prior to the confluence ("ptc") the River Irk. In contrast PO_4 does not deteriorate between Broadway and Williams Road. Both NH_4-N and PO_4 are also poor in South Culvert.

3.7 Lines of Evidence and Scoring

3.7.1 Lines of Evidence

To help constrain the likely causes of poor water quality in Moston Brook, the following lines of evidence were considered:

- **Approach A (variation across sub-catchments).** This approach examined the number and relative proportion of pressures in the different sub-catchments, e.g. the number and density of landfills.
- **Approach B (variation in time)**. This approach examined changes in water quality over time (short and long-term) as well as variation of water quality with flow. The timing of activities was also noted e.g. the opening of the M60 and the presence of poor water quality before then.
- **Approach C (downstream changes)**. This approach looked for changes in water quality as the brook passed by different pressures (e.g. combined sewer overflows or landfills).
- **Approach D (source apportionment)**. This approach used source apportionment tools (in particular the Environment Agency's SAGIS tool) to identify the relative contribution different sources of pollution make to the total load.

Use of these different approaches allowed evidence to be drawn out of the processed data sets and reviewed reports. In all cases, evidence was evaluated in terms of links to the poor WFD water quality parameters (DO, BOD, NH_4-N and PO_4), and other water quality issues (e.g. metals, oils, sediment) were not considered. This was to keep the investigation of causes focussed on the WFD failures.

3.7.2 Scoring Evidence

The strength of each line of evidence was evaluated (in the Evidence Pack tables, see Section 3.8.3) using a scoring system developed on the previous Evidence and Measures project on the Tidal Ribble water-bodies. It is very difficult to compare evidence from very different information sources and viewpoints. Some information is quantitative, some is qualitative (e.g. observations) and there is a need to capture the opinions of stakeholders. As a result, the scoring of evidence in the context of whether a suspected cause (e.g. landfill, wrong connections) is the likely cause of the specified WFD water quality failures (e.g. DO, BOD, NH_4-N, PO_4) for a given reach is as set out in Table 3.2.

Table 3.2 Rules for Scoring Evidence

Score	Meaning of Score	Further Comment
[+]	Evidence supports	
[-]	Evidence opposes	
[0]	Evidence is uncertain	This is used when the evidence, although relevant, is inconclusive.
[NE]	No evidence	This is used to recognise that a line of evidence (e.g. dataset or report) has been examined but there is no evidence to add e.g. SAGIS (Approach D) does not provide estimates of inputs from landfills.
[NA]	Evidence not applicable	This is used rarely where the approach is not relevant to a suspected cause e.g. Approach D SAGIS source apportionment is not applicable to geomorphology as a potential cause of poor water quality.

Notes:

3.8 The Evidence Packs

3.8.1 General

The Evidence Packs provide the main evidence related outputs from this project and were used with stakeholders at the Causes and Measures Workshops (see Sections 4 and 5 respectively) to succinctly convey a lot of information in a short period of time. The packs include an "Intro Pack", Reach Specific Evidence Packs and a source apportionment evidence pack. Further information on these is provided below.

3.8.2 The Intro Pack

The "Intro Pack" presents background information common to the whole of Moston Brook, the charts of downstream water quality changes and the long-term water quality (in terms of WFD water quality status).

3.8.3 The Reach-Specific Evidence Packs

The "Reach-Specific Evidence Packs" as implied by their name provide evidence related to the specific reach of Moston Brook and largely have the same content as follows:

- An opening slide showing a photo of the brook in that reach and of the sub-catchment area;
- A table and chart summarising water quality in terms of WFD status for the downstream monitoring point of that reach;
- A GIS produced map showing the monitoring points and sub-catchment;
- A GIS produced map showing the suspected problems identified by EA staff at the meeting of 20 September 2012;
- A GIS produced map showing the suspected problems identified by a number of stakeholders at the Moston Brook Officer's Group Meeting of 15 November 2012;
- A GIS produced pressures maps showing the location or areal extent of consented discharges, specifically combined sewer overflow discharges (sized by spill volume), landfills and pollution events;
- A collation of charts showing the variability of water quality in that reach versus flow estimates (for the brook prior to the confluence with the River Irk);
- A slide showing important evidence specific to that reach only;
- A GIS produced map showing the extent of the United Utilities sewer network.
- The Evidence Tables (see Section 3.8.4 for further details);
- The Evidence Conclusions (see Section 3.8.5 for further details).

3.8.4 The Evidence Tables

The Evidence Tables are part of the Evidence Packs. They present evidence from use of the different approaches discussed in Section 3.7.1 and score that evidence according to the approach set out in Section 3.7.2. Evidence Tables were prepared where there was evidence, for the following suspected causes:

- Landfill;

- Intermittent Discharges (specifically overflows from combined sewers and sewage pumping stations);
- Wrong connections (from connection of sewage and / or grey water discharges into surface water sewers);
- Transport (including the M60, other roads and railway);
- Industrial / mining;
- Retail;
- Parks and Gardens;
- Urban (a catch all for more general pressures and reflecting that SAGIS outputs are for a general "Urban" source);
- Geomorphology.

Feedback from both the Causes and Measures Workshops was that the stakeholders found these tables particularly useful within the time they had available.

3.8.5 The Evidence Conclusions

The Evidence Conclusions tables are conclusions made by the Project Team. They represent the team's overview of the Evidence Tables and consider the consistency and strength of the different strands of evidence. They provide a conclusion as to whether a suspected cause appears to be an actual cause of poor WFD water quality and make recommendations as to whether measures are needed.

3.8.6 Iteration of the Evidence Packs

The Evidence Packs and their Conclusions were revised following their use at the Causes Workshop as preparation for the Measures Workshop. Edits, including both additions and deletions, were shown so that stakeholders could check where and how their comments had been addressed.

3.9 Source Apportionment

3.9.1 Overview

Source apportionment is the process of trying to assign greater or lesser importance to different likely causes of, in this context, poor WFD water quality. For this project, three approaches have been used; (1) SAGIS the Environment Agency's national tool; (2) an approach focussed on Moston Brook, based partly on SAGIS but also using more localised assumptions; and (3) an empirical approach based on monitoring data. Further information on these three approaches is provided in the following subsections.

3.9.2 Use of SAGIS

A GIS based source apportionment tool (SAGIS) has recently been developed for the Environment Agency which aims to provide an overview of the contribution of all sources of chemicals and hence the big picture for a catchment before control of individual sources are considered in more detail SAGIS is designed to apportion loads and concentrations of chemicals to WFD water bodies and to estimate how much nitrate (NO_3) and phosphate (PO_4), for example, are being provided to a stream from different sources. SAGIS includes

inputs from both point sources, such as combined sewer overflows, and diffuse sources, such as urban or agricultural runoff, using a grid of inputs.

SAGIS was designed for comparing catchments, which are much larger than Moston Brook. Nevertheless Moston Brook is covered by about 12 SAGIS grid squares so although the scale is crude, SAGIS can be used to give an initial indication of where its national experience would suggest the main sources of NO_3 and $P0_4$. SAGIS does not provide outputs for BOD and NH_4, but the NO_3 loading is understood to contain NH_4 loading. SAGIS does not specifically include inputs from landfill (a source of NH_4) or sewage via wrong connections (a source of NH_4, BOD, PO_4). Despite enquiries, it has not been possible to ascertain exactly what the SAGIS "Urban" component considers.

For Moston Brook, SAGIS gives the major sources of nitrate and phosphate as: intermittents (sewage overflows), urban and "background" (Table 3.3). The SAGIS grid indicates that the urban inputs of phosphate are higher upstream of Broadway than they are downstream of Broadway. This is likely to reflect less green spaces (and conversely a higher housing density) upstream of Broadway.

Table 3.3 Main Sources of Nitrate and Phosphate in Moston Brook indicated by SAGIS

Nitrate	Phosphate
Intermittents (sewage overflows)	Intermittents (sewage overflows)
Urban	Urban
Background	

Notes:

3.9.3 Application of Data From Elsewhere to Moston Brook

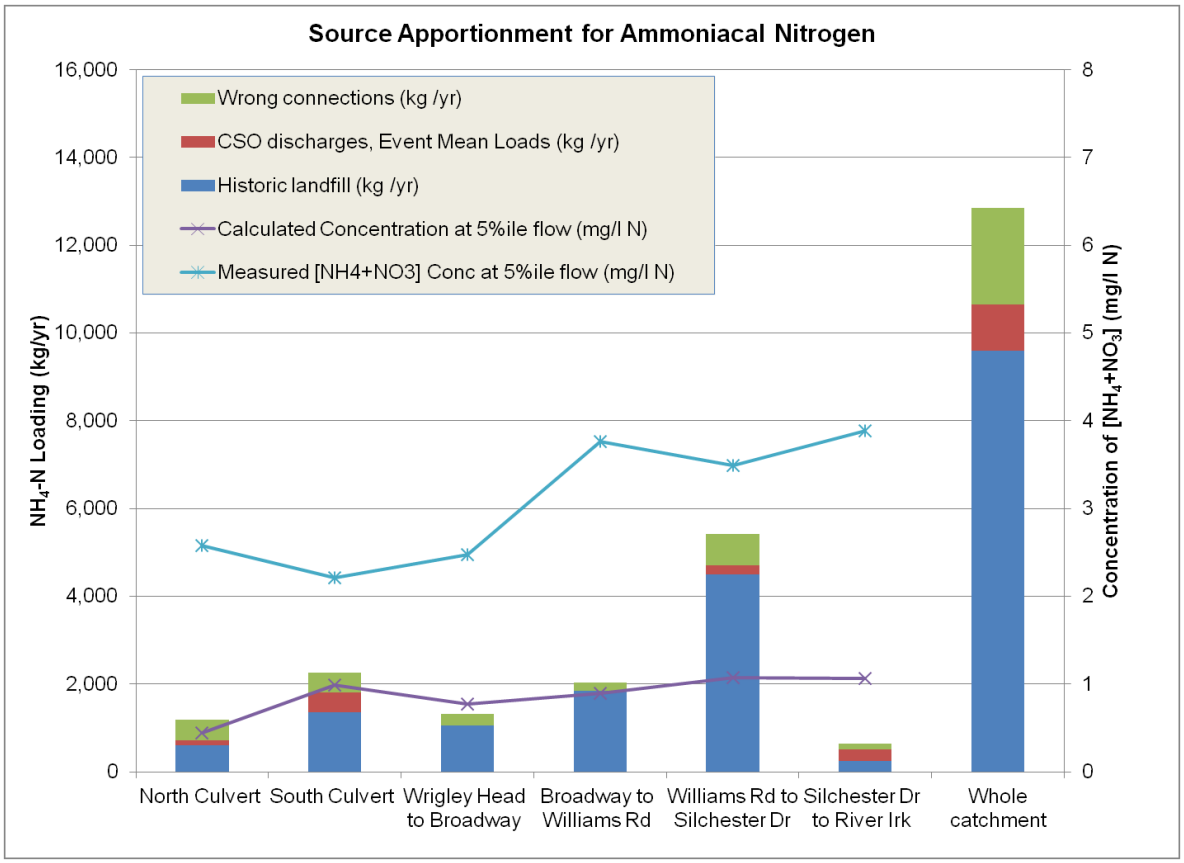
Ammonia and phosphate contribute to the WFD failure of Moston Brook and combined sewer overflows, landfill and wrong connections are all suspected causes. There are no consistent national or local datasets available for estimating the contribution from these three sources, but there is nevertheless some data that can be applied as long as the uncertainty is appreciated. Estimates were obtained for each sub-catchment as follows:

- For combined sewer overflows (CSOs), the Environment Agency and United Utilities have some data for the average concentration of ammonia and phosphate in a CSO spill that are accepted locally. Multiplying these by the average spill volumes per year gives an estimate of the annual load from CSOs.
- We estimated the load of ammonia and phosphate from historic landfill based on "guestimates" of leachate concentrations, rainfall infiltration rates and the landfill area.
- For wrong connections, Severn Trent Water and Thames Water have conducted surveys, which allow rough estimates of the ammonia and phosphate load from the number of properties in the sub-catchment, % of properties wrongly connected, number of people per property, domestic effluent per person and the concentration of ammonia or phosphate in domestic effluent.

Using these estimates the bar charts in Figure 3.5 show the contribution of the above three sources (CSOs, historic landfill, wrong connections) to the total ammonia load in each sub-catchment. To check whether these loads are plausible, the purple line in Figure 3.5 shows the estimated (calculated) concentration based on adding the loads from the bar charts to the 5%-ile (high) flows for Moston Brook (based on the Agency's flow estimates discussed in Section 3.4.3). This can be compared with the observed concentration (cyan line) at 5%ile

flows. Although there is considerable uncertainty in the loading and concentration estimates, as observed concentrations are about four times larger than the estimated concentrations (purple line), it does suggest that CSOs, historic landfills and / or wrong connections are worse than would typically be expected.

Figure 3.5 – Source Apportionment Estimates at 5%-ile (High) Flows



Note: None.

Similar plots at 50%-ile (mean) flows showed the estimated concentrations (purple line) following the variation in the observed concentrations in the upstream reaches of the brook but then in the two downstream reaches (Williams Rd – Silchester Dr – River Irk) the observed concentrations are much higher than the estimated. This suggests that much more ammonia is entering the stream than would be expected from typical landfill, CSO and wrong connections assumptions, i.e. some things are much worse than would be expected.

3.9.4 Empirical Source Apportionment

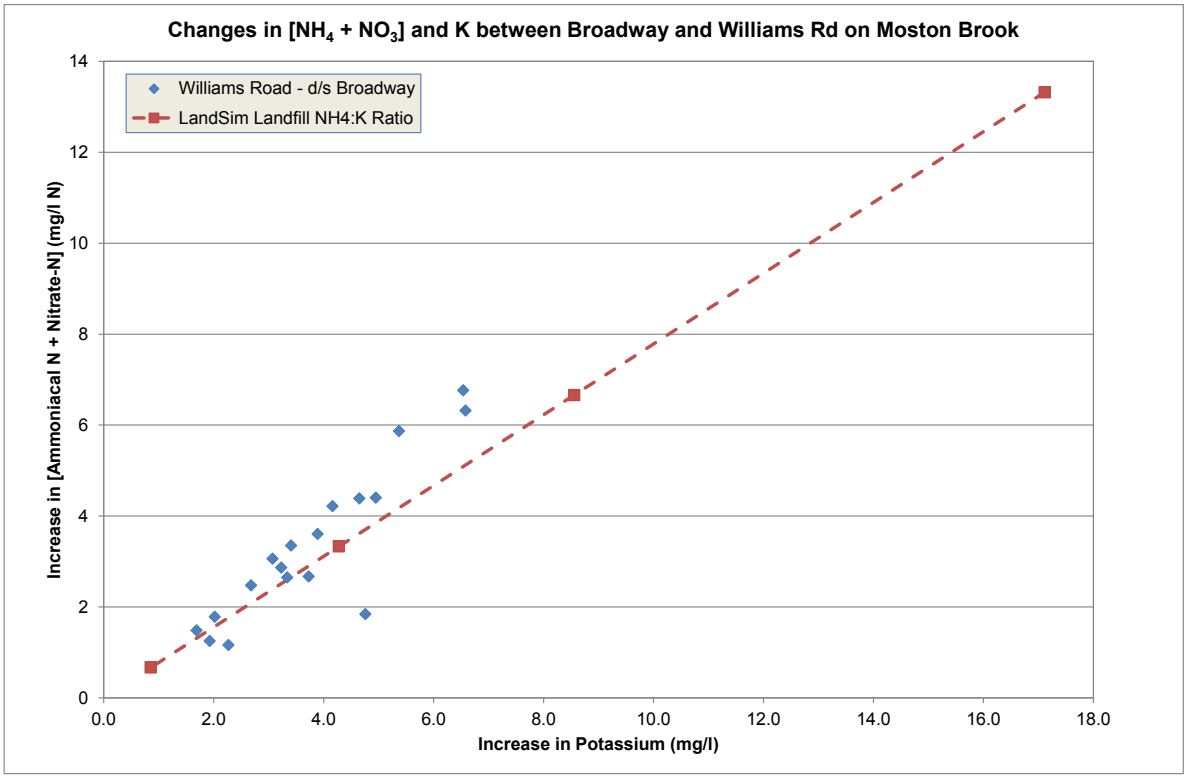
The third approach to source apportionment was to use water quality data to work out the likely size of a cause of deteriorating water quality in two reaches as discussed in the following subsections. Further details are provided in the Source Apportionment Evidence Pack.

Broadway to Williams Road (likely impact from Hardman Fold)

Based on the evidence in the Broadway to Williams Road Evidence Pack, the most likely cause of deterioration in water quality between Broadway and Williams Road is an input of landfill leachate from Hardman Fold via westwards flow of contaminated groundwater beneath Broadway and then discharge into Moston Brook. To test this and to assess whether the rate of leachate discharge that would be needed was realistic, the water quality changes were examined more closely.

Rather than absolute concentrations, increases in concentrations were examined between Broadway and Williams Road. Increases in concentrations of ammoniacal nitrogen and potassium were compared to each other and found to have a ratio consistent with that typical of landfill (as defined by their mean concentrations reported in the Environment Agency's (2007) landfill modelling software, LandSim v2.5.17). This is illustrated on Figure 3.6.

Figure 3.6 – Landfill Leachate Signature Downstream of Broadway



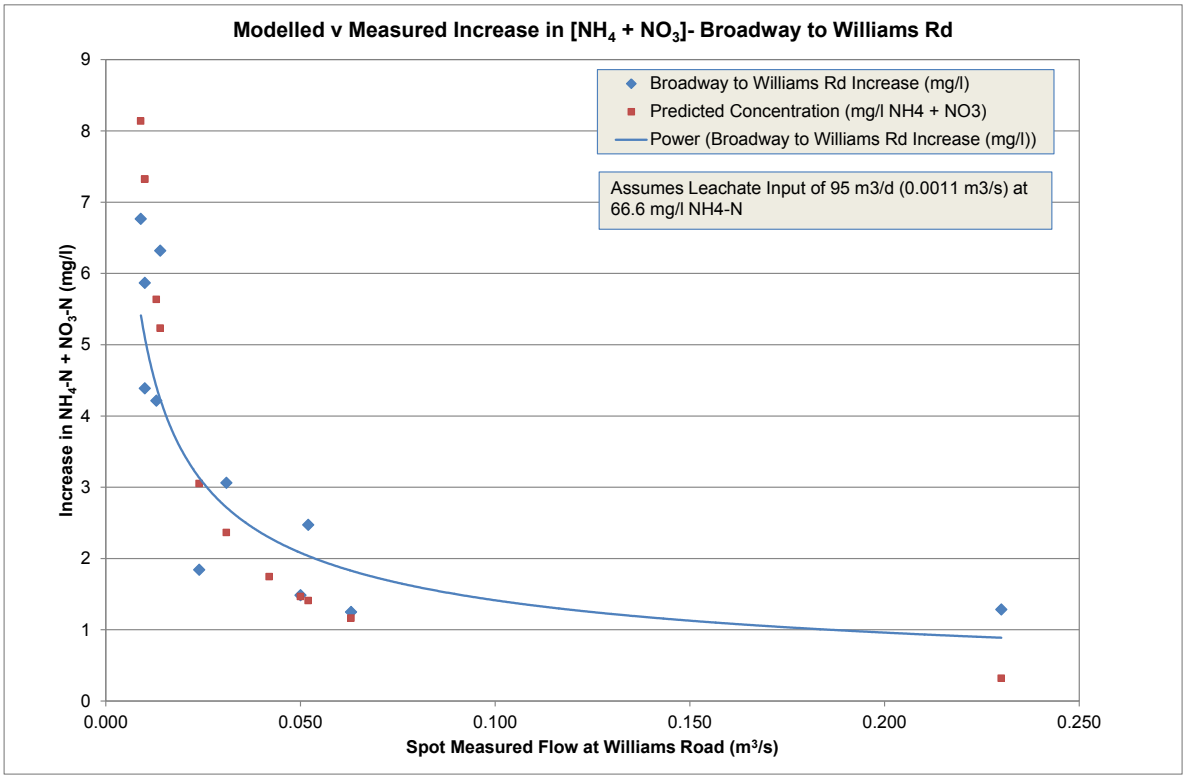
Note: LandSim ratio from mean concentrations in LandSim software (Environment Agency, 2007). The Increase in Ammoniacal Nitrogen plus Nitrate Nitrogen allows for some nitrification of ammoniacal nitrogen in the Brook.

The size of the likely landfill leachate input was estimated by comparing modelled water quality with measured increases in concentration of ammoniacal nitrogen and potassium at different flows in Moston Brook. The modelled water quality used measured ammoniacal nitrogen concentrations from Hardman Fold landfill for the period March 2009 to March 2012 and measured spot flow readings at Williams Road on the dates of the water quality samples in the Brook. For potassium, the same approach was undertaken although in the absence of measured potassium concentrations in the Hardman Fold leachate, the LandSim ratio of K:NH_4-N was used. The modelling was undertaken in Microsoft Excel by setting up a simple formula:

$$\text{Modelled increase in concentration in Moston Brook} = \frac{\text{Measured concentration in leachate} \times \text{Leachate discharge}}{\text{Flow in Moston Brook}}$$

The modelled increase in ammoniacal nitrogen in Moston Brook is compared to the measured increase in concentration between Broadway and Williams Road in Figure 3.7. The leachate discharge was adjusted until the modelled predictions matched the measured data. A leachate discharge of 95 m^3/day gave the best fit.

Figure 3.7 – Modelled versus Measured Changes in NH_4-N and NO_3-N at Williams Road



Note: The blue diamonds are the measured increases in concentration between Broadway and Williams Road and the red squares are the modelled increases assuming 95 m^3/day of leachate with a concentration of 66.6 mg/l NH_4-N.

The 95 m^3/day of landfill leachate input was compared to the possible size of leachate generation and loss in Hardman Fold to check if it was realistic. Taking into account the plan area of the landfill (~9.7 ha) and an estimated effective rainfall of ~0.5 m/year (assumes no cap and poor drainage on the landfill), Hardman Fold is predicted to produce ~133 m^3/day of leachate. Of this it is known that an average of 31.5 m^3/day of leachate was extracted between July 2010 and June 2012 and so giving a possible loss of leachate of (133 - 31.5=) 101.5 m^3/day. This is very similar to the 95 m^3/day estimated from modelling and so provides further supporting evidence that Hardman Fold landfill is a likely and plausible cause of deterioration in water quality between Broadway and Williams Road.

Williams Road to prior to the confluence with the River Irk

Through using the same approach as discussed above, NH_4-N and PO_4 concentration increases between Williams Road and the Irk are shown to be the same as in sewage (after Environment Agency, Ref). Furthermore by using the same method, albeit it with estimates of flow prior to the Irk rather than spot flow measurements, a sewage input of 625 m^3/day was estimated.

As water quality appears to vary diurnally at this downstream end of Moston Brook and water quality samples may have been collected during peak times, it is possible that the 625 m^3/day sewage input is overestimated and may be closer to 200-300 m^3/day. At an average sewage domestic discharge rate of 0.18 m^3/head/day then this still equates to sewage inputs from 1100-1700 people or 450-700 properties (at 2½ people per average property).

3.10 Outputs from the Analysis of Evidence

The main outputs from the analysis of evidence were the Evidence Packs and the slides on source apportionment which participants used as their evidence base at the Causes Workshop. A list of the outputs included on the project CD is given in Appendix C.

4. Causes Workshop and its Outputs

4.1 Purpose and Result of the Causes Workshop

The Causes Workshop (10 January 2013) was a one-day workshop, where the participants aimed to reduce the list of *suspected causes* of WFD failure described in Table 2.2 into a list of *main causes* of failure in each of the sub-catchments. This was achieved and they are shown in Table 4.1.

Table 4.1 Agreed Main Causes of WFD Failure for Each Sub-catchment

Sub-catchment	Main Causes[1]
North Culvert	Intermittent sewage discharges, wrong connections
South Culvert	Intermittent sewage discharges, wrong connections
Wrigley Head – Broadway	None – although action may be required here on the landfill to address issues downstream
Broadway – Williams Rd	Landfill, wrong connections
Williams Rd – Silchester Dr	Wrong connections, intermittent sewage discharges
Silchester Dr – River Irk	Wrong connections, intermittent sewage discharges

Notes:

1 As agreed by stakeholders at the Causes Workshop (average score of 3 or more in Table 4.3).

The procedure by which this consensus was reached is described in more detail below.

4.2 Preparing for and Running the Workshop

4.2.1 Preparation

The main materials prepared in advance of the workshop were the Evidence Packs described in Section 3.8 and some large (A1 or A0) maps printed from the GIS showing the OS 1:25,000 basemap and the key pressures. The Evidence Packs were sent out to the participants two days before the workshop; less time than desired but an outcome of processing and interpreting still incoming data up to the last minute.

From past experience from this and other Evidence and Measures projects, it is preferable to limit the workshop participants to no more than 20. More than 20 people from stakeholder organisations could have been involved so the main representatives from organisations were requested to select carefully the people they sent to the workshops, choosing people who; a) had technical expertise in the areas related to the suspected causes of WFD failure, and b) who had the authority to suggest measures at the Measures Workshop. The people selected to attend the workshops were asked to be responsible for communicating with other people who might want to know the results or provide input.

The list of attendees was discussed by the project team prior to the workshop. Working groups (sewage, landfill and overview) were agreed and a recommended order of priority of reaches for the different groups was prepared.

4.2.2 Running the Workshop

20 participants from 6 partner organisations (Environment Agency, United Utilities, Oldham District Council, Manchester City Council, Salford University, Highways Agency) attended the Causes Workshop on 10 January 2013. In addition, the project's independent consultants, Paul Hulme and Nick Rukin, who had analysed the evidence and produced the Evidence Packs, presented the Evidence Packs and ran the workshop. Appendix A provides a full list of the stakeholders involved in the project.

The approximate timing of the workshop between 9.30 am to 4.00 pm is set out in Table 4.2.

Table 4.2 Causes Workshop Agenda Items and Timings

Agenda Item	Duration
Introduction	10 mins
Presentation: WFD failures, list of suspected causes, Evidence Packs	1 hour
Groups: Review evidence for errors or omissions	2 hours
Lunch	*55 mins*
Presentation of source apportionment estimates	30 mins
Groups: Score each suspected cause of WFD failure	50 mins
Individuals: Record their initial ideas for measures.	10 mins
Feedback and actions arising to be done before Measure Workshop.	35 mins

Notes:

A limited amount of time (one hour) was spent introducing participant's to the evidence packs via the presentation so as to leave plenty of time for groups to explore the Evidence Packs and discuss any inaccuracies or omissions in the following group session.

For the two group sessions, the participants were divided into three groups: one containing people who had technical expertise in sewage related issues, one containing people who had technical expertise with landfill and contaminated land and a third group with people whose technical expertise varied (ecology, geomorphology, community projects, co-ordinators for the Moston Brook Project, the Irwell Catchment Pilot and the Irk and Medlock Valley Programme). Each of the three groups had a pre-designated leader and note-taker recording their group's comments in a spreadsheet.

During the morning group session, it was suggested to participants that, whilst it was sensible to work from upstream to downstream, they planned their time to allow more effort to be focussed on the important areas. The important areas were highlighted in a hand-out. When reviewing the Evidence Packs, participants were asked to record any errors or omissions that they identified, the evidence on which this was based, who would provide additional information and by when. During this session the facilitators, who had prepared the Evidence Packs, were on hand to answer questions about the Evidence Packs.

The afternoon session focussed on reaching consensus on the main causes of failure for each sub-catchment. The procedure used is described in Section 4.3.

Each participant provided feedback via a standard feedback form (see project CD) and was also invited to feedback informally via the Environment Agency project manager, Danielle Soulsby.

After the workshop participants were encouraged to follow-up on the comments they had raised related to the evidence presented in the Evidence Packs and, where appropriate, provide additional evidence. This was included in a revised version of the Evidence Packs circulated to the participants prior to the Measures Workshop. A note of the actions taken was included in the spreadsheet of participants' comments.

4.3 Consensus on Main Causes of WFD Failure

4.3.1 Scoring Suspected Causes

Participants scored each suspected cause in each sub-catchment according to whether the evidence in the Evidence Packs supported it as an actual cause of failure. A score of 0 means that "this suspected cause is definitely not a cause of the WFD failures"; a score of 5 means that "this suspected cause is definitely a major cause of the WFD failures". A suspected cause with a high score means stakeholders consider there is enough strength of evidence to identify this as a main cause of failure and hence to proceed to selecting measures.

Each person filled in their own individual scoresheet and these were averaged following the workshop. We also asked each group leader to fill in the same scoresheet after obtaining consensus from the group for each score. This gave us three "group consensus" scoresheets which were also averaged following the workshop. During the scoring by "group consensus" group leaders were asked to flag any suspected causes about which the group could not agree. There were none.

4.3.2 Results of the Scoring

Table 4.3 presents the average score from the 3 "group consensus" scoresheets. This highlights those suspected causes believed to be the most likely causes of WFD failure and the sub-catchment they are located in. Participants agreed that a suspected cause with an average score of 3 or more could be considered a main cause of WFD failure and these were listed in Table 4.1.

For each suspected cause, the range of scores, given to it by the individual participants, gives an indication of the uncertainty within the group. The maximum range was 5 (min score 0, max score 5) and for the 17 individual scoresheets about 60% of the suspected causes had a range of 3 or more. 10% of the suspected causes had a range of 5, i.e. one person gave it a score of 0 whilst another gave it a score of 5. A large range in scores can be a) because it reflects the natural tendency different people have to interpret the same strength of evidence in different ways or b) because it reflects actual uncertainty in the strength of evidence.

Only 2 suspected causes (intermittent sewage discharges in sub-catchments 5 and 6, see Table 4.4) had a range of 3 or more following the "group consensus" scoring. It also transpired, at the subsequent Measures Workshop, that this was because some participants gave intermittent discharges a low score here because they knew that work was planned to deal with it. The range of scores from the three "group consensus" scoresheets was much smaller than the individual scoresheets and participants agreed at the Measures Workshop that this reflected their consensus on the *most likely* causes of WFD water quality failure (Table 4.1).

Table 4.3 Average "Group Consensus" Scores for Each Suspected Cause

Average of the 3 "roup consensus" scoresheets						
Group	(All)		Colouring	0	3	5
Average of Score	Sub-catchment					
Suspected Cause	1) North Culvert	2) South Culvert	3) Wrigley Head - Broadway	4) Broadway - Williams Rd	5) Williams Rd - Silchester Dr	6) Silchester Dr - R Irk
1) Landfill	1.0	1.7	2.7	5.0	2.3	1.0
2) Intermittent sewage discharges	3.0	4.7	1.3	1.0	3.0	3.7
3) Wrong connections	3.0	3.7	1.7	3.3	4.3	5.0
4) Transport (including highways)	1.7	#N/A	1.3	1.7	#N/A	#N/A
5) Industrial	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
6) Retail	1.0	#N/A	#N/A	#N/A	#N/A	#N/A
7) Parks and gardens	0.7	#N/A	#N/A	#N/A	#N/A	#N/A
8) Urban	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
9) Geomorphology	0.7	0.7	1.0	1.0	1.3	1.0
10) Cemetery				1.0	2.0	

Notes: Score of 0 (white) means "definitely not a cause of the WFD failures"; score of 5 (red) means "definitely a major cause of the WFD failures". A score of 3 or more was agreed to be a *main cause* of failure.

Table 4.4 Range of Scores from the Three "Group Consensus" Scoresheets.

Range (max - min) from the 3 "group consensus" scoresheets						
Range of score	Sub-catchment	(red means range in scores >3)				
Suspected Cause	1) North Culvert	2) South Culvert	3) Wrigley Head - Broadway	4) Broadway - Williams Rd	5) Williams Rd - Silchester Dr	6) Silchester Dr - R Irk
1) Landfill	2	1	1	0	1	0
2) Intermittent sewage discharges	2	1	1	2	4	3
3) Wrong connections	2	2	2	1	1	0
4) Transport (including highways)	1	#N/A	1	1	#N/A	#N/A
5) Industrial	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
6) Retail	0	#N/A	#N/A	#N/A	#N/A	#N/A
7) Parks and gardens	1	#N/A	#N/A	#N/A	#N/A	#N/A
8) Urban	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
9) Geomorphology	1	1	2	2	1	0
10) Cemetery	0	0	0	0	0	0

4.4 Initial Ideas for Measures

After each group had reached consensus on the suspected causes of failure and whilst the evidence was fresh in their minds, individuals recorded their own ideas for measures that would target these main causes of failure. After the workshop these were collated and circulated prior to the Measures Workshop.

4.5 Outputs from the Workshop

The key output from the Causes Workshop was the agreement reached on the main causes of WFD failure in each sub-catchment. In terms of tangible products the workshop also produced the following:

- Spreadsheet of raw scores from participants' scoresheets for each suspected cause;;
- Record of comments, errors, omissions, actions arising suggested by the group with actual changes to the Evidence Packs added after the workshop;
- Feedback spreadsheets providing feedback on the process;
- Initial hand-written ideas on measures to target the main agreed causes of WFD failure, later recorded in a spreadsheet.

A list of the outputs included on the project CD are given in Appendix C.

4.6 Participants' Feedback

Participants commented that they found the Evidence Packs to be a useful and efficient method of relaying evidence on the causes and that this helped focus discussion. Some participants would have liked the Evidence Packs to have been distributed earlier before the workshop to have allowed them to study the evidence more closely.

Overall the participants found the preparation for the workshop and the workshop itself to be very valuable.

5. Measures Workshop and its Outputs

5.1 Purpose and Result of the Measures Workshop

The Measures Workshop (14 February 2013) was a one-day workshop, where the participants had the chance to review the changes made to the Evidence Packs as a result of their comments at the Causes Workshop and to comment on the consensus reached on main causes of WFD failure. The main aim of the day was come up with "concrete" measures to address the key causes of failure in specific locations.

Participants devised 67 specific measures. Some of the key potential ones are included in Table 5.1.

Table 5.1 Main Causes of WFD Failure and Selected Potential Measures for Each Sub-catchment

Sub-catchment	Main Causes[1]	Measures[2]
North Culvert	Intermittent sewage discharges, wrong connections	EA and UU work together to investigate any uncharted combined sewage overflows (CSO) and wrong connections - easy ones now, harder ones next AMP cycle. Look at Suffolk Street CSO data to ensure it only spills when it is supposed to. Check tank meets design criteria.
South Culvert	Intermittent sewage discharges, wrong connections	Display the unique ID number on each CSO to enable the public to report incidents. Surface water management plans - remove surface water system connected to foul system. See Note 3.
Wrigley Head – Broadway	None – although action may be required here on the landfill to address issues downstream	Hardman Fold: capping with suitable design, install leachate drain/interceptor & enhanced toe drain. Need full info about GMWDA infrastructure already in place. Surface water transfer from canal or surface drains to increase flow in the brook, dilute & increase resilience to pollution.
Broadway – Williams Rd	Landfill, wrong connections	Stop up and divert the drains at 2 sites; the Lancaster Club & Lower Memorial Park (ref to Groundwork report). Wrong connection awareness campaigns either by post or email. Influence planners and local authority to open up culverts. Remove weir and replace with rock ramp for aeration.
Williams Rd – Silchester Dr	Wrong connections, intermittent sewage discharges	Rationalisation of 6 CSOs into 2 in culvert between Kenyon Lane and Potters Lane. EA to attend Category 3 pollution incidents that have been identified as a risk in Moston Brook (for sewage).
Silchester Dr – River Irk	Wrong connections, intermittent sewage discharges	UU and EA BA team to develop a joint survey to identify known and unchartered combined sewage overflows (CSOs) and wrong connections (with potentially some water quality sampling).
All		Investigate having Moston Brook scorecard to demonstrate the complex WFD WQ issues in a simple way - do every year and published in libraries etc. Make use of existing groups, organisations etc. Highlight specific issues e.g. fly tipping. Have awards associated with it, could attract funding.

Notes:

2 As agreed by stakeholders at the Causes Workshop (average score of 3 or more in Table 4.3).
3 This is a headlines summary of the measures identified at the Measures Workshop.
4 The measures developed appear to assume that current known problems with sewage discharge from the Alford St pumping station will be addressed in planned AMP5 works by 2015.

5.2 Consideration of Additional Information

A limited amount of additional information was examined between the Causes Workshop (10 January 2013) and the Measures Workshop (14 February 2013). As noted in Section 3.8.6, the Evidence Packs and their Conclusions were revised following their use at the Causes Workshop as preparation for the Measures Workshop.

One suspected cause, parks and gardens upstream of Wrigley Head, which was included in the Evidence Packs at the Causes Workshop was discounted afterwards following evidence provided by Oldham District Council. A new suspected cause was added by participants at the Causes Workshop, a cemetery, which drains towards Deans Brook that meets Moston Brook just downstream of Williams Road. The other suspected causes remained the same. Some additional pieces of evidence were also added including the results from a site investigation and monitoring study at the Manchester Academy. Edits, including both additions and deletions, were shown in the revised Evidence Packs so that stakeholders could check where and how their comments had been addressed.

5.3 Preparing for and Running the Workshop

5.3.1 Preparation

The main materials prepared in advance of the Measures Workshop were the revised Evidence Packs, the table of average scores for each suspected cause (see Table 4.3), and the participant's initial ideas for measures collected at the Causes Workshop. These materials were circulated to participants for review before the workshop. At the workshop each group was provided with the same large (A1 or A0) maps showing the OS 1:25,000 basemap and the key pressures, which were used at the Causes Workshop and a set of A4 OS basemaps maps 1:10,000 scale.

Prior to the workshop, the project team discussed the grouping of participants and designated a group leader.

5.3.2 Running the Workshop

21 participants from 6 partner organisations attended the Measures Workshop. 15 of these had previously attended the Causes Workshop.

The workshops are more productive when participants commit to attending both the Causes and Measures Workshops, and ideally one of the initial meetings as well. This is because what is learned in the Causes Workshop about the evidence and how it points to certain specific main causes of failure is the foundation for targeted evidence-based measures. On a previous project where many of the participants changed between workshops, an additional workshop had to be scheduled to build consensus.

The project team's independent consultants, Paul Hulme and Nick Rukin, again ran the workshop. Appendix A provides a full list of the stakeholders involved in the project.

The approximate timing of the workshop between 9.30 am to 4.00 pm is set out in Table 5.2.

Participants were reminded of the changes to the Evidence Packs and the consensus reflected by the scores for each suspected cause (Section 4.3) and agreed that these scores reflected the consensus on the *main causes* of failure. These main causes are listed in Tables 4.1 and 5.1 and provided the foundation for proceeding to devising the measures.

Table 5.2 Measures Workshop Agenda Items and Timings

Agenda Item	Duration
Introduction	10 mins
Presentation: Reminder of WFD failures, suspected causes scores from Causes Workshop, list of agreed main causes of WFD failure, changes to Evidence Packs	30 mins
Presentation: Introduction to selecting measures, note existing or planned measures.	20 mins
Groups: Record measures to target main causes of WFD failure	2 hours
Feedback, comparison between groups and questions.	10 mins
Lunch	*50 mins*
Groups: Record measures to target main causes of WFD failure (contd.)	1 hour 40 mins
Feedback on what has been achieved and agree next steps	50 mins

Notes:

During the introduction to working in groups on selecting measures, participants were given some guidance on how to go about the measures selection so as to use the time as productively as possible.

Firstly stakeholders informed the group about measures they were aware of which had recently been implemented or were planned that would influence any of the main causes of WFD failure.

Secondly participants were encouraged to:

- Make each measure specific in terms of the cause of WFD failure that it is designed to address and the location or locations where the measure needs to be implemented.
- First devise measures for the main causes of failure (Table 4.1) and afterwards consider whether some of the minor causes required any low cost measures.
- Devise measures that involved concrete actions aimed at improvements on the ground and not simply to call for more investigations. This was because the participants had agreed the main causes of WFD failure in each sub-catchment and no-one thought that any existing relevant evidence had been missed. However, it was conceded that clearly in some situations, an investigation could be the best concrete next step, such as trying to pin down which of several areas of housing are discharging sewage because of wrong connections.
- Not filter out measures on the basis of high cost, but to simply note the cost. This was because the workshop aimed to gather as wide a variety of potential measures for dealing with a main cause of WFD failure as possible.
- Remember that prioritisation of measures based on cost, or other considerations, was not their responsibility but the responsibility of business planners in the next stage of the Evidence and Measures approach (Stage 5 in Section 1.6).

Measures were recorded in a spreadsheet under the list of headings provided in Table 5.3. Where participants did not have the information related to a particular heading at the workshop, a blank was left and the need for action after the workshop noted.

During the final feedback session, participants agreed to review the measures spreadsheets and to meet quarterly to promote, fund and monitor the implementation of the measures they had devised.

Table 5.3 Headings for Measures Worksheet

Measures Worksheet Heading
Description of action
Proposer(s)
Who will take ownership of measure?
Specific location where will it be implemented
What agreed main cause(s) of failure from the Causes WS will this address?
WFD Reason For Failure
Why do you think it would work?
What difference (improvement) do you think this measure will make?
How long before improvements are likely to be seen?
How long do you think the measure will continue to have effect?
List any likely consequences (neutral or bad) for birds, farming, food production, flooding etc.
How long will measure take to implement?
What monitoring can we carry out after the measure has been implemented to assess the impacts of the measure?
Are there opportunities to involve other stakeholders?
Do you know of any other activity already addressing this cause of failure?
Do we need to do anything before the measure can start?
Estimated cost
Possible sources of funding
What might stop us implementing this measure?
Any other risks?
Any other information?

5.4 Outputs from the Workshop

The main output from the Measures Workshop was the draft measures spreadsheet. Following review after the workshop, the three group's measures were collated into a single spreadsheet by the Environment Agency project manager. An additional output was the participants' feedback forms.

5.5 Participants Feedback

A copy of the feedback form used at the end of the Measures Workshop is included on the project CD. Participants relayed that they had been happy with the preparation for the Workshop and the running of the Workshop itself. They had found the process a constructive way of devising evidence based measures.

Some stakeholders commented on how useful it was to work in technical groups armed with evidence to then come up with measures. A positive spirit of working together appeared to be evident. Some stakeholders said that lack of funding might be a significant barrier to the implementation of the measures they had selected during the workshop.

6. Lessons Learned

6.1 Purpose of this Section

This section provides a commentary on the lessons learned from this project that should be taken to the next such project.

6.2 Data Collection

6.2.1 Data Share

This was the first time that the Environment Agency project manager and the consultants had used the Environment Agency's new DataShare system. After some initial problems learning how to find and select datasets from the online system, the team found the use of DataShare valuable in transferring and licensing commonly used datasets.

6.2.2 Fruitful Datasets

It aids the data analysis to have as many of the "most fruitful datasets" available at the start of the project as possible. The team found that they were able to identify about 80% of data that turned out to be "most fruitful" by skimming through some key reports identified by Environment Agency staff and listening to key concerns at a telephone conference before the initial meetings.

Some of the data anticipated to be fruitful before the start of the project proved of limited use. For example on previous projects, significant time had been spent processing and interpreting fish data. For Moston Brook, due to the water quality problems, fish were absent, thus leaving no data of substance. The lesson here is that although experience from undertaking successive projects will help focus data collection and evaluation, each catchment will have its own balance of data availability and problems and the approach must work efficiently and effectively with whatever is available.

6.2.3 Additional Data

Reviewing reports and speaking to stakeholders often reveals additional data. Examples include an Environment Agency 1990 survey of water quality and UU flow measurements in Moston Brook. Some of this additional data can yield very strong evidence and it can come through at all stages of the approach. The approach therefore needs to accommodate late identified data as much as possible, but a cut-off needs to be made to allow evidence to be extracted and included in the Evidence Packs in time to issue before the workshops.

6.3 Data Processing

Some of the spreadsheets developed for previous Evidence and Measures projects proved useful and saved time. An example of this is the workbooks used to produce the WFD water quality status charts. For other data, data in new layouts was combined with other available data (e.g. water quality and flows) in new spreadsheets to draw out evidence supporting charts or tables. It therefore appears that a standard approach to processing may apply to less than 50% of a project and project teams will have to use their Excel skills (particularly VLOOKUPs, SUMIFS and COUNTIFS) and to draw out evidence from other datasets.

6.4 Evidence Packs

Although not all stakeholders will have time to read through the Evidence Packs before the workshops, it is important to send them out perhaps a week before the workshop, so that those who have the time or prefer to scrutinise the evidence can review them.

The Evidence Packs appeared to work well based on the feedback received from workshop participants. Some people just used the Evidence Tables and the Conclusions Tables, whilst others scrutinised the supporting information.

6.5 Stakeholders

6.5.1 Participants Committed To Attending Both Workshops

The Causes and Measures Workshops are more productive when most, and ideally all, of the participants commit at the beginning of the project to attending the initial meeting, the Causes Workshop and the Measures Workshop. The number of participants at the Causes and Measures Workshops were 20 and 21 respectively and 15 of these attended both.

6.5.2 Number and Experience Of Workshop Participants

From past experience from this and other Evidence and Measures projects, it is preferable to limit the workshop participants to no more than 20.

More than 20 people from stakeholder organisations could have been involved so the main representatives from organisations were requested to select carefully the people they sent to the workshops, choosing people who; a) had technical expertise in the areas related to the suspected causes of WFD failure, and b) who had the authority to suggest measures at the Measures Workshop. The people selected to attend the workshops were asked to be responsible for communicating with other people who wanted to know the workshop results or provide input.

When planning the project, it is easier to prepare for workshops where the participants have a relevant technical background. This reduces the amount of work related to explaining concepts and background before and during the workshops. That said it is difficult or perhaps unsatisfactory to exclude stakeholders from the process, and the workshops had more participants than envisaged at the project planning stage. A balance must be (and was) gained between nurturing participants enthusiasm for the process, time and budget taken in preparing, and time on the day providing background or explaining details.

6.6 Workshops

6.6.1 Feedback On Evidence Packs

At the Causes Workshop, groups were asked to review the Evidence Packs and record where there were inaccuracies or omissions. However, it is important to focus on the positive as well as the negative and would have been better to ask them to also note where they agreed with the conclusion in the Conclusions Tables.

6.6.2 Source Apportionment Estimates

The source apportionment information was presented separately in the afternoon of the Causes Workshop, i.e. after the groups had been through the main Evidence Packs (see Table 4.2). However, this gave undue weight to the source apportionment, which was a line

of evidence that was highly uncertain. In future it would probably be better to incorporate this into the Evidence Packs.

SAGIS outputs were used, but despite enquiry there is uncertainty as to what some of the outputs (e.g. urban) take account of in terms of pressures. Also SAGIS is not at present designed for catchments as small as Moston Brook so using it here had limitations. Nor does SAGIS estimate BOD and ammoniacal nitrogen loads.

7. Conclusions and Recommendations

7.1 Summary and Conclusions

Note: *A summary of the agreed main causes of WFD failure and selected measures for each sub-catchment of Moston Brook is provided in Table 5.1.*

The Defra / EA Evidence and Measures (E+M) approach had previously been applied and developed on two catchments; the rural River Petteril catchment in North Cumbria and, Savick Brook and the South Fylde Drains (part of the Tidal Ribble) in Lancashire. The latter catchment had included urban areas. The project team was invited to use the approach on Moston Brook under much more of a delivery rather than R&D focus, with results required in a six month period.

Moston Brook is situated in northeast Greater Manchester / Oldham and reportedly has the worst water quality of waterbodies in the Environment Agency's Northwest region. Significant parts of the brook are culverted and for decades it appears to have suffered from pollution from sewage and old landfills. The causes (in terms of where, how much and who was responsible) of water quality problems had not been agreed amongst stakeholders. In addition to the need to meet Water Framework Directive (WFD) targets, there is a strong local community aspiration to improve the amenity value of the brook. The poor water quality was affecting both targets.

Using the experience of the previous two projects, the Moston Brook E+M approach was scoped out and work commenced in September 2012. Suspected causes, fruitful data sets, pertinent reports and lines of enquiry were identified in discussion with the Environment Agency team and subsequently with other stakeholders.

Evidence was drawn out of the available information and summarised in Evidence Packs. Some source apportionment work was also undertaken, starting with application where possible using the Environment Agency's SAGIS tool outputs. The Evidence Packs and source apportionment work were used at a Causes Workshop on 10 January 2013 (less than 4 months from project start). 20 participants attended the workshop, worked in three groups (sewage, landfill and overview) and came to consensus on the likely main causes of poor water quality (in terms of WFD) (see Table 5.1).

Following a small amount of additional evidence gathering, the Measures Workshop was held on 14 February 2013. 21 participants attended, 15 of these were the same as at the Causes Workshop, and again worked in three groups (sewage, landfill and overview). They agreed again that the causes of poor WFD water quality they had identified at the previous workshop were unchanged and worked hard to produce over 60 measures focussed on addressing those causes.

Workshop participants gave feedback that the preparation for the workshops, primarily the Evidence Packs, had really helped them move forward to identify causes of poor WFD water quality and then to provide focussed measures. There was a strong sense of collaborative working, which hopefully should prove invaluable in implementing the measures in the coming years.

7.2 Recommendations

The main recommendations for Moston Brook are:

- To maintain the positive spirit of cooperation between stakeholders by keeping actions focussed on the evidence based understanding of causes and designed measures. This should start with a meeting of stakeholders within 3 months of the Measures Workshop, so by mid-May 2013.
- To check where measures can be combined to achieve wider benefits and delivery by a number of stakeholders and so allow working relationships to be nurtured further.
- For stakeholders to work closely to find funding solutions that will allow implementation of the measures and where barriers to this are found to report these to higher levels in their organisation and to Defra (potentially via pjHYDRO if appropriate).
- To predict the outcomes of measures in terms of water quality and then monitor and review water quality as appropriate. Water quality should respond rapidly (less than a month) to most measures.
- Lessons learned from working together and the implementation and success of measures should be disseminated widely through conferences and Agency, local authority and UU bulletins.

With respect to the local application of the E+M approach, it is recommended that:

- Other catchments are selected for application of the approach. With a group of stakeholders already familiar with the approach, and who have started working together, there should be economies in effort and strengthening of collaborative spirit.
- With stakeholders gaining increasing familiarity with the approach, there is the potential to agree a higher level extrapolation of results and approach from Moston Brook and other closely examined catchments to develop measures in a wider area.

7.3 What Next for Moston Brook?

In addition to the above recommendations, the Environment Agency is already working to the following commitments:

- The Environment Agency will undertake an assessment of costs and benefits to prioritise the measures. They then plan to put forward a project bid to the Environment Agency's Environment and Business programme, in the hope of obtaining future funding to implement some of the measures. If this funding was obtained, the Environment Agency will work in partnership with Oldham Council and Groundwork to bid for landfill tax funding. This would be used towards improving the bank side habitat and access around the upstream section of the brook.
- The Environment Agency will promote the project via newsletters aimed at a variety of stakeholders to raise the awareness of water quality at Moston Brook.
- Within United Utilities (UU) AMP5 programme of works, a number of improvements are already planned to consented sewage outfalls and Alford Street pumping station. The Environment Agency will work closely with UU to monitor and report the benefits of these schemes on Moston Brook's water quality. The schemes will be put in place by 31 March 2015.

8. References

APEM, May 2009	Moston Brook, Culvert Investigation. Draft Report May 2009, APEM Ref 410705, 12pp + CCTV footage. Prepared for the Environment Agency.
Atkins, August 2002	Moston Brook Pollution Prevention Project, Desk Study, Final Report. Prepared for the Environment Agency, dated August 2002. 45+ pages + a number of large appendices.
Environment Agency, 2007	LandSim Manual Release 2.5.17. Environment Agency R&D Publication 120. Prepared by Golder Associates.
Environment Agency, 2011a	WFD Investigation Report: for Waterbody GB112069061080, Environment Agency internal draft report prepared on 10 May 2011, 11pp.
Environment Agency, 2011b	Moston Brook WFD Investigation Final Report. Environment Agency internal report prepared June 2011.
Environment Agency, 2012	Statement of Requirement for Moston Brook Action Project using an Evidence and Measures Approach provided by email on 13 July 2012.
Groundwork, March 2008a	Preliminary Risk Assessment of Moston Brook, Moston / Failsworth, Greater Manchester, March 2008. Report ref FSE96995A.1948. 44pp + figures and appendices.
Groundwork, March 2008b	Moston Brook Feasibility Study. Prepared by Groundwork Oldham & Rochdale. 67pp plus appendices.
Manchester City Council, April 2011	Preliminary Risk Assessment and Site Investigation On Moston Brook Sites (Williams Road, Broadway Common and Wrigley Head). Report prepared by the Contaminated Land Section of Manchester City Council, dated 20 April 2011, Ref CLS/2011/1, 53pp.
Mouchel, May 1993	Drawing entitled: Moston Brook Outfall – General Arrangement, prepared by Mouchel, drawing reference 80538/-/05/201 Rev C dated 10 May 1993.

Appendix A
List of Stakeholders Involved in the Project

2 Pages

LIST OF INTERNAL STAKEHOLDERS (PAGE 1 OF 2)

Stakeholders			Project Board	Initial EA Workshop (20 Sept 2012)	Moston Brook Officers Group (15 Nov 2012)	Causes Workshop (10 Jan 2013)	Measures Workshop (14 Feb 2013)
Name	**Role / Job Title**	**Organisation**					
Danielle Soulsby	Project Manager	Environment Agency	X	X	X	X	X
Sarah Peet	Project Executive	Environment Agency	X				
Jez Westgarth	Project Sponsor	Environment Agency	X				
Anne-Marie Bowman	Technical Specialist Data Reporting	Environment Agency	X	X			
Katherine Causer	Irwell Pilot Project Manager	Environment Agency		X	X	X	X
David Holden	Technical Specialist – Landfill Gas	Environment Agency				X	X
Tracey Smith	Analysis and Reporting Monitoring Officer	Environment Agency		X		X	
Charlotte Billingham	Geomorphology Advisor	Environment Agency				X	X
Gary Morris	Biodiversity Officer	Environment Agency		X		X	X
Richard Leaver	Environment Officer	Environment Agency					X
Valdis Anspoks	Environment Officer	Environment Agency					X
Colin Liptrot	Operations Delivery Team Leader	Environment Agency				X	X
Matt Harris	Regional Environment Planning Officer	Environment Agency		X		X	X
Paul Bowden	FCRM Advisor	Environment Agency		X			
Catriona Hare	Senior Environment Planner Officer	Environment Agency		X			
Andrew Morisse	Analysis and Reporting Monitoring Officer	Environment Agency		X			
Rachel Goodwin	Facilitator - Senior Environment Planner Officer	Environment Agency				X	
Kate Gamble	Facilitator – Senior Environment Planner Officer	Environment Agency					X
Ruth Davies	Facilitator - Environment Planner Officer	Environment Agency				X	X
Charlotte Jacks	Facilitator - Environment Planner Officer	Environment Agency				X	

Note: X = Attendance

LIST OF EXTERNAL STAKEHOLDERS (PAGE 2 OF 2)

Stakeholders			Project Board	Initial EA Workshop (20 Sept 2012)	Moston Brook Officers Group (15 Nov 2012)	Causes Workshop (10 Jan 2013)	Measures Workshop (14 Feb 2013)
Name	**Role / Job Title**	**Organisation**					
Ian Fullalove	Wastewater Network Manager	United Utilities			X	X	X
Ian Wyllie	Wastewater District Manager	United Utilities				X	X
James Ashall	Wastewater District Manager	United Utilities			X	X	X
Ann Bates	Moston Brook Project Officer	Oldham Council			X	X	X
Othman Benghalon	Senior Technical Officer	Oldham Council			X		X
David Barlow	Biodiversity Engagement Manager	Manchester City Council			X		
Rory Gaffney	Regeneration Ward Officer	Manchester City Council			X		
Jo Fraser	Irk and Medlock Valley Programme Coordinator	Manchester City Council			X	X	X
Matt Schofield	Director	Irwell Rivers Trust			X		X
Andrew Clark	Lecturer in Environmental Management	Salford University				X	X
Ben Atkinson	MSc Student	Salford University				X	X
Michael Aiken	Engineering Assistant	Greater Manchester Waste Disposal Authority			X		
Martyn Cox	Assistant Asset Manager	Highways Agency				X	
Lee Dudley	Senior Woodland Creation Advisor	Woodland Trust					X
Paul Hulme	Environmental Consultant	P J Hydro	X	X	X	X	X
Nick Rukin	Hydrogeological Consultant	RUKYDRO Limited	X	X		X	X
Rachel Welsby	Facilitator - Environment Planner Officer	Environment Agency				X	

Note: X = Attendance

Appendix B
Data Inventory

1 Page

Data Inventory for the Moston Brook Evidence and Measures Project (Page 1 of 2)

Date	Description
18/09/12	Slides from Geomorphologist
18/09/12	Catchment Conceptualisation
19/09/12	Information (maps and risk assessment) for Site Visit
20/09/12	NIRS pollution incidents within a 500m buffer of waterbody boundary (2002 to 2012)
20/09/12	NIRS notifications within a 500m buffer of waterbody boundary (2002 to 2012)
20/09/12	NIRS notifications within a 3km buffer of waterbody boundary (2002 to 2012)
20/09/12	Water Quality Monitoring Data
20/09/12	WIMS Consents Data and Discharge Exemptions
20/09/12	IPPC Licences Data
20/09/12	Invertebrates Data
20/09/12	SAGIS outputs
20/09/12	Spot flow gaugings from 1996 to 2010
20/09/12	Breathing Apparatus Team culvert information for 8 sites
20/09/12	SIMCAT model results
20/09/12	APEM, Culvert Investigation (May 2009)
20/09/12	Hidden Watercourses of Bolton, Manchester and Stockport (May 2012)
20/09/12	Groundwork Oldham and Rochdale, Moston Brook Feasibility Study (March 2008)
20/09/12	Lancaster Club PA study
20/09/12	MCC, Preliminary Risk Assessment and Site Investigation on Moston Brook Sites (April 2011)
20/09/12	PB Limited, Preliminary Risk Assessment of Moston Brook (March 2008) for Groundwork Oldham and Rochdale
20/09/12	Atkins, Moston Brook Pollution Prevention Project, Desk Study Final Report (August 2002) for the Environment Agency (reference: 50022718/CJ/sb/077.22244).
20/09/12	Salford Uni work (Investigation of Contaminated Land (by Despoina Korai) & The Effect of Heavy Metals on the soil and vegetation using Moston Brook as a case study)
26/09/12	Inverts v WQ appraisal and expected scores
02/10/12	Link to Simon Papprill presentation on Oldham Council's general work
02/10/12	Full record of Invertebrates
03/10/12	Start up Workshop comments as GIS layer
04/10/12	Flow Data for Collyhurst and Scotland Weir
05/10/12	Additional details for selected consented discharges
11/10/12	DRN Guidance to find culvert attributes
22/10/12	Confirmation of Water Quality Peak Times on logger data
23/10/12	CSO Spill frequencies, duration and volumes
24/10/12	Moston Brook Flow Estimates
24/10/12	Moston Brook Mitigation Measures for WFD Status
26/10/12	Digitised WQ logger data from Moston WFD Draft 2011 (D074)
31/10/12	GMWDA summary of 20 No boreholes of 10-12 m deep designed to reduce leachate head in Hardman Fold landfill
01/11/12	Royton WWTQ Daily Rainfall from 1996
01/11/12	UU CSW Ionic Surfactants Survey by Grontmij (Dec 2011)
05/11/12	Additional SAGIS plots
08/11/12	Moston Brook WFD Final report June 2011.pdf from Tracey Smith and supporting monitoring data
08/11/12	Location of leachate wells and sample data for Hardman fold
09/11/12	Updated BA Team Culvert Info
12/11/12	Digital Communications Academy, Harpurhey - Planning Application Reports

Data Inventory for the Moston Brook Evidence and Measures Project (Page 2 of 2)

Date	Description
12/11/12	Salford University MSC dissertation proposals from Ann Bates
13/11/12	ODC Final Master Plan
13/11/12	EA Reconditioning Reports for Culverts
20/11/12	GMWDA email regarding leachate volumes extracted at Hardman Fold
22/11/12	Sewer Network files
22/11/12	Shapefile from Officers Group Meeting Comments
29/12/12	1995 Water Quality Survey Sample Results
29/11/12	Moston Brook Outfall from M60 from Highways Agency
12/12/12	Further WQ monitoring data from 1980s and 1990s
12/12/12	Numbers of Properties in Each Sub-catchment
13/12/12	Link to Historical Photographs of Moston Brook
18/12/12	Sub-catchments with areas defined and updated GIS
03/01/13	UU response on wrong connections and CSO maintenance
10/01/2013	**Moston Brook Causes Workshop**
11/01/13	Revised collated WQ data including 1990s data
11/01/13	Historical Land Use Maps from Oldham Council
14/01/13	Confirmation of no fertiliser use on Parks and Gardens
14/01/13	Historical Maps of Hardman Fold from Oldham Council
17/01/13	APEM CCTV footage
24/01/13	Info on filling of Landfill at Moston Vale
29/01/13	Sketch Map related to mining issues
30/01/13	Local resident report - photos of Moston Brook
31/01/13	Latest gas monitoring results for Lancaster Club
04/02/13	UU CCTV work on sewers near Silchester Road
08/02/13	UU Flow Survey Data May to Oct 2008
12/02/13	Ben Atkinson MSc Dissertation - Moston Brook: evaluating compliance with the EU Water Framework Directive
13/02/13	Delivery Dates for Irk UIDs
14/02/2013	**Moston Brook Measures Workshop**

Appendix C
List of Outputs Included on the Project CD

1 Page

The following project outputs are included on the project CD:

- List of stakeholders involved in the project;
- Spreadsheet and shapefile of issues in the catchment from the Initial EA Workshop;
- Spreadsheet and shapefile of issues in the catchment from the Officers' Group Meeting;
- Slides of the initial conceptualisation for Moston Brook prepared by the Environment Agency;
- Geomorphology slides prepared by the Environment Agency;
- From the analysis of evidence:
    - Data inventory spreadsheet;
    - Evidence Packs prepared for Causes Workshop;
    - Revised Evidence Packs prepared for Measures Workshop following input from participants at Causes Workshop;
    - Source apportionment presentation and spreadsheet;
- From the Causes Workshop:
    - Scores spreadsheet and template;
    - Spreadsheet of participants' comments at Causes Workshop with note on follow-up action and location of changes to Evidence Packs;
    - Participant's initial ideas for measures;
    - Feedback form template;
- From the Measures Workshop:
    - Final collated measures spreadsheet.
    - Feedback form template

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