Institute of Freshwater Ecology

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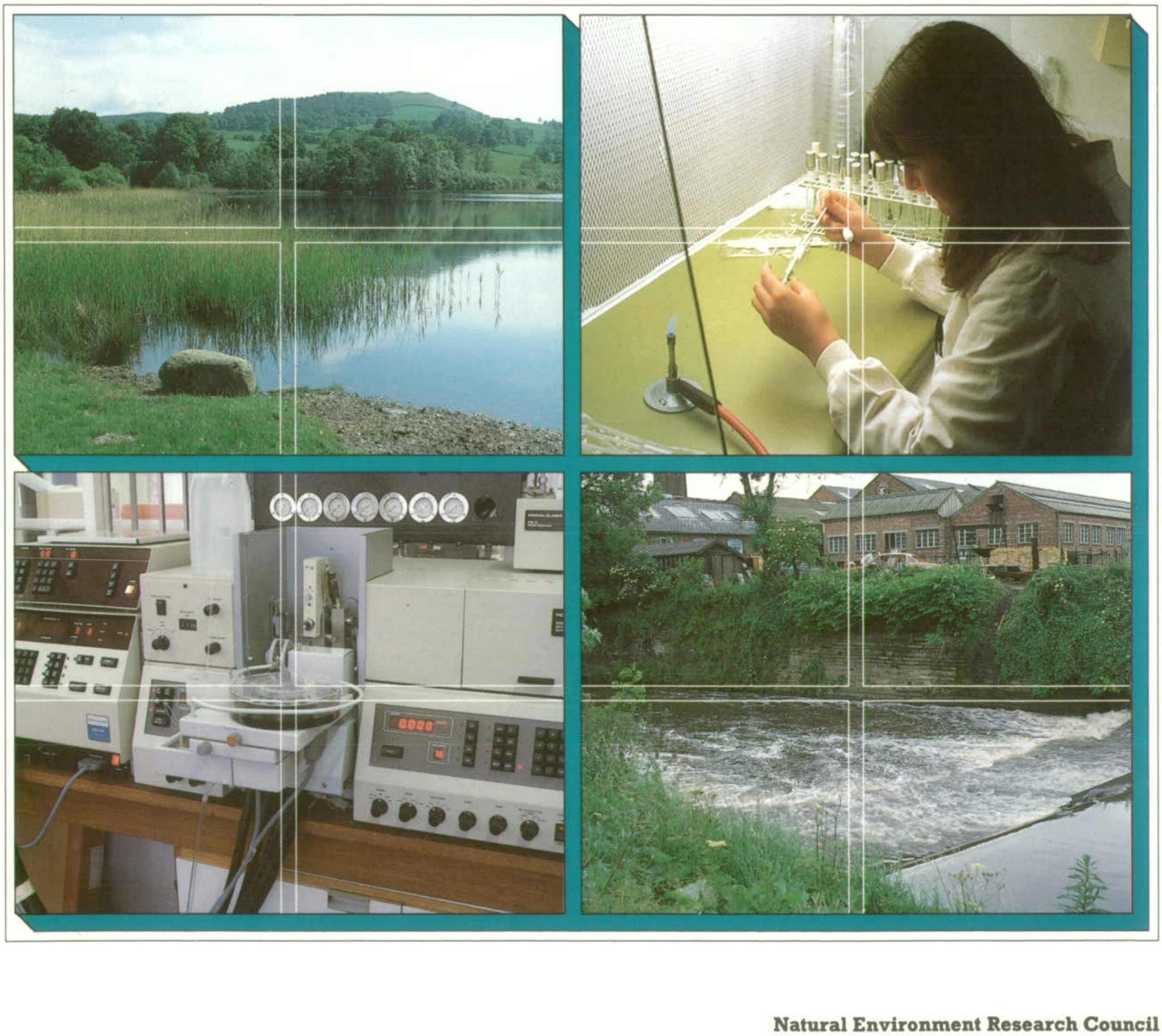

Natural Environment Research Council

INSTITUTE OF FRESHWATER ECOLOGY
River Laboratory, East Stoke, Wareham, Dorset BH20 6BB

Tel: 0929 462314
Fax: 0929 462180

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Project leader:	F.H. Dawson
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CONTENTS

SUMMARY

The River Wyre contains a good mixed salmonid and coarse fishery with sensitive spawning areas downstream and upstream of the NWEP pipeline crossing point (RVX153). In view of the sensitive nature of the site the Institute of Freshwater Ecology (IFE) was requested to monitor selected physical parameters downstream of the crossing during pipeline construction.

Construction activities at the Wyre did not appear to have had any immediate and significant effect on aquatic biota downstream of the crossing point. The increased sediment deposition downstream of the crossing is likely to be ephemeral and will be removed during winter floods.

The success of bank reinstatement can not be commented on at present as work was still in progress when the IFE monitoring equipment was removed.

To determine the medium term success of reinstatement, it is recommended that a further ecological survey is undertaken in the year following pipeline construction. This should show special regard towards the regeneration of vegetation similar that previously found at the site and to localised erosion in the vicinity of the crossing.

1 INTRODUCTION

1.1 The North West Ethylene Pipeline

The North Western Ethylene Pipeline (NWEP) from Grangemouth to Stanlow consists of approximately 410 km of '10 inch' (250mm) diameter pipe with two-pumping stations, twenty five block valves, pigging facilities and two metering stations. Interconnection facilities at Grangemouth admit ethylene to the pipeline and into the existing high and low pressure pipelines at Stanlow. There are also SCADA and communication systems, cathodic protection systems and operation and maintenance facilities.

1.2 NWEP Environmental Requirements

The project environmental policy (Environmental Statement, NWEP, SCUK) recognises that the successful execution of the project relies on the identification of potential environmental impacts and the definition and implementation of appropriate mitigation measures.

Several environmental studies have influenced the chosen pipeline route by identifying constraints within progressively narrower corridors. These studies have included the collation of existing information, remote sensing and both reconnaissance and detailed biological surveys (see Appendix). Additionally, organisations including the National Rivers Authority (NRA), water purification boards, English Nature, and local authorities have been consulted at all stages of the project; these reports have not been made available to the IFE.

1.3 The Impact Of Pipeline Construction On Rivers

The impact of pipeline construction on the rivers and streams it crosses will be directly through the excavation of banks and beds and from the use of piped diversions. Additionally, the construction operation will lead to considerable quantities of sediment being suspended in the flowing water and, whilst this may be a temporary phenomenon with fairly rapid settlement, it will cover a considerable area downstream. The possible environmental impacts of this increase in suspended solids may result from one or more of the following factors:

1) The direct mechanical effect of elevated suspended solid concentrations on organisms and plants by increasing abrasion, clogging of respiratory surfaces etc.

2) The reduction in dissolved oxygen concentration brought about by the respiration of suspended organic matter as it passes downstream. This could result in particular in fish kills.

3) The reduction in light penetration due to the increased turbidity of the water and the subsequent reduction in photosynthetic rates of submerged macrophytes. This will not only affect the plant community and dissolved oxygen concentration but also the animals that depend on them for food, shelter and support. The severity of this will, to some extent, be dependent on the time of day during which construction is carried out as a result of the diurnal variation in oxygen concentration of natural waters.

4) The modification of habitat on the settlement of suspended material. Settlement may change the nature of the bed thereby adversely affecting the biota, e.g., fish spawning and invertebrate feeding.

5) The visual impact and downstream passage of sediment plumes.

2 METHODS

A reconnaissance survey of the River Wyre was initially undertaken in January 1990 to determine the relevant ecological or conservation characteristics of the watercourse. This included:

i) A classification of the substrate types of the stream bed, banks and adjacent land as either bed rock, boulders (>256mm), cobbles (65-255mm), pebbles and gravel (2.1-64mm), sand (0.06-2mm) and silt and clays (0.004-0.05mm).

ii) Physical characteristics including channel width , mean water depth and mean water velocity were measured at the pipeline crossing point. Subsequently an estimate of stream discharge ($m^3 s^{-1}$) was made using the equation:

$$Q = AV$$

Q= discharge

A= cross-sectional area (mean depth x mean width)

V= mean water velocity

iii) A water sample was collected for subsequent chemical analysis at the River Laboratory. This included pH, conductivity ($\mu s^{-1} cm^{-2}$), calcium carbonate levels ($mg\ l^{-1}$), anions and cations ($mg\ l^{-1}$) and the consequent ion balance.

iv) A study of adjacent features including land use either side of the stream and up and downstream of the crossing point, the degree of maintenance of the stream and its fishery status. The presence of pipes, drains, bridges, culverts etc was also noted.

v) A list of all plant genera (and the number of species in each genus growing in the channel and the adjacent land area that is affected by the pipeline construction (see report RL2). Plant identifications were corroborated where necessary by taking specimens back to the laboratory and using standard taxonomic reference texts.

vi) Invertebrates were sampled at the crossing point by a standard three minute kick sample. The samples were sorted on the bank by spreading them out on a tray and picking out individuals of each family present and different species of each family where possible (see report RL2). A score based on the results was then assigned to the site. In the laboratory, identifications were checked and scores amended where necessary.

A second more extensive survey of the River Wyre was undertaken in August 1990 (see report RL8). This included all the above together with the following:

i) A list of all plant *species* rather than *genera* growing at the site.

ii) A list of all macroinvertebrate *genera* (often species) rather than *families*.

iii) A sketch map detailing the position and degree of cover of the various plant stands for a distance of 50 metres above and below the proposed crossing point.

To monitor the effects of construction at the site two multi-channel computerized field data collection systems were installed approximately 100m downstream of the crossing point on the 2nd January 1992. This distance was considered necessary to allow uniform mixing of suspended materials likely to travel for a significant distance downstream and to avoid confusion of actual site operations between sides of the river. Each system was fitted with sensors for solar irradiance, temperature, dissolved oxygen, turbidity and water depth.

The turbidity and dissolved oxygen sensors were suspended at approximately two thirds water depth, ie. the conventionally-accepted level of mean water flow.

The monitoring site was re-visited on the 10th January when the following tasks were performed:

1) The sensors were carefully cleaned using a soft clean cloth.

2) The performance of the oxygen sensors and thermistors were checked by relating their voltage outputs to their calibration lines. 'Spot' temperature was recorded using a platinum thermometer and dissolved oxygen concentration determined by Winkler titration.

3) The performance of the turbidity sensors was checked by measuring the zero and full scale deflection outputs and relating these to their calibration values.

4) Batteries were replaced with fully charged ones.

3 RESULTS

The details of topography, adjacent features etc. are given together with a discussion of the botanical, invertebrate and morphological quality of the River Wyre. The map is based on a 1:10,000 site map supplied by Shell, and illustrates the position of the pipeline crossing point.

The results of the chemical analysis of the water samples are given in Table 3.1.

Km pt.	Site	RVX No.	NGR
309.55	RIVER WYRE	153	34/468420

Crossing date: January 1992

Crossing method: "Wet cut"

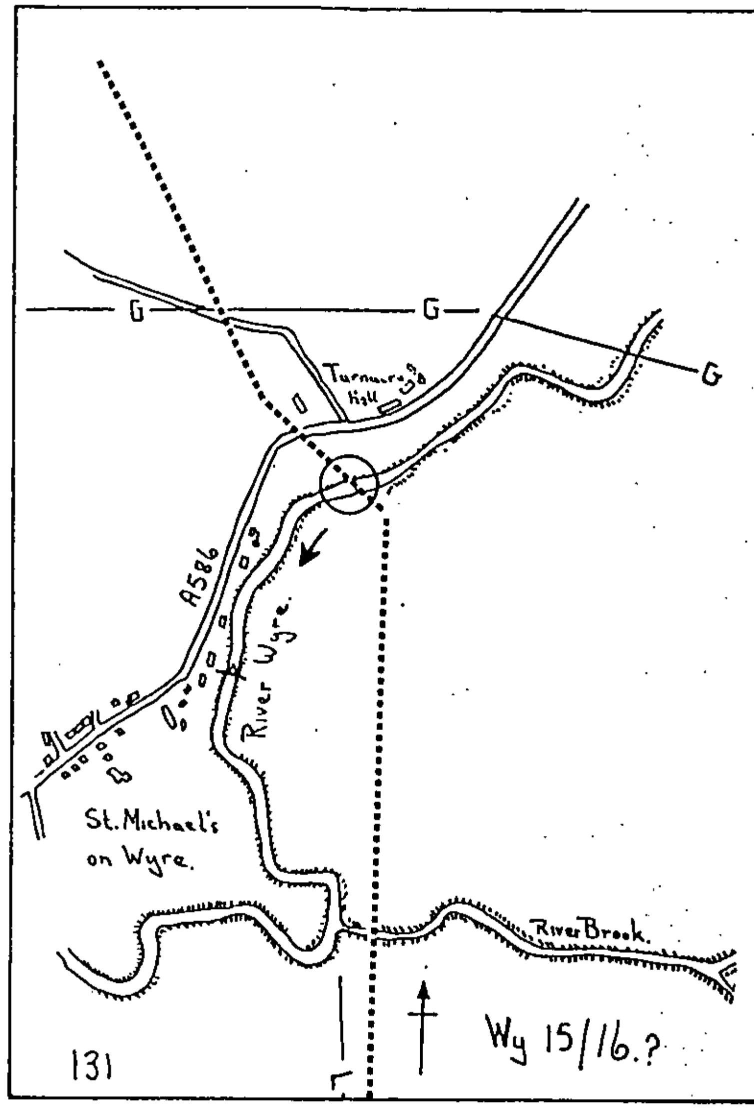
Source: Abbeystead Reservoir fed by Tarnbrook Wyre and Marshaw Wyre which rise in the Forest of Bowland
Receiving water: Morecambe Bay at Fleetwood approx. 25km downstream

Physical characteristics:
Mean width: 15m : Mean depth: 2 m
Slope: 1.5m/ km
Bed type: Embanked drain (?)
Canopy: Open
Substrate:
Bed; Silt (75%), pebbles/gravel (10%) boulders/ cobble (10%), sand (5%)
Banks; Silt/clay (80%), sand (10%), pebbles/gravel (10%)

Water Chemistry: see Table 3.1

Adjacent features:
Land use: Improved agricultural, residential
Fishery interest: Good mixed salmonid and coarse fishery

Overall reconnaissance survey score 3+



3.1 SITE DESCRIPTION/ MORPHOLOGY

A slow flowing spatey drainage river in a deep, three tiered channel with berms at two levels, about 1.5m per tier. There is some slumping of the sandy soil at the top of the channel although most of the steep sides are protected by vegetation. The river has a silty/ sandy bed overlying cobbles/ gravel with boulders and some clay at the base of the banks (no cores were taken). The bed was not as consistent as would be expected in a dredged drain, with water depth varying between 80 and 150cm in mid-channel when water levels were low (August 1990).

3.2 FLORA

The terrestrial bank vegetation consists mainly of sown grasses with some herbs, including thistles, *Tussilago farfara* and *Calystegia sepium*, and *Phalaris arundinacea* nearer the water.

Aquatic and riparian vegetation in the vicinity of the the proposed crossing point was found to be sparse at the time of the reconnaissance survey although an improved aquatic flora was recorded in August 1990. However, no unusual species were identified and two alien species were recorded; *Impatiens glandulifera* and *Mimulus guttatus*. There are a few young willows especially near the water on the right bank.

3.3 INVERTEBRATE FAUNA

Apart from Coenagriidae all taxa found were low scoring families indicating a poor faunal community. Of note is the presence of the freshwater sponge *Spongilla lacustris* which may be adversely affected by increased sediment load during construction.

3.4 FISHERY INTEREST

The Wyre contains a good mixed salmonid and coarse fishery (salmon, sea trout, brown trout, chub, dace, roach and bream). There is a salmon and sea trout spawning area approximately 1.6km upstream of the proposed crossing and bream and chub immediately downstream of the crossing. Previous IFE reports recommended crossing the river between mid March and the end of April to minimise any potential impact on fish populations.

3.5 OTHER

Kingfishers have nested in this stretch of river in the past two years, presumably in the exposed soil of slumps.

Many mink are reported to be present in the area.

[For information on the potential for bacterial corrosion during construction see Hall et al. (1991). For information on the prevention, containment and removal of oil spills see Dawson and Shand (1991).]

TABLE 3.1 WATER CHARACTERISTICS

	WINTER 1990	SUMMER 1990	20.01.92
Discharge $m^3 s^{-1}$	10	5.4	
Velocity $m\ s^{-1}$	0.4	0.2	
pH	7.6	7.1	
Conductivity $\mu s\ cm^{-1}$	217	300	260
Anions, mg l^{-1}			
Alkalinity meq l^{-1}	0.86	1.88	1.10
Chloride	23.0	17.0	30.1
Sulphate	33	30	27.4
Nitrate N	2.7	1.25	2.87
Phosphate P	0.002	0.465	0.254
Silicate Si	2.0	0.61	3.08
Cations, mg l^{-1}			
Calcium	24	36	29.6
Magnesium	2.8	5.5	4.22
Sodium	8.9	23.5	13.8
Potassium	4.2	2.0	3.46
Ion balance (m.eq.l)	2.14:1.95	2.99:2.86	2.52:1.10

3.6 CONSTRUCTION MONITORING

Typical oxygen saturation over the monitoring period was 100% and baseline optical density was approximately 0.40 units (~ 40% light transmittance).

Two spates were recorded between the 3rd and 6th January (Fig. 3.1) which increased optical density to 1.76 (<2% light transmittance). Unfortunately, the turbidity sensor was fouled at the peak of the initial spate so that the reduction in optical density was not recorded when the spates subsided. However, an estimate of optical density values between the 4th and 6th has been made based on previous experience.

Trench excavation, pipe installation, backfilling etc. on the River Wyre took place between the 10th and 15th of January. The work rate appears to have been fairly intensive although several breaks (planned ?) were incorporated into each days programme which allowed water turbidity to return to near baseline levels (Fig. 3.2). The increase in the rivers suspended solid load during construction was comparable to that resulting from the previous floods with optical density reaching a maximum of 1.77 (<2% light transmittance). However, no suppression in dissolved oxygen saturation was recorded between the crossing point and the IFE monitoring station approximately 200m downstream.

Post construction observations indicated increased sediment deposition downstream of the crossing point. These deposits are likely to be ephemeral and will be removed during winter floods.

Bank reinstatement was still in progress when the IFE monitoring equipment was removed on the 20th January. Consequently the immediate degree of success of reinstatement can not be commented on.

Fig. 3.1 Variation in solar irradiance, temperature, dissolved oxygen, optical density and water depth on the River Wyre (RVX153), 2.01.92-20.02.92

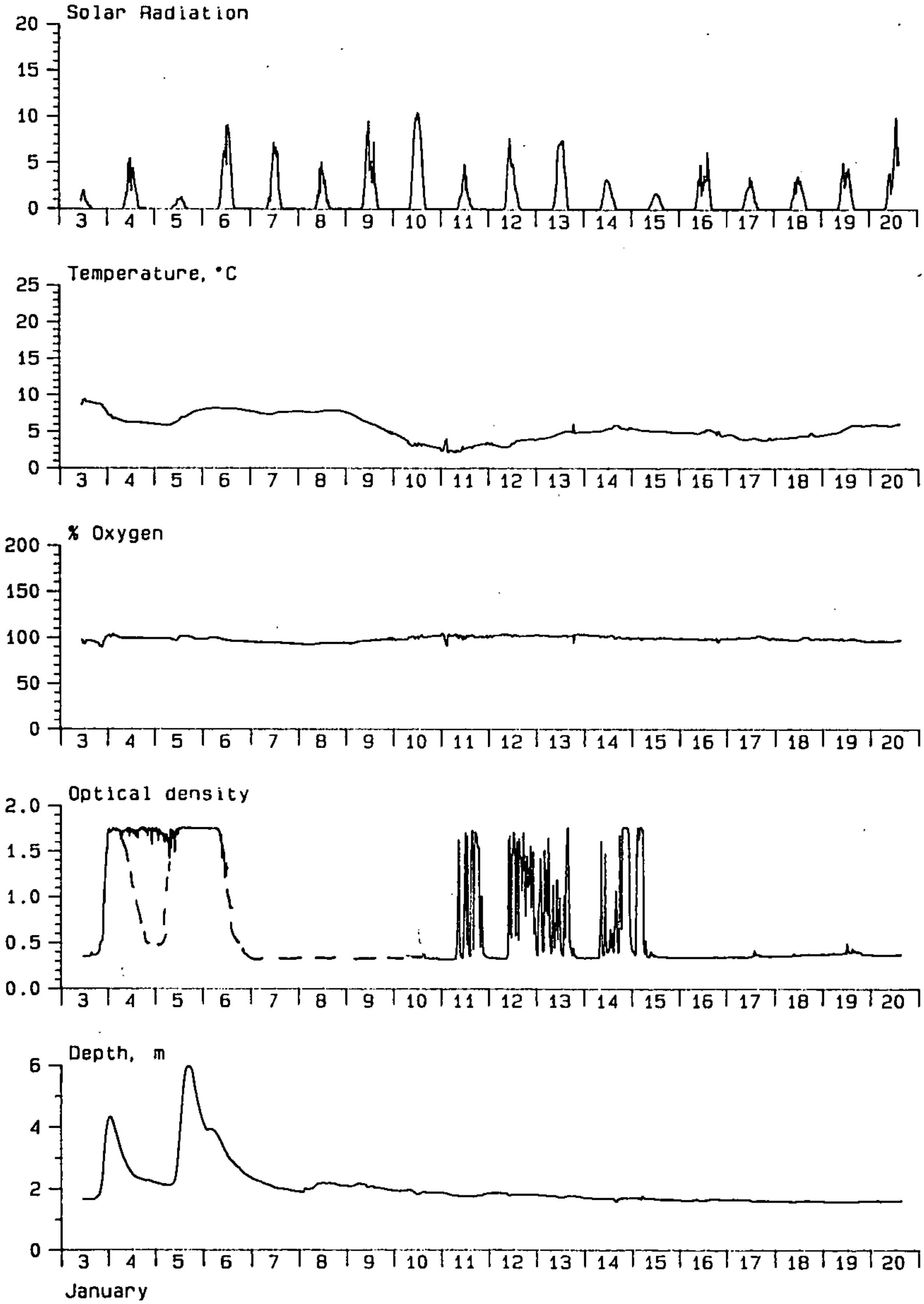
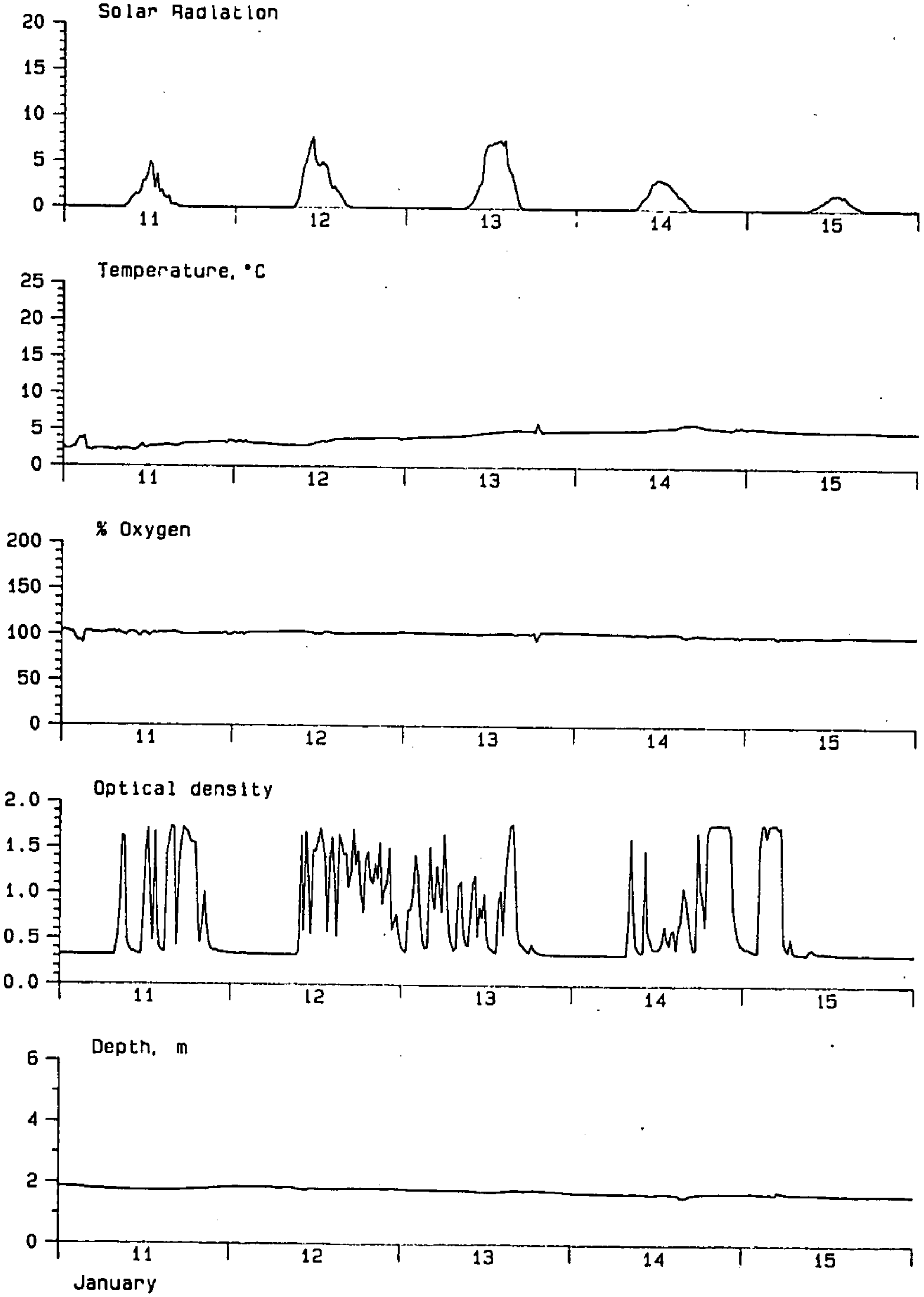


Fig. 3.2 Variation in solar irradiance, temperature, dissolved oxygen, optical density and water depth on the River Wyre (RVX153), 11.01.92-15.01.92



4. RECOMMENDATIONS

To determine the medium term success of reinstatement, it is recommended that a further ecological survey is undertaken in the year following pipeline construction. This should show special regard towards the regeneration of vegetation similar that previously found at the site and to localised erosion in the vicinity of the crossing.

APPENDIX

Previous IFE reports relating to NWEP

Carling P.A. (1990) North Western Ethylene Pipeline. Site reconnaissance surveys - field data for stability calculations of watercourses. Interim Report WI2 to Shell Chemicals U.K. Ltd (Bechtel Ltd), 182 pp

Dawson F.H., Welton J.S., Henville P., Casey H. & Smith S.M. (1990a) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase I - Reconnaissance survey. Report RL1 to Shell Chemicals U.K. Ltd , 160 pp.

Dawson F.H., Welton J.S., Henville P. & Smith S.M. (1990b) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase II - Further Reconnaissance surveys. Report RL2 to Shell Chemicals U.K. Ltd, 65 pp.

Dawson F.H., Welton J.S., Westlake D.F. & Armitage P.D. (1990c) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase II - Specific Detailed Biological Surveys within kilometre points 0-58. Report RL4 to Shell Chemicals U.K. Ltd, 69 pp.

Dawson F.H., Welton J.S., Westlake D.F. & Armitage P.D. (1990d) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase II - Specific Detailed Biological Surveys within kilometre points 58-90. Report RL6 to Shell Chemicals U.K. Ltd, 66 pp.

Dawson F.H., Welton J.S., Westlake D.F., Blackburn J.H., Morris K.H. & Smith S.M. (1990e) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase II - Specific Detailed Biological Surveys within kilometre points 90-131. Report RL7 to Shell Chemicals U.K. Ltd, 64 pp.

Dawson F.H., Welton J.S., Westlake D.F., Morris K.H. & Smith S.M. (1990f) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase II - Specific Detailed Biological Surveys within kilometre points 131-406. Report RL8 to Shell Chemicals U.K. Ltd, 111 pp.

Dawson F.H., Welton J.S., Westlake D.F., Shand A., Dear B.E. & Smith S.M. (1990) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase II - Final report of baseline surveys of botanical, zoological and physical parameters with general reinstatement recommendations. Report RL9 to Shell Chemicals U.K. Ltd, 320 pp.

Dawson F.H., & Shand A. (1991) North Western Ethylene Pipeline Project. Recommendations for monitoring of river crossings sites during construction. Report RL10 to Shell Chemicals U.K. Ltd, 54 pp.

Dawson F.H., Henville P. & Shand A. (1991) North Western Ethylene Pipeline Project. Monitoring of river crossings sites during construction - a compilation of results, (19.4.91 - 24.6.91). Report RL11 to Shell Chemicals U.K. Ltd, 56 pp.

Dawson F.H., Henville P. & Shand A. (1991) North Western Ethylene Pipeline Project. Monitoring of river crossings sites during construction - a compilation of results, (24.6.91 - 18.8.91). Report RL12 to Shell Chemicals U.K. Ltd, 78 pp.

Dawson F.H., Henville P., Shand A.& Smith S.M. (1991) North Western Ethylene Pipeline Project. Monitoring of river crossings sites during construction - a compilation of results, (18.8.91 - 30.9.91). Report RL13 to Shell Chemicals U.K. Ltd, 80 pp.

Dawson F.H., Henville P. & Shand A. (1991) North Western Ethylene Pipeline Project. Monitoring of river crossings sites during construction - a compilation of results, (1.10.91 - 30.10.91). Report RL14 to Shell Chemicals U.K. Ltd, 38 pp.

Welton, J.S. (1990a) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase I - Fisheries information - ENGLAND. Report RL5 to Shell Chemicals U.K. Ltd (Bechtel Ltd), 17 pp.

Welton, J.S. (1990b) North Western Ethylene Pipeline Project. Freshwater Ecological Survey, Phase I - Fisheries information - SCOTLAND. Report RL3 to Shell Chemicals U.K. Ltd (Bechtel Ltd), 9 pp.

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