WATER RESOURCES ACT 1991

THE WALES ROD AND LINE (SALMON AND SEA TROUT) BYELAWS 2017

THE WALES NET FISHING (SALMON AND SEA TROUT) BYELAWS 2017

DOCUMENT NRW/6

PROOF OF EVIDENCE

OF

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on behalf of
NATURAL RESOURCES WALES

NOVEMBER 2018

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1 Personal Background

1.1 My name is Robert Vaughan and I am the Manager of Sustainable Land, Farming and Forest Management for Natural Resources Wales (**"NRW"**). I have worked for NRW, its predecessor bodies in Wales and for other similar bodies in England for 36 years. During this time, I have worked on surface and groundwater catchment matters, principally the management of surface and ground water resources and quality, forestry policy, agriculture and land-use management, flood risk management, and research and innovation. I have also contributed to national (England and Wales) fora to oversee technical, scientific and policy advances in the sustainable management of catchments and their natural resources. In undertaking these roles I have worked closely with fisheries experts and stakeholders to develop the sustainable management of natural resources ("**SMNR**") which in turn supports the sustainable fisheries management of our catchments.

1.2 I am a Master of Science in Water Resources Technology

2 Scope of evidence

2.1 Capitalised terms used in this proof of evidence that are not defined in the proof are defined in the Glossary appended to the proof of Mr Gough[1].

2.2 The causes of salmon and sea trout stock depletion include the range of pressures which damage the environmental quality of our rivers[2]. As outlined in the proof of evidence of Mr Peter Gough[3], NRW are responding to the problem of salmonid stock depletion in three main ways by:

(i) proposing catch control byelaws with effect for a period of ten years applying to rod and net fishing on rivers that are wholly within Wales, and which will ensure that spawning populations are maximised (the **All Wales Byelaws**), NRW is also proposing further byelaws in respect of cross border rivers;

(ii) implementing a suit of land management measures aimed at improving the river environment; and

[1] **NRW/1D**
[2] **NRW/1, section 1**
[3] **NRW/1, section 7**

(iii) implementing remedial action to restore river habitat quality and to address other factors operating in the freshwater environment.

2.3 My evidence addresses the suite of land management measures NRW are proposing to implement in order to improve the river environment. These measures aim at remedial action to restore river habitat quality and to address other factors operating in the freshwater environment. They are complimentary to the implementation of the All Wales Byelaws, and, when deployed in combination with the byelaws will help to secure the urgently needed regeneration of fish stocks in Wales.

2.4 The condition of the rivers in Wales depends heavily on land management decisions. What happens within the catchment impacts on the way rainfall finds its way to surface water courses. The resulting fluvial flows can be dramatically affected. High flow events caused by land management changes that increase runoff have a dramatic impact on erosion and the morphology of rivers. Similarly the flora and fauna, including fish, can be detrimentally impacted. Conversely the loss of water caused by rapid runoff means that flows drop off quickly leading to low river flows in dry periods, again impacting heavily on river fauna including salmon and trout.

2.5 Similarly rapid runoff carries materials such as sediment or nutrients from our urban and rural landscapes into water courses. With increasing compaction and sealing of our soils these impact on the quality and condition of rivers and directly damage the condition of the river and pollute the water it contains.

2.6 Across Wales our land and our rivers are used as a means of waste and sewerage disposal. In most, but not all cases, regulations control the discharge to limit the impact. However there remain risks of pollution from both permitted discharges, diffuse sources and from accidental discharges.

2.7 This evidence considers these varied issues and describes how NRW identifies these challenges and what steps are being pursued in order to reduce the impact on fish populations. They are many and varied. Some solutions fall under the existing legislation, but many involve new initiatives which explore alternative approaches which will take time to completely solve the issue identified. Restoring damaged ecosystems is a long-term process and NRW will need to manage the expectations of those seeking instantaneous improvements. Additionally, where required, changes in business practices and culture, legislation and policy and the commitment of

investment, may take time to secure particularly during economically challenging times.

3 Overview

3.1 Wales is renowned for its beautiful and varied landscape. Yet no corner of Wales remains untouched by human influence stretching back over thousands of years. Much of what is regarded as a pristine natural environment owes its condition to centuries of land management intervention.

3.2 In more recent times the scale and impact of modern approaches to land management has led to further accelerated changes in the way our landscape operates. Many changes have provided a positive impact, but most have had direct and indirect detrimental consequences.

3.3 It is NRW's job to look after natural resources and what they provide for us all. NRW's work helps reduce the risk to people and properties from flooding and pollution. It prosecutes those who breach the regulations for which NRW are responsible for. NRW look after special places for well-being of people, for wildlife and timber; and it works with others to help us all to manage them sustainably.

3.4 Land use in Wales can usefully be split into 3 parts; Urban (7%), Woodland cover (14%) and Agricultural (79%). NRW plays its part in all of these land uses. Moreover NRW itself is a direct manager of land, with its role of managing the Welsh Government ("**WG"**) Woodland estate; some 7% of Wales, managing entirely, or in partnership, 58 of the 76 National Nature Reserves across Wales, as well as land used for flood alleviation purposes.

3.5 The people who work in NRW must have the knowledge, expertise, and passion to help make SMNR a reality. The Well-being Objectives developed by NRW set out how these will be delivered through[4]:

3.5.1 championing the Welsh environment and the sustainable management of Wales' natural resources;

3.5.2 ensuring land and water in Wales is managed sustainably and in an integrated way;

[4] **NRW/5, section 4**

3.5.3 improving the resilience and quality of our ecosystems; reducing the risk to people and communities from environmental hazards like flooding and pollution;

3.5.4 helping people live healthier and more fulfilled lives;

3.5.5 promoting successful and responsible business, and using natural resources without damaging them.

3.6 NRW use the powers provided through Welsh, UK and European legislation to achieve these outcomes. Of particular importance is the recent development of Welsh Legislation with the first statutory Natural Resource Policy[5] which is central in enabling the preparation of Area Statement. We believe that the Welsh legislation, enshrined in the Well-being and Future Generations (Wales) Act 2015 (**"the 2015 Act"**)[6] and the Environment (Wales) Act 2016[7], provides a strong foundation to build the resilience of our natural resources and ecosystems. It also delivers strong and healthy communities, protects us from hazards such as climate change, flooding and poor land, air and water quality, and supports a green economy which underpins viable incomes for families across Wales.

3.7 To achieve this objective, it is critical that all sectors across Wales break from their traditional silos, and look for opportunities to build new alliances and networks. It is also important that there is a move from tackling issues where they impact, to an approach where the root cause is identified and the focus is brought there to solve the problem.

3.8 Finally NRW must ensure it properly investigates and understand the issues faced across Wales.

3.9 NRW is committed to playing its part through actively seeking out opportunities to build new approaches through its role on Public Services Boards. Here NRW aims to

3.9.1 challenge the status quo to maximise the collective contribution across the Well-being Goals;

[5] **POL/22**
[6] **LEG/23**
[7] **LEG/25**

3.9.2 lead the preparation of Area Statements, actively reaching out to partners and stakeholders to build evidence and jointly owned perspectives on the risks and opportunities in a particular place. This then allows society to identify the priorities to be taken forward through the work of NRW and others;

3.9.3 share evidence, information and expertise with partners and those traditionally not engaged with. This helps define the challenges and jointly build solutions which maximise the contribution across the Well-being Goals;

3.9.4 work with other regulators and partners to ensure that the new ways of working to deliver wider public benefits are fully recognised. For example the role of the farming sector in engaging with and supporting changes to land management;

3.9.5 lead discussions with sectors on applying the new ways of working in practice, discussing any implications for regulation and the potential use of experimental powers.

3.10 These matters lie at the heart of NRW's Well-being Objectives.

3.11 The State of Natural Resources Report (**"SoNaRR"**)[8] sets out the state of Wales' natural resources (our air, soil, geology, water and the biodiversity), the pressures on them and the resultant risks and threats to people's health, economic prosperity and social wellbeing, as set out in the 2015 Act. This is the first report of its kind and the first statutory product derived from the Environment Act 1995[9]. It looks at the issues facing the natural habitats of important and iconic wildlife species to better understand the worrying decline in biodiversity. The report highlights that policy and decision-makers across the public sector need to start considering the key risks to natural resources and the benefits that they provide, in all that they do.

[8] **POL/19**
[9] **LEG/11**

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4 Conservation principles

4.1 Throughout my career I have been guided by the legislation and directives that steer how NRW manages the environment. Similarly the WG 2018/2018 remit letter[10] sets out their strategic remit for NRW detailing what they want us to achieve each year. This includes reversing the decline in biodiversity and pursuing SMNR and achieving the Well-being goals. These directions, often originating where Government has recognised the need for change and taking steps to remedy them, have provided huge improvements to the Welsh Environment. NRW continually reviews the effectiveness of these directions and the means by which they are implemented, and ensure they apply, and update, them in the most effective way. However, as societal expectations increase and our knowledge of impacts on the environment improve, these may need enhancement. I have been involved in a number of legislative change programmes both with Welsh and Westminster Governments and the European Parliament designed to introduce these enhancements.

4.2 Unfortunately, these approaches do not always accommodate rapid change, keep pace with scientific understanding of the environment and can be rather inflexible. As a consequence, NRW has also championed the need to properly understand and define the challenges faced, to search for solutions from as wide a field of expertise as possible; often beyond the traditional market place, to find potential solutions and to consider tackling the issue as close to its source as possible. Through these approaches NRW has delivered a number of specific projects which identify ways to counteract the detrimental impacts on our environment and by design or as a consequence halt and enhance the impacts felt by fisheries.

4.3 The following sections include this work.

[10] **POL/39**

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5 Water Quantity

5.1 Fish require adequate volumes and flows to survive and river flow variations are important for migration and reproduction.

5.2 On average Wales sees 1310mm depth of rainfall each year. Distribution is not uniform and ranges from less than 700mm in the Welsh borders to over 4,000mm in Snowdonia. 45% of the rainfall is lost through evaporation or is used by plants. That which remains is called the effective rainfall and totals on average around 730mm. Due to the shallow soils across Wales and lack of major water bearing geology (aquifers) very little water is retained within catchments and so it quickly finds its way to the river system and the sea. As a consequence Wales is characterised by spate river flows which respond quickly to rainfall, but also fall away quickly to low flow condition whenever extended dry periods are experienced.

5.3 Due to the great variation in river flows direct river abstraction is un-reliable. As a consequence in excess of 150 reservoirs have been constructed, ranging from modified natural lakes to purpose built dams. These provide more reliable supplies for power generation, industry agriculture and public supplies both in Wales and further afield.

5.4 NRW has the duty to conserve, augment, redistribute and secure the proper use of water resources. In practice this means that action is taken to ensure that water is available (as far as is practicable) to meet justified needs. NRW control how much, where and when water is abstracted by issuing water abstraction and impoundment licences. NRW ensure that new abstraction licences are sustainable meeting the requirements of environmental legislation and meeting our regulatory principles. These licences are also assessed to ensure they do not cause deterioration in the Water Framework Directive 2000/60/EC ("**the WFD**")[11] status and comply with the Conservation of Habitats and Species Regulations[12]. By issuing these environmentally protective licences we ensure that standards set out in legislation are designed to protect fish and meet in river needs.

5.5 Certain abstractions have remained exempt from licensing control. So that water resources are managed in a fair and comprehensive way, NRW is bringing the majority of these exempt abstractions above 20 cubic metres (4,000 gallons) of water

[11] **LEG/16**
[12] **LEG/26**

each day into the abstraction licensing regime over the next four years. NRW is also working with WG to reform the abstraction licensing system to ensure sustainable management of our water resources now and in the future. These changes will take river fauna needs into account.

5.6 Most older reservoirs were designed for direct water supply via pipelines from the reservoir direct to urban areas. As a consequence the rivers downstream of the dam often suffer from reduced flows. More recently river regulating reservoirs have been the preferred option as these only need to release water to satisfy demand, often many miles downstream, when river flows are naturally low. This is a far more effective use of resources and ensures that water remains in the river for much of their length. It also enables releases of water into our rivers for other uses such as freshet flows to encourage fish movement.

5.7 Although these reservoir assets are owned by the Water Undertakers, they are operated by agreement with NRW (and the Environment Agency for cross border rivers) to ensure additional water is available for such environmental benefit. In Wales the Rivers Dee, Wye, Severn, Usk, Tywi, Conwy, Clwyd, Cleddau, Aled and Dwyfor all benefit from enhanced river flow releases with some benefiting from be-spoke flows specifically designed to aid fish movement. These releases are not only designed to increase flow volume, but also to aid temperature control particularly when summer temperatures can cause stress in fish.

5.8 With regards to the River Dee, NRW directly manage and operate the Dee Regulation Scheme, to meet the requirements of the Dee and Clwyd River Authority Act (1973) (**LEG/35**). NRW are responsible for producing the operating rules, and managing reservoir releases and river flows and day to day operational management of flows on the Dee and the longer term strategic management of the Dee Regulation Scheme.

5.9 Dŵr Cymru Welsh Water ("**DCWW**") is investigating options to mitigate the downstream impacts of a number of their other direct supply reservoirs. Here they propose to release additional water when available to support the lower downstream flows caused by direct supply and are investigating options for sediment management in reservoir catchments.

5.10 SoNaRR[13] highlights that changes to drainage, flows and water levels are identified as having an impact or likely to have an impact on 45 of 112 (40%) Natura 2000 protected sites. Reduced flows caused by abstraction present risks to migratory fish and wider biodiversity. The WFD[14] investigations have identified 29 (3%) water bodies failing environmental objectives because of changes to flows and water levels (WFD, Chapter 3, part A). The following sections on drainage and restoring sustainable abstraction explain these issues further and the measures being taken by NRW and out partners to resolve them.

[13] **POL/19**
[14] **LEG/16**

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6 Development and Drainage

6.1 The propensity for low river flows in Wales is exacerbated due to the changes human interventions have made to land. The urban landscape with its roads, pavements and buildings has sealed soil thereby removing the ability for rainfall to soak naturally into the ground. To compensate, drainage systems capture rainfall and move it swiftly to the nearest watercourse or sewer. This creates rapid flood runoff which contains dust, grit, oils, detergents, metals, road salt, bacteria from animal faeces and other particulates it collects along the way. This pattern of run-off not only increases the risk of localised flooding but creates a boom and bust flow profile in water courses and introduces peaks of poor water quality. As a consequence, the risk to fish populations in urban areas, and those migrating through these areas, from pollution and very variable flows can be high.

6.2 Sustainable Drainage Systems ("**SuDS"**) are designed to reduce the potential impact this drainage runoff creates. They do this by following a cascade approach that attempts to mimic natural drainage. The SuDS approach initially treats rainwater on the surface and close to where it falls. It then looks to drain away surface water run-off through sequential systems which collect, store, and clean the rainwater before allowing it to be released slowly and steadily back into the environment,, This sequential approach is referred to as the SuDS Management Train. Each step is optimised before moving onto the next. SuDS techniques typically use combinations of installations such as permeable paving, soakaways, green roofs and swales.

6.3 The existing sewer systems in many parts of Wales were not designed to accommodate all the foul and rain water that now drains from our homes and surrounding impermeable areas. Furthermore longer term, climate change and population growth are set to exacerbate these pressures; and there are already many examples of surface and sewer flooding in our towns and cities as a result of increased stormier weather and fewer places for rainfall to soak into the ground. Through adopting SuDS measures rapid runoff is replaced by approaches that reduce flood run-off, bolster local groundwater and baseflows in rivers, provide cleaner water, provide homes for nature and protect fish.

6.4 NRW are working together with partners from across Wales to deliver large-scale implementation of SuDS. New Welsh Legislation is due on 7th January 2019 making sustainable drainage systems on new developments mandatory. Schedule 3 to the

Flood and Water Management Act 2010[15] makes SuDS a mandatory requirement for all new developments of more than a single house or where the construction area is 100m2 or more. The legislation will ensure resilient drainage systems for new developments in both urban and rural areas.

6.5 Introducing SuDS into new developments is only part of the solution. There are only around six thousand new properties added each year to the 1.3 million homes in Wales. Delivering the benefits of SuDS will require retrofitting them into the existing urban and rural infrastructure.

6.6 Fortunately this is already happening. In Llanelli and Gowerton, Swansea the amount of rainfall runoff entering the combined sewer network has caused sewer flooding in residential areas. Additionally combined sewer overflows have damaged the shellfishery in the Loughor Estuary. As a consequence new developments were curtailed. To address this, DCWW, working with NRW and Local Authorities has developed the RainScape surface water management scheme. This has reduced surface water in sewers creating wider benefits to the local environment, businesses and residents. The results so far have exceeded expectations, removing greater volumes of surface water than expected.

6.7 The City of Cardiff Council, DCWW and NRW have similarly invested in Greener Grangetown. This scheme catches, cleans and diverts rainwater directly into the River Taff instead of pumping it over eight miles through the Vale of Glamorgan to the sea. It includes 104 attractive rain gardens and kerbside planting areas to help absorb rainfall, increase biodiversity and provide the community with more green spaces on their streets. These help to make this urban area a greener, cleaner place to live and now rainwater enters the river rather than the sewer.

6.8 In rural mid Wales the Afon Cain, a tributary of the upper River Severn drains an area of 78 square kilometres. The dominant land-use is agriculture (beef and sheep), with small areas of commercial and privately owned forestry. Monitoring evidence suggested that the Cain valley would not achieve WFD Good Ecological Status due to organic and nutrient pollution from agriculture and vehicle contaminants. NRW worked to engage and build trust locally, give guidance on good environmental management and the economic and social benefits this can deliver. In Llanfyllin itself

[15] **LEG/32**

a new SuDS based car park was developed to improve the water quality and biodiversity.

6.9 NRW continue to work with WG, the Welsh Local Government Association, professional bodies, developers, water companies and academic institutions, to promote SuDS in Wales and help deliver the benefits they bring.

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7 Rural SuDS

7.1 In rural areas the application of modern farming systems has delivered a very similar outcome to our towns and cities; land management that by default as well as by design has reduced infiltration rates of soil. As a result rainfall runoff is increased leading to greater flood levels, longer periods of low-river flows, increased sediment and poor water quality as the rainfall washes material off the fields. This summer's dry weather also demonstrated how this loss of water from land can increase the impact of dry periods and detrimentally affect rural areas.

7.2 This has come about as modern approaches to farming has seen stocking levels increase, heavier breeds utilised, increased drainage of fields, gripping of hill tops and ploughing of fields, loss of soil carbon, new crop types that often leave soils bare in winter as well as increased mechanisation, compaction of soils and the removal of hedgerows.

7.3 NRW and its partners have worked on a number of schemes to rectify many of the negative impacts of modern farming. One such scheme is Pontbren. Here a group of farmers in the hills of the River Severn Catchment felt current agricultural policy was unsustainable.

7.4 They established shelter belts and hedges to enable stock to remain outdoors over the winter. It was then that the farmers observed changes in water run-off from the fields. Research followed which has provided important evidence on the role of trees in the control of runoff and pollution prevention.

7.5 The work showed that soil in the fields had become relatively impermeable near the surface and quickly became saturated when it rained. Once saturated the rain simply ran over the surface taking with it any loose sediment and any fertiliser or chemicals. Once this overland flow reached the nearby streams the peak flow was sufficient to create serious erosion problems and an increased flood risk downstream. Within the tree-planted areas, from which sheep were excluded, there was significantly less overland flow and a 67 times improvement in infiltration. Modelling showed that shelter belts located in the right place could reduce peak flood flows by 40%.

7.6 Wildlife has also benefited. Fencing the riparian woodlands reduced disturbance and allowed bankside vegetation to develop and the streams to resume a more natural profile with pools and riffles. Reduced sediment levels ensure clean river gravels and after a long absence trout have returned and otters and water vole have followed.

7.7 The lessons learnt at Pontbren were incorporated into the 2014-20 Rural Development Programmes (**"RDP"**)[16]**.** This provides agri-environment and forestry funding in the UK and is the opportunity to ensure other farmers can adopt the approach. NRW are working closely with WG as they develop the replacement for the RDP to ensure the principles of Pontbren are embedded in the public goods approach.

[16] **POL/34**

8 Restoring Sustainable Abstraction

8.1 The Restoring Sustainable Abstraction (**"RSA"**)[17] programme was set up to solve environmental risks or problems caused by licensed water abstractions. This meets the requirements of environmental legislation, such as Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (**"the Habitats Directive"**)[18] and the Countryside and Rights of Way Act 2000[19]. NRW and its predecessor bodies have successfully worked with licence holders through the programme to reduce the amount of water abstracted. NRW have also worked with licence holders to prevent and reduce damage to the environment in other ways, such as by:

8.1.1 Seeking alternative solutions that use water more efficiently and less harmfully. This has included research which has identified best practice water use approaches for industry and agricultural

8.1.2 Ensuring only water that is needed is allowed to be taken. This prevents damage to the environment, for example, by removing risk to Habitats Directive sites.

8.1.3 Placing conditions on licences that allow water to only be taken at times when it is least likely to harm the environment.

8.1.4 Working with other organisations and local groups to solve abstraction-related problems.

8.1.5 Restoring physical processes for example through gravel management and habitat improvement.

8.2 NRW identify, investigate and solve environmental risks or problems caused by unsustainable licensed water abstraction through considering the level of environmental impact abstractions are causing or could cause. NRW then work with those abstractors to find effective solutions. The changes made are aimed at restoring water levels in rivers, streams, lakes, wetlands and marshes. They also improve wildlife habitats and protect fish, endangered species and provide opportunities for recreation.

[17] **POL/35**
[18] **LEG/9**
[19] **LEG/33**

8.3 The RSA programme investigations have helped identify improvements that meet the UK's objectives under the WFD. Water in rivers, estuaries, coasts and aquifers will improve under measures set out to deliver the WFD such as in River Basin Management Plans. Under the Habitats Directive[20] NRW do not consent activities which adversely impacts (or carries a risk of adverse impact) a European designated site. To ensure all existing abstraction licences are compliant, NRW undertook the Habitats directive review of consents (unpublished). When a licence change is needed it is done through either a voluntary change (section 51 of the Water Resources Act 1991 (the **WRA**)), or a compulsory change (section 52 of the WRA)[21].

8.4 The RSA programme is already preventing damage at 12 HD sites in Wales. Over 40 abstraction licences have been modified or revoked. Licence variations have included adding hands-off flow conditions, requirements for abstraction screens to stop fish getting trapped and reducing abstraction volumes. These changes benefit the rivers: Dee, Wye, Usk, Teifi, Tywi, Gwyrfai and Eastern and Western Cleddau. Variations to a small number of licences are still being progressed to meet the Habitats Directive[22] and should be modified by 2020.

8.5 Through working with licence holders NRW have also made changes to several licensed abstractions affecting non designated and local sites to restore sustainable abstraction. These have seen reduced abstraction and civil engineering solutions. NRW continue to investigate abstractions to determine if licence change is needed.

8.6 An example of this work can be seen on the Afon Afan. Here the Afan Water Management Group was set up to tackle low flows caused by uncontrolled abstraction by Associated British Ports and Tata Steel with associated environmental impacts. These low flows prevented fish movement at the weir. The river flow has been improved through the recent refurbishment of the Greenpark Weir installation of a water management system.

8.7 The Rivers Wye and Usk have been designated under the Habitats Directive Special Areas of Conservation (**"SAC"**) for protected species including migratory fish. The River tributaries also support UK Biodiversity Action Plan (BAP) species, many of

[20] **LEG/9**
[21] **LEG/6**
[22] **LEG/9**

which are at risk from abstraction. These include otter, watervole, twaite and allis shad and many others.

8.8 The Usk and Wye Abstraction Group oversee the protection of the Usk and Wye SACs. The Group's members include DCWW; Wye & Usk Foundation; Canal & River Trust and Severn Trent Water. With NRW and the Environment Agency they have explored solutions that provide the best available environment for the rivers and their protected species and habitats, whilst minimising the impact on water company supplies and allowing the Monmouthshire and Brecon canal to operate. A number of abstraction licences have been varied under the Habitats Directive review of consents to protect the Wye and Usk SACs. The improvements include:

8.8.1 increasing releases from reservoirs to support abstractions at low flows;

8.8.2 extra reservoir releases during and after spates to reinstate natural flows and encourage fish migration;

8.8.3 reductions in abstractions

8.8.4 less daily river level fluctuations caused by abstraction;

8.9 A voluntary revision for an abstraction licence was issued for an Afon Llynfi papermill. This followed discussions with the company to reduce its abstraction volume without hindering production whilst providing environmental benefit by reducing the temperature of the discharge. The solution ensures the watercourse no longer risks drying up at times of low flow. The papermill invested a significant amount of time and money to improve their water efficiency and reduced their daily licensed volume from just over 18 million litres per day to 12 million litres per day and their annual volume by more than 2,000 million litres. The licence changes also saved the company over £10k per year in abstraction charges as well as other reduced site costs through lower pumping, heating, treatment and discharge costs.

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9 Hydro Electric Power Generation

9.1 There has been a significant increase in the number of abstractions for hydro-electric power generation from rivers and streams across Wales. Salmon spawning habitat is protected from high levels of abstraction under our existing hydropower licencing guidance. However, NRW have changed the guidance to increase the level of flow protection given to salmon spawning grounds to reduce risk of further salmon population decline.

9.2 The arrangement of run-of-river hydropower schemes leads to a flow depleted reach between the point of abstraction and point of discharge with an affected reach length usually between 400m and 1.5km. In our approach to licensing hydropower, NRW allow a proportion of river flow to be abstracted whilst maintaining a Hands off Flow[23] (**"HoF"**).

9.3 NRW Licence a proportion of river flow for abstraction. This allows a naturally variable flow to be maintained within the depleted reach to support in-stream ecology. NRW allow a greater amount of water to be abstracted in upland catchments with flashy hydrology (where flows respond quickly to rainfall) and least at sites where a higher level of flow protection is required to meet conservation needs.

9.4 Atlantic salmon are present in many of our rivers in Wales and are a designated feature for some SACs under the HD and also some Sites of Special Scientific Interest (**"SSSI"**). NRW restrict abstractions for hydropower in designated sites to meet flow standards which equate to an abstraction up to a maximum 40% of the instantaneous river flow above a protected low flow.

9.5 This means that the river habitat in designated sites where salmon, and other designated flow-sensitive species are present, are afforded the highest level of protection. Where salmon are present in rivers outside designated sites, NRW maintain environmental river flows in depleted reaches by restricting abstractions to 50% and 70% of available flow depending on the nature of the river flow.

[23] Threshold flows below which abstraction should cease or be very limited.

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10 Forestry

10.1 NRW are committed to improving the environmental quality of the Welsh Government's Woodland Estate ("**WGWE"**). NRW are addressing WFD failures by implementing the UK Forest and Water Guidelines 5th edition ("**UKFWG"**)[24] standards by 2021. Well maintained culverts[25], effective silt traps, roadside drains separate from any natural watercourses, riparian zones[26] and appropriate water management within the forest are all essential for maintaining good ecological status. NRW ensure pollution safeguards are in place when forest operations are carried out and are preparing forest resource plans and identifying potential risks, such as civil engineering, clear-felling and restocking and plan to implement ways to mitigate them.

10.2 Historic barriers to fish migration on the WGWE are mostly due to hanging culverts. These have been corrected and culvert design improved to prevent them re-occurring. Furthermore, river walks are being carried out across the estate to record any further barriers. These are then removed as soon as practical.

10.3 Where legacy forest drainage systems and roadside drains are connecting to watercourses, these are disconnected from the watercourses in accordance with the Guidelines. This ensures that water is discharged slowly into buffer areas and not directly into watercourses thereby reducing the impact that poor water quality may have on the river fauna.

10.4 The disconnection of drainage systems will have multiple benefits: firstly precipitation will be forced into the soils to assist buffering of any acidity. Secondly water will be held back in the forest for longer as the water cannot run straight off into watercourses through the man-made drainage system. This in turn delays and lessens the flood peak downstream where communities may be at risk; at the same time this also provides regulation of flow and maintenance of base-flow in dry periods. Furthermore, such disconnections greatly minimise the risk of sediments or other pollutants from entering the river network as operational sites will no longer be as well connected through drainage channels.

[24] **POL/9**
[25] A tunnel carrying a stream or open drain under a road or railway.
[26] The interface between land and a river or stream.

10.5 Restoration of afforested deep peat is another means by which NRW can potentially improve the aquatic system through activity on the WGWE. Following the publication of the Forest Research report "A Strategic Assessment of Afforested Peat Resources in Wales and the biodiversity[27], GHG flux and hydrological implications of various management approaches for targeting peatland restoration", guidance was written for peat restoration on the WGWE. The report includes a national assessment of the afforested deep peat across Wales which considers;

10.5.1 the current status of the peat; hydrological integrity of the site;

10.5.2 consequence of restoration in terms of greenhouse gas emissions;

10.5.3 ecological integrity of the site and climatic integrity of the site.

10.6 Using these criteria, a site's potential for restoration was scored to prioritise sites with good potential over those which are merely retaining the existing peat. The report also highlights the top 10 sites for restoration potential. And work has commenced to restore many of these sites.

[27] **POL/36**

11 Water Quality

11.1 Fish require water which is not polluted.

11.2 SoNaRR[28] describes the progress Wales has made in protecting and improving water quality in recent decades, but also highlights the significant challenges that remain. In 2015, 63% of all freshwater water bodies defined by the WFD were not achieving good or better overall status[29]. One out of six freshwater habitat types are in Favourable Conservation Status[30]. 2.4% of Wales' land area is designated as a Nitrate Vulnerable Zone (**"NVZ"**) as a result of agriculture. The Loughor Estuary, River Loughor, River Wye, Tawe Estuary, Cardiff Bay, River Alyn are all designated as Urban Waste Water Treatment (**UWWT**) Directive Sensitive Areas

11.3 Working with the Water Industry regulator (Ofwat), Government and the Water Companies, NRW, and its predecessor organisations have helped drive investment to improve water quality DCWW and Hafren Dyfrdwy have made further proposals for significant investments to meet their statutory environmental requirements to protect and improve the quality of surface waters in their PR19 business plans (2015-2025) recently submitted to Ofwat ("**PR19 Business Plans"**)[31].

11.4 This has been a key mechanism in improving river conditions as sewage and waste water can contain large amounts of nutrients (such as phosphorus and nitrates), ammonia, metals and other damaging substances including viruses and bacteria. Pollutants enter the water environment through discharges from sewage treatment works, sewage overflows (either treated or untreated) and privately owned septic tanks and treatment plants. During periods of wet weather, storm overflows also contribute to the impact. This can affect the water environment and in particular bathing and shellfish waters. Changes in weather patterns and population distribution, alongside the need for new housing and other premises (as described in the SuDS section above) all contribute to pressure on the infrastructure used to deal with our sewage and waste water. With ageing networks, future development and

[28] **POL/19**
[29] Chapter 3, Part A, **POL/19**
[30] **POL/41**
[31] **POL/40**

increased run-off entering the network; this can overload works, increase the number of spills from overflows and have a detrimental effect on habitats.

11.5 The overall DCWW Water investment programme for 2015-20 is £1.5 billion. It includes £55.9m of capital investment for water quality improvement schemes. DCWW's proposed PR19 Business Plan[32] will make further investments to improve approximately 300km of river quality. Significant investment will also go into addressing point source impacts from sewage treatment works and discharges from the sewer network. This will reduce pollutants such as ammonia and nutrients that disturb the natural ecological balance of water bodies and cause excessive growth of vegetation and algae. Habitat improvement schemes are planned to reduce the impact of physical modifications caused by water company operations. Measures will also ensure compliance with the Eels (England and Wales) Regulations 2009[33], which require water intakes to be screened to prevent eels from being drawn out of the river into drinking water treatment works.

11.6 Despite this, there are still significant challenges. 63% of all Welsh water bodies defined under the WFD (598 out of 942) fail to meet good or better overall status. In addition, only one out of six freshwater habitat types are in Favourable Conservation Status[34].

11.7 As control of regulated discharges has become increasingly effective, the significance of other sources of pollution has become more evident. These sources, known as diffuse pollution, typically consist of discharges or contamination that, while relatively minor individually, collectively have a significant impact on water quality. The contamination is frequently associated with runoff created by rainfall and its chemical and microbial composition can be extremely variable. NRW have identified eight areas to prioritise our effort to tackle diffuse pollution, namely:

11.7.1 industrial estates,

11.7.2 small sewage discharges (private),

11.7.3 drainage misconnections,

11.7.4 surface water drainage from developed areas,

[32] **POL/40**
[33] **LEG/19**
[34] See **POL/41**

11.7.5 livestock management,

11.7.6 land management,

11.7.7 storage – slurry, fuel, oils, chemicals,

11.7.8 mine waters

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12 Urban Pollution

12.1 Pollution from towns, cities and transport affects 12% of water bodies. A combination of misconnections of our dirty water (from sewage and washing) at our workplaces (in particular industrial estates) and homes together with rainwater collected from manmade surfaces such as building roofs, roads and pavements collectively contribute to a mixture of water pollution within our towns and cities. This can have an impact on our rivers, lakes, groundwater, estuaries and coastal waters. In some instances pollutants from historically contaminated land and atmospheric deposition contributes to surface water and groundwater pollution.

12.2 Tackling this is complex due to the nature and number of small discharges that collectively have a locally significant impact. For example, locating the source of pollution from an industrial estate where different business handle different materials and have different infrastructure. This is recognised by the WG's Water Strategy and NRW's Diffuse Pollution Plan, both of which are included in the Programme of Measures to protect and improve our waters. Wales also has an opportunity to minimise impacts from historic and future developments through better urban design and planning.

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13 Agriculture

13.1 Evidence shows that whilst there are a range of factors influencing water quality in Wales, there is continued and damaging nutrient enrichment of surface and groundwaters resulting from agricultural practices.

13.2 The frequency of agricultural pollution incidents in Wales is a source of concern to NRW. The agricultural industry has been responsible for between 120 to 170 substantiated pollution incidents during each of the last eight years. Over 60% of these incidents took place within South West Wales, peaking in the months of January to May. Some 50% of substantiated agricultural pollution incidents have been traced back to dairy farming, although it is important to note that only 3.8% of dairy farms in Wales are involved in a substantiated pollution incident each year while the figures taking all farms into account is around 1%.

13.3 In this context, it is significant that the size of the Welsh dairy herd has increased by 12.5% over the last five years whilst the number of dairy producers has declined by 9.4% over the same period. Not only has the average herd size increased, but there has been a greater concentration of livestock within the most economically attractive dairying areas.

13.4 Recent survey work by the Agriculture and Horticulture Development Board (AHDB) indicates that half of Dairy respondents were planning to increase production at some point over the next 5 years. If acted upon Welsh milk production could increase by 9% (or 111 million litres) by 2022.

13.5 Moreover NRW farm visits and river walks have identified evidence of poor agricultural land management practice. Often infrastructure is found to be contributing 37% of the diffuse pollution issues identified. Poaching from livestock in fields adjacent to rivers were also frequently identified.

13.6 Agricultural pollution can take two forms: point source and diffuse pollution.

13.7 Point source pollution is from a single identifiable discharge, such as a pipe or ditch. If pollutants such as slurry, silage, fuel oils, milk, soil or sewage sludge find their way into watercourses in sufficient volume, they increase the demand for oxygen, with fish kills being just one of the most distressing and visible outcomes. The impacts on

ecology and fish stocks will often take much longer to address and it can take many years for the water course to recover.

13.8 Diffuse pollution is caused by a variety of land management activities that have no specific point of discharge. Sources of diffuse pollution are often individually minor, but collectively can result in significant environmental damage. Examples of diffuse agricultural pollution include slurry spreading and its subsequent washing off through rain into water courses, over application of fertilisers and chemicals, livestock damaging to river banks or animals in the water course.

13.9 The Nitrates Directive 1991[35] aims to protect surface and groundwaters from nitrate pollution from agricultural activities. Currently, 2.4% of Wales is designated as a NVZ as a result of agriculture. In 2016 NRW undertook a review of water quality data to meet the requirements of the Directive. Evidence was presented to WG to designate further catchments in Wales, which would increase the percentage of land designated to approximately 7%. Within designated NVZs a Nitrates Action Plan[36] with specific restrictions on land spreading of slurry are enforceable. WG announced on 14th November that new regulations covering the whole of Wales will be introduced in Spring 2019. The standards will include new rules on nutrient management on farms; NRW will work with Welsh Government and the sector to implement these changes which will come into force in January 2020.

13.10 Glastir is WG's sustainable land management scheme. They are entirely voluntary schemes and form a large part of a wider investment in Wales under the RDP[37]. The objectives of Glastir are to bring about beneficial environmental outcomes by:

13.10.1 managing soils to help conserve carbon stocks and reduce soil erosion;

13.10.2 improving water quality and reducing surface run-off;

13.10.3 managing water to help reduce flood risks;

13.10.4 conserving and enhancing wildlife and biodiversity;

13.10.5 managing and protecting landscapes and the historic environment;

[35] **LEG/4**
[36] **POL/43**
[37] **POL/34**

13.10.6 creating new opportunities to improve access and understanding of the countryside

13.11 Glastir supports the implementation of measures over and above legal requirements, cross compliance and usual farming practice. Glastir supports environmental work targeted at specific locations that are best placed to deliver the aims of the scheme. Expressions of Interest for a Glastir contract, submitted by applicants, are scored on the ability of a holding to deliver the objectives set by the WG.

13.12 For water quality, mapped layers identify areas where NRW believes that land management practices are contributory factors to WFD failing water quality standards including those related to fish. Within these priority areas, Glastir is used to promote soil management and ways to reduce the effect of nutrient, sediment and faecal bacteria pollution. The plans are also used to assist the delivery of the most appropriate management options and capital works to gain the best outcome for water quality priorities through Glastir.

13.13 For water quantity, mapped layers have been used to identify appropriate locations for "Pontbren" style field interventions which can increase infiltration. This improves local water quality, reduces peak runoff to protect flood risk sites downstream, and provides increased dry weather river flows; thereby protect river flora and fauna downstream.

13.14 To date, Glastir has delivered over targeted management to deliver beneficial outcomes for water objectives across Wales. The approach has been a key component of the thinking underway as WG develop their post CAP agricultural scheme.

13.15 The Water Strategy for Wales[38], launched by the Minister for Natural Resources in 2015, sets out the direction for water policy over the next 20 year. It is accompanied by an action plan (at Annex A). It aspires to ensure that Wales continues to have a thriving water environment which is sustainably managed to support healthy communities, flourishing businesses and the environment. The resulting action plan identifies six policy priorities between 2015 and 2018, including "to review and where appropriate change current practices and regulatory approaches to tackle diffuse pollution."

[38] **POL/7**

13.16 To pursue this, NRW has brought together a wide range of partners representing the land management sector to explore the right balance of regulatory measures, voluntary initiatives and investment that can deliver substantial reductions in agricultural point source and diffuse pollution episodes.

13.17 The sub-group is developing a mutual understanding of the root causes of pollution problems before identifying the spectrum of approaches available for driving improvements. The sub-group are developing an enabling framework that can support farmers in taking action, where required, whilst simultaneously advising on improvements to the underpinning regulatory structure. Our initial focus has been on slurry and nutrient management whilst still recognising that soil runoff and agri-chemicals such as crop protection products also contribute to water quality issues.

13.18 Each of the partners has made a significant commitment to the work of the Wales Land Management Forum (**"WLMF"**) sub-group on agricultural pollution. This now represents a genuine multi-stakeholder co-production approach to the SMNR. Our approach involves using the ways of working enshrined in the new legislative framework in Wales, coupled with applying the principles of good regulation, to deliver the aspirations for SMNR and to deliver the well-being goals.

13.19 This is a very new way of working which is strongly collaborative, involves taking ownership of a seemingly intractable problem and recognising that significant change will be needed in both attitudes and ways of doing things to succeed. The WLMF sub-group now includes representation from NFU Cymru, Farmers' Union of Wales (FUW), Country Land and Business Association (CLA), DCWW, the Tenant Farmers Association Cymru (TFA), Hybu Cig Cymru (HCC), AHDB Dairy, the Carmarthenshire Fishermen's Federation (CFF), NRW and WG's Environment & Rural Affairs Department as well as Water Branch. All meetings are chaired by an NRW Board Member.

13.20 The approach adopted is in line with NRW's working definition of regulation. This is an intervention that makes a positive difference, which includes other synergistic mechanisms of bringing about positive change alongside formal regulation underpinned by legislation, such as stimulating voluntary initiatives and targeted investments.

13.21 The integrated regulatory framework has been divided into five interlinked core themes. Each of these themes are fundamental to the success of the framework with

a major role to play and all of them will need to be progressed to achieve the positive outcomes desired:

13.21.1 Ensuring better advice and guidance is provided and taken up by farmers;

13.21.2 Improving the existing range of investment incentives;

13.21.3 Developing a voluntary, farmer-led approach to nutrient management;

13.21.4 Ensuring the formal regulatory regime is sufficiently robust to achieve the outcomes required;

13.21.5 Identifying and promoting innovation.

13.22 Some work streams, such as advice and guidance, have an emphasis on tackling diffuse pollution and others, such as regulation, are more likely to be tackling point source pollution incidents. For example some catchments and water bodies are more affected by diffuse pollution, some by point source pollution (which doesn't necessarily have a long-term effect on water quality even if short term pollution incidents damage fish populations and ecology for years to come) and some are affected by both. However, the five core work themes are being developed further to deliver a more comprehensive rounded programme.

13.23 Several initiatives have started to help land managers. Farming Connect has a tackling agricultural pollution programme that provides support, advice and guidance to farmers through film, e-fact sheets and case studies. Advice is available to individual businesses registered with Farming Connect or groups of businesses for nutrient management planning, improving farm infrastructure including clean-dirty water separation, slurry, manure and silage storage and many more technical aspects. To date a number of targeted events have been held across Wales at locations where farming is believed to contribute to WFD failing water bodes.

13.24 With support from NRW and others NFU Cymru is running a project to assess the benefits that Assurance schemes could deliver to the farming community through raising standards.

13.25 NRW has appointed eight new agricultural officers who aim to visit around 30% of the 1,700 dairy farms in Wales this year. They will help the industry ensure it is following best practises and complying with the relevant regulations to prevent

agricultural pollution. Once the officers are on the farm the aim will be to help farmers understand how their day to day activities could reduce the risk of any potential pollution to water.

13.26 The officers will work in partnership with others to help develop innovative new ideas, technology and practices which can further reduce agricultural pollution. NRW has been working with partners to deliver a range of projects to reduce farm pollution. The new officers will work with other organisations to coordinate these anti-pollution initiatives, including Farming Connect, the DCWW catchment team and Afonydd Cymru Catchment Officers. We're also looking for additional funding to extend the project to 2021 so that NRW staff can visit every dairy farm in Wales.

14 Innovation

14.1 Investment in new techniques and innovative approaches to ensure the sustainable management of the bi-products and polluting substances generated by modern farming practices has, perhaps, not progressed as quickly as it has elsewhere. Similarly approaches to tackle the risk of air and water pollution and soil erosion are still not widespread across Wales. This may stem from a range of factors. These include a lack of recognition or knowledge of the true value of the materials being lost from farm land as well as the impact that poor management of such substances can have. It may also stem from a lack of investment in research, management of assets, and techniques

14.2 Yet it is widely recognised that many potential pollutants can, if handled and treated carefully, be useful and valuable to the agricultural sector and are, in fact, vital and aligned with the circular economy approached embedded in the Natural Resources Policy.

14.3 In order to innovate, we must avoid falling straight into “solution mode”. Instead the challenges need to be exposed, such as the need to move slurry from being seen as simply a waste and convert it into a valuable product at a farm scale. An s wide as possible audience is then required to understand our challenges and see if they have novel solutions.

14.4 A number of challenges have already been set and innovative solutions are being trialled so that successful approaches can be available in the market place. One such trial is Prosiect Slurri, led by Coleg Sir Gar’s Gelli Aur agricultural campus and Power and Water, a Swansea-based company specialising in electrochemical-based water treatments. This removes air and water in slurry, reducing its overall volume by up to 80 per cent. The water extracted from the slurry is purified, allowing it to be recycled or discharged into a watercourse, while the nutrients are used to produce good quality fertiliser. With this approach slurry storage on farm is kept to an absolute minimum.

14.5 A further project has looked at providing a cheaper or longer lasting means of stock control on farms. This has developed new anti-rotting treatments for fence-posts, alternative fence posts and radio and sound collars for tracking and controlling animal movements and behaviour. These products could enable better riparian protection through providing more effective barriers to stock.

14.6 Further challenges are being looked at through the WLMF Sub Group with the aim of defining the issue and using innovation funding to seek solutions.

15 Forestry

15.1 Acidification of rivers and lakes due to the atmospheric deposition of sulphur and nitrogen compounds continues to impact our upland water bodies. It has particularly damaging impacts on fish. The source of this pollution is industry and transport and there have been international controls on acidic emissions resulting in great reductions. However, the response of acidified waters has been slow, and, in some cases, full biological recovery is expected to take many more years. Air emission reductions should continue to be the primary response to the issue of acid deposition. However, there are opportunities to promote the recovery process through land management changes. There are also short term fixes where recovery is urgently needed.

15.2 In some locations the atmospheric pollutants are captured by tree canopies, which can lead to the exacerbation of acidification compared to shorter types of vegetation. It is therefore important to manage forestry within vulnerable areas to ensure acidification is not exacerbated and opportunities for improvement are realised. There are guidelines in place as part of the UK Forestry Standard to ensure this happens.

15.3 On the WGWE we aim to minimise the risk of forestry activities causing damage to water quality. All current plans and operations on the WGWE consider: the potential exacerbation of acidification through scavenging of atmospheric pollutants; the risk of sedimentation from run-off during operations; and the potential harmful effects of using pesticides. NRW also looks to influence similar standards across the private sector.

15.4 The standards set by the introduction of the Forest and Water Guidelines means that forestry practice has improved greatly in recent decades, however, much of the forests were planted before these guidelines were published, and the areas being felled now are likely to have been planted when it was common practice to leave no riparian buffer area, and drains were cut to get water out of the forest as quickly as possible to better establish trees. The current practice is to apply the latest standards when forests areas are felled and restocked, however, where there are WFD failures, this approach may not be achieving water quality improvements as quickly as required.

15.5 Within the WGWE, waterbodies not currently meeting good status are prioritised for actions to improve water quality, principally to minimise acidification Where forestry is considered a potential pressure, and where there is greater than 30% closed canopy cover (research evidence suggests that below 30% closed canopy cover in a catchment it is unlikely that tree cover will have any measurable impact on acidification), or where there is more than 20% closed canopy cover where forestry is considered a major pressure, the waterbody is prioritised for action.

15.6 NRW have identified 22 such water bodies. The first step requires a river walk surveys to assess if the watercourses meet the standards set out in the UK Forest Standard Guidelines - Forests & Water. The surveys record riparian vegetation information, such as density of canopy and tree type; forest information, including distance between the watercourse and the commercial crop; any connections between the river network and forest drainage and roadside drains; invasive species and any barriers to fish migration.

15.7 Where necessary, riparian areas will be improved through interventions such as clearance of excessive tree regeneration and the planting of native broadleaved species. Even where the forest has been planted with appropriate buffer areas established, over time natural regeneration or excessive tree growth requires intervention in order to achieve the standards set out in the Forests and Water Guidelines. This includes prescribed buffer widths.

15.8 Interventions to buffer acidification have been used across Wales for many years. They include calcium carbonate spread in hydrological source areas, limestone sand added directly to watercourse and the large scale dosing units employed at Llyn Brianne. All are designed to quickly reduce acidity and support fish where acid rich waters currently restrict fish. NRW has recently worked with partners to produce guidance on the use of liming.

16 Mining

16.1 Wales has a long history of mining and quarrying for construction material, metals and coal. A large number of these activities have now ceased, however, rainfall, surface and ground water still flows through the abandoned workings and through the surface spoil heaps that remain. In doing so they liberate materials which then pollute water courses and groundwater. The pollution is often so toxic that fish cannot survive in the watercourse affected.

16.2 Drainage of these workings can leach out metals and minerals making many of the discharges acidic. This polluted drainage can have severe environmental impacts. Perhaps the most striking is the orange staining of watercourses caused by oxidised iron. In contrast, some mine and quarry discharges and downstream water courses can be crystal clear. This is where the toxicity of the mixture of metals present is such that there is no visible in-stream life and no algae or plankton in the water column to impair visibility.

16.3 Mine water remediation can involve treatment of point-source discharges or interventions to separate clean surface water from contaminated mine waste or underground workings. Treatment can be achieved using active or passive technology, but the latter is likely to be cheaper and more sustainable in the long term. Soluble metals such as zinc and cadmium are, however, relatively difficult to remove in such systems; therefore large scale systems with long residence times may be required to achieve adequate treatment.

16.4 Wales has 1,300 metal mines many of which impact on 67 WFD surface and groundwater bodies which contain 700km of river channel. This represents nearly 8% of WFD failures in Wales. Our Metal Mines Strategy[39]focuses on a prioritised top fifty Welsh mines. The rugged remote upland terrain and poor access to energy and transport infrastructure precludes the use of traditional treatment approaches on most sites. As a consequence NRW have looked to innovative approaches to tackle and fund many of the challenges faced.

16.5 At Frongoch Mine in mid Wales NRW have developed the largest remediation scheme in the UK. Using European Regional Development Funds the 3 hectare site has been re-profiled and capped to minimise water ingress, and has drainage channels that convey clean runoff through a new wetland habitat. Additionally NRW

[39] POL/38

have used Innovation funding to set a challenge to Companies to develop mine water remediation technology that can work in a Welsh landscape. At Frongoch an Electrochemical Coagulation system has been trialled by North Wales company, Elentec. This has recently finished initial trials and has removed 99.9% lead (Pb), 94% zinc (Zn) and 65 to 70% of the cadmium (Cd) from highly polluted drainage at the site.

16.6 A second innovation programme has used Sono-electrochemistry with Swansea based Power & Water at Cwm Rheidol. This has seen the removal of a former Vertical Flow Pond followed by installation and operation of a trial which delivered 99.95% removal of target metals in filtered samples. Further projects are being developed in the Teifi catchment at Abbey Consols, and Esgair Mwyn, and at Cwmystwyth and Dylife. These are all aimed at dramatically improving the water quality in a number of mid Wales's rivers which have suffered high metal pollution for centuries. At the same time NRW are seeking to enhance the recreational, heritage, educational and cultural potential of these important sites and to consider operational power requirements through solar and hydropower options.

16.7 The Coal Authority currently operates 15 treatment schemes at abandoned coal mines in Wales using funding from the Department of Energy and Climate Change (DECC). 12 are in the Western Wales River Basin District and three in the Severn. These schemes must continue to operate to prevent deterioration in rivers and groundwater. Since 1994, the Coal Authority has cleaned up and protected over 240 km of rivers, protected drinking water supplies, and groundwater resources, and each year stops over 3,000 tonnes of iron and other contaminants causing pollution.

17 Chemicals

17.1 Our society has developed numerous chemical products for a variety of uses. Some substances pose a threat to the environment because of their toxicity, persistence and tendency to bio-accumulate. Once they are in the environment, or in animals or humans, it is very difficult to get rid of them. There are strict regulatory codes governing the use of chemicals.

17.2 Changes to the application methods for protecting farm stock has been taken up widely by farmers and the cases of sheep dip pollution is now relatively rare. This followed many cases of pollution which had devastating impacts on stream invertebrates even when farmers were applying best practice techniques for both the application and disposal of sheep dip.

17.3 Despite the routine water monitoring by NRW and Water Undertakers increasing traces of other pesticides are being detected in new areas. While these levels are too low to pose a risk to those using and drinking the water, they are enough to risk breaching rigorous drinking water standards.

17.4 To safeguard raw water quality and reduce the risk of pollution, NRW worked with DCWW to operate a free and confidential pilot pesticide disposal scheme as part of the PestSmart campaign. PestSmart is DCWW umbrella scheme for the management and safe use, storage and disposal of pesticides in drinking water catchments. It aims to protect raw water quality across Wales by driving behavioural change towards pesticides and stimulating a 'smarter', more sustainable approach to weed, pest and disease control that does not adversely impact people, water or wildlife. The pilot was run in six drinking water catchments which were selected by DCWW based on potential pesticide risk. These were the Upper Wye, Towy, Teifi, Pendine, Alaw and Cefni catchments.

17.5 Professional pesticide users including farmers, land managers, growers, game keepers and foresters were targeted. The scheme was administered, promoted and managed by DCWW. NRW established the contract, provided chemical knowledge and, with WG, funded the collection and disposal costs. Collections were undertaken in June 2017. Participation was allocated on a first come, first served basis. At the point of collection, all participants were issued with DCWW's best practice guidelines

for chemical use, storage and disposal. Piloting a pesticide disposal scheme in six target catchments has provided the information to enable the promotion of a Wales wide scheme.

17.6 This Wales-wide scheme will commence in 2019. It will again be run as a PestSmart initiative through the almost. £1 million funding from the RDP[40]. Following this successful partnership approach, NRW and the Wales Pesticide Partners have confirmed their support for future disposal schemes.

17.7 In 2015 DCWW successfully worked with NRW and the farming industry on an innovative campaign to tackle the rising levels of the grassland herbicide MCPA. The campaign works with farmers and land managers to promote better advice on handling, applying and disposing of grassland sprays, guidance on mechanical control of rushes and improving land condition to addressing the underlying causes of infestations.

17.8 Weed wipers apply herbicides directly to plants like rushes and grassland weeds thereby using fewer chemicals and dramatically reducing spray drift. As a consequence the pose a lower risk to water quality. They have the added benefit of only being licensed for use with Glyphosate, a chemical which has potentially less impact on water quality as it can break down quicker at around 2-3 days compared to MCPA, which breaks down in 15 to 25 days. In the target catchments, DCWW are offering farmers and land managers the chance to try a weed wiper for free.

17.9 Pesticide risk is also an issue in Forestry operations. Without protection or a reduction in weevil populations it is extremely difficult to re-establish forests. Currently pesticides provide sufficient plant protection to allow crop establishment. Whilst the potential for environmental damage from substances such as cypermethrin are very high, the industry has a very good track record in following best practice in its use.

17.10 As well as making best use of chemicals NRW are also working towards using less pesticide, using pesticides with a lighter environmental footprint, and improving our Integrated Pest Management (IPM) systems. NRW have already ceased the use of Cypermethrin altogether as a top up chemical.

[40] **POL/34**

17.11 On the WGWE we currently use two methods of tree protection that involve the use of insecticides - pre-plant treatment at the nursery with insecticides that are electrostatically applied and post-plant treatment in the forest with aqueous sprays. The use of this spray is in low concentrations, highly targeted through the use of knapsack sprays or drench guns with measured doses being delivered with the use of a dye in the mixture to aid precision applications. NRW also apply alternative methods of control, including physical methods such as barriers and coatings, a biological control method through the use of nematodes in the forest and apply knowledge based systems such as implementing a fallow period of 1 to 5 years; using the “Hylobius Management Support System” decision support system which is a restock planning tool; and the use of continuous cover forestry systems where applicable.

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18 Fuels and Oil

18.1 Oil and fuel pollution continues to be one of the most common and serious causes of water pollution in Wales. Regulations setting minimum standards for storage were introduced in Wales in 2016, England introduced their regulations in 2001 resulting in a significant reduction in the number of incidents since then. Whilst there are far fewer sites where chemicals are stored, and proportionately fewer pollution incidents reported, NRW propose to seek improved uptake of existing pollution prevention guidance to reduce the risk of pollution.

18.2 Whilst there are far fewer sites where chemicals are stored, and proportionately fewer pollution incidents reported, NRW propose to seek improved uptake of existing pollution prevention guidance to reduce the risk of pollution .Fuel and oil can harm wildlife with wildfowl being particularly vulnerable, both through damage to the waterproofing of their plumage and through ingestion of oil during preening. Mammals such as water voles may also be affected. The flesh of fish exposed to oil can become tainted.

18.3 Oil is a highly visible pollutant that affects the water environment. It can reduce levels of dissolved oxygen and taint drinking water supplies from both surface and groundwater even at very low concentrations, making them unsuitable for use.

18.4 Fuel and oil can harm wildlife with wildfowl being particularly vulnerable, both through damage to the waterproofing of their plumage and through ingestion of oil during preening. Mammals such as water voles may also be affected. The flesh of fish exposed to oil can become tainted.

18.5 Ensuring improved management of storage facilities is critical to reducing the number of spills and leaks that occur. The oil storage provisions of the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Wales) Regulations 2010 (SSAFO) have been repealed and replaced by the (Control of Pollution) (Oil Storage) (Wales) Regulations Wales 2016 (**"the Oil Storage Regulations"**)[41]. The Oil Storage Regulations now apply to the storage of any oil on farms including the storage of oil used for heating and/or power on premises. It includes horticulture, fruit growing, seed growing, market gardens and nursery grounds. Where persistent bad practices

[41] **LEG/36**

and non-adherence to the legislation are identified NRW undertake proactive enforcement (see guidance on the Oil Storage Regulations[42].

[42] **POL/42**

19 Septic Tank Registration

19.1 There could be as many as 100,000 properties in Wales not connected to the public foul sewerage system. In most cases, these properties will rely on a septic tank, a cess pit (a sealed tank) or a package sewage treatment plant for their sewage treatment. All such systems run the risk of polluting their local environment and pose a risk to health if they are not properly installed and maintained. Studies from Lough Leane in Ireland show that 85% of tanks had not been serviced and were full of sludge. UK studies found that septic tanks contributed up to 76% of the phosphates in a catchment. In some locations there may be so many systems that even well maintained systems will collectively overload the capacity of the local environment to effectively absorb the discharges.

19.2 Through the Environmental Permitting Regulations 2010[43] all discharges from septic tank and small sewage treatment plants in Wales require registration. This allows the risk these systems pose to be estimated. NRW use the information to investigate the cumulative impact on the water environment and identify if further steps, such as the construction of new public sewers or better maintenance of existing septic tanks, is appropriate where the environment is currently at risk. NRW have also developed best practice guidance and deliver programmes to address local impacts and to improve the management of Small Sewerage Discharges.

[43] **LEG/34**

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20 Summary and conclusions

20.1 The diverse range of measures explained above aim to help alleviate the numerous pressures which damage the environmental quality of our rivers, and to improve the river environment. These measures are aiming to remedial action to restore river habitat quality and to address other factors operating in the freshwater environment.

20.2 By establishing an improved river environment, NRW are aiming to provide a better habitat for salmon and sea trout. The measures explained will work in tandem with, and are complimentary to, the implementation of the All Wales Byelaws. These broad measures will help secure the improved outcomes for fish stocks anticipated as a result of the Byelaws.

21 Statement of truth

21.1 I hereby declare that:

I. This proof of evidence includes all the facts which I regard as being relevant to the opinions that I have expressed and that the inquiry's attention has been drawn to any matter which would affect the validity of that opinion;

II. I believe the facts that I have stated in this proof of evidence are true and that the opinions I have expressed are correct; and

III. I understand my duty to the inquiry to help it with matters within my expertise and I have complied with that duty.

Robert Vaughan

Manager of Sustainable Land, Farming and Forest Management

Natural Resources Wales