Cyfoeth Naturiol Cymru
Natural Resources Wales

Biennial report to the Minister for Climate Change

Reservoir Safety in Wales

For the period 1 April 2019 to 31 March 2021

Natural Resources Wales

September 2021

Foreword

Natural Resources Wales is the enforcement authority for the Reservoirs Act 1975 in Wales, and I am pleased to provide this report to the Minister on our activities from 1 April 2019 to 31 March 2021.

It is our duty to ensure reservoir owners and operators comply with the law. Our ultimate purpose is to provide reassurance that the flood risk from reservoirs is well managed.

Wales is famous for its reservoirs. We have some of the oldest dams in the UK, dating back to the Middle Ages. The Elan Valley system is recognised as a triumph of Victorian engineering. Ffestiniog power station was the first major pumped storage hydro-electric power facility. Llyn Brianne is the UK's tallest dam and Clywedog the tallest buttress dam. But they also carry an inherent risk which, if unmanaged, can have tragic consequences.

In our report we have tried to capture the scale of reservoir management in Wales and the performance of reservoir owners or operators. We also recognise the challenges where there is still work to be done in this important area.

We have a dual role. As well as being the regulator, we manage and operate a substantial portfolio of our own reservoirs for flood management and conservation benefits, and those within the Welsh Government Woodland Estate providing popular public amenity. We specifically report on our activities in each role.

The reporting period was one of change. A major reservoir incident in England prompted Defra to commission an independent review of reservoir safety; the recommendations from which are substantial and complex. This period of change is set to continue and will produce its own challenges as we progress.

The continuing effects of the Covid-19 pandemic has changed how we work. This coupled with the Climate and Nature Emergencies makes it even more important to ensure we have confidence that reservoir safety in Wales is being well managed, whilst making the most of their value in helping to manage natural resources in a sustainable way.

Our report provides a summary of the activities we have undertaken to discharge our duty as required by section 3 of the Reservoirs Act 1975, specifically we report on:

(a) the number of large raised reservoirs that have been registered
(b) the steps NRW has taken to ensure the undertakers of large raised reservoirs have complied with the requirements of the 1975 Act; and
(c) a statement as to—
    i) the number of large raised reservoirs for which we are the undertakers; and
    ii) any steps we have taken to observe and comply with the requirements of the 1975 Act.

Finally, we report on the activities we do beyond what the law requires. Compliance is not the same as doing all that is expected to manage safety. Our report summarises the steps we are taking to transform NRW from being an enforcement authority for the Reservoirs Act 1975, to becoming a regulator of reservoir safety more widely.

Clare Pillman
Chief Executive

Contents

The Reservoirs of Wales

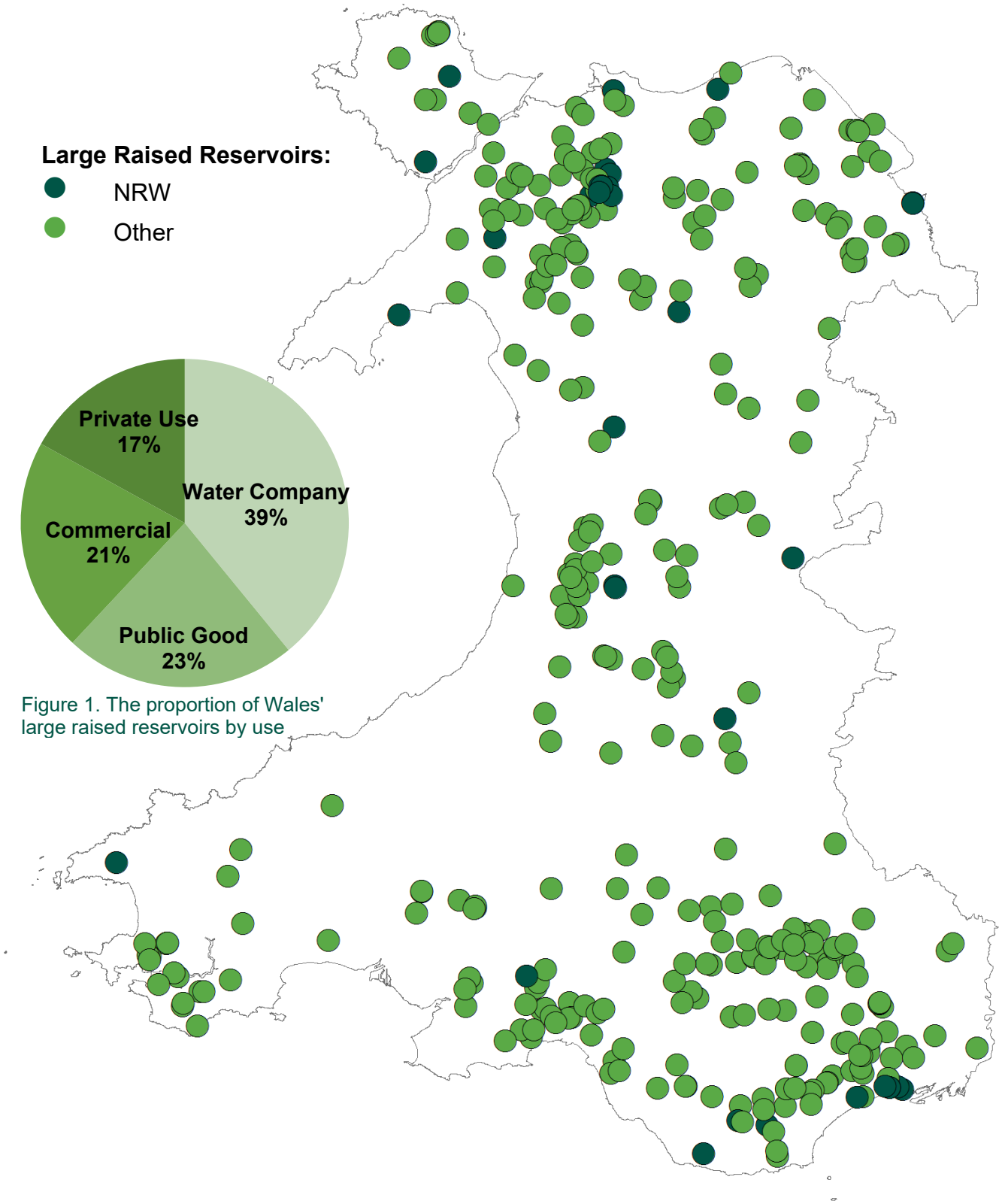

Figure 1. The proportion of Wales' large raised reservoirs by use

Reservoir Safety in Wales 2019—21

The 2019 incident at Toddbrook reservoir in Derbyshire is a stark reminder of the need for a thorough safety regime, and the incident proved the value of well-prepared emergency plans. The subsequent independent review by Prof. David Balmforth provided recommendations for further improvements in reservoir safety practice, which we are now reviewing with other regulators and with the reservoir community.

Throughout the challenges presented by coronavirus Covid-19, we maintained our regulatory service. Reservoir owners, operators and engineers continued their activities as “essential work” under lockdown rules which helps confirm the view that many reservoir owners take their responsibilities and liabilities seriously.

Most reservoir owners comply with the law, and compliance has remained steady compared with previous years. This also means there has been no improvement. There are reservoir owners who have failed to meet minimum standards and whilst it has been a difficult year with Covid restrictions, we do not think this has had a substantial negative effect. We are revising our regulatory approach to dig deeper into the root causes of non-compliance.

Reservoir owners often balance multiple demands, and where there is a conflict for budget and resource, legal compliance is a strong driver in decision making. However, the Balmforth review highlights a misalignment between compliance and safety. Action may be lacking in important areas of risk reduction which are not specified in the Reservoirs Act, resulting in a safety system which has an over-reliance on reaction to legal requirements rather than a proactive approach to risk management.

However, some owners are doing more than what is required by law and demonstrate a clear commitment to reservoir safety. We will work with these organisations to develop a vision for reservoir safety in Wales, with clear outcomes to act as better measures of safety than just compliance.

For those owners that lack the commitment to maintain a safe reservoir, we are reviewing our regulatory approach to include clearer penalties for failing to meet the most basic requirements of the law and good practice.

The Balmforth review makes the case for change in policy and practice. This needs careful consideration through discussion with professional partners to establish the correct changes before we can refine our decisions or make recommendations to Government for any legislative change to support this.

The impacts of Coronavirus COVID-19

Half of the reporting period was affected by the coronavirus pandemic and Government restrictions were imposed on the public, with some reduction in restriction for essential workers. The first restrictions were imposed from 23 March 2020. At this time, we provided guidance that the duties required for reservoir safety were essential and should be continued but taking precautions where necessary. Welsh Government provided letters of authority for reservoir panel engineers to travel and carry out their work. We ensured these were provided to all engineers working in Wales.

By August 2020, it was apparent that undertakers were experiencing disruption and delays caused by the restrictions, with contractors and consultants unable to deliver to the timescales agreed previously. We amended our regulatory decision to allow undertakers to

submit a case for us to withhold enforcement action where delays caused by Covid-19 were experienced. We attached conditions to these requests to include written agreement by the engineers that safety would not be adversely compromised, and made sure additional precautions were in place.

We received just three applications. In two cases the delayed work was still current at the close of the reporting period but returned to compliance in summer 2021.

The Toddbrook reservoir incident

On the 1st of August 2019, a major incident was declared at Toddbrook reservoir, Whaley Bridge in Derbyshire. During a flood event, a fault in the spillway design caused the concrete to fail leading to erosion of the earth embankment. A major multi-agency response was required and around 1,500 residents were evacuated from their homes for several days.

Defra commissioned Professor David Balmforth to carry out an independent review of the incident. His first report, Toddbrook Reservoir Review: Part A (www.gov.uk), highlighted the importance of spillway construction and the essential need to complete maintenance work and follow the recommendations of reservoir engineers.

The Environment Agency, as the regulator in England, produced a Technical Note on the causes of failure which we circulated to all reservoir undertakers in Wales. We also took the opportunity to assess the availability of onsite emergency flood plans which we describe later in this report.

Prof. Balmforth raised a view that compliance with the Reservoirs Act did not always mean reservoirs were as safe as they should be. In response to this concern, we reviewed our approach to regulation of reservoir safety. We established that our duty given under section 2(3) of the Reservoirs Act 1975 has been fulfilled, but also committed to provide further reassurance of reservoir safety by widening our focus to non-statutory beneficial outcomes.

In May 2021, we received Prof. Balmforth's second report, Reservoir Review: Part B (www.gov.uk), which focusses on reservoir safety more widely and looked at practices in other risk management sectors. We are pleased that many of Prof. Balmforth's recommendations align with our proposed change in regulatory approach.

Reservoir Flood Mapping

We have continued to produce flood maps to show the extent and consequence of flooding in a worst credible case scenario following the failure of a reservoir. We have received the first outputs from this project which will continue throughout 2021.

Two sets of maps are produced for each dam break scenario to show flooding during "dry day" and "wet day" scenarios so we can establish the incremental impacts caused by the failure of a dam over and above a fluvial flood. Where a reservoir has multiple dams, a set of maps has been produced for each dam. The finished maps have the following primary purposes:

- To provide evidence to inform our risk designation and set the appropriate level of regulation
- To provide emergency planners information about reservoirs in their area
- To help reservoir owners prepare their own emergency plans; and

- To inform the public about flood hazard from reservoirs.

Dŵr Cymru Welsh Water which manages the largest proportion of reservoirs in Wales, has produced its own suite of maps for most of its reservoirs. These maps are to the same specification as ours to support the aims above. We are grateful to Dŵr Cymru Welsh Water for this commitment which accounts for nearly half the maps to be produced.

Risk Designation

The Reservoirs Act 1975 places a duty on us to designate large raised reservoirs as high-risk reservoirs if we think an uncontrolled release of water could endanger human life. This is a consequence-based assessment and does not confer any likelihood of failure.

Undertakers for high-risk reservoirs must adhere to all the requirements of the law, most importantly the inspection and supervision elements provided by qualified civil engineers. Lower risk reservoirs do not have this requirement.

Our designation process has two initial phases:

- Phase 1: designation of reservoir regulated prior to the 2016 Regulations
- Phase 2: designation of reservoirs registered since 2016.

We completed Phase 1 in 2017 with 88% of pre-2016 reservoirs being designated as high-risk reservoirs. The remaining 12% of these reservoirs were shown to pose a sufficiently low hazard and were released from the statutory requirement for inspection by independent engineers.

Phase 2 provisional designations will be completed throughout 2021, with final designations in 2022.

Regulation of the Reservoirs Act 1975

Our principal duty is to ensure reservoir undertakers observe and comply with the Reservoirs Act 1975. This law was established to minimise the risk of dam failure and the subsequent flood risk. The law only applies to large raised reservoirs which are designed or used for collecting and storing 10,000 cubic metres of water, or more, above the natural level of the surrounding land and includes artificially raised lakes.

The law requires undertakers to appoint qualified civil engineers at specific points in the lifetime of a reservoir. These engineers are appointed to specialist reservoir panels by Government to fulfil roles required by the Reservoirs Act. When a qualified civil engineer is in place to supervise activity at a reservoir, we are provided with reassurance that an independent professional view of safety is given and any shortfalls will be identified and escalated if needed.

The most important indicators of reservoir safety are based on this principle of oversight by engineers, specifically:

- The appointment of a Construction Engineer to design and supervise the construction and alteration of reservoirs
- The appointment of a Supervising Engineer (SE) for every high-risk reservoir. The SE is obliged to provide a written statement and report on how undertakers are performing

on the recommendations made by a Construction or Inspecting Engineer, and must notify any breaches of the law
- The appointment of an Inspecting Engineer (IE) for every high-risk reservoir to carry out a periodic inspection. The IE must be independent of the undertaker. In the report of their inspection, the IE will normally make recommendations for work to be completed along with surveillance and monitoring recommendations
- Receipt of certification by an IE to confirm satisfactory completion of statutory measures to be taken in the interests of safety.

We are also reporting on the activities which are required of undertakers but do not require oversight by engineers. Specifically:

- Maintenance of the reservoir
- Monitoring and record keeping
- Registration

We report on each of these indicators for the period April 2019 to March 2021. The annexe to this report provides additional information about the reservoirs which remain in breach of the law.

Construction and alteration

During the reporting period we monitored construction activities at 16 reservoirs. All reservoirs under construction had the appropriate Construction Engineer appointed. We also investigated two sites where we became aware of potential new reservoir construction without an engineer. In each case our staff surveyed the sites and confirmed the capacities were below the 10,000m^3 threshold required for registration.

Table 1 shows four appointments of Construction Engineers to oversee construction, alterations or to provide first inspections of reservoirs newly designated as high-risk reservoirs.

Table 1. Showing the Large Raised Reservoir for which a Construction Engineer has been newly appointed

Reservoir	CE Appointment
Pendinas	17/12/2021
Aston No.2	01/07/2020
Crai No.2	12/06/2020
Dyffryn No.1	12/06/2020

Preliminary Certificates were given for the seven reservoirs shown in Table 2. These include two extremes of reservoir use. Llyn Mawr at the National Botanic Garden of Wales forms part of the restoration of a Regency inspired landscape, whilst Surf Snowdonia is a very modern design of reservoir which generates waves for surfing.

Table 2. Showing large raised reservoirs for which we received Preliminary Certificates

Reservoir	CE Appointment	Preliminary Certificate
Pontarddulais Flood Storage Area	04/12/2017	29/01/2021
Rhyl Golf Course Flood Storage Area	31/05/2020	02/11/2020
Dolwen	09/02/2020	22/12/2020
Llwyn Onn 1	22/02/2017	04/10/2017
Llwyn Onn 2	06/11/2017	10/09/2018
Surf Snowdonia	02/07/2014	30/09/2019
Llyn Mawr	27/09/2018	27/07/2020

Final Certificates were given for five reservoirs, shown in Table 3. Two were for flood risk management by Local Authorities, two for alteration works and one to confirm the satisfactory re-use of a previously abandoned reservoir.

Table 3. Showing the Large Raised Reservoirs for which construction has been confirmed complete with a Final Certificate

Reservoir	CE Appointment	Preliminary Certificate	Final Certificate
Coldbrook Flood Attenuation Scheme	31/08/2014	26/05/2017	26/05/2020
Llyn Gweryd	21/08/2019	13/11/2019	06/12/2019
Rhymney Bridge No.2	20/08/2013	10/01/2017	17/04/2020
Llanishen	10/02/2016	05/05/2016	05/05/2019
Tredegar Park Golf Course Flood Attenuation	12/06/2015	04/08/2016	04/08/2019

Supervision

We can report that at the end of the reporting period, all high-risk reservoirs have the required Supervising Engineer appointed.

We processed 109 new engineer appointments. At two reservoirs the undertakers did not appoint a Supervising Engineer and we considered it necessary to serve enforcement notices requiring an appointment to be made. Our notices were duly complied with.

We received and processed 359 Supervising Engineers' statements. These statements provide progress updates and inform us of any areas of concern. In summary:

- We received 44 notifications of undertakers failing to record water levels and other monitoring activities under section 11 of the Reservoirs Act.
- At nine reservoirs the Supervising Engineer provided a statutory Direction to the undertakers to carry out a regular visual inspection and to provide a report of their findings. On three occasions, the Supervising Engineer felt it necessary to notify us that visual inspections were not completed satisfactorily. These were all rectified within the reporting period.

The number of compliance issues regarding day-to-day monitoring and surveillance reported to us are relatively low compared to the overall volume of work carried out at reservoirs. However, we have identified this as an area where we can see improvements can be made. Supervising Engineers have an important relationship with undertakers and we will work them to identify where we can support their work to make sure these activities are carried out promptly and properly to prevent small problems growing into more significant ones later on.

Inspection

The periodic inspection of a high-risk reservoir must be carried out by an Inspecting Engineer who is independent of the undertaker and who was not the appointed Construction Engineer.

During the two years, we received 52 inspection reports for high-risk reservoirs. Two reservoirs were not inspected within the recommended timeframe. One of these is an orphaned dam with no owner which we are monitoring. However, we cannot legally carry out an inspection using our default step-in powers until the inspection due date has expired. This is a regrettable circumstance where the law is silent on orphan reservoirs.

Nevertheless, we have maintained a close watch on the reservoir and are implementing several measures to increase the safety of the reservoir. We have subsequently arranged for the inspection and throughout the period, we have sought and acted on the advice of the Inspecting Engineer.

The second missed inspection was subject to a delay caused by Covid-19. With the advice and agreement of the Inspecting Engineer we applied a regulatory decision for completion of the inspection by June 2021, which has been completed.

The maximum time between inspections is 10 years. For inspections carried out during this period the average time between inspections is 7½ years.

Measures to be Taken in the Interests of Safety

During an inspection, the Inspecting Engineer may make a recommendation as to measures to be taken in the interests of safety; we call these MITIOS. These recommendations are statutory requirements and the Inspecting Engineer prescribes a timescale within which the MITIOS must be completed.

Overall, there were 320 MITIOS required during the reporting period. Just over half of these (168 or 53%) were for physical works to be undertaken. These measures range in scale from minor repairs and clearance of vegetation, through to complete replacement of spillway structures which may take several years to complete. The other half of measures are as follows:

Investigations	88	(28%)
Design review	40	(13%)
Emergency planning	13	(4%)
Monitoring	10	(3%)
Records	1	(<1%)

At 31 March 2021, 37 MITIOS were overdue at 11 reservoirs. These are listed in the annexe to this report. We have served enforcement notices at five reservoirs requiring the work to be done and investigations remain ongoing at the remaining six reservoirs.

We have reviewed all the MITIOS certified complete within the period. Almost half did not manage to complete within the timeframe prescribed by the Inspecting Engineer. This is clearly inadequate with much room for improvement by undertakers to act more swiftly and by us to regulate more effectively. We are not clear on the cause of the delays and this is something we seek to understand better.

Reservoir maintenance

Where an Inspecting Engineer makes a recommendation for maintenance, the undertaker is obliged to complete this. Maintenance by its nature is ongoing and Supervising Engineers have a duty to provide statements on progress. We recorded a failure to complete maintenance at three reservoirs during the period. The required work has since been completed.

Monitoring and record keeping

Regular inspection to monitor water levels and changes in a reservoir are important. Good record keeping of this provides a long-term view of a reservoir’s behaviour. During the two-year period we recorded 43 occasions where this had not been carried out adequately.

This is normally monitored by the Supervising Engineer, but we have increased the level of scrutiny by us to ensure follow up action is taken by the undertakers.

Registration

We continue to seek out reservoirs which we think have the potential to be large raised reservoirs, but which are not registered. We recorded two offences of a failure to register in the reporting period. One of these has now been registered the other is subject to an ongoing investigation.

The total number of registered reservoirs is shown in Figure 2. The total number of registered large raised reservoirs in Wales 2013-2021.Figure 2.

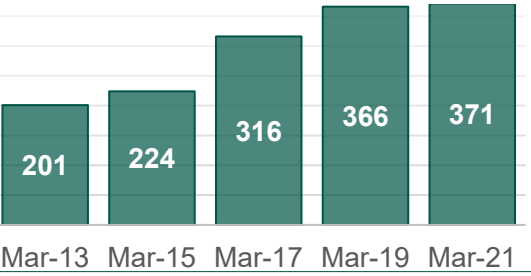

Figure 2. The total number of registered large raised reservoirs in Wales 2013-2021.

Orphan Reservoirs

Where there is no owner, or we cannot identify an owner, we refer to reservoirs as being an orphan reservoir. There are currently two reservoirs in Wales which we consider to be orphans and at each we have taken the following steps using our reserve powers.

- Appointed a Supervising Engineer
- Appointed an Inspecting Engineer
- Committed to the completion of matters to be taken in the interests of safety (MITIOS).

The safety works are substantial and are planned across several years. Expenditure is shown in the table

Table 4. Expenditure at orphan reservoirs over the last two years.

Reservoir	2019-20	2020-21
Cwm Clydach	£214,000	£210,000
Llyn Cae Conroy Upper	£-	£45,000
Annual spend at orphans	**£214,000**	**£255,000**

Future inspections may reveal additional work is needed and we will explore opportunities to lower the level of risk by reducing the volume or decommissioning to reduce the substantial burden of ongoing monitoring and supervision by us.

Our reserve powers under the Reservoirs Act do not include the authority to complete all desirable works, for example, we can complete MITIOS but we have no power to undertake more regular maintenance activities. We have identified opportunities to include some activity within our wider roles under the Water Framework Directive and the Environment Act. For example, remediation and mitigation of mine water pollution carries similar solutions for proper drainage and monitoring as for reservoir safety.

Emergency Plans

In 2019 we undertook a survey to establish the availability of onsite emergency plans. Onsite plans are those plans held by reservoir undertakers to guide their own actions during an incident and do not include plans held by Local Resilience Fora on how the

emergency services will respond. Surveys were sent to the undertakers for 367 large raised reservoirs. We received 209 responses and additional follow up work was undertaken to gain extra information.

Emergency plans at High-Risk Reservoirs

At High-Risk Reservoirs, the survey confirmed 72% had an emergency plan in place. The remaining 28% either failed to respond or confirmed a plan was not written. The reasons provided for not having an emergency plan were given as:

- A plan is in production but not yet complete
- Programmed to be produced, but a lower priority than other activity
- Reservoir still under construction
- Risks covered by other existing procedures
- No recommendation to prepare one and not a statutory requirement
- A lower risk profile.

There is no requirement under the Reservoirs Act 1975 to have an emergency plan. It is reassuring that many High-Risk Reservoirs already had a plan, but also concerning that over a quarter did not. We pursued this through voluntary measures, which increased the availability of emergency plans at High-Risk Reservoirs to 85% at the end of the period.

Emergency plans at other reservoirs

We received information for 59 reservoirs not designated as High-Risk Reservoirs or which were not yet designated. 25 of these reservoirs had an emergency plan, 34 did not.

By 31 March 2021, there were 117 reservoirs where we had not established the presence of an emergency plan. The nil responses and poorer uptake were predominantly with undertakers of privately owned reservoirs. Many of these reservoirs are those which have been registered since 2016 where undertakers may be less familiar and need more advice.

We expect all reservoirs to have an emergency plan which is proportionate to their inherent risk. This need is not enforceable by law and our work through 2021 and onwards will continue to pursue emergency planning through voluntary means. We expect steady progression on this. We will be publishing fresh guidance to support our work and propose emergency planning to be a measure in our proposed performance-based charging scheme. This will focus our regulatory effort where it is needed most and benefit those that adopt sound emergency planning principles.

Future Regulatory Approach

Data presented in this report shows we have maintained a good level of compliance with the Reservoirs Act 1975 across Wales. However, we are seeking to secure more reservoir safety outcomes than provided for in law. We have started to move our focus from traditional compliance to one which will promote reservoir safety more widely.

This change will encompass our duties under the Wellbeing of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016; and further consider the recommendations of Prof. Balmforth arising from his review of reservoir safety.

In 2021 we will develop our vision for what reservoir safety means in Wales and the outcomes we'll seek to achieve in support of that vision.

Prof. Balmforth found that the current reservoir safety regime is well understood but has not kept pace with other high-hazard sectors. He recognises opportunities for better risk management and makes 15 recommendations for modernising the reservoir safety framework. Some of these are complex and will require collaboration with stakeholders outside of Wales to maintain harmony across UK practice. The recommendations include:

- Development of an improved risk-based approach to reservoir safety
- Review of owners' roles and responsibilities
- Review of reservoir engineer availability, responsibilities, and development
- New responsibilities, duties, and powers for regulators
- Review of the legislative framework.

We are working with Dŵr Cymru Welsh Water, Hafren Dyfrdwy and the British Dam Society, as principal stakeholders, to develop:

1. A clear vision and objectives for reservoir safety in Wales
2. A regulatory process which focuses on positive outcomes, not just compliance
3. Improved access to advice, guidance and training.

We will work with Welsh Government to make sure any changes are a benefit to Wales. The recommendations are complex and will require work to assess the impact, the costs, and the best ways of implementing them.

We are reviewing our charging scheme to make our fees more transparent and to recover our costs from undertakers relative to our regulatory activity. We intend to alter our fee structure to reflect differing scales of hazard posed by reservoirs. We also intend develop a tiered scheme to allow lower fees for undertakers who achieve beneficial outcomes, and higher fees for those where we need to regulate more firmly and take more action. Our proposed scheme will be provided to our charge-payers consultative group for comment.

Management of NRW reservoirs

NRW has a dual role, being the enforcement authority and a reservoir undertaker. This poses a potential conflict of interest which we manage by separating our operational and enforcement duties at directorate level. We are required to report on the steps we have taken to observe and comply with the requirements as an undertaker.

We manage 35 large raised reservoirs. These reservoirs have a variety of purposes, principally for flood risk management, conservation and as part of the Welsh Government's Woodland Estate. These are quantified in Table 5 below.

Table 5. The number of reservoirs managed by NRW, showing their primary use and risk designation at 31 March 2021.

Reservoir Status	WGWE	FRM	Conservation	Total
High-Risk Reservoirs	6	11	3	*20*
Reservoirs to be designated in 2021	6	1	4	*11*
Reservoirs not designated as High-Risk	2	1	1	*4*
total	***14***	***13***	***8***	***35***

Our last report set out the challenges experienced by the change in regulatory threshold, from 25,000m^3 to 10,000m^3, with additional reservoirs needing to be managed in

accordance with the 2016 regulations. We have continued this work and several schemes have now been completed or are near completion as described below.

Capital projects

NRW has progressed capital schemes over the last two years to implement essential improvements at several sites. The range of work included construction of a new flood storage reservoir through to major renovation of older reservoirs built over 150 years ago to bring them up to an acceptable modern standard. The scale of these works was substantial and reflected in the expenditure for each year, shown in Table 6 below:

Table 6. Expenditure on capital projects for the last two years

Funding route	**2019-20**	**2020-21**
Non-FRM expenditure	£1.93m	£2.84m
FRM Grant in Aid	£753,000	£883,000
Total annual spend	**£2.68m**	**£3.72m**

Each of these schemes is described below.

Pontarddulais Flood Storage Reservoir

We completed the construction of a reservoir at Graig Merthyr to provide 175,000m^3 flood storage capacity to reduce the extent of flooding in Pontarddulais. We experienced delays following our main contractor going into administration. The first Preliminary Certificate was issued by the Construction Engineer in 2019 marking completion of most elements of construction. A further Preliminary Certificate was issued in January 2021 specifying that the reservoir may be filled to its designed Top Water Level.

Cronfeydd Gwydyr Project

This project achieved restoration of several reservoirs in the Gwydyr forest near Betws-y-Coed, forming part of the Welsh Government Woodland Estate. These 19th century reservoirs were built to power the mining industry of the day. They remained derelict for a century prior to the creation of NRW and the deterioration was extensive. After several years of determined effort, we are proud of the significant improvements made.

- The dams at Cyfty reservoir were strengthened and improved with new inlet and by-pass works, a new spillway and draw-off facility
- A new labyrinth weir spillway and draw-off facility at Llyn Goddionduon
- Llyn Tynymynydd dam strengthening, drainage works and a new spillway.

The large scale of work was hampered when our contractor went into administration. We appointed a new contractor soon after, but the works were delayed, and the project subsequently completed outside the statutory timeframe. We are disappointed by this because the project not only increased safety but also enhances the amenity at this prime visitor location and our failure to meet the deadline does not reflect the effort applied.

Other MITIOS works

Our inspection regime also implemented safety measures at the following reservoirs:

- Pont y Cerbyd – reinforcement of the spillway at this flood storage reservoir
- Hendre Ddu Upper – new drains and V-notch weirs, and reinforcement of the spillway
- Dyffryn Conwy Flood Storage Area – reconstruction of the Whitebarn culvert

- Llyn-yr-Wyth Eidion – re-construction of a fish pass to function as a spillway
- Bwlch Nant-yr-Arian – construction of a new spillway and draw-off facility. Installation of upstream face protection
- New Pool – drainage, re-routing of the spillway and a comprehensive investigation of the outlet. There is a long-term plan at this reservoir with proposed improvements in the design stage with construction anticipated in 2022-23.

Capital investment was also used for surveys, studies and designs for substantial projects at Llyn Tegid, Afon Wydden, Llyn Fuches Las, Pandora, Pen-y-Gwaith, Llyn Llywelyn and Pysgodlyn Mawr. Figure 3 and the accompanying table below illustrate the number of safety measures NRW has completed in recent years.

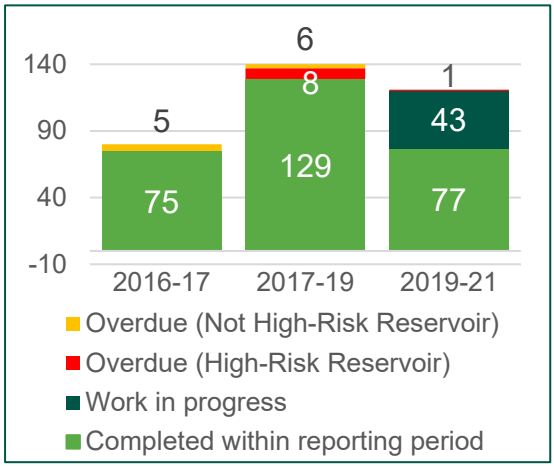

Figure 3. The number of MITIOS carried out at reservoirs managed by NRW.

Status of MITIOS at end of each reporting period	2016-2017	2017-2019	2019-2021
Overdue (Not High-Risk)	5	6	0
Overdue (High-Risk)	0	8	1
Work in progress	0	0	43
Completed within reporting period	75	129	77

Figure 4. Completing improvements at Cyfty North, using stone blocks in preference to concrete where possible.

Discontinuance projects

In our review of reservoirs, we identified several that no longer have a purpose but would require substantial investment to keep safe. We have decommissioned these reservoirs to remove the flood risk:

- Llyn Llaeron and Llyn Ratcoed 2019
- Rhiw Bach Quarry and Hendre Ddu Isaf 2020

A Qualified Civil Engineer has issued the appropriate certificate of discontinuance for all these sites.

Onsite emergency plans

We hold onsite emergency flood plans for all our designated high-risk reservoirs and for two non-statutory reservoirs and for the two ‘orphan’ reservoirs that we are currently monitoring. These plans are reviewed and updated on an annual basis as part of the Supervising Engineer’s examination.

Incident exercises

We held an exercise during September 2020 to test our response to an emergency at one of our reservoirs. This built on previous exercises carried out in 2018 and 2019 to test whether lessons learnt, new training and procedures were properly implemented. It also included adaptation to meet Covid-19 restrictions.

The exercise tested a range of staff from initial call handlers to our external contractors and showed our new procedures had embedded well. We will continue to run training events and are planning further exercises.

Incidents at NRW managed reservoirs

In November 2019, we responded to an incident at one of our reservoirs which involved leakage through an earthen dam whilst water levels were held high by a period of prolonged wet weather. Our onsite flood plan was followed successfully. Other emergency responders were informed but we did not require action by them.

A post incident review was carried out to identify improvements. We also commissioned a full inspection of the reservoir which identified issues attributed to the original design. A project is underway to rectify these with substantial works anticipated to start late in 2021.

Flood mapping, risk assessment and management

With our responsibility for 35 registered reservoirs and many smaller ones, we have taken care to assess the risks to focus our activity. As part of the capital programme for reservoir compliance, we have undertaken several modelling and mapping studies. We have produced reservoir flood maps for Pysgodlyn Mawr, Llyn Fuches Las, Llyn Bowlen & New Pool. Aerial drone surveys have also been carried out at Bwlch Nant-yr-Arian, Pandora, Pen-y-Gwaith, New Pool & Hendre Ddu.

These surveys form the basis for our reservoir portfolio risk register which we review and update every six months to confirm our highest risk sites and target future investment.

Staff training and development

We have an established training programme for our reservoir keepers who monitor and maintain our reservoirs on a regular basis. We have formally trained 83 staff in this role under the tutorship of an All Reservoirs Panel Engineer. Refresher training was provided in July 2019 and further refresher courses are planned.

To ensure we have a core of technically competent staff to whom we entrust the safety of our reservoirs, we have produced a development programme to help aspiring keepers and

engineers work towards becoming reservoir Supervising Engineers. This programme is led by our existing Supervising Engineers and other lead specialists.

Approach and plans for the next two-year period

Our reservoir compliance programme will continue to invest capital funding in the region of £2.5m per year for future improvements which are not covered by a Flood Risk Management budget. Ongoing revenue funding is also needed for supervision, maintenance, and operational requirements.

We have programmed capital projects for six reservoirs in the Welsh Government Woodland Estate which we expect to be designated as high-risk reservoirs. Our four undesignated reservoirs at conservation sites pose a lower risk but some work is expected to keep them in good condition.

At our reservoirs built for flood risk management purposes, major projects are programmed for Llyn Tegid to be delivered before the end 2022. Other FRM schemes are planned for Cowbridge, Afon Wydden, Afon Rhyd Hir, Frampton and Crafnant Loop flood storage areas.

Summary

The safety of Wales' reservoirs is clearly important, and the purpose of our regulation is to provide reassurance to the public that reservoir owners are doing all that could be reasonably expected of them to keep their reservoirs safe.

This report has highlighted the status of compliance with the Reservoirs Act and has drawn attention to those areas where improvements are needed. We have maintained a good level of compliance with principal requirements but need to do more work to understand day-to-day reservoir management issues that may cause small problems to grow. More work is needed by undertakers to ensure maintenance and safety measures are acted on more swiftly and never delayed.

The 2019-21 period has been challenging for all people and businesses responsible for delivering reservoir safety. Wales has uniquely reduced the reservoir capacity threshold to 10,000m^3 and that is now paying dividends by highlighting the inferior safety of these smaller reservoirs. Where these are designated as High-Risk Reservoirs, undertakers need to implement an appropriate safety regime, often for the first time. As the inspections are carried out, we expect a marked increase in number of statutory measures to be taken.

The Toddbrook incident prompted the independent review of reservoir safety. The legacy of this will be felt for some years as we consider and act upon the recommendations from that report. It is undoubtedly a time of change in how we deliver regulation, and this stimulates our wish for a clear vision for what reservoir safety means in Wales. We cannot do that alone and we'll continue to work with principal stakeholders and other UK partners to identify the outcomes we need to achieve beyond legal compliance.

The coronavirus pandemic challenged us to work differently, which we did with good success. A high level of responsibility was shown by many undertakers and by the engineers that support them as they carried out their work under difficult restrictions.

We are very conscious that the diversity of reservoirs and their owners requires differing approaches by us. We are actively moving our approach from one of compliance to one which seeks better outcomes. We have highlighted our first steps in this direction by increasing emergency planning through voluntary measures. Our focus now is on implementing the lessons and understanding gained to drive a clear safety agenda which Wales can be proud of.

Figure 5. Looking through the notch at Llyn Llaeron which was formed to discontinue the reservoir and remove the flood risk. Additional works were undertaken to maintain heritage structures at the site.

Annexe 1

Unresolved breaches of the Reservoirs Act at 31 March 2021

Reservoir	Undertaker	Requirement	Offence	Notice Served	Response
Barlwyd Isaf	JW Greaves & Son Ltd.	S10(6)	MITIOS incomplete by due date	No notice issued	Covid-19 Regulatory Decision applied Completion expected 2021.
Caerphilly Castle Inner Moat	Cadw	S10(6)	MITIOS incomplete by due date	S10(7)(b)	Under investigation
Cwm Clydach	Orphan dam, private landowner, Neath Port Talbot CBC	S10(1) S10(6)	Failing to have a large raised reservoir inspected MITIOS incomplete by due date	S10(7)(a)	Orphan dam. NRW's reserved powers in force. Inspection carried out.
Gwastad Mawr Flood Storage Area	Newport City Council	S10(6)	MITIOS incomplete by due date	S10(7)(b)	Under investigation
Llyn Cae Conroy Upper	Orphan dam	S10(6)	MITIOS incomplete by due date	S10(7)(b)	Orphan dam. NRW's reserved powers in force. MITIOS underway.
Llyn Crafnant	The Crafnant Trust	S10(6)	MITIOS incomplete by due date	No notice issued	Under investigation
Llyn Maen Bras	Rhiwlas Hydroelectric Limited	S10(6)	MITIOS incomplete by due date	No notice issued	Resolved May 2021
New Pool	NRW	S10(6)	MITIOS incomplete by due date	No notice issued	Resolved April 2021
Roath Park Lake	Cardiff Council	S10(6)	MITIOS incomplete by due date	No notice issued	Under investigation
Upper Trebeddrod	Carmarthenshire County Council	S10(6)	MITIOS incomplete by due date	No notice issued	Under investigation
Waun Pond	Private Landowners | Blaenau Gwent CBC	S10(1)	Failing to have a reservoir inspected.	No notice issued	Covid-19 Regulatory Decision applied. Completed June 2021.
Waun-y-Pound Upper	Fragile Limited	S10(6)	MITIOS incomplete by due date	S10(7)(b)	Under investigation

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