

# Don't damn ageing dams

ICOLD has issued an in-depth rebuttal of a recent report which suggests that decommissioning of ageing dams will increase as water storages become more expensive to maintain and pose a greater safety risk



**A REPORT BY THE** United Nations University has said that by 2050, most of the world's population will live downstream of dams operating at or beyond their design life, which could have implications on public safety, escalating maintenance costs, and reservoir sedimentation.

*Ageing Water Infrastructure: An Emerging Global Risk* was published by the Canada-based UNU Institute for Water, Environment and Health (UNU-INWEH) in January 2021. It provides an overview of dam ageing by world region and primary function, along with dam decommissioning or ageing case studies from the US, France, Canada, India, Japan, Zambia, and Zimbabwe.

"This report aims to attract global attention to the creeping issue of ageing water storage infrastructure and stimulate international efforts to deal with this emerging, rising water risk," said co-author Vladimir Smakhtin, Director of UNU-INWEH.

According to the report, most of the 58,700 large dams worldwide were constructed between 1930 and 1970 with a design life of 50 to 100 years, adding that at 50 years a large concrete dam "would most probably begin to express signs of ageing." While acknowledging that dams that are well-designed, constructed, and maintained can "easily" reach 100 years of service, the report authors predict an increase in decommissioning as economic and practical limitations prevent ageing dams from being upgraded, or if their original use is now obsolete.

"Underlined is the fact that the rising frequency and severity of flooding and other extreme environmental events can overwhelm a dam's design limits and accelerate a dam's ageing process. Decisions about decommissioning, therefore, need to be taken in the context of a changing climate," Smakhtin said.

"A few case studies of ageing and decommissioned large dams illustrate the complexity and length of the process that is often necessary to orchestrate the dam

removal safely," co-author and UNU-INWEH Adjunct Professor R. Allen Curry added. "Even removing a small dam requires years (often decades) of continuous expert and public involvement, and lengthy regulatory reviews. With the mass ageing of dams well underway, it is important to develop a framework of protocols that will guide and accelerate the dam removal process."

Decommissioning will also have various positive and negative economic, social, and ecological impacts to be considered in a local and regional context that is "critical to protect the broader, sustainable development objectives for a region," the report says.

## ICOLD responds

On 2 February 2021, President of the International Commission on Large Dams (ICOLD) Michael Rogers issued the following response to the report:

I appreciate the efforts of the authors to contribute to the discussion of the importance of maintaining global infrastructure, especially the critical function of dams and hydropower in modern society. However, "ageing" infrastructure, as characterised in this article and although a familiar soundbite, does a disservice to the real challenges and the benefits of dams in society, and thus the discussions our societies should be having on this important topic. As such, I am concerned that the article will not meet the desired intent to progress the discussion on the management of risks associated with dams.

I believe that the authors of this article attempt to directly link dam risk with decommissioning and removal, as evidenced by the lack of mention regarding the societal benefits of dams. Dams stand head-and-shoulders above all other renewable energy sources by providing society with more than just clean renewable hydropower energy. They can also provide reliable water supplies, flood control, recreation, and an adaptation to climate change like no other renewable

Above: Derwent Dam in Derbyshire, England was built in 1916

with the ability to store water and energy; and not just while the sun shines and the wind blows.

As a representative of our industry, ICOLD has been studying and documenting the state of the practice of dam engineering for more than 90 years. As President, I can relate to you that our industry would characterise the most significant challenges to dams as:

- A rapidly changing natural world that both threatens to make natural events such as floods and earthquakes more frequent and intense, while at the same time placing more demand on those key societal benefits that dams offer such as clean water and clean power.
- Infrastructure which was designed and constructed with the science and engineering of decades past that now require an infusion of investment to address the advancements in our profession for safety and reliability.
- A fundamental disconnect in society regarding how land development behaviour has privatised gains in and around dams, while socialising the losses and risks that invariably come with increasing populations.

So, I submit that the authors have missed the point and that the challenge is not really ageing of dams. Engineering design and construction of dams must be appreciated for its robust nature intrinsic for generations in practice and regulation. Dams are designed, built, carefully supervised, and maintained as an ever indispensable, vital part of our society's critical infrastructure. Careful regulation and a strong professional state of the practice built on global cooperation through ICOLD have shown that dam structures can have a life expectancy of hundreds to thousands of years.

ICOLD exists to facilitate sharing of knowledge and experience so that dams are designed and built with a strong focus on meeting design intent with consideration for resiliency and sustainability for the future. One need only look at the Roman dam near Extremadura in Spain.

Proserpina Dam, which was commissioned back in the 1st century AD, was built to provide water supply to the city of Emerita Augusta. This dam has lasted more than 2000 years serving as a key part of the regional infrastructure to provide clean water to local residents. It shows that with proper engineering, good construction and regular maintenance, the dams that we design and build today can continue to serve people of our world for many, many generations.

It is inaccurate and a gross misunderstanding of the technology of dam design to describe the average life expectancy of a dam to be 50-100 years, as represented in the article. Modern high hazard dams have been designed for extreme events such as "probable maximum" flood and "maximum credible" earthquakes, events which have a probability of one in thousands of years. ICOLD has been a driving force for global cooperation and collaboration in dam safety through publications and regular technical seminars and training. More than just a repository of the World Registry of Dams (WRD) referenced in the UNU-INWEH article, the 104 countries of ICOLD – a United Nations of dam engineering – brings together knowledge and experience without regard to political or geographic boundaries. Through ICOLD's publications of experience and guidelines, the world's population

is better served by those in the profession of dam engineering committed to excellence and safety.

ICOLD's recent World Declaration on Dam Safety reaffirms our industry's commitment to the safe development of dams around the world. The World Declaration touches different areas, including ICOLD's long-term mission and commitment to dam safety considering the changing conditions of dam safety around the world. The declaration addresses the important aspects of dam safety, including structural integrity, surveillance and monitoring, instrumentation, and basic design, and discusses what it means to have a successful dam safety program.

A critical statement in the ICOLD World Declaration is that for the hundreds of thousands of dams of all sizes around the world, we must all do our part in managing risks:

- Owners must take full responsibility for their projects with a regular and routine safety assessments.
- Governments must also do their part to protect those at risk with strong governance and oversight.
- Communities must plan and develop land around critical infrastructure in a responsible and sustainable manner.

The continued use of dams of all sizes must be weighed against their ability to continue to serve a useful purpose related to their design intent and risks for continued operations. Our industry considers decommissioning of dams in context as just one of many risk management strategies, but certainly not the sole means or even primary means of addressing risks as implied in the article.

The cost of dam removal is influenced by many site-specific factors, including treatment of accumulated reservoir sediments, stream restoration, and loss of operational benefits (flood control, water supply, power, recreation, etc.). While there are certainly exceptions, in general the experience of our industry has been that regular refurbishment and good upkeep will be less expensive than dam removal, and more beneficial to society. When these critical risk management decisions are made on dams, multiple criteria are considered, not just economics. Chief among the decision objectives are public safety and the co-equal goals of the environment.

Instead of the ageing of water storage infrastructure, the largest "emerging" risk factor should be the increase in unregulated downstream development without consideration of the corresponding risk escalation. Society has been quick to "privatise development gains and socialise development risks". That is, profits from flood plain development are kept by the developers, while damages from developing



Above: ICOLD President Michael Rogers issued a response to the report by the United Nations University which describes ageing water infrastructure as an emerging global risk. He invited the authors to participate in further conversation



Left: Hoover Dam in the US. The ICOLD President says ageing is not an emerging risk but a long-held, well-documented and understood element of risk that dam engineers consider in the design and construction of all dams

## References

Ageing Water Storage Infrastructure: An Emerging Global Risk by Duminda Perera, Vladimir Smakhtin, Spencer Williams, Taylor North, Allen Curry. January 2021

<https://inweh.unu.edu/ageing-water-storage-infrastructure-an-emerging-global-risk/>

in known flood risk areas are left to insurances and government reimbursement of losses.

There are many strong advocates for increasing safety related investment in dams. For example, the World Bank in just the last few years has invested over US\$1 billion in the Dam Rehabilitation Improvement Program (DRIP) in India. More investment like this is needed around the world, especially in those countries like the US where recognised lack of investment in critical infrastructure has been documented by the American Society of Civil Engineers and others for decades. Unfortunately, only when a bridge collapses; a power grid shuts down; or a dam spillway erodes does the proper (but short-lived) attention be brought to bear on the systemic problems.

I applaud the UNU-INWEH for this publication – any publication – that brings to light the infrastructure challenges of our generation. We should be reminded that: “We are made wise not by the recollection of our past, but by the responsibility for our future.” (George Bernard Shaw).

We owe it to the next generations to take care of what has been given to us so that they may have similar opportunities for success. In a society focused on “green” sustainability, more recognition is needed of the benefits of carbon-clean and renewable hydropower as the world’s largest and most viable market for clean power and water for developed and developing countries and people on our planet. Water is a renewable resource in the hydrologic cycle powered by strong cosmic features – sun, wind, and gravity – that sustains our planet. A strong four-legged chair of water, sun, wind, and gravity can support

a growing global population using the experience gained in a history of good and tragic lessons learned.

Nothing – not man nor the grandest feat of man’s ingenuity – can escape the rigors of time. As stated in the UNU-INWEH article, it is agreeable that “value judgements will determine the fate of many of these large water storage structures.” These value judgements, however, must be informed by science and not passions to remove these silent protectors and servants of citizens in our modern society.

Dams should not be damned for their age or environmental stigma. Science and technology demonstrate that water can work with solar, wind and gravity forces to create a sustainable and environmentally friendly service to meet the basic needs of humankind around the world for clean and reliable sources of water and power, along with the protections of flood control and many other benefits.

In summary, “Ageing” is not an emerging risk in the profession of dam engineers. Rather, it is a long-held, well-documented and understood element of risk that is considered in the design and construction of dams of all sizes.

I invite your representatives to participate in broadening the conversation addressed in the subject article by attending and engaging with our profession at our next Congress in Marseille, France in November 2021, and to recognise the hard work and progress already made in solving these challenges.

We are paying attention to this risk and would welcome your help and contributions. As a representative of the profession, ICOLD remains committed to this vision of Better Dams for a Better World. ●

## Response from report authors

**In a recent letter to ICOLD president Michael F. Rogers, Dr Vladimir Smakhtin, Director, UNU-INWEH, responded to the organisation’s concerns about the report on behalf of the authors:**

It may be important to note from the start that we are neither pro-dam nor anti-dam organisation and we are not trying to position ourselves as any such. Our Institute, as you might have seen on our web site, is a UN think tank on water and focuses on water development issues of global significance. Part of our mandate under our current 5-year strategy is to examine emerging and chronic water-related risks, alerting of the former, and trying to find ways to accelerate the alleviation of the later. It is in this context that our analysis of aging water storage has been undertaken. I am pleased to report that, to date, this study featured in some 280 media stories in almost 50 countries in 13 languages reaching an estimated 1.5 billion readers worldwide. This shows a large interest to the topic, and hence our study did actually “meet the desired intent to progress the discussion on the management of risks associated with dams”.

“Aging” is not a new term, even if it may be seen as incorrect or vague from an engineering perspective. Everything becomes older with time, including infrastructure of any kind. Whether it is 50 or 150 years, time comes when one has to deal with the issue and we better know how then. Our report is based entirely on literature review and available online databases. We therefore have not proposed our own thresholds for dams’ longevity or milestones of their age, and I think we have been quite cautious and clear about this. We also mentioned in the report that a well-engineered, well inspected and maintained structure can last for generations. Yet it would be incorrect however, in our view,

to ignore the fact that dams operate in various socio-political contexts, with variable levels of funding to support maintenance, with different upstream basin conditions and intensity of development and hence they are “ageing” at different paces. With massive spread of dams globally, this is certainly an issue to be aware of, and there is a range of dam stakeholders, beyond engineers, who may not be. One can argue even further that even if a dam is perfectly functional after a 100+ years, it is the changed social/environmental values and/or more affordable with time alternative sources of energy or technologies of water supply that can make it obsolete.

It was not an intention to link dam risks with dam decommissioning / removal. We simply see decommissioning as i) just one way of dealing with a dam that has become obsolete or risky due to age, and ii) a trend that is becoming more pronounced in some regions. We are also well aware of the benefits of dams but discussing those was not the scope of the report – they have been widely discussed elsewhere (as well as dam impacts, for that matter). Overall, while we may have some differences in opinion on the challenges to dams, including on those challenges that you have listed, we largely agree that, as you put it “dams should not be damned for their age or environmental stigma”, and we do not think that our report sends a message that they should. We are indeed pleased to receive your constructive comments and hope that this exchange may lead to some collaboration in the future.