Center for American Progress

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Aging Dams and Clogged Rivers

An Infrastructure Plan for America's Waterways

By Jenny Rowland October 2016

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Introduction and summary

U.S. infrastructure is in bad shape. Across the country, streets marred with potholes, overcrowded airports, and out-of-date school facilities have become the norm. But the United States' failing infrastructure causes more than just commonplace inconveniences. Crumbling infrastructure poses real dangers to Americans' health and safety, as illustrated by the contaminated water system in Flint, Michigan; flooding due to poor storm water drainage systems in Texas and Louisiana; the failing metro system in Washington, D.C.; and blackouts caused by extreme weather and outdated electrical grids in cities across the country.

A new report from the American Society of Civil Engineers, or ASCE, quantifies how the United States' chronic underinvestment in infrastructure—spending only half of what is needed—has created an investment gap that affects the economy, safety, jobs, communities, and health. As infrastructure continues to age without proper investment and upkeep, the costs to maintain and repair it continue to rise over time. The report found that if infrastructure deficiencies are not addressed, it could cost the economy almost $4 trillion in gross domestic product, or GDP, and 2.5 million jobs by 2025.[1] In short, policymakers' short-term cost cuts will cause massive expenses in the long term.

The country's dam infrastructure is not exempt from this underinvestment. With an ASCE grade of a D, the country's nearly two million dams are one of the most pressing infrastructure challenges for safety, the environment, and the economy.[2] While most of these dams were originally built for economic purposes—including to power mills and factories developed during the industrial revolution and for flood and debris control, water storage and irrigation, hydropower, navigation, and recreation—many of their original purposes and benefits have diminished. In fact, many dams are now obsolete, costly, aging, and unsafe.

Despite a recent decrease in dam construction, the country has still built the equivalent of one dam every day since the signing of the Declaration of Independence.[3] These dams range from small embankment dams that are less than 25 feet high to the Hoover Dam, which is several hundred feet high. Most dams were built before the 1980s, and as technologies have improved and knowledge of the environmental impacts of dams has expanded, the need for many of these structures no longer exists. For example, now that there are more efficient ways to irrigate crops and store water, some small dams that were used for industrial factories or to power mills are no longer needed, and dams that are filled with sediment or that reduce fish populations can cost much more to maintain than to remove.[4] It is unsurprising, then, that the country has an abundance of dams that no longer serve the purpose for which they were intended and that are worthy of deliberate removal.

In 2015, for example, government officials in Texas were forced to confront the dangers associated with failing dams in the state when a heavy rain exposed critical safety problems at Lewisville Lake Dam in Dallas. The 60-year-old dam is one of the riskiest in the nation. If it were to fail, it would cover the city of Dallas in 50 feet of water, resulting in significant loss of life.[5] A former U.S. Army Corps of Engineers dam safety coordinator described the potential failure of this dam as "a much bigger magnitude to the Dallas area than Hurricane Katrina was to New Orleans."[6]

Functional or not, the dams that dot the country cannot simply be ignored or forgotten. Indeed, these dams pose a significant safety problem: ASCE classifies nearly 4,000 dams as "deficient."[7] Furthermore, these structures continue to block an estimated 600,000 miles of rivers in the United States.[8] A new analysis by the Center for American Progress for this report demonstrates that dams and reservoirs have modified the flow of 71 percent of Western rivers by length and that Western rivers are 66 percent more fragmented than they would be in their natural state.

This report aims to outline the next phase in federal dam policy and update the values and goals surrounding dam infrastructure and healthy rivers. It offers a few policy solutions:

1. Incentivize the decommissioning and removal of obsolete and unnecessary dams:
    - Include decommissioning and removal as a required option in National Environmental Policy Act, or NEPA, review, as well as in federal dam funding and permitting.
    - Incentivize private capital to work on dam removal.
    - Perform a comprehensive review of federal dams to address safety concerns and determine if they are providing a net benefit to taxpayers.

2. Modernize dams that are beneficial and needed:
    - Fix safety problems through a federal Safe Dams Fund.
    - Add sustainable hydropower, pumped storage, and small hydropower to existing dams where appropriate.
    - Improve dam management and technologies to reduce environmental impact.

Infrastructure problems often do not get the attention and funding that they deserve until they reach the level of disaster. Rather than jumping from crisis to crisis, policymakers should address America's dam infrastructure problem before the safety risks, costs, and environmental damage become worse than they already are.

Overview of the state of America's dam infrastructure

The U.S. Army Corps of Engineer's National Inventory of Dams, or NID, tracks more than 87,000 dams in the United States that fit certain height and storage requirements. The information from the database provides critical information about the general age, safety, ownership, and construction of this infrastructure.

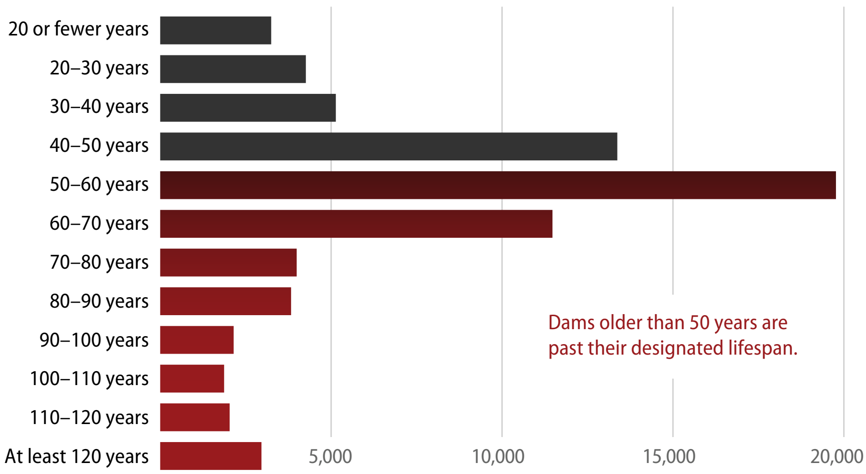
Like much of America's infrastructure, the country's dams are aging. 50 years is considered to be the designated lifespan of most dams, and the ASCE estimates that the average age of the country's dams is 52 years old.[9]

As dams age, physical weaknesses, cracks, rust, and leaks form and require frequent and expensive care to keep them running and safe. With the exception of earthquakes and extreme weather events, age is the leading cause of dam failure.[10]

According to the "completion date" information available in the NID, by 2020, 65 percent of recorded dams will be more than 50 years old. Twenty-seven percent of those dams will be older than 80 years—far past their designated lifespan.[11]

FIGURE 1

Number of dams per age range, by 2020



Source: United States Army Corps of Engineers, "CorpsMap: The National Inventory of Dams," available at http://nid.usace.army.mil/cm_apex/f?p=838:12 (last accessed September 2016).

Because most dams were built before 1980, each year, more dams will reach the end of their productive and safe lifespans.

The Federal Emergency Management Agency, or FEMA, oversees the National Dam Safety Program and the Federal Guidelines for Dam Safety, which were written to encourage both federal and nonfederal dam owners and regulators to employ strict safety standards. The guidelines classify dams under three "hazard potential" levels that define the "degree of adverse incremental consequences of a failure or mis-operation of a dam."[12] Dams are categorized as either low, significant, or high hazard, in increasing order.

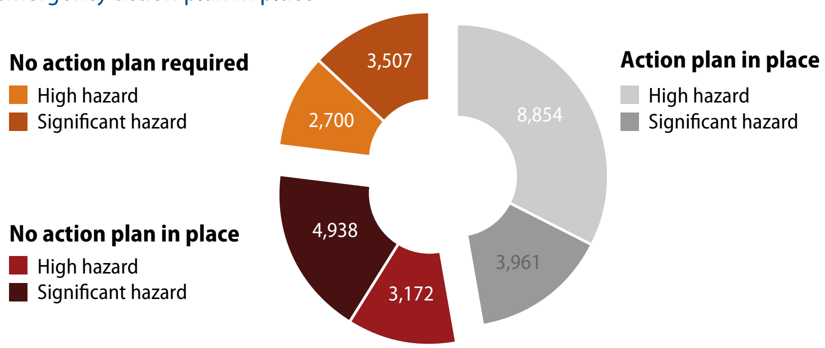
Dams whose failure would likely cause loss of human life are classified as high hazard. Significant hazard classification means that loss of life is not probable, but that the likelihood of economic losses, environmental damage, and disruption of critical facilities necessary for disaster response is high. Low hazard dams are those whose failure would result in low economic and environmental losses, primarily limited to the owner's property.[13] While hazard potentials do not reflect the actual condition of dams, they do give an idea of the danger they would pose if they failed.

While dam failure has not been common, it can be deadly and devastate communities and their surrounding environments. As dams age, failure is expected to become more common, as seen in the deadly 2015 breaching of at least 20 dams in South Carolina.[14] FEMA's dam safety guidelines also include instructions on creating an emergency action plan, or EAP, for use in the event of a dam failure.

FIGURE 2

Emergency action plans of high and significant hazard dams

Less than half of all high and significant hazard dams have an emergency action plan in place



Source: United States Army Corps of Engineers, "CorpsMap: The National Inventory of Dams," available at http://nid.usace.army.mil/cm_apex/f?p=838:12 (last accessed September 2016).

EAPs are critical safety tools that can significantly reduce the risks to life, property, and the environment in the event of a dam failure and are recommended for all high and significant hazard dams.

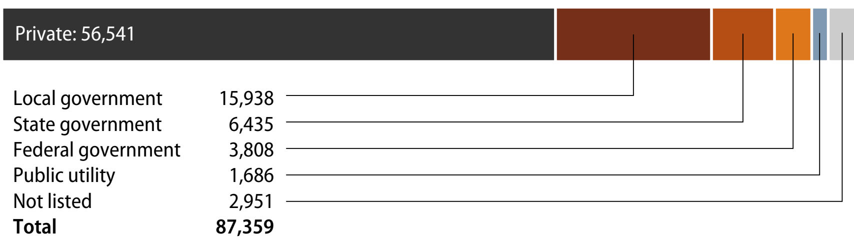
Of the dams listed in the NID, 31 percent are classified as either significant or high hazard. Less than half of those dams have an EAP. (see Figure 2) Although the creation of EAPs has increased significantly in the past 15 years, at least seven states still report that less than half of their high hazard dams have an EAP.[15]

Just as the number of overage dams is rising every year, so is the number of high and significant hazard dams. This is not because more high hazard dams are being built; rather, it is primarily due to "hazard creep": With an area the size of Los Angeles being lost every year to development in the West, rural and urban population sprawl has created new development downstream of many existing dams, putting more people at risk should a dam fail.[16]

Dam owners are ultimately responsible for the safety, upkeep, repair, removal, and liability of their dams, making ownership an important aspect of dam infrastructure. More than 65 percent of U.S. dams are privately owned, followed by 18 percent owned by local governments, 7 percent owned by state governments, and 4 percent owned by the federal government. Others are either not listed or owned by the public utility. Each state is bound to a different set of safety and inspection standards, making it nearly impossible to ensure consistent conditions throughout the nation's aging system of dams.

FIGURE 3

Number of U.S. dams, by ownership



Source: United States Army Corps of Engineers, "CorpsMap: The National Inventory of Dams," available at http://nid.usace.army.mil/cm_apex/f?p=838:12 (last accessed September 2016).

Federal dams are inspected and repaired by the different federal agencies that oversee them, while most of the 95 percent of the nation's state, local, and private dams are inspected by the state in which they are located. Costs for repairs and maintenance are generally borne by the private owner.

While the safety standards for federally owned dams are quite strict, those for dams not federally owned vary by state. A 2008 Congressional Research Service study found serious concerns with states, local governments, and other nonfederal dam owners without sufficient budgets to maintain and rehabilitate their dams.[17] According to the Association of State Dam Safety Officials, the average annual state dam safety budget is about $688,000 with about eight dam inspectors per state. For the average state regulating 1,700 dams, that leaves each inspector overseeing about 200 dams with a budget of less than $500 per dam.[18]

Furthermore, there is not enough federal money available for the repair and removal of nonfederal dams. Various agencies—including the U.S. Fish and Wildlife Service, or USFWS; FEMA; and the Environmental Protection Agency, or EPA—provide only small grants, which can be very specific. FEMA mitigation funding often funds dam repair, but its disaster funding is only available once a dam fails; it does not sponsor general dam rehabilitation.[19]

With their increasing age and cost, the current state of dam infrastructure is poor. Crumbling dams not only pose a safety risk to the communities that surround them—they also pose significant risks to U.S. rivers and wildlife. Dam owners must weigh these upkeep costs against a dam's ecological costs.

Condition of America's rivers

There are few things that cause rivers as much harm as dams. By definition, dams turn rivers into lakes and reservoirs, which has profound ecological implications. They block the movement of water, sediment, fish, and other species, which can harm aquatic habitats, impair water quality, alter recreational opportunities, and degrade river ecosystems.[20]

A new CAP and Conservation Science Partners analysis of dams and reservoirs in the West found that river flow is highly modified and that western rivers are highly fragmented because of dams. As rivers run from their headwaters to the sea, dams and reservoirs impede and alter their flow. In fact, dams have modified the flow of 71 percent of western rivers, by length, compared with their natural flow. In terms of water volume or discharge, 96 percent of streams exhibit flow modification. Flow modification represents the degree of stream flow regulation, calculated as the cumulative volume of reservoir storage by upstream dams relative to a river's unaltered mean annual flow.[21] Altering the natural flow of rivers from dams disorients fish and changes the quality, temperature, and composition of the water. Altered flow regimes are thought to be one of the most serious threats to the sustainability of river systems.[22]

Dams and reservoirs also fragment rivers. The analysis found that rivers are now about two-thirds more fragmented than they would be without dams. The average number of river miles for each continuous, undammed stretch of river network has shrunk to 54 miles from 146 miles in the rivers' natural state.[23]

Two significant environmental threats that dams pose are to wildlife and the climate. By blocking a river, dams can prevent fish movement and migrations and impede the ability of fish to access spawning and foraging habitats. Similarly, dams take a direct toll on shellfish and snails and indirectly affect ecosystems and species that depend on these creatures. The large amounts of sediment and debris trapped behind their walls can also damage river and stream habitats and deprive coastal lands of the sediment needed to sustain beaches and prevent coastal erosion. Large artificial reservoirs also emit methane—a powerful greenhouse gas—as the submerged vegetation within them decays.[24] In a recent study, scientists estimated that artificial reservoirs emit nearly 1.5 percent of global greenhouse gas emissions.[25]

Aquatic wildlife has been impacted in nearly every watershed where dams are present. In New England, the U.S. Fish and Wildlife Service estimates that 91 percent of the migratory fish habitat is blocked by dams.[26] Nationwide, nearly half of the spawning habitat for American shad has been lost to dams.[27] The impacts have been particularly clear in the Pacific Northwest's Columbia River basin, where 130 dams block the river system and salmon and steelhead trout populations are about a tenth of the size that they were before the dams were built. The National Marine Fisheries Service has estimated that the cost of salmon fishery losses due to dams in the basin for the period between 1960 and 1980 alone is $6.5 billion.[28]

In addition to water quality and wildlife issues, dams can also impact water quantity and supply. By exposing a larger surface area of water, dam reservoirs cause more water to be lost to evaporation than moving rivers with natural floodplains.[29] In some cases, this lost water can be significant and pose an important challenge to western riverine systems, which frequently struggle with drought.[30]

Rivers also have important recreational and cultural benefits. Rivers are considered cultural resources, and dams can infringe upon the fishing rights of American Indian and Alaska Native nations. For example, the removal of the Great Works and Veazie dams from Maine's Penobscot River restored vital cultural and natural resources for the Penobscot Indian Nation.[31]

Viewing dams—and rivers—as part of U.S. infrastructure

To properly determine which dams are needed and which should be removed, the United States must better assess and value the benefits of healthy rivers as part of the country's infrastructure system.

The benefits that river systems provide should be valued in much the same way that we value the functions of other infrastructure, including dams. While dams are traditionally valued for providing services such as recreation, irrigation, and flood protection, healthy rivers can provide many similar functions. Properly protected and restored rivers, wetlands, and surrounding forests provide ecosystem services in the form of clean water, wildlife habitats, and recreation opportunities.[32] In some cases, a properly restored floodplain may provide better protection against flooding than a deficient or hazardous dam.[33]

These services provided by natural systems are commonly referred to as ecosystem services. Green infrastructure recognizes these benefits and is "an approach to water management that protects, restores, or mimics the natural water cycle."[34] In addition to restored ecosystems, green infrastructure often also includes tools such as bioswales and porous concrete. Ecosystem services—such as flood risk reduction and water quality improvements—provided by green infrastructure are often more cost effective than traditional gray infrastructure. For example, New York City saved more than $5 billion by investing in the protection and restoration of land within the Catskill/Delaware watershed rather than the construction of a water filtration plant.[35] With the threat of climate change already present and worsening, the country is learning that healthy rivers, wetlands, and coasts are valuable to the U.S. economy and Americans' safety.

Dam removal is one way to efficiently get rid of costly and dangerous gray infrastructure and restore healthy river ecosystems that act as critical local infrastructure.

Case studies of successful dam removal and river restoration

Approximately 1,300 dams have been removed since 1912, and dam removal is often the most effective way to restore a damaged river system.[36] There are many examples of sites where dams have been removed and, consequently, riverine and nearby ecosystems have thrived.

Glines Canyon Dam and Elwha Dam

When the Glines Canyon and Elwha dams were constructed in the early 20th century in Washington state, native salmon and trout species faced major disruptions to their migratory patterns. The dams also prevented the free flow of sediment and flooded sacred native cultural sites. After public backlash, significant tribal input, and the passage of a congressional act, the largest dam removal project in the world to date began in September 2011.[37] With the last of the Glines Canyon Dam removed in 2014, the Elwha River now flows freely and provides salmon and trout with 45 miles of unobstructed river passage. A year after the removal of the Elwha Dam, the largest run of Chinook salmon in decades returned to the river, with 75 percent of spawning fish observed upstream of the former dam site.[38] In fact, overall fish populations are at their highest levels in 30 years.[39]

Great Works Dam and Veazie Dam

Dams were constructed on the Penobscot River in Maine in the early 1900s, obstructing 100 miles of river way and flooding miles of habitat, which prevented the passage of its 11 native sea-running fish species looking to spawn upriver.[40] After a major restoration project—in which the Great Works Dam and the Veazie Dam were removed, in 2012 and 2013 respectively, and a man-made river to bypass another dam was created—the river is coming back to life.[41] Fish stocks—such as the American shad, the alewife, and the Atlantic salmon—are progressively recovering.[42] In fact, the U.S. Fish and Wildlife Service expect the benefits of this restoration to total more than $500 million for the local Maine economy.[43]

Marvel Slab Dam

In 2004, the obsolete Marvel Slab Dam on Alabama's Cahaba River was successfully removed. The dam was about 40 years old, constructed for transporting coal and logging trucks across the river, and posed safety problems for boaters, swimmers, and other recreationists because of the dangerous conditions it caused. The removal project eliminated a public safety hazard by opening 40 miles of the Cahaba River. Ten years of monitoring has revealed the restoration of 60 species of fish, mussels, and snails, including the endangered round rock snail.[44] These recoveries are only a few examples of many exemplifying the resiliency of river ecosystems and the economic benefits that healthy rivers provide communities.

An infrastructure plan for America's waterways

1. Incentivize the decommissioning and removal of obsolete and unnecessary dams

For many obsolete and unnecessary dams, maintenance and repair can be significantly more expensive than removal, with costs only increasing as dams continue to age.[45] Right now, however, there are many barriers and few incentives to decommissioning dams, despite the safety and environmental benefits of their removal.

One of the largest barriers to dam removal is cost. Depending on a dam's size and situation, the cost of removal can vary from tens of thousands to hundreds of millions of dollars.[46] But there are many examples of cost benefit analyses showing removal to be more cost effective than keeping up with structural repairs.[47] A study done by the Massachusetts Department of Fish and Game found that removing the dams included in their study would be 60 percent less expensive than the cost of repairing and maintaining those dams over a period of 30 years.[48] Incentivizing the upfront cost for dam removal is a critical part of reviving American dam policy.

Include decommissioning and removal as a required option in NEPA review and federal dam funding and permitting

Federal agencies are simply not required to consider dam removal when overseeing dam permitting and review processes. By including dam decommissioning as part of their guidelines and criteria, decision-makers in charge of federal programs related to the permitting, review, and funding of dams would be better positioned to fully consider dam removal when taking action.

The Council on Environmental Quality should include dam removal as a reasonable alternative that must be considered for any National Environmental Policy Act assessments and review involving dams, particularly for those greater than 50 years in age. Further, any alternatives that include continued operation of a dam should take into consideration the life expectancy of the dam, including its cumulative effects on sediment, marine fisheries, endangered species, and water quality, as well as mitigation costs and the performance of the dam under a changing climate. Such assessments should also include the impacts on tribal communities, including any treaty-established fishing rights, and the cultural resources linked to river ecosystems.

Numerous existing federal funding programs should be modified to better include dam removal. Funding grants from the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration typically target specific species but do not consider broader ecosystem benefits. Instead of species-specific grants, federal funding should take a more holistic and ecosystem-level approach that looks at the improved ecosystem services resulting from the removal of a dam. Expanding the scope of funding would inevitably lead to some grantees considering dam removal as an option.

Dam removal language should also be incorporated into infrastructure, safety, and disaster grant programs. For example, when dams are destroyed or damaged during storms, Federal Emergency Management Agency, or FEMA, funding frequently requires that dams be repaired to pre-disaster condition rather than considering removal. FEMA pre-disaster mitigation and post-disaster funding programs should be reviewed to prioritize dam removal as an eligible activity.

An October 2015 executive memorandum requiring federal agencies to develop and institutionalize policies that promote formal consideration of ecosystem services into their agencies' planning, investments, and regulatory activities could be used to justify such action.[49] Federal agencies with programmatic responsibilities for America's fleet of dams could fulfill this requirement through better accounting of the ecosystem services generated by healthy rivers in the absence of specific dams. Fully incorporating this into agency missions could provide significant new clarity within the government and for the public on the long-term costs and benefits of dam removal.

Incentivize private capital to work on dam removal

In many cases, dam removal provides the most effective solution for restoring natural river functions and fish populations.[50] To help attract private capital to finance the decommissioning of unneeded dams, the Army Corps of Engineers and the EPA should alleviate permitting complications such as unclear and intensive requirements that are associated with small dam removals under Section 404 of the Clean Water Act and make it easier for mitigation bankers to get restoration credits through dam removal, as explained below.

Section 404 of the Clean Water Act set up the country's most well-established mitigation program as a way to protect natural systems from development projects. The regulations direct the Army Corps and the EPA to require compensatory mitigation for development activities that adversely affect wetlands, streams, and rivers.[51] So if the construction of a road, mine, or building impairs wetlands or a body of water, a developer must provide the restoration or enhancement of an equivalent amount of a similar aquatic resource.[52] Mitigation banking, which provides such restoration and enhancement ahead of development, has flourished in the wake of this regulatory clarity and has proven to be an effective market-based conservation tool to address the loss of wetlands.

There are a few examples of dam removal under Section 404 in North Carolina, South Carolina, Ohio, and Maine, but permitting for dam removal mitigation credits can be a slow and difficult process that includes extra requirements.[53] Because dam removal is not as streamlined or predictable as a typical Section 404 wetlands restoration project, the process of generating credits is not straightforward, and regulations, as they apply to dams, are not clear.[54]

To make the Section 404 program—and other possible mitigation programs—more applicable to dam removal, policymakers need to develop a system that assesses the value of the ecosystem services and other benefits that come from free-flowing rivers. Specific guidance and criteria could be based on past and present protocols used by the Wilmington, North Carolina, and New England districts of the Army Corps of Engineers.[55] In addition, to ensure greater permitting efficiencies, project reviewers should be trained on evaluating dam removal as a mitigation project.

Perform a comprehensive review of federal dams to address safety concerns and determine if they are providing a net benefit to taxpayers

Federal agencies that oversee dams should complete a comprehensive review of all federal dams to identify which need repair, which are no longer serving their intended purpose, and which should be removed. This review would identify unneeded and/or obsolete federal dams and determine if removal would be beneficial to the taxpayer. It would also identify needed dams with structural problems that should be fixed or upgraded. All federal agencies dealing with dams should adhere to the same streamlined process to determine which dams no longer serve their intended purpose and plan to remove them.

One possible example for creating a more streamlined approach to the review, repair, and decommissioning of deficient dams is the Federal Highway Administration's National Bridge Inventory, or NBI. The NBI is primarily used for identifying deficient and obsolete bridges for federal funding purposes.

The NBI is very similar to the Army Corp's National Inventory of Dams in that the inventory contains a variety of information on the country's bridges, including size, inspection date, and location, among other characteristics. Similar to the dam hazard rating, bridges are given a structural evaluation on a scale from 0 to 9—classifying any bridges with scores below 4 as either "structurally deficient" or "functionally obsolete".[56]

To determine if a bridge is qualified to remain in service, the Federal Highway Administration gives a bridge sufficiency rating. The rating is calculated on a percentage scale, with 100 percent being completely sufficient and 0 percent being completely insufficient. The score is based on different percentages of factors: 55 percent for the structural evaluation, 30 percent for the obsolescence of its design, and 15 percent for the importance of the bridge to the public.[57] A sufficiency rating of 80 percent or less is required for federal repair funding, while 50 percent or less is required for federal replacement funding.[58]

Federal dams could use a similar sufficiency rating to determine if dams are in need of repair or if they should be recommended for removal. A dam sufficiency rating would similarly need to take into account a structural analysis, a cost-benefit analysis, its age and obsolescence, and the importance of the dam in providing its intended service. The review should also include an analysis for the possibility of adding sustainable hydro, explained in more detail below. The process would identify federal dams that no longer serve their purpose and where removal may be more beneficial to the taxpayer in the long run. It could also be used as a template for and possibly expanded to nonfederal dam officials to use in the states.

2. Modernize dams that are beneficial and needed

Dams that have been deemed cost effective or needed and those that cannot be removed at this time should be assessed for modernization and upgrades that could help improve the dammed river system. Dam assessments should include basin-scale opportunities to meet public and ecosystem needs through coordinated reservoir upgrades and operations. This will be especially critical as local, regional, and federal agencies look to modernize water infrastructure to mitigate the effects of droughts and floods with a changing climate. These modernizations should focus on fixing safety problems, adding hydroelectric capabilities where appropriate, retrofitting dams with new technology, and improving management to reduce environmental costs.

Fix safety problems through a federal Safe Dams Fund

The problem of deteriorating nonfederal dams also needs to be addressed. A Congressional Research Service study from 2008 identified that one of the barriers to rectifying dam safety issues is that there is "currently no federal policy that describes the conditions under which federal funding is appropriate" for rehabilitation of nonfederal dams.[59]

FEMA's National Dam Safety Program currently provides some funding for training, technical assistance, inspections, and help creating emergency action plans, but the money is not used for dam repair. This is especially important given that the federal government usually has to pay for the cleanup and consequences if a dam fails, costing taxpayers more in the long run. Hundreds of dam failures have occurred throughout U.S. history, resulting in billions of dollars in property damage and more than 3,000 deaths; in the past 10 years, there have been more than 175 failures.[60]

Congress should direct FEMA to start a federal Safe Dams Fund that provides matched grants to state dam safety offices to keep dams safe and properly maintained. This includes fixes to any structural deficiencies or deterioration and appropriate upgrades needed due to changed technical standards or change in hazard potential.[61]

The focus of this program should be on improving the safety of small dams. Although the grant would be administered by FEMA, the focus would be not on rebuilding but on resiliency and safety. This proposed fund is similar to the bipartisan High Hazard Potential Small Dam Safety Act introduced by Sens. Jack Reed (D-RI) and Shelley Moore Capito (R-WV) to provide federal assistance for the repair and removal of nonfederal high hazard dams.[62]

Any project considered for funding should also be required to assess if dam removal, rather than upkeep, is the best option. This will help ensure that funds are not wasted on high hazard or deficient dams that no longer provide benefits substantial enough to justify their continued maintenance. It would also remove the most expensive, dangerous, and environmentally harmful structures.

A financing mechanism should be put in place to pay for the fund through bonding, financing, or other fees paid for by dam owners so that the federal government does not subsidize poor dam maintenance by private owners.

Add sustainable hydropower, pumped storage, and small hydropower to existing dams where appropriate

Of the nearly 2 million dams in the United States, only around 3 percent currently generate hydropower, while the rest—if in operation—are used solely for recreation, flood control, or water storage, among other purposes.[63] Recent modeling by the U.S. Department of Energy for its "Hydropower Vision" report found that hydropower capacity—both generation and storage—could be increased significantly by mid-century.[64] Although the report did not consider the lifecycle costs of dams nor the climate, environmental, or social, costs of dams, the potential for new hydropower on existing dams is significant.

Hydropower is an important component of the U.S. energy mix, but in most cases, it is not carbon neutral, and as this report has explored, dams can have severe impacts on their surrounding ecosystems. In fact, the United Nations does not consider large-scale hydropower to be a renewable energy source, particularly if new dams are created.[65] Depending on size and location, hydroelectric dams in the United States have a lifecycle emission rate in the range of 0.5 to 250 kilograms of carbon dioxide equivalent per megawatt-hour, primarily from facility construction and biomass decomposition from reservoir flooding.[66] A new study estimates that dammed reservoirs worldwide produce as much as 1.5 percent of all human-caused greenhouse gas emissions on a 100-year timescale.[67] While there is still uncertainty in the range of emissions from hydroelectric facilities, the primary source is the buildup of organic matter from the oxygen-deprived layer at the bottom of dam-created reservoirs, which emit significant amounts of methane pollution, a potent greenhouse gas.[68]

Given the environmental and safety costs and concerns involved with dams, policymakers should not expect to obtain significant additional hydropower capacity through the construction of new dams. Instead, policymakers should seek to create low-impact hydropower by improving the efficiency and capacity of existing hydropower dams, examining the feasibility of adding pumped storage hydropower to existing facilities through low-impact design, and exploring options for installing small hydro on existing dams where appropriate.

Pumped storage hydropower acts like a battery by pumping water from a lower reservoir to a higher one for use as stored energy.[69] The storage potential from pumped hydro resources presents an opportunity for bolstering the deployment of wind and solar energy, which have variable electricity outputs, by adding grid stability.[70] The Department of Energy's report modeled the possibility of an additional 36 gigawatts of capacity by 2050 using PSH under a combination of technology and finance scenarios.[71]

So-called small hydro is another option for expanding hydropower with relatively less environmental externalities. Small hydro is small-scale hydroelectric power that generally generates less than 30 megawatts of power as distributed generation. This type of hydro project can be built using existing dam infrastructure. Though small hydro does not produce the same amount of energy as large dams, it tends to have a much lower environmental impact.[72]

In Kansas, for instance, a 2-megawatt small hydroelectric plant that has been operating since 1874 powers 1,800 homes.[73] Similarly, recent Department of Energy grant awardees are developing less environmentally impactful technologies, including Natel Energy, which designed a low-head, low-flow turbine applicable to existing dams or run-of-river sites.[74] These projects—and others like them—help meet energy demands without the impact of large-scale dams that disrupt entire ecosystems.

Reservoir-specific studies and nutrient controls that minimize the amount of organic matter entering a reservoir can also help better measure and slow the amount of methane associated with existing hydroelectric dams.[75]

Policymakers should take advantage of the hydropower capacity that can be developed responsibly and use existing facilities rather than build new dams. Even in the retrofitting of old dams, new hydro capacity should be built with environmental considerations in mind and only when appropriate.

Improve management and technologies to reduce environmental impact

Research has identified technology and management techniques that help preserve the natural flow and function of a dammed river system. When possible, dams that are determined to be necessary should use these types of solutions to minimize negative impacts on the ecosystem. A few examples are detailed below.

Fish passage solutions—such as fish ladders, fish screens, or trap and haul collectors—have been common upgrades to many large dams to help fish continue their migrations.[76] While fish passage structures are often used, they do not always lead to a self-sustaining recovery and fail to address other negative impacts dams have on fish habitat and the river system. When fish passage solutions are used, volitional fish-ways—which help fish migrate around a dam when they are physiologically ready, as opposed to being trapped and hauled or moved through dangerous hydropower turbines—should be prioritized.[77]

Because dams are not the only barriers to fish in rivers, fish and flood friendly culverts and bridges should also be used when possible. New design standards such as stream simulation design are recognized for their ability to maintain aquatic connectivity.[78] They are also more resilient to floods, reducing costs, and improving safety. Massachusetts is one state that has already implemented this standard.[79]

Glen Canyon Dam is one example where the incorporation of new management techniques has helped reduce the impacts of the dam on the river. Because of flow disruption, 90 percent of the sediment that would normally travel through the Colorado River in the Grand Canyon is trapped behind the Glen Canyon Dam. In order to preserve fine sediment and establish habitats for native species, the government partnered with scientists to pilot controlled high-flow releases over the past two decades that simulated seasonal floods.[80] Not only did these high-flow experiments return nutrient-rich sediment downstream to bolster sandbars and shorelines, they also improved habitat conditions, allowing once-strained trout populations to flourish.

These are not long-term solutions to creating healthy rivers, but while dams are still a critical part of American infrastructure, these solutions help to lessen the negative impacts.

Conclusion

America's thousands of aging, abandoned, hazardous, and deficient dams pose critical safety, environmental, and economic problems. Mechanisms should be put in place to improve the safety and productivity of existing and necessary dam infrastructure, as well as to reduce their environmental costs and social and financial liabilities. The decommissioning of dams and the restoration of healthy and productive rivers should be prioritized to deal with this infrastructure crisis before it is too late.

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