

Funding Dam Removals Through Section 404 and Natural Resource Damage Regulatory Compliance

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1. Introduction

The United States has a diverse experience with dam removal. In some places, the motivation for dam removal was migratory fish passage. Opportunities to naturalize riverine flow patterns to support resident fish or improve water quality conditions motivated other removals. In some places, a dam was removed to eliminate a drowning hazard, and in other instances, removing a dam in poor condition was less costly than paying to repair it. However, more often than not, multiple motivations led to removing a dam; these varied depending on whether the dam owner was a private individual, a business, a community association, or a state or local government. The nation's dam removal experience reflects diversity in not only motivations and ownership but also scale and cost, ranging from a few relatively large structures in major rivers to hundreds of small and sometimes partially breached dams (Walls and Gonzales). The cost to remove a dam can be significant. Small dams can cost \$100,000 or more, but larger dams, often those with sediment management requirements, can run well into the millions. The cost to remove the dam itself may only be a small part of the total cost of removal. Project management extends over several years to build public support, obtain dam and landowner agreement, navigate permitting processes, and secure and coordinate multiple funding sources; nongovernmental organizations (NGOs) and staff at resource agencies make direct expenditures and provide in-kind services for project management costs.

This diversity in motivations, ownership scale, and cost understandably has allowed dam removal advocates to draw upon multiple funding sources, often for the same dam. This paper reports on two of the less well-understood sources of funding, both of which involve parties that face regulatory obligations to offset impacts to aquatic environment. These funding sources appear attractive because they do not rely on the dam owner or on payment from federal or state grant programs, which need a revenue source. One possibility is when an individual, business, or agency of government is issued a Section 404 Clean Water Act (CWA) permit to discharge fill material (pollutants) in US waters with a resulting loss of wetlands or stream habitat. The permittee must provide compensatory mitigation that will restore wetland or stream habitat in the watershed where the permit was issued, and funding dam removal may facilitate such restoration.

Another possible funding source is when a “responsible party” (RP) named in a Natural Resources Damage Assessment must compensate for damages (injury) to aquatic resources from an unpermitted discharge of a pollutant (most often a chemical spill). After state or federal agency trustees assess the damage, they decide what aquatic habitat restoration projects will compensate for the damages. The RP is directed to implement that project or to pay for its implementation by others; dam removal might be one of these projects. The use of these funding sources to pay for dam removal and the challenges for expanding the use of these funding sources are the subject of this report.¹

¹ This report includes only as much background material as is needed to understand the potential to fund dam removal through Section 404 permitting and the NRDA process. Extensive discussions of these programs' legal and regulatory structures and processes can be found at numerous places in the literature. An up-to-date source for basic information has been published by The Nature Conservancy (Wilkinson et al., 2017).

2. Dam Removal and Section 404 of the CWA Compensatory Mitigation

2.1. 404 Basics

Section 404 of the CWA is administered by the US Army Corps of Engineers (Corps), subject to Environmental Protection Agency oversight. The basic permitting process can be simply described. A Corps district office² receives an application for a permit to discharge fill material into the jurisdictional waters of the United States (where the CWA applies).³ The application can come from individuals, businesses, or agencies of government, such as a state department of transportation (DOT) or a water supply authority. The applicant is expected to, in sequence, design its project to avoid and then minimize fill discharge to the extent practicable. If fill placement is deemed unavoidable, and the Army Corps of Engineers district office agrees, the discharge will be permitted if the applicant agrees to provide compensatory mitigation. Compensatory mitigation includes restoring, creating, or enhancing wetland or stream habitat of the same types as the lost habitat.⁴ This strict sequencing requirement is a disincentive to seeking a permit, which minimizes the number of permits issued for placing fill material.

Compensatory mitigation is quantified as mitigation credits, which are created by changing the existing hydrology and vegetation in an area that had once been a wetlands or stream riparian area or sometimes an upland, replacing the current condition with a different and desired wetlands or stream riparian habitat type.⁵ The credits can be created on-site, meaning on or near

the place where the fill was permitted, or in a different location (“off-site”). Whether on- or off-site, the number and types of habitat credits created must be certified after review by an **interagency review team (IRT)**.

Certified habitat credits can be used by a permittee as compensatory mitigation for a single permit, or the credits can be banked for future use. A large commercial business with many planned projects may need credits for future permits, or a state DOT can anticipate needing compensation for many permitted fills as it builds and restores highways and bridges. These entities might decide to incur the cost to create credits for a **single-user mitigation bank** (both investing in and obtaining certification for it). A **commercial mitigation banker** invests in creating mitigation credits with the expectation of selling those to Section 404 permittees at a price that will recover costs plus earn a return on investment. If the permittee does not make compensation on-site and is not in the position to create a single-user bank and no commercial seller is available in the area, a fee can be paid in lieu of providing actual credits. **In-lieu fee (ILF)** programs sponsored by a government entity or NGO can accept these payments and the responsibility for meeting the permittee’s compensatory mitigation obligation and then use the accumulated proceeds for credit creation. For ease of exposition, commercial mitigation banks and ILFs will be referred to in this report as “third-party compensatory mitigation.”⁶

Prior to 2008, compensatory mitigation was criticized for widespread mitigation project failures, mostly at projects constructed by permittees on their own property. The failures were attributed to limited information on best practices, limited regulatory oversight of the permittees’ site development, and an absence of long-

- 2 Implementing authority is delegated to each of the Corps’ 45 district offices.
- 3 Discharge of fill material can be permitted by an individual or a general permit (which includes both nationwide and regional general permits). Individual permits are required when the area affected exceeds a threshold, such as ½ acre. General permits cover categories of similar activities and may be specific to a particular entity, such as a DOT.
- 4 In some situations, district offices may accept preservation of habitats that might otherwise be lost over time as mitigation credits.
- 5 Compensatory mitigation for stream impacts is a growing area within compensatory mitigation (Institute for Water Resources 2015).
- 6 There are three parties involved when a permit is issued. Party 1 is the permittee that needs credits to offset impacts of a single permit. Party 2 is the regulatory agency. Party 3 is an entity other than the permittee that creates credits for use as compensatory mitigation. The term “third party” is widely used when describing the 404 process. See **interagency review team**.

term management requirements. An influential 2002 **National Academies of Sciences (NAS) report** described technical and regulatory reforms that would assure successful creation of mitigation credits. In 2008, the Corps issued a **mitigation rule** that accepted the NAS call for a “watershed approach” and allowed Corps districts to certify compensatory mitigation credits anywhere within a HUC8 watershed, called the “service area.” The service area focus would make it possible to choose better sites for creating credits but not allow them to be used in areas far removed from the area of the fill.

The rule also sought to limit the time between the permitted fill and fully functioning compensatory mitigation. Again, following the NAS report, Corps districts would discourage permittees from offering their own compensatory mitigation at the site of the fill. The 2008 rule established regulatory preferences for compensatory mitigation provided in advance, encouraging the use of commercial mitigation credit sellers. In the absence of a commercial seller in a watershed, a payment to an ILF would be accepted as compensatory mitigation.⁷

The rule directed Corps districts to increase regulatory oversight of all compensatory mitigation providers in an effort to increase accountability for credit creation success. Districts were expected to assure that credits were equivalent to the area and type of wetland or riparian habitats lost when the permit was issued (in kind) or knowingly accepted as a substitute for the type of habitat lost (out of kind). District protocols specify wetlands and stream credit types and quantities that can be certified for use as compensatory mitigation. In addition, districts rely on an IRT process to advise on the credits that could be issued at a site. The credit certification process requires both financial assurances posted in case the habitats fail to become fully functional after being used as offsets and legal and financial commitments to long-term site protection and management, to assure that the created credits survive over time. The 2008 mitigation rule and the rationale for its development are context for understanding the challenge of expecting single-user banks, commercial sellers, and ILFs to help pay for dam removal.

2.2. Dam Removal for Creating Compensatory Mitigation Credits

Dam removal facilitates the restoration of riverine hydrologic conditions at a mitigation project site, making it possible to manipulate the hydrology and do more work on the site. Once the dam is removed, water diversion structures might be built elsewhere on the site, along with land contouring, vegetative planting, and exotic plant removal, as needed to create certain number and type of vegetative coverings (wetland or riparian) that could be certified after the IRT process as compensatory mitigation credits.

In September 2018, the Corps headquarters issued a **regulatory guidance letter** on dam removal and mitigation credits: “... the removal of obsolete dams and other obsolete instream structures can be an effective approach to restoring river and stream structure, functions, and dynamics. These restoration activities may be performed by mitigation banks and ILF programs to generate mitigation credits that can be sold or transferred to permittees to fulfill compensatory mitigation requirements...” Notably, specific protocols on how to define stream credits from dam removal were the responsibility of the districts. As discussed earlier, individual Corps districts take headquarters guidance into account, and a decision may be an exception to strict adherence to the guidance when that is technically defensible and supported by stakeholders and the IRT process. One case in the next section includes such an exception.

2.3. Dam Removal and Compensatory Mitigation: Case Stories

The Ohio Department of Transportation (ODOT) develops single-user stream credit mitigation banks to compensate for unavoidable and minor stream habitat impacts. ODOT removed several small dams as part of this effort, until 2005. The Corps district certified the credits based on an approved design and construction plan, and post construction monitoring and reporting of the resulting changes in vegetative

7 The **2008 mitigation rule** and its requirements followed years of policy debate, court rulings, implementing regulations, and guidance documents. For a retrospective, see http://archive.wetlandstudies.com/services/Documents/IWR_mitigation_rule_retrospective.pdf and http://archive.wetlandstudies.com/services/Documents/IWR%20R-03_Factsheet.pdf.

cover was required.⁸ After 2005, ODOT continued to develop single-user banks across the state, but until it fully funded the **Tait dam removal** in 2018, none of these banks involved dam removal. The Tait dam removal had to pass through the IRT process to get certification for the number of credits it would be awarded. The crediting question was how to establish the footprint and area inundated pool of the dam; the stream credits awarded would be based on the delineation of the pool. The **certification process** was completed in 2018, several years after the removal was proposed.

Three dams have been removed in North Carolina, creating stream mitigation credits for a commercial mitigation banker. The first two, in 2005 and 2006, were the Carbondon and Lowell Mill Dams. These removals allowed for credits that were sold to the North Carolina Ecosystem Enhancement Program, a state ILF program that collects payments mainly from the North Carolina DOT. In 2017, after the 2008 mitigation rule, the same company removed the Milburnie Dam on the Neuse River. That experience created disagreements over the number of credits that would be certified from it. As with the Tait Dam in Ohio, the question was how to define the area of influence of the upstream pool. The Corps district began to draft standard operating procedure (SOP) guidance for quantifying the number of credits from a dam removal project. Eventually, after 2010, the Corps ceased work on the draft and stopped approving dam removals for mitigation credit altogether, although the Milburnie removal was completed.

An ILF program collects payments and can use the accumulated funds, after review via the IRT process, to create credits that offset permitted wetlands and stream habitat loss. The ILF program operated by the Nature Conservancy in Virginia, the Virginia Aquatic Resources Trust Fund (VARTF), paid for two dam removals to facilitate hydrologic restoration needed to create credits that would be equivalent to the habitats lost when the permits were issued under the condition that the permittee pay a fee to the ILF. The VARTF was able to claim wetland credits under existing wetland crediting protocols, thus avoiding the challenge of quantifying the stream benefits from a dam removal. There were ancillary improvements to fish habitat, but this was not

the motivation for the dam removal, and improved fish passage did not yield any compensatory mitigation credits.

A Corps district expects the compensatory mitigation to be equivalent to the type of wetland and stream habitats lost to the fill. For example, miles opened up for fish passage may be acknowledged, but these would be categorized as ancillary and would not usually be available to satisfy a 404 compensatory mitigation obligation, although exceptions may be made. The Maryland DOT State Highway Administration (MDOT SHA) paid a share of the \$17 million to remove the Bloede Dam on the Patapsco River. After an extended and costly IRT process, **MDOT SHA's contribution** earned it a specific number of stream restoration credits, many of which were banked for later use. The largest of the other funders was the **National Oceanic and Atmospheric Administration (NOAA)**, which contributed \$9 million, most of it from a **Natural Resource Damage Assessment (NRDA) settlement**; \$750,000 came from an NOAA fish passage program grant. Others included the Maryland Department of Natural Resources, Coca-Cola Foundation, Keurig-Green Mountain, and National Fish and Wildlife Foundation (NFWF) (using Hurricane Sandy disaster relief money). In this case, and in contrast to the VARTF crediting, fish passage benefits created by dam removal were certified for use as compensatory mitigation credits for stream impacts. This decision may have been influenced by the long-standing federal and state resources agencies advocacy for removal of Bloede Dam and the opportunity to engage MDOT SHA in closing the funding gap.

2.4. Funding Partnerships for Dam Removal

The strict Section 404 sequencing requirements minimize the number of permits issued for placing fill material in US waters. Within this demand-constrained setting, single user banks and 3rd party providers must meet regulatory requirements governing the service area where they can be used and the number and type of credits that might be certified. To select a credit

⁸ For example, see <http://web.epa.state.oh.us/dsw/nps/NPSMP/docs/stjohnncasestudy.html>.

creation site that includes a cost for dam removal, a single-user banker, and especially commercial credit sellers and ILFs, must at a minimum know how many credits will be certified. No Corps district that guides that calculation has an SOP. To invest in what can be an expensive project with high project management costs, the same SOP also might need to include acceptances of “out-of-kind” benefits from dam removal (as with the Bloede Dam). Even out-of-kind credits may not be enough to justify a high dam removal cost if the credits cannot be sold outside the HUC 8.⁹

These constraints mean that the prospect of single-user mitigation banks, commercial credit sales, or ILF programs fully funding dam removal will be limited by the regulations and practices governing the administration of the 404 program.¹⁰ Funding partnership arrangements might secure funds from credit providers for dam removal. One possibility would be for advocates of removing a specific dam to assess the potential for the removal to generate compensatory mitigation credits and then identify a single-user banker or third-party provider willing and able to pay a share of the removal cost, in return for credits being certified. The remaining costs would be paid by other sources. A variant of this partnership is for the single-user banker or third-party provider to select a project site that includes dam removal and then seek out other funders to help pay for the costs. In all cases, the allocation of

costs between the mitigation site developer and other partners would be negotiated case by case. However, as is always the case when multiple funding sources pay for dam removal, its advocates will likely bear the significant project management costs of coordinating disparate funding sources, each of which has different missions and rules for accessing and using funds. It is unlikely that a third-party provider is going to accept these costs.

3. Dam Removal for Satisfying NRDA Settlements

3.1. Natural Resources Damage Breaks

When there is an unpermitted release of a pollutant into the aquatic environment, such as a chemical or oil spill at a manufacturing operation or pipeline leak, a responsible party (RP), as defined under different federal and state laws,¹¹ can be required to bear the cost for remedial actions to remove the pollutant or render it harmless in place.¹² For some pollutants, the discharge was legal at the time but has since been deemed an environmental or health concern.¹³ In addition to remediation, the RP will be expected to compensate for any environmental “injury,” defined as the temporary or permanent loss of aquatic life or environmental services

9 The watershed setting also matters. The service area over which certified credits may be used is unlikely to be expanded beyond the HUC 8, a dam in the service area must correspond to locations where mitigation credits can be created, and the dam owner must be amenable to its removal.

10 The Endangered Species Act (ESA) requirements also can be met through compensatory mitigation. The US Fish and Wildlife Service (USFWS) issues “incidental take” permits, and compensation for harm from the permitted action can be secured through payment to a conservation bank or an ILF program. Dam removal at commercial conservation banks or an ILF program might be accepted as compensation, if the take was for an ESA-listed threatened or endangered aquatic species and if dam removal would increase the populations of that species. The conservation banking program structure grew alongside the 404 wetlands banking experience described in this **research report**. The available data on conservation banking do not report any dam removals being used to create conservation bank credits or paid for by ILF programs.

11 State laws can be highly variable. Some piggyback on federal law, and some have their own processes: <https://www.arnoldporter.com/-/media/files/perspectives/publications/2019/07/state-by-state-nrd-guide.pdf?la=en&hash=31A56D761CF7B0D8BE989247B8D43F6B3F5973A2>.

12 **Clean Water Act** (CWA), 33 USC. 1251-1376; and the federal **Oil Pollution Act**.

13 This occurs with PCBs that may be in river sediments and trapped behind a dam. The responsible party (RP) may have assumed the responsibility when it acquired an asset or business that originally released the pollutant. This is the case under the federal “Superfund” program (the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**, as amended, 42 USC. 9601 et seq.; the CWA, 33 USC 1251-1376; and the federal Oil Pollution Act).

(mainly recreational opportunities).¹⁴ Compensation might include removing a dam or contributing to the cost of removal.¹⁵

An NRDA process is managed by federal or state trustees (any agency authorized to secure payment for injuries under federal law). Federal trustees will typically include the NOAA and the US Fish and Wildlife Service (USFWS). Other agencies, such as the National Park Service (NPS), US Department of Agriculture (USDA), and Bureau of Land Management (BLM), can be trustees if the injury affects environmental assets in their area of jurisdiction. States also can designate agencies as trustees under federal law or for state-specific programs.

The trustee responsibility begins with **overseeing an NRDA process** to ensure that the public is compensated for the interim environmental services lost. An injury assessment involves collecting data, reviewing literature, and developing models that can be used to relate the amount and nature of the pollutant to its adverse effect on aquatic life and human uses of the resource. This assessment is used to establish the extent of the injury. Habitat equivalency analysis (HEA) and resource equivalency analysis (REA) are commonly used to estimate ecological losses and to scale restoration. **HEA** estimates the amount of aquatic habitat lost (acres) over the duration of the injury. REA is similar but would estimate the number of particular animals or plants lost from the spill/accident.¹⁶ Often, the injury event can result in diminished recreational services. For instance, a spill or contaminated site on a river may temporarily close a park or close a local recreational fishery. Recreational demand analysis can be used to estimate the type and scale of recreational user days lost or diminished due to the closures.

After the NRDA, the trustee makes a judgment about what constitutes an **adequate compensation**. Trustees evaluate compensatory restoration projects based on several criteria, including but not limited to a close nexus to the type of lost services, cost of restoration project, probability of achieving desired outcomes (efficacy), and measurable restoration results. The trustee process for determining the acceptable offset projects comes from both technical studies and public comment and suggestions for compensation projects for impacts to different resource types (e.g., bird losses, impacts to coastal habitats, losses of human recreational uses). The trustees can require the RP to be responsible for implementation or fund another entity, such as the NFWF or an NGO, to implement the project.

3.2. Dam Removal for Satisfying RPs Compensation Requirements

When a spill causes aquatic species (fish or benthic communities, including mollusks) to suffer mortality, whether briefly or lingeringly, the injury might be offset by dam removals that expand the area of flowing water habitat suitable for the injured species; when migratory species are injured, dam removal expands access to river habitats that had been blocked by the dam.¹⁷ Dam removal also can increase access to whitewater recreation, as an offset to recreational injuries. The dam removal project seeks to create the hydrology and hydraulics characteristic of free-flowing waters in areas that were under the pool and below the dam. The project may also include such additional actions as removing or managing movement of trapped sediment, vegetating or stone armoring some parts of the stream channel to avoid bank erosion, acquiring land to create space for channel meandering, and placing logs or rock features to create riffles.

¹⁴ Consent decrees and supplemental environmental projects are processes under the CWA that are similar to the NRDA process and that might lead to dam removal. Columbus, OH satisfied a supplemental environmental project requirement by contributing to the **removal of the Fifth Avenue dam on the Olentangy River, Akron Ohio** is under a consent decree to deal with CSO and SSO (maybe both) and motivated by the opportunity to **control the costs of a diversion tunnel** by removing dams.

¹⁵ This remedial action requirement can affect a dam owner's willingness to consider removal. A dam may have trapped contaminated sediment, and removal might release that sediment into the larger environment. The owner may resist removal if it will be held responsible for the cost of dealing with that contaminated sediment. In fact, the possibility of contaminated sediment behind the dam causes some owners to simply not even ask about removal. However, if a dam that trapped contaminated sediment is targeted for removal, having an RP with an obligation to extract the sediment can make removal possible.

¹⁶ In some cases, unit replacement value tables are used when an HEA assessment is too expensive.

¹⁷ An alternative to removal is building fish bypass facilities, which an RP might also pay for.

Examples exist across the nation (see next section) of trustee approval of dam removal as compensation for injury, but no compiled database currently tracks how many dams were removed under NRDA, the size or characteristics of the dams, or the NRDA funds made available for dam removal.¹⁸ The next section describes several cases where trustees have accepted dam removal as injury compensation.

3.3. Dam Removal and Compensation: Case Stories

Pennsylvania is a national leader in removal of small dams that no longer serve a useful purpose, and several dams have been removed with NRDA settlement funds. A zinc smelting facility located in the Borough of Palmerton discharged a variety of metal contaminants into the air, land, and water over most of the twentieth century. The discharge resulted in damage to aquatic habitat, biota, and recreational use in the Aquashicola Creek and the Lehigh River (US Department of the Interior et al. 2011). The Superfund trustees (three federal agencies and four state agencies¹⁹) identified dam removal as a way to promote fish passage and a preferred compensation alternative for injuries to aquatic resources and recreational fishing. Final approval of dam removal as an alternative was contingent on securing landowner agreement and a feasibility study that was paid for by settlement funds and grants from NOAA and American Rivers. The feasibility study was completed in 2008. With the removal deemed feasible and the agreements reached, in 2019, 11 years after the settlement agreement, the Klondike Dam on the Leigh River was removed with settlement funds,²⁰ creating two miles of flowing stream habitat and removing a barrier to further shad upstream migration (US Fish and Wildlife Service and the Wildlands Conservancy 2019).

Also in Pennsylvania, in 2005, 100 million gallons of coal ash slurry managed by PPL Martins Creek Steam Electric Station was discharged on land and into Oughoughton Creek and then the Delaware River (Pennsylvania Department of Environmental Protection 2011). The spill resulted in downstream violations in water quality standards for contaminants (such as arsenic) and elevated deposition in sediments. The spill was determined to adversely impact benthic macroinvertebrate and mussel communities. Trustees, led by the Pennsylvania Department of Environmental Protection, identified dam removal as the preferred compensatory restoration alternative.²¹ An HEA analysis was used to quantify the extent of the injury (mussels served as the reference species) and estimate the total miles of aquatic habitat restoration that would need to be created. A number of potential dam removal projects in Pennsylvania and New Jersey were identified, and in 2016, the RP agreed to pay \$902,150 to Pennsylvania for unspecified dam removal projects as a final settlement (PA Media, 2016).

In February 2014, a Duke Power coal ash storage facility failed and spilled 27 million gallons of ash pond water into the Dan River, near Eden, North Carolina; the flow entered Virginia. The trustees found that contaminants in the ash pond water caused injury to fish and other aquatic biota (benthic invertebrates and mussels) in Virginia (Dan River Natural Resource Trustee Council 2020). The spill also closed several public parks next to the river and altered recreational fishing activities due to temporary closures and fish advisories. Removing a retired hydropower dam (25 feet high) on the Pigg River (a tributary to the Dan) was identified as a potential restoration project just months after the spill (US Department of the Interior et al. 2014), after a local nonprofit organization, Friends of the Rivers of Virginia (FORVA) formally submitted this as a compensatory restoration alternative. FORVA, local government

18 This site does not purport to be comprehensive: <https://www.doi.gov/restoration>.

19 USFWS, US Parks Service, NOAA, PA Department of Conservation and Natural Resources, PA Department of Environmental Protection, PA Fish and Boat Commission, and PA Game Commission.

20 The removal project was further justified by a 2013 dam inspection report of the earth dam that found significant deficiencies in its structure and rated it as a high-hazard structure.

21 The NRDA assessment team included the Pennsylvania Fish and Boat Commission, New Jersey Department of Environmental Protection, and Delaware River Basin Commission.

officials, and the FWS had discussed removing the dam for several years before the spill, and at the time of the spill, FORVA owned the dam. In fact, FORVA and state/federal agencies had participated in multiple studies about the consequences of dam removal (sediment contamination, endangered species, etc.) in the early 2010s (Tanger).²² Removal would open up the river to recreational boating, restore aquatic riverine habitat, and support restoration of the endangered log perch. These benefits generally aligned with the damages associated with recreation, habitat, and aquatic biota. Out of a list of more than 20 potential restoration projects identified in 2014, the trustees took advantage of the prior work on dam removal and chose to rank the Pigg dam as the top priority (Tanger 2020). Duke Power provided FORVA approximately \$1 million to remove the dam in 2016 (less than two years after the spill and still several years ahead of a final settlement) and funded five years of post-removal monitoring.

In another location in Virginia, federal and state trustees announced a \$42 million Superfund settlement with Dupont Corporation over historical mercury contamination of the South River (a tributary to Virginia's Shenandoah River). The contamination injured water quality, aquatic biota (fish, invertebrates), terrestrial biota, and river-based recreation over several decades. Unlike the Pigg River and Tinker Creek, few dams in the area have the potential for removal, so that has not been listed as priority compensation project in the 2017 restoration plan and settlement (US Fish and Wildlife Service and Commonwealth of Virginia 2017).

The Holyoke Gas Works, in Massachusetts, discharged coal tar waste to the Connecticut River between 1905 and 1952. A contaminated area on the river bottom was delineated, and the Holyoke Water Power Company, City of Holyoke Gas and Electric Department, and city of Holyoke were named as the RPs and agreed to pay \$345,000 to be used to **restore natural resources**. The trustees identified two priority levels (tiers) for the funds. Level 1 included **removal of the Bartlett Rod Shop Company dam** on Amethyst Brook in **Pelham, MA** and completing construction of the Manhan River fishway. The **Bartlett Rod Shop dam** had no current

value to its owner and was **subject to state-mandated safety repair**. The dam on the Manhan River remained in operation so a fishway was added with settlement funds.

From the 1950s through the 1970s, paper mills in Kalamazoo, Michigan discharged polychlorinated biphenyls (PCBs) to the Kalamazoo River and Portage Creek. An NRDA process under Superfund found injuries to fish, mammals, and birds, leading to human consumption fish advisories. The RP, NCR Corporation, funded the Alcott Street Dam removal in Kalamazoo and an Allegan City Dam repair to include a fish ladder. They considered removing the Allegan City Dam, but the trustees rejected that as an alternative under an **initial settlement**. In December 2019, additional **settlement terms were announced**. The cleanup will cost an estimated \$55 million and will take **three years to complete**. In that time, NRC Corp. is responsible for excavating the contaminated sediment, stabilizing 2.4 miles of riverbank, removing a third dam—Trowbridge Dam—and restoring any areas impacted by the removal efforts.

Releases of acid mine drainage and toxic metals to the Sacramento River watershed from the **Iron Mountain Mine Superfund Site** in northern California triggered an NRDA process that concluded that approximately 20 million fall-run Chinook salmon were killed in the river between 1981 and 1996 and that the public lost the use of 2,024 acres of public land for recreation activities. The trustees were able to secure funds to restore habitat and create recreation opportunities; that included the RP **paying \$11 million to remove the Saeltzer dam in 2000** and add a fish ladder to the Spring Creek Dam. **These actions** were taken to increase the area available for salmon spawning habitat in the Sacramento River watershed and to increase recreational opportunities. Some of the funds were used to reimburse the trustees for the cost of the NRDA process.

New Jersey has a long-standing aggressive approach to seeking NRDA settlements through its Office of Natural Resource Restoration (ONRR). **Settlement funds** have been directed toward many different kinds

²² Many of these studies were paid for by American Electric Power as part of a dam relicensing condition for two power dams in the Roanoke River watershed.

of wetland and riverine restoration projects, including dam removal. In fact, the staff leadership at the New Jersey ONRR has made dam removal a priority use of NRDA funds and used HEA analysis to conclude that it is acceptable compensation for injury. The **staff have found** that dam removal is a readily accepted option among RPs and simultaneously provides immediate and certain ecological benefits to the state. This **emphasis on dam removal**, in a state that has thousands of smaller dams with no current beneficial use, supports a state focus on dam removal as a watershed restoration priority.

The **New Jersey ONRR** lists eight current and past dam removals supported by NRDA funds. The Weston Mill dam on the Millstone River, a tributary of the Raritan River, was removed with settlement funds from an American Cyanamid Superfund site. An industrial site in the Bridgewater Township released hazardous substances for most of twentieth century, causing injury to water quality, riverine sediment, and aquatic resources in the Raritan River and Cuckold's Brook (NOAA et al. 2016). The trustees prioritized restoration alternatives that could enhance or restore habitat of federal fish species of concern, such as migratory American shad, blueback herring, and American eel. Given the effectiveness of dam removal to provide fish passage, the Weston Mill dam was identified a preferred alternative.

The Weston Mill dam removal built on prior removals on the Raritan, also supported by NRDA funds. Three low-head dams on the Raritan (the Calco, Nevius Street, and Robert Street Dams) were removed between 2011 and 2012 from several sites owned by a refining and polymer manufacturer (El Paso Corporation 2009). The three dams opened approximately 10 miles of river to migratory fish species.

3.4. Advocacy for RP Funding of Dam Removal

One recent report concluded that "... NRD may not be a widely available tool for supporting barrier removal projects on a national scale. ... NRD funds are allocated in limited locations and only a subset of these settlements may support dam removal projects."²³ This skepticism about the potential for NRDA funding is based on that report's examination of a select few cases. However, the additional case descriptions here suggest a somewhat more optimistic assessment of NRDA as a funding source. Our insights from these few cases are working hypotheses more than firm conclusions, but we offer the following observations.

First, dam removal, with only limited added investment, can create a free-flowing river to support resident fish populations (some threatened, such as the logperch in VA) or benthic species (primarily mussels) injured by the pollutant. In some cases, removal also will quickly expand access to upstream habitats, which can compensate for injury to migratory species (such as shad and salmon). For this reason, trustees may be open to considering dam removal as an injury compensation project.

Second, NRDA trustees are more inclined to accept dam removal if the dams are small and the area where compensation is needed has several dams to choose from or the dams are in need of repair and provide limited benefits to the owner.²⁴

Third, spills are random events; as a result, so too is NRDA funding for dam removal. Moreover, even if a possible injury and possible RP are identified, the NRDA can be a long and drawn-out process. However, that process can be shortened and dam removal can

23 Wilinson, et. al, 2017 concluded, "NRDA settlements average \$135 million from 2012-2015. Of these settlements, 77% of projects related to injured water resources, and 33% were estimated to impact freshwater stream resources. Applying these percentages, we reached the final estimate of \$34 million. However, because settlements take years to negotiate, and vary widely from year to year, it is difficult to conclude that these dollars are dependably available on an annual basis."

24 When migratory fish passage is the goal of NRDA, but removal is not acceptable to the owner or community, an RP instead might be required to pay for fish bypass. The RPs in Massachusetts and California paid for a dam removal in one location but also for a fish bypass at a different dam.

result if local NGOs (as in Virginia) or state agency staff (as in New Jersey) are positioned to quickly identify possible removals that would address the injury and offer coordinated and effective advocacy to the NRDA process.

4. Conclusion

Section 404 compensatory mitigation and NRDA compliance requirements do not rely on federal or state grant programs, which need funding from a revenue source or the dam owner. The case examples in this paper illustrate these programs providing funding for dam removal in some places and under certain circumstances. However, there are limits to relying on these programs as a significant funding source for dam removal in the future.

Section 404 sequencing discourages placement of fill in waters of the US and in so doing limits the demand for compensatory mitigation credits. In this demand-constrained setting, single-user bankers and third-party providers must meet regulatory requirements that resulted from the decades of policy debate, regulatory refinement, and court rulings that led to the 2008 mitigation rule. That rule means that Corps districts will limit the service area where credits can be used and how many and what type of credits can be certified for use as compensatory mitigation as a result of dam removal. These limits discourage single-user bankers and third-party providers from selecting mitigation project sites that involve removing a dam. What the cases do suggest is that a single-user banker or third-party mitigation provider might participate in a partnership to fund dam removal, if the 404 regulatory process will certify a number and type of compensatory mitigation credits that have value to the credit provider.

NRDA funding can be significant but is location specific. The NRDA process has resulted in funding for dam removal when the trustees concluded that the river habitats and recreational opportunities of a free-flowing river would compensate for the NRDA-determined injury. Persistent advocacy for dam removal as an acceptable form of compensation, whether by one or more of the trustees or by NGOs, may increase consideration of dam removal as acceptable compensation.

In both the 404 and NRDA contexts, advocates for removal of a specific dam should seek out multiple funding sources even if single-user bank, third-party 404 or NRDA funds can be secured. In one case, the aforementioned Bloede Dam in MD, both NRDA funds and payments from MDOT as a single-user mitigation banker contributed to the costs. Removal advocates will need to coordinate disparate funding sources, each which has different missions and rules for accessing and using the funds.

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