Maryland
Dam Removal Guidelines

April 2024

Maryland Department of the Environment

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Maryland
DEPARTMENT OF PLANNING
MARYLAND HISTORICAL TRUST

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EXECUTIVE SUMMARY

Dams, like other critical water infrastructure, require regular maintenance to provide clean and safe water to all Marylanders. As communities age, dams may become obsolete or fall into disrepair whereby their removal can help protect downstream communities and restore aquatic ecosystems. The Departments of Environment (MDE), Natural Resources (DNR), and Planning (MDP) recognize the benefits of dam removal and developed this guidance to assist dam owners, non-governmental organizations, funding agencies, local governments, and other interested parties in navigating the assessment, planning, and regulatory process for removing or modifying dams.

The guidance builds upon a six-step process developed by the State of Georgia for evaluating dam removal projects. These steps include: (1) researching the dam; (2) researching the river and surrounding landscape; (3) understanding the regulatory process; (4) planning and design; (5) implementation/deconstruction; and, (6) post-removal actions. Each dam removal project is unique, can involve multiple stakeholder groups, and requires authorizations or permits from the MDE, as well as other local and federal entities. The overall goal of this guidance is to make dam removals or modifications easier by clarifying the regulatory and resource considerations that project proponents should consider early in their planning process. There is also a section on the unprecedented federal infrastructure funding that Marylanders can leverage to implement priority dam removal projects.

By understanding and anticipating the public safety and environmental factors considered in dam removal projects, project managers and dam owners will be better prepared for the regulatory approval process. It is also important to acknowledge that specific projects, like obsolete dam removals from small ponds in cold water streams, can have both human and resource benefits that simplify decision-making and Departmental approvals. Accordingly, this guidance should not be perceived as a barrier to beneficial dam removal projects, and the Departments will work closely with applicants to efficiently navigate this guidance and assist with project approvals. Links to resources and information that will assist dam owners and project managers early in their planning process are included throughout the guidance so that site-specific considerations and resource trade-offs can be effectively anticipated and addressed.

Early coordination with state and federal permitting agencies through pre-application meetings is strongly encouraged to help applicants receive more timely approvals. Successful dam removal projects will also be assured by working collaboratively with affected property owners and stakeholders during the early planning stages, and by understanding the dam's significance to local communities.

Dam removal and modification projects provide opportunities to restore natural hydrology and ecosystem function to Maryland's waterways while at the same time protecting public safety from aging infrastructure and climate stressors. Maryland's Environment, Natural Resources, and Planning Agencies are available to assist dam owners and project managers through the planning and regulatory approval processes. Working together we can realize the most successful outcomes and benefits of dam removals by connecting with our communities as we are reconnecting our ecosystems.

INTRODUCTION

Throughout history dams of diverse sizes and materials have been constructed for an array of purposes, including generating hydropower, supplying drinking water, flood protection, and recreational use. Over time these structures can fall into disrepair or obsolescence due to changing demographic and economic conditions. Removing or modifying obsolete or unsafe dams can restore aquatic habitat for ecologically or commercially important fisheries, facilitate river and stream recreation, and provide dam owners with a cost-effective option for addressing unsafe, aging infrastructure. According to American Rivers' database on dam removals, over 1,722 dams have been removed in the United States. In 2019 alone, 90 dams were removed reconnecting nearly 1,000 river miles.

This guidance provides dam owners and project managers in Maryland with the information and resources needed to undertake a dam removal or modification project. All such projects have unique aspects, varying complexity depending on the factors driving project initiation and permitting. These factors can include restoration of aquatic life or water quality, improvement of public safety or cost reductions, and/or the protection of endangered species or historic or cultural sites. While many excellent sources of information on dam removal are available, this guidance is specifically intended to address information gathering and the State regulatory and permitting process in Maryland. It provides direct links to the most-up-to-date information on relevant State resources and regulatory agencies.

This guidance provides information and references a stepwise approach to dam removal, encompassing information gathering, permitting, design and removal. Project managers and dam owners should note that moving from concept and planning to actual removal of a dam may not be a linear process. Each of the steps may proceed at different speeds, with many occurring at the same time or in a different order. It is also important to acknowledge that specific projects, like dam removals for small ponds in cold water streams, can have both human and resource benefits that significantly simplify decision-making and Departmental approvals.

Dam removal is a relatively new form of aquatic restoration in Maryland, and experienced consultants and engineers may not be familiar with the associated logistical challenges of these projects. To achieve successful implementation of dam removal projects, it is important to work closely with the regulatory agencies and ensure that the contractor hired to remove the structure works closely with the consulting team designing the project. This will help to ensure that what is "on paper" can be implemented on the ground and in the water. This is important in terms of human safety, habitat considerations, cost, and timing as we look ahead to successfully removing dams in Maryland.

There are ample opportunities to remove obsolete dams that no longer serve a purpose and restore free flowing waters in the U.S. and in Maryland. Over 90,000 large and hazardous dams are identified in the U.S. Army Corps of Engineers' (USACE) National Inventory of Dams (NID) (see Figure 1). There are over 600 dams in Maryland, ranging in height from six to 296 feet. The Dam Safety Program maintains the Maryland Dam Inventory database, and has developed a web map with selected information from the database for use by the public.

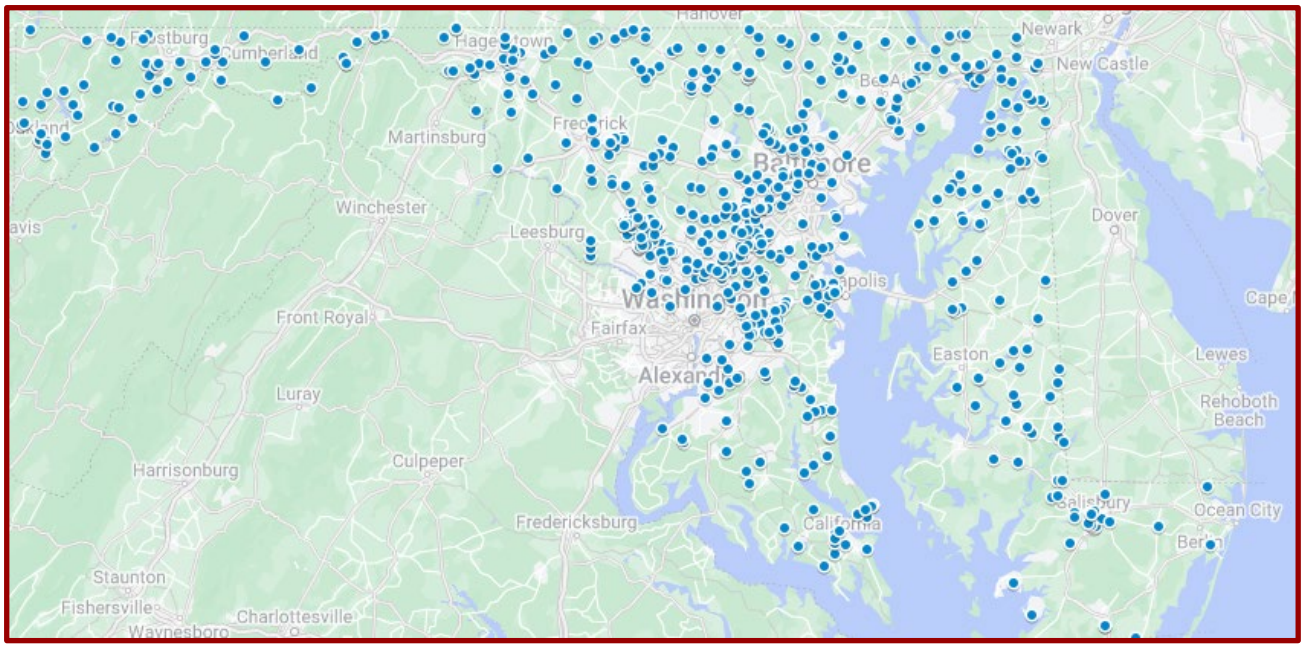


Figure 1: 425 Maryland dams in the U.S. Army Corps of Engineers' (USACE) National Inventory of Dams (NID) database.

In addition, there are many thousands of small dams that do not meet the criteria for inclusion in the Maryland Dam Inventory. There are no natural lakes or ponds in the State of Maryland, so all ponded bodies of water exist due to a dam constructed by man or natural processes (beavers, coastal deposition). Nationally, the number of these dams is estimated to range from 2,000,000 to as many as 2,500,000 (Poff and Hart, 2002). Many of these smaller dams, such as those built to support the early mill economy, are considered obsolete and may no longer serve a functional purpose (Graf, 1993, EPA, 2016).

As outlined in Step 3 (page 19), a dam in Maryland is defined as "any obstruction, wall, or embankment, together with its abutments and appurtenant works, if any, in, along, or across any stream, heretofore or hereafter constructed for the purpose of storing or diverting water or for creating a pool upstream of the dam, as determined by the Dam Safety Program" [COMAR 26.17.04.02]. All dams (and small ponds) are regulated by the state.

Small ponds are defined as those dams that meet the following criteria:

- The contributory drainage area is less than 1 square mile (640 acres);
- The dam is not greater than 20 feet in height measured vertically from the lowest point on the top of the dam to the lowest point on the upstream toe of the dam;
- The pond is classified as a low hazard structure, the failure of which is unlikely to cause loss of life or property damage; and
- The maximum storage volume behind the dam is not greater than 50 acre-feet.

In addition to the information provided in this guidance, project managers and dam owners may find the following resources of value:

- American Rivers' Removing Small Dams, A Basic Guide for Project Managers provides general information for project managers including project management and design, information on potential funding sources, and recommendations on community involvement.
- The Environmental Protection Agency's Frequently Asked Questions on Removal of Obsolete Dams provides information on water quality, Clean Water Act (CWA) permitting requirements, and EPA- related funding sources.
- A wide variety of other state-specific guides are also available with excellent resources, including Massachusetts, New York, Texas, and Vermont

STEP 1: RESEARCH THE DAM

Getting Started

The first step in a dam removal project is to gather information about the dam and think about the purpose and need of the project. The dam's name and address will be helpful for all subsequent steps in the removal process. The Dam Safety Program web map includes layers that serve as excellent resources to help determine the physical address of the dam, or the closest address nearby, as well as the dam's latitude and longitude. The purpose and need for dam removal will vary from project to project and may include a variety of reasons, including:

1. The dam has a combination of marginal benefits and high dam safety risks that would be very expensive to repair. The dam and reservoir no longer fulfill a purpose for the owner;
2. The dam or reservoir presents a hazard to public safety or downstream resources. These include hazards such as falling, tripping, slipping, getting caught in spillway flows, and being an attractive nuisance to children. Because of these hazards, the area may have to be fenced or signed. The reservoir may attract unsupervised swimmers. Boaters may be drowned by going over the spillway;
3. Dam repair, operation, and maintenance costs are prohibitive. By permanently breaching a dam, owners can save on annual maintenance/operating/monitoring costs, inspection and repair costs, as well as the costs to annually exercise and update emergency action plans;
4. A desire to provide landscape scale restoration. Dams are human-made structures and thus are an interruption in the natural landscape. While some dams blend into the surrounding landscape, others are obviously out of place in a natural landscape;
5. A desire to return the stream to its natural free-flowing condition or restore aquatic habitat/connectivity. Removal of the dam allows migration and transport of these organisms between formerly isolated, segmented stream sections. Some organisms (such as fish) travel along the stream during certain times of year and dam removal allows these processes to resume. The Maryland Department of Natural Resources (DNR) has a fish passage page with additional resources, including fish passage goals and prioritization tools. The National Fish Passage Program can also provide professional assistance during planning, design, implementation and post-removal monitoring and should be contacted early in the planning process; and,
6. While dam removals alone do not currently qualify for total maximum daily load (TMDL) nutrient credits, certain restoration actions post dam removal (i.e., stream restoration, wetland creation, or reforestation) do qualify for TMDL credit. More information and Chesapeake Bay Program

approved best management practices can be found HERE. MDE is exploring opportunities to develop a framework for generating credits through dam removal.

When considering removal, the owner must be cognizant that dams may have benefits not immediately apparent. For example, the removal of a dam may result in more frequent/severe downstream flooding. This may necessitate the need for enlargement of hydraulic structures downstream including bridges and culverts or to obtain easements from downstream property owners. Reservoirs also provide aquatic habitat for fish, amphibians, aquatic plants, as well as waterfowl. Some dams may have historical or cultural value. The positive and negative effects of a particular dam/reservoir should be carefully evaluated during the dam removal decision-making process. In certain cases, the function provided by the dam will need to be replaced with an alternative structure.

A significant amount of data and information can be collected upfront by the project manager or dam owner to save costs and time before beginning the permitting process or selecting an engineer to construct the project. As noted throughout the document, the project manager or dam owner should keep an open line of communication with the regulatory and supporting agencies [MDE, DNR, Maryland Historic Trust (MHT), USACE]. This communication will be critical in determining how much information is needed for the federal Clean Water Act (CWA) permitting process. The amount of information needed for permitting and to have sufficient information for removing the dam will vary for each project. The information outlined below may be needed for permitting, as well as to design the removal project and conduct effective outreach.

Determining the Current Dam Ownership

Dam owners have responsibility for maintaining their dam to ensure its structural integrity, the safety of those who recreate on or around the dam, and the liability associated with any potential dam failure. Maintaining dams over a long period of time may cost more when compared to the one-time cost of removal for obsolete dams that no longer serve a purpose. According to the Maryland Dam Safety Program, the “owner” of a dam is anyone who owns any portion of the dam or appurtenant works. It is important to note that all portions of the dam may not be visible due to reservoir levels, and therefore dam ownership may not be obvious. In many cases, land records can be used, along with tax records; however, property boundary surveys may be necessary if ownership cannot be clearly determined from these records.

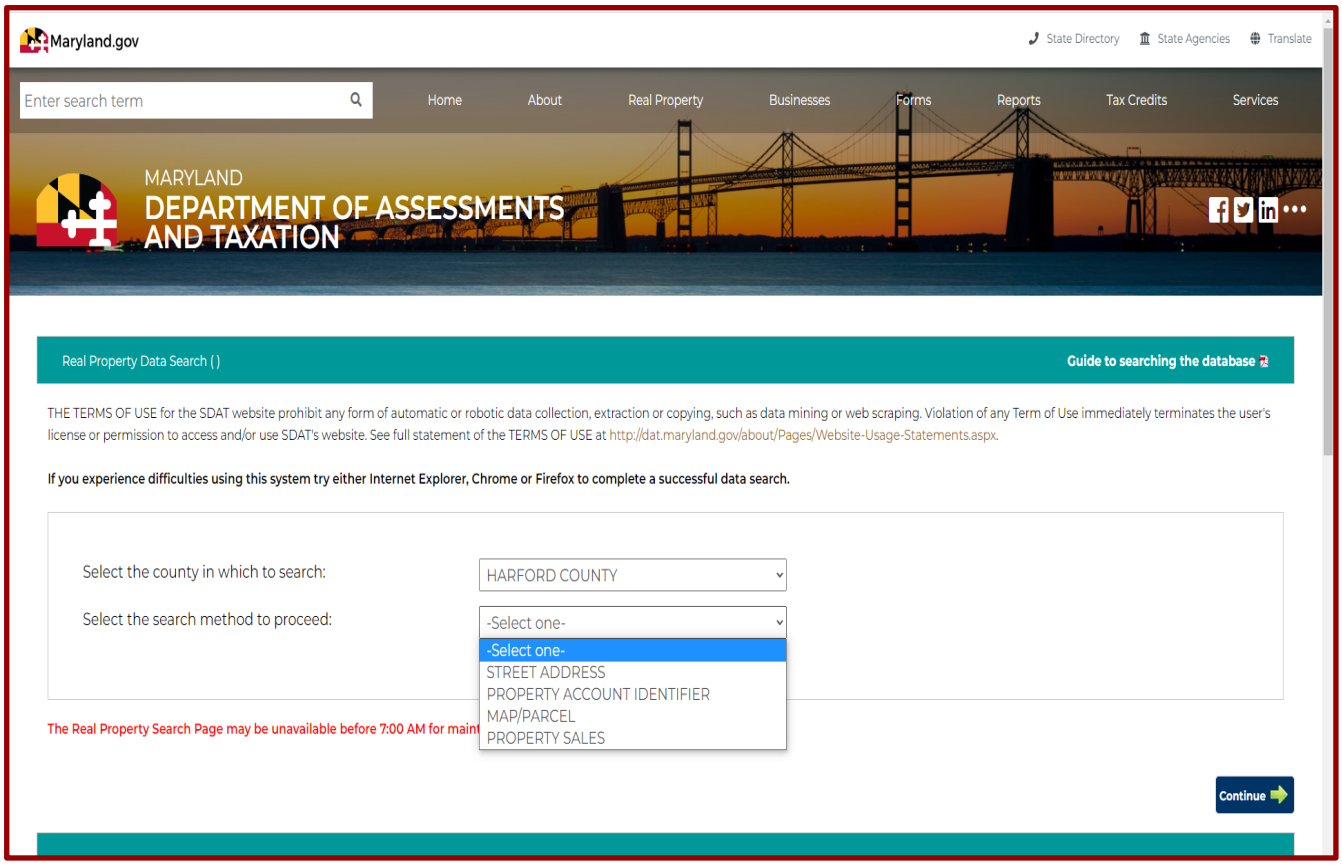


Figure 1.1: Maryland Department of Assessment and Taxation tool for determining dam and property ownership.

In certain cases, the definition of dam owner can extend to the members of a homeowner's association (HOA) or council of unit owners. Where a dam owner(s) is not taking adequate steps to prevent or mitigate a dam failure in an emergency, the Maryland Dam Safety Program can take control of the dam and perform necessary actions to prevent or reduce the harm from an inevitable failure. In such cases, costs incurred by the State will be considered a debt and must be reimbursed by the property owner. Where the dam is owned by an HOA, members of the entire HOA will become responsible for this debt and the State may file a lien to recover costs.

In Maryland, dams are owned by federal, state, or local governments, public utilities, private individuals, HOAs, and private businesses. Approximately 50% of the dams in Maryland are owned by private individuals/entities. In many cases, a dam may be owned by multiple entities.

In addition to determining basic ownership of the dam, project managers will also need to determine:

- Who currently owns the property on either side of the dam?
- Who currently owns land downstream of the dam that could be impacted by its removal?
- What is the current ownership of homes/lands on impounded waters that could be impacted?

Additional resources available to help determine this information in Maryland includes the following:

- If a Dam Safety permit has been issued for a dam after approximately 1990, a "Memorandum of Land Restrictions for Dam or Reservoir" may have been filed with the property records.

- Adjacent property owners/neighbors may provide sources of information for dam ownership.
- Local libraries, historical associations and museums are excellent sources of local information if searching for addresses, latitude/longitude or a dam's name.

Physical Properties of the Dam

Once the dam owner has decided to move ahead with removal, information on the physical construction of the dam and surrounding structures should be collected for the permitting process. The Maryland Dam Safety Program maintains a permanent file on each dam in the state inventory, and is a good place to start research.

Researching the historical background of the dam may provide important information on the original design and materials used to build the dam. Understanding how the dam was built is critical for estimating costs of removal and designing the deconstruction. The following information should be compiled:

- Any existing maps or photographs that show the dam and the surrounding landscape, such as historic aerials, USDA soil maps, topo maps, etc.
- Any existing technical plans on the dam, including 'as-builts' showing construction material.
- Dam dimensions (i.e., height and width)
- Date constructed. If the date of a dam's construction is known but other construction details are lacking, local newspapers may be able to provide additional information about a dam's history.
- Date modified (any significant additions, upgrades, repairs, operation and maintenance history).
- Construction material (e.g., earthen, rock, concrete, fill material inside dam, mixed, etc.).
- Original and current purpose (flood control, hydropower, amenity pond, water supply, etc.).
- Dam type – is water impounded (creating a lake or pond behind the dam) or is the water freely flowing over the dam without causing significant modification of the shape of the river or stream upstream of the dam (known as a run-of-river dam)?
- Ancillary features.
    - Is there a powerhouse, turbines, sluice run, bypass channel, etc.? Are the control structures currently functioning?
    - Do gates still open? Have they been removed? Are panels missing?
    - Is there water passing through the dam?
    - Is there a roadway on the top of the dam?
    - Are there overflow spillways or discharge pipes, or leakage through the dam?
    - Does the normal discharge from the dam spillway or outlet works promote or enhance a cold water thermal regime?
    - Are foliage/trees growing on the dam? If so, what is the size?

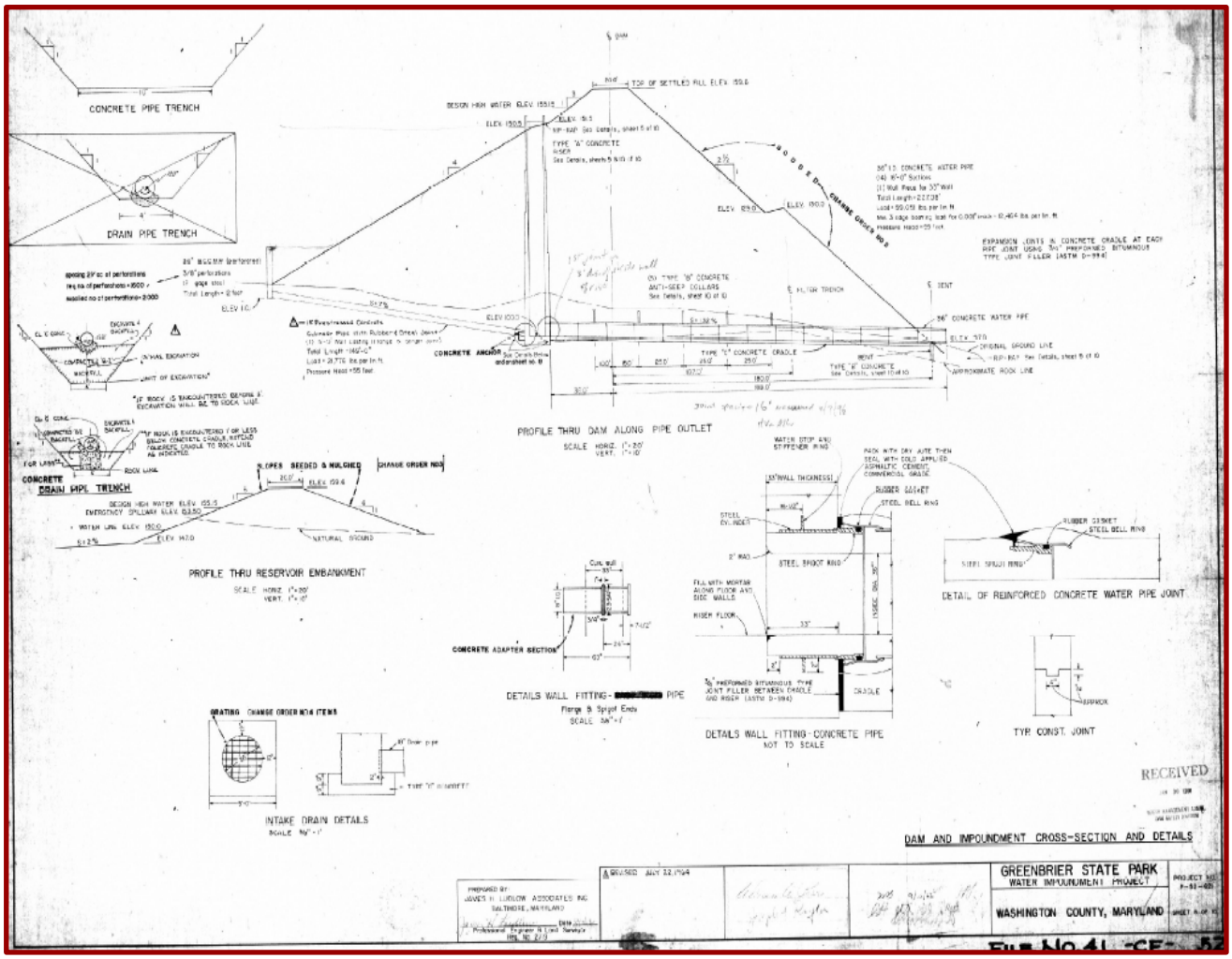


Figure 1.2: Greenbrier State Park Dam Design Drawings from Dam Safety Program Archives.

Public Infrastructure

Removing a dam may impact infrastructure in the area surrounding the dam. A project manager or dam owner should identify public and private infrastructure upstream and downstream of the dam. At a minimum, upstream infrastructure should include the length of any impounded waters, which can be determined by measuring from the top of the dam back to the bed of the river.

- Note approximate distance from dam to bridges, abutments and retaining walls. The National Highway System bridge condition information is a valuable data source, along with the Maryland Department of Transportation, State Highway Administration (MDOT SHA), MDE, and local public works departments.
- Identify roads either on the dam, or those in close proximity, identify road ownership (state, local, private) by contacting the county, municipality, or the MDOT SHA.
- Identify water utility lines (e.g., sewer/stormwater) by contacting local public works departments.
- Identify underground and aerial utility lines such as gas, electric, telecommunications, and cable lines by visual observation and by contacting Miss Utility https://www.missutility.net or call 800-257-7777(MD's Western Shore); 800-441-8355 (MD's Eastern Shore).

- Consult Google Earth to identify land uses, structures, infrastructure and other important features that might not be obvious or visible during a site visit.

Historic Significance of the Dam

Some dams and their associated structures are designated historic properties – defined as any prehistoric or historic district, site, building, structure, or object that is listed on or eligible for listing on the National Register of Historic Places (NRHP). Information on when a dam and associated structures were built, and their historical significance will be needed for the permitting process. Books, historic photographs, maps, and other historical documents can provide details about historical dam ownership, construction, and use. The Maryland Historic Trust (MHT) library and cultural resources files are the best sources of information on historic properties in Maryland. Other sources include the Maryland State Archives, County tax and property records, local libraries, college and university libraries, historical associations, and museums. To begin the process, access the following resources at MHT:

- Check to see if the dam is listed on the Maryland Inventory of Historic Properties (MIHP) and if it is NRHP listed or eligible by searching MHT's online cultural resources files at MEDUSA. Please note that data on archeological sites is only available to qualified, registered users. MEDUSA includes a tutorial that can assist new users in navigating the platform.
- To check to see if the dam has been identified by MDOT as a historic bridge, please see MDOT's photos and map of historic bridges HERE.

If the dam is not listed on the MIHP, check to verify that it is over 50 years old. The Maryland Dam Safety Program should be a first point of contact. If existing records do not note the age of the dam, the following resources may help identify at least a date range within which it was constructed:

- Historic Aerials
- Historical USGS Maps
- Nineteenth century historic maps at atlases: https://historicmapworks.com/Browse/Maps/.
- Maryland's tax assessor records may also include historical information
- Sanborn Fire Insurance Maps for Cities and Large Towns in Maryland

The following resources may also help determine the age of the dam, provide additional information about its history, or identify if it is in a historically important area:

- The Maryland Archives maintains a list of links to statewide resources available online: https://msa.maryland.gov/msa/homepage/html/digital.html.
- Many Maryland communities and counties have a published local history, which may include basic information about the age of a dam and associated properties and identify relevant individuals and/or business interests. These can often be found and accessed digitally via a web search.
- Digital Maryland is a collaboration of the Enoch Pratt Free Library and the Maryland State Library that provides web access to statewide resources.
- The MHT Library in Crownsville is open to the public by appointment. For information on the MHT Library collection and to make an appointment, contact Lara Westwood by email at lara.westwood@maryland.gov, or by phone at (410) 697-9546.

Figure 1.3: Prettyboy Dam under construction. The 7,380-acre Prettyboy Reservoir is owned by the City of Baltimore and was constructed in 1932. Image used with permission from Baltimore City DPW.

Current Regulatory Status of the Dam

All dams in Maryland are regulated by the Maryland Dam Safety Program. The State of Maryland recognized the need to regulate dams in 1931, following a significant drought and dam failures in neighboring states. The Maryland Legislature charged the newly formed Water Resources Commission of Maryland with preparing a report including recommended legislation, which was subsequently enacted in 1933. This original legislation created permit requirements to control the construction and repairs of reservoirs, dams, and waterway obstructions; included provisions for public hearings and the ability to order dam owners to remove a dam if found to be unsafe. This basic legislative intent - to protect public interests and safety and ensure that dams are designed, constructed, and operated in acceptable manners - has remained virtually unchanged through over thirteen modifications to the law.

On a national level, the 1950s through 1970s saw the construction of many thousands of dams, including those that are the most well-known by the public. This era also saw some of the worst modern dam failures including Buffalo Creek (WV) with 125 fatalities, Rapid City (SD) with 237 fatalities, Teton Dam (ID) with eleven fatalities, and Laurel Run Dam (PA) with 40 fatalities. The Kelly Barnes Dam near Toccoa, Georgia, burst on November 6, 1977, after two days of heavy rain, causing 39 fatalities and leaving 60 injured. In response to that tragedy, then-President Jimmy Carter asked the Secretary of the Army to inspect 9,000 dams across the country, an undertaking that led to the creation of the National

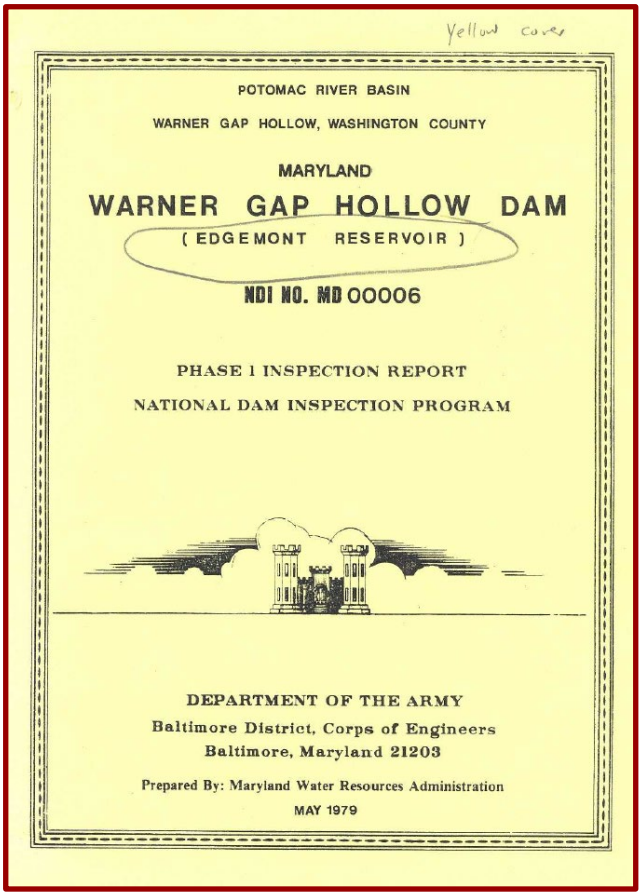
Inventory of Dams and the establishment of the National Dam Safety Program (NDSP). While Maryland had an existing Dam Safety Program at this time, one could argue that the “modern incarnation” of the Dam Safety regulations and program was created in 1978, concurrent with the NDSP Phase 1 Inspection Program.

Section 5-503 of the Environment Article, Annotated Code of Maryland requires that a person proposing to construct, reconstruct, change, or repair any reservoir, dam or waterway obstruction shall obtain a waterway construction permit from MDE. Dams in Maryland are classified by the potential consequences of failure:

- Low Hazard (loss of life is unlikely and damage is limited);
- Significant Hazard (small possibility of loss of life, damage causes property loss and/or interrupts use of public utilities or roads); and
- High Hazard (loss of life is probable, serious damage to structures, important roads, public utilities or railroads)

A subset of low hazard dams that meet the following criteria are referred to as “small ponds”.

- the contributory drainage area is less than 1 square mile (640 acres);
- the dam is not greater than 20 feet in height measured vertically from the lowest point on the top of the dam to the lowest point on the upstream toe of the dam; and,
- the dam can impound no greater than 50 acre-feet of water at the crest elevation;


Yellow cover

POTOMAC RIVER BASIN

WARNER GAP HOLLOW, WASHINGTON COUNTY

MARYLAND

WARNER GAP HOLLOW DAM

(EDGEMONT RESERVOIR)

NDI NO. MD 00006

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

Prepared By: Maryland Water Resources Administration

MAY 1979

Figure 1.4: Secretary of the Army serving under President Carter (1977) inspected 9,000 dams across the country. This led to the creation of the National Inventory of Dams.

In lieu of obtaining a permit from the MDE Dam Safety program, most small ponds may be reviewed and approved by the local Soil Conservation District, or a designee of MDE, provided the small pond meets the minimum standards for safety set forth in MDE rules and regulations.

STEP 2: RESEARCH THE RIVER AND SURROUNDING LANDSCAPE

Researching the river ecosystem and surrounding riparian area around the dam is critical to understanding the potential impact of dam removal. This section also provides information on factors to consider before applying for any dam removal permits.

Basic Description of the Resource

In addition to hard copies of maps of a river and its surrounding landscape, the United States Geological Survey (USGS) National Map Viewer is a good resource for basic information that may be needed for the permitting process. To use this map viewer:

- Zoom in on the topo map to see the official name from the US Geographic Names Information System (GNIS) for a stream or river. Small streams may not have an official name.
- Identify tributaries and see if there are confluences with other major rivers up or downstream.
- Identify the stream by segment description, if necessary; e.g. “from Hwy 110 to the confluence with Big Creek.”
- If a waterbody is impounded, determine if the impoundment has its own name that differs from that of the dam. Many dams can be found in the “Dams” layer, a sublayer within the “Cultural Points” group layer in the “GNIS” layer.
- Turn on the “Watershed Boundary Dataset” layer to obtain a watershed Hydrologic Unit Code (HUC) name and number.
- USGS stream gauge locations are visible in the “Point Event” sublayer within the “National Hydrography Dataset” layer.
- Obtain land cover classifications and topographic/elevation data from various layers.

Other good resources for information about rivers and streams include:

- The Freshwater Network’s Aquatic Barrier Map and DNR’s Fish Passage Prioritization Tool provide information about various aquatic passage barriers, including dams.
- The USGS StreamStats site provides estimated streamflow statistics and various watershed characteristics, including land use.
- The Watershed Resources Registry (WRR) can be used to identify environmental impacts and needs. Refer to the WRR tutorial for more details on using the application for these purposes.

American River’s Removing Small Dams: A Basic Guide for Project Managers (pg. 16) provides an excellent description of a process to complete geomorphological surveys and base mapping, which will be needed to assess hydraulics and sediment. Overall, this guide states that the survey should include:

1. Cross sections of the river and adjacent land, upstream and downstream of the dam.
2. A longitudinal profile of the “thalweg” (i.e., the deepest part of the river channel) through the impoundment, upstream and downstream of the dam.
3. A survey of the depth of soft sediment throughout the impoundment (often described as the “depth of refusal,” or the point where a rod hits a harder surface and cannot easily be pushed further down).

4. A delineation of the resource areas that will be affected, including wetlands, and ordinary high and low water marks. For additional information on wetlands and sediment, see Sections 2.4 and 2.5, respectively.
5. A hydrology and hydraulics (H&H) assessment to assess the magnitude and frequency of flows in the river (including depths, velocity, and scour potential).

Natural Resource, Ecological, and Water Quality Factors to Consider Before Applying for Dam Removal Permits

Dams can serve as barriers to fish migration, contribute heating or cooling to downstream cold water habitats and species that inhabit them, have sediments built up behind them that may be contaminated, provide critical habitat for rare, threatened, or endangered (RTE) species or impact them with removal, or serve as a barrier separating invasive or exotic species from native species. Many times, there are also trade-offs between ecological benefits and impacts of dam removal that should be considered carefully during planning, design, and construction phases of a project. The sections below identify some of the factors that should be considered early in the project development lifecycle to inform dam removal planning, design, construction, and post-removal management needs.

Wetlands: The presence of jurisdictional wetlands regulated under State and Federal law is an important consideration in the regulatory permitting process. Permanent and temporary impacts to nontidal wetlands require State and federal authorization. Additionally, the State of Maryland's Nontidal Wetlands Division (NWD) regulates the nontidal wetland buffer (generally 25-feet but expanded to 100 feet for wetlands of Special State Concern or adjacent to steep slopes or highly erodible soils). When reviewing a project for impacts to nontidal wetlands and/or the nontidal wetland buffer, the NWD considers project purpose and need, alternative site analysis and avoidance and minimization of impacts.

Wetlands may have been present prior to the dam construction, or the construction of the dam may have created wetlands adjacent to the impounded area of the river or stream over time. Dam removal could have direct and immediate effects on any existing wetlands within the project area directly around the dam. Wetlands may have existed on the lowest terraces of the floodplain before impoundment, and removal of the dam could prompt re-establishment of the original wetland community. Alternatively, wetlands created by a dam could be cut off from their water source post-removal, if the river drops back down into its original channel. These wetlands would then have relict hydric soils, (soils that are either permanently or seasonally saturated by water), and the community could eventually revert to an upland.

A wetland specialist should be engaged to identify and map all wetlands that would or could be affected by the project. The MDE Nontidal Wetlands Division may also consider the relative environmental condition and functionality of the wetlands, which means that a functional assessment may also be required. There are various functional assessment methods available, one or more of which may be applicable when used by a qualified wetland specialist.

Sediment Quality and Release: Dams inherently trap and allow sediments to deposit within the impoundment. The release of sediments during a dam removal is a major concern because it can offset gains made by local governments to reduce nutrient loading to the Chesapeake Bay, reduce spawning habitat, suffocate aquatic life, and can release contaminants into the aquatic environment and drinking water sources. Movement of sediment can be especially harmful to species that lack the ability to move from areas affected by sediment accumulation or release (e.g., freshwater mussels, eggs). Development

of a sediment management plan will be required for dam removal projects, the details of which are discussed in Sediment Management Plan section (page 32) of this document.

Tier II High Quality Watersheds: Tier II waters have water quality that is significantly better than the minimum regulatory requirements, as specified in Maryland's water quality standards. Federal and State regulations require special protection of these high-quality waters from degradation. Maryland has 263 Tier II streams designated based on the presence of diverse fish and insect communities that are indicators of healthier water quality. To determine whether a proposed dam removal is in a Tier II watershed, please refer to Maryland's interactive map of designated Tier II waters.

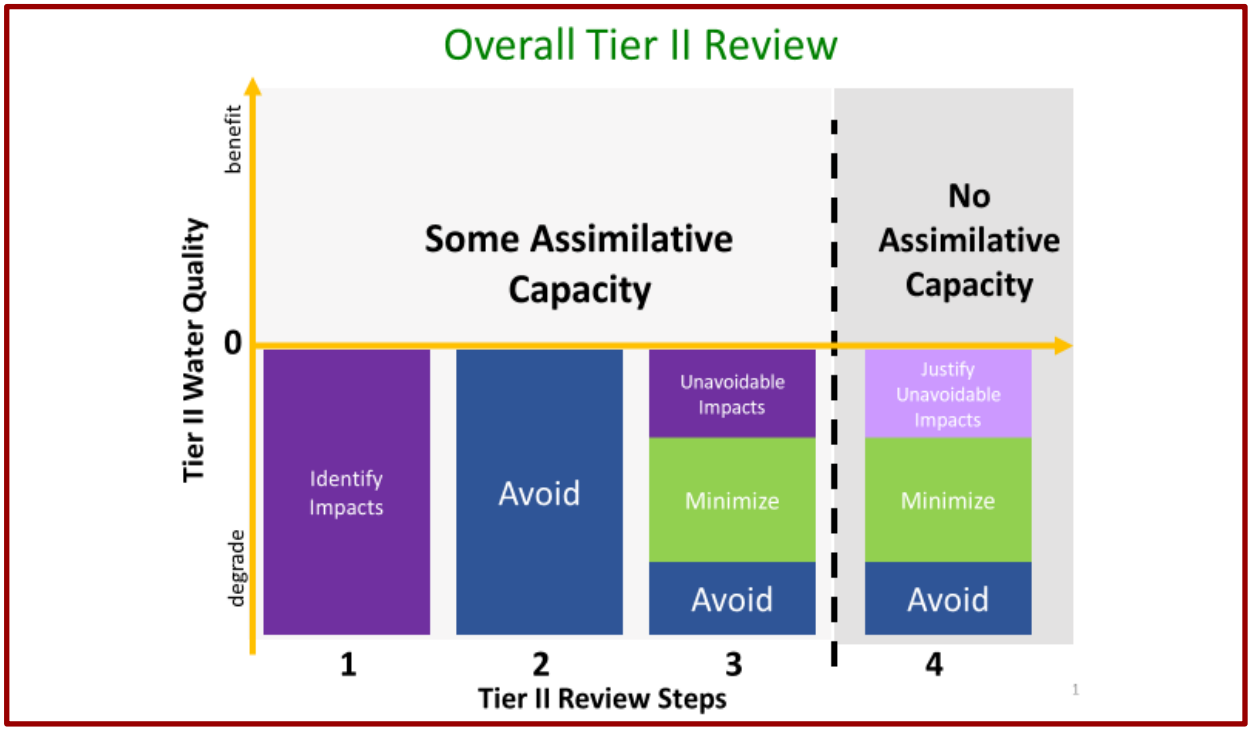


Figure 2.1: General steps in the Tier II antidegradation review process.

Dam removals or modifications in Tier II waters will require an antidegradation review. The purpose of the Tier II antidegradation review is to prevent degradation to high quality waters because of permitted activities. The review process identifies impacts associated with a given regulated activity, and then identifies if there are appropriate alternatives that may avoid these impacts to Tier II waters. If impacts cannot be avoided, then the review identifies reasonable alternatives that may minimize or mitigate impacts within the Tier II watershed. More broadly, the review identifies practices that could be considered along with existing conservation, restoration, and planning activities. More information on Tier II waters and necessary protective design considerations, can be found on the MDE website.

Coldwater/Thermal Impacts: Impoundments increase the surface area and residence time of water causing it to warm to levels that may threaten cold water aquatic species. Dam removal can restore the cold water regime of the existing stream or receiving water body. By improving water temperature conditions, the stream ecosystem may also benefit from improved dissolved oxygen and reduced algal growth.

Removal of inline ponds provides the greatest thermal benefit and is a top priority for DNR. Research by DNR has determined a positive correlation between the number of ponds in a watershed and the mean water temperature in streams of the Piedmont region. This work demonstrated an approximate cumulative 0.15°C increase in stream water temperature per pond. To determine if the impoundment is in a cold water watershed please consult the DNR Coldwater Resources Mapping Tool and look for areas shaded in blue (brook trout), green (brown or rainbow trout), pink (aquatic insects), or peach (stocked trout). For further clarification on whether an existing dam or its removal may impact cold water resources, please contact DNR Freshwater Fisheries Program.

In some limited cases, larger dams have been designed to release water from deep or intermediate gates/valves to enhance or prolong the cold water discharge regime. In those cases, careful consideration must be given to potential adverse effects that dam removal might cause to the existing recreationally important tailwater trout resource.

Migratory Species: Dams act as barriers to fish passage for both migratory (e.g. shad, herring, American eel), and resident (e.g. brook trout, bass, minnows, suckers) species. Removing dams opens up habitat and may increase spawning and reproduction, genetic diversity, and overall abundance. To determine if your dam is a fish passage barrier, please visit the Freshwater Network's Aquatic Barrier Map. You may also contact DNR's Fish Passage Program or reference their Fish Passage Prioritization Tool for additional guidance.

Aquatic Nuisance Species: or invasive species (e.g. flathead catfish, blue catfish, and northern snakeheads) may be present upstream or downstream of an existing dam. Removal of the dam would facilitate up or downstream expansion into the watershed. Maryland has designated several species as invasive and a list can be found on the DNR Website. Invasive species can be present in the water column (e.g. fish), on the bottom (e.g. rusty crayfish, hydrilla, zebra mussels) or attached to surfaces (e.g. didymo, New Zealand mud snail). Thus, it is important to assess the fauna and flora above and below an existing dam to document the presence of invasive species and determine the overall risk of expansion and/or ecological damage that may result. If harmful invasive species are present and subsequent barrier removal may cause additional harm to RTE, native, or recreationally important species, then removal must be carefully considered by the approval agencies based on case specific benefits and potential negative impacts. Contact DNR's Freshwater Fisheries Program for more local assistance.

Rare Threatened and Endangered (RTE) Species: Existing dams, especially those with impoundments that have accumulated significant amounts of sediment and function as more of a wetland, may provide habitat for certain State Listed RTE Species. Furthermore, a dam may serve as a barrier in preventing predatory or invasive species movement up or down stream which may be detrimental to RTE species. A site fauna and flora assessment should be completed, reviewed, and approved by DNR's Resource Assessment Service, Freshwater Fisheries, and Wildlife and Heritage Service. If RTE species are determined to be present and affected by the dam removal, stricter measures must be implemented to ensure minimal impacts and may include such options as;

- Species specific time-of-year (TOY) restrictions
- Habitat mitigation to replace what may be lost
- Collection and translocation of species to suitable habitat

Freshwater Mussels: Removal of dams may provide a myriad of benefits to mussel populations. Opening passage to fish species that serve as mussel hosts may permit range expansion and access to suitable habitats upstream. It may also improve genetic diversity of the existing population by allowing downstream mussel populations to reproduce with those upstream.

In some cases, particularly in larger riverine systems where downstream habitat has stabilized from a dam, a removal may have negative impacts during and after removal. This is more common in older mill dams that have accumulated materials and reached an equilibrium with occupied mussels, particularly those species with Centrarchid hosts (e.g. Unicorn Lake and Northern Lance). Additionally, dam blockages can inadvertently concentrate mussel host fish, resulting in hot spots of reproduction. Dams may also improve food supply for mussels via warming water temperatures and increased algal production. These positive benefits to mussels, owed to impoundments, are typically the exception rather than the norm and depend on both location and ecological function, which is determined on a case-by-case basis. This is especially true when the dam in question is directly up or downstream of a RTE mussel species.
For biological descriptions and range information please consult the Maryland Bivalve Manual or contact the DNR Natural Heritage Program.

Time of Year Restrictions: Project and construction scheduling must plan for instream construction closure periods to protect the aquatic habitat based upon the designated uses of the waterbody where the dam is located. Designated use maps can be found HERE.

- Instream construction in Use I waters is prohibited between the dates of March 1st and June 15th, inclusive, of each calendar year.
- Instream construction in Use II waters is prohibited between the following dates of each calendar year:
    - SAV Closure: 4/15 to 9/15 or 4/15 to 10/15
    - Ruppia Closure: 4/15 to 10/14
    - Fish Closure: 2/15 to 6/15 or 3/1 to 6/15
    - Oysters Closure: 12/15 to 3/31 or 6/1 to 9/30 for spat
    - Turtles Closure: 2/16 to 9/30
    - Historic Waterfowl Closure: 11/15 to 3/1
- Instream construction in Use III waters is prohibited between the dates of October 1st and April 30th, inclusive, of each calendar year.
- Instream construction in Use IV waters is prohibited between the dates of March 1st and May 31st, inclusive, of each calendar year.

Forest Resources: Removal of native trees for dam removal projects should be avoided to the maximum extent possible. Trees and forests provide necessary functions for aquatic resource health such as; nutrient inputs, habitat formation, water infiltration to reduce flooding, and canopy shading to keep water temperatures cool. Trees also provide carbon sequestration and cooling to help mitigate climate warming. However, sometimes tree removal to provide access for heavy equipment may be necessary to complete work. In this case, the amount of forest cover that is removed should be minimized.

Public Safety, Water Quality Treatment, Cultural and Recreational Factors to Consider Before Applying for Dam Removal Permits

Dams provide many important services to the public, including flood control and hydroelectric power, recreational assets for fishing and boating, or structures of historical or cultural significance. Researching these human aspects that dams provide is important for understanding the dams value and function for local individuals and communities, and what outreach is appropriate, before getting too far down the road with a particular removal effort or modification.

Flood Control and Water Quality Treatment: Since dams are typically designed to hold back water, their removal can reduce water quality treatment for stormwater runoff or change water surface elevations downstream that can potentially result in increased flood risks. During the permitting process, agency staff will conduct a detailed review of these potential impacts, so preparing for this assessment early in the project planning phase is advisable.

Many existing dams were constructed or modified for the purpose of providing flood control for downstream property. Local and state stormwater and flood management agencies may have information about the existing structure and its water quality treatment or flood control benefits. MDE hosts the StormwaterPrint web application where known stormwater management structures are mapped and characterized. The applicant may also consider contacting the Maryland Dam Safety Program, the local soil conservation district, or the local public works department for more information on stormwater management structures.

In addition, the Federal Emergency Management Agency (FEMA) creates flood hazard maps that outline some of the flood risk areas in municipalities around the country. As a starting point, you can search for FEMA flood mapping information using the dams address on the Maryland Flood Risk Application website. This can provide a helpful initial screening of FEMA flood zone areas above and below the dam that may require fuller assessment during the permitting process. Many local jurisdictions have also mapped local flood risk areas and may have this information posted online.

Historic/Cultural Resources: Removal of a dam may affect historic properties, including significant archaeological sites and historic districts, that are located within or near the project limits. Effects can be through direct impact to a historic property or through character altering changes in their setting and landscape. When a historic dam must be removed, the adverse effect can be resolved through consultation with MHT and other interested parties as well as through activities to record the affected historic property and interpret its story to the public.

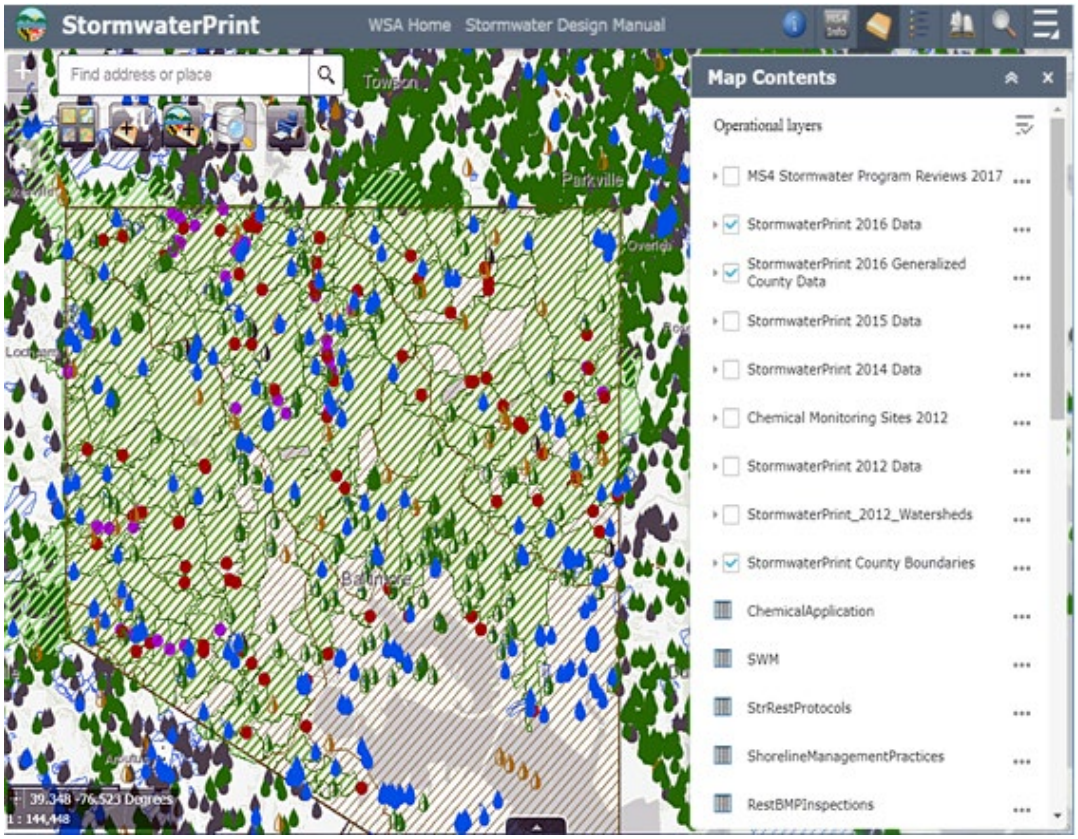


Figure 2.2: MDEs StormwaterPrint web application where known stormwater management structures are mapped and characterized.

As noted in Section 1.5, online sources should be accessed and researched to determine if known historic resources are in or near your project area. Information on archeological resources in your project area can be obtained by qualified agency or consultant team staff with MEDUSA accounts, or through initiation of project review with MHT. For details on the Section 106 / historic preservation review process and how to initiate project review by MHT, please see Section 3 (page 20) of these guidelines and check our Project Review and Compliance webpage.

MHT encourages applicants to contact MHT early in project planning to initiate our review of the project's possible effect on historic properties. Early coordination can identify historic and cultural resources to consider during project design, thereby avoiding delays during review of the permit application by MDE and the USACE.

Recreational Impacts/Benefits: Impounded waters may provide a myriad of uses to current owners, adjacent landowners and the surrounding community. These may include but are not limited to: fishing, boating, canoeing/kayaking, walking trails, wildlife viewing or other aesthetics. Determining the existing uses with dam owners and/or community and adjacent landowners is a great starting point to identify the existing uses. Understanding the dam's role and value in the community will help inform necessary measures and actions needed to address local concerns.

Restoration Post-Dam Removal: Post dam removal measures may require habitat mitigation to offset losses from the removal process. These may include riparian restoration to provide canopy shading to the stream corridor and reduce sediment and nutrient transport. Additional stabilization measures may be needed to account for changes to channel hydrology that pose flooding risks to human life and/or infrastructure through fluvial morpho-hydrological processes. Loss of recreational benefits may require boat and or hand launches to be installed to maintain all or a portion of these benefits.

Equity: Maryland has an environmental justice (EJ) screening tool that identifies underserved and overburdened areas in Maryland and applicants for dam removal projects need to consider whether their project may impact those communities. If so, applicants or project managers should conduct additional outreach and engagement with those communities to ensure their input is considered and that dam removals will not disproportionately affect those communities. Doing so will reduce the permit issuance time since EJ screening and outreach also occurs during the permitting process.

STEP 3: UNDERSTANDING THE REGULATORY AND PERMITTING PROCESS FOR DAM REMOVALS OR MODIFICATIONS IN MARYLAND

State Regulatory Authorities Overview

The State of Maryland has permitting procedures in multiple program areas that applicants must follow when considering dam removal.

Maryland's Nontidal Wetlands, Waterway, and Dam Safety Permitting Process: Maryland's nontidal waterway and dam safety authority can be found in Environment Article, §1-404 and §5-501—514, Annotated Code of Maryland. The Dam Safety and Waterway Construction regulations (COMAR 26.17.04) assure that activities in a waterway or its floodplain do not create flooding on upstream or downstream property, meet applicable dam safety criteria, maintain fish habitat and migration, and protect waterways from erosion. A person is required to obtain a permit (or permits) from MDE to change the course, current, or cross-section of a nontidal stream or body of water, or to construct, reconstruct, repair, alter or remove a dam, reservoir or similar waterway obstruction.

Maryland's nontidal wetland authority can be found in Environment Article, §5-901—911, Annotated Code of Maryland. The nontidal wetland regulations (COMAR 26.23) pertain to marshes, swamps, bogs, wet meadows, and bottomland forests. The following activities impacting nontidal wetlands are regulated by MDE: grading or filling; excavating or dredging; changing existing drainage patterns; disturbing the water level or water table; and, destroying or removing vegetation. While most dam removal projects typically only impact nontidal wetlands and waterway resources, there are times when a project may be proposed at or near the confluence with state tidal waters or wetlands. In this case, Maryland's tidal wetlands authority can be found in Environment Article, §16-101–503, Annotated Code of Maryland and applicable regulations (COMAR 23.02.04 and COMAR 23.02.04).

What is the process to obtain Tidal, Nontidal Wetland or Waterway approval and Dam Safety Permits?
Applicants proposing to remove a dam should first request a pre-application site meeting using the online request form. The pre-application meeting is an opportunity for project applicants and review agency representatives to evaluate the site, discuss project proposals and alternatives, address specific

questions, and raise concerns regarding potential project impacts. The coordination that occurs at a pre-application meeting can help expedite the permitting process.
Once the pre-application meeting has been completed and preliminary engineering and natural resource assessments have been made, the applicant must complete a "Joint Federal/State Application for the Alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland" application (often referred to as a JPA), as well as the Dam Safety Appendix B. These documents can be obtained from the MDE website.
The original application plus six (6) copies of the application, plans, vicinity maps and any supporting documentation should be mailed to:

Regulatory Services Coordination Office (RSC)
MDE, Water & Science Administration
Washington Boulevard, Suite 430
Baltimore, Maryland 21230-1708

Applications require a minimum $750 application fee (waived for state and local government projects), the application fee along with a copy of the first page of the application should be sent to:

MDE
PO Box 2057
Baltimore, Maryland 21203-2057

Additional fees may apply, and can be found on the Wetlands and Waterways Fee Schedule.

Upon receipt of the application package, MDE will screen and forward the application to the following MDE Divisions and governmental agencies (as appropriate):

- MDE Nontidal Wetlands Division
- MDE Tidal Wetlands Division
- MDE Waterway Construction Division
- MDE Dam Safety Permits Division
- DNR Environmental Review Program
- Maryland Historic Trust
- U.S. Army Corps of Engineers (USACE).

Dam removal projects will require the posting of a public notice, the opportunity to comment and request a public hearing. As part of the application process, the applicant will be required to notify contiguous property owners, property owners impacted by the removal, and local elected officials.

Applications for dam removal projects should anticipate a minimum of 12 months for permitting due to the many stakeholders and considerations required. Once a nontidal permit is issued the construction must begin within two (2) years and be completed within five (5) years, although extensions may be granted by MDE.

Section 401 State Water Quality Certification and Coastal Zone Management Act Consistency Determination: A Section 401 state water quality certification (WQC), which ensures the protection of state water quality standards, is necessary for any project that requires a federal license or permit that

may result in a discharge to waters of the U.S, including activities requiring a USACE Section 404 permit. Similarly, under the Coastal Zone Management Act (CZMA), direct Federal actions, Federal license or permit activities and federal financial assistance activities that have foreseeable coastal effects must be consistent with the enforceable policies of state coastal management programs approved by National Oceanic and Atmospheric Administration (NOAA). The process by which a state decides whether a federal action meets its enforceable policies is called federal consistency review.

The goal of MD Coastal Consistency reviews is to ensure that federal-related projects or activities with foreseeable effects on Maryland coastal resources (e.g., wetlands, forests, rivers, beaches) and coastal uses (e.g., navigation, fishing, agriculture, energy development) are consistent with Maryland Coastal Zone Management Program's (CZMP) enforceable policies (effective 7/6/2020). Maryland has issued Section 401 water quality certifications and coastal zone consistency determinations for activities covered by the USACE's Maryland State Programmatic General Permit (MDSPGP-6), Regional General Permits and Nationwide Permits in USACE Baltimore and Philadelphia Districts in Maryland. For dam removal projects that qualify for one of these authorizations from USACE, Maryland's WQC and CZMA consistency determination are incorporated into the USACE authorization and need not be individually requested.

For projects that do not qualify for one of these above noted USACE permits, the project will be required to request an individual WQC from Maryland, as well as an individual CZMA consistency determination for the dam removal project. Typically, the USACE or the federal licensing or permitting agency will inform a project proponent of the need to obtain individual WQC and CZMA consistency determinations through the application review process, as the federal licensing or permitting agency cannot issue their authorization until these requests are satisfied by Maryland. Instructions for completing a Section 401 WQC request and CZMA consistency determination request can be found on MDE's webpages (Section 401 WQC, CZMA Consistency Determination).

NPDES Permitting for Construction Stormwater Permits: If one or more acres of land is disturbed during the dam removal project, an NPDES Stormwater Construction Permit will be needed. Specifically, a permit is needed, "where construction activities will result in contiguous land disturbances equal to or greater than one (1) acre or tracts of less than one (1) acre that are part of a larger common plan of development with a combined disturbance of one (1) acre or greater." (MDE Construction Stormwater Permit Fact Sheet). Step-by-step instructions for applying for coverage under a general permit can be found on the MDE Construction Stormwater General Permits Webpage.

Maryland Historical Trust (MHT) / State Historic Preservation Office (SHPO) Coordination:
As discussed in Step 1, the applicant should have collected relevant historical background information on the dam. That information will be used when the USACE Project Manager is assigned to coordinate review of the project with the Maryland Historical Trust (MHT) as Maryland's State Historic Preservation Office (SHPO). Section 106 of the National Historic Preservation Act (NHPA) requires that federal agencies consider the impacts of their "undertakings" on historic properties. "Undertakings" are anything a federal agency does, funds, or regulates in some way (such as, permits, licenses, etc.). More information on Section 106 can be found on the Advisory Council on Historic Preservation's webpage.

The overall purpose of Section 106 is to consider historic properties during a project's planning process. As such, SHPO, the federal agency, and other consulting parties (tribes, the public, etc.) should be

involved early and often throughout the project's timeline. Those parties can provide feedback on alternatives, technical assistance, and similar comments. The Section 106 process often cannot be completed until a preferred alternative has been selected as final, the scope of work is known, and project plans are near completion. Without this information, impacts to historic properties cannot be completely assessed. Additionally, considering the proximity to water and the nature of dam removal causing ground disturbance, keep in mind that any cultural resources surveys to identify historic properties (archaeological and above-ground historic structures) may need to be completed by a Secretary of the Interior's Qualified Professional in the appropriate field. All surveys needed are the responsibility of the applicant.

Although some federal agencies delegate the responsibility for this review to applicants, USACE is one of the federal agencies that does not delegate their Section 106 responsibilities. Applicants should be in constant contact with their USACE Project Manager, who understands the process and will consult with an internal USACE cultural resource specialist and, if necessary, the SHPO. Formal consultation with the SHPO may or may not be needed and will be determined by the USACE Project Manager. Be responsive to the USACE Project Manager's requests for any additional information to keep the process moving forward. Applicants should note that one outcome of a review may be an adverse effect determination. If this happens, applicants should remember that a Section 106 assessment of effects is based solely on the impacts on historic properties, with no consideration given to potential benefits to the environment, the surrounding community, costs, or similar factors.

If a project is determined to have an adverse effect, it simply means a few more steps are necessary to proceed. The first two steps are to look at all alternatives that would avoid or minimize the impact to historic properties, such as maintaining the dam as-is, partial versus full breach, etc. If, after all alternatives have been explored that avoid or minimize the adverse impact of partial or full demolition and data-driven explanations for ruling out these alternatives have been provided, with SHPO's and other consulting parties' acceptance, then the third step is mitigation. Mitigation must benefit preservation/history and have some linkage with the impacted area. Once mitigation is agreed to by all parties and a legally binding Memorandum of Agreement or Permit Special Condition is executed, then the project can continue concurrently with the mitigation.

The Advisory Council on Historic Preservation (ACHP) is charged with ensuring federal agency regulatory compliance with the NHPA. Although ACHP is usually not involved with the Section 106 process it will occasionally become involved if the project is precedent-setting, very complicated, if it engenders numerous conflicting viewpoints, or if the applicant is asked to involve one of the required consulting parties. If the project is determined to have an adverse effect, the federal agency or their delegate is required to ask the ACHP if they want to be involved in the resolution of adverse effects, regardless of whether it has been involved in the past. Most of the time, the agency does not get involved unless one of the above circumstances occurs.

Details on the Section 106 / historic preservation review process specific to Maryland is available on MHT's Project Review webpages. MHT highly encourages early coordination on all projects to avoid possible adverse effects to historic properties through project design. Instructions on how to submit projects to MHT for our review can be found on the MHT website. In order to review and provide informed comments on a project, MHT will need project location map(s), address of property (when available), photographs of the dam and project area, a project description or concept plans, and the

results of any research done on the dam (per Section 1.5 of these guidelines). If applicants have additional questions, they may reach out to MHT's Project Review and Compliance team. MHT staff and agency assignments are listed on the staff reviewers web page (contact list).

Critical Area Commission (CAC) coordination: In 1984 the Maryland General Assembly enacted the Chesapeake Bay Critical Area Protection Program to control future land use development in the Chesapeake's watershed within 1000 feet of the tidal influence of the Bay. The Chesapeake Bay Critical Area Commission was charged with devising a set of criteria which would minimize the adverse effects of human activities and foster consistent, uniform and more sensitive development activity within the Critical Area. In cooperation with the Critical Area commission, local critical area management programs are administered by the 61 local governments whose jurisdictions are partially or entirely within the Critical Area. If the project occurs within the Critical Area and is on State owned lands:

- Contact the CAC for additional consultation (410-260-3460 or through specific contacts HERE).
- Consult the Commission's website for information regarding submittal dates necessary for processing a project. Typically, the submission is required a minimum of 90 days prior to a Commission meeting.
- Mitigation at a 1:1 ratio will be required for disturbance to the 100-foot and expanded Buffer, with an additional 1:1 required for canopy removed.
- An authorization through the Critical Area Program will be required for any project within the 100 foot or expanded buffer.

If the project occurs on privately owned land, the applicant must contact the appropriate county or town Critical Area program.

Maryland Department of Natural Resources (DNR) Forest/Tree Law coordination: The Forest Conservation Act requires that before the issuance of a grading or sediment control permit, the applicant shall have an approved Forest Conservation Plan and Forest Stand Delineation (Nat. Res. Art. § 5-1601– § 5-16122, Annotated Code of Maryland). The Maryland Forest Service recommends that the forest stand delineation and forest conservation plan be submitted to our office for review and approval. The Act provides for the retention of forested areas in sensitive areas on the subject property as one method of mitigation. For more information and contacts please visit the DNR website.

Any tree that originates within a public road right-of-way is considered a roadside tree under the Maryland Roadside Tree Care Law (Nat. Res. Art. § 5-406, Annotated Code of Maryland) and Regulations (COMAR 08.07.02). Any plans to remove, trim, or plant trees within the public right-of-way are required to obtain a permit from the Maryland Department of Natural Resources Forest Service. For more information and permit application form visit the DNR website.

Federal Regulatory Authorities Overview

The USACE regulates discharges of dredged or fill material into waters of the United States and structures or work in navigable waters of the United States under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. The type of USACE permit required depends upon factors such as the location, type of work, whether it affects "Section 404" and/or "Section 10" waters, and amount of impact. Types of USACE permits include the Maryland State Programmatic General Permit (MDSPGP), Individual, Nationwide and Regional General Permits. MDSPGP, Nationwide and Regional General Permits are created for routine activities that would cause no more than minimal

adverse environmental impacts, individually and cumulatively. These permits are issued as a federal action, subject to state regulatory approvals (see below), and must be renewed every five years.

Section 404 of the Clean Water Act requires that a permit be obtained before dredged or fill material can be discharged into jurisdictional waters of the United States, with some limited exemptions for forestry, ranching, and farming activities. The USACE is the primary agency for issuing Section 404 permits, conducting or verifying jurisdictional determinations, as well as enforcing permit conditions (for more information see EPA 404 Permit Program). The EPA works closely with the USACE to interpret policy, guidance, and environmental criteria used in permitting, including by ensuring that water quality is protected as outlined in Section 404(b)(1) guidelines (40 CFR Part 230).

Section 10 of the Rivers and Harbors Act (1899) governs the construction and modification of structures created in navigable waters of the United States. On a case-by-case basis, dam breaching, dam modification or dam removal activities may require a permit under Section 404 or Section 10. The USACE has guidance stating that "...if a dam operator modifies or deviates from normal operation of the dam in such a manner that bottom sediment accumulated behind a dam could be removed and transported downstream through the dam, either deliberately or accidentally, that activity may require a permit pursuant to Section 404." (Regulatory Guidance Letter (RGL) 05-04).

Additionally, 33 USC 408 (Section 408) requires the USACE to process requests by private, public, tribal, or other federal entities to make alterations to, or temporarily or permanently occupy or use, any federally authorized Civil Works project. In addition to structures, alteration of flowage easements and other associated areas are subject to Section 408 review. All USACE Districts are currently developing Standard Operating Procedures (SOP) for requests to alter USACE Civil Works projects. The USACE Project Manager (PM) will determine whether a proposed project has the potential to adversely affect a federally- authorized project.

USACE Permitting Overview: The North Atlantic Division of the USACE includes five districts in the Northeastern U.S. and Europe: Baltimore, New England, New York, Norfolk, Philadelphia, and Europe. Applications for federal permits to remove a dam located within the geographic boundaries of the State of Maryland would be processed by the Regulatory Division of the Baltimore or Philadelphia Districts. If a dam removal project is proposed on waters forming State boundaries, applicable USACE Districts with adjoining regulatory boundaries will determine the "lead" District for permit application and processing. Persons or parties planning dam removal projects on rivers or streams forming Maryland state boundaries should begin that process by contacting the Baltimore District office below for a determination:

U.S. Army Corps of Engineers
Regulatory Branch, Baltimore District
2 Hopkins Plaza
Baltimore, Maryland 21201
NAB-Regulatory@usace.army.mil.

Individual v. General Permits: Two types of Section 404 or Section 10 permits may be used to authorize dam removal projects – an Individual Section 404 or Section 10 Permit or one of the general permits as noted previously (MDSPGP, Regional General Permits and Nationwide Permits). The USACE

District office decides on a case-by-case basis which type of permit is needed. Large, complex projects with potential for significant impacts may require review and authorization under the Individual permit process where site-specific conditions are required to minimize environmental impacts. Small projects expected to have minimal adverse effects may be handled under the general permit process that requires standard best practices.

Applicants should begin to collect the information on their project as outlined in Steps 1 & 2 of this document for initial scoping of the project. Once that is done, but prior to completing and submitting any permitting application forms, applicants should begin the informal process by discussing the proposed project with the appropriate USACE office. The length of the Section 404/Section 10 regulatory process will depend in large part upon the type of permit required, the complexity of the proposed project, quality and thoroughness of information submitted by the applicant, and the applicant's responsiveness to requests for information from the USACE.

To implement the Maryland State Programmatic General Permit, version 6 (MDSPGP-6) and to streamline the overall state and federal permitting process within Maryland, MDE and USACE have developed a joint permitting application (JPA) process, which is implemented in accordance with the MDSPGP-6 and an interagency "Standard Operating Procedure" document. This process allows the majority of applicants proposing activities that impact state- and federally regulated wetlands and waters to submit a single application to MDE. In many cases under the MDSPGP-6 where projects qualify as a minor "Category A" project, MDE issues both state and federal approvals. Projects that do not qualify as "Category A" but are determined to be a "Category B", "Alternate" or "Enforcement" project, are transmitted directly to USACE for separate federal review and permitting. It should be noted that the USACE 2021 Nationwide Permit 53 – Removal of Low-Head Dams is not suspended in Maryland and became effective 2/25/2022 and expires 3/14/2026. More information on the USACE Nationwide Permit 53 use, including the regional conditions in Maryland can be found on the USACE Baltimore District webpage and on the USACE Philadelphia District webpage. The USACE may also consider the removal of a dam to qualify for compensatory mitigation credits as outlined in the Regional Guidance Letter (RGL)18-01- Determination of Compensatory Mitigation Credits for the Removal of Obsolete Dams and Other Structures from Rivers and Streams issued September 25, 2018.

The JPA process includes interagency coordination and review between the USACE and MDE, as well as other applicable state and federal agencies responsible for the management of protected resources, including DNR, Maryland Historical Trust (MHT), Critical Area Commission (CAC), National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS), United States Coast Guard (USCG), etc. Upon receipt of a JPA, MDE categorizes the application for qualification under the MDSPGP-6. This includes an initial "screening" of the application using geospatial data in a Geographic Information System (GIS) to determine whether the proposed project has the potential to adversely affect certain resources (e.g., federal navigation channels or other projects, historic or archaeological resources, submerged aquatic vegetation, protected species or their habitats, etc.). If MDE determines that the project, due to the type, scope or location of the activity, or due to the presence of protected resources, does not qualify under the MDSPGP-6 as a "Category A", then the application is forwarded to the USACE for federal review and permitting, which may require an individual WQC and CZMA consistency determination as discussed above. MDE continues to review the application for any applicable state permit or license.

FEMA Permitting Overview: If the dam removal includes modifications (filling, dredging, embankment removal) within the FEMA 100-yr floodplain, the applicant will be required to initiate a revision to the FEMA floodplain maps. A Letter of Map Revision (LOMR) is a document that officially revises a portion of the effective National Flood Insurance Program (NFIP) map according to requirements and procedures outlined in Part 65 of the NFIP regulations. A LOMR allows FEMA to revise flood hazard information on an NFIP map via letter without physically revising and reprinting the entire map panel. This process typically takes less time and is less expensive than a Physical Map Revision (PMR).

LOMRs include the revised portion of the flood hazard map, affected flood profiles, and floodway data tables from the Flood Insurance Study (FIS) report as attachments to the letter. LOMRs are like PMRs in that they are used to change flood risk zones, floodplain and/or floodway delineations, flood elevations, and/or planimetric features; however, because of their limited distribution, LOMRs are primarily intended for small areas of change and areas where flood hazards are typically decreasing.

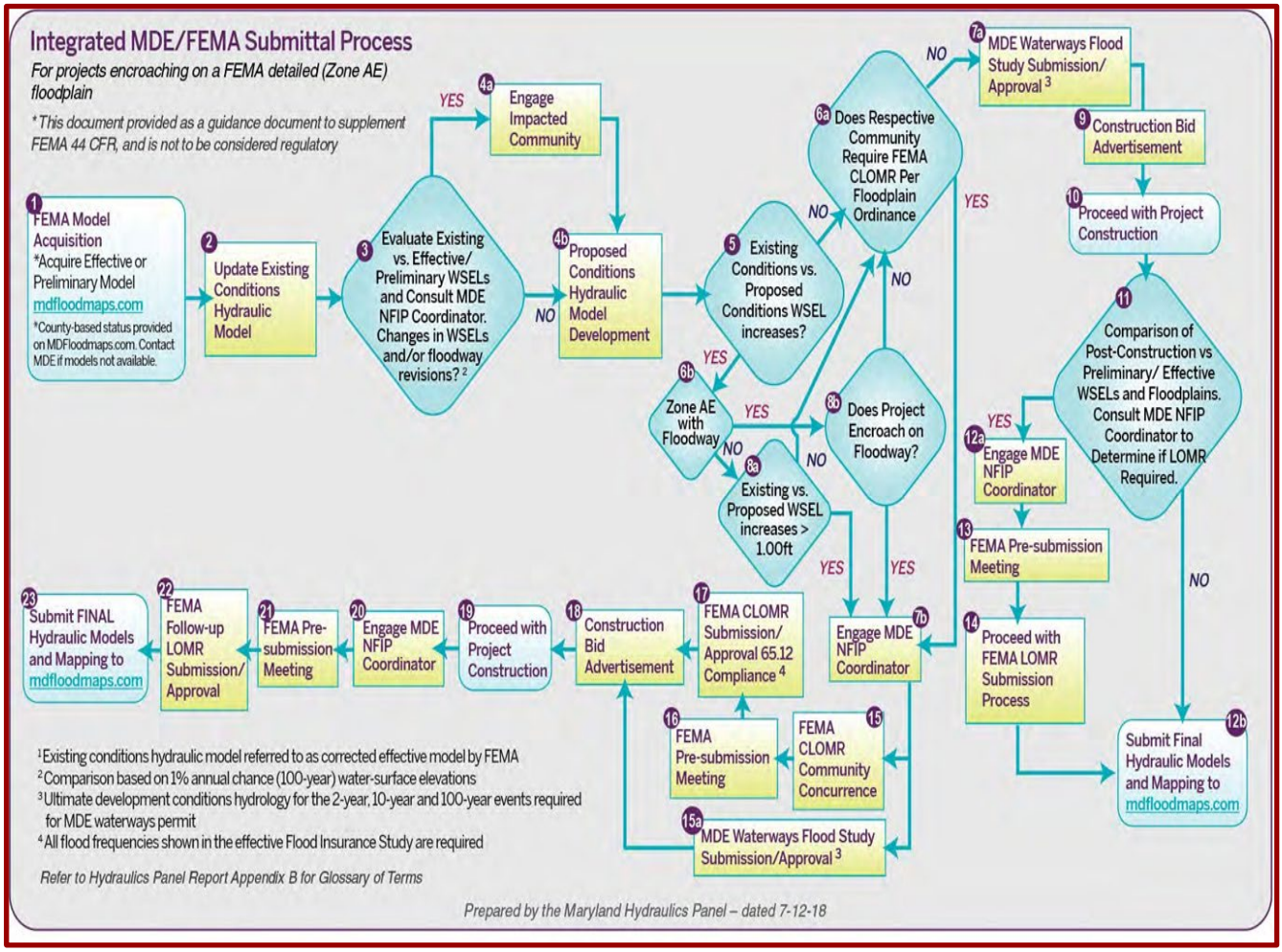


Figure 3.1: Flow chart of the recommended process for projects encroaching on a detailed floodplain (Zone AE).

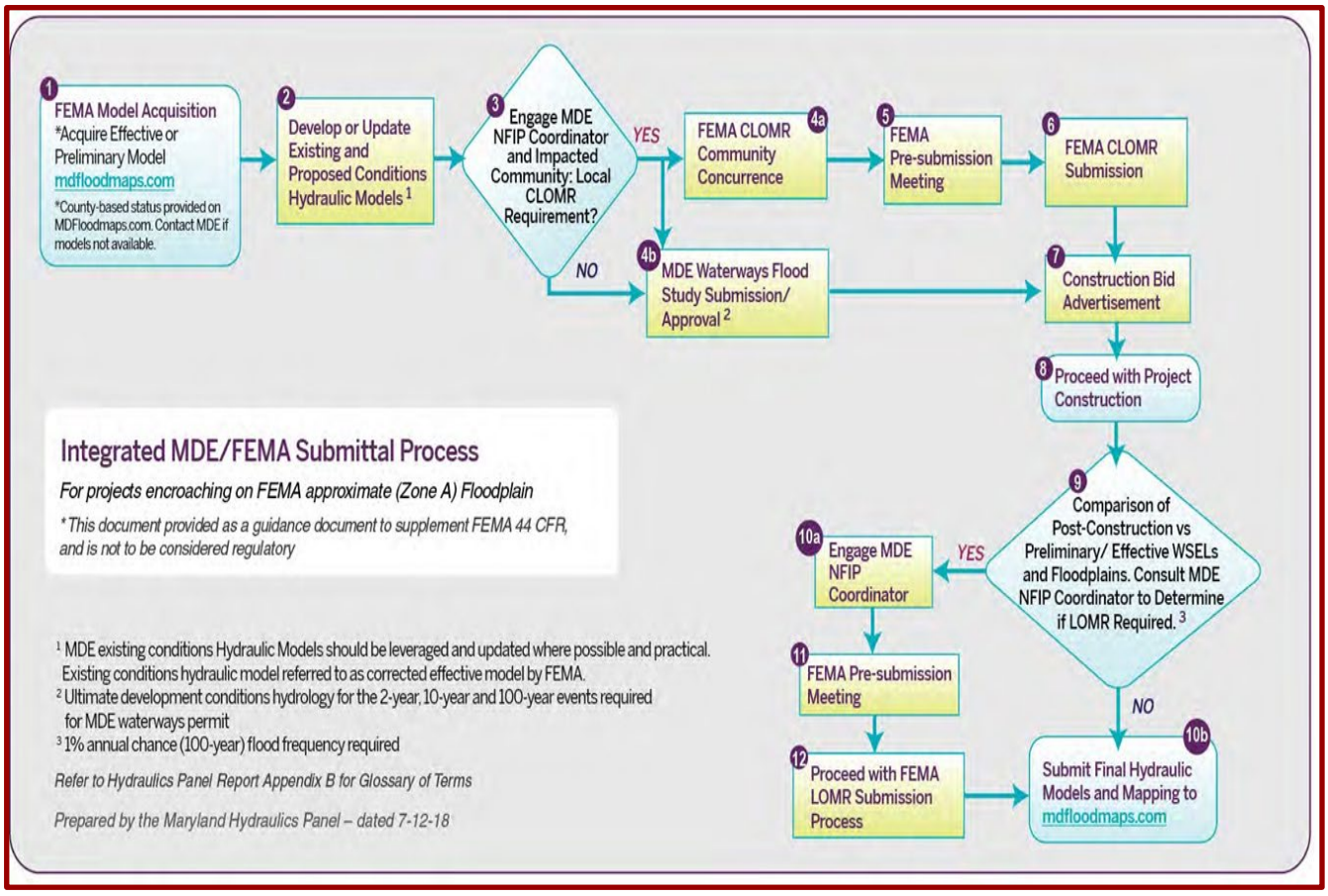


Figure 3.2: Flow chart of the recommended process for projects encroaching on an approximate floodplain (Zone A)

STEP 4: PLANNING AND DESIGN OF THE PROJECT

Once the information outlined in steps 1, 2, and 3 of this guidance has been gathered, it is time to begin the planning and design phase. Project planning and design are case-specific and can be simple or, in the case of larger projects, involve multiple intermediate steps including a feasibility study, conceptual design, and a preliminary design, before the final design is completed. Dam removal planning and design is not a linear process. It is the job of the owner's project manager to coordinate multiple work streams in synchrony through the planning, design, and implementation phases.

Identifying Consultants

Dam removal, as a practice, occurs infrequently in Maryland. One of the most critical tasks in the dam removal process is the selection of qualified consultants to lead the project. Environmental, economic, ecological, engineering, social and legal complexities require a multidisciplinary approach. An effective lead consultant can assist project partners in building a successful team. Dam removal projects depend on effective communication between project partners, regulators, and consultants. For this reason, taking the time to carefully research the dam, the river and surrounding landscape, and the basic regulatory process prior to selecting consultants is essential. If the project manager or dam owner is uncertain of how to find qualified professionals, the Maryland Dam Safety Program can provide a list of consultants who have previously completed successful dam removal projects. At least one member of the project team must be a Professional Engineer, licensed in the State of Maryland.

Identifying Relevant Stakeholders

As a project plan is being developed, it will be important to consider those outside the core project partners that will be affected by the dam removal. Careful consideration of values and opinions of relevant stakeholders can help to minimize conflict as information about the project becomes public. From the outset of the planning process, the project team should develop a clear outreach plan to share with stakeholders on the purpose and intent of the removal. This plan should include any additional outreach that may be needed to engage traditionally underserved or environmental justice communities that may be impacted by the project. Maryland has an environmental justice screening tool that can be used to identify underserved and overburdened areas in Maryland. The facts related to benefits of dam removal, including in this guidance, may provide helpful information during the outreach portion of the project.

Evaluation of Project Alternatives

As information from all relevant stakeholders is assimilated by the project team, it is important to remember that the final plan will be evaluated by multiple regulatory agencies. The final design may include a comprehensive evaluation of designs utilizing the information gathered on impacts to resources, associated costs and benefits that may result in modification of the original planned design. This process should begin with careful consideration of all potential effects of removing the dam. Much of the information required has already been described in previous sections of this guidance. Beyond information gathered for the permitting process, this step should consider all stakeholders involved.

Examples of the types of effects to consider in selection of the final design are:

- Ecological effects (Please refer to Step 2.0 Basic Description of the Resource, Mapping & Surveys of this document for details)
- Economic considerations
- Dam owner costs and benefits
- Societal costs and benefits
- Recreational costs and benefits
- Environmental costs and benefits
- Property value considerations
- Costs/risks associated with dam
- Availability of funding for dam repair or removal
- Societal issues
- Community relationship to the river
- Services provided by the dam
- Community sentiment towards the river and the dam and dam removal process
- Historical significance of the dam
- Recreational safety
- Technical/Engineering Issues
- Feasibility of repairing and maintaining the existing structure
- Feasibility and design of dam removal

This evaluation of project alternatives should describe a process that achieves the goal(s) of the project while at the same time achieving broad acceptance among stakeholders.

Stages of Project Design

For simple dam removal projects, the information gathered in steps 1, 2 and 3 of this guidance plus the results of project alternatives analysis may be sufficient to develop a final project design for the purposes of permit application. This determination should be made by the lead consultant for the project. For more complex projects, and to ensure successful implementation subsequent to permitting, additional stages will likely be required. These intermediate stages may include the following.

Feasibility Studies: If problems or unanswered questions arise during the early stages of information gathering and project planning, a more detailed feasibility study may be warranted. This study may be conducted by project partners with appropriate skills, by consultants, or a combination of the two. Feasibility studies often involve additional data collection including economic, technical, legal, and logistical considerations. The goal of this process is to provide the best available solution to achieve all identified project goals.

Conceptual Design: Once the project team feels an optimal approach to meeting their goals has been identified, it is time to prepare a concept-level description of planned work. This concept-level description may be referred to as a “10% design” and will include preliminary drawings or other materials that can be used to articulate the overall design to key stakeholders, including regulators, so they can provide feedback before details are finalized.

Preliminary Design: After any questions or concerns raised by key stakeholders and regulatory agencies have been addressed, a more detailed plan, sometimes referred to as a “30% design” can be prepared.

Final Design: The last stage of the design phase is the preparation of construction documents and specifications. These documents convey all project design requirements through detailed drawings and specifications. All required machinery, equipment, and material specifications must be clearly indicated. A technical memorandum describing the analysis process and approach will also be included. Final design may include the following:

- Design drawings showing plans for dam removal, sediment management, and channel restoration plans as necessary to reflect the project complexity. Plan sheets typically include base maps and drawings of:
    - Existing site conditions
    - Staging areas and access
    - Removal plan
    - Dewatering plan (sometimes completed by the contractor)
    - Delineation of resource areas
    - Proposed plan view
    - Proposed cross sections
    - Proposed longitudinal profile
    - Erosion prevention and sediment control practices
    - Infrastructure replacement/protection
    - Habitat feature installation schematics

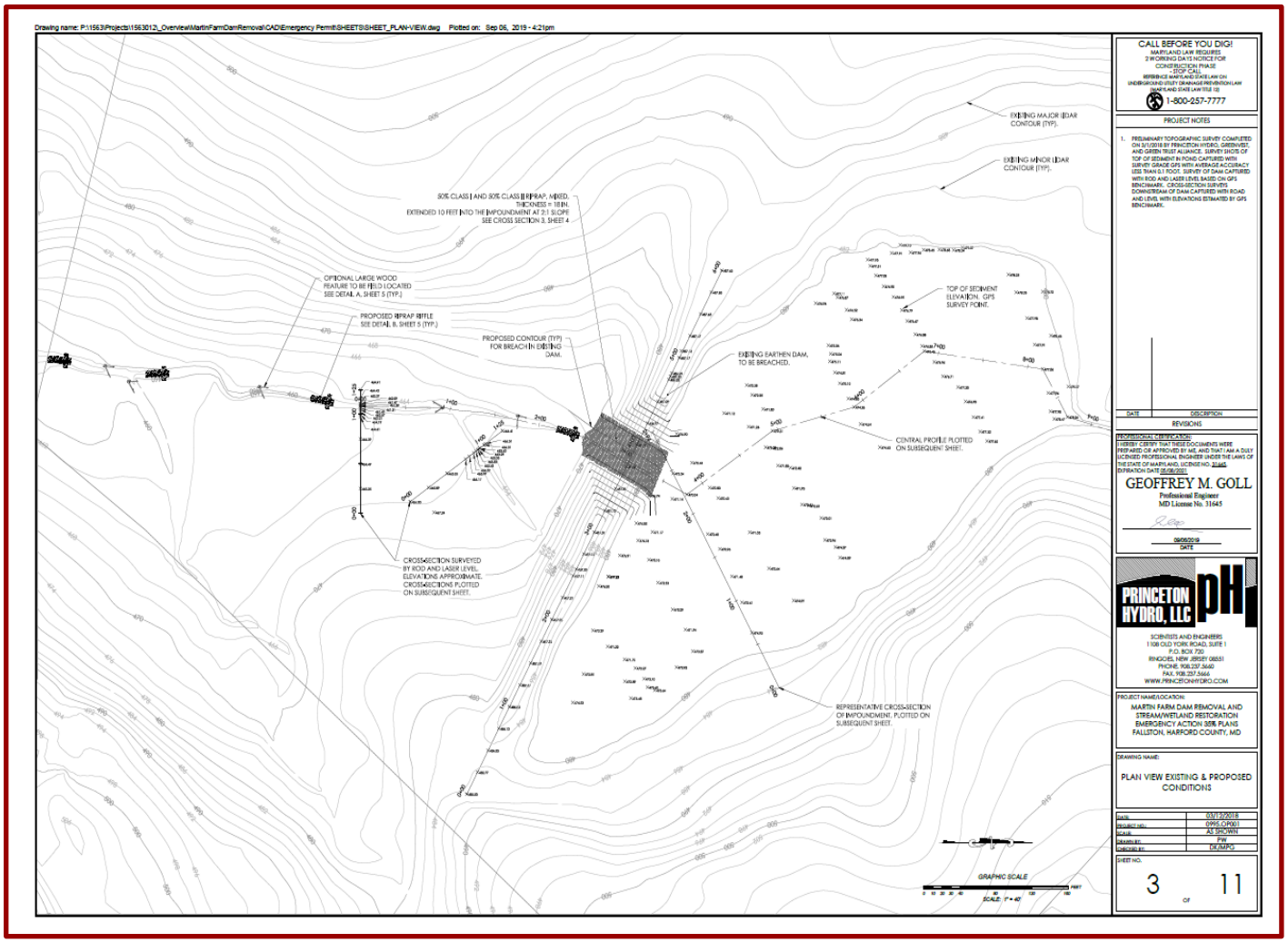


Figure 4.1: Construction plans for Martin Farm Pond Controlled Breach (MD Dam No. 531).

Final design also includes project specifications that provide details on the construction work that will be completed. For very simple projects, specifications may be included directly on the design plans. Typically, specifications detail the following:

- Timeline for construction and restoration
- Construction equipment needs
- Material specifications and quantities
- Project sequencing
- Staging area treatment
- Site access route treatment
- Dewatering
- Other site-specific details, i.e., planting plans, traffic control, infrastructure protection, etc.

Pre-Construction Public Relations: At this stage of the project, it is very important to ensure that the community is aware of the upcoming removal and has a chance to ask questions and get information.

American River's Removing Small Dams, A Guide for Project Managers provides a good overview on this process (see Step 7).

Additional Planning Considerations:

- Initiate pre-application screening through the Trilogy Letter process with DNR and MHT 3-6 months in advance of applying for MDE permits. The Trilogy Letter process provides early screening for three key resources (rare, threatened and endangered species, fisheries and historic resources).
- Data collected during the preliminary design can provide the baseline for post-project monitoring if the preliminary design analysis is done with monitoring in mind (See 'project monitoring' in Step 6: Post-Removal Actions for more information.).
- Permit Identification - The lead consultant will assist the applicant in applying for the appropriate federal, state, and local permits required. Permits must be on site and available during construction.
- Technical Memorandum - A Technical Memorandum, prepared to accompany all design documents submitted for permit consideration, should describe the analysis and provide a recommended approach for each issue.
- Cost Estimate – The design team, with the help of the lead consultant, should develop cost estimates to bring the recommended approach to completion, including costs of permitting and construction.

The following "Example: Project Tasks for a Work Plan" checklist identifies tasks for a relatively complex project. Not all these tasks may be necessary for any given project, and some additional tasks may be needed depending on the project.

EXAMPLE: PROJECT TASKS FOR A WORK PLAN[1]

- ☑ Hire Project Engineer
- ☑ Create Scope of Work (SOW) and timeline for all project staff and/or contractors
- ☑ Create Education and Outreach strategy
- ☑ Conduct outreach to affected stakeholders
- ☑ On-going communication with your group (watershed council, federal/state partners, other)
- ☑ Participate in public meetings with affected stakeholders
- ☑ Build Technical Team and facilitate Technical Team meetings
- ☑ Collect background site data
- ☑ On-going communication with agency staff
- ☑ Participate in Technical Team meetings; incorporate feedback into project design & timeline
- ☑ Create a hydrological model of the system
- ☑ Conduct topographic and bathymetric site survey (including longitudinal profile)
- ☑ Collect current discharge data
- ☑ Conduct pebble counts

[1] Modified based on Hoffert-Hay, D. 2008. *Small Dam Removal in Oregon: A Guide for Project Managers.* Oregon Watershed Enhancement Board.

- ☑ Conduct sediment sampling
- ☑ Conduct geomorphic survey
- ☑ Collect and analyze discharge data from historic records.
- ☑ Create reports, maps and alternatives analysis of site options for maintaining or removing dam
- ☑ Develop conceptual design for preferred alternative
- ☑ Develop preferred alternative to the 60% design level to submit for permits
- ☑ Prepare permit applications and all necessary accompanying data
- ☑ Prepare 90% design for final permit agency review
- ☑ Prepare 100% design
- ☑ Prepare bid and specification documents and distribute to potential contractors
- ☑ Manage bid process to select project contractors(s) for project implementation
- ☑ Provide construction oversight
- ☑ Provide any required site monitoring during construction (typically water quality sampling)
- ☑ Prepare as-builts upon project completion
- ☑ Prepare final reports for funding agencies
- ☑ Conduct archaeology survey (per SHPO standards)

Maryland Design Criteria

General Design Criteria: The following general design criteria apply to most dam removal projects in Maryland:

- Concrete and masonry dams must be removed completely (abutment to abutment, including foundation) to avoid potential hazards should the structure foundation become exposed, or remaining parts become attractive nuisances for future river users.
- A sediment and erosion control plan must be approved by the local Soil Conservation District.
- Removal of a dam that provides stormwater management must ensure that equal or greater management be provided by new or retrofit structures within the same watershed.
- Stream baseflow must be maintained during construction. Limited short duration interruptions may be required and accepted if coordinated with MDE and DNR.
- If trees are removed, new ones should be planted in areas along the stream corridor (i.e., buffer zone).
- Areas devoid of forest cover should also be planted with appropriate tree species, particularly once a dam is removed and new areas of land are exposed.
- Sites for access roads and staging areas, when possible, should be located on the north side of stream corridors. This prevents removing shading that directly absorbs sunlight.

Dam Safety Design Criteria: The design of the breach and removal must be performed by a qualified professional engineer. The Department's Dam Safety Program has the following design requirements for dam decommissioning projects:

- Masonry or concrete gravity dams should be removed entirely. Earthen embankments should be breached by construction of a properly sized and armored channel excavated through the embankment.
- The breach channel location should be at the original stream channel, where known, or the maximum section of the dam. This will reduce the likelihood of a shallow pool of impounded water remaining after the breach is complete.
- The breach channel should be excavated through the embankment fill materials to a natural undisturbed ground surface.
- The breach channel must be sized to ensure that no more than three (3) feet of water is impounded during the 24-hour 100-year storm event.
- The breach channel side slopes must be two (2) horizontal to one (1) vertical (2H:1V) or flatter.
- A pilot channel to convey base flow is recommended.
- The breach channel must be stabilized using materials appropriate for the depths and velocities of flow during the 24-hour, 100-year storm event. The stabilization should extend at least two (2) feet vertically above the anticipated 100-year water surface elevation.

Waterways Design Criteria: The Dam Safety Program will review the project plans and calculations to ensure compliance with the provisions of state law and regulation pertaining to waterway construction. An analysis of the pre- and post-project hydraulics is required, and impacts to the course, current or cross-section of the stream (based on filling, changing water surface elevations, or change in tractive force) must be evaluated. Requirements for the analyses are described below:

- Analyses must review for the following: changes in water surface elevation on non-project properties for the 100-yr, 24-hour flood condition (using Atlas14 rainfall depth and distribution) and will require:
    - All modeling to be completed by a Maryland licensed PE.
    - HEC-RAS models, to be reviewed and accepted by Dam Safety.
    - Both steady and unsteady flow analyses will be accepted.
    - 1D and 2D models will be accepted.
    - Storage may be considered.
    - Analysis of steady state models should be carried downstream to a point where the drainage area is ten times the drainage area at the spillway discharge, to a major river, or to a point of convergence whichever is first. Unsteady models should be carried to a point of convergence (within 0.1 ft) or a major river, whichever is first.
- Existing conditions shall be evaluated based on existing land use and zoning.
- Proposed conditions shall be evaluated based on ultimate development of existing zoning.
- Project applicants are required to purchase, place in easement, or get an agreement letter from persons impacted by the dam removal.
- Impacts are defined as an increase of peak water surface elevation of 0.1 ft or greater, both upstream and downstream of the dam.
- Changes in tractive force/shear forces acting upon the wetted boundary of the stream channel (temporary or permanent) must be evaluated. Where a project changes tractive force, the applicant will need to demonstrate adequate armoring, or that the area already sees equivalent forces not captured in a model.

- Once an applicant demonstrates armoring or equivalent existing forces, the impact can be accepted.
- Planned fill placement within the limits of the 100-year floodplain (not limited to the FEMA mapped floodplain) both upstream of the dam, within the reservoir, and downstream must be documented. Filling should be accounted for in models.
- Temporary and permanent impacts will be accepted once water surface elevation changes or tractive force changes are accepted.

Sediment Management Plan Criteria: Sediment management plan development should be led by the project team, with input from MDE, and must: a) identify the volume and thickness of sediment within the impoundment; b) identify past or ongoing upstream sources of pollution/contaminants that may be trapped in the sediment; c) assess the feasibility of sediment removal and/or capping/stabilization; d) evaluate on-site and/or offsite sediment disposal or beneficial reuse options; and, e) account for sensitive aquatic resources present and their life history requirements to minimize mortality.

Based upon the sediment characterization and site assessment findings, offsite disposal or on-site stabilization practices may be considered prior to dam removal. Components of the sediment management plan should include:

- Sediment sampling: consult with MDE to determine if a sediment sampling and testing work plan is necessary. If sampling and testing of sediment is required, submit that to the MDE prior to commencing work. Implement the approved sediment sampling plan and any subsequent Departmental requirements based on the sampling results, including monitoring or other measures deemed necessary to meet water quality standards and protect aquatic life;
- Analysis of whether sediment removal should occur, or wetland creation if no contamination or thermal impacts exist;
- Analysis of sediment transport impacts downstream post-removal (i.e., how much sediment was the dam trapping that will now be transported and potentially impact downstream resources? Will the “restored” area include sediment sinks, what is the rate of accumulation?); and,
- Post Dam Removal Management of sediments (invasives, scouring, floods).

MDE recommends that analysis be conducted on representative samples of the sediment within the impoundment to determine appropriate disposal locations, the potential for capping in-situ, and potential environmental exposure pathways to future river users. The number of samples collected at a proposed dam removal site shall follow the guidance in the table below based on project size (cubic yards of material or acres covered) and characteristics, as well as aquatic receptors. Sampling should include appropriate quality assurance and quality control measures, including collection of blind duplicate samples, matrix spikes, field blanks, rinsate/equipment blanks, and trip blanks. Upon review of the data submitted, MDE may require additional sampling prior to permit issuance.

Table 4.1: Guidance for number of sediment samples

Volume of accumulated sediment (CY)	Number of Sample Locations	Number of Composites Analyzed
< 5,000	4	1
5,000 - 20,000	4	1
20,001 - 100,000	8	2
100,001 - 200,000	12	3
200,001 - 300,000	16	4
300,001 - 400,000	20	5
> 400,001	24	6

Chemical and physical characteristics of sediment are important when determining material suitability for future use. Table 2 includes a broad suite of parameters that are typically tested to identify sediment chemical and physical characteristics.

Table 4.2: Guidance for physical and chemical testing of sediment

Typical Sampling Analyses	Analytical Method*
Physical Properties	
Grain Size	ASTM D-422
Percent Moisture	ASTM D-854
Atterberg Limits	ASTM D-4318
Unified Soil Classification System (USCS)	ASTM D-2487
Chemical and Nutrient Analyses	
Metals and Inorganic Analytes	
Toxicity Characteristic Leaching Procedures (TCLP) - Full Analysis	SW-846 EPA Method 1311
Priority Pollutant Metals	SW-846 EPA Method 6020
Mercury	SW-846 EPA Method 7471
Organic Analytes	

Total Organic Carbon	SW-846 EPA Method 5310B modified (Lloyd Khan)
Volatile Organics (VOCs) - TCP	SW-846 EPA Method 8260
Semivolatile Organic Compounds (SVOCs) - TCL, including Polycyclic Aromatic Hydrocarbons (PAHs)	SW-846 EPA Method 8270
Organochlorine Pesticides	SW-846 EPA Method 8081
Polychlorinated Biphenyls (PCBs) Aroclors	SW-846 EPA Method 8082
Dioxins	SW-846 EPA Method 8280
Furans	SW-846 EPA Method 8090
TPH-DRO/GRO	SW-846 EPA Method 8015
pH	EPA 9040
Total Sulfates, Sulfides	SW-846 EPA Method 9035 or other as is appropriate

Reservoir Dewatering Plan Criteria: A reservoir dewatering plan must be submitted in the permit application documents. This plan must address the following issues:

- Method(s) employed to draw down the reservoir.
- Approximate duration and schedule for dewatering, taking into account time of year restrictions and thermal loading concerns in cold water resource areas.
    - Where possible, plan to dewater the impoundment outside summer period or when water temperature is less than 68°F. If this is not possible, then spray irrigation is preferred.
    - Drawdowns during time of year restrictions will be considered on a case-by-case basis by MDE.
- A plan for maintenance of base flow during the removal process.

Reservoir and Stream Restoration Plan Criteria: For in-stream dams, once a dam is removed the reservoir area will be returned to a flowing stream channel; due to this, a reservoir restoration plan must be submitted as part of the permit application documents. This plan must address the following issues:

- Method(s) employed to restore/enhance the ecological function of the former reservoir bottom that has become exposed because of the project. This restoration area may also extend downstream and upstream of the former dam and reservoir.
- Considerations for developing stable stream channel(s), including appropriate stabilization, grade control, and similar features in accordance with sound restoration practices and consistent with the Maryland Waterway Construction Guidelines.

- Planting plans that emphasize removal of invasive plant species, identification of different planting zones based on anticipated future conditions (e.g., uplands, wetlands, wet tolerant), appropriate native species for planting, and stream shading.
- A post-construction monitoring and adaptive management plan and schedule.

STEP 5: IMPLEMENTATION AND CONSTRUCTION

As dam removal is a relatively new form of aquatic restoration in Maryland, even experienced consultants and engineers may not be familiar with the associated logistical challenges. For this reason, successful implementation of a dam removal project depends on linking the contractor who will remove the structure with the consulting team designing the project to be certain that what is "on paper" can actually be implemented on the ground and in the water. In addition, the contractor and design team must anticipate and be able to react in a timely manner to changing or unexpected conditions that become exposed during the removal process. This is important in terms of human safety, habitat considerations, cost, and timing.

Figure 5.1: MDE photo of stabilized breach channel at former Martin Farm Pond Dam (MD Dam No. 531).

Once an initial conceptual design is available, a site visit should be scheduled with the USACE project manager, MDE's Dam Safety Program and Nontidal Wetlands Division, consulting engineer and the contractor who will implement the final plan (if known). This will allow all parties to talk through the design and make changes as needed. Additional site visits will likely be required throughout the planning and design process.

While the final approach for removing the structure will have been documented during the project planning and design phase, some issues may have a significant effect on implementation. These include:

- The condition of the dam and associated structures in terms of safety concerns including public access to the site;
- Access to the site by contractors for construction equipment, materials, and staging areas; and,
- Site limitations, such as utilities or topographic constraints.

Project Deconstruction

Once all the work on planning and design has been completed, and all necessary permits have been obtained, removal can be scheduled. The physical work of removal will likely take a relatively short time in comparison to all other stages of a project.

The project manager should work closely with the consulting team to select an experienced contractor to do the physical work of removal or deconstruction. Construction may be bid out to qualified contractors, and it is important to ensure that all contractors are licensed, bonded, and insured. During construction, the project manager and other members of the design team should always be present on-site to oversee the process. For all dam removal projects, unforeseen circumstances may arise, requiring rapid decision-making and response.

If site monitoring is required by the permit (e.g., water quality, biological, geomorphological monitoring, etc.), it should be done by professionally qualified personnel. Site monitoring may help to demonstrate the ecological impact of the removal. Even if monitoring is not required by the project permit, video and photographic documentation of all critical steps of the removal process are recommended to document and help communicate the outcome of the project to stakeholders.

Once removal is initiated, it may become necessary to deviate from the original approved project design. If this occurs, the Dam Safety Program and the SCD should be contacted to determine if the deviation requires a permit modification, or if the modifications should simply be noted on the design drawings.

Public Relations During Construction

Dam removal is an uncommon event and will likely get a lot of attention. It is important to plan to have sufficient personnel prepared to handle visitors to the site and even inquiries from local media. While this is an excellent opportunity to tell your project's story, everyone involved must exercise all appropriate safety precautions. Prior to initiating construction, the project manager should delegate someone with detailed knowledge of the overall plan to interact with visitors, consult with the contractors and equipment operation crew, and establish a designating viewing zone a safe distance from the active site.

STEP 6: POST REMOVAL ACTIONS

Monitoring project results is an important step in the dam removal process. First, a project evaluation should be completed to determine if the engineering design was constructed properly and to ensure that the project is performing successfully in terms of infrastructure and public safety. If required by the permit, environmental monitoring may be needed to demonstrate that habitat restoration goals were met.

Project Evaluation

If required by the permit or of interest to the project manager or dam owner, the project team should plan to complete regular inspections of the removal site. They may seek the assistance of the lead consultant in developing a checklist of issues to inspect periodically. The checklist might include visual or quantitative assessments of vegetation growth, erosion and sediment transport, and scour around remaining infrastructure, such as abutments.

Figure 6.1: Former Bloede Dam site on the Patapsco River. Approximately 60 miles of habitat, including the mainstem and tributaries, are now open to migratory and resident fish post removal.

Environmental Monitoring

If required, environmental monitoring of dam removal projects will involve evaluating changes in ecological, hydrologic, and geomorphic parameters to assess project success. If a monitoring plan was developed during the project development phase, it will have established pre-project baseline conditions. Trained personnel from universities, environmental consulting firms, or scientific staff from various non-

profits can complete environmental post-construction monitoring activities to evaluate how conditions have changed. In some cases, state or federal agencies can aid with project monitoring, such as by evaluating fish populations before and after dam removal.

The U.S. National Oceanic and Atmospheric Administration (NOAA), in cooperation with various partners, has prepared useful monitoring-related resources including the Stream Barrier Removal Monitoring Guide by the Gulf of Maine Council on the Marine Environment and NOAA's Guide for Monitoring and Evaluation for Restoration Projects.

A useful approach to post-project monitoring includes the development of fixed photo stations to photograph the site from the same location repeatedly over time. In addition, there are a number of parameters that can be monitored to track the ecological success of a project. Broad categories include:

- Ecological Response
    - Evaluate changes in fish, benthic macroinvertebrate, and other aquatic species communities.
    - Evaluate vegetation regrowth on exposed lands, quantifying both native and invasive exotic species abundance and distribution.
- River Channel Response
    - Evaluate sediment transport and deposition, erosion, and habitat structure by surveying channel morphology and analyzing bed material samples.
- Water Quality Response
    - Evaluate changes in water quality, including such parameters as water temperature, dissolved oxygen, and turbidity.
- Hydraulic Response
    - Evaluate changes in flow velocities that may impact aquatic species movement and recreational boating safety in the river.

Finally, once the removal is complete, report it to American Rivers to add it to the database and get a dot on the national tracking map!

Figure 6.2: Former Martin Farm Pond Dam 54 months following breach completion.

FUNDING RESOURCES

There are many resources and funding programs for dam safety and removal. With the recent passage of the Bipartisan Infrastructure Law (BIL), Congress provided significant funding increases for several Dam Safety programs, including:

- $585 million total for Section 8A grants to States (High Hazard Potential Dam Rehab grants), of which Not Less Than $75M shall be for dam removal
- $148 million total for Section 8(e) grants to States (state assistance grants)
- $67 million total under FEMA Operations and Support for dam safety activities and assistance to States under sections 7 through 12 of the National Dam Safety Program Act (all other NDSP areas)
- $118 million total for NRCS Small Watershed Rehab Program Grants
- Rehab WIFIA - $64 million total (includes CWIFP – the new USACE program for low-interest loans for dam repair)
- NOAA - $492 million for studies including modernized precipitation frequency and probable maximum studies (i.e., nationwide PMP estimates)

- Approximately $800 million for dam removal projects
- Approximately $800 million for dam safety, environmental and electric grid upgrades for hydropower dams.

Much of this increased BIL funding went into existing funding programs. In 2020, Resources for the Future published four separate briefs summarizing funding possibilities for dam removals and the logic behind each possibility. The first brief sets the stage for three issue briefs that provide more detail on (i) federal funding programs, (ii) state and local funding approaches, and (iii) funding by permittees under Section 404 of the Clean Water Act or by responsible parties under various federal and state laws that require compensation for natural resources damages. MDE also provides links to some funding programs for dam removal.

Entities interested in applying for these grants are encouraged to reach out to MDE staff. Any questions about funding, policy or other items relating to ponds and dams can be directed to the Chief of the Dam Safety Permits Division at 410-537-3552. With proper research, planning, and coordination, dam removals in Maryland can be a viable and cost-effective approach that protects public safety, restores aquatic ecosystems, and provides resiliency to our aging infrastructure.

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