6. DAM AND LEVEE FAILURE

6.1 Hazard Profile

6.1.1 Hazard Description

A dam is an artificial barrier built to contain, control or divert water, wastewater, or any liquid-borne material. The purpose of a dam is to store water, wastewater, or liquid borne materials for several reasons, including flood control, human water supply, energy generation, recreation, or pollution control (ASDSO 2024). Many dams fulfill a combination of these functions. Dams require regular maintenance to retain their level of protection.

A levee is a raised embankment along the edge of a river, canal, or other waterway to prevent flow in the waterway from overflowing onto surrounding lands. A levee is usually earthen and runs parallel to the course of the waterway in its floodplain.

A dam failure is any malfunction or abnormality outside of the design that adversely affects the primary function of impoundment (FEMA 2018). When dams fail or overtop, they can lead to major flooding and cause catastrophic impacts especially in downstream areas (ASDSO 2024). Dam failures cause serious downstream flooding either because of partial or complete dam collapse. Failures are usually associated with intense rainfall and prolonged flood conditions; however, dam breaks may occur during dry periods as a result of progressive erosion of an embankment. The greatest threat from a dam break is to areas immediately downstream.

Dam failures occur when the dam is damaged or destroyed, releasing water or other liquid stored behind the dam. Throughout history, hundreds of dams failed in the United States, causing property and environmental damage, injuries, and fatalities. Dam failures can occur suddenly, without warning, and may occur during normal operating conditions. This is referred to as a “sunny day” failure. Dam failures may also occur during a large storm event. Significant rainfall can quickly inundate an area and cause floodwaters to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows, and a failure may occur. Dam failures are most likely due to one or a combination of the following events (ASDSO 2024):

- Overtopping caused by water spilling over the top of a dam
- Foundation defects, including settlement and slope instability
- Cracking caused by movement
- Inadequate maintenance and upkeep
- Seepage filtration that enables the formation of sinkholes in the dam

A levee failure or breach causes flooding in landward areas adjacent to the structure. The failure of a levee could be devastating, depending on the level of flooding for which the structure is designed and the amount of landward development present. Large volumes of water may be moving at high velocities, potentially causing severe damage to buildings, infrastructure, trees, and other large objects. Levee failures are generally worse when they occur abruptly with little warning and result in deep, fast-moving water through highly developed areas.

REGULATORY OVERSIGHT OF DAMS

National Dam Safety Program

The potential for catastrophic flooding caused by dam failures led to enactment of the National Dam Safety Act (Public Law 92-367), which for 30 years has protected Americans from dam failures. The National Dam Safety Program is a partnership among states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under the program, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and purchases of needed equipment. FEMA has also expanded existing and initiated new training programs. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most dams in the United States (FEMA 2024).

New Jersey Department of Environmental Protection Dam Safety Section

The New Jersey Department of Environmental Protection (NJDEP) Dam Safety Section has responsibility for overseeing dam safety in the state. The primary goal of the oversight program is to ensure the safety and integrity of dams in New Jersey and thereby protect people and property from the consequences of dam failures. The Dam Safety Section reviews plans and specifications for the construction of new dams or for the alteration, repair, or removal of existing dams and must grant approval before the owner can proceed with construction. New Jersey's Safe Dam Act requires dams to meet state dam safety standards. NJDEP has enforcement capabilities to achieve compliance with the standards. This includes issuing orders for compliance to dam owners and pursuing legal action if the owner does not comply (with possible fines levied on a per-day basis for violations) (NJDEP 2024).

NJDEP assigns one of four hazard ratings to state-regulated dams in New Jersey (State of New Jersey 2017):

- Class I (High-Hazard Potential)—Failure of the dam may result in probable loss of life and/or extensive property damage.
- Class II (Significant-Hazard Potential)—Failure of the dam may result in significant property damage; however, loss of life is not envisioned.
- Class III (Low-Hazard Potential)—Failure of the dam is not expected to result in loss of life or significant property damage.
- Class IV (Zero-Hazard Potential)—Failure of the dam is not expected to result in loss of life or significant property damage.

Hazard potential is based on the consequences of dam failure and not the dam condition or the probability of failure occurring.

Existing dams are periodically inspected to ensure that they are adequately maintained, and owners are directed to correct any deficiencies found. The owners or operators of all dams that raise the waters of any stream more than 70 feet above its usual mean low-water height or that impound more than 10,000 acre-feet of water must have a regular inspection performed annually and formal inspections performed every three years by a state-licensed professional engineer. These inspections must be attended by a professional engineer assigned from the NJDEP (State of New Jersey 2024). Inspection guidelines are summarized Table 6-1.

Table 6-1. Dam Inspection Requirements

Dam Size/Type	Regular Inspection	Formal Inspection
Class I (High Hazard) Large Dam	Annually	Once every 3 years
Class I (High Hazard) Dam	Once every 2 years	Once every 6 years
Class II (Significant Hazard) Dam	Once every 2 years	Once every 10 years
Class III (Low Hazard) Dam	Once every 4 years	Only as required
Class IV (Zero Hazard) Dam	Once every 4 years	Only as required

Source: State of New Jersey 2017

Based on the inspection, owners are required to note the extent of deterioration as a basis for long term planning, periodic maintenance, or immediate repair; to evaluate conformity with current design and construction practices; and to determine the appropriateness of the existing hazard classification. NJDEP has guidelines to meet the requirements of the National Inventory of Dams condition assessment of existing dams. Table 6-2 summarizes the definitions for each potential deficiency rating.

Table 6-2. Dam Deficiency Ratings

Rating	Definition
Satisfactory	No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria. Minor maintenance items may be required.
Fair	Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.
Poor	A dam safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. Poor also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.
Unsatisfactory	Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

Source: NJDEP 2017

The Dam Safety Section also coordinates with the Division of State Police and local and county emergency management officials in the preparations and approval of emergency action plans (EAPs). The state requires all high hazard and significant hazard dams to have NJDEP-approved EAPs in place. It is the responsibility of the dam owner to review and update the EAP on an annual basis.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers (USACE) is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. USACE has inventoried dams and has surveyed each states and federal agency's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of the dams. USACE has also developed guidelines for inspection and evaluation of dam safety (USACE 2014).

Table 6-3 lists USACE-developed ratings of hazard potentials of dams, based on potential consequences of a dam failure. According to New Jersey's State HMP, the level of impact that a failure would have can be predicted based upon the USACE hazard rating.

Table 6-3. USACE Dam Hazard Ratings

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

Source: USACE 2014

a. Categories are assigned to overall projects, not individual structures at a project.

b. Loss-of-life potential is based on inundation mapping of area downstream of the project. Analyses of loss-of-life potential should take into account the population at risk, time of flood wave travel, and warning time.

c. Lifeline losses include indirect threats to life caused by the interruption of lifeline services from project failure or operational disruption; for example, loss of critical medical facilities or access to them.

d. Property losses include damage to project facilities and downstream property and indirect impact from loss of project services, such as impact from loss of a dam and navigation pool, or impact from loss of water or power supply.

e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) has the largest dam safety program in the United States. FERC cooperates with several federal and state agencies to ensure and promote dam safety and, more recently, homeland security. A total of 3,036 dams are part of regulated hydroelectric projects and are included in the FERC program; two-thirds of these dams are more than 50 years old (FERC 2020). Concern about their safety and integrity grows as dams age, rendering oversight and regular inspection especially important. FERC staff inspect hydroelectric projects on an unscheduled basis to investigate the following issues (FERC 2020):

- Potential dam safety problems.
- Complaints about constructing and operating a project.
- Safety concerns related to natural disasters.
- Issues concerning compliance with terms and conditions of a license.

Every five years, an independent consulting engineer, approved by FERC, must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with total storage capacity of more than 2,000 acre-feet (FERC 2020). FERC staff visit dams and licensed projects during and after floods, assess extents of damage, and direct any studies or remedial measures the licensee must undertake.

FERC requires licensees to prepare EAPs and conducts training sessions on developing and testing these plans. The plans outline an early warning system in the event of an actual or potential sudden release of water from a dam failure. The plans include operational procedures that may be implemented during regulatory measures, such as reducing reservoir levels and downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that all applicable parties are informed of the proper procedures in emergencies (FERC 2020).

Regulatory Oversight of Levees

New Jersey

Currently in the State of New Jersey, no single agency oversees the operation and maintenance of levees or levee systems nor has specific regulatory authority or responsibility over the safety of existing or proposed levees or levee systems. Oversight is accomplished through coordination of federal, state and local authorities (State of NJ HMP 2019).

USACE and FEMA

USACE and FEMA have differing roles and responsibilities related to levees. USACE addresses a range of operation and maintenance, risk communication, risk management, and risk-reduction issues as part of its responsibilities under the Levee Safety Program. FEMA addresses mapping and floodplain management issues related to levees, and it accredits levees as meeting requirements set forth by the National Flood Insurance Program.

Depending on the levee system, USACE and FEMA may be involved with the levee sponsor and community independently or—when a levee system overlaps both agency programs—jointly. Under both scenarios, the long-term goals are similar: to reduce risk and lessen the devastating consequences of flooding. Some USACE and FEMA partnering activities related to levees include:

- Joint meetings with levee sponsors and other stakeholders
- Integration of levee information into the National Levee Database
- State Silver Jackets teams
- Sharing of levee information
- Targeted task forces to improve program alignment

The Silver Jackets is a program that provides an opportunity to consistently bring together multiple state, federal, tribal, and local agencies to learn from each other and apply their knowledge to reduce risk. The Program's primary goals include the following:

- Create or supplement a mechanism to collaboratively identify, prioritize, and address risk management issues and implement solutions
- Increase and improve risk communication through a unified interagency effort
- Leverage information and resources and provide access to such national programs as FEMA's Risk Mapping, Assessment, and Planning (MAP) and USACE's Levee Inventory and Assessment Initiative
- Provide focused, coordinated hazard mitigation assistance in implementing high-priority actions such as those identified by state hazard mitigation plans

- Identify gaps among agency programs and/or barriers to implementation, such as conflicting agency policies or authorities, and provide recommendations for addressing these issues

Coordination between USACE and FEMA with regard to levees is now standard within many of each agency's policies and practices. Over the past several years, both agencies coordinated policies where appropriate; jointly participated in meetings with stakeholders; and participated in many multiagency efforts, such as the National Committee on Levee Safety, the Federal Interagency Floodplain Management Task Force, and the Silver Jackets Program.

National Committee on Levee Safety

Congress created the National Committee on Levee Safety to "develop recommendations for a national levee safety program, including a strategic plan for implementation of the program." The Committee is made up of representatives from state, regional, and local agencies; the private sector; USACE; and FEMA (USACE n.d.).

6.1.2 Location

NJDEP has identified and classified one dam in Hudson County: the Hackensack Reservoir Dam along the Passaic River. The reservoir is surrounded on all four sides by embankments comprised of soil, with a clay layer, covered by stone block. The dam is an earthen dam with conduits for overflow and water distribution and was constructed around 1900.

According to the National Levee Database, Hudson County has no active levee systems (USACE n.d.). However, he City of Hoboken is undertaking a significant infrastructure project, known as the Rebuild By Design - Hudson River project, to mitigate the impacts of severe coastal flooding. This initiative involves the construction of a hybrid levee and flood wall system strategically positioned at the northern and southern ends of the city (City of Hoboken n.d.).

Hudson County considers the locations of dams and levees to be sensitive information. A map is not included, and municipal-level statistics are not listed in this HMP due to these sensitivities.

6.1.3 Extent

The extent or magnitude of a dam failure event can be measured in terms of the classification of the dam. Additionally, there are two factors that influence the potential severity of a full or partial dam failure: the amount of water impounded; and the density, type, and value of development and infrastructure located downstream (FEMA 2018).

Hudson County contains one dam: the Hackensack Reservoir Dam. This structure is rated as a high hazard potential dam, as shown in Table 6-4. The failure of this dam could cause probable loss of life or property damage. Hazard potential is based on the consequences of dam failure and not the dam condition or the probability of failure occurring. Last inspected in October 2023, the Hackensack Reservoir Dam is in fair condition and last updated its EAP in November 2023.

Table 6-4. Dams by Hazard Classification in Hudson County

Hazard Ranking	Number of Dams
High	1
Significant	0
Low	0
Total	1

Source: USACE n.d.

Dam failures may or may not leave enough time for evacuation of people and property, depending on their abruptness. Seepages in earth dams usually develop gradually, and if the embankment damage is detected early, downhill residents have at least a few hours or days to evacuate. Failures of concrete or masonry dams tend to occur suddenly, sending a wall of water and debris down the valley at more than 100 miles per hour (mph). Survival would be a matter of having the good fortune not to be in the flood path at the time of the break. Dam failures due to the overtopping of a dam normally give sufficient lead time for evacuation.

Levees require maintenance to continue to provide the level of protection they were designed and built to offer. Maintenance responsibility belongs to a variety of entities including local, state, and federal government and private landowners. Well-maintained levees may obtain certification through independent inspections paid for by their owners. Levees can also be accredited by FEMA if they meet certain design, data, and documentation standards that show it reduces the base flood hazard (i.e., one-percent annual chance flood event) (FEMA 2021).

6.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Hudson County was not included in any major disaster (DR) or emergency (EM) declarations for dam or levee failure-related events (FEMA 2023).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in contiguous counties. Between 2019 and 2023, Hudson County was not included in any USDA dam or levee failure-related agricultural disaster declarations (USDA 2024).

Previous Events

No known dam or levee failure events impacted Hudson County between August 2019 and December 2023 (NJDEP 2024, NOAA-NCEI 2024, FEMA 2024). As noted in previous HMPs, there have been no dam or levee failure events recorded in Hudson County prior to 2019.

6.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Based on NJDEP, FEMA, and NOAA-NCEI records, no dam or levee failure events have occurred or affected Hudson County (NJDEP 2024, NOAA-NCEI 2024, FEMA 2024). Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. Combined with the lack of recorded events in the County, there is likely a low probability that a dam or levee failure will occur in the future. However, the construction of new dam and levee structures could increase failure risks, and failure risks increase as dams age or are not maintained properly.

There are many regulatory bodies and mitigation measures in place to protect communities from the impacts of dam or levee failures. Even with these safeguards, dams and levees experience "residual risk," which refers to the risk of more severe events than those that the facility was designed to withstand. However, overall, the probability of any type of dam failure is low given New Jersey's dam safety regulatory and oversight environment.

Based on historical records and input from the Steering Committee, the probability of occurrence for dam or levee failure in the County is considered "rare."

Effect of Climate Change on Future Probability

Climate change can impact stored water systems as increased rainfall accumulations can cause reservoirs to overtop or rivers to run higher. Dams are designed using a hydrograph to evaluate dam safety issues for situations where the reservoir inflow peak discharge is greater than the maximum spillway capacity, the reservoir has large surcharge storage, and/or the reservoir has dedicated flood control space. Increased precipitation due to climate change may result in overtopping, as the hydrographs are based off historical events (FEMA 2013). Similarly, levees are designed to contain high river flows determined by historical records. Increased rainfall due to climate change can lead to flows beyond those the levee was intended to contain, with the resulting potential for the levee to fail or be overtopped.

6.1.6 Cascading Impacts on Other Hazards

Dam and levee failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam or levee failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat. Floods caused by dam and levee failures have caused loss of life and property damage (FEMA 2013).

6.2 Vulnerability and Impact Assessment

To assess Hudson County's risk to dam and levee failure, a qualitative review was implemented and supplemented with information from Section 4.3.7 (Flood) from this HMP.

6.2.1 Life, Health, and Safety

The impact of dam and levee failure on life, health, and safety is dependent on several factors such as the class of dam/levee, the area that the dam/levee is protecting, the location of the dam/levee, and the proximity of structures, infrastructure, and critical facilities to the dam or levee structure.

Overall Population

The entire population residing within a dam failure inundation zone is considered exposed and potentially vulnerable to a dam failure event. The potential for loss of life is affected by the warming time provided, and capacity and number of evacuation routes available to populations living within these areas. Those most at risk include the economically disadvantaged and the population over the age of 65 due to their limited capability to respond or mitigate against dam failures.

Socially Vulnerable Population

People living below the poverty level are more at risk during a dam failure event because they may be unable to evacuate based upon the net economic impact to their family. Elderly populations are more likely than the general population to need medical attention, and the availability of medical services may be limited due to isolation during a dam failure event. This population also faces difficulties in evacuating. There is often limited warning time for a dam failure event. Populations without adequate warning of the event are highly vulnerable.

Without a quantitative assessment of potential impacts of a dam failure on socially vulnerable populations, the Planning Partners can best assess mitigation options through an understanding of the general numbers and locations of such populations across Hudson County. Section 3.6.4 provides detailed data on socially vulnerable populations within the planning area. Table 6-5 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a dam failure will be similar to the countywide numbers.

Table 6-5. Distribution of Socially Vulnerable Populations by Municipality

	Countywide Total		Municipality Highest in Category		Municipality Lowest in Category	
Category	Number	Percent	Number	Percent	Number	Percent
Population Over 65	**86,664**	**12.0%**	Jersey City 32,671	North Bergen **16.6%**	East Newark **308**	Hoboken **6.4%**
Population Under 5	**86,664**	**12.0%**	Jersey City 20,476	Bayonne **7.1%**	East Newark **106**	East Newark **4.1%**
Non-English-Speaking Population	**93,494**	**12.9%**	Jersey City 29,070	West New York **24.5%**	East Newark **474**	Hoboken **4.3%**
Population With Disability	**61,174**	**8.4%**	Jersey City 22,396	Union City **11.2%**	East Newark **209**	Weehawken **6.2%**
Population Below Poverty Level	**99,546**	**13.7%**	Jersey City 43,134	East Newark **24.6**	East Newark **638**	Seacaucus **5.1%**
Households Below ALICE Threshold	**63,893**	**21%**	Jersey City **119,278**	Union City **49%**	East Newark **846**	Hoboken **20%**

6.2.2 General Building Stock

All buildings and infrastructure located in the dam and levee failure inundation zone are considered exposed and potentially vulnerable. Widespread damage to buildings and infrastructure affected by an event would result in large costs to repair these locations. Property located closest to the dam inundation area has the greatest potential to experience the largest, most destructive surge of water.

Dam and levee failure can cause severe downstream flooding and may transport large volumes of sediment and debris, depending on the magnitude of the event. Widespread damage to buildings and infrastructure affected by an event would result in large costs to repair these locations. In addition to physical damage costs, businesses can be closed while flood waters retreat, and utilities are returned to a functioning state.

6.2.3 Community Lifelines and Other Critical Facilities

Dam and levee failures may also impact critical facilities and infrastructure located in the downstream inundation zone. Consequentially, dam failure can cut evacuation routes, limit emergency access, and/or create isolation issues. All transportation infrastructure in the dam failure inundation zone is vulnerable to damage, which can potentially cut off evacuation routes, limit emergency access, and create isolation issues. Utilities such as overhead power lines, cable, and phone lines are also at risk. The loss of these utilities could further exacerbate isolation issues for the inundation areas, making it difficult for residents to communicate and access essential services.

6.2.4 Economy

Flooding from a dam or levee failure can cause extensive structural damage to private property and public utilities, cutting off essential services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities can be temporarily out of operation. Debris from damaged buildings can accumulate, adding to the costs of removal. Additionally, the closure of businesses due to such flooding can have a severe impact on the local economy. When businesses cannot operate, it affects not only the revenue of those businesses but also the livelihoods of employees and the overall economic stability of the community. The inability to access shopping centers or workplaces further amplifies the economic strain by halting business operations, reducing revenue, impacting employment, disrupting supply chains, and decreasing consumer spending, all of which hinder the local economy's stability and recovery.

6.2.5 Natural, Historic and Cultural Resources

NATURAL

The environmental impacts of a dam and levee failure can include significant water-quality and debris-disposal issues or severe erosion that can impact local ecosystems. Floodwaters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals may get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. The destruction of local ecosystems is a significant concern

because they are essential for maintaining biodiversity, supporting wildlife, and providing critical services such as clean water, air, and soil health.

HISTORIC

Dam and levee failures may impact historic resources by the resulting flood waters. Historic buildings and structures, sites, monuments, districts, and historic documents are often irreplaceable, and may become damaged or destroyed in the flood waters following a dam or levee failure. The loss of these resources is all the more painful as residents rely on the presence of these resources to reinforce connections with neighbors and the larger community, and to seek comfort in the aftermath of a disaster.

CULTURAL

Cultural resources include "moveable heritage," such as collections of artifacts, statuary, artwork, and important documents or repositories. These resources are housed in libraries, museums, archives, historical repositories, or historic properties. Flood waters following a dam and levee failure creates the largest risk to these resources. Similar to historic resources, residents may rely on the presence of cultural resources to reinforce connections with neighbors and the larger community, and to seek comfort in the aftermath of a disaster.

6.3 Future Changes That May Affect Risk

6.3.1 Potential or Planned Development

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by a dam and levee failure event if the structures are located within the flood protection area and mitigation measures are not considered. Therefore, it is the intention of the County and all participating municipalities to discourage development in vulnerable areas or to encourage higher regulatory standards at the local level. Due to the sensitive nature of dam locations and downstream inundation zones, an assessment to determine the proximity of these new development sites to potential dam inundation cannot be performed at this time.

6.3.2 Projected Changes in Population

The New Jersey Department of Labor and Workforce Development produced populations projections by County from 2014 to 2019, 2024, 2029, and 2034. According to these projections, Hudson County is projected to have an increase in population in the upcoming years. These projection totals include a population of 747,400 by 2029, and 766,500 by 2034 (State of New Jersey 2017). An increase in population density can impact the number of persons exposed to the probable maximum flood inundation hazard areas. Higher density can not only create issues for local residents during evacuation of a dam or levee failure event but can also have an effect on commuters that travel into and out of the County for work. Refer to Chapter 3 (County Profile), which includes a more thorough discussion about population trends for the County.

6.3.3 Climate Change

Most studies indicate that the State of New Jersey will experience a rise in average annual precipitation, primarily in the form of heavy rainfalls, which could elevate the risk of dam failures. Increased precipitation may place additional stress on dam structures. Existing flood control systems might struggle to manage the higher water flow from more frequent, intense rainfall events. This could lead to more frequent overtopping of dams and flooding of county assets in adjacent inundation areas. However, the probable maximum flood used in dam design may still accommodate these climate changes.

Projections suggest that annual precipitation in the State of New Jersey could increase by 4 percent to 11 percent, potentially affecting the hydrographs of many dammed rivers. This rise in precipitation could reduce the designed margin of safety, known as freeboard, for dams. A decrease in freeboard may result in floodwaters overtopping the dam or creating unintended loads, potentially leading to dam failure (NJOEM 2024)

6.3.4 Other Identified Conditions

When assessing the risk of dam and levee failure in the future, several conditions should be considered. Aging infrastructure is a significant risk factor, as many dams may not meet current safety standards and are more susceptible to failure due to wear and tear. Historical design and construction flaws can also become critical over time, especially under changing environmental conditions. Inadequate maintenance and delayed repairs further increase the risk of dam failure (FEMA 2018).

Issues with upstream dams can impact downstream dams, potentially leading to cascading failures. Development in areas surrounding dams, known as hazard creep, can heighten the potential consequences of a dam failure. Additionally, cybersecurity attacks and other security threats can alter dam operations and pose significant risks (CRS Report 2023).