

5.4.7 Levee Failure

This section provides a hazard profile (description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment of the levee failure hazard for the Allegany County Hazard Mitigation Plan (HMP).

5.4.7.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, probability of future occurrences, and impacts of climate change for the levee failure hazard.

Description

Levees are man-made structures, usually consisting of an engineered earthen embankment designed and constructed to contain, control, or divert the flow of water to provide protection from temporary flooding. A levee is built parallel to a body of water, typically a river, to protect the lives and properties behind it. Typically built as barriers between floodwaters and a nearby municipality, levees include a series of culverts, canals, ditches, storm sewers, or pump stations, called interior drainage systems. These systems channel water from the land side of a levee through to the water side. There are thousands of miles of levees across the United States, none of which provides full protection from flooding (Federal Emergency Management Agency [FEMA] 2013c).

Overtopping occurs when floodwaters exceed the height of a levee. When overtopping occurs, water passing over the levee can erode the structure, worsening the flooding and potentially causing an opening or breach in the levee through which floodwaters may pass. A breach can occur gradually or suddenly, but the most dangerous and damaging breaches happen quickly during periods of high water. The ensuing surge of water can flood a large area behind the failed levee with little to no warning (American Society of Civil Engineers 2010).

U.S. Army Corps of Engineers (USACE) operates, maintains, and evaluates levees to determine whether they meet accreditation requirements. Most levees are owned by local communities and flood control districts that also ensure proper operation and maintenance of the levee system (FEMA 2013c).

According to the 2014 New York State (NYS) HMP, levees are one of many types of flood-control projects overseen by State agencies. The nature and design of levees often require significant amounts of land that are obtained by NYS as lands in fee title and permanent easements in order to construct, operate, and maintain these projects. These property rights allow New York State Department of Environmental Conservation (NYSDEC) and its agents to access project lands to conduct maintenance activities including mowing, sediment removal from drainage channels and waterways, concrete repair, and functional equipment checks (New York State Division of Homeland Security and Emergency Services [NYS DHSES] 2014).

According to the National Committee on Levee Safety (NCLS), properly functioning levees reduce the risk of flooding for communities. However, an unexpected levee breach or failure can be catastrophic, with the flooding causing loss of life, emergency evacuations, and insufficient time to reduce damages to property (NCLS n.d.).

Regulatory Oversight for Levees

USACE and FEMA have differing roles and responsibilities related to levees. Under the Levee Safety Program, USACE is responsible for addressing a range of operation and maintenance, risk communication, risk management, and risk reduction issues. 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 (NFIP).

USACE and FEMA may be involved with the levee sponsor and community independently. Alternatively, when a levee system overlaps both agency programs, the sponsor will work with the two agencies 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

Coordination between USACE and FEMA with regard to levees is now standard practice. The agencies coordinate policies, jointly participate in meetings with stakeholders, and participate in multiagency efforts such as the National Committee on Levee Safety, the Federal Interagency Floodplain Management Task Force, and the Silver Jackets Program.

The Silver Jackets is a program intended to bring together multiple state, federal, and sometimes tribal and local agencies across the country to learn from one another and apply their knowledge to reduce the risk of flooding and enhance response and recovery efforts when such events do occur. 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 (FEMA’s Risk Mapping, Assessment, and Planning (Risk MAP) Program 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

The Silver Jackets are currently active in New York State.

National Committee on Levee Safety

Congress created the National Committee on Levee Safety (NCLS) to “develop recommendations for a national levee safety program, including a strategic plan for implementation of the program” (NCLS 2010). The Committee adopted the vision of “an involved public and reliable levee systems working as part of an integrated approach to protect people and property from floods,” and has been working toward this goal since October 2008 (NCLS 2010). The Committee is made up of representatives from state, regional, and local agencies; the private sector; USACE; and FEMA.

New York State

Under New York Environmental Conservation Law Article 16, NYSDEC is required to be the non-federal sponsor to participate in the Federal Flood Control Program. The two major components of the program are described below:

1. Project Operation and Maintenance and Major Repair and Rehabilitation: NYSDEC is required by contract with the federal government to operate, maintain, and rehabilitate projects in an “as constructed” state of readiness. The NYSDEC Division of Water (DOW) and Division of Operations (OPS) jointly perform duties to operate these projects. The DOW observes weather and local conditions to determine when a project needs to initiate and cease operation. DOW also identifies critical work needs, whereas the OPS performs maintenance and operations work, including mowing levees; cleaning ditches; lubricating equipment; and operating pumps, closures, structures, and gate valves. Repair and replacement work such as stabilization in areas of channel bank erosion threatening levees and walls is accomplished in conformance with NYS and USACE requirements to assure flood protection reliability.
2. New Project Development: Development of new levee and other flood protection projects are coordinated between NYS and the federal government, including conducting studies of economical and environmentally sensitive alternatives to provide flood protection, reduce flooding damages, and upgrade existing projects.

Extent

In the event of a levee failure, floodwaters may ultimately inundate the protected area landward of the levee. The extent of inundation depends on the flooding intensity – failure of a levee during a 1-percent annual chance flood will inundate the approximate 100-year floodplain previously protected by the levee. The structures closest to the levee overtopping or breach location will suffer the most damage from the initial embankment failure flood wave, and other buildings landward of the breach area will be damaged by inundation (FEMA 2004).

Levees require maintenance to continue to provide the level of protection they were designed and built to offer. The responsibility for conducting routine maintenance and inspections belongs to a variety of coordinating entities including local, state, and federal government and private landowners. Well-maintained levees may obtain certification through independent inspections. However, levee owners must maintain the levee and pay for an independent inspection in order to be certified for maintaining flood protection. Not surprisingly, un-certified levees have a higher risk of failure. In addition, insurance rates may increase for properties located in the inundation area of uncertified levees as identified on FEMA Flood Insurance Rate Maps (FIRM) because FEMA notes that the structures are not certified to protect from a 1-percent annual chance flood event (FEMA 2004).

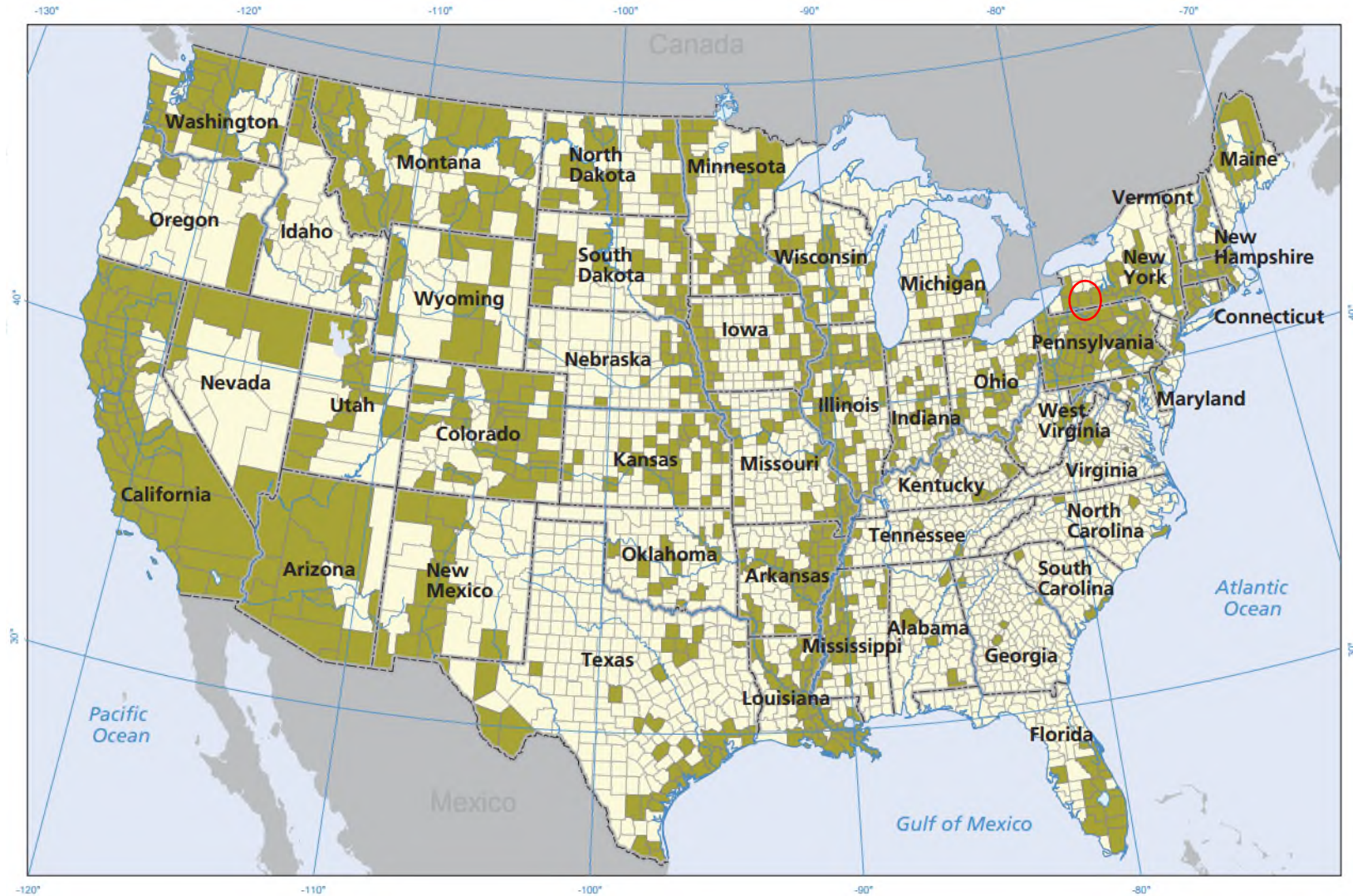
Like dam failures, warning time depends on the cause of the failure. Despite warnings regarding the structural integrity of the system, a levee failure caused by structural failure can be sudden and perhaps with little to no warning. If heavy rains are impacting a levee system, communities located in the immediate danger zone can be evacuated before a failure occurs. If the levee failure is caused by overtopping, the community may or may not be able to recognize the impending failure and evacuate. If a levee failure occurs suddenly, evacuation may not be possible.

Levee failures can also cause secondary hazards including severe downstream, landslides, bank erosion, and destruction of habitat. Environmental incidents may ensue due to hazardous materials released when floodwaters infiltrate facilities that store these types of materials.

Location

Upwards of 100,000 miles of levees stretch across the United States, and over 85 percent are thought to be locally owned. The remaining 15 percent are overseen by USACE or other federal or state agencies. FEMA has estimated that levees are located in approximately 22 percent of the counties in the United States, and 43 percent of the population lives in counties with levees. Figure 5.4.7-1 shows the counties in the United States and New York State that contain levees, including Allegany County, according to the American Society of Civil Engineers.

Figure 5.4.7-1. United States Counties Where Levees Are Found



Source: American Society of Civil Engineers 2010

Note: Information shown on this figure is current as of August 2009. The red oval indicates the approximate location of Allegany County.

A comprehensive listing regarding the types and locations of levees across NYS and Allegany County is not available. This is mostly because many of the levee systems were not built through formal processes, and therefore never fully documented. Table 5.4.7-1 lists the locations of levee systems in Allegany County as reported in the USACE National Levee Database. These systems represent the major structures in which the USACE has provided some degree of assistance or oversight during development. The table includes levees that are owned federally, by the State, or locally. According to USACE, Allegany County has three levees, all of which are sponsored, monitored, or maintained by NYSDEC. The following table provides details about those levees.

Table 5.4.7-1. Number of Levees in Allegany County

Sponsor (s)	System Name	Segments	Length (miles)	RIP Status	Inspection Rating
NYSDEC Region 9	Wellsville, Genesee River, Left Bank	1	0.91	Active	Unacceptable
NYSDEC Region 9	Wellsville, Dyke Creek, Left Bank	1	0.18	Active	Unacceptable
NYSDEC Region 9	Wellsville, Genesee River, Right Bank	1	0.38	Active	Unacceptable

Source: USACE n.d.

Note: All levees shown were federally constructed by USACE, then turned over to public sponsor operations and maintenance

RIP Rehabilitation and Inspection Program

All three levees recorded in Allegany County are part of the Wellsville Flood Damage Reduction Project located on the Genesee River and Dyke Creek in the Village and Town of Wellsville. The project was authorized in two phases: the first in November 1966 and the second in June 1975. The project consists of channel improvements with control and drainage structures, including low levees in the vicinities of Pearl and State Street, between State Street to upstream of West Dyke Street, and above the upstream sheet pile weir near the Village line and near the upper limit of the project. Another levee was constructed above Miller Street.

The project was originally designed to protect the Village of Wellsville against damage from floods equal to a 50-year discharge in the Genesee River and Dyke Creek, and to reduce damages in the event a larger flood should occur on either. The improvement was extended downstream into the Town of Wellsville to accomplish the lowering of stages in the Village. The project was modified by NYS Department of Transportation (NYSDOT) after Tropical Storm Agnes in 1972, based on new frequency curves and a design flow equivalent to a 20-year discharge of the Genesee River and 35-year discharge of the Dyke Creek (NYSDEC n.d.A).

In addition to the levees listed on the USACE National Levee Inventory, NYSDEC also reports on the Bolivar Flood Damage Reduction project, which includes a levee constructed in 1982, currently operated and maintained by the Village of Bolivar. The project was designed to provide protection along 4,750 feet of Root Creek where the maximum flood of record occurred in June 1972 with a peak flow of 2,000 cubic feet per second (cfs) (NYSDEC n.d.B).

FEMA Accredited Levees

Many levees shown on the effective FIRMs have never been remapped by FEMA since their original mapping in the 1970s and 1980s. Originally, FIRMs showed levees as providing protection from the base flood as long as they were designed and constructed in accordance with sound engineering practices. Beginning in 1986, levees have been shown as accredited on FIRMs only when they meet the requirements of Title 44, Chapter 1, Code of Federal Regulations (44 CFR) Section 65.10, “Mapping Areas Protected by Levee Systems,” including certification by a registered professional engineer or a federal agency with responsibility for levee design.

Since 1986, levees that do not meet the requirements of 44 CFR 65.10 cannot be shown as accredited on a FIRM. Furthermore, floodplain areas behind unaccredited levees are mapped as high-risk areas subject to FEMA’s minimum floodplain management regulations and mandatory flood insurance purchase requirement.

In 2004, as it initiated work under the Flood Map Modernization Initiative (Map Mod), FEMA determined that analysis of the role of levees in flood risk reduction would be an important part of the mapping efforts. A 2005 report noted significant documentation gaps on the status of the nation’s levees and that the condition of many levees and floodwalls had not been addressed since their original inclusion in the NFIP. As a result, FEMA established policies to address existing levees.

FEMA Accredited Levees are now generally discussed in two main types: those mapped on Digital Flood Insurance Rate Maps (DFIRM) since Map Mod, and those that are mapped prior to the initiative and not mapped on DFIRMs (FEMA 2012).

FEMA-Accredited Levees Mapped on DFIRMS

As DFIRMs are developed, levees fall under one of the three following categories: Accredited Levee, Provisionally Accredited Levee (PAL), and De-Accredited Levee. Accredited levees are documented to provide protection from at least the 1-percent-annual-chance flood, and therefore the area behind it will be mapped as moderate-risk with the exception of areas of residual flooding (interior drainage). The purchase of flood insurance is not mandated in a moderate-risk area, but flood insurance is strongly recommended.

A levee for which data and documentation are not readily available, and no known deficiency precludes meeting requirements of 44 CFR 65.10, may be deemed a PAL. FEMA will allow the party seeking recognition up to two years to compile and submit full documentation to show compliance with 44 CFR 65.10. The area behind a provisionally accredited levee will be mapped as moderate-risk with no mandatory flood insurance purchase requirement.

A levee for which data and documentation is not readily available, and is not eligible for the PAL designation will be de-accredited by FEMA. FEMA evaluates the level of risk associated with each non-accredited levee through its Levee Analysis Mapping Procedures (LAMP) criteria to consider how to map the floodplain and determine which areas on the dry side of the levee will be shown as high risk. The mapping will then be updated to reflect this risk (FEMA 2012).

Previous Occurrences and Losses

Between 1954 and 2015, FEMA has not included the NYS in any levee failure-related major disasters (DR) or emergencies (EM).

For this 2017 HMP Update, levee failure events impacting Allegany County between 1950 and 2015 were researched. In June 1972, Tropical Storm Agnes caused extensive damage to the Wellsville Flood Damage Reduction Project. Emergency restoration work was needed along almost the entire length of the improved river and creek channels to restore the Genesee River and Dyke Creek channels to their pre-Agnes condition. Emergency shoal removal, replacement of compacted embankments and levees, and restoration of bank stone protection was initiated shortly after the storm in June, and completed in November 1972. Additional rectification work was further required and completed in 1976 (NYSDEC n.d.A).

According to the National Climatic Data Center (NCDC), there have been no recorded events of levee failure in Allegany County. In addition, the 2011 HMP states that there has not been a failure in the history of Allegany County. Please note that not all events that have occurred in Allegany County are included in the HMP due to the extent of documentation and the fact that not all sources may have been identified or researched.

U.S. Department of Agriculture (USDA)-reported crop losses provide another indicator of severity of previous events. Additionally, crop losses can significantly impact the economy by reducing produce sales and purchases. Such effects may have long-term consequences, particularly if crop yields are low the following years as well. Although Allegany County has undergone annual crop losses due to natural hazard events, USDA does not note in its records from 1989 to 2015 that any of these losses resulted from levee failure damages (USDA 2016).

Probability of Future Occurrences

A complete levee failure, like a dam failure, is rather infrequent and typically coincides with the events that cause them such as heavy rainfall, storm surge, or hurricanes. As previously stated, there have been no major documented levee failures in Allegany County to date; however, the potential does exist given the condition of the regulated levees in the County. The three regularly inspected levees in Allegany County have not scored well in terms of structural standing.

Table 5.4.7-2 shows the current inspection ratings for levees in New York under the USACE program.

Table 5.4.7-2 Inspection Status of Allegany County Levees Monitored by U.S. Army Corps of Engineers

System Name	Last Inspection	Inspection Rating*
Wellsville, Genesee River, Left Bank	09/24/13	Unacceptable
Wellsville, Dyke Creek, Left Bank	09/24/13	Unacceptable
Wellsville, Genesee River, Right Bank	09/24/13	Unacceptable

Source: USACE n.d.

*Three National Levee Database Inspection Ratings can be given: Acceptable, Minimally Acceptable, and Unacceptable.

For the 2017 HMP update, a query of the National Oceanic and Atmospheric Administration (NOAA)-NCDC storm events database was used to identify the number of levee failures or incidents that occurred between 1950 and 2015. There was no record of any such events in Allegany County (NOAA-NCDC 2016). Because no levee failures have been recorded over 65 years, and only one levee has had reported damaged (damage to Wellsville Flood Control Project structures during Tropical Storm Agnes in 1972, as reported by NYSDEC), the future probability is unlikely.

Section 5.3 of this HMP ranks identified hazards of concern for Allegany County. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for levee failure in the County is considered “low” (likely to occur within 100 years, as presented in Table 5.3-3). The ranking of the levee failure hazard for individual municipalities is presented in Section 5.3 and in the jurisdictional annexes.

Climate Change Impacts

Levees in Allegany County may be affected by the impacts of climate change. Of particular concern may be the stress that an increase in the intensity and frequency of precipitation events could have on levee systems. With an increased volume of stormwater entering waterways, the levee systems may have to retain more water from storms themselves. As mentioned, many of the County’s levees are structurally deficient, and may be strained by increased intensity of storms.

Climate change is beginning to affect both people and resources in NYS, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already evident within the State. The Integrated Assessment for Effective Climate Change in NYS (ClimAID) was undertaken to provide decision-makers with information on the State’s vulnerability to climate change, and to facilitate development

of adaptation strategies informed by both local experience and scientific knowledge (NYS Energy Research and Development Authority [NYSERDA] 2011).

Each region within NYS, as defined by ClimAID, has attributes that will be affected by climate change. Allegany County is part of Region 3, the Southern Tier. Some of the issues of this region that are affected by climate change include projected agricultural revenue losses as and milk production loses, as dairy dominates the agricultural economy; increase incidence of Susquehanna River flooding; and increases in invasive insects, weeds, and other pests (NYSERDA 2011).

Annual average precipitation is projected to increase by up to one (1) to seven (7) percent by the 2020s, by four (4) to 10 percent by the 2050s and six (6) to 14 percent by the 2080s. During the winter months, additional precipitation will most likely occur in the form of rain, and with the possibility of slightly reduced precipitation projected for the late summer and early fall (NYSERDA 2014).

The projected increase in precipitation is expected to occur via heavy downpours and less in the form of light rains. Over the past 50 years, heavy downpours have increased, and this trend is projected to continue, contributing to localized flash flooding in urban areas and hilly regions. Total precipitation amounts have slightly increased in the northeastern states by approximately 3.3 inches over the last 100 years. The number of two (2)-inch rainfall events over a 48-hour period has increased since the 1950s (a 67-percent increase). The number and intensity of extreme precipitation events are increasing in NYS as well (Cornell University College of Agriculture and Life Sciences 2011). As a result of these higher-intensity rainfall events, the failure probability of uninspected, unregulated, or poorly rated levees may increase.

5.4.7.2 Vulnerability Assessment

To understand risk, a community must evaluate its assets that are exposed or vulnerable to the identified hazard. For the levee failure hazard, all assets protected by levees are exposed to the effects of a levee failure. This section addresses the following factors to evaluate and estimate the potential impacts of the levee failure hazard on Allegany County:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on (1) life, safety, and health of residents; (2) general building stock, critical facilities, and the economy; and (3) future growth and development
- Change of vulnerability as compared to that presented in the 2011 Allegany County HMP
- Future growth and development
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

While levees can help reduce the risk of flooding, they do not eliminate the risk. Levees can and do deteriorate over time and must be maintained to retain their effectiveness (FEMA 2016). As discussed above, levee failure events may occur suddenly, without warning, or during normal operating conditions. Additionally, events can occur as a result of a natural hazard event, including severe weather, earthquakes, and flooding. The direct and indirect losses associated with levee failures include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure, and stress on community resources. The warning time for a levee failure event is often limited, which contributes to the direct and indirect losses. Because there are potentially more levees in the County than are known and documented, it is impossible to estimate the exact exposure to the hazard. The Village and Town of Wellsville are the only Allegany County municipalities containing USACE levees.

Data and Methodology

As noted in Section 5.1 (Methodology), a digitized FIRM was not available for the vulnerability assessment. A Quality 3 (Q3) (dated 1996) provided by Allegany County was used to evaluate flood risk. It is unknown if the USACE levees in the Village and Town of Wellsville were analyzed and mapped in the Q3 to depict the effect on the landward side of the levee systems. Levee-failure inundation areas were not provided for the purposes of this planning effort. Therefore, a qualitative assessment is provided below.

Impact on Life, Health, and Safety

The entire population in a levee-protected zone is considered exposed and potentially vulnerable. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also highly vulnerable because they are more likely to seek or need medical attention that may not be available because of isolation during a flood event and they may have more difficulty evacuating.

Often, warning time for levee failure is limited. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard. Ongoing mitigation efforts, including dissemination and early warning systems noted in Section 6 (Mitigation Strategies) of this plan update, should help avoid the most likely cause of injury: persons trying to cross flooded roadways or channels during a levee failure-induced flood.

Impact on General Building Stock, Critical Facilities, and Economy

All buildings and infrastructure located in the levee protection zone are considered exposed and potentially vulnerable. Properties located closest to the levee have the greatest potential to experience the largest, most destructive surge of water. All transportation infrastructure in the inundation zone is vulnerable to damage, which could result in cutting off evacuation routes, limiting emergency access, and creating isolation issues. Utilities such as overhead power, cable, and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

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.

Change of Vulnerability

Overall, the County's vulnerability has not changed and all areas within a levee-protected zone will continue to be exposed and potentially vulnerable to levee failure events. As the levees continue to age and degrade, vulnerability will increase unless improvements are made and reflected in the USACE inspection reports.

Future Growth and Development

As discussed in Sections 4 and 9, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the levee failure hazard if located within a levee-protected area. Volume II, Section 9 of this plan identifies specific areas of development in both tabular form and on the hazard maps included in the jurisdictional annexes therein.

Additional Data and Next Steps

Because of the sensitive nature of the levee failure hazard and information surrounding levee protection zones, potential losses have not been quantified and presented in this plan. To estimate potential losses to population, buildings, critical facilities, and infrastructure, levee failure inundation areas and depths of flooding may be used to generate depth grids. Hazards U.S.-Multi Hazard (HAZUS-MH) may be used to estimate potential losses for the County and participating municipalities.