

**NRCS Brodhead Tributaries
Canadensis, Pennsylvania
PA-464**

Appendix D: Investigations and Analyses Report

1. Project Formation

This section summarizes the investigations and technical basis used to define the problems at PA-464 (Goose Pond Run Dam) and to develop feasible rehabilitation alternatives in accordance with the National Watershed Program Manual (NWPM, June 2024) and the Principles and Requirements for Federal Investments in Water Resources (PR&G, 2013). Planning activities were conducted in support of a Supplemental Watershed Plan–Environmental Assessment (Plan-EA) pursuant to NEPA and NRCS guidance for PL-566 watershed structures.

Goose Pond Dam (PA-464) is a floodwater retarding structure located on Goose Pond Run in Barrett Township, Monroe County, Pennsylvania. Constructed in 1976 as part of the Brodhead Creek Watershed project authorized under Public Law 83-566, the dam provides critical flood attenuation for the community of Canadensis, protecting approximately 345 residents, local businesses, public utilities, and key transportation routes.

A multi-disciplinary planning effort led by the project team began in 2022 to evaluate the condition of the dam, determine its compliance with modern dam safety criteria, inventory potentially affected resources, and develop feasible long-term alternatives.

These investigations were supported through topographic and bathymetric surveys, geotechnical investigations, sediment surveys, and hydrologic/hydraulic modeling. The project team conducted wetland and biological assessments, cultural resource surveys, soil assessments, and land use evaluations. Consultation and coordination included PADEP Dam Safety, USACE (Philadelphia District), USFWS, the Pennsylvania Natural Heritage Program, PA SHPO, and multiple Tribal Nations.

Project formulation considered structural and non-structural alternatives. Rehabilitation options were developed to balance public safety, regulatory compliance, environmental protection, and community needs. The planning process emphasized reducing flood risk, maintaining coldwater fisheries habitat, protecting wetlands and water quality, and avoiding impacts on cultural resources.

In addition to the site-specific investigations at PA-464, planning and technical studies were developed concurrently with PA-463 (Leavitt Branch Dam), located approximately 1.5 miles to the north. As such, multiple technical studies, including aspects of the hydrologic and hydraulic analyses, Phase I archaeological survey, and dam breach modeling, were performed on a watershed basis that, when appropriate, encompassed both structures. This integrated approach ensured consistency in modeling downstream inundation zones, characterizing cumulative cultural and environmental effects, and defining public safety risks where the breach waves intersect. Although each dam is documented under a

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separate Supplemental Watershed Work Plan, the shared technical foundation strengthens the accuracy of project formulation, facilitates interagency review, and supports efficient application of NRCS watershed planning procedures.

2. Detailed Cost Estimate

The detailed engineer's opinion of probable costs below accounts for estimated quantities of material and labor.

Table D-1: Preferred Alternative Detailed Cost Estimate

Item No.	Work or Material	Estimated Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing (Trees and Brush) - Embankment	0.5	Acre	\$4,000.00	\$ 2,000
2	Clearing and Grubbing (Trees and Brush) - Borrow Area	7.8	Acre	\$4,000.00	\$ 31,200
3	Selective Concrete Demolition - Principal Spillway Impact Basin	47	CY	\$125.00	\$ 5,875
4	Demolition and Disposal - Chain link Fence	80	LF	\$5.00	\$ 400
5	Erosion and Sediment Control (assume % of Construction Cost)	1	LS	5%	\$ 496,022
6	Erosion Control blanket (for slopes >= 3H:1V) Embankment	25,290	SY	\$15.00	\$ 379,350
7	Construction Survey - Stakeout, As-Built, Quantities, etc.	1	LS	\$90,000.00	\$ 90,000
8	Mobilization and Demobilization (assume % of Construction Cost)	1	LS	5%	\$ 496,022
9	Traffic Control Plan, Bonding of Roads for Site Access, Permits, etc.	1	LS	\$40,000.00	\$ 40,000
10	Reservoir Control or water, Dewater Excavations, etc. (assume % of Construction Cost)	1	LS	4%	\$ 396,818
11	Excavation - Embankment - Topsoil Stripping (12-inches)	9,680	CY	\$15.00	\$ 145,200
12	Excavation Borrow Area - Soil and Weathered Rock Excavation	77,420	CY	\$15.00	\$ 1,161,300
13	Excavation - Borrow Area - Topsoil Stripping (12-inches)	16,330	CY	\$15.00	\$ 244,950
14	Excavation - Auxiliary Spillway Channel - Topsoil Stripping (12-inches)	5,490	CY	\$15.00	\$ 82,350
15	Excavation - Cutoff Wall - Soil and Weathered Rock Excavation	1,500	CY	\$15.00	\$ 22,500
16	Excavation - Embankment Foundation Preparation	2,000	CY	\$15.00	\$ 30,000
17	Excavation - Removal of Existing Embankment Toe Riprap	170	CY	\$80.00	\$ 13,600
18	Earth Fill - Main Embankment - Fill	77,416	CY	\$25.00	\$ 1,935,400
19	Earth Fill - Auxiliary Spillway Channel and Left Embankment Fill	6,885	CY	\$25.00	\$ 172,125

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20	Earth Fill – Cutoff Trench Wall Backfill	1,160	CY	\$25.00	\$ 29,000
21	Embankment - Topsoil Placement (12-inches)	9,680	CY	\$13.00	\$ 125,840
22	Embankment - Seeding and Mulching	6.0	Acre	\$4,500.00	\$ 27,000
23	Borrow Area- Topsoil Placement (12-inches)	16,330	CY	\$13.00	\$ 212,290
24	Borrow Area - Seeding and Mulching	10.2	Acre	\$4,500.00	\$ 45,900
25	Auxiliary Spillway Channel and Left Embankment - Seeding and Mulching	5,490.0	CY	\$13.00	\$ 71,370
26	Auxiliary Spillway Channel and Left Embankment - Seeding and Mulching	3.4	Acre	\$4,500.00	\$15,300
27	Embankment Toe Drain Coarse Drain fill	640	CY	\$170.00	\$ 108,800
28	Embankment Toe Drain Fine Drain fill	8,760	CY	\$170.00	\$ 1,489,200
29	Embankment Toe Drain 8" PVC Internal Drain Pipe	576	LF	\$80.00	\$ 46,080
30	Cleanout Access Manhole	4	EA	\$11,500.00	\$ 46,000
31	Restoration of Site Access	1	Acre	\$6,000.00	\$ 6,000
32	Restoration of Staging Areas	2	Acre	\$6,000.00	\$ 12,000
33	Replace Fence Along Impact Basin	80	LF	\$150.00	\$ 12,000
34	Drainage for Spring Above Aux. Spillway and Ditch Regrade	1	LS	\$75,000.00	\$ 75,000
35	Broad Crested Weir- Cutoff Wall	340	CY	\$1,700.00	\$ 578,000
36	Broad Crested Weir- Control Section (concrete)	890	CY	\$1,700.00	\$ 1,513,000
37	Broad Crested Weir- Training Wall Cutoff	200	CY	\$1,700.00	\$ 340,000
38	Broad Crested Weir- Grouted Rock Anchor at Cutoff	750	LF	\$350.00	\$ 262,500
39	Remove and Install Reservoir Drain Valve	1	LS	\$100,000.00	\$ 100,000
40	Principal Spillway Intake Tower Repair	1	LS	\$60,000.00	\$ 60,000
41	Foundation Preparation and Cleaning for Aux. Spillway	78	SY	\$45.00	\$ 3,510
42	Conduit Extension of Principal Spillway	60	LF	\$1,715.00	\$ 102,900
43	Contractor Quality Control	1	LS	\$250,000.00	\$ 250,000
44	Field Office for exclusive use by the engineer, NRCS, and owner	1	LS	\$60,000.00	\$ 60,000
45	Temporary Support of Excavation	1	LS	\$60,000.00	\$ 60,000
46	Grout Existing Drainpipe – Abandon	300	LF	\$65.00	\$ 19,500
47	Impact Basin	1	LS	\$195,000.00	\$ 195,000
Total Cost of Construction					\$11,599,302
Contingency (25%)					\$2,899,825
Engineering Design					\$750,000
Land Rights					\$65,000
Total Cost					\$15,314,127

3. Cost Distribution

Federal cost share for total eligible dam rehabilitation costs is 65%. Federal engineering services and project administration costs, as well as permit and land rights acquisition costs, are not included when calculating eligible federal cost share. Real property rights, permits, annual O&M costs, and local administration costs are 100% the local funds, while engineering design and federal administration costs are 100% the federal funds.

4. Engineering

Topographic Survey and Sediment Survey

To supplement data from available as-built drawings, topographic survey data was collected. The accuracy of the topographic data allowed for the development of a topographic surface consisting of 1-foot contour intervals.

Equipment utilized was Leica GS18 Survey grade GPS units, a static X90 GPS unit, a Leica GS15 survey grade GPS unit, and several 3-second Leica robotic total stations. A grid pattern of measurements was taken, with a reading roughly every 25 feet on man-made features, and roughly every 50 feet on the natural features which is an industry standard for 1-foot contours. The field data picked up the location of the principal spillway inlet and outlet structures, the extents of the reservoir, the auxiliary spillway, the downstream channel, utility poles, and other improvements in the area of the dam.

The survey data collected at the Goose Pond Dam was compared to critical elevations reported on the NRCS As-Built Plans, which is assumed to be in the NGVD29 vertical datum. Using the NOAA NGS Coordinate Conversion and Transformation Tool (NCAT) to generate a conversion factor from NGVD29 to NAVD88 datum, a converted height difference of -0.556 was calculated.

Goose Pond Dam Sediment

Bathymetry data was obtained by sonar readings using a dual frequency survey-grade real time kinematics (RTK) global positioning system (GPS) unit (Leica GS18) in base and rover configuration in conjunction with a dual frequency sonar probe (SEAFLOOR HYDROLITE-DXF). Horizontal control was coordinated with ground location data via the survey grade base and rover GPS system. A survey grid in the Lower Pond was established by multiple east-west passes and north-south passes with the boat while collecting sonar data. This resulted in a collection of sonar shots at a frequency of 100-ft on-center or less. Due to its

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small area, a survey grid in the Upper Pond could not be established efficiently with east-west and north-south passes of the boat. Instead, the field surveyor conducted modified circle passes with the sonar boat to achieve a data collection grid on approximately 50-ft centers and obtain the required coverage at the areas the boat was able to access.

Visual reviews indicate several large vegetation masses in the open water within the upper pond, and survey shots within these areas were performed on foot. There were several large areas with masses of floating vegetation in the Upper Pond at the time of the survey and were primarily located in the vicinity where the stream enters the reservoir from the north. The survey team could not walk or boat into these masses and bathymetric shots were not obtained at these areas. The GPS shot density in the upper portion of the pond varied primarily between 10 and 40-ft, except in the immediate vicinity underneath the largest floating mass, where the widest gap between shots was approximately 70-ft. To affirm the depths of submerged sediment between the elevation models, periodic field depth measurements were taken at GPS shots using a survey rod, by extending the rod into the sediment and measuring the depth of the rod extension. The correlation between sonar produced sediment depths to manual depths is generally within 0.1-ft or less. In addition, a visual review at the stream confluence with the reservoir was conducted to ascertain the extent of accumulated aerated sediment.

Inspections

Visual

The project team performed visual inspections to document current conditions at Goose Pond Dam (PA-464). The entire dam was walked and appurtenances inspected.

Internal Pipe

The project team conducted a robotic video inspection of the interior of the principal spillway conduits and embankment internal drains as part of the documentation of the existing conditions of Goose Pond Dam.

Sediment Storage & Stage Storage

The submerged sediment volume in the reservoir was estimated by creating two (2) surfaces, one for the bottom of reservoir and the second for the underlying restrictive layer. The two surfaces were compared using functions in AutoCAD to determine the historical accumulated sediment volume for each dam.

The elevation-storage relationship for Goose Pond Dam was calculated using the average end area method. The 2008 PAMAP LiDAR and surveyed contours were combined to

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compute storage volumes and surface areas at specified intervals. The calculated volume for the existing conditions included only the flood pool storage. Storage values were calculated from the normal pool elevation to an elevation higher than the top of dam in 2-foot elevation increments. Any aerated sediment was accounted for in the stage storage.

Slope stability

The project team completed limit equilibrium slope stability analyses using the computer program Slide by Rocscience for the existing dam configuration along the dam sections. Slope Stability analyses were completed in accordance with applicable design conditions listed in TR-60 and PADEP requirements using Spencer's method of slices for circular failure surfaces.

Drain and Filter Criteria

The Drain Capacity calculations were completed for the internal drain materials and embankment and foundation soils adjacent to the internal drain in accordance with the NRCS Chapter 26 – Gradation and Design of Sand and Gravel Filters. The project team also compared filter criteria scenarios to the USACE permeability criteria outlined in the USACE EM 1110-2-2300 document. The project team used flow rates from seepage analyses with the pool at the maximum pool level (top of dam elevation, El. 1203.8) per TR-60. The drain dimensions were estimated based on the NRCS 1971 As-Built Drawings for Goose Pond Dam.

5. Biology

Wetlands

Wetland investigations were completed to identify and delineate jurisdictional wetlands and other Waters of the United States (WOTUS) that may be affected by rehabilitation activities at PA-464 (Goose Pond Dam). Delineation was performed by the project team following the 1987 U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual and the 2012 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region. The work was consistent with NRCS guidance and NEPA requirements for PL-566 watershed planning.

Wetland boundaries were defined using indicators of hydrophytic vegetation, hydric soils, and wetland hydrology. Field methods included:

- Completion of routine wetland determination forms
- Use of the 50/20 rule for vegetation dominance

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- Evaluation of hydric soils using NRCS Field Indicators (v8.2)
- Identification of primary and secondary hydrology indicators (e.g., drainage patterns, oxidized rhizospheres, saturated soil)

Global Positioning System (GPS) coordinates were recorded at PA-464 (Goose Pond Dam) using sub-meter accuracy Trimble devices to support future mapping and planning documentation. The delineated wetland boundaries were digitized in ArcGIS Pro 3.2 and overlaid with topographic base layers for integration into project planning maps and environmental resource figures.

Field Verification

Site investigations conducted June 6–7, 2022 documented ordinary high water (OHW) indicators, perennial flow conditions, channel and bank stability, and wetland hydrology, vegetation, and soils in the vicinity of the dam. Supplemental NRCS and D&K inspections in 2022–2023 provided additional field observations at and downstream of the outlet. These field-based verifications corroborate desktop mapping results and informed construction-phase risk screening and environmental impact avoidance measures.

Rare, Threatened, and Endangered Species

To identify and evaluate potential effects to federally and state-listed species, the project used a two-step approach, a desktop consultation screening followed by targeted field habitat reconnaissance.

Desktop screening (federal and state). An official USFWS Information for Planning and Consultation (IPaC) query was completed on May 29, 2024, for the PA-464 action area. The IPaC package provided the official species list and mapped resources (e.g., migratory birds, any designated critical habitat if present) to guide subsequent field efforts. A Pennsylvania Natural Diversity Inventory (PNDI) environmental review was conducted on July 9, 2024; the receipt captured agency responses (USFWS, PFBC, PGC, DCNR) and conservation-measure notes tied to the submitted footprint, methods, and timing. These desktop outputs established the initial species/habitat universe and informed the focus of field reconnaissance.

Field habitat reconnaissance. Ground surveys were performed from June–July 2024 across the dam embankment (crest, slopes, and toes), the auxiliary spillway channel and control section, the ephemeral flood pool, existing access corridors, and the modeled downstream breach zone used for FWOP screening. Survey coverage was designed to be

systematic and mappable, analogous in discipline to a topographic grid, to ensure all areas of potential effect were appropriately reviewed for species and habitat indicators.

6. Hydrology

Precipitation Data

The source of precipitation data used in the hydrologic and hydraulic analysis is the National Oceanic and Atmospheric Administration (NOAA) Atlas-14 Volume 2.0 Version 3.0 (retrieved October 7, 2021) and PADEP PMP Tool. The PADEP developed the PMP Tool for the estimation of state specific PMP values throughout the Commonwealth of Pennsylvania. The PADEP PMP tool was used to develop updated PMP depths and temporal distributions. The PADEP PMP tool outputs rainfall depths for the 24-hour, 12-hour, 6-hour, 3-hour and 2-hour and temporal distributions for Local, General, and Tropical storm type PMP events.

The PSH was developed following NRCS procedures in NEH-630.21 as incorporated in the SITES computer program. Two scenarios are considered for the principal spillway hydrograph (rainfall & runoff). Rainfall input includes the 100-year, 10-day event and the 100-year, 1-day (24-hour) event as referenced from NOAA Atlas 14. Runoff inputs include the 100-yr, 10-day event and the 100-yr, 1-day (24-hour) event as referenced from NEH 630.21 Figure 21-2 and Figure 21-3.

The auxiliary spillway was assessed using a stability design hydrograph (SDH). The SDH inputs were developed for the 6- and 24-hour events. The SDH rainfall input for a high hazard dam was computed using the formula found in TR 210-60. Figure 2-2 of TR 210-60 defines the precipitation data for the freeboard design hydrograph (FBH) at a High Hazard classified dam to be the probable maximum precipitation (PMP). The NRCS 6-Hour dimensionless design storm distribution for the FBH design storm from NEH-630.21 Figure 21-9 was also analyzed with the PMP storms.

Upstream Dams

The upstream dams play a big role in the analysis of PA-464. Upstream of Goose Pond, there are two dams: Oak Springs, and Lake Lenape. Lake Lenape and Oak Springs data was not available, and many parameters were estimated. In the analysis, it is assumed that the dams do not overtop before the 100-year storm event since there are no records of failure.

Table D-2: Upstream Dams Overtopping by Storm Frequency

Dam	100-Year	200-Year	500-Year	FBH
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Oak Springs Lake	X	X	X	X
Lake Lenape	X	X	X	X

The upstream dams were analyzed for storm events and breaches. The breach parameters were estimated using guidelines from PADEP Division of Dam Safety, FEMA, and TR-60. The water surface elevation of the dams at the time of breach is assumed to be 0.1 feet above the dam crest elevation for overtopping breaches and at normal pool for piping breaches.

Hydraulic Analysis

Existing Conditions

Since Leavitt Branch Dam and Goose Pond dam have generally the same downstream impacted area, the modeling of Goose Pond Dam considered the effects of Leavitt Branch Dam operating in normal conditions. Leavitt Branch auxiliary spillway crest is activated for storm frequencies of 50-year and above. Goose Pond auxiliary spillway crest is activated for storm frequencies of 100-year and above. The 500- year frequency storm did not overtop Leavitt Dam and Goose Pond Dams. However, Leavitt Branch Dam's auxiliary spillway breaches during the 380-year storm.

Table D-3: Future CN Frequency Storm Event Peak Inflows and Maximum Water Surface Elevation

Storm	Goose Pond Peak Inflow (cfs)	Goose Pond Max WSEL (ft)*
50-year	2,449.9	1,185.52
100-year	10,667.0	1,197.40
200-year	11,394.7	1,198.37
500-year	12,268.9	1,199.82
FBH	22,010.9	1,206.52

*Existing Top of Dam Low Point at El. 1203.7

Existing Integrity

NRCS integrity analyses for the PA-464 dam were conducted in accordance with NRCS methods in NEH Part 628, Chapter 51 - Earth Spillway Erosion Model (NEH-628.51) (NRCS 1997) as incorporated in the SITES model. The integrity analysis is based on the auxiliary spillways ability to pass the design flood events without head cutting occurring through the auxiliary control section (resulting in dam failure). The geotechnical and geologic investigations provided information related to the auxiliary spillway material properties.

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The auxiliary spillway does not meet current NRCS integrity criteria during the future watershed condition scenario. The control section breached during the FBH event.

Existing Stability

NRCS stability analyses for the auxiliary spillway was conducted in accordance with NRCS methods in NEH Part 628, Chapter 51 - Earth Spillway Erosion Model (NEH-628.51) (NRCS 1997) as incorporated in the SITES model. The stability analysis is based on the auxiliary spillway's ability to pass the SDH flood events without the vegetal cover surface of the spillway failing. In accordance with NRCS requirements in TR 210-60, auxiliary spillway stability analyses were performed using the 24-hour and 6-hour SDH. The auxiliary spillway meets current NRCS stability criteria based on the Total Allowable Vegetal Stress.

PA-464 Breach

The breach parameters were estimated using guidelines from PADEP Division of Dam Safety, FEMA, and TR-60. Four Breach scenarios were analyzed: Hydrologic Breach, Static Breach, Seismic Breach, and a No-Action Breach. The hydrologic breach assumed the reservoir water surface elevation is assumed to be 0.1 feet above the Top of Dam elevation, as this is when the dam is considered to fail per input received from the NRCS. Overtopping breaching methods were used in HEC-HMS with the NRCS provided spreadsheet using TR-210-60 minimum peak breach discharges.

The static breach water surface elevation criteria assume the water surface elevation is either at the crest of the auxiliary spillway or at the maximum reservoir water surface elevation obtained by routing a 100-year storm-generated inflow hydrograph through the dam, whichever is higher. The 100-year inflow hydrograph for the static breach does not include the breaching of the upstream dams. Goose Pond's auxiliary spillway crest elevation was higher than the 100-year pool elevation; therefore, auxiliary spillway crest elevation was used in this evaluation. Piping breach failure methods were used in HEC-HMS with the NRCS provided spreadsheet using TR-210-60 minimum peak breach discharges.

The seismic breach water surface elevation for the dam assumes the reservoir is at the elevation of the principal spillway weir. Piping breaching methods were used in HEC-HMS with the NRCS provided spreadsheet using TR-60 minimum peak breach discharges. The piping breach elevation was estimated halfway between the pool level and the pond bottom elevation. This elevation still accounts for some hydrostatic pressure and is a more probable elevation than it being closer to the pond bottom. The seismic breach also assumed all upstream dams of Goose Pond breach due to the seismic event for this evaluation.

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The no-action breach assumes the dams are in place, “as-is” existing conditions. Based on the deficiencies of the dam, the probable failure mode of the Goose Pond Dam is overtopping of the dam’s crest during the 58%FBH.

7. Geology

Area geology

The Goose Pond Dam is located in the Glaciated Low Plateau Section of the Appalachian Plateaus Physiographic Province. Geologic conditions at Goose Pond Dam were determined through review of available state and regional mapping resources and incorporated into project documentation. Bedrock information is based on Pennsylvania Geological Survey bedrock geologic mapping, which identifies the Long Run Member of the Catskill Formation (Devonian age) underlying the site. Bedrock at the sites is nearly horizontally bedded, interpreted from same available geologic mapping resources, indicate the bedrock dips at 5 degrees or less. Two small folds are presented in the vicinity of the site, which likely lead to small variations in the bedrock orientation. Surficial deposits were characterized using Pennsylvania Geological Survey surficial geology mapping, which indicates the deposits at Leavitt Branch Dam are comprised of the Alluvium, Woodfordian Outwash, and Woodfordian Ground Moraine. These sources provided the basis for describing the bedrock and surficial geology within the project area.

Subsurface exploration

The project team performed subsurface investigation activities at Goose Pond Dam. A total of eleven (11) borings were completed as part of this investigation and were advanced using both sonic and conventional drilling methods. Five (5) borings were to verify subsurface conditions related to the dam embankments and foundations and to support the evaluation of the seepage conditions and stability of the existing dam. Six (6) borings were completed to verify subsurface conditions related to the auxiliary spillway and to support evaluation of the existing auxiliary spillways’ stability and erodibility. Due to expected difficult drilling conditions, soil and weathered rock drilling within the embankment was completed using sonic drilling methods. Only conventional drilling methods were performed in the auxiliary spillway of the Goose Pond Dam due to the anticipated shallow depth to bedrock. A project team field representative classified all soil and rock that were encountered based on visual observations of sonic core samples, split-barrel samples, cuttings during drilling, and rock core samples.

Seismic potential

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In accordance with Technical Release 210-60, “Earth Dams and Reservoirs” (TR-60), the project team compiled data from available resources on magnitude 4 or greater earthquakes, and any active or capable faults within 62 miles (100 kilometers) of the Goose Pond Dam.

In accordance with Part 4 of TR-60, probabilistic seismic hazard curves were generated using the USGS Earthquake Hazards Program Unified Hazard Tool for the Maximum Design Earthquake (MDE) and Operating Basis Earthquake (OBE) as defined in TR-60 for the site based on return periods of 10,000 and 500 years, respectively. A probabilistic seismic hazard curve was also generated for the Maximum Credible Earthquake (MCE) as defined in the Pennsylvania Code for the site based on a return period of 2,500 years per Pennsylvania Code requirements.

Liquefaction Potential

Since the probable ground acceleration with 2 percent probability of exceedance in 50 years is between 10 and 20 percent of gravity (%g), the hazard classes are high, and the effective dam heights are greater than 20 feet, the liquefaction potential of the sites was evaluated in accordance with 210-VI-NEH, Part 631, Chapter 2, Section 631.0207.

Subsurface conditions

The borings completed within the Goose Pond Dam embankment encountered up to 108.9 feet of embankment materials overlying 0 to 23.5 feet of foundation soils, which are underlain by lithic sandstone bedrock.

Subsurface conditions encountered within the auxiliary spillway level section and downstream of the level section generally consist of 0.2 to 0.4 feet thick topsoil overlying approximately 8.7 feet to more than 36 feet thick glacial till deposits with isolated glacial outwash deposits, which are underlain by shaley siltstone and sandstone bedrock.

8. Land Use

Land uses for the existing watershed condition are based on the 2019 National Land Cover Data (NLCD) raster for the Continental United States, which is publicly available by the Multi-Resolution Land Characteristics Consortium (MRLC). This data set was selected as the most recent classification of land use within the watershed.

The estimation of future land uses is based on local comprehensive plan studies prepared by local governments and the USGS conterminous United States (CONUS) Land Cover Projections for 2100. The USGS CONUS Land Cover Projects for 2100 are only used when a

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comprehensive plan study was not available for certain areas of the watershed or if the CONUS Future Projections produced a larger future curve number. The following local comprehensive plans are available for the development of the Future Land Use projections for the purpose of estimating a future curve number to perform the H&H analyses:

- Barrett Township, Comprehensive Plan Update, 2008
- Monroe County Comprehensive Plan Update, December 2014
- Pike County Comprehensive Plan, Final Plan, November 2006

Where the comprehensive plans did not provide data, the base 2019 NLCD land use map was also updated based on USGS land cover prediction data, which makes inferences about land use change based on generalized future socioeconomic scenarios that are deemed plausible based on current and anticipated trends. The future land cover prediction data was obtained from the USGS Earth Resources Observation and Science (EROS) Center. USGS EROS manages the Conterminous United States Landscape Projections data set, which ranges from years 1992 to 2100.

9. Water quality

The PA-464 project area lies within the Goose Pond Run watershed, a sub-watershed of the Brodhead Creek system that ultimately drains to the Delaware River. To characterize existing water quality and evaluate potential effects, the assessment followed NWPM §501.45 guidance to summarize conditions and cite supporting sources rather than restate raw data. It relied on: (1) Pennsylvania DEP's Integrated Water Quality Report (2024) Viewer to identify designated uses and any 305(b)/303(d) listings for the local assessment units; (2) Chapter 93 Water Quality Standards to confirm applicable designated uses and antidegradation context in the Brodhead basin; (3) county-level stream studies (macroinvertebrates, chemistry, and habitat) that include Brodhead and monitored tributaries; (4) DRBC program materials establishing Special Protection Waters (SPW) downstream on the Middle Delaware; and (5) project field reconnaissance (wetlands/stream observations) and engineering plans for construction BMPs.

Existing condition (summary of findings). The Brodhead watershed is broadly recognized for high-quality cold-water conditions, with many segments designated HQ-CWF under Chapter 93. County monitoring (2019–2024) reports aquatic-life communities and chemistry consistent with high attainment on mainstem Brodhead and select tributaries in Monroe County. Goose Pond Run is a tributary within this system; downstream receiving waters of the Delaware River (Middle Delaware) are managed as SPW, reinforcing anti-

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degradation expectations for discharges in the basin. (Where the DEP viewer identifies a specific Goose Pond Run assessment unit, those AU IDs and any listed causes/sources were reviewed directly in the 2024 interface.)

Impact evaluation approach (alternatives). Effects were evaluated by: (a) checking whether either alternative would change designated uses or cause/expand an impairment on the relevant DEP assessment units; (b) screening construction-phase risks (erosion/turbidity, sediment delivery, accidental releases) against standard NRCS/PA erosion & sediment control BMPs in the plans; and (c) considering operational conditions of a dry detention structure (i.e., no permanent pool) and downstream antidegradation protections (SPW). Where applicable, known point sources to Goose Pond Run (e.g., small, permitted discharges) were considered for cumulative context, with compliance governed by DRBC and DEP permits.

Surface Water Designation and Existing Conditions

Findings from desktop datasets were confirmed by site reconnaissance during wetlands and stream investigations in 2022 and 2023. Field crews documented ordinary high water indicators, perennial flow in Goose Pond Run, bank stability, and evidence of coldwater habitat conditions (e.g., substrate type, shading, temperature). Wetland assessments included hydrology (saturation, seepage), vegetation communities, and soil profiles to verify jurisdictional boundaries. Observations at the auxiliary spillway and downstream channel documented areas of erosion and sediment deposition relevant to construction-phase risk screening. These on-the-ground observations were georeferenced with GPS, photographed, and logged in field forms to corroborate desktop data and ensure the accuracy of the assessment.

Influence of the Existing Dam on Water Quality

The project team, DDK, evaluated how the existing floodwater retarding structure affects water quality using: (1) DDK topographic and sediment surveys from 2022–2023; (2) volumetric sediment computations in the H&H Appendix that blend those surveys with NRCS as-builts and 2008 PAMAP LiDAR to build a reservoir DEM; (3) field reconnaissance during the June 6–7, 2022 wetlands/waterways investigation; and (4) visual/ROV inspections of appurtenant works. This approach follows NWPM guidance to document the procedures, techniques, and data resources used in the analysis.

Sediment Retention

DDK's July 2022 and January 2023 surveys mapped the reservoir bottom and restrictive layer at Goose Pond Dam (PA-464). Bathymetric sonar and hand-probe depth readings were used to characterize submerged and aerated sediments in both the Upper and Lower

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Ponds. The H&H team compared current storage derived from the DEM to historic storage between key control elevations (principal weir, auxiliary crest) to compute accumulated sediment volumes. For Goose Pond, the analysis estimates substantial submerged and aerated sediment deposits since installation (1975–2022), reflecting physical evidence of storm-event trapping and long-term deposition.

Water Temperature

Information on temperature influence at PA-464 was determined from field observations recorded during the 2022–2023 bathymetric and reservoir surveys. Documentation notes shallow water depths in both the Upper and Lower Ponds and extensive floating vegetation mats in the Upper Pond. Continuous temperature data were not collected on-site, and no gauges were used for this project. The inference about limited thermal influence was drawn directly from the physical site observations documented in survey reports.

Nutrient dynamics

The role of wetlands in nutrient retention was determined through delineations and field verification conducted in June 2022. Wetland data sheets and memoranda documented hydrology, vegetation, and soil conditions at and below the spillway, including Wetlands A and B. These records describe observed vegetation and hydrologic functions that support sediment and nutrient retention.

Turbidity/suspended solids

Sediment trapping capacity was determined using DEM-based volumetric calculations from the 2022–2023 surveys. The analysis compared current storage conditions to original design storage to calculate accumulated sediment volumes. This documented storage loss provides the basis for identifying the dam as a sediment trap during storm events.

Aquatic Habitat

Wetland and riparian conditions were determined through delineations performed June 6–7, 2022, under the 1987 Corps Manual and 2012 Northeast Regional Supplement. Field forms and data sheets documented dominant species, hydrology, and soil conditions. Riparian conditions were noted during the same field investigations, with records describing shading and cover along Goose Pond Run. Amphibian, reptile, and bird observations were also recorded during field visits.

10. Economic Analysis

This section presents the economic analysis conducted in support of the Plan-EA for Goose Pond Dam (PA-464) in Monroe County, Pennsylvania. The economic analysis was performed in accordance with applicable federal guidance, including:

- *Principles and Requirements for Federal Investments in Water Resources* (2013) and associated *Interagency Guidelines* (2014);
- *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983); and
- *National Watershed Program Manual* (2024).

All monetary values are expressed in 2025 price levels. Annual values are discounted using the Fiscal Year 2025 federal discount rate of 3 percent.

The analysis compared two alternatives: (1) the No Action / Future Without Federal Investment (FWOFI) Alternative, under which the dam continues to operate (with no work beyond routine operation and maintenance undertaken by the local sponsor) until such time that the dam is expected to fail and (2) the Preferred Alternative, consisting of structural rehabilitation of Goose Pond Dam. Consistent with NRCS National Instruction Title 390, Part 303 (2022), the No Action Alternative assumed no capital improvements beyond routine maintenance. Benefits of the Preferred Alternative were quantified as the reduction in flood damages relative to this baseline. For this analysis, the No Action and FWOFI alternatives were treated as equivalent based on coordination with the project sponsor.

Study Area and Analysis Framework

Goose Pond Dam (PA-464) is on the Goose Pond Run, a tributary of Brodhead Creek, and controls 6.85 square miles of watershed. The dam lies approximately north of the town of Canadensis, PA in the north central section of Barrett Township, Monroe County, PA. The study area for the economic analysis encompassed the downstream areas of Goose Pond Dam (PA-464) subject to flood impacts (Figure 1). Given the potential for overlapping flood extents due to the close proximity of Leavitt Branch Dam (PA-463) and Goose Pond Dam (PA-464), the two dams were evaluated within a shared economic study area for purposes of flood damage assessment (Figure 2). The study area for the analysis was defined using the maximum extent of inundation resulting from a breach of both dams under existing conditions. In this scenario where the 9,285-year, 6-hour storm was run for both the Leavitt Branch and Goose Pond watersheds concurrently, the Leavitt Branch Dam's auxiliary spillway breached at the flow rate equal to the flow from the 380-year, NOAA 24-hour event and the Goose Pond Dam overtopped and breached at the 9,285-year NOAA 6-hour event. This boundary encompassed the farthest extent of flooding for the flood events examined

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within the scope of the project. All other flood events examined for the analysis (2-year through 500-year flood events for No Action/FWOFI for each dam, Preferred Alternative for each dam, decommissioning scenarios for dams and individual breach scenario of each dam) fell within this breach floodplain. Individually, the boundary of the inundation limit for the breach of the Goose Pond Dam was greater than that of Leavitt Branch Dam's breach.

Flood damages to structures were estimated using HEC-FIA (Version 3.0). The model integrates hydraulic output data (including gridded depth, duration, and arrival time), terrain elevation, and structure-specific attributes to estimate flood damages. Structure elevations were represented using terrain data in combination with an assumed foundation height of 1.0 foot above ground surface. Structure locations, types, and values, along with corresponding content values and depth-damage functions, were incorporated into the model.

Using the output hydraulic data, the 2- year, 5-year, 10-year, 25-year, 50-year, 100-year, and 500-year flood events were modeled in HEC-FIA for No Action/FWOFI Alternative and Preferred Alternative conditions for each dam. The breach flood event under the No Action/FWOFI was also modeled. Depth-damage factors for the various structure types and contents were obtained from USACE data provided by NRCS (NRCS 2018). The No Action/FWOFI Alternative presents a baseline for comparison to estimate flood protection being provided by rehabilitation and is compared to the Preferred Alternative.

The No Action / FWOFI Alternative for Goose Pond Dam is modeled assuming both dams remain in operation for non-breach events. For breach scenarios, Leavitt Branch Dam is assumed to fail at flows comparable to the 380-year event, while Goose Pond Dam is assumed to breach under the 9,285-year event.

Roadway damages from flooding depend on unique study area factors, such as the roadways' height, distance from and position relative to the flood water. Therefore, published damage factors for roadways were not readily available. To estimate roadway damages, project civil engineers used project data (digital fieldview, mapping, and hydraulic modeling) to develop a series of assumptions regarding flood impacts on study area roadways. Cleaning and repair costs per linear foot were estimated by project civil engineers for roadways in the study area, based on removing flood debris and repairing damaged roadways. Using ArcGIS, the roadway mileage inundated under each flood event was calculated. Mileage inundated was multiplied by the percentage of flooded surface that would require cleaning and repair. Damaged surface (feet) was multiplied by the cleaning and repair costs (per foot) to obtain damages. Damage to overtopped bridges was assumed to be captured in roadway cleanup costs.

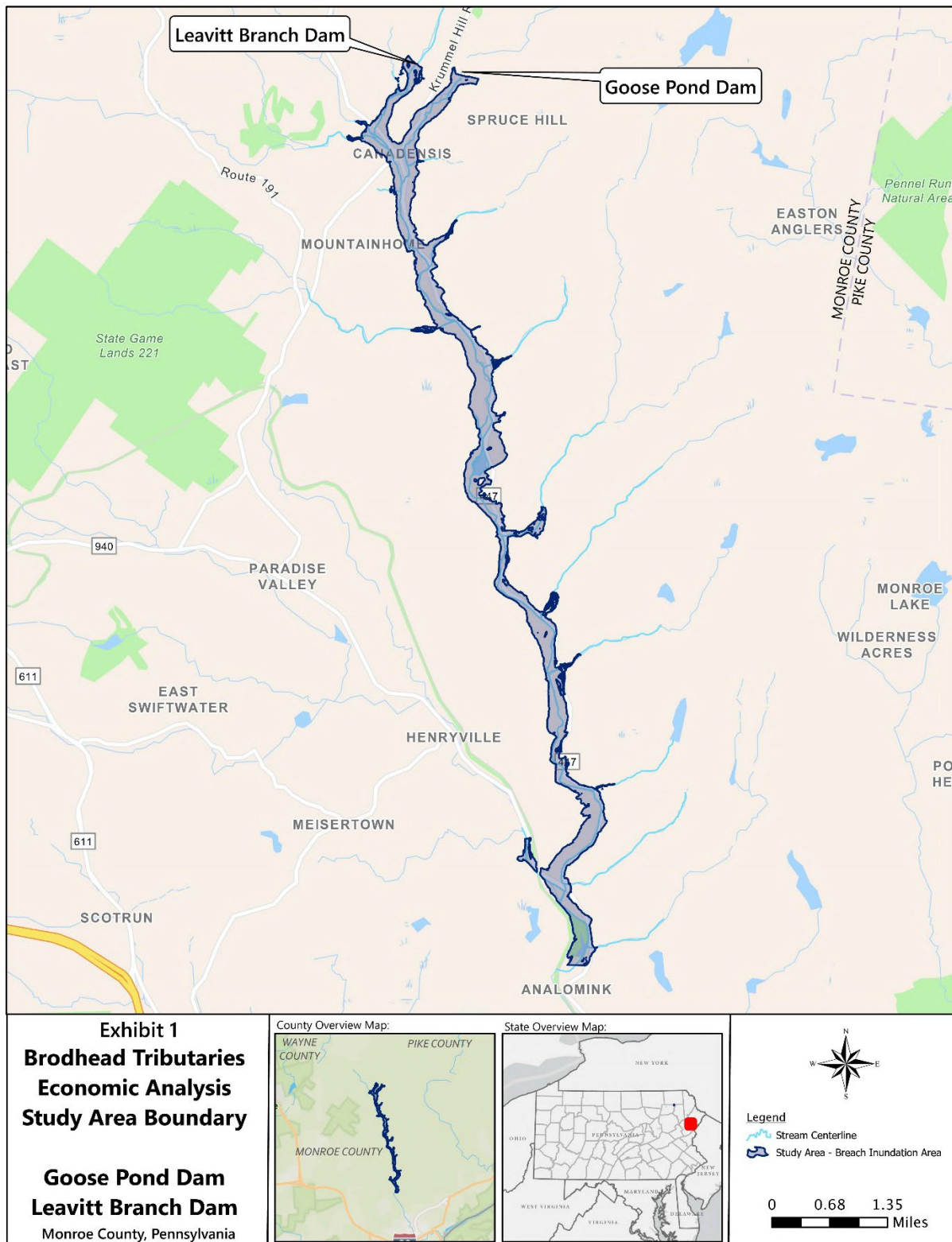


Figure 1



Structures and Vehicles

Study area structures were identified and categorized by land use type using GIS tax parcel data obtained from the Monroe County Tax Assessors Office (Monroe County Tax Assessors Office, 2023). The accuracy of the parcels database was verified via an examination of aerial photography.

Table D-4 presents the number of housing units affected by flooding under Goose Pond Dam (PA-464) breach conditions and selected without-dam flood events, representing properties that benefit from flood protection provided by the dam.

Table D-4: Number of Housing Units Receiving Flood Protection from PA-464 Dam

PA-464	Number of Housing Units
Breach	102
500-year without dam	55
100 year without dam	33

A dam failure event in the study area would lead to economic damage to homes, businesses and infrastructure within the town of Canadensis. Under breach conditions, a total of 149 structures were inundated, the majority of which experience flood depths greater than 1.0 foot above ground surface. This includes 102 homes as shown in Table D-4 above, 7 apartments, 28 commercial buildings, 1 school, 6 garages, 4 churches and a post office. Only 3 structures experience shallow flooding of less than 1.0 foot, indicating that breach conditions result in widespread and substantial structural impacts across the study area.

Structure value was estimated using the assessed value of buildings from the Monroe County tax database. Contents values for residential structures were valued at 50% of the total structure value, or 25% for garages and commercial/institutional structures were valued at 200% of total structure value, based on NRCS guidance.

Vehicles were included in the model, using HEC-FIA default settings for number of vehicles per property. One vehicle each was assumed for the residential structures. The Federal Emergency Management Agency HAZUS-MH MR3 Technical Manual methodology (FEMA HAZUS) was used to estimate personal vehicle value (FEMA, 2018). The FEMA HAZUS methodology provides vehicle age distribution data by vehicle classification and uses half of the average new car value for average used car vehicle values, based on National Automobile Dealers Association (NADA) data. Based on a 2025 average transaction price for a new mid-sized car (Kelley Blue Book, 2025), the average study area vehicle was assumed to be valued at \$18,141. No vehicles were assigned to commercial or institutional structures in the model, which is a conservative estimate to avoid over counting flooded vehicles.

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Roadways and Roadway Bridges

Roadways were divided into three categories: unpaved, local and state roads. Total mileage for each roadway type in the study area was estimated using ArcGIS. Table D-5 presents mileage impacted by the breach, 500 and 100 year without each dam event for PA-464.

Table D-5: Roadways within the Without Dam Floodplain for PA-464

PA-464			
	Breach	500-year without dam	100-year without dam
Roadway Type	Roadway Length (Miles)	Roadway Length (Miles)	Roadway Length (Miles)
Unpaved Road/Driveway	2.30	1.18	0.76
Local Road	1.11	0.95	0.63
State Road	11.12	7.71	5.24
Total	14.53	9.84	6.63
Source: Gannett Fleming, 2025.			
*Totals may not add up due to rounding.			

There are 20 roadway bridges within the study area breach event (under existing conditions) floodplain.

Damages to Structures and Vehicles

Flood damages to structures and vehicles under the No Action / FWOFI and Preferred Alternatives are summarized in Tables D-6 through D-9. These tables present results by structure type and flood event, including total damage and average flood depths.

Table D-6: HEC-FIA Output, Both Dams in Place

Flood Event	# of Structures Damaged	Structure Type	Sum of Structure Damage	Sum of Contents Damage	Sum of Vehicle Damage	Sum of Total Damage	Avg. Depth of Flooding (ft.)
Breach	28	Commercial	\$1,399,221	\$6,387,794	\$126,988	\$7,914,004	14.72
500-yr	19	Commercial	\$169,153	\$1,467,885	\$0	\$1,637,038	0.69
100-yr	3	Commercial	\$71,499	\$387,040	\$0	\$458,539	0.52
50-yr	2	Commercial	\$57,988	\$177,900	\$0	\$235,888	0.75
25-yr	2	Commercial	\$15,812	\$61,339	\$0	\$77,152	0.36
10-yr	2	Commercial	\$718	\$15,802	\$0	\$16,520	-0.15
5-yr	1	Commercial	\$440	\$9,676	\$0	\$10,115	0.22
2-yr	1	Commercial	\$0	\$0	\$0	\$0	-0.03
Breach	6	Institutional	\$440,278	\$3,846,737	\$0	\$4,287,015	12.94
500-yr	4	Institutional	\$75,128	\$744,265	\$0	\$819,393	0.90
100-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00

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50-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
25-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
10-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
5-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
2-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
Breach	115	Residential	\$7,871,142	\$5,500,298	\$1,761,210	\$15,132,649	13.05
500-yr	50	Residential	\$960,374	\$799,413	\$197,393	\$1,957,181	1.04
100-yr	15	Residential	\$131,042	\$87,301	\$10,464	\$228,807	-0.37
50-yr	8	Residential	\$66,749	\$18,798	\$0	\$85,547	-0.55
25-yr	8	Residential	\$52,752	\$4,418	\$0	\$57,170	-0.78
10-yr	3	Residential	\$13,193	\$4,415	\$0	\$17,608	-0.87
5-yr	2	Residential	\$5,084	\$4,413	\$0	\$9,496	-0.90
2-yr	2	Residential	\$5,002	\$4,409	\$0	\$9,411	-0.92

* Totals may not add up due to rounding.

**Negative flood depth is indicative of flooding at the basement level.

Table D-7: HEC-FIA Model Results, Damages Resulting from Both Dams in place

Flood Event	# of Structures Damaged ¹	Structures by Type			Total Structure Damage	Total Contents Damage	Total Vehicle Damage	Total Damage
		Res.	Comm.	Inst.				
Breach	149	115	28	6	\$9,710,640	\$15,734,829	\$1,888,198	\$27,333,668
500-yr	73	50	19	4	\$1,204,655	\$3,011,563	\$197,393	\$4,413,611
100-yr	18	15	3	0	\$202,541	\$474,341	\$10,464	\$687,346
50-yr	10	8	2	0	\$124,737	\$196,699	\$0	\$321,435
25-yr	10	8	2	0	\$68,565	\$65,757	\$0	\$134,322
10-yr	5	3	2	0	\$13,911	\$20,217	\$0	\$34,129
5-yr	3	2	1	0	\$5,523	\$14,088	\$0	\$19,612
2-yr	3	2	1	0	\$5,002	\$4,409	\$0	\$9,411

* Totals may not add up due to rounding.

Table D-8: HEC-FIA Output, Goose Pond Dam (PA-464) Preferred Alternative

Flood Event	# of Structures Damaged	Structure Type	Sum of Structure Damage	Sum of Contents Damage	Sum of Vehicle Damage	Sum of Total Damage	Avg. Depth of Flooding (ft.)
500-yr	19	Commercial	\$165,909	\$1,389,846	\$0	\$1,555,754	0.64
100-yr	2	Commercial	\$70,851	\$233,357	\$0	\$304,208	1.20
50-yr	2	Commercial	\$57,980	\$177,880	\$0	\$235,860	0.75
25-yr	2	Commercial	\$15,812	\$61,339	\$0	\$77,152	0.36

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10-yr	2	Commercial	\$718	\$15,802	\$0	\$16,520	-0.15
5-yr	1	Commercial	\$440	\$9,676	\$0	\$10,115	0.22
2-yr	1	Commercial	\$0	\$0	\$0	\$0	-0.03
500-yr	4	Institutional	\$81,090	\$770,724	\$0	\$851,814	1.02
100-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
50-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
25-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
10-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
5-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
2-yr	0	Institutional	\$0	\$0	\$0	\$0	0.00
500-yr	49	Residential	\$872,761	\$689,495	\$175,646	\$1,737,903	0.92
100-yr	12	Residential	\$107,035	\$77,366	\$9,355	\$193,756	-0.39
50-yr	8	Residential	\$66,495	\$18,786	\$0	\$85,282	-0.57
25-yr	8	Residential	\$52,626	\$4,418	\$0	\$57,044	-0.78
10-yr	3	Residential	\$13,075	\$4,415	\$0	\$17,490	-0.87
5-yr	2	Residential	\$5,084	\$4,413	\$0	\$9,496	-0.90
2-yr	2	Residential	\$5,002	\$4,409	\$0	\$9,411	-0.92

*Totals may not add up due to rounding.

**Negative flood depth is indicative of flooding at the basement level.

Table D-9 : HEC-FIA Model Results, Goose Pond Dam (PA-464) Preferred Alternative Damages

Flood Event	# of Structures Damaged ¹	Structures by Type			Total Structure Damage	Total Contents Damage	Total Vehicle Damage	Total Damage
		Res.	Comm.	Inst.				
500-yr	72	49	19	4	\$1,119,760	\$2,850,064	\$175,646	\$4,145,471
100-yr	14	12	2	0	\$177,886	\$310,723	\$9,355	\$497,964
50-yr	10	8	2	0	\$124,475	\$196,667	\$0	\$321,142
25-yr	10	8	2	0	\$68,439	\$65,757	\$0	\$134,196
10-yr	5	3	2	0	\$13,793	\$20,217	\$0	\$34,011
5-yr	3	2	1	0	\$5,523	\$14,088	\$0	\$19,612
2-yr	3	2	1	0	\$5,002	\$4,409	\$0	\$9,411

Tables D-10 presents the calculation of the expected annual damage for structures and vehicles under the No Action/FWOFI and Preferred Alternative for Goose Pond Dam (PA-464). Calculation of the expected annual damage (EAD) accounts for the probability of exceedance of each flood event magnitude. The expected annual damage is the area under the frequency-damage curve. The difference in damages between the No Action/FWOFI and the Preferred Alternative for the Goose Pond Dam (PA-464), \$23,294, represents the expected annual flood damage reduction benefit associated with the Preferred Alternative.

Table D-10: Expected Annual Damage for Structures and Vehicles, Goose Pond Dam (PA-464)

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Flood Event	Exceedance Probability	No Action -Goose Pond		Preferred Alternative -Goose Pond	
		Damages	Contribution to EAD	Damages	Contribution to EAD
9285	0.0001	\$27,333,668	2,944	\$19,373,496	2,087
500	0.002	\$6,810,487	32,305	\$ 4,145,471	22,252
100	0.010	\$687,346	29,991	\$497,964	18,574
50	0.020	\$321,435	5,044	\$321,142	4,096
25	0.040	\$134,322	4,558	\$134,196	4,553
10	0.100	\$34,129	5,054	\$34,011	5,046
5	0.200	\$19,612	2,687	\$19,612	2,681
2	0.500	\$9,411	4,353	\$9,411	4,353
		Total EAD	\$86,936	Total EAD	\$63,642

Damage to infrastructure

For Goose Pond Dam, Expected Annual Damages to roadways was estimated at \$565,675 under the No Action/FWOFI Alternative and at \$545,932 under the Preferred Alternative (Table D-11). The difference in damages between No Action/FWOFI and the Preferred Alternative conditions, \$19,743, represents the expected annual flood damage reduction benefit for roadway infrastructure.

Table D-11: Expected Annual Damage to Roadways, Goose Pond Dam (PA-464)

Flood Event	Exceedance Probability	No Action -Goose Pond		Preferred Alternative-Goose Pond	
		Damages	Contribution to EAD	Damages	Contribution to EAD
9285	0.0001	\$18,445,436	\$1,987	\$16,627,778	\$1,791
500	0.002	\$11,102,448	\$27,957	\$7,660,773	\$22,981
100	0.010	\$2,733,237	\$55,343	\$2,648,295	\$41,236
50	0.020	\$2,168,401	\$24,508	\$2,165,753	\$24,070
25	0.040	\$1,740,355	\$39,088	\$1,740,355	\$39,061
10	0.100	\$1,237,882	\$89,347	\$1,237,882	\$89,347
5	0.200	\$898,305	\$106,809	\$898,305	\$106,809
2	0.500	\$572,606	\$220,637	\$572,606	\$220,637
		Total EAD	\$565,675	Total EAD	\$545,932

*Totals may not add up due to rounding

Administrative Cost Savings to the National Flood Insurance Program (NFIP)

By reducing the size of the 100-year floodplain, the study area dams reduce the number of properties that must participate in the NFIP, which enables a saving in the administrative

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costs of the program. According to NRCS technical guidance based on a FEMA actuarial rate review, each policy is estimated to incur an administrative cost of \$407 per year. This value results from updating the original 2015 NRCS estimate using the Bureau of Economic Analysis (BEA) Gross Domestic Product Implicit Price Deflator (Townsend, 2016, FEMA 2011, BEA 2025).

The 100-year floodplain under the Preferred Alternative for PA-464 has 4 fewer properties than the 100-year floodplain under the No Action Alternative. Thus, there is a saving of \$1,628 in administrative costs per year for this alternative which is included in total benefits as shown in Table D-12.

The 100-year floodplain under the respective dam decommissioned conditions and the Preferred Alternative were also compared using ArcGIS. Compared to the Goose Pond Dam decommissioned scenario, the Preferred Alternative for the Goose Pond Dam reduces the number of properties within the 100-year floodplain by 33 properties. These properties do not require participation in the NFIP. This reduction represents a saving in administrative costs of \$13,431 per year for the Goose Pond Dam Preferred Alternative. While these savings are not included in the calculation of the annual flood protection benefits provided by each dam, they underscore the importance of flood damage protection offered by each dam.

Total Benefits

The Preferred Alternative for Goose Pond Dam provides total annual flood damage reduction benefits of \$44,665, consisting of \$23,294 from reduced damages to structures and vehicles, \$19,743 from reduced roadway damages and \$1,628 from avoided NFIP administrative costs (Table D-12).

Table D-12: Annual Flood Damage Reduction Benefits, Goose Pond Dam (PA-464)

Flood Damages	No Action Scenario	Preferred Alternative	Annual Flood Reduction Benefit
Structures and Vehicles	\$86,936	\$63,642	\$23,294
Infrastructure	\$565,675	\$545,932	\$19,743
Insurance Administration Costs	\$7326	\$5,698	\$1,628

*Totals may not add up due to rounding.

Total*

\$44,665

11. Cultural Resources

The evaluation of cultural resources for the PA-464 Watershed Rehabilitation Project was conducted to ensure compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (36 CFR Part 800), as well as the National Environmental Policy Act (NEPA) and NRCS environmental compliance procedures. The investigation was designed to identify any potential effects on historic properties within the Area of Potential Effect (APE) for the proposed rehabilitation project at Goose Pond Dam.

Methodology

The cultural resources evaluation was completed in two phases:

1. **Desktop review and archival research** utilizing the Pennsylvania State Historic Preservation Office (PA SHPO) Cultural Resources Geographic Information System (CRGIS), historic topographic maps, aerial imagery, and the National Register of Historic Places (NRHP) database.
2. **Field reconnaissance and architectural survey** conducted in July 2024 by Hartgen Archeological Associates. The field survey evaluated above-ground resources and existing land conditions within all portions of the APE, including:
 - The dam embankment and principal spillway
 - Auxiliary spillway
 - Upper and lower flood pool areas
 - Downstream Breach Inundation Zone
 - Temporary access routes and staging areas

The APE was delineated to encompass areas subject to direct physical alteration, ground disturbance, hydrologic change, and potential indirect visual and auditory effects.

12. Property Rights

Based on Monroe County GIS data, Goose Pond Dam is located on the Deer Run Hunting Club property, but the Monroe County Commissioners have a permanent easement for the dam and most of the corresponding TOD pool level to perform operation and maintenance activities. The existing easement also does not include the original borrow area located

east of the auxiliary spillway, on the Deer Run Hunting Club's property. A small sliver of the embankment and right abutment is not currently covered by the existing easement on the Hunting Club's property.

13. Zoning

PA-464's watershed is zoned for resort, conservation/recreation, and residential purposes, according to the county comprehensive plans. The zoning areas were considered when developing the future curve number by estimating the potential of developing the conservation/recreation woodland areas. These areas were assumed to be developed into resort or residential area with a higher curve number.