

SUPPLEMENTAL WATERSHED PROJECT PLAN NO. 4
AND ENVIRONMENTAL EVALUATION
FOR
MILL RUN WATERSHED
RAINBOW DAM (PA-460)
(CRAWFORD COUNTY, PENNSYLVANIA)



PREPARED BY
USDA NATURAL RESOURCES CONSERVATION SERVICE

IN COOPERATION WITH
CITY OF MEADVILLE, PA

May 2019

Non-Discrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotope, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

U.S. Department Agriculture Natural Resources Conservation Service		May 2015		Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet		County(s):	Crawford	State(s):	Pennsylvania
Sponsoring Local Organization(s):		Hydrologic Unit Code:		050100040906	
City of Meadville 894 Diamond Park Meadville, PA 16335-2603		Watershed Project Number:		422007	
		Watershed Site Number:		Rainbow Dam (PA-460)	
		NID Number:		PA00177	

A. Authority and Program Criteria

Original Program Authority:		Public Law 83-566				
Current Program Authority:		Section 14 of Public Law 83-566				
Current Hazard Classification:		High				
Design Hazard Classification:		High				
Status of Operation and Maintenance		There were no post construction changes to the structure that influence the safety of the dam. No road cuts, quarries or mining activities were observed in the vicinity of the dam or reservoir. At the time of the site walk, the dam and associated structures were found to be functional and operation and maintenance is current.				
Sedimentation (acre-feet/year) ^{1/}	Originally Planned	0.72	Actual	0.11	Future	0.17
Evaluation of Potential Rehabilitation Projects			Updated:	Yes		
Sponsor's Application Submission date		4/4/2014	NRCS acknowledges Valid Application:			4/14/2014
Will upstream land rights be obtained to top-of-dam elevation per NWPM 505.36G? ^{2/}						Yes
Are basic assumptions and decisions (Investigation and Analysis) included in the administrative record?						Yes
Is the Investigation and Analysis (I&A) attached to the Plan-EE?						Yes
Does planning and analyses comply with 1983 P&G?						Yes

^{1/} If future sediment storage is provided for less than 100 years, explain rationale in Section L Additional Notes and Comments.

^{2/} Provide rationale for selected land rights elevation if below top-of-dam in Section L Additional Notes and Comments

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s):	Pennsylvania
Sponsoring Local Organization(s):	Hydrologic Unit Code:		050100040906
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number:		422007
	Watershed Site Number:		Rainbow Dam (PA-460)
	NID Number:		PA00177

B. Purpose and Need for Action

Purpose and Need:

The purpose of the project (Project Purpose) includes the following:

- Maintain the current level of flood damage reduction provided by the Rainbow Dam (PA-460), designed with a 1% use auxiliary spillway, for public safety, bridges, roads, urban areas, other lands, buildings, structures, infrastructure, and other features.
- Comply with applicable design, performance and safety criteria for Natural Resources Conservation Service (NRCS) and Pennsylvania Department of Environmental Protection (PADEP).

The need for this Supplemental Watershed Plan (Project Need) arises from the fact that an analysis of the existing Rainbow Dam, based on current NRCS design and safety criteria, indicated that the dam would be overtopped during the Freeboard Hydrograph storm event. The dam was originally constructed in 1964 with a 100-year service life. Rainbow Dam provides protection during the 100-year flood event for 30 residential and 51 non-residential (commercial, religious, governmental, etc.) properties. There are no critical structures or facilities located within the 500-year floodplain downstream from the dam that could be protected with increased detention at the dam. NRCS has classified Rainbow Dam as a High Hazard potential dam and PADEP has classified Rainbow Dam as a Hazard Potential Category 1 dam. Both evaluations are based on the potential for loss of life due to the prevalence of 11 bridges, more than 20 roads and 1300 buildings existing in the downstream dam breach inundation zone. The Project Need includes the following:

- Continue providing flood damage reduction for the 100-year recurrence interval flood event downstream from the dam.
- Address applicable NRCS and Commonwealth of Pennsylvania standards and design criteria for public health and safety to reduce the risk of loss of human life.

U.S. Department Agriculture Natural Resources Conservation Service May 2015		Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet		County(s): Crawford	State(s): Pennsylvania
Sponsoring Local Organization(s):		Hydrologic Unit Code:	050100040906
City of Meadville 894 Diamond Park Meadville, PA 16335-2603		Watershed Project Number:	422007
		Watershed Site Number:	Rainbow Dam (PA-460)
		NID Number:	PA00177

C. Watershed Rehabilitation Alternatives with Rationale for Level of Analysis

Alternative	Alternative Description and Major Feature	Cost	Carried Through Analysis	Rationale
No Action/Future Without Federal Project	Minimum constructed breach of the embankment to remove the storage function of the dam and restore the stream to a free-flowing state through the impoundment area and the footprint area of the dam. • Demolish the existing reinforced concrete Auxiliary Spillway. • Excavate an opening through the dam. • Use the existing auxiliary spillway location for onsite disposal. • Remove the principal spillway inlet structure, conduit and impact basin. • Connect the old stream bed to the downstream channel. • Resume normal stream flow. • Provide rock riprap slope protection. • Vegetate the accumulated sediment.	\$1,746,000	Yes	No Action
Decommissioning	Dam Decommissioning: Federally-assisted removal of the entire embankment and restore the stream and 100-year floodplain to a free-flowing state through the impoundment area and the footprint area of the dam. • Complete removal of the dam. • Restoration of dam site to original conditions. • Stabilizing the site. • Reduced downstream flood protection up to the 100-year recurrence interval, currently provided by the dam. Non-Structural Measures: Floodproof or relocate existing structures in the downstream 100-yr floodplain. • Floodproofing or relocating 30 residential and 51 non-residential structures. • The affected municipalities are the City of Meadville and Vernon Township. Total Cost:	\$2,579,000 \$39,736,000 \$42,315,000	No	Exorbitant Costs and Social Disruptions

U.S. Department Agriculture Natural Resources Conservation Service		May 2015		Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet		County(s):	Crawford	State(s):	Pennsylvania
Sponsoring Local Organization(s):		Hydrologic Unit Code:		050100040906	
City of Meadville 894 Diamond Park Meadville, PA 16335-2603		Watershed Project Number:		422007	
		Watershed Site Number:		Rainbow Dam (PA-460)	
		NID Number:		PA00177	

Alternative	Alternative Description and Major Feature	Cost	Carried Through Analysis	Rationale
Rehabilitation	Federally-assisted rehabilitation of the dam to NRCS and Commonwealth of Pennsylvania High Hazard Class dam design criteria. • Maintain the dam crest at current Elevation of 1189.8 feet. (No induced flooding). • Extend the principal spillway conduit. • Construct a new concrete impact basin. • Construct a new retaining wall between the embankment and the auxiliary spillway exit channel. • Reline the primary spillway conduit. • Install a chimney drain. • Reinforce the downstream slope with earth fill at 3:1 within the original construction boundaries. • Lengthen the auxiliary spillway control section to 406 feet, maintaining the existing spillway crest at Elevation 1184.3 feet. • Repair the existing concrete auxiliary spillway and exit channel as needed. • Any other additional items identified as being deficient.	\$2,643,000	Yes	NED Alternative
Non-Structural Measures (Acquisition Relocation of Structures in Inundation Areas)	• Maintain the dam at current configuration. • Acquire and/or relocate 618 residences and 379 commercial properties including 4 daycare centers; local, state and federal government offices; and 5 senior citizen housing complexes within the breach inundation zone. • The affected municipalities are City of Meadville and Vernon Township. • Prevent development in breach inundation area.	\$456,716,000	No	Exorbitant Cost and Social Disruption
Non-Structural Measures (Floodproofing of Structures in Inundation Areas)	• Maintain the dam at current configuration. • Construct 5,417 linear feet of levees and/or floodwalls. • Protect 23 residences and 9 commercial properties by constructing a levee and/or floodwall. • Floodproof 169 residences and 34 commercial structures by elevating them above the breach water surface. • Acquire and/or relocate 426 residences and 336 commercial properties not protected by the levees and/or floodwalls. • The affected municipalities the City of Meadville and Vernon Township. • Prevent development in breach inundation area.	\$455,967,000	No	Exorbitant Cost, Social Disruption and Publicly Unacceptable.

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	County(s):	Crawford	State(s): Pennsylvania
	Hydrologic Unit Code:		050100040906
	Watershed Project Number:		422007
	Watershed Site Number:		Rainbow Dam (PA-460)
	NID Number:		PA00177

D. National Economic Development (NED) Account

To open - RT click, select Worksheet Options, then Open to use this sheet	No Action	Rehabilitation
NED Benefits and Costs	Alt 1	Alt 2
Project Investment	\$1,746,000	\$2,643,000
NRCS		\$1,861,500
Sponsors	\$1,746,000	\$781,500
NED Plan3/		
Beneficial Annual		\$155,400
Adverse Annual		\$86,000
Net Beneficial	\$0	\$69,400
Benefit to Cost Ratio		1.8
Comparison of NED Benefits and Costs (Table 6) 4/	No Action	Rehabilitation
Agricultural Related		\$102,300
Non-Agricultural Related		\$0
Other - Cost Avoidance		\$53,100
Other Purpose -		\$0
Other Purpose -		\$0
Other Purpose -		\$0
Total Benefits	\$0	\$155,400
Average Annual NED Costs (Table 4)	No Action	Rehabilitation
Amortized Installation	\$53,100	\$80,400
Other Direct Costs-		\$0
Operation, Maintenance, and Replacement		\$5,600
Total Adverse 5/	\$53,100	\$86,000
Average Annual Flood Damage Reduction (Table 5)	No Action	Rehabilitation
Agricultural		
Floodwater - Crop and Pasture		
Floodwater - Other Ag	\$102,400	\$100
Sediment and Erosion - Sediment		
Sediment and Erosion - Channel		
Other		
Sub-total Ag Damages	\$102,400	\$100
Non-Agricultural		
Floodwater - Urban		
Other		
Indirect - Damage reduction benefit		
Sub-total Non-Ag Damages	\$0	\$0
Total Damages	\$102,400	\$100

ENTER ALL END NOTES (FOOTNOTES) FOR ABOVE TABLE IN SECTION L

3/ If NED plan is negative describe reasoning using NWPM 505.35B(1)(iv).

4/ Price Base 2019.

5/ Amortized over 103 years (100 years – service life and 3 years – implementation) at 2.875% discount rate.

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s): Pennsylvania	
Sponsoring Local Organization(s):	Hydrologic Unit Code: 050100040906		
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number: 422007		
	Watershed Site Number: Rainbow Dam (PA-460)		
	NID Number: PA00177		

E. Regional Economic Development (RED) Account

The RED account was not evaluated in the plan since it was not identified as an issue during plan development.

F. Other Social Effects (OSE) Account

Record additional social effects of the alternatives to the human environment not covered in the P&G National Economic Development Account or in the NRCS-CPA-52.			
	No Action	Rehabilitation	
Resource Concerns (describe existing conditions)	Amount, Status, Description (Document both short and long term impacts)	Amount, Status, Description (Document both short and long term impacts)	Amount, Status, Description (Document both short and long term impacts)
Public Health and Safety	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	
Floodplain Management	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	
Parklands	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	
Regional water resource plans	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	
Recreation	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	
Land Values	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	
Groundwater/Sole Source Aquifer	Choose an item.	Choose an item.	Choose an item.
See NRCS-CPA-52	See NRCS-CPA-52	See NRCS-CPA-52	

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	County(s):	Crawford	State(s): Pennsylvania
	Hydrologic Unit Code:		050100040906
	Watershed Project Number:		422007
	Watershed Site Number:		Rainbow Dam (PA-460)
	NID Number:		PA00177

G. Potential Modes, Parameters and Consequences of Failure

Modes of Dam Failure	Nonstorm Breach Reservoir Elev. (ft-NAVD88)	Peak Breach Discharge - cfs	Population at Risk	Potential
Stability	1,189.8	24,500	1,200	Low
Hydrologic	1,189.8	41,800*	2,650	Medium
Seismic	1,184.3	16,200	750	Medium
Seepage	-	-	-	Low
Material Deterioration	-	-	-	Medium
Other:				Choose an item.

*Includes inflow from upstream Tamarack Dam breach (PA-461A)

Source: NRCS Failure and Risk Indexes Spreadsheet from March 2018 Breach Analyses for Supplement No. 3 to the Watershed Work Plan for Mill Run Watershed – Rainbow Dam (PA-460).

Consequences and Other Notes:

CONSEQUENCES OF DAM FAILURE

Inundation due to dam failure potentially has the following consequences.

Loss of Life. The breach inundation study indicates that a dam failure may result in inundation of residential structures and transportation facilities. The estimated Population at Risk is 1500 and the associated Risk Index is 3894. Each potential rehabilitation project is assessed by a standardized ranking process that evaluates the condition of the dam and consequences of dam failure. This results in a "failure index" and "risk index" for each dam.

Release of Harmful Materials. Large volumes of sediment and eroded embankment material released to the stream would harm water quality, degrade aquatic habitat, and reduce downstream channel capacity. Further, the inundation area includes agricultural land uses that may store hazardous materials.

Infrastructure Destruction. Residential dwellings, fences, roads, bridges, public utilities, and farm equipment may be damaged or destroyed.

BREACH ASSUMPTIONS

The breach inundation maps used in this plan were provided by the City of Meadville. The breach analysis met all the PADEP, Division of Dam Safety's criteria and, provides an incremental breach analysis based on modeling of storage capacity and reservoir surface area for normal pool and maximum storage elevations. The peak breach discharge used for developing the inundation maps was 52,677 cfs based on an incremental analysis process to determine the highest runoff event during which the threat downstream from a breach exceeds the threat from that same runoff event with no dam failure.

The incremental analysis begins with the Probable Maximum Flood event runoff and reduces from there to determine the runoff event used for the breach discharge. This peak breach discharge exceeds the TR-60 upper bound condition of 36,980 cfs minimum peak breach discharge considering dam embankments less than 103 feet in height. The hydrologic and hydraulic analyses were also approved by the PADEP. The results of the breach were used to generate the flood inundation maps for the current Beechwood Dam Emergency Action Plan. New breach maps will be prepared as part of the final rehabilitation design. The NRCS Pennsylvania State Conservation Engineer concurs that the dam was originally built as and still is a High Hazard Potential Dam.

H. Consultation, Coordination and Public Participation

U.S. Department Agriculture Natural Resources Conservation Service May 2015 Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed:	Mill Run Watershed		
	County(s):	Crawford	State(s):	Pennsylvania
	Hydrologic Unit Code:		050100040906	
	Watershed Project Number:		422007	
	Watershed Site Number:		Rainbow Dam (PA-460)	
		NID Number:		PA00177

Agency/Public Participation	Meeting/Contact	Date Complete	Site Visit	Date Complete
USFWS - ESA Sec 7/ Sec 12 PL -566	Letter	10/26/2016	No Invite	Click here to enter a date.
USACE District – <i>Pittsburgh District</i>	Other-Explain	Click here to enter a date.	No Invite	Click here to enter a date.
PA Department of Conservation and Natural Resources	Other-Explain	Click here to enter a date.	No Invite	Click here to enter a date.
PA Game Commission	Other-Explain	Click here to enter a date.	No Invite	Click here to enter a date.
PA Fish and Boat Commission	Other-Explain	Click here to enter a date.	No Invite	Click here to enter a date.
PA Department of Environmental Protection, Division of Dam Safety	Other-Explain	8/10/2016	No Invite	Click here to enter a date.
Crawford County Emergency Management	Public Meeting	10/22/2015	Yes	10/22/2015
Meadville City Council	Public Meeting	10/22/2015	Yes	10/22/2015
Monthly City Council Meetings starting 11/2015	Public Meeting	Monthly	No	N/A
Public Participation	Public Meeting	10/22/2015	Yes	10/22/2015
Public Participation	Public Meeting	9/21/2016	No	9/21/2016
	Choose an item.	Click here to enter a date.	Choose an item.	Click here to enter a date.

Explanations:

NRCS, the Council of the City of Meadville and members of the Project Team conducted a project kickoff meeting at the City of Meadville Administration Building, 894 Diamond Park, Meadville, PA, on October 22, 2015 after a walk of the project site. Shortly after this meeting, a Public Participation Plan was prepared to serve as a guide for carrying out the activities related to consultation, coordination and public participation. The planning effort was conducted in close coordination with the PADEP's Bureau of Waterways Engineering Division of Dam Safety.

Public scoping open forums were conducted by the Council of the City of Meadville at their regular meetings. The Council of the City of Meadville received input, discussed problems and opportunities, and issued updates on progress. All Council meetings are open forums conducted in compliance with the Commonwealth of Pennsylvania Sunshine Act which requires public agencies to hold certain meetings and hearings open to the public.

NRCS met with PADEP Division of Dam Safety on August 10, 2016, at the NRCS office in Harrisburg, PA. This meeting reviewed the proposed rehabilitation alternatives and provided guidance as to acceptability through PADEP.

The Project Team and NRCS met with the Council of the City of Meadville at their regularly scheduled Work Session at the City of Meadville Administration Building, 894 Diamond Park, Meadville, PA, on September 21, 2016. This meeting provided instruction and guidance on the project scope and the extent of activities required for developing the Supplemental Watershed Plan and Environmental Evaluation. The following topics were discussed:

- Problems and opportunities identified

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	County(s):	Crawford	State(s): Pennsylvania
	Hydrologic Unit Code:		050100040906
	Watershed Project Number:		422007
	Watershed Site Number:		Rainbow Dam (PA-460)
	NID Number:		PA00177

- Sponsor objectives
- Alternatives considered
- Alternatives evaluated and comparison of effects

The Sponsor allowed public input at all meetings prior to and during the planning process. The Draft Supplemental Watershed Work Plan No. 4 and Environmental Evaluation for Mill Run Watershed, Rainbow Dam (PA-460) was available upon request. A newspaper article was published by The Meadville Tribune on September 18, 2016 describing the information provided at the September 21, 2016 Public Meeting.

The following agencies and elected officials received the Draft Supplemental Watershed Plan No. 4 and Environmental Evaluation Abstract and Summary Sheet for Mill Run Watershed, Rainbow Dam (PA-460):

- Appalachian Regional Commission
- Association of State Dam Safety Officials
- Crawford Central School District
- Crawford County Commissioners
- Crawford County Conservation District
- Crawford County Office of Emergency Services
- Crawford County Planning Commission
- Division of Dam Safety, Bureau of Waterways, Engineering & Wetlands
- French Creek Valley Conservancy
- Meadville City Council
- Meadville City Fire Department
- Pennsylvania DEP Northwest Office
- Pennsylvania Emergency Management Agency
- Pennsylvania Fish & Boat Commission
- Pennsylvania's Association of Floodplain Managers
- Pennsylvania's Governors Policy Office
- Pennsylvania Association of Soil Resource Conservation & Development Councils
- The Honorable Bradley T. Roae
- The Honorable Michael Kelly
- The Honorable Michelle Brooks
- The Honorable Patrick Toomey
- The Honorable Robert B. Casey, Jr.
- USDA NRCS, Crawford County Field Office
- US Fish & Wildlife Service, PA Ecological Services Field Office
- West Mead Township Supervisors

The Pennsylvania Natural Diversity Inventory (PNDI) online database queried PA Fish and Boat Commission, PA Department of Conservation and Natural Resources, PA Game Commission, and US Fish and Wildlife Service (USFWS) to determine if protected species or species proposed for protection ranged within the watershed. As documented in the NRCS-CPA-52 form, this review of the natural heritage data indicates that none of the project alternatives pose a risk of adverse impact to individuals, populations or threatened flora or fauna. No impacts to federally-listed species were identified within the Project study area based on the PNDI review. Consultation with USFWS, as required by Section 12 of Public Law 83-566, was conducted and documented with correspondence dated October 26, 2016. USFWS responded in writing November 21, 2016. The correspondence stated, "Mill Run is a tributary of French Creek. French Creek is inhabited by four mussel species that are federally listed as endangered: clubshell (*Pleurobema clava*), northern riffleshell (*Epioblasma torulosa rangiana*), rayed bean (*Villosa fabalis*), and snuffbox (*Epioblasma triquetra*). French Creek is also inhabited by the rabbitsfoot mussel (*Quadrula cylindrica cylindrica*), that is federally listed as threatened, and is designated critical habitat for the species."

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s): Pennsylvania	
Sponsoring Local Organization(s):	Hydrologic Unit Code: 050100040906		
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number: 422007		
	Watershed Site Number: Rainbow Dam (PA-460)		
	NID Number: PA00177		

USFWS recommended that considered project alternatives consider avoid direct and indirect adverse effects (disturbance to, or alteration of, French Creek, including changing hydrology, siltation or contaminant discharges) to mussels and their habitat in French Creek. The location of rehabilitation to Rainbow Dam is approximately 9,000 feet upstream from the confluence of Mill Run entering French Creek. A detailed project description and plans documenting how direct and indirect impacts will be avoided, through sediment control during construction activities, will be provided to USFWS during the design phase for concurrence that the action is not likely to adversely affect.

According to correspondence received from Mr. John J. Kraeuter, Chief, Environmental and Geological Services Section, PADEP, dated November 16, 2016, the Project is considered a Non-Reporting Activity provided the impacts to "waters" at the site fall below the impact thresholds of the permit: less than one-half acre of impacts to waters and less than 250 linear feet of stream impacts; therefore, no further Section 404 permit coordination with the U.S. Army Corps of Engineers (USACE) is required at this time.

As per the Pennsylvania State Programmatic General Permit (PASPGP-5) issued by the USACE, the PADEP has been given the authority to review projects such as the Rainbow Dam (PA-460) for the Section 404 Clean Water Act requirements. Council of the City of Meadville will be responsible for obtaining the necessary permits from the PADEP.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s): Pennsylvania	
Sponsoring Local Organization(s):	Hydrologic Unit Code: 050100040906		
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number: 422007		
	Watershed Site Number: Rainbow Dam (PA-460)		
	NID Number: PA00177		

I. Cultural Resources ^{7/}

	Date
Literature Review conducted	8/26/2016
Pedestrian Survey conducted	10/5/2015
Consultation with State Historic Preservation Office	10/5/2016
Consultation with State Tribal Historic Preservation Office	Click here to enter a date.
Consultation with Tribes	Click here to enter a date.
Tribes Contacted: There are currently no federally recognized tribes in Pennsylvania. Cultural Resources Identified: Prior to construction of the dam, consultation with the State Historic Preservation Office (SHPO) determined that no archeological, historic, or cultural resources would be disturbed by the proposed dam construction. Since the dam was built in the footprint previously cleared for such resources, none of the proposed project alternatives pose a risk of impact to archeological or historic resources. A recent follow up review of the National Register of Historic Places website reconfirmed that while several historical sites are nationally listed for Crawford County, none occur in the area of potential effect for the Project. On October 12, 2016, the Pennsylvania Historical and Museum Commission confirmed there are no known archeological or historical sites in the area of potential effect. There are cultural resources downstream from the project site. The City of Meadville has 8 buildings listed on the National Register of Historic Places. These include the Meadville Downtown Historic District, Dr. J.R. Mosier Office, Roueche House, Baldwin-Reynolds House, Judge Henry Shippen House, and Ruter and Bentley Halls located on the campus of Allegheny College. No cultural resources are known in the proposed construction area. The Pennsylvania SHPO confirmed in a letter dated October 19, 2016, that No Effect is anticipated.	

^{7/} Consultation correspondence and agency letters reside in the administrative record file.

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	County(s):	Crawford	State(s): Pennsylvania
	Hydrologic Unit Code:		050100040906
	Watershed Project Number:		422007
	Watershed Site Number:		Rainbow Dam (PA-460)
	NID Number:		PA00177

K. Land Use in Drainage Area

Land Use/Resource Types	Existing Condition	No Action	Rehabilitation	
To use Rt click, select Worksheet Object, then Open to enter data in Excel	Affect Area - acres			
Cropland	307.83	216.11	216.11	
Pasture and Rangeland	643.27	295.58	290.61	
Forest	2145.55	860.09	860.09	
Farmstead				
Residential	751.8	2484.4	2484.4	
Commercial				
Transportation				
Stream/channel *	3.0	4.0	3.0	
Lake/open water	230.6	224.6	230.6	
Wetlands-herbaceous/fringe				
Wetlands-scrub/shrub				
Wetland - forested				
Other: Shrub/Scrub	2.8			
Other: _____				
Totals (Acres)**	4084.8	4084.8	4084.8	
* Also indicate lengths (feet) in notes below.				
** Totals will be red color until sum equals existing condition total.				
Notes: Stream length - 19,006 feet				

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s): Pennsylvania	
Sponsoring Local Organization(s):	Hydrologic Unit Code: 050100040906		
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number: 422007		
	Watershed Site Number: Rainbow Dam (PA-460)		
	NID Number: PA00177		

L. Risk and Uncertainty

Project risk and uncertainty primarily exist in the engineering and economics analyses of the Project alternatives. The Project Team based all preliminary designs and cost estimates on an additional 100 years of functional life using data from the as-built plans, available GIS data, recent topographic surveys, and bathymetry. Abbreviated geotechnical explorations were conducted, and the designs relied on minimal soil mechanics data from the original dam design, as-built plans, field observations and experience. Hydrologic data was measured using available GIS data, and field observations. The data used and the design parameters developed are based on proven models, tools and standard engineering procedures. Accuracy of the data impacts uncertainty of the reservoir operation levels, discharge capacities, breach inundation areas, flood damage area, design life, and structure function. Failure of the existing dam would most likely occur as a result of (1) breach of the embankment due to extreme storm events, (2) a seismic event, or (3) deterioration and failure of the principal spillway conduit.

The Project Team used the Economics and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies to account for flood control benefits associated with the alternatives. Predicting economic benefits naturally involves a moderate degree of uncertainty. The economic analysis used an indexing approach to predict benefits. Uncertainty in the prices paid by consumers will vary in the future. Consequently, the change in consumer price is the index that is most likely to reflect the value of preventing flood damage.

The original benefits for the Project were indexed to current dollars using applicable indexes. The scope of the study did not include re-evaluation or reconsideration of the original benefits. The estimated average annual flood damage reduction benefits and intensification benefits may vary from those displayed.

Uncertainties with the analysis of environmental impacts lie with the identification of wetland areas, riparian habitat, and streams. Trained specialists identified environmentally-significant areas using standard, well-accepted protocols.

Within the context of this study, all alternatives were considered on a comparable basis. There does not appear to be any area that would have resulted in a different decision by using different procedures or conducting more intensive studies.

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s): Pennsylvania	
Sponsoring Local Organization(s):	Hydrologic Unit Code: 050100040906		
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number: 422007		
	Watershed Site Number: Rainbow Dam (PA-460)		
	NID Number: PA00177		

M. List of Preparers

Name	Current Position - Years	Education	Experience (Years)	Applicable Certifications
NRCS				
Walter Hosea Latshaw, PE	State Conservation Engineer (retired 2017)	BS Agricultural Engineering Pennsylvania State University	42	
Heather L. Smeltz, PE	Civil Engineer/Cultural Resources Coordinator	BS Agricultural & Biological Engineering Pennsylvania State University MS Biological & Agricultural Engineering North Carolina State University	13	
Donald Murray	Agricultural Engineer	BS Agricultural Engineering Pennsylvania State University	37	
Tim Ridley, PE, PS	Hydraulic Engineer	BS Civil Engineering West Virginia University	37	
Jeff McClure, PG	Geologist	BA Biology, BA Geology, BS Geology West Virginia University	31	
Capital RC&D Council				
Jeffrey D. Mahood	Environmental Planning Specialist/Economist	BS Environmental Resource Management Pennsylvania State University	35	
KLA Environmental Services, Inc.				
Kevin L. Shamburg, PE	Project Administrator	BS Civil Engineering Kansas State University	37	
Frank C. Mercurio, PE	Senior Engineer	BS Environmental Resources Engineering Humboldt State University	38	
Elliott R. Harris, PE	Project Engineer	BS Fisheries and Wildlife Biology BS Agricultural Engineering Kansas State University	14	
Jarred D. Green, PE	Project Engineer	BS Civil Engineering Kansas State University	10	
Eldon R. Colson, Jr.	Project Technician	Natural Resources Hutchinson Community College	22	
Ramona V. Newsom	Technical Information Specialist	BS Business Administration Brown Mackie College	36	
Amec Foster Wheeler				

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed		
Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	County(s):	Crawford	State(s): Pennsylvania
	Hydrologic Unit Code:		050100040906
	Watershed Project Number:		422007
	Watershed Site Number:		Rainbow Dam (PA-460)
		NID Number: PA00177	

Timothy Dean, PE	Project Manager/Dam Engineer	BS Geography Pennsylvania State University M. EPC Soil Physics Pennsylvania State University	30	
Mohamed Agnaou, PE	Dam Engineer	BS Civil and Environmental Engineering Temple University ME Water Resources Engineering Colorado State University	14	
James Barbis, PE, CFM	Senior Water Resource Engineer	BS, Sport Biology ME, Water Resources and Environmental Engineering Villanova University	5	
Douglas Tate, PE	Senior Geotechnical Engineer	BS Engineering, The University of Alabama in Birmingham	35	
Davide Motta, Ph.D.	H&H Modeler	Ph.D. Civil Engineering University of Illinois at Urbana-Champaign M.S. Civil Engineering University of Illinois at Urbana-Champaign Laurea (Equivalent to B.S. and M.S.) Environmental Engineering Politecnico di Milano, Italy	8	
Larry Sciple, PG	Project Geologist	BS Geology, The University of Tennessee MS Geology, Vanderbilt University	40	
Dan Bolender, PLS	Surveyor	B.Sc. Petroleum Engineering, University of Wyoming	28	
Todd Hunter, LIT	Surveyor	Associate of Applied Science, Architecture and Civil Engineering Technology, Central Maine Technical College	24	
Steven Mazza	Engineering Technician	BA History Franciscan University of Steubenville	14	
Sarah Dickert	Engineering Technician / GIS Analyst	BS Civil Engineering, Bucknell University	1	
Ashley Husted	Environmental Scientist	BS Environmental Studies, Minor in Biology Ursinus College	7	

U.S. Department Agriculture Natural Resources Conservation Service May 2015	Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet	County(s): Crawford	State(s): Pennsylvania
Sponsoring Local Organization(s):	Hydrologic Unit Code: 050100040906	
City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed Project Number: 422007	
	Watershed Site Number: Rainbow Dam (PA-460)	
	NID Number: PA00177	

Ghazoll Motlagh, EIT, CFM	Engineering Technician	BS Civil Engineering – Water Resources Pennsylvania State University	8	
Brian Sariano	Environmental Scientist	BA in Geoenvironmental Science Shippensburg University	27	
Jennifer Poole, GIT	Project Geologist	BS-Environmental Science, University of North Carolina at Chapel Hill MS- Geological Sciences, University of Missouri-Columbia	6	
Nathan Long, PE, PG	Senior Geotechnical Engineer	BS Geological Engineering, The University of Mississippi	13	

N. Additional Notes and Comments

Notes for Section D. National Economic Development (NED) Account:

- The agricultural-related benefits line item in the table includes flood damage reduction for residential, commercial, and transportation infrastructure.

Notes for Table A:

- The horizontal datum was based on the North American Datum of 1983 (NAD83) using the Pennsylvania State Plane coordinate system, North Zone. Survey data were collected in the North American Vertical Datum of 1988 (NAVD88) and a shift of 0.7 feet was applied to adjust the measured elevations to the as-built plans reference, which is the National Geodetic Vertical Datum of 1929 (NGVD29).
- The design storm hydrographs are based on modeling multiple subwatersheds with differing Runoff Curve Numbers. Consequently, a watershed-wide runoff depth is not readily available and is not included.
- On April 14, 2016, NRCS Resource Soil scientist visited the site to look for aerated sediment deposits. Based on collected field data, an estimated aerated sediments volume of 0.2 acre-feet was found in gravel fan deposits, and near the mouth of the tributary (Mill Run) upstream of Rainbow Dam. No evidence of aerated sediment deposition further upstream was observed. By considering the actual sedimentation rates, determined based on deposits accumulated since the dam was built, NRCS recommends that future submerged and aerated sediment estimates be based on 150% of the measured current sediment deposits. Therefore, the predicted rates for sediment accumulation are 0.16 acre-feet/year for submerged and 0.006 acre-feet/year for aerated. Based on the available 25.26 acre-feet of volume remaining in the sediment pool, approximately 158 years of sediment life remain beyond 2015. The expected aerated sediment volume over that same period is estimated at 0.9 acre-feet.

Discharge capacities for the two-way principal spillway riser were calculated by SITES in association with the routing of design storms.

U.S. Department Agriculture Natural Resources Conservation Service		May 2015		Watershed: Mill Run Watershed	
Watershed Rehabilitation Worksheet		County(s): Crawford		State(s): Pennsylvania	
Sponsoring Local Organization(s):		Hydrologic Unit Code: 050100040906			
City of Meadville		Watershed Project Number: 422007			
894 Diamond Park		Watershed Site Number: Rainbow Dam (PA-460)			
Meadville, PA 16335-2603		NID Number: PA00177			

Table 2 - Estimated Cost Distribution																
Item Description	Installation Costs - Public Law 83-566 1/						Installation Costs - Other Funds 1/						Total Installation Cost			
	Construction 3/	Engineering	Real Property Rights	Relocat. Payments	Project Admin.	Total Federal Cost	Construction 3/	Engineering 4/5/	Real Property Rights	Natural Resource Rights	Relocat. Payments	Required Permits		Project Admin. 2/	Total Non-Federal Cost	
Rehabilitation of dam	\$1449,500	\$330,000	\$0	\$0	\$82,000	\$186,500	\$775,500	\$0	\$0	\$0	\$0	\$1000	\$5,000	\$781,500	\$2,643,000	
1/ Price Base:															May-2019	
2/ Includes		\$0	for relocation assistance advisory service													
3/ Includes		\$0	of PL-566 funds and \$0 of non-federal funds for cultural resource protection and mitigation measures													
4/ Includes		\$0	for real property costs for mitigation													
5/ Includes		\$0	for surveys, legal fees, and other costs													

U.S. Department Agriculture Natural Resources Conservation Service May 2015 Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed:	Mill Run Watershed		
	County(s):	Crawford	State(s):	Pennsylvania
	Hydrologic Unit Code:		050100040906	
	Watershed Project Number:		422007	
	Watershed Site Number:		Rainbow Dam (PA-460)	
		NID Number:	PA00177	

Item	Unit	Existing	Alt 1 No Fed Action	Alt 2 Rehab Option A
Preferred Alternative	-	-		
Class of structure	-	High	N/A	High
Seismic zone	-	1	1	1
Uncontrolled drainage area	mi ²	3.56	3.56	3.56
Controlled drainage area	mi ²	2.82	2.82	2.82
Total drainage area	mi ²	6.38	6.38	6.38
Runoff curve No. (1-day) (AMC II)	number	81	81	81
Time of concentration (Tc)	hrs.	5.95	5.95	5.95
Elevation top of dam ^{1/}	ft.	1189.80	N/A	1189.80
Elevation crest auxiliary spillway	ft.	1184.30	N/A	1184.30
Elevation crest high stage inlet	ft.	N/A	N/A	N/A
Elevation crest low stage inlet	ft.	1163.50	N/A	1163.50
Assumed hydrologic breach elevation	ft.	1189.8	N/A	1189.8
Assumed static breach elevation	ft.	1189.8	N/A	1189.8
Assumed seismic breach elevation	ft.	1184.3	N/A	1184.3
Auxiliary spillway type	type	Concrete Weir	N/A	Concrete Weir
Auxiliary spillway bottom width	ft.	286	N/A	406
Auxiliary spillway exit slope	percent	N/A	N/A	N/A
Length of Dam	ft.	2020	N/A	2020
Maximum height of dam	ft.	42	N/A	42
Volume of fill	yd ³	97,700	N/A	101,400
Total capacity ^{2/}	acre ft.	750.13	N/A	750.13
Sediment submerged	acre ft.	25.26	N/A	25.26
Sediment aerated	acre ft.	0.2	N/A	0.2
Sediment life remaining	years	158	N/A	158
Beneficial use (identify use)	acre ft.	N/A	N/A	N/A
Floodwater retarding	acre ft.	385.35	N/A	385.35
Between high and low stage	acre ft.	N/A	N/A	N/A
Sediment pool ^{2/}	acres	4.97	N/A	4.97
Beneficial use pool (identify use)	acres	N/A	N/A	N/A
Floodwater retarding pool ^{3/}	acres	44.82	N/A	44.82

U.S. Department Agriculture Natural Resources Conservation Service May 2015 Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): City of Meadville 894 Diamond Park Meadville, PA 16335-2603	Watershed:	Mill Run Watershed		
	County(s):	Crawford	State(s):	Pennsylvania
		Hydrologic Unit Code:	050100040906	
		Watershed Project Number:	422007	
		Watershed Site Number:	Rainbow Dam (PA-460)	
	NID Number:	PA00177		

Table A – Comparison Table of Structural Options (cont.)				
Principal spillway design				
Item	Unit	Existing	Alt 1 No Fed Action	Alt 2 Rehab Option A
Rainfall volume (1-day)	in	5.22	N/A	5.22
Rainfall volume (10-day)	in	8.27	N/A	8.27
Runoff volume (10-day)	in	7.00	N/A	7.00
Capacity of low stage (max.)	ft ³ /s	264.2	N/A	253.4
Capacity of high stage (max.)	ft ³ /s	N/A	N/A	N/A
Diameter of conduit	in	42	N/A	42
Type of conduit	-	RCP	N/A	RCP
Frequency of operation of auxiliary	%	1	N/A	1
Auxiliary spillway hydrograph				
Rainfall volume	in	9.48	N/A	9.48
Runoff volume	in	See Section L	N/A	See Section L
Storm duration	hrs.	6	N/A	6
Velocity of flow (Ve)	ft/s	51.93	N/A	51.93
Max. Reservoir water surface elevation	ft	1186.81	N/A	1186.46
Freeboard hydrograph				
Rainfall volume	in	25.33	N/A	25.33
Runoff volume	in	See Section L	N/A	See Section L
Storm duration	hrs.	6	N/A	6
Max. Reservoir water surface elev.	ft	1190.95	N/A	1189.76
Capacity equivalents (watershed inches)				
Sediment volume	in	0.07	N/A	0.07
Floodwater retarding volume	in	1.13	N/A	1.13
Beneficial volume (identify use)	in	N/A	N/A	N/A
^{1/} All elevations are to be recorded in North American Vertical Datum 1988 (NAVD88).				
^{2/} If reservoir contains beneficial storage or if sediment capacity will not store water, show area in parenthesis and footnote accordingly in Section L.				
^{3/} Crest of auxiliary spillway.				

Appendix A

COMMENTS AND RESPONSES

This activity is Categorically Excluded under the provisions of NEPA. Public and interagency input was received during project planning as described in Consultation, Coordination, and Public Participation. No comments were received on the draft document.

Appendix B

PROJECT MAP

Figure B-1
Project Location Map
Rainbow Dam (PA-460)

Meadville, PA

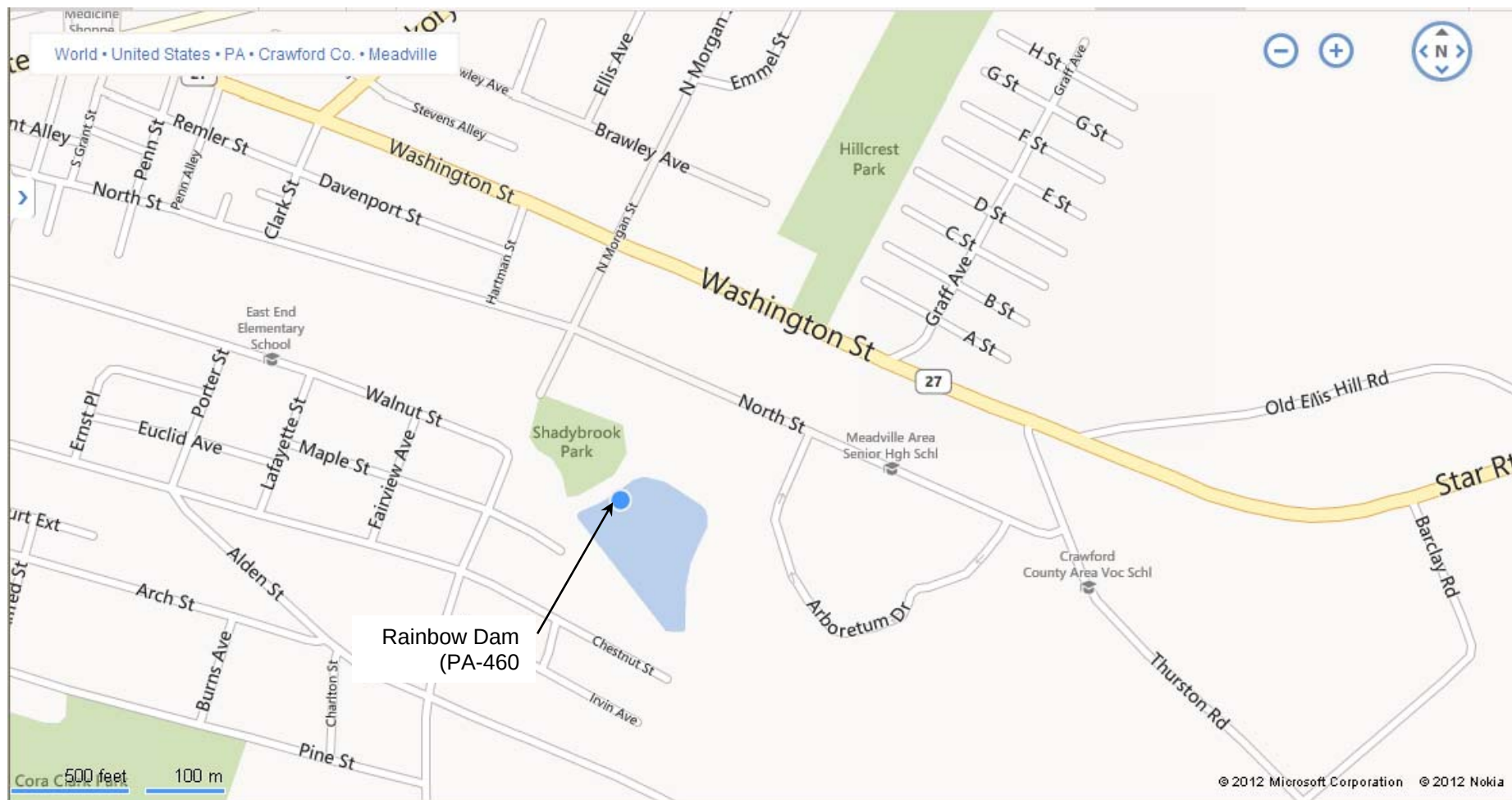


Figure B-2
Project Watershed Map
Rainbow Dam (PA-460)

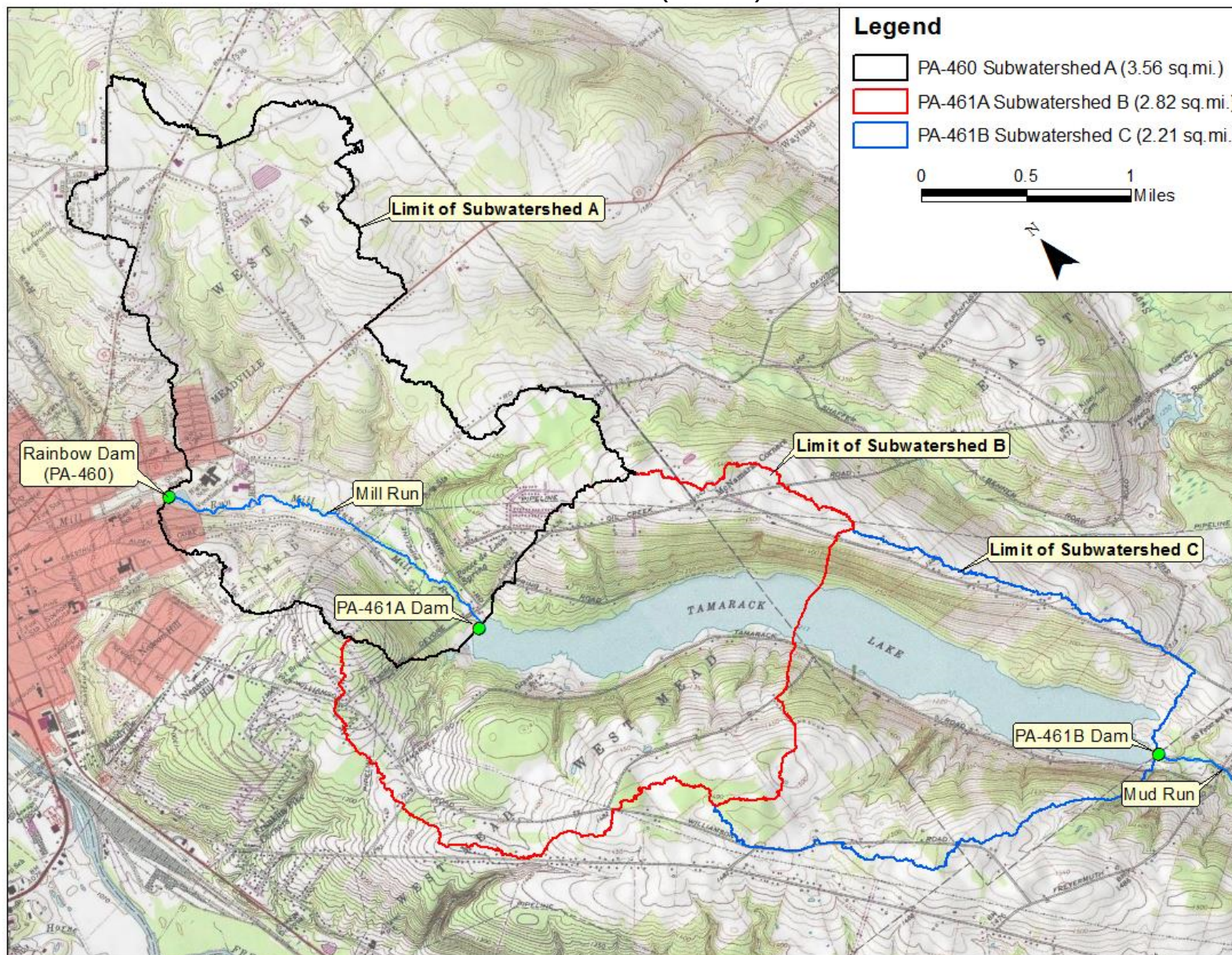
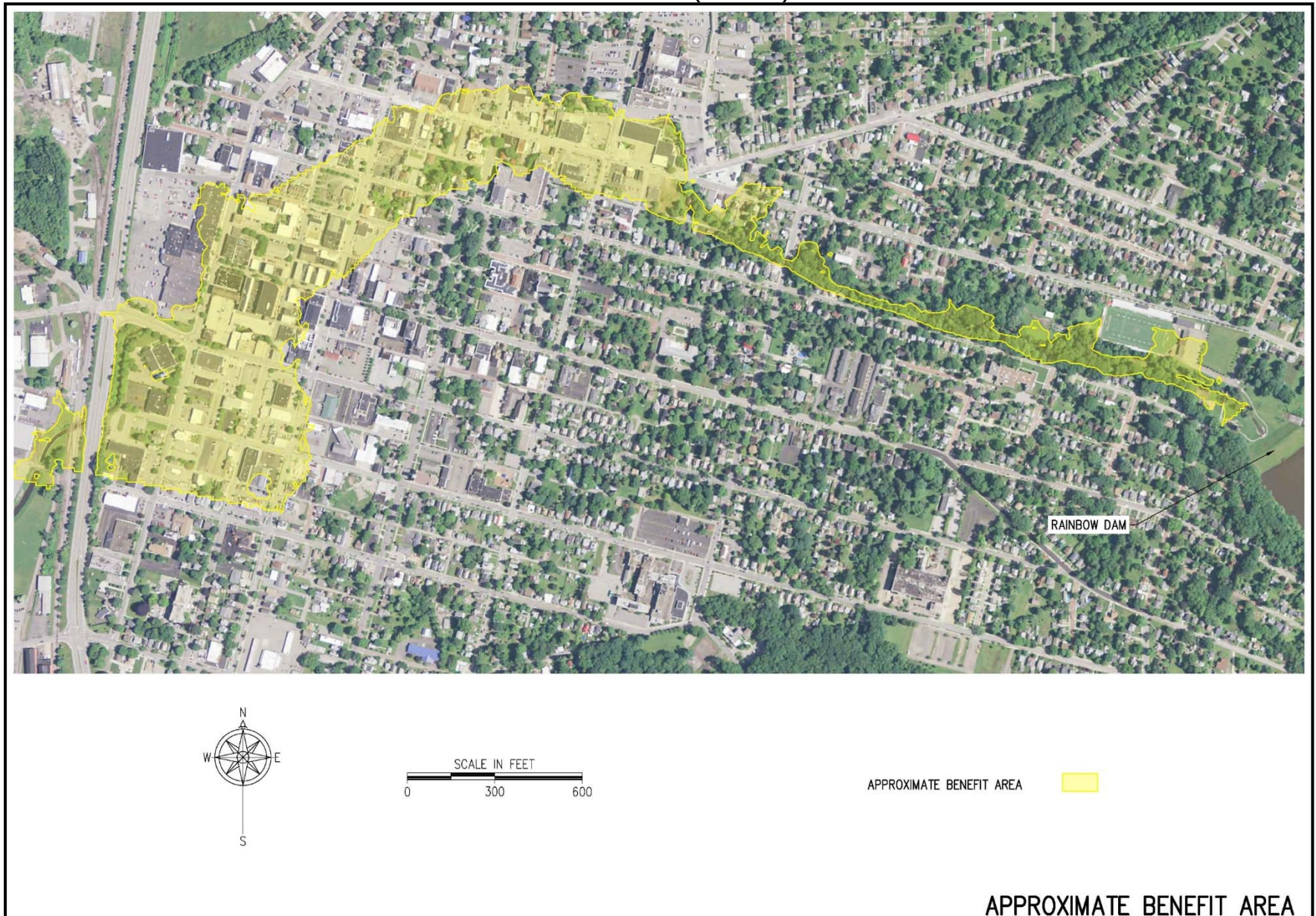


Figure B-3
Project Benefit Area Map
Rainbow Dam (PA-460)



Appendix C

SUPPORT MAPS

Figure C-1
Rainbow Dam (PA-460) Rehabilitation Alternative Plan View

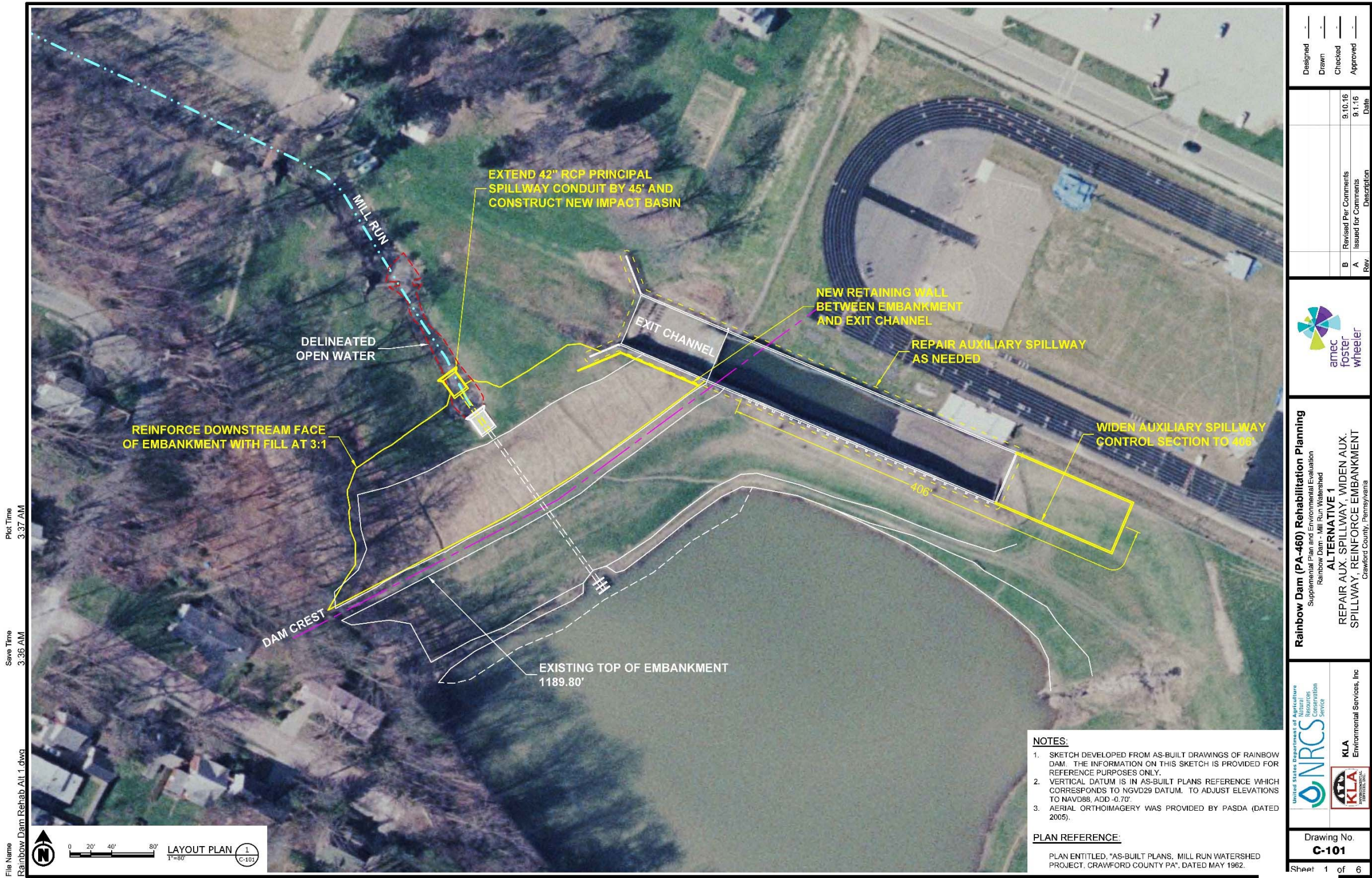


Figure C-2
Rainbow Dam (PA-460) Rehabilitation Alternative Profile View

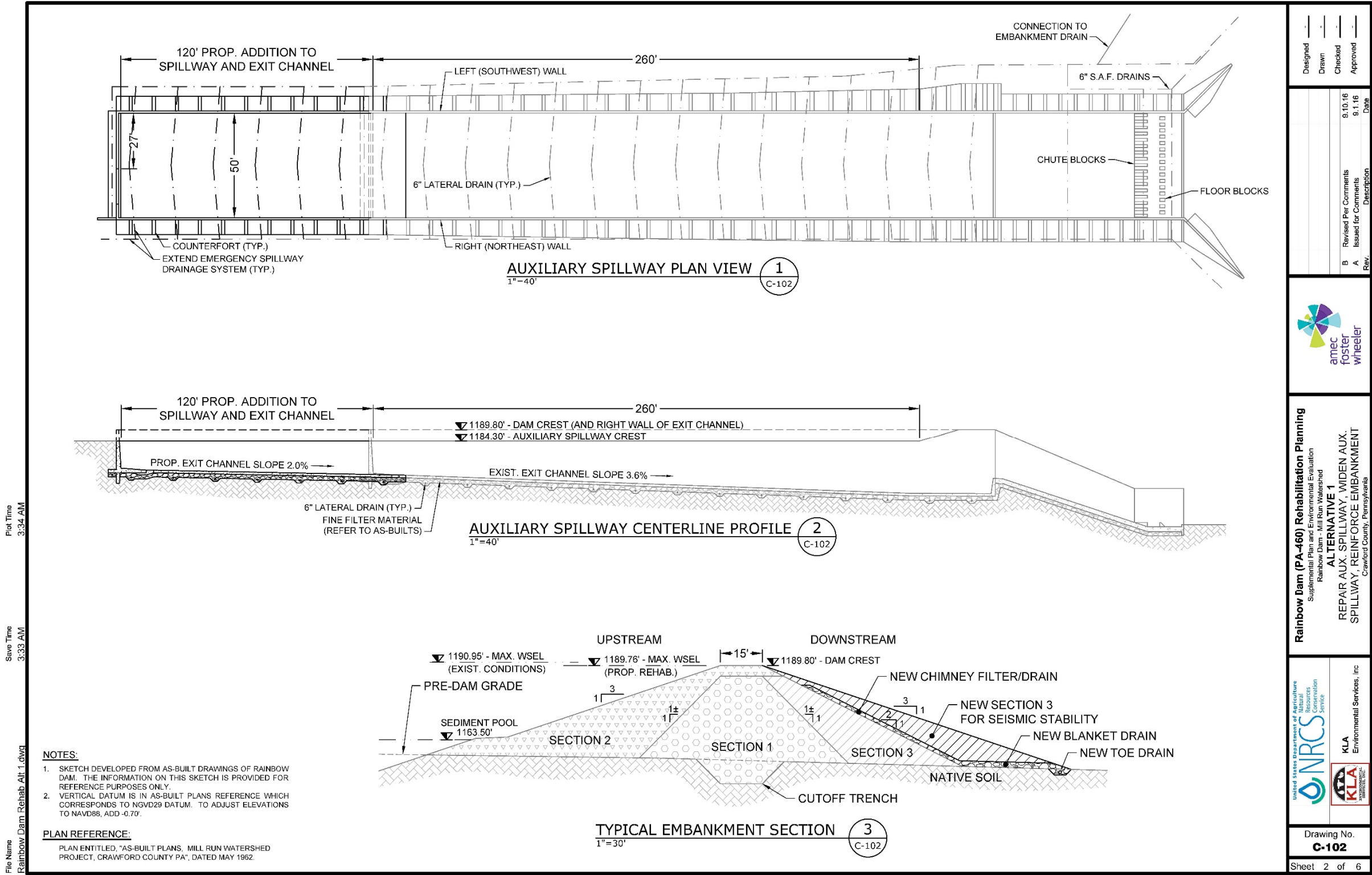


Figure C-3
Rainbow Dam (PA-460) Future Without Federal Project Alternative Plan View

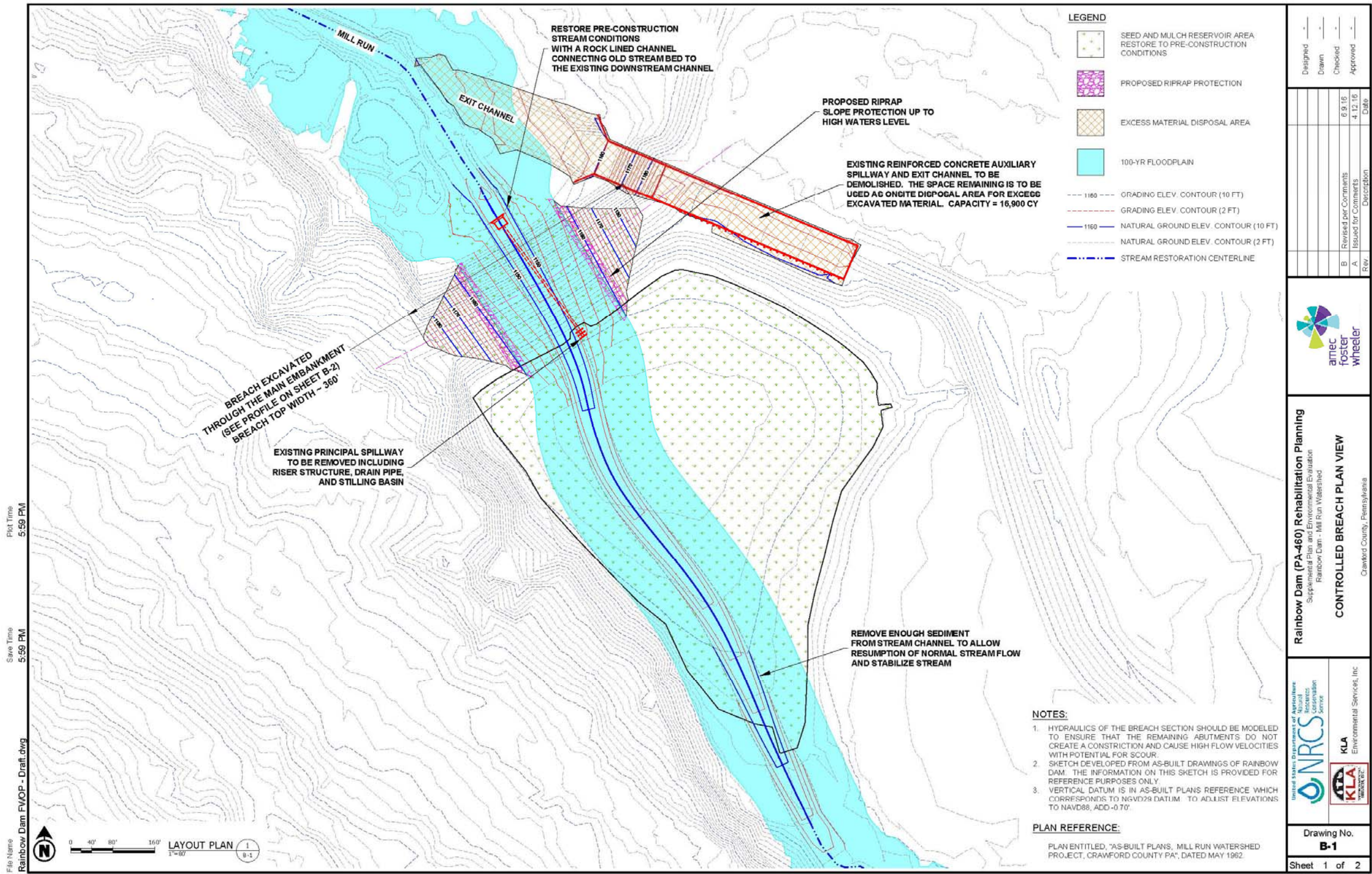


Figure C-4
Rainbow Dam (PA-460) Future Without Federal Project Alternative Profile View

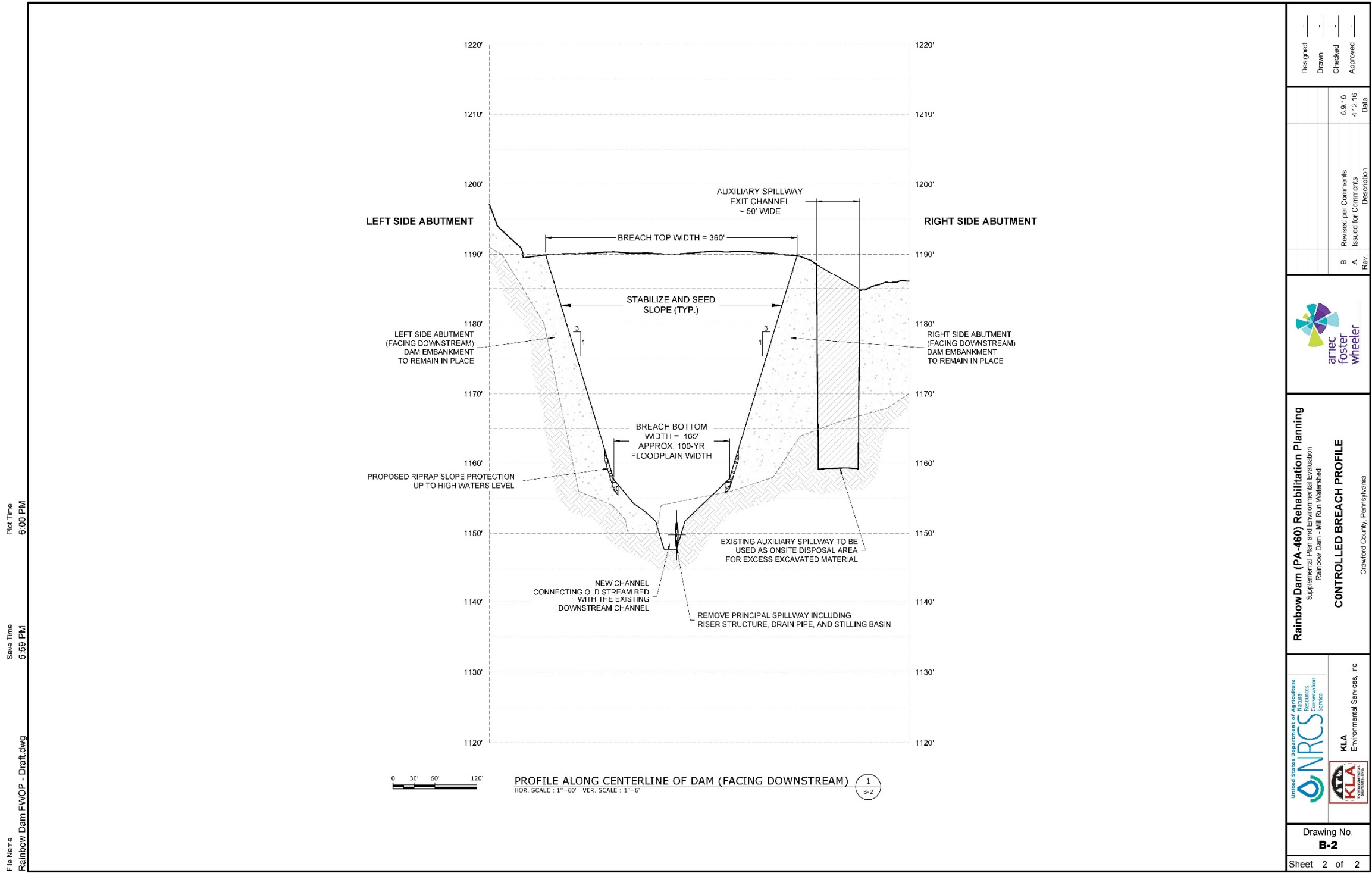


Figure C-5
Rainbow Dam (PA-460) Decommissioning Alternative Plan View

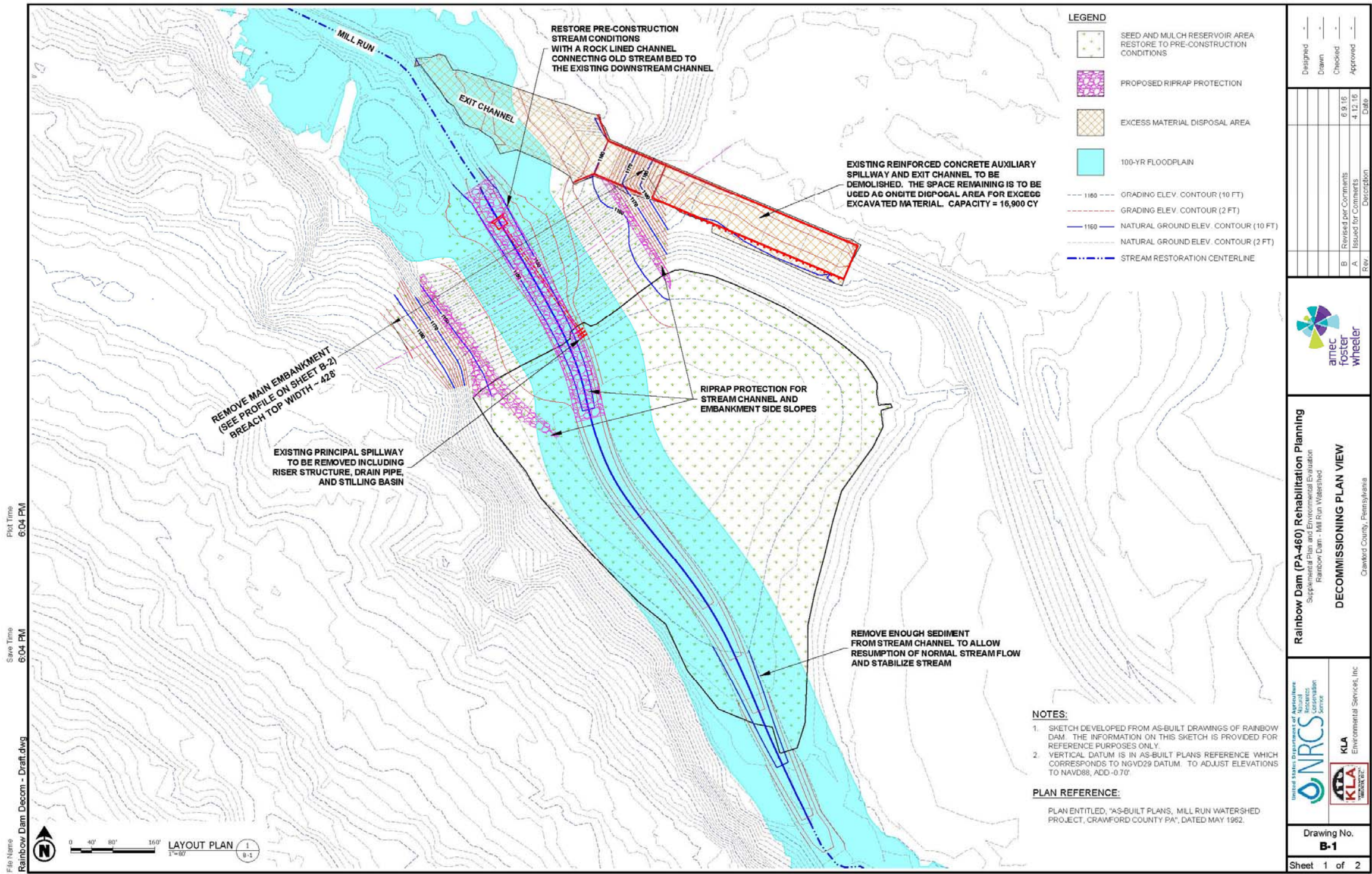


Figure C-6
Rainbow Dam (PA-460) Decommissioning Alternative Profile View

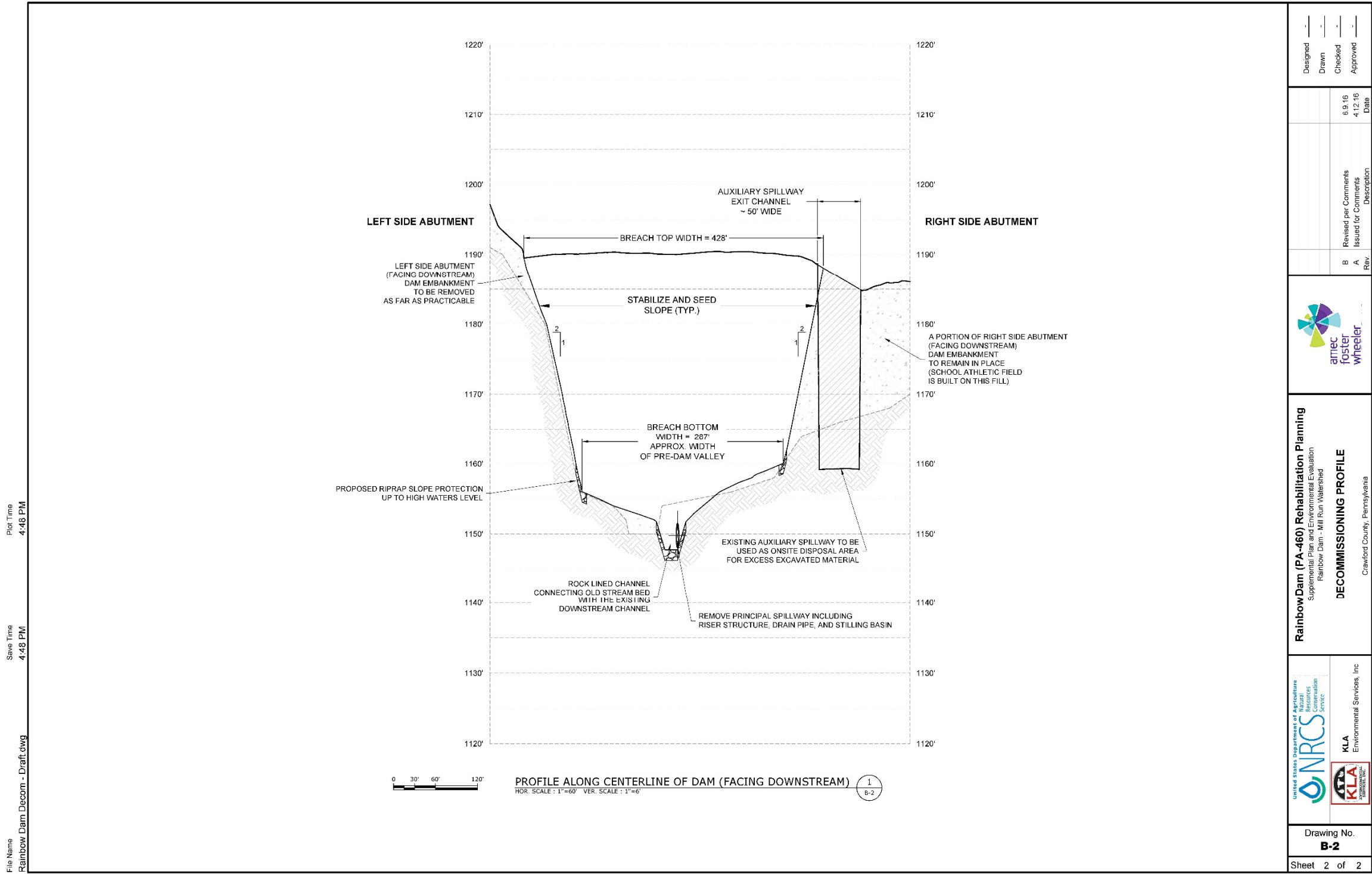


Figure C-7
Rainbow Dam (PA-460) Decommissioning Alternative Nonstructural Measures

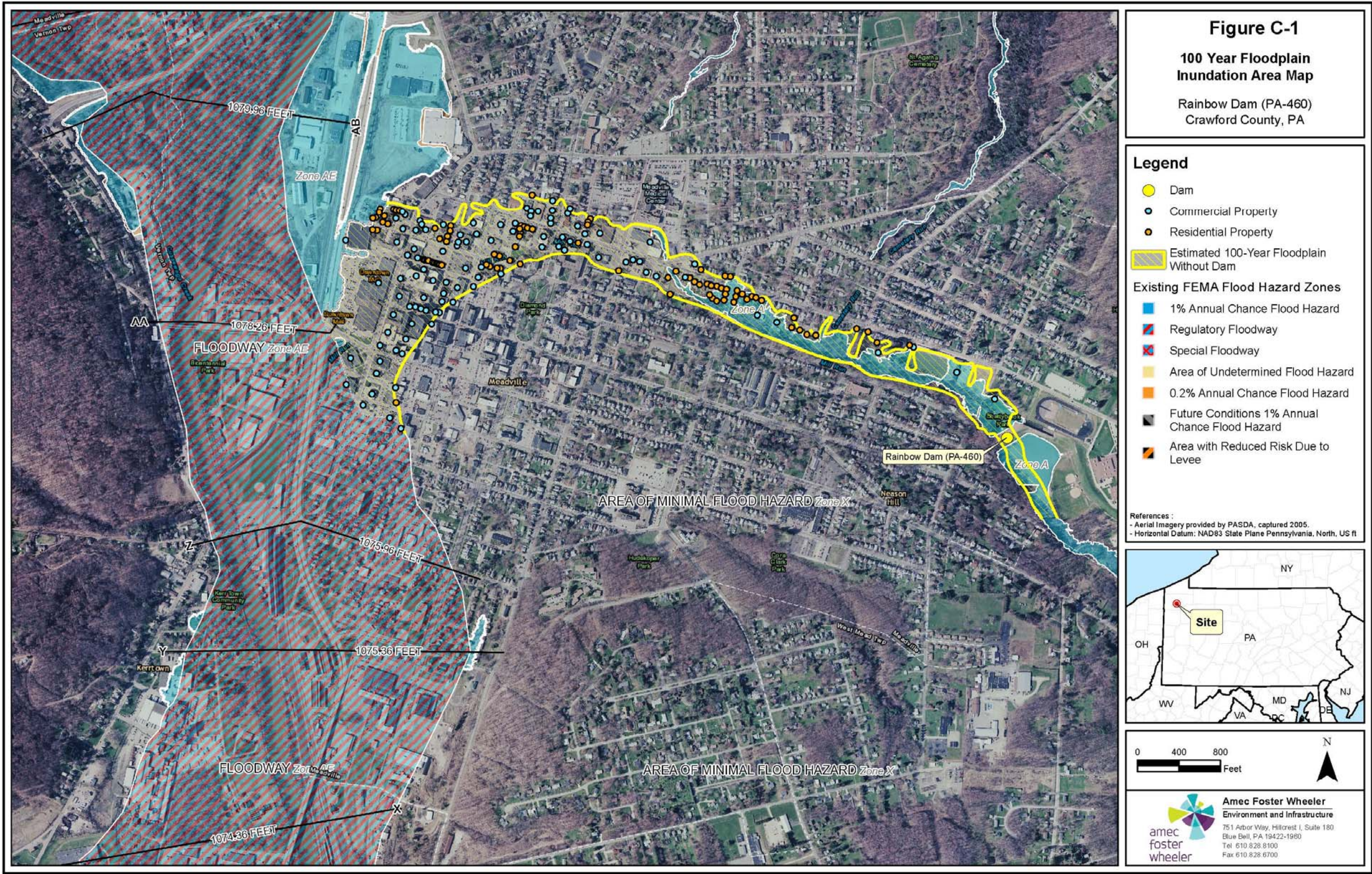


Figure C-8
Rainbow Dam (PA-460) Wetlands Map

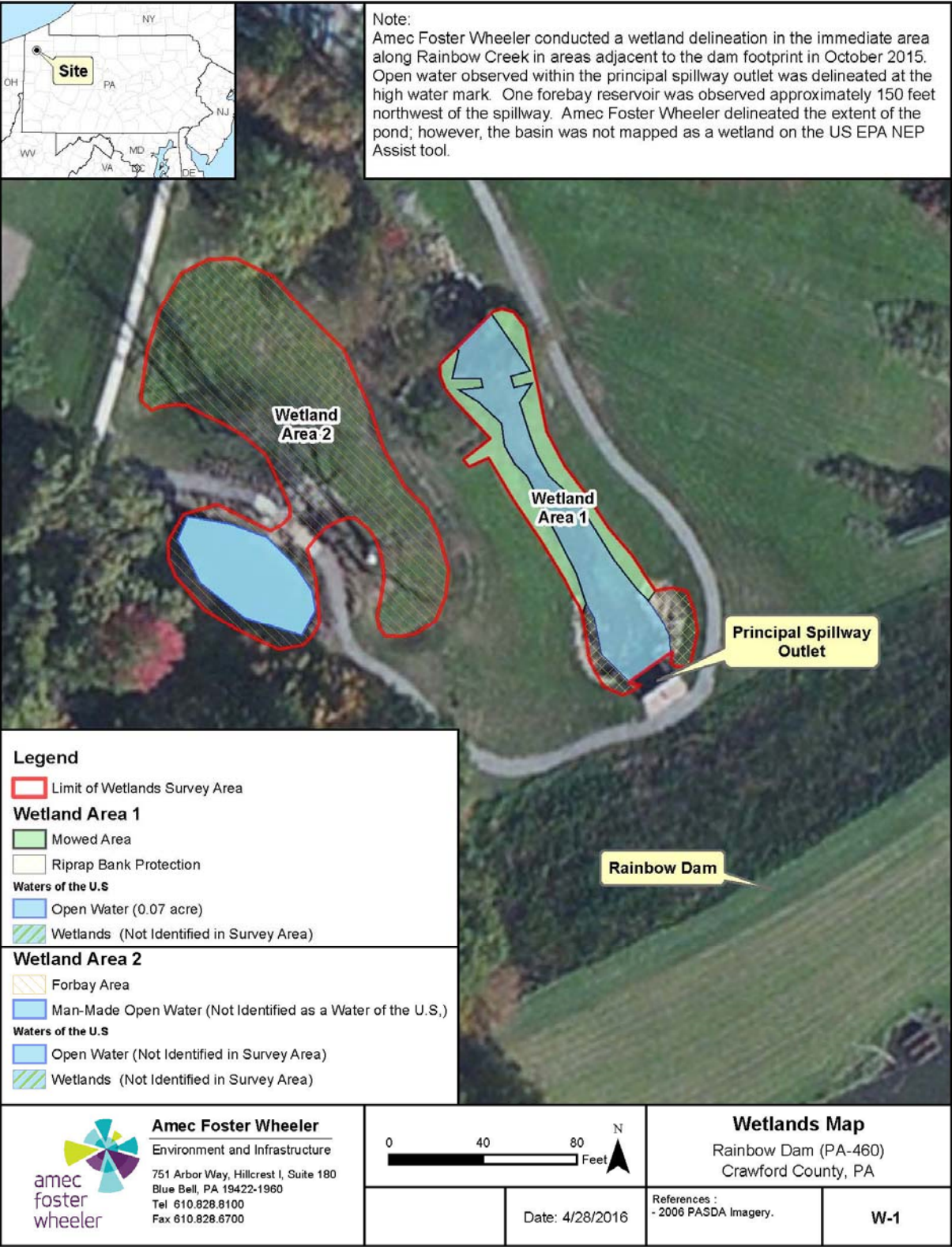


Figure C-9
Rainbow Dam (PA-460) Breach Inundation Map

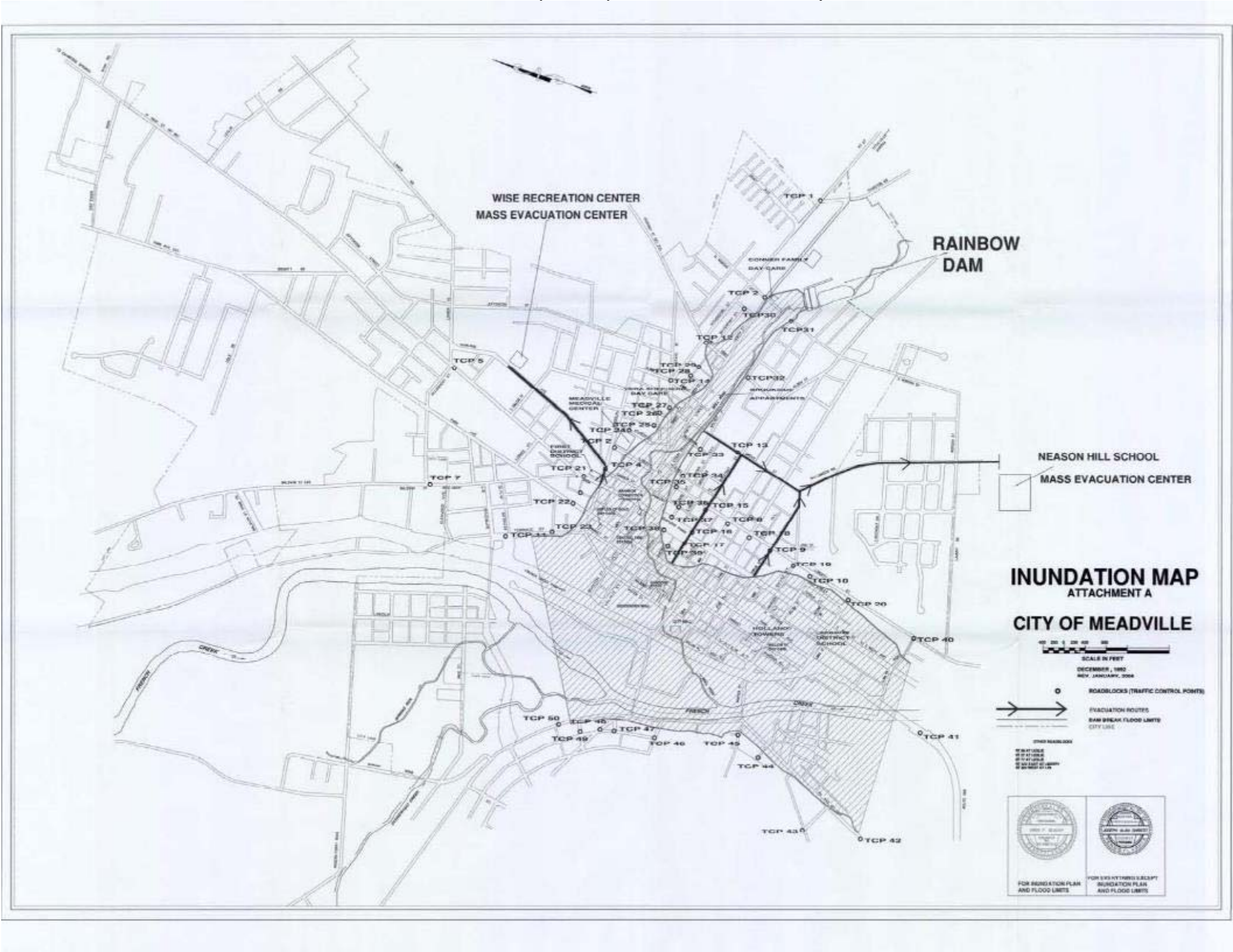


Figure C-10
Rainbow Dam (PA-460) FEMA Map



Figure C-11
Rainbow Dam (PA-460) Existing, Rehabilitated and FWOP Frequency Flood – 100-Year

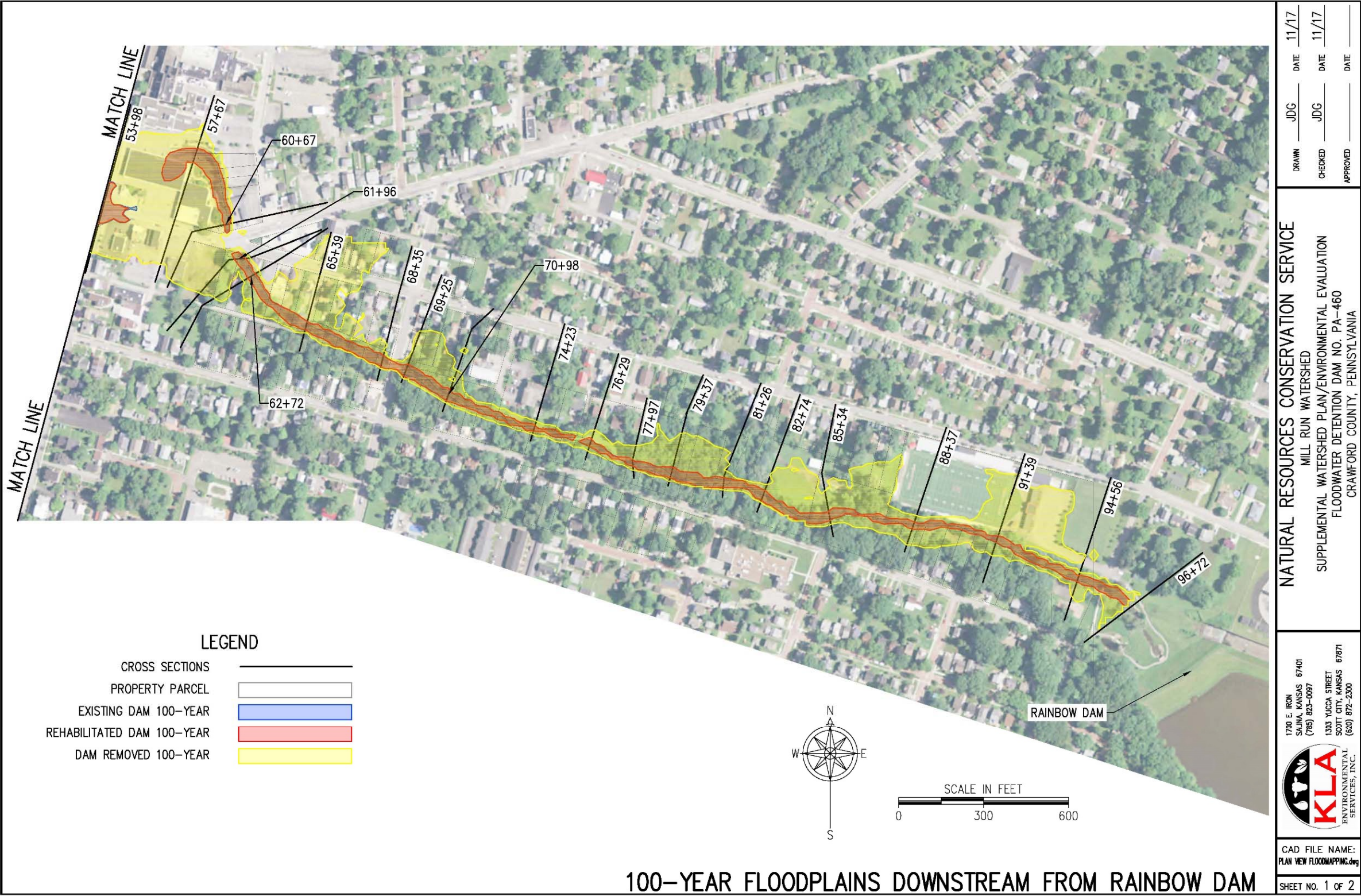


Figure C-12
Rainbow Dam (PA-460) Existing, Rehabilitated and FWOP Frequency Flood – 100-Year

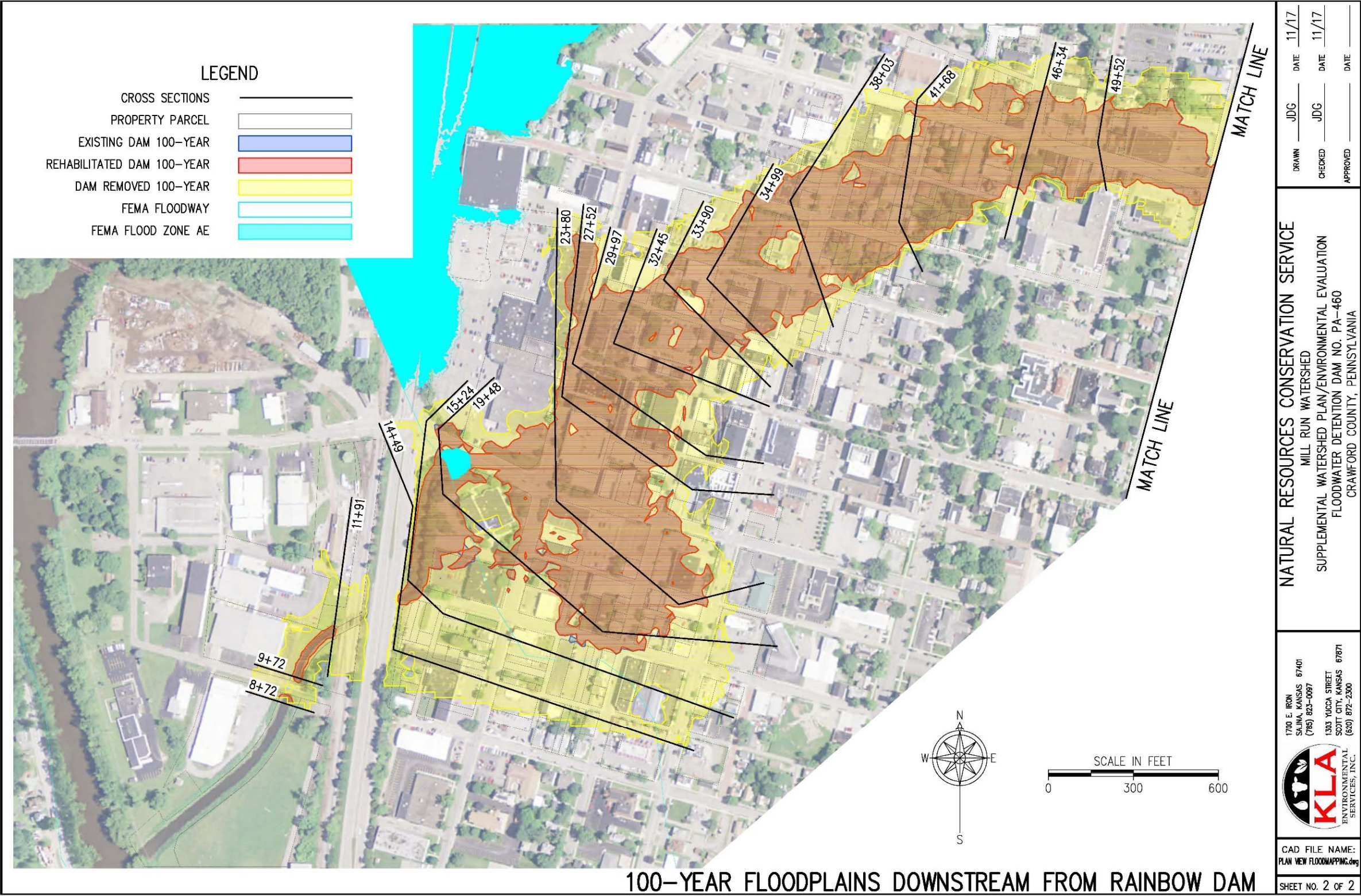


Figure C-13
Rainbow Dam (PA-460) Existing, Rehabilitated and FWOP Frequency Flood – 500-Year

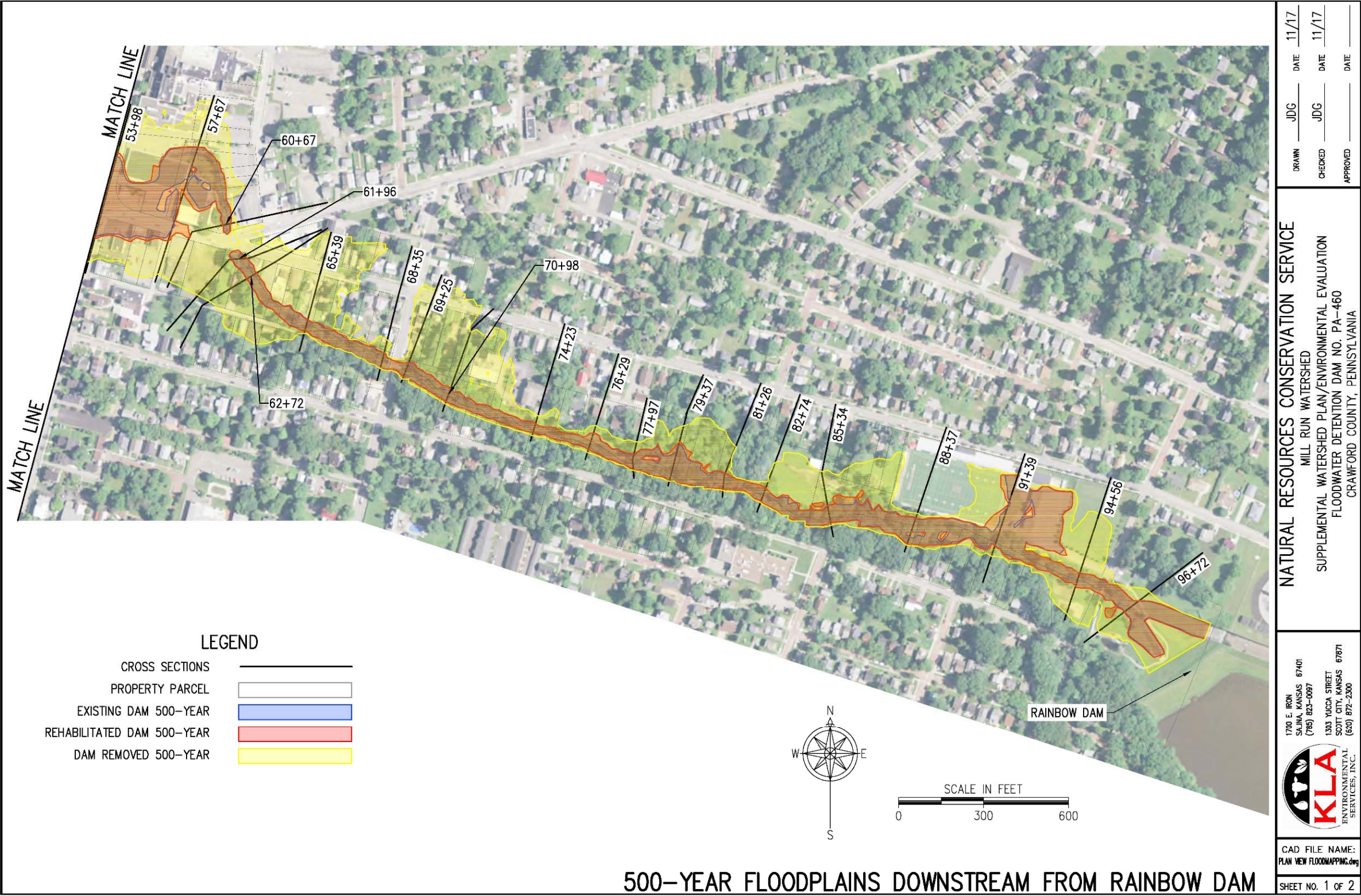
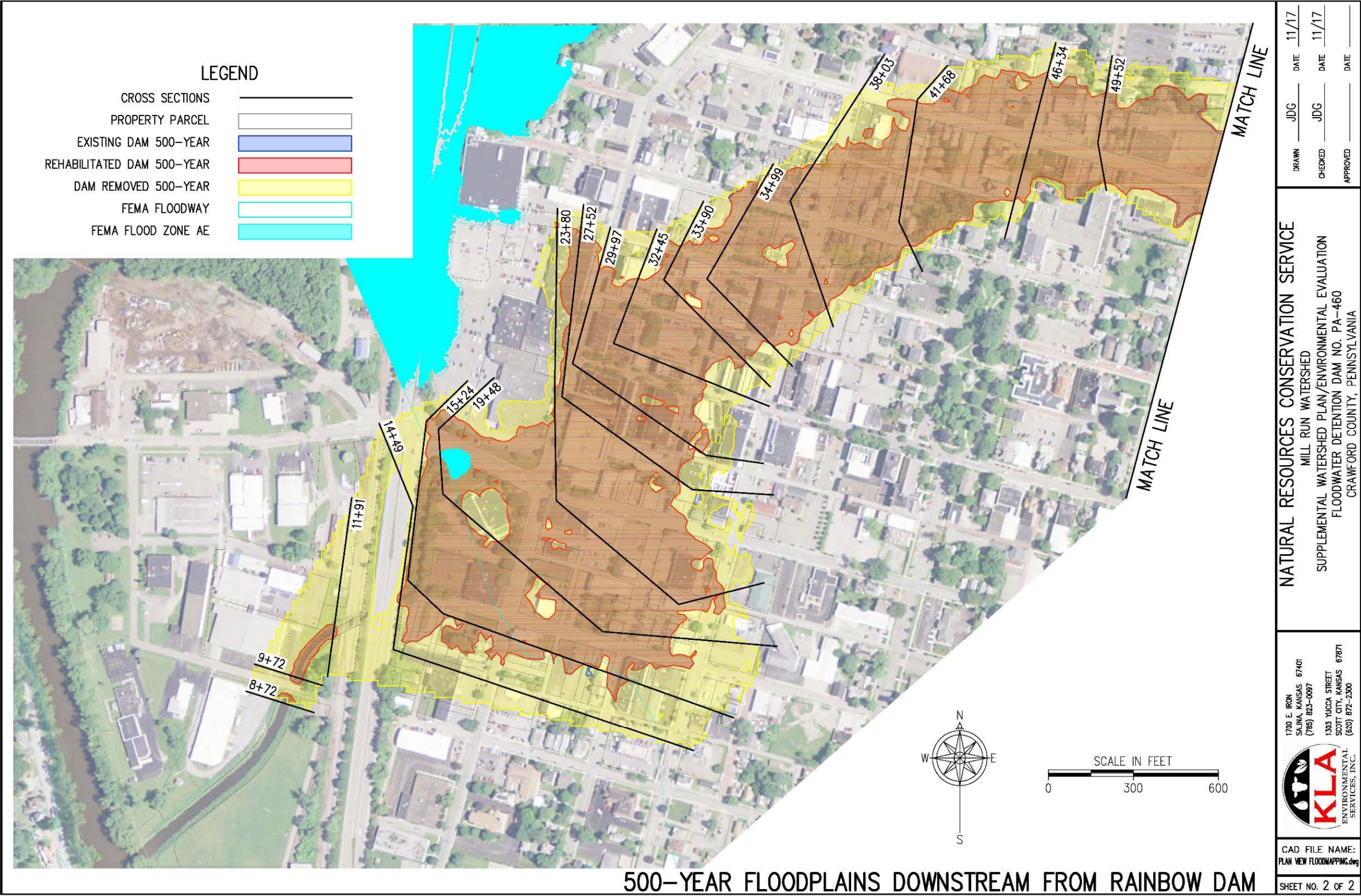


Figure C-14
Rainbow Dam (PA-460) Existing, Rehabilitated and FWOP Frequency Flood – 500-Year



Appendix D

INVESTIGATIONS AND ANALYSES REPORT

D.1 INTRODUCTION

This Appendix provides supplementary information regarding the investigations and analyses conducted for the project. The administrative record contains additional information relevant to each of the sections in this Appendix.

D.2 EXISTING DATA

NRCS provided the following existing data from its archived files to the Project Team:

- As-Built Plans
- Detailed Report of Geology Investigations
- Soil Mechanics Reports
- Breach Inundation Studies
- Stream Hydrology Studies
- Design Documentation
- General Work Plan & Supplements
- Watershed Work Plans
- Supporting Documentation
- Environmental Studies

D.3 EFFECTS ANALYSIS

Ecological, cultural, and socio-economic effects of alternatives were evaluated using the NRCS-CPA-52 – Environmental Evaluation form. This analysis was conducted with consideration to the public participation scoping requirements set forth in the National Watershed Program Manual (NWPM) by considering the potential occurrences of and/or project impacts/risks to the list of 31 natural resources and other issues of concern presented in Section 501.24 Part B of the NWPM. The information presented in the Plan-EE is an overview of the relevant watershed characteristics compiled from existing information. In addition, various websites, as referenced, were used to provide information on natural resource conditions at the site. On-site observations were made to confirm and supplement the compiled site information presented in this report.

Once alternatives were formulated, the Project Team evaluated the effect of each alternative on relevant resource concerns and special environmental concerns. The Dam Rehabilitation alternative involves minimal changes to the existing features and functions of the dam and the construction will be confined to the existing dam and auxiliary spillway.

A Pennsylvania Natural Diversity Inventory search was completed to determine potential impacts to threatened and endangered species. Additional correspondence was exchanged with U.S. Fish and Wildlife Service (USFWS) and Pennsylvania Fish and Boat Commission (PAFBC) concerning the extent of the alternatives. USFWS recommended that considered project alternatives consider avoid direct and indirect adverse effects (disturbance to, or alteration of, French Creek, including changing hydrology, siltation or contaminant discharges) to mussels and their habitat in French Creek. The location of rehabilitation to Rainbow Dam is approximately 9,000 feet upstream from the confluence of Mill Creek entering French Creek. A detailed project description and plans documenting how direct and indirect impacts will be avoided, through sediment control during construction activities, will be provided to USFWS during the design phase for concurrence that the action is not likely to adversely affect.

The USFWS National Wetlands Inventory (NWI) mapping tool was used to review NWI maps. Wetlands are present at the immediate vicinity of Rainbow Dam, specifically north of the spillway. A wetland delineation was conducted in the immediate area along Mill Run downstream of the dam spillway in October 2015. Open water observed within the principal spillway outlet was delineated at the high-water mark. One forebay reservoir was observed approximately 150 feet northwest of the spillway. No other wetlands were identified near the dam embankment and auxiliary spillway footprints.

The No Action/Future Without Federal Project (FWOP) includes removal of a portion of the existing embankment to allow flood flows to pass unimpeded and consequently would impact the hydrology upstream and downstream from the dam resulting in transport of sediment downstream of the dam. The

hydrologic changes would have some effect on wetlands located in the existing reservoir storage pool, by changing the depth and duration of floodwater. The change would also increase flood flow depth and duration downstream, including increased streambank erosion and increased flood damages. The portion of the dam removed with the FWOP has little or no habitat value, so the primary on-site effects will be small improvements in habitat value at the site of the embankment.

D.4 ECONOMIC AND SOCIAL EFFECTS

Service Life. The limiting factor for the anticipated service life of the rehabilitated structure is functional life of the principal spillway and auxiliary spillway structures. The anticipated life of the remaining sediment pool is approximately 158 years at the expected sedimentation rate. This supports a project service life of 100 years and allows up to 3 years for implementation.

Economic Analysis Summary. This analysis was completed according to Attachment 3, Resource and Economic Evaluation in the Project Statement of Work. Changes to the land use composition of the benefit area since the last supplement were incorporated and evaluated by prorating the original benefits to the revised land use composition based on a ratio of areas for each land use. After updating based on land use changes, the original benefits for the project were indexed to current dollars and prorated for the Rainbow Dam (PA-460) based on the ratio of Average Annual Flood Prevention Benefits for each dam in the original Watershed Work Plan.

The Project Team observed the dam site and the flood impact zones below the dam. The predominant land uses in the benefit area were qualitatively inventoried and the changes observed from the original plan and supplements were noted. The previously formulated flood damage benefits were adjusted consistent with the increase in floodplain development observed since the original evaluation. After adjusting the flood damage reduction benefits based on the changes in land use, all benefits were indexed to reflect current values. Indexing was completed using procedures consistent with National Watershed Program Handbook 604.1 (B).

The results of this Project Benefit Analysis will be used to determine the relative benefit/cost ratio for each project alternative by comparing the average annual benefit with the amortized rehabilitation costs.

The following is brief outline of the Project Benefit Analysis:

1. Inventory the previous Supplemental Watershed Plans and determine the most recently calculated benefits.
2. Allocate the Watershed Work Plan benefits to the appropriate project (Rainbow Dam).
3. Evaluate substantial changes in number of houses and businesses with reduced flood damages.
4. Determine the appropriate economic indices for each of the benefit items.
5. Calculate all economic indices for each price base.
6. Update the flood damage reduction benefits allocated to the Rainbow Dam to current values.

The original benefits in the Mill Run Watershed Plan and supplements were assigned to each planned measure in the 1960 Watershed Plan based on a September 1957 Price Base. Supplemental Watershed Plan No. 2 in 1962 continued to use the original benefits with a September 1957 Price Base. Therefore, the original benefits for Rainbow Dam will be based on Table 8a – Benefits and Costs by Construction Units in the original Watershed Work Plan. These original benefits are assigned to the appropriate floodwater damage reduction benefit categories using the ratios of the benefits noted in Table 7 – Monetary Benefits from Structural Measures and Land Treatment Measures for Watershed Protection from the original Watershed Work Plan.

Although the benefit analysis described results in a large amount of uncertainty in the potential National Economic Development (NED) benefits and costs of the respective alternatives, the potential variation will not affect the NED plan selection, thus an abbreviated analysis can be used per Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G).

Population-At-Risk. The population-at-risk was estimated based on the dam breach inundation zone and affected structures from the Emergency Action Plan (EAP) and the Evaluation of Potential

Rehabilitation Projects worksheet included in the NRCS Dam Rehabilitation Assessment Report, January 27, 2010.

Land Use Change Analyses. Changes to the land use composition of the benefit area since the last supplement were incorporated and evaluated by prorating the original benefits based on a ratio of the areas for each land use experiencing notable changes.

Table D-1

Floodwater Retarding Structure	Observed Floodplain Development ¹			
	1959 (Sq.Ft.)	2013 (Sq.Ft.)	1959 (Acres)	2013 (Acres)
PA-460	238,133	242,778	5.47	5.57

¹ Land use increases to development are less than 2% of total developed area.

Changes to the land use composition of the benefit area since the last supplement were considered. Small changes in the land use of less than two percent were identified within the City of Meadville. Since there is no notable change to the land use downstream from Rainbow Dam, no update was made to the project benefits for land use changes.

It is assumed that the land treatment measures accounted in the original Watershed Work Plan and Supplements have been implemented. Therefore, the estimated average annual damage values identified as "After Land Treatment" were carried forward as the estimated average annual damage without project.

Economic Index. P&G section 1.7.2(a)(4)(ii) and 2.1.1(b)(2) allows abbreviated procedures to evaluate project benefits. Consequently, indexing will be used instead of hydrologic and economic evaluation for updating the benefits for those areas where no substantial land use changes have occurred. The original and supplemented project benefits were indexed to Price Base 2016 consistent with the tools provided at the NRCS Economics Web Site:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/tools>

The project benefits were last updated in 1959 (Price Base 1957) in the original Watershed Work Plan for Mill Run Watershed.

Updated flood control benefits were calculated consistent with P&G and NREH Part 611. Benefits represent costs or damages that would occur in the absence of the Project. Indexing methods are described in P&G 2.1.1 (b)(2).

NED Analysis. The P&G was used to determine the NED Alternative. This alternative is defined as that which maximizes the net benefits consistent with protecting the Nation's environment. The economic evaluation was performed in accordance with Chapter 2, Section 4 of the P&G and the NRCS National Watershed Program Manual (Parts 501.11 A(2); 501.12 C; 505.35 B (1) (iii)-(1V); 505.35 E-F).

D.5 ENGINEERING

Surveys. To supplement data from available as-built drawings, the Project Team conducted a topographic field survey of the site October 2015 to supplement the data available from the as-built drawings. Survey ground spot elevations were collected along the centerline and edges of the dam crest, along the upstream and downstream faces of the dam embankment, along the auxiliary spillway (exit channel), and around the inlet / outlet structures, areas surrounding the normal pool, and the wetlands adjacent to the dam. Additional survey points were collected for the concrete structures including the auxiliary spillway weir structure (control section), side walls, inlet box, chute channel, principal spillway

riser, and downstream impact basin. Survey point elevations were obtained using a survey grade GPS receiver with an OPUS solution.

The horizontal datum was based on the North American Datum of 1983 (NAD83) using the Pennsylvania State Plane coordinate system, North Zone. Survey data were collected in the North American Vertical Datum of 1988 (NAVD88) and a shift of 0.7 feet was applied to adjust the measured elevations to the as-built plans (Reference 1) reference, which is the National Geodetic Vertical Datum of 1929 (NGVD29).

The bathymetric and sediment surveys of the permanent pool area were performed in October 2015. The results of these surveys are provided in the separate sediment survey submittal.

Breach Inundation Study. The breach analysis used in this plan was provided by the Pennsylvania Department of Environmental Protection (PADEP), Division of Dam Safety. The breach analysis met all of the PADEP, Division of Dam Safety's criteria and, provides an incremental breach analysis based on modeling of storage capacity and reservoir surface area for normal pool and maximum storage elevations. The hydrologic and hydraulic analyses were also approved by the PADEP. The results of the breach were used to generate the flood inundation maps for the current Rainbow Dam Emergency Action Plan. The NRCS State Conservation Engineer concurs with the hazard classification of high assigned to this dam. The results of the breach were used to generate the flood inundation maps for the current Rainbow Dam Emergency Action Plan.

Flood Storage Capacity. The flood storage curve for existing conditions was developed using the ArcGIS Surface-Volume Tool. The flood storage capacity of Rainbow Dam was determined by evaluating the cumulative storage capacity above the normal pool elevation.

Hydrologic and Hydraulic Evaluation. Because of the complexity of the watershed upstream of Rainbow Dam, caused by the presence of the upstream structure Mill Run PA-461A and the impoundment regulated by structures Mill Run PA-461A and Mill Run PA-461B, the hydrologic and hydraulic evaluation was carried out considering the following subwatersheds:

(A) the drainage area upstream of site Mill Run PA-460 (Rainbow Dam) and downstream of Mill Run PA-461A. This drainage area is the one considered in the Final Design Report (Reference 3); (B) the drainage area upstream of Mill Run PA-461A up to the watershed divide; and (C) the drainage area upstream of Mill Run PA-461B ((B)+(C) is the total drainage area to Lake Tamarack). The watershed delineation of the Mill Run PA-461A&B dams followed the PASDA Lidar boundaries. Based on the delineation, the watershed area being credited to Mill Run PA-461A is 71% of the total area draining to Tamarack Lake.

The state-rehabilitated Mill Run PA-461A has an armored auxiliary spillway that allows passage of the PMF event in a manner that would not lead to failure from overtopping. Inflow hydrographs were developed for the drainage areas upstream of Rainbow Dam that included the discharge hydrograph from Mill Run PA-461A.

Runoff Curve Number. The Runoff Curve Number (RCN) development for the Rainbow Dam watershed followed TR-55 methodology. Arc Hydro tools, in conjunction with the USACE HEC-GeoHMS software, were used to combine land use data with corresponding soil types and develop a weighted RCN for the entire watershed.

The 2011 NLCD land cover classification was assumed representative of the current land cover conditions in the Mill Run watershed. The projected future land use conditions RCN was developed based on the Future Land Use Comprehensive Plan developed by Pashek Associates for the Crawford County Planning Commission. No other additional land use changes were projected for the design life of the rehabilitated dam.

Time of Concentration. The Time of Concentration (Tc) for Subwatersheds A and B was developed using the segmental/velocity approach, described in TR-55, and the USACE HEC-GeoHMS software. An automated tool in HEC-GeoHMS uses the terrain to determine the paths with minimal slope for shallow concentrated flow, sheet flow, and open channel flow. The HEC-GeoHMS tool develops a preliminary longest flow path using the DEM, which can be adjusted as needed. The adjustments include identifying the locations

of flow-type transitions from sheet flow to shallow concentrated flow, and from shallow concentrated flow to channel flow.

Precipitation Data. Precipitation data for the three subwatersheds upstream from Rainbow Dam watershed was derived using the following sources:

- Hydrometeorological Report 51 – Probable Maximum Precipitation (PMP) Estimates, United States East of the 105th Meridian, which provides PMP values for various storm durations; and
- NOAA Atlas 14, Volume 2 (Ohio River Basin and Surrounding States) – Provides rainfall depth-duration-frequency data for 13 Mid-Atlantic and central states. The data can be accessed online at <http://hdsc.nws.noaa.gov/hdsc/pfds/>

Rainfall depth from the above-mentioned sources was used to develop design hydrographs and evaluate the principal spillway capacity; stability and integrity of auxiliary spillway; and dam capacity (top of dam elevation). The 10-day draw-down and the starting water surface for the principal spillway hydrograph (PSH) met the requirements of TR-60.

Technical Release 60 (TR-60) design criteria require that the principal spillway capacity be evaluated by routing the Principal Spillway Hydrograph (PSH) with a combined 1-day/10-day 100-year return period rainfall. Two methods for estimating runoff volumes were considered: (1) the runoff curve number procedure and (2) runoff volumes based on stream gage studies (TR-60, Figures 2-1(a) and 2 1(b)). The procedure that results in the higher auxiliary spillway crest elevation, when the PSH is routed through the structure, will be used. The top of dam elevation and integrity of the auxiliary spillway (e.g., head-cutting and breaching) were evaluated by routing the Freeboard Hydrograph (FBH). For “High Hazard” dams, such as the Rainbow Dam, the FBH is generated by a PMP storm. Short duration (6-hour) and long duration (24-hour) storms were analyzed and the most critical result used. The stability of the auxiliary spillway (e.g., erosion and scour along the exit channel) was not evaluated by routing the Stability Design Hydrograph (SDH), because the auxiliary spillway is structural and is resistant to erosion.

PADEP commonly requires the temporal distribution of the PMP to follow the Hydrometeorological Report 51/52 critically stacked distribution or, for drainage areas less than 10 square miles, a distribution based on USACE EM 1110-2-1411. For Rainbow Dam, the Project Team developed a HEC-1 model using the hydrologic inputs for the SITES model (RCN and Tc) to apply the EM 1110-2-1411 distribution. The starting water surface elevation for the auxiliary and freeboard hydrographs met the requirements of TR-60.

The analysis of the existing Rainbow Dam, based on current NRCS design and safety criteria, found that the dam would be overtopped during the Freeboard Hydrograph storm event.

Sediment Volume. The Project Team performed a field measurement of sediment thickness at 105 locations utilizing a 1-inch rod, with a 2-inch square plate attached to its end. The rod was pushed for total refusal and the thickness of sediment at each location was calculated by subtracting the refusal elevation from the top of sediment elevation. The areas surrounding the impoundment are vegetated (mostly grass except for the West side of the impoundment where trees are present) and well maintained. No significant presence of aerated sediments was observed.

The 2007 LiDAR survey data from the Pennsylvania Department of Conservation and Natural Resources (DCNR) obtained through the Pennsylvania Spatial Data Access (PASDA) was used to derive the storage values above elevation 1,163.5 feet (normal pool). The vertical accuracy error was calculated and is shown on the Storage Map. Overall the LiDAR data is of high quality and minor elevation differences were noticed. The Reservoir Storage Map shows samples of the minor errors that were calculated throughout the site. Amec Foster Wheeler considers this error to pass the qualitative acceptance published by The Pennsylvania Spatial Data Clearinghouse (PASDA) for Crawford County and can meet the need to calculate an accurate storage volume.

Amec Foster Wheeler developed a digital surface to reflect the reservoir floor elevations at the 105 field locations where sediment thickness was measured, and a second digital surface to reflect the elevation of refusal below the reservoir floor. Then, using the Autodesk Civil 3D Composite Volume tool, the volume between the two digital surfaces was calculated to provide the sediment volume. Based on the 105

sediment depth field measurements, the total sediment volume was estimated to be 5.43 acre-feet. The total volume is categorized as submerged sediments.

On April 14, 2016, NRCS Resource Soil scientist visited the site to look for aerated sediment deposits. Based on collected field data, an estimated aerated sediments volume of 0.2 acre-feet was found in gravel fan deposits, and near the mouth of the tributary (Mill Run) upstream of Rainbow Lake. NRCS observed no evidence of aerated sediment deposition further upstream.

Amec Foster Wheeler also developed a sediment map to provide the locations of sediment thickness measurements and the interpolated sediment thickness surface. The ArcGIS Spatial Analyst tool was used to develop a "depth chart" created from the difference between the two digital surfaces representing the current top and bottom elevation of sediments. The interpolated sediment depths were then depicted as polygons with different colors representing a range of sediment depths. All sediment is submerged below the normal pool elevation of 1,163.50 feet.

The annual sedimentation rate based on the measured sediment volume was evaluated and compared to the design sedimentation rate, as well as the projected sedimentation rate for the 55-year period from 2015 to 2070. The projected sedimentation rate was computed using the existing and future (build-out) land use conditions within the drainage area located between PA-460 and PA-461A, in accordance with NEH Section 3, Chapter 8 and SCS-ENG-309.

By considering the actual sedimentation rates, determined based on deposits accumulated since the dam was built, NRCS recommends that future submerged and aerated sediment estimates be based on 150% of the measured current sediment deposits. Therefore, the predicted rates for sediment accumulation are 0.16 acre-feet/year for submerged and 0.006 acre-feet/year for aerated. Based on the available 25.26 acre-feet of volume remaining in the sediment pool, approximately 158 years of sediment life remain beyond 2015. The expected aerated sediment volume over that same period is estimated at 0.9 acre-feet.

The portion of Mill Run watershed upstream of structure Mill Run PA-461A was not considered in the sediment volume evaluation, reasonably assuming that all corresponding sediment is stored in the impoundment upstream of Mill Run PA-461A. The soil loss rates for the different land use conditions were based on the PA-460 Mill Run Design Report.

Site Walk. The Project Team conducted a site visit to document the current conditions of Rainbow Dam, located in Crawford County, on October 5, 2015. The site visit included a visual review and photographic documentation of the exposed areas of the dam and associated structures.

Embankment and Foundation Geology. An preliminary geologic investigation of the existing dam embankment was conducted. The geology of the dam and foundation are based on information acquired from published geologic information of the area, the preliminary geologic investigation, and the investigations and analyses conducted during the original design of the dam.

Auxiliary Spillway Conditions. The quality of the concrete within the auxiliary spillway was determined based upon the cracks, concrete joint integrity, a chain drag survey, and core sampling.

There is evidence of flexure and shear cracks in several locations within the auxiliary spillway. In some locations, cracks are large enough for vegetation to grow, up to one-quarter inch wide. The frequency of the cracks covers less than an estimated 15% of the structure.

The walls are out of plumb downstream of the chute spillway, which is a concern. This is a known issue that has been continuously monitored by the City of Meadville. Monitoring is planned to continue, checking specific joints of concern for possible continued offset movement.

A chain drag over the exposed spillway floor detected 15 anomalies during the survey. A potential cause for anomalies in these areas could be through adjacent or nearby cracks.

Five concrete core samples were obtained from the structural spillway floor. The amount of concrete core recovered varied between 14 inches and 27 inches. The coring detected three cores with one to five inches less than the published design thickness. Material beneath the concrete consisted of silty, fine- to coarse-grained sand with trace gravel. The Project Team did not observe any voids beneath the concrete slab.

Based on the testing, the Project Team developed a rating system to evaluate the concrete auxiliary spillway. Based upon the extent of cracks, condition of joints, magnitude of spalling, and limit of delamination, a total rating of 9 out of a possible 12 points (75%) was determined. With the concrete assessment achieving over half the available rating, it is the Project Team's opinion that the concrete is in fair condition.

Seismic Evaluation. Based upon the design report, the slope stability analyses did not include analyses of seismic stability. The Project Team obtained and evaluated existing geologic, geophysical, and available seismologic information; and prepared a seismotectonic evaluation of the area to determine that there are not "active" or "capable" faults at the site. The study included an assessment of the suitability of existing data to evaluate definitively the existence of faults at the site. Additionally, the Project Team obtained a probabilistic seismic hazard curve for the site from the USGS Earthquakes Hazard Program and based the earthquake loading on an annual exceedance probability of 1×10^{-4} which represents a return period of about 10,000 years or an approximate probability of exceedance in 50 years of 0.5%.

Amec Foster Wheeler mapped the location of three M4+ earthquakes since 1700 within a 100-kilometer radius of the site. No faults are mapped within the 100-kilometer radius; however, there is not enough data to evaluate definitively the existence of faults at the site. Using USGS web tools, Amec Foster Wheeler determined the 10,000-year return earthquake event to have a PGAM = 0.330g and the 2,500-year return earthquake event to have a PGAM = 0.117g at Rainbow Dam.

Principal Spillway Video Inspection. The Project Team conducted a robotic Televideo (TV) inspection of the principal spillway, embankment drains, and auxiliary spillway drain as part of the documentation of the current conditions of Rainbow Dam (PA-460), located in Meadville, Crawford County, Pennsylvania on October 26, 2015. This inspection report provided joint gap and surficial observations to document the current conditions of the principal spillway. Additionally, the report provided video inspections of the accessible portions of the embankment drains and the auxiliary spillway drain. The outlet of the S. A. F. drain was not found and no inspection of that drain was conducted.

Based on our observations, it is Amec Foster Wheeler's opinion that the principal spillway RCP is in good physical condition. However, the interior pipe joint seals have generally disintegrated and no longer function. Only a few short segments of a few joints remain. To extend the life of the pipe, the interior joints should be cleaned and sealed. Amec Foster Wheeler reported that the dam and RCP are structurally stable and not subject to significant movement in future. Therefore, it was recommended that each joint should be cleaned to expose fresh, sound substrate concrete and sealed using a non-shrink, Portland cement based grout. Likewise, the apparent longitudinal crack in the east, lower quadrant should be physically inspected to determine that it is indeed a crack, and, if it is a crack, cleaned to expose fresh, sound substrate concrete and sealed using a nonshrink Portland cement based grout.

Toe Drain and Auxiliary Spillway Drain Video Inspection. The Project Team performed a TV inspection of the Rainbow Dam toe drains and Auxiliary Spillway drain on October 26, 2015. The objective of the inspection was to document the current condition and identify any potential issues of the drains. Amec Foster Wheeler used a VuTEK® Pipe Camera to perform the inspection. This equipment provided video inspection by manually pushing camera through the 6-inch diameter CMP drain pipes.

The observable lengths of both embankment drains for the dam and auxiliary spillway underdrain are in good physical condition. Currently, it is rather difficult to inspect these pipes due to their small diameter and 90° bends. Amec Foster Wheeler recommended that the upstream ends and/or selected strategic locations of each embankment drain be fitted with either a manhole or angled cleanout pipes to launch inspection and/or cleaning equipment. Periodic inspection and cleanout should be performed.

Slope Stability. The Project Team estimated the slope stability of the existing dam by numerically modeling a two-dimensional section through the embankment and subgrade using Geo-Slope International's Geo-Studio 2012 software entitled SLOPE/W and SEEP/W. The soil strength and seepage properties were obtained from the 2015 explorations and tests, the 1962 design documents, and the 1964 study.

The Project Team considered four general Conditions to evaluate the stability of the dam:

- Condition 1 – the low pool stage at the invert of the inlet pipe to evaluate end-of-construction conditions (Not evaluated due to the age of the dam).
- Condition 2 – sudden drawdown from the permanent pool to the lowest ungated stage. .
- Condition 3 – the flood stage pool at the crest of the Auxiliary Spillway.
- Condition 4 – Pseudo-static Seismic analysis at permanent pool stage, downstream face using horizontal seismic acceleration of $PGA_M = 0.330g$ for the site.

It was noted that Condition 4 is modified from the 2005 TR-60 based upon the NRCS SOW requirements. The Seismic and Stability Report provides a summary of the TR-60 stability analysis results for the cases analyzed. Graphic outputs were provided for each stability case as well as the graphic output for the simplified seepage analysis.

Additionally, for the 25 PA Code § 105.97 (Pennsylvania Code, 2011) criteria analyses, Amec Foster Wheeler analyzed the following four general cases to evaluate the stability of the dam.

- Case P1: Normal pool, Elevation 1163.5 feet, with steady-state seepage conditions
- Case P2: Maximum pool (crest of dam) (Elevation 1189.8 feet NGVD29 per as-built plans)
- Case P3: Sudden Drawdown from permanent pool to lowest ungated discharge, elevation 1163.5 feet to elevation 1157.5 feet (upstream slope).
- Case P4: Pseudo-static Seismic analysis at permanent pool stage, Elevation 1163.5 feet, downstream face using MCE horizontal seismic acceleration of $PGA_M = 0.117g$ for the site.

Because NRCS completed construction of the Rainbow Dam 53 years ago (1963), the end-of-construction, Case P5 was not evaluated.

Based upon the original design and current studies soil parameters and conservative assumed conditions, it is Amec Foster Wheeler's opinion that the seepage/stability analyses indicate that the dam meets the current NRCS TR-60 and 25 PA Code § 105.97 slope stability requirements for static stability, including sudden drawdown. The existing dam fails to meet the current NRCS standard for seismic stability based upon the 10,000-year return earthquake. The existing dam does meet the current PADEP standard for seismic stability based upon the 2,500-year return earthquake.

Downstream Effects. A hydrologic evaluation of the Mill Run watershed upstream and downstream of Rainbow Dam was completed for three scenarios: the existing conditions (with Rainbow Dam in-place), with Rainbow Dam rehabilitated and the FWOP scenario with Rainbow Dam removed. Hydrologic models of the watershed were developed to determine the peak discharges downstream of the dam for 100-year and 500-year, 24-hour storm events.

A HEC-HMS model was developed for seven uncontrolled subareas downstream of Rainbow Dam and the three subareas upstream of Rainbow Dam, including Mill Run PA-461A and PA-461B dams. The stage-storage-discharge relationship for Mill Run PA-461A was taken from the design documentation and drawings provided by Pennsylvania Fish and Boat Commission. The stage-storage-discharge relationships for Rainbow Dam were taken from the SITES routing results.

The USACE HEC-RAS version 5.03 hydraulic computer model was used to analyze the study reaches within the Mill Run Watershed to the confluence with French Creek.

The developed HEC-RAS model considered three scenarios for the 100-year and 500-year storm events: (1) Rainbow Dam as it exists today, (2) a FWOP scenario with Rainbow Dam removed, and (3) Rainbow Dam for the rehabilitation alternative. Cross sections for the HEC-RAS models were developed in Autodesk Civil 3d 2016 using Pennsylvania 1-meter DEM LiDAR elevation data. Stream centerlines were digitized

from the available aerial photography. Manning's n values were estimated from aerial photography along with HEC-RAS User's Manual. Bank stations were set based on LiDAR data. HEC-RAS results for the 100-year and 500-year flood events were mapped based on the elevation data from the LiDAR 1-meter DEM.

The results of hydraulic study mapping show the increased flooding with Rainbow Dam removed. Removal of the Rainbow Dam for decommissioning or FWOP would result in increased downstream flooding depths and damages. Without Rainbow Dam, an additional 30 residential properties and 51 commercial properties would experience flooding and during the 100-year event.

The peak discharges for the existing and rehabilitated Rainbow Dam scenarios were nearly the same (less than 4 percent difference) at all locations for the 100-year event, so there is no discernable difference with the mapping. For the 500-year event, the peak discharge increases from approximately 1,195 cfs to 1,310 cfs for the rehabilitated auxiliary spillway versus existing auxiliary spillway. For the 500-year event, there is increased flooding depth of less than 0.5 foot for approximately 4,700 of stream length directly downstream of the dam. This increase does not result in additional downstream properties being affected by the 500-year event. No induced flooding beyond the initial 4,700 feet of stream length is anticipated for storm events less than the 500-year event.

No critical structures or facilities were identified downstream from Rainbow Dam that could be removed from the 100-year or 500-year floodplains by increasing the level of flood protection at Rainbow Dam. This is due to the effects of uncontrolled drainage downstream from the dam.

Upstream Effects. An increase of the water surface elevation above top of dam may cause induced flooding to public roads, private or public utilities including septic systems, water sources, and burial or historical sites located in the flood pool area above the dam. Unprotected dwellings, including basements, would be removed from areas of induced flooding.

The effect of raising the top of dam and maximum water surface elevation was considered for each rehabilitation alternative. Costs for additional flowage easements as well as structure removal were included when developing the alternative cost estimates.

The rehabilitated Rainbow Dam scenario does not recommend raising the crest of the dam. No induced flooding upstream of the dam is anticipated after rehabilitation.

Alternative Formulation. The Project Team completed a conceptual/preliminary engineering analysis to determine the alternatives to be evaluated in detail. The alternatives considered included the following:

Future Without Federal Project (FWOP) (No Action) – The FWOP Alternative was identified in coordination with NRCS and the Sponsor and is also known as the No Action Alternative. The FWOP Alternative is a minimum level Sponsor breach of the dam, as directed by PADEP. According to the National Watershed Program Handbook, FWOP is based on the course of action that the Sponsor is most likely to take in the event that no federally-financed rehabilitation works were to be undertaken.

The FWOP, identified in coordination with the City of Meadville was indicated to be a minimum level breach of the dam, such as the removal of a portion of the earthen embankment, as directed by the PADEP.

Rehabilitation to Current High Hazard Class Dam Standards – Multiple rehabilitation options were considered during the engineering analysis and eliminated from detailed evaluation in consultation with the Sponsor. The rehabilitation options considered modifications to the auxiliary spillway, dam crest and/or principal spillway to upgrade the dam to current NRCS High Hazard Class criteria. Changes included widening and raising the auxiliary spillway, raising the crest elevation, modifying the principal spillway, armoring the spillway and combinations thereof. All the rehabilitation options were formulated assuming an evaluated design life of 100 years and upgrading the internal drainage controls in the dam. The preferred rehabilitation option, for detailed evaluation, was selected based on effectiveness, efficiency, constructability, and compatibility with the purpose and need for the project.

The rehabilitation option selected as the Rainbow Dam rehabilitation alternative would require construction and modification in three locations of the dam: the auxiliary spillway, the downstream toe, and the upstream face of the dam.

The Project Team formulated a matrix of dam features, deficiencies and potential solutions to explore alternatives for dam rehabilitation. Options were evaluated in consultation with the Council of the City of Meadville and based on effectiveness, efficiency, constructability and compatibility with the purpose and need for the project. Rehabilitation options considered but dismissed from further evaluation included the following:

- Demolish and remove the existing concrete auxiliary spillway and exit channel. Construct a new RCC armored spillway within the dam embankment with a 400-foot wide crest at Elevation 1184.30 feet. Maintain the design settled dam crest at Elevation 1189.8 feet. Extend the principal spillway conduit and construct a new concrete impact basin. Dismissed from further evaluation due to higher cost.
- Replace the existing 42-inch principal spillway conduit with 3 new 96-inch diameter RCP conduits. Construct a new concrete intake structure with a total weir length of 40 feet at the existing normal pool elevation of 1163.5 feet. Construct a new concrete impact basin. Maintain the design settled dam crest at Elevation 1189.8 feet. Repair the existing concrete auxiliary spillway and exit channel. Dismissed from further evaluation due to higher cost and social disruption.
- Raise dam crest to Elevation 1191.0 feet and reinforce the downstream slope at 3V:1V. Raise the high school perimeter dike to Elevation 1191.2 with earth fill. Extend the principal spillway conduit and construct a new concrete impact basin. Repair the existing concrete auxiliary spillway and exit channel. Dismissed from further evaluation due to higher cost and social disruption.
- Raise the settled dam crest to Elevation 1191.0 with a Geocell© wall and reinforce the downstream slope at 3:1 slope. Raise the high school perimeter dike to Elevation 1191.2 with a Geocell© wall. Extend the principal spillway conduit and construct a new concrete impact basin. Repair the existing concrete auxiliary spillway and exit channel. Dismissed from further evaluation due to higher cost and social disruption.
- Add a new RCC armored spillway within the dam embankment, with a 100-foot wide crest at Elevation 1184.3 feet. Maintain the dam crest at Elevation 1189.8 feet. Repair eroded areas of the embankment and reinforce the downstream at 3:1 slope. Extend the principal spillway conduit and construct a new concrete impact basin. Repair the existing concrete auxiliary spillway and exit channel. Dismissed from further evaluation due to higher cost.
- Design Rainbow Dam to be resilient to a catastrophic failure of Mill Run PA-461A Tamarack Dam by raising the crest of the dam embankment to Elevation 1191.1 and adding a new RCC armored spillway within the dam embankment, with a 400-foot wide crest at Elevation 1184.3 feet. Repair eroded areas of the embankment and reinforce the downstream at 3:1 slope. Extend the principal spillway conduit and construct a new concrete impact basin. Demolish and remove the existing concrete auxiliary spillway and exit channel. Dismissed from further evaluation due to higher cost and NRCS Conservation Engineering Director's concurrence that the armored auxiliary spillway at Mill Run PA-461A&B allows passage of the PMF event in a manner that would not lead to failure from overtopping.

Dam Decommissioning with Nonstructural and Other Measures – The Decommissioning Alternative was formulated to restore the stream by reconnecting the upstream and downstream channel in a non-erosive manner and restoring the stream/river. The entire dam embankment would be excavated to allow normal flows and up to 100-year flood flows through the site in a non-erosive manner. Accumulated sediment would not be removed. The Decommission Alternative was developed in consideration of guidance in NRCS National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices. The Decommissioning Alternative would eliminate flood storage and protection provided by the dam, which could possibly expose downstream properties to an increased risk of flooding, property damage, and loss of life. As a result, the Decommissioning Alternative alone would not meet the objective to maintain the downstream flood damage reductions provided by the existing project. To meet this objective, the Decommissioning Alternative would have to be supplemented by other measures such as floodproofing or relocation of structures located within the 100-year floodplain. Estimated costs of the

Nonstructural and Other Measures include relocation, property acquisition, demolition, and site stabilization/restoration along with decommissioning utilities, septic structures, wells and similar facilities.

Acquisition/Relocation of At-Risk Structures and Other Non-Structural Measures (Floodproofing in the Inundation Areas) – These alternatives were formulated to remove the downstream hazard and allows the Rainbow Dam to be reclassified as a Low Hazard Potential Class dam. Land use restrictions were considered to prevent future upgrades to High Hazard Potential Class dam due to downstream development within the breach inundation area. The threat to human life from sudden dam failure would be reduced by relocating the residential and commercial structures and raising and/or relocating the roadways within the potential breach inundation.

Cost Estimates. The Project Team prepared predictions of probable costs for all alternatives. The predictions of probable costs are intended for comparing the alternatives. Unless otherwise noted predictions of probable costs were prepared using the RS Means method for engineering cost estimation.

Appendix E

OTHER SUPPORTING INFORMATION

Public Law 83-566 Project Information Mill Run Watershed Supplemental Watershed Plan/EE Rainbow Dam (PA-460) Meadville, PA	
Rehab General Description Data	
Project Number	2007
Hydrologic Unit Area:	05010004
Longitude (decimal format):	-80.1327
Latitude (decimal format):	41.6355
Area of Project (acres):	4,083
Project Evaluation Life:	103 Years
Project Discount Rate:	2.875%
Price Base:	2019
B/C Ratio:	1.8 to 1.0
Total Cost (Table 1):	\$2,644,000
Total Public Law 83-566 Cost:	\$1,862,000
Dam Number	PA-460
National Inventory of Dams (NID):	PA00177
Congressional District of dam:	03-PA
FIPS Code of dam:	039
# Single-Purpose Floodwater Retarding Structures Planned:	1
# Multi-Purpose Structures Planned:	0
Rehab Project Purposes:	Flood Damage Reduction

Public Law 83-566 Project Information Greene-Dreher Watershed Supplemental Watershed Plan/EE Rainbow Dam (PA-460) Meadville, PA	
Sponsor Data	
Organization:	Council of the City of Meadville
Sponsor Representative (optional):	Andy Walker
Sponsor Title:	City Manager/City Clerk
Sponsor Type:	City
Address:	894 Diamond Park
City:	Meadville
State:	Pennsylvania
Zip:	16335
Phone:	814.724.6000
Email:	awalker@cityofmeadville.org
O&M Responsibility (Yes/No):	Yes

Public Law 83-566 Project Information Greene-Dreher Watershed Supplemental Watershed Plan/EE Rainbow Dam (PA-460) Meadville, PA	
Rehab Budget Request Data	
Failure Index:	83
Population at Risk:	2,650
Price Base:	2019
Estimated Installation Cost (Watershed Agreement):	\$2,644,000
Priority - State Dam Safety Agency:	High
Number of Municipal Water Supply Users:	0

Public Law 83-566 Project Information Greene-Dreher Watershed Supplemental Watershed Plan/EE Rainbow Dam (PA-460) Meadville, PA	
Rehab Subset of Benefits Data	
Price Base:	2019
Total Funds Needed (FA/TA) (Table 2): Public Law-83-566 NRCS	\$1,449,500/\$412,000
Other Than Public Law-83-566:	\$782,000
Agricultural Related Flood Damage Reduction Benefits (Average Annual):	\$102,300
Non-Agricultural Related Flood Damage Reduction Benefits (Average Annual):	-
Agricultural Related Non-Flood Damage Reduction Benefits (Average Annual):	\$53,100
Non-Agricultural Related Non-Flood Damage Reduction Benefits (Average Annual):	-
Beneficiaries (No.):	13,388
Visitor Days (Optional):	0
Farms and Ranches Benefited (No.):	Not Evaluated
Bridges Benefited (No.):	1
Public Facilities Benefited (No.):	5
Businesses Benefited (No.):	379
Homes Benefited (No.):	618
Reduced Erosion (Tons/Yr.):	0
Reduced Sedimentation (Tons/Yr.):	604
Streams/Corridors Enhanced/Protected (Miles):	0.75
Lakes/Reservoirs Enhanced/Projected (Surface Acres):	5
Domestic Water Supplies Benefited (No.):	0
Incidental Recreation Benefited (No. of Water Bodies/Stream Segments):	2
Groundwater Recharge (Acre-Feet):	0
Wetlands Created, Enhanced, or Restored (Acres):	0
Upland/Riparian Habitat Created/Enhanced (Acres):	0
Threatened and Endangered Species Benefited:	5
Population with Reduced Risk:	2,650

[illegible]

Concentrated flow	A controlled breach of the dam would result in the draining of the impoundment behind the dam and exposing what is currently lake bottom. These newly exposed soils could be subject to increased concentrated flow (gully) erosion if it is not vegetated and stabilized quickly.	☐	No effect	☐		☐
Evidence of concentrated flow (gully erosion) was not observed in the project area. Concentrated flow erosion upstream contributes to the sedimentation behind the dam.		NOT meet PC		NOT meet PC		NOT meet PC
Excessive bank erosion from streams, shorelines or water conveyance channels	Without the dam, flow issues may create bank erosion over time. With increased flood flows.	☐	No effect	☐		☐
There was no evidence of excessive bank erosion observed in the project area.		NOT meet PC		NOT meet PC		NOT meet PC
Compaction	N/A	☐	N/A	☐		☐
There were no soil compaction issues observed.		NOT meet PC		NOT meet PC		NOT meet PC
Organic matter depletion	N/A	☐	N/A	☐		☐
There was no organic matter depletion noted or observed in the project area.		NOT meet PC		NOT meet PC		NOT meet PC
Other	N/A	☐	N/A	☐		☐
There were no soil degradation issues identified as a concern.		NOT meet PC		NOT meet PC		NOT meet PC
WATER: EXCESS / INSUFFICIENT WATER						
Excess (Ponding, flooding, seasonal high water table, seeps, and drifted snow)	Residential, commercial and transportation resources will be a greater risk of flood damage. Average annual flood damage reduction benefits of \$97,600 will be lost.	☐	The accepted alternative would maintain flood damage reduction downstream from the dam with an average annual value estimated at \$97,600.	☐		☐
The dam controls runoff and mitigates flooding. There is no evidence of excessive seepage that would affect the normal pool elevation and pose a risk to the downstream community.		NOT meet PC		NOT meet PC		NOT meet PC
Other	N/A	☐	N/A	☐		☐
There were no other water concerns noted.		NOT meet PC		NOT meet PC		NOT meet PC
WATER: WATER QUALITY DEGRADATION						
Excess nutrients in surface and ground waters	N/A	☐	N/A	☒		☐
There were no groundwater quality issues identified or observed at the project site. No known nutrient related surface water concerns were found.		NOT meet PC		NOT meet PC		NOT meet PC
Pesticides transported to surface and ground waters	No effect	☐	No effect	☐		☐
There are currently no concerns regarding the transportation of pesticides to surface ground waters.		NOT meet PC		NOT meet PC		NOT meet PC
Excess pathogens and chemicals from manure, bio-solids or compost applications	No effect	☐	No effect	☐		☐
There were no excess pathogens and chemicals from manure, bio-solids or compost applications observed within the project area.		NOT meet PC		NOT meet PC		NOT meet PC
Excessive sediment in surface waters	A controlled breach of the dam will cause sediment currently trapped by the dam to be delivered downstream. Sediment originating from upstream land use will flow through the creek to downstream stream segments without settling out in Rainbow Lake.	☐	No change upstream. Short-term increase in suspended sediment and turbidity may occur downstream during construction, but proper controls will minimize erosion. Sedimentation will continue to be trapped at the current rate.	☐		☐
Excessive sediment in surface waters was not observed at the site. The historical average sedimentation rate was 0.11 acre-feet/year and is projected to be 0.17 acre-ft/year into the future.		NOT meet PC		NOT meet PC		NOT meet PC

Elevated water temperature	A controlled breach of the dam may impact water temperature by reducing solar exposure that occurs within Rainbow Lake.	☐	No effect	☐		☐
Elevated water temperatures were not detected at the project site.		NOT meet PC		NOT meet PC		NOT meet PC
Other	N/A	☐	N/A	☐		☐
SOLE SOURCE AQUIFER - Rainbow Dam is not located in an area with an underlying sole source aquifer. There are no ground water concerns identified in the project area.				NOT meet PC		NOT meet PC
AIR: AIR QUALITY IMPACTS						
Pennsylvania air quality non-attainment counties can be found at:						
PM	http://www.epa.gov/pmdesignations/2006standards/final/region3.htm					
Ozone:	http://www.epa.gov/reg3arid/airquality/ozone8hrmaintareas_2.htm					
Emissions of Particulate Matter (PM) and PM Precursors	There will be some short term minor air quality impacts effects during construction (dust and exhaust). BMPs will be utilized during construction to control dust.	☐	There will be some short term minor air quality impacts effects during construction (dust and exhaust). BMPs will be utilized during construction to control dust.	☐		☐
Crawford County, PA is not listed within the non-attainment area.		NOT meet PC		NOT meet PC		NOT meet PC
Emissions of Ozone Precursors	There will be some short term minor air quality impacts effects during construction that could result in the release of ozone precursors.	☐	There will be some short term minor air quality impacts effects during construction that could result in the release of ozone precursors.	☐		☐
Crawford County, PA is not listed as non-attainment status for 8-hour ozone.		NOT meet PC		NOT meet PC		NOT meet PC
Objectionable odors	N/A	☐	N/A	☐		☐
No objectionable odors or odor sources were noted within the project area.		NOT meet PC		NOT meet PC		NOT meet PC
Other	N/A	☐	N/A	☐		☐
The project does not pose any other significant impacts to air quality.		NOT meet PC		NOT meet PC		NOT meet PC
PLANTS: DEGRADED PLANT CONDITION						
Undesirable plant productivity and health	Flooding or super saturated conditions in the downstream area may impact the health of surrounding vegetation.	☐	Vegetation may be disturbed during construction. Invasive plant species may be introduced but will be minimized with replanting and management of noxious plants.	☐		☐
Vegetation across the project area is generally healthy and well maintained. It does not appear to be in degraded condition.		NOT meet PC		NOT meet PC		NOT meet PC
Inadequate structure and composition	N/A	☐	N/A	☐		☐
There were no identified structural or compositional inadequacies noted in project area.		NOT meet PC		NOT meet PC		NOT meet PC
Excessive plant pest pressure	No effect	☐	No effect	☐		☒
There were no excessive plant pest pressure observed or identified in project area.		NOT meet PC		NOT meet PC		NOT meet PC
Other	N/A	☐	N/A	☐		☐
There were no other plant degradation concerns.		NOT meet PC		NOT meet PC		NOT meet PC

ANIMALS: INADEQUATE HABITAT FOR FISH AND WILDLIFE				
Habitat degradation	A controlled breach of the dam would result in the draining of the impoundment behind the dam, thus changing the current habitat for aquatic species currently in the lake and around the lake periphery, and upstream wetlands. A controlled breach could also result in increased sedimentation and nutrient loading downstream, the elimination of stream obstruction for migratory fish passage, the elimination of lake ecosystem, reduced habitat value for waterfowl and an increase in the riparian corridor.	☐ NOT meet PC	Fish and waterfowl may be impacted during construction due to the temporary drawdown of the sediment pool. The fish and wildlife impacts will be managed in accordance with PA Fish and Boat Commission (PFBC) requirements.	☐ NOT meet PC
Inadequate feed and forage	N/A	☐ NOT meet PC	N/A	☐ NOT meet PC
Inadequate feed or forage is not a concern within the project area.				
Inadequate livestock water	N/A	☐ NOT meet PC	N/A	☐ NOT meet PC
Inadequate livestock water is not a concern within the project area.				
Other	N/A	☐ NOT meet PC	N/A	☐ NOT meet PC
There were no other concerns related to animals associated with this project.				
ENERGY: INEFFICIENT ENERGY USE				
Equipment and facilities	During construction, an increase in equipment and facilities will be required. Mowing and maintenance routines for the dam will be discontinued.	☐ NOT meet PC	During construction an increase in equipment and facilities will be required. Normal mowing and maintenance routines will be reconvened following project completion.	☐ NOT meet PC
Rainbow Dam is not used for energy production nor do operations there require consumption of energy except for the occasional mowing and general maintenance activities.				
Farming/ranching practices and field operations	N/A	☐ NOT meet PC	N/A	☐ NOT meet PC
Rainbow Dam is not used for farming or ranching practices or their associated field operations.				
HUMAN: ECONOMIC AND SOCIAL CONSIDERATIONS				
Labor	Following the completion of the transition period when the dam is removed, staff time required to maintain the site will no longer be needed.		No change in staff time needed to maintain the dam.	
Rainbow Dam is owned and maintained by City of Meadville. The labor needed to maintain the dam and associated recreation facilities is estimated as the equivalent of 0.2 staff years part time staff				
Management Level	Following the completion of the transition period when the dam is removed, staff time required to manage the maintenance of the site will no longer be needed.		No change in staff time needed to maintain the dam.	
Management needed to maintain the dam and reservoir is estimated as the equivalent of 0.5 part time staff.				

Public Health and Safety			
Rainbow Dam was designed and constructed to prevent flood damage downstream. Approximately 1,550 full-time residents and 379 downtown businesses, agencies, and service providers are located within the inundation zone. The service providers include an elementary school and a technical school, 4 daycare centers, and local, state, and federal governmental offices including the Meadville City Hall. There are also 5 senior housing complexes located in the inundation area. This information was obtained from the EAP.	Residential, commercial and transportation resources will have a greater risk of flood damage. The average annual flood damage reduction benefits of \$97,600 will be lost. FWOP would eliminate breach inundation risk to downstream residents.	Maintain flood damage reduction downstream from the dam with an average annual value estimated at \$97,600. Reduced breach inundation risk to downstream residents.	
PARKLAND- Shady Brook Park is located at the foot of Rainbow Dam. The dam itself and the impoundment are not situated within the park boundary. No other parks are located downstream within the inundation zone.	PARKLAND - A controlled breach of the dam would result in the draining of impoundment behind the dam. Effects could be realized at Shady Brook Park.	PARKLAND - Temporary closure of Shady Brook Park would be required during construction activities causing minor inconvenience to park users.	
REGIONAL WATER RESOURCE PLANS-Rainbow Dam is subject to the Crawford County Act 167 Stormwater Management Plan.	REGIONAL WATER RESOURCE PLANS A controlled breach of Rainbow Dam would result in the draining of impoundment behind the dam. This would have implications to the Crawford County Stormwater Management Plan that would require this plan to be revisited and updated.	REGIONAL WATER RESOURCE PLANS Improvements to the dam would result in positive effects which may need to be reflected in an update to the Crawford County Stormwater Management Plan.	
Rainbow Lake, as well as French Creek below the confluence with Mill Run are both impaired by pollutants and have a fish consumption advisory.	The fish consumption advisory for Rainbow Lake would be discontinued because the pool would be removed. French Creek below the confluence with Mill Run would continue to be impaired by pollutants and have a fish consumption advisory.	Rainbow Lake, as well as French Creek below the confluence with Mill Run would continue to be impaired by pollutants and have a fish consumption advisory.	

Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.

In Section "G" complete and attach Environmental Procedures Guide Sheets for documentation as applicable. Items with a "●" may require a federal permit or consultation/coordination between the lead agency and another government agency. In these cases, effects may need to be determined in consultation with another agency. Planning and practice implementation may proceed for practices not involved in consultation.

G. Special Environmental Concerns (Document existing/ benchmark conditions)	J. Impacts to Special Environmental Concerns					
	No Action		Alternative 1		Alternative 2	
	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action
●Clean Air Act <i>Guide Sheet FS1 FS-2</i> Rainbow Dam is located in Crawford County, which is not listed on the non-attainment status for 8-hour ozone or particulate matter.	There will be some temporary affects during construction including dust and exhaust. Control measures would be implemented during construction to minimize impacts.	☐	There will be some temporary affects during construction including dust and exhaust. Control measures would be implemented during construction to minimize impacts.	☐		☐

•Clean Water Act / Waters of the U.S. <i>Guide Sheet Fact Sheet</i> Mill Run is designated as a Warm Water Fishery (WWF) waterbody. No TMDLs or WRAS are associated with Mill Run. Mill Run is impaired by the following source causes: Agriculture - Organic Enrichment/Low D.O.; Hydromodification - Flow Alterations ; Flow Regulation/Modification - Thermal Modifications.	No material will be filled or dredged within the bed and bank of a jurisdictional stream.	☐	Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance greater than 1 acre, and erosion and sediment control plan approval.	☐		☐
•Coastal Zone Management <i>Guide Sheet Fact Sheet</i> Rainbow Dam is not located within a Coastal Zone Management area.	N/A	☐	N/A	☐		☐
Coral Reefs <i>Guide Sheet Fact Sheet</i> The project area is not subject to coral reef regulations. Coral reefs do not exist in Pennsylvania.	N/A		N/A			
•Cultural Resources / Historic Properties <i>Guide Sheet Fact Sheet</i> There are cultural resources downstream from the project site. The City of Meadville has 8 buildings listed on the National Register of Historic Places. These include the Meadville Downtown Historic District, Dr. J.R. Mosier Office, Roueche House, Baldwin-Reynolds House, Judge Henry Shippen House, and Ruter and Bentley Halls located on the campus of Allegheny College. No cultural resources are known in the proposed construction area and none of the cultural resources are within the downstream flood zone below Rainbow Dam.	No effect.	☐	The Pennsylvania SHPO confirmed in a letter dated October 19, 2016, that No Effect is anticipated.	☐		☐
•Endangered and Threatened Species <i>Guide Sheet Fact Sheet</i> A PNDI database search on June 29, 2016 presented that 9 state listed special concern species (Alasmodonta marginata, Amblema pilcata, Amia calva, Anodontoides ferussacianus, Fusconaia subrotunda, Ichthyomyzon bdellium, Lampsilis fasciola, Lasmigona compressa, Pleurobema sintoxia), and 2 state-listed endangered species (Noturus eleutherus, Noturus stigmosus) may exist near the project area. Upon review of site details by PFBC, that agency determined on July 11, 2016, that these species are not known to exist in the vicinity of the project area. The US Fish and Wildlife Service (USFWS) states in a November 21, 2016 letter that French Creek is inhabited by four mussel species that are federally listed as endangered, and one that is threatened.	As project alternatives are considered, USFWS requests a detailed project description and detailed project plans documenting how direct and indirect impacts to mussels and their habitat will be avoided.	☐	As project alternatives are considered, USFWS requests a detailed project description and detailed project plans documenting how direct and indirect impacts to mussels and their habitat will be avoided. The location of rehabilitation to Rainbow Dam is approximately 9,000 feet upstream from the confluence of Mill Creek entering French Creek. A detailed project description and plans documenting how direct and indirect impacts will be avoided, through sediment control during construction activities, will be provided to USFWS during the design phase for concurrence that the action is not likely to adversely affect.	☐		☐

Environmental Justice <i>Guide Sheet Fact Sheet</i> The Rainbow Dam Inundation Zone minority population is 7.2%, and the percentage of the population below the poverty line is 26.0%. These numbers are in comparison to those of Crawford County (3.6 and 14.4% respectively) and the Commonwealth of Pennsylvania (20.5% and 12.3% respectively).	No disproportionate adverse effects are anticipated to any ethnic, racial, or socioeconomically disadvantaged families or groups downstream of the dam. Removal of the dam would increase the risk of flooding downstream including to those socioeconomically disadvantaged populations that reside downstream. However, the effects would not be disproportionately focused on the socioeconomically disadvantaged groups.	☐	No disproportionate adverse effects are anticipated to any ethnic, racial, or socioeconomically disadvantaged families or groups downstream of the dam. Improvement of the dam would reduce the risk of flooding downstream including to those socioeconomically disadvantaged populations that reside downstream. However, the effects would not be disproportionately focused on the socioeconomically disadvantaged groups.	☐		☐
•Essential Fish Habitat <i>Guide Sheet Fact Sheet</i> There are no essential fish habitats in the project area or in Pennsylvania.	N/A	☐	N/A	☐		☐
Floodplain Management <i>Guide Sheet Fact Sheet</i> Mill Run and Rainbow Dam are located in Zone A and are within the 100-year floodplain. Rainbow Dam reduces flood elevations downstream and reduces average annual flood damages by \$97,600.	Residential, commercial and transportation resources will be at a greater risk of flood damage. Average annual flood damage reduction benefits of \$97,600 will be lost.	☐	Maintain flood damage reduction downstream from the dam by continuing to reduce the flooding risk of 30 residential and 51 non-residential structures that would be within the 100-year floodplain without the dam. There are no critical structures or facilities located within the 500-year floodplain downstream from the dam that could be protected with increased detention at the dam. Maintain flood damage reduction downstream from the dam with an average annual benefit value estimated at \$102,300 plus \$53,100 of No-Action cost avoided.	☐		☐
Invasive Species <i>Guide Sheet Fact Sheet</i> Invasive Species are a concern to the PA natural environment. There are noted invasive species on site including Common Yarrow, Canada Thistle, and Queen Anne's Lace.	A controlled breach of the dam would result in the exposure of bare soils that are presently lake bottom. Newly exposed bare soils may be subject to invasive plant growth. Invasive plant species growth will be minimized by planting adapted species.	☐	Construction activities may introduce invasive plant species but replanting adaptive species will minimize the impact.	☐		☐
•Migratory Birds/Bald and Golden Eagle Protection Act <i>Guide Sheet Fact Sheet</i> Mill Run and Rainbow Lake attract a variety of migratory water fowl.	Migratory birds and nesting activities could be temporarily disturbed during construction. Scheduling of construction activities will be coordinated with appropriate wildlife agencies to avoid adverse impacts. Draining of the impoundment may affect the type of migratory bird species that frequent the location.	☐	The project alternative may temporarily impact migratory birds and nesting activities during construction. Scheduling of construction activities will be coordinated with appropriate wildlife agencies to avoid adverse impacts.	☐		☐
Natural Areas <i>Guide Sheet Fact Sheet</i> There are no designated natural areas within the project boundary.	N/A	☐	N/A	☐		☐
Prime and Unique Farmlands <i>Guide Sheet Fact Sheet</i> The project area is compromised of certain soil types designated as prime or unique farmlands and farmlands of statewide importance.	Removal of the dam will result in increased flooding and inundation of prime or unique farmland soils downstream. However, it is noted that the majority of land use downstream is developed and not used for farming.	☐	There will be no adverse effects as no land within the project area will be converted from important farmland to a non-agricultural use.	☐		☐

Riparian Area <i>Guide Sheet Fact Sheet</i> There are riparian areas within the project area including naturalized wetlands and forested areas. Riparian areas surround the Lake and impoundment consist of wooded area and mowed lawn. Riparian areas of Mill Run downstream of the impoundment consist of wooded area and residential properties.	With removal of the dam, downstream areas could be inundated with flood waters resulting in a loss of shoreline riparian areas. In addition, riparian areas associated with the perimeter of upstream impoundment would be reduced and be limited to the course of the creek.	☐	There could be temporary effects to the riparian and wetland areas during construction. Restorative actions will be implemented prior to project completion.	☐		☐
Scenic Beauty <i>Guide Sheet Fact Sheet</i> Rainbow Dam is located immediately upstream of Shady Brook Park. There is a scenic quality to the general landscape existent within the park but there is no formal scenic beauty plan or requirements associated with Shady Brook Park.	FWOP would result in a loss of aesthetic appeal of lake, replaced by stream and riparian scene. Negative scenic views will regularly occur because of flood damages to downstream areas.	☐	Alternative 1 would provide temporary impacts while the lake is drawn down and unsightly construction equipment is onsite. However, long-term scenic beauty will be maintained.	☐		☐
•Wetlands <i>Guide Sheet Fact Sheet</i> Wetlands are present in the immediate vicinity of Rainbow Dam specifically north of the spillway. Approximately 0.07 acres of wetland are associated with the dam and impoundment.	A controlled breach of the dam will adversely impact the wetlands within the immediate upstream vicinity of the dam and around the periphery of Rainbow Lake at the upper reaches of the lake. Flooding may alter the function and composition of the wetland area downstream of the project area. Wetlands at the stilling basin would be removed (and mitigated, if required, approximately 0.07 acres).	☐	0.07 acres of open water wetlands associated with the downstream stilling basin will be disturbed as a result of the construction of the existing spillway extension and toe drain pipes. A State Programmatic General Permit or a Joint Permit application, meeting Section 404 requirements may be required.	☐		☐
•Wild and Scenic Rivers <i>Guide Sheet Fact Sheet</i> Mill Run and Rainbow Dam are not Federally or State listed wild and scenic rivers.	N/A	☐	N/A	☐		☐
K. Other Agencies and Broad Public Concerns	No Action		Alternative 1		Alternative 2	
Easements, Permissions, Public Review, or Permits Required and Agencies Consulted.	Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance, and erosion and sediment control plan approval.		Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance, and erosion and sediment control plan approval.			
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)	Residential, commercial, and transportation resources will be at greater risk of flood damage. The average annual flood damage reduction benefits of \$97,600 will be lost. There would be an increased downstream delivery of sediment and nutrients, loss of wetland and lake habitats, change in riparian areas from shoreline to streamside, and other effects listed previously in CPA-52. The breach inundation threat is eliminated.		There are no adverse cumulative environmental, socioeconomic, or infrastructural impacts anticipated for the dam rehabilitation project.			
L. Mitigation (Record actions to avoid, minimize, and compensate)	Erosion & sediment and dust control measures will be utilized to minimize temporary effects. All work will be designed and performed to avoid and/or minimize impacts to wetlands. If required, the impacted wetlands will be mitigated.		Erosion & sediment and dust control measures will be utilized to minimize temporary effects. All work will be designed and performed to avoid and/or minimize impacts to wetlands. If required, the impacted wetlands will be mitigated.			

M. Preferred Alternative	✓ preferred alternative	☐	☒	☐
	Supporting reason		Rehabilitation Alternative will meet Purpose and Need for Project and maintain flood damage reduction downstream from the dam with an average annual value estimated at \$97,600 and \$53,100 in No-Action cost avoided. This is the National Economic Development (NED) Alternative with net benefits of \$64,700 and a B:C ratio of 1.8 to 1. (see 1/9/2016 Economic Analysis)	

N. Context (Record context of alternatives analysis)		Mill Run	HUC 50100040906	Allegheny River Watershed
--	--	----------	-----------------	---------------------------

The significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality.

O. Determination of Significance or Extraordinary Circumstances

Intensity: Refers to the severity of impact. Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

If you answer ANY of the below questions "yes" then contact the State Environmental Liaison as there may be extraordinary circumstances and significance issues to consider and a site specific NEPA analysis may be required.

Yes	No	
☐	☒	• Is the preferred alternative expected to cause significant effects on public health or safety?
☐	☒	• Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?
☐	☒	• Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial?
☐	☒	• Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment?
☐	☒	• Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration?
☐	☒	• Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time?
☐	☒	• Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species.
☐	☒	• Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment?

P. To the best of my knowledge, the data shown on this form is accurate and complete:

In the case where a non-NRCS person (e.g. a TSP) assists with planning they are to sign the first signature block and then NRCS is to sign the second block to verify the information's accuracy.

Signature (TSP if applicable)	Title	Date
Signature (NRCS)	Title	Date

If preferred alternative is not a federal action where NRCS has control or responsibility and this NRCS-CPA-52 is shared with someone other than the client then indicate to whom this is being provided.

The following sections are to be completed by the Responsible Federal Official (RFO)

NRCS is the RFO if the action is subject to NRCS control and responsibility (e.g., actions financed, funded, assisted, conducted, regulated, or approved by NRCS). These actions do not include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance and situations where NRCS is making a technical determination (such as Farm Bill HEL or wetland determinations) not associated with the planning process.

Q. NEPA Compliance Finding (check one)

The preferred alternative:

Action required

☐	1) is not a federal action where the agency has control or responsibility.	Document in "R.1" below. No additional analysis is required
☒	2) is a federal action ALL of which is categorically excluded from further environmental analysis AND there are no extraordinary circumstances as identified in Section "O" .	Document in "R.2" below. No additional analysis is required
☐	3) is a federal action that has been sufficiently analyzed in an existing Agency state, regional, or national NEPA document and there are no predicted <u>significant adverse environmental effects or extraordinary circumstances</u> .	Document in "R.1" below. No additional analysis is required.
☐	4) is a federal action that has been sufficiently analyzed in another Federal agency's NEPA document (EA or EIS) that addresses the proposed NRCS action and its' effects and has been formally adopted by NRCS . NRCS is required to prepare and publish its own Finding of No Significant Impact for an EA or Record of Decision for an EIS when adopting another agency's EA or EIS document. (Note: This box is not applicable to FSA)	Contact the State Environmental Liaison for list of NEPA documents formally adopted and available for tiering. Document in "R.1" below. No additional analysis is required
☐	5) is a federal action that has NOT been sufficiently analyzed or may involve predicted significant adverse environmental effects or extraordinary circumstances and may require an EA or EIS.	Contact the State Environmental Liaison. Further NEPA analysis required.

R. Rationale Supporting the Finding

R. Findings Documentation	
R.2 Applicable Categorical Exclusion(s) (more than one may apply)	(14) Repairing or maintaining principal spillways and appurtenances associated with existing serviceable dams, originally constructed to NRCS standards, in order to meet current safety standards. Work will be confined to the existing footprint of the dam, and no major change in reservoir or downstream operations will result; (15) Repairing or improving (deepening/widening/armoring) existing auxiliary/emergency spillways associated with dams, originally constructed to NRCS standards, in order to meet current safety standards. Work will be confined to the dam or abutment areas, and no major change in reservoir or downstream operation will result; (16) Repairing embankment slope failures on structures, originally built to NRCS standards, where the work is confined to the embankment or abutment areas;
7 CFR Part 650 <i>Compliance With NEPA</i> , subpart 650.6 <i>Categorical Exclusions</i> states prior to determining that a proposed action is categorically excluded under paragraph (d) of this section, the proposed action must meet six sideboard criteria. See NECH 610.116.	

I have considered the effects of the alternatives on the Resource Concerns, Economic and Social Considerations, Special Environmental Concerns, and Extraordinary Circumstances as defined by Agency regulation and policy and based on that made the finding indicated above.

S. Signature of Responsible Federal Official:

Signature

Title

Date

Additional notes