



US Army Corps
of Engineers®

JOHNSON COUNTY, KENTUCKY SECTION 202 PROJECT
VOLUME 1: DETAILED PROJECT REPORT AND ENVIRONMENTAL
ASSESSMENT



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U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

Executive Summary

This Detailed Project Report (DPR) presents the findings of a feasibility study with an integrated Environmental Assessment (EA) of proposed flood risk management improvements for the City of Paintsville and Johnson County, Kentucky. This analysis was conducted under authority granted by Section 202 of the Energy & Water Development Appropriation Act, 1981, P.L. 96-367, tit II, § 202 (1981), and related laws, to study, design and construct the most cost effective “flood control measures” to provide “...a level of protection against flooding at least sufficient to prevent any future losses...from the likelihood of flooding such as occurred in April 1977...” in the Levisa Fork basin. Appropriations for this project are provided under the Supplemental Appropriations to the Supplemental Appropriation to the Bipartisan Budget Act of 2018, P.L. 115-123, Div. B, Subdiv. 1, tit. IV (2018) (formally known as the “Further Additional Supplemental Appropriations for Disaster Relief Requirements Act, 2018”). The Louisville District, U.S. Army Corps of Engineers is the lead district for this study with support from the Buffalo, Huntington and Nashville Districts.

Hydrological analyses determined the April 1977 flood was equivalent to a 20-year frequency (5% AEP) in the City of Paintsville, The Levisa Fork General Planning Supplement (GPS) (1991) states “...in those areas where the 100-year frequency elevation exceeded the elevation of the April 1977 flood, the 100-year frequency event was used as the target level of protection”, the 100-year frequency (1% AEP) was used as the minimum programmatic goal for flood risk reduction in this study. The Levisa Fork GPS specifically determines the City of Paintsville and Johnson County as a target 1% AEP minimum level of risk reduction.

The recurrence of the April 1977 flood would result in significant damages to over 4,770 structures in the Levisa Fork basin, approximating \$384 million in 2019 dollars. In addition to structural damages, transportation facilities within the Levisa Fork basin would approach approximately \$14.7 million dollars (2019 dollars) in flood damages. Furthermore, frequent over-bank flooding is a severe problem in Johnson County. Streams in the county undergo extreme flow fluctuations from both localized and regional storm events. This results in the inundation of the floodplain within the project area that has led to loss of life (most recently in 2017), property damages, lost business and tax revenues, missed school days, social disruption of the community, and threatened regionally critical infrastructure.

In addition to reducing flood risk for the City of Paintsville and Johnson County, several opportunities to improve other aspects of the City of Paintsville and Johnson County were identified. These opportunities include: incentivizing structural maintenance; improving local housing and commercial quality; developing a permanent floodplain evacuation plan; upgrading housing stock through demolition of deteriorated floodplain housing units and/or the rehabilitation of new units; and the restoration of riparian and bottomland habitat.

Project planning objectives are centered on the development of flood risk reduction measures, structural and non-structural, for the City of Paintsville and surrounding Johnson County, Kentucky which: 1) comply with Section 202, and related laws, and USACE policies and technical guidance; 2) reduce the financial and/or personal losses of flooding; and 3) maintain, to the extent possible, the social, cultural and economic cohesion of the communities.

Initial measures were developed by the Project Development Team (PDT), Non-Federal Sponsor (NFS), and other stakeholders. This included eleven (11) structural measures (floodwalls and levees, pump stations, closure structures, gravity outlets, interiors floodwalls and levees, detention basins, interceptor sewers and pipes, stream channel modifications, diversion channels, operational changes, and dam structures) and four (4) non-structural measures (flood proofing, raise-in-place, buy-outs, and the

development of a flood warning and emergency evacuation plan) that were compared and evaluated against the project planning objectives for their completeness, effectiveness, efficiency, and acceptability. Four (4) structural measures were screened out when compared to these objectives.

Eleven management measures (seven structural, four non-structural) were used to develop three structural alternatives for the City of Paintsville and one non-structural alternative for the area of Johnson County outside the City of Paintsville. These alternatives were compared and evaluated against the project planning objectives and screened for their completeness, effectiveness, efficiency and acceptability. Alternative 1 was screened out due to not meeting all of the project planning objectives or the Planning Guidance Notebook (PGN) evaluation criteria. Alternative plans 2, 3, and 4 were determined to meet all objectives and criteria, but needed reformulation to accommodate the dynamic hydrologic conditions within the City of Paintsville ranging from backwater flooding, interior ponding, and the City of Paintsville's ability to Operate, Maintain, Repair, Replace, and Rehabilitate (OMRR&R) proposed structural measures. As a result of this reformulation, the need for pump stations was eliminated.

The reformulated plans (2R, 3R, and 4R) were compared for cost effectiveness for overall risk reduction per structure. It was determined that alternative 2R, when combined with alternative 4R, provided the most cost-effective flood risk reduction to the City of Paintsville and Johnson County. The Recommended Plan consists of some 9,565 linear feet of floodwalls/levee, a backwater control closure structure on Paint Creek, four road closures, local drainage facilities including an interceptor sewer, and a flood warning system to address emergency evacuation for the entire county including the City of Paintsville; as well as a voluntary non-structural program focused on buy-outs in Johnson County for structures in the floodplain not benefiting from flood risk reduction provided by Alternative 2R.

After considering the engineering, economic, environmental, and social aspects relative to the identified flood risks to the City of Paintsville and Johnson County, Kentucky, the PDT's Recommended Plan consisting of a structural element (Alternative 2R) and a non-structural element (Alternative 4R) be constructed by USACE under authority granted by Section 202. Furthermore, the integrated environmental analysis indicates the environmental, cultural, and historic impacts of the Recommended Plan were considered minimal especially in comparison to the positive economic and social impacts associated with the Recommended Plan.

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OTHER VOLUMES

Volume 2. Engineering Analysis and Design

Volume 3. Environmental Documentation

Volume 4. Real Estate Plan

Volume 5. Project Cost Estimate

Volume 6. Non-structural Analysis

Volume 7. Additional Documentation

Acronyms and Abbreviations

AST Aboveground Storage Tank

ASA(CW) Assistant Secretary of the Army for Civil Works

ACE Annual Chance Exceedance

AEP Annual Exceedance Probability

AFWS Automated Flood Warning System

BCR Benefit to Cost Ratio

CAA Clean Air Act of 1970

CAAA Clean Air Act Amendments of 1990

CELRD Corps of Engineers Great Lakes & Ohio River Division

CEORD Corps of Engineers Ohio River Division

CEQ Council on Environmental Quality

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act of 1980

C.F.R. Code of Federal Regulations

CFS Cubic Feet per Second

CO Carbon Monoxide

CWA Clean Water Act of 1977

CWL Construction Work Limits

DAQ Division for Air Quality

dbh Diameter at Breast Height

DPR Detailed Project Report

DSS Decent, Safe and Sanitary

EA Environmental Assessment

EM Engineering Manual

EO Executive Order

EPA Environmental Protection Agency

ER Engineer Regulation

ESA Endangered Species Act of 1973

EWDA Energy & Water Development Appropriation Act

F Fahrenheit

FAAM Focus Alternative Array Milestone

FDA Flood Damage Analysis

FONSI Finding of No Significant Impact

FPPA Farmland Protection Policy Act of 1981

FRM Flood risk management

ft Feet

FWCA Fish and Wildlife Coordination Act

FWEEP Flood Warning and Emergency Evacuation Plan

FY Fiscal Year

GDM General Design Memorandum

GIS Geographic Information System

H&CD Housing and Community Development

HTRW Hazardous, Toxic, and Radioactive Waste

HQUSACE Headquarters of the United States Army Corps of Engineers

IFLOWS Integrated Flood Observing and Warning System

iPaC Information for Planning and Consultation

KAR Kentucky Administrative Regulations

KDFWR Kentucky Department of Fish and Wildlife Resources

KDOW Kentucky Division of Water

KGS Kentucky Geological Survey

KRS Kentucky Revised Statute

LOMR Letter Of Map Revision

M Million

NAAQS National Ambient Air Quality Standards

NED National Economic Development

NEPA	National Environmental Policy Act	USGS	U.S. Geological Survey
NFIP	National Flood Insurance Program	UST	Underground Storage Tank
NHPA	National Historic Preservation Act of 1966	WQC	Water Quality Certification
NPDES	National Pollutant Discharge Elimination System	WRDA	Water Resources Development Act
NRHP	National Register of Historic Places		
NRCS	Natural Resource Conservation Service		
NS	Non-structural		
NWI	National Wetland Inventory		
OSA	Office of State Archaeology		
O&M	Operations and Maintenance		
OMRR&R	Operation, Maintenance, Repair, Replacement & Rehabilitation		
OSHA	Federal Occupational Safety and Health Administration		
P&G	Principles and Guidelines		
PCA	Project Cooperation Agreement		
PGN	Planning Guidance Notebook		
P.L.	Public Law		
PPA	Project Partnership Agreement		
PSA	Public Service Authority		
RE	Real Estate		
RM	River Mile		
RRPS	Risk Reduction Per Structure		
SHPO	State Historic Preservation Office		
SPF	Standard Project Flood		
US	United States		
USACE	U.S. Army Corps of Engineers		
U.S.C.	U.S. Code		
USDA	U.S. Department of Agriculture		
USEPA	U.S. Environmental Protection Agency		
USFWS	U.S. Fish and Wildlife Service		

1. GENERAL

This Detailed Project Report (DPR) presents the findings of a feasibility study with an integrated Environmental Assessment (EA) of proposed flood risk management (FRM) improvements for the City of Paintsville and Johnson County, Kentucky. This analysis was conducted under authority granted by Energy and Water Development Appropriation Act, 1981, P.L. 96-367, tit. II, § 202 (1981) as well as the Supplemental Appropriations Act, 1982, P.L. 97-257, Ch. V, 96 Stat. 818, 832 (1982) and Energy and Water Development Appropriations Act, 1997, 104 P.L. 206, 110 Stat. 2984, 2990 (1996) to study, design and construct the most cost effective “flood control measures” to provide “...a level of protection against flooding at least sufficient to prevent any future losses...from the likelihood of flooding such as occurred in April 1977...” in the Levisa Fork basin. The Levisa Fork basin includes Johnson County, Kentucky. Appropriations for this project are provided under Supplemental Appropriations to the Bipartisan Budget Act of 2018, P.L. 115-123, Div. B, Subdiv. 1, tit. IV (2018).

Impacts to the human environment by the Recommended Plan were evaluated pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality regulations (40 C.F.R. §§ 1500-1508), and the USACE implementing regulation, Procedures for Implementing NEPA (33 C.F.R. §§ 230.1-230.26) and Engineering Regulation (ER) 200-2-2 (USACE 1988).

The US Army Corps of Engineers (USACE) Louisville District is the lead district for this DPR with support from the Buffalo, Huntington and Nashville Districts. This DPR presents recommendations for structural measures (which alter the flow and/or movement of water in the project area) and non-structural measures (which physically alter the buildings, structures, and/or other resources in the floodplain of the project area) to reduce flood risks in both the City of Paintsville and Johnson County.

1.1. REPORT ORGANIZATION

Given the scope and scale of the issues covered under the Section 202 authorization, this DPR does not strictly adhere to the standard template established by the USACE Great Lakes and Ohio River Division (CELRD) for DPRs prepared for much smaller projects authorized under the Continuing Authorities Program (CAP). Instead the layout of this DPR also accounts for USACE guidance for feasibility reports and associated NEPA documentation for project proposals of much larger scale than CAP projects. This DPR is organized as follows:

- **Section 1.** General Information: discusses background, underlying project authority and other pertinent guidance, describes the location, and scope of the study and frames the decision to be made.
- **Section 2.** Purpose and Need: identifies problems and opportunities to be addressed.
- **Section 3.** Affected Environment: describes the physical, biological, and human baseline conditions in the Johnson County area, with emphasis on those resources potentially impacted by proposed actions and alternatives.
- **Section 4.** Plan Formulation: discusses the identification of potential measures to address project area problems and development of alternatives. These alternatives include a plan of no action and various combinations of structural and non-structural measures. The most cost effective plan that meets the planning objectives and PGN evaluation criteria is identified.
- **Section 5.** Environmental Effects: analyzes the potential environmental, cultural and socioeconomic effects of the proposed actions and considered alternatives. This analysis is required by NEPA (42 United States Code (U.S.C.) 4321 et seq.), the Council on Environmental Quality (CEQ) Regulations Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (C.F.R.) 1500-1508), and Engineer Regulations (ER) 200-2-2 and ER 1105-2-100.

- **Section 6.** Mitigation of Adverse Impacts: discusses the nature and scope of mitigation required from the Recommended Plan through consultation with resource agencies.
- **Section 7.** Implementation Requirements: presents the requirements and capabilities of the agency to move forward with the Recommended Plan.
- **Section 8.** Public Involvement: discusses the agency's effort to involve and engage the public.
- **Section 9.** Recommendations: details the Recommended Plan based on the results of our analysis.
- **Section 10.** List of Preparers: provides the names of the persons who authored the document and their areas of expertise.
- **Section 11.** References: provides bibliographical information for cited sources.

1.2. BACKGROUND

In April 1977 the Big Sandy River basin was hit with devastating flooding along multiple tributary streams in the multistate area of Virginia, West Virginia, and Kentucky. A Presidential Disaster Declaration was issued as a result of this flooding and included 15 Kentucky counties, among which was Johnson County in the Levisa Fork basin. While there were no casualties in Johnson County, the flood reportedly killed 10 people in eastern Kentucky and 22 people in the region. Damages in all of the affected basins were estimated at \$175 million at the time, or roughly \$743 million in 2019 dollars. A recurrence of the April 1977 flood would result in damages to over 4,770 structures in the Levisa Fork basin, approximating \$384 million in 2019 dollars. In addition to structural damages, flooding damages to transportation facilities within the Levisa Fork basin would approach \$14.7 million in 2019 dollars. Additional damages to infrastructure such as sewage and water treatment facilities, airports, substations, and railroads, have not been quantified.

1.3. STUDY & PROJECT AUTHORITY

This report is prepared in accordance with, and in response to, the following authorities:

1. **Energy and Water Development Appropriation Act, 1981, P.L. 96-367, tit. II, § 202 (1981):**

SEC. 202. (a) The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to design and construct, at full Federal expense, such flood control measures at or in the vicinity of

(1) Pikesville, Kentucky, and of Grundy, Virginia, on the Levisa Fork of the Big Sandy River,

(2) Pineville, Kentucky, on the Cumberland River, and

(3) Williamson and Matewan, West Virginia, on the Tug Fork of the Big Sandy River,

as the Chief of Engineers determines necessary and advisable to afford these communities and other flood damaged localities and their immediate environs on both the Levisa and Tug Fork of the Big Sandy River and Cumberland River a level of protection against flooding at least sufficient to prevent any future losses to these communities from the likelihood of flooding such as occurred in April 1977, at an estimated cost of \$284,000,000. Non-Federal interests shall hold and save the United States free from damages due to construction works referred to in this section, and maintain and operate all such works after their completion in accordance with regulations prescribed by the Secretary of the Army.

(b) There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this section.

(c) The Congress finds that the benefits attributable to the objectives set forth in section 209 of the Flood Control Act of 1970 exceed the cost of the flood control measures authorized by this section.

2. **Supplemental Appropriations Act, 1982, P.L. 97-257, Ch. V, 96 Stat. 818, 832 (1982):** States in part: "Flood control measures authorized by Section 202 of the 1981 Energy and Water

Development Appropriations Act involving high levees and floodwalls in urban areas should provide for a standard project flood level of protection when consequences from overtopping caused by large floods would be catastrophic."

3. **Energy and Water Development Appropriations Act, 1997:** States in Section 105 that "[from the date of enactment of this Act, non-structural flood control measures implemented under Section 202(a) of P.L. 96-367 shall prevent future losses that would occur from a flood equal in magnitude to the April 1977 level by providing protection from the April 1977 level or the 100-year frequency event whichever is greater."
4. **Supplemental Appropriations to the Bipartisan Budget Act of 2018, P.L. 115-123, Div. B, Subdiv. 1, tit. IV (2018):** Division B, Subdivision 1, Title IV reads in-part: For an additional amount for " Construction" for necessary expenses to address emergency situations at Corps of Engineers projects, and to construct, and rehabilitate and repair damages caused by natural disasters, to Corps of Engineers projects, \$15,055,000,000, to remain available until expended:... Provided further, That the completion of ongoing construction projects receiving funds provided under this heading shall be at full Federal expense with respect to such funds:... Provided further, That any projects using funds appropriated under this heading shall be initiated only after non-Federal interests have entered into binding agreements with the Secretary requiring, where applicable, the non-Federal interests to pay 100 % of the operation, maintenance, repair, replacement, and rehabilitation costs of the project and to hold and save the United States free from damages due to the construction or operation and maintenance of the project, except for damages due to the fault or negligence of the United States or its contractors: Provided further, That such amount is designated by the Congress as being for an emergency requirement pursuant to section 251 (b)(2)(A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985: Provided further, That the Assistant Secretary of the Army for Civil Works shall provide a monthly report to the Committees on Appropriations of the House of Representatives and the Senate detailing the allocation and obligation of these funds, beginning not later than 60 days after the enactment of this subdivision.

1.4. ADDITIONAL GUIDANCE

There have been multiple additional directives from both Congress and the USACE chain of command regarding the conduct of evaluations performed under the Section 202 Program:

1. **Section 202 General Plan for Project Implementation (April 28, 1982) (General Plan for Project Implementation):** Based upon the Section 202 legislation, the USACE Ohio River Division (CEORD - now part of CELRD) submitted to the Assistant Secretary of the Army for Civil Works [ASA(CW)] for approval its proposed implementation plans for flood damage reduction measures for the entire Section 202 Program area (consisting of the Levisa and Tug Forks of the Big Sandy River Basin and the Upper Cumberland River Basin). The document contained general programmatic guidance as well as implementation recommendations for an initial 17 projects in the three basins covered under the Section 202 project authority
2. **ASA(CW) Memo for the Acting Director of Civil Works (August 12, 1982):** States in part: "The Corps should proceed to do whatever it can through proper design and by requiring adoption of appropriate non-structural measures by local interests to reduce the intangible costs of a levee or floodwall failure or overtopping."
3. **ASA(CW) Memo for the Acting Director of Civil Works (October 4, 1982):** States in part and references P.L. 97-257 as quoted previously: "In order to comply with this Congressional direction

your proposed plan for structural protection at each community will have to include an evaluation in terms of this legislative provision."

4. **98. STAT . 284, P.L. 98-332 (July 1984)** Notwithstanding current administrative procedures, the Secretary of the Army, acting through the Chief of Engineers, is directed to implement immediately non-structural flood control measures such as relocation sites, flood proofing and floodplain acquisition and evacuation as described in the General Plan for Section 202 Program Implementation prepared by the Ohio River Division in 94 Stat. 1339. April 1982 and as authorized by Section 202 of P.L. 96-367:
5. **Section 103b of P.L. 99-662 (Water Resources Development Act (WRDA) 1986):** States that "the non-Federal share of the cost of non-structural flood control measures shall be 25% of the cost of such measures. The non-Federal interests for any such measures shall be required to provide all lands, easements, rights-of-way, dredged material disposal areas, and relocations necessary for the project, but shall not be required to contribute any amount in cash during construction of the project."
6. **Levisa Fork Basin General Planning Supplement (June 28, 1991):** This report was submitted to facilitate the requirements of Action Point 2, Select Alternative Plans, as outlined in CEORD Regulation 1105-2-4. It states that in areas where the 100-year frequency (1% Annual Exceedance Probability [AEP]) elevation exceeds the elevation of the April 1977 flood event, the 100-year frequency event was used as the target for flood risk reduction. In Table 5-1 ("Specific Project Elements") the planning supplement identified Johnson County and, specifically Paintsville, Kentucky, as an area to use the 100-year flood level (1% AEP) as the minimum programmatic goal for flood risk reduction.
7. **CEORD Regulation 1105-2-4 Responsibilities, Requirements, and Procedures for Implementing the Section 202 Program (March 10, 1992):** This regulation describes responsibilities, requirements, and procedures for implementing activities in accordance with Section 202 and the General Plan for Project Implementation, as submitted to the ASA(CW) and approved in April 1982. The intent of this regulation is to provide comprehensive guidance for managing the Section 202 Program in a responsible manner that is both cost-effective and responsive. Quoting from the document: "The objective of the Section 202 Program is to implement cost-effective measures that will assure a level of protection against flooding such as occurred in April 1977."
8. **Section 202 of P.L. 104-303 (WRDA 1996):** States in (b) of Section 202 that the Secretary of the Army shall revise the criteria and procedures for calculating the non-Federal sponsor's ability to pay the non-Federal cost share.

1.5. STUDY AREA

The watershed of the Levisa Fork of the Big Sandy River is located in the coalfields of Eastern Kentucky amid the foothills of the Appalachian Mountains in the Cumberland Plateau. It is the most significant coal producing region in the state and is also important in terms of natural gas production. As part of the Big Sandy River Basin, the study area lies within the Mountain and Creek Bottom Area, which is characterized by high, sharp-crested ridges with little level upland area and narrow stream valleys. Flat, level ground is usually found along stream terraces, where local communities are typically located. Levisa Fork flows through the southeastern portion of Johnson County, Kentucky. The Paint Creek tributary has its confluence with the Levisa Fork in Johnson County, approximately 62.7 miles above the Levisa Fork confluence with the Big Sandy River at Louisa, Kentucky. **Figure 1** is a location map for the study area.

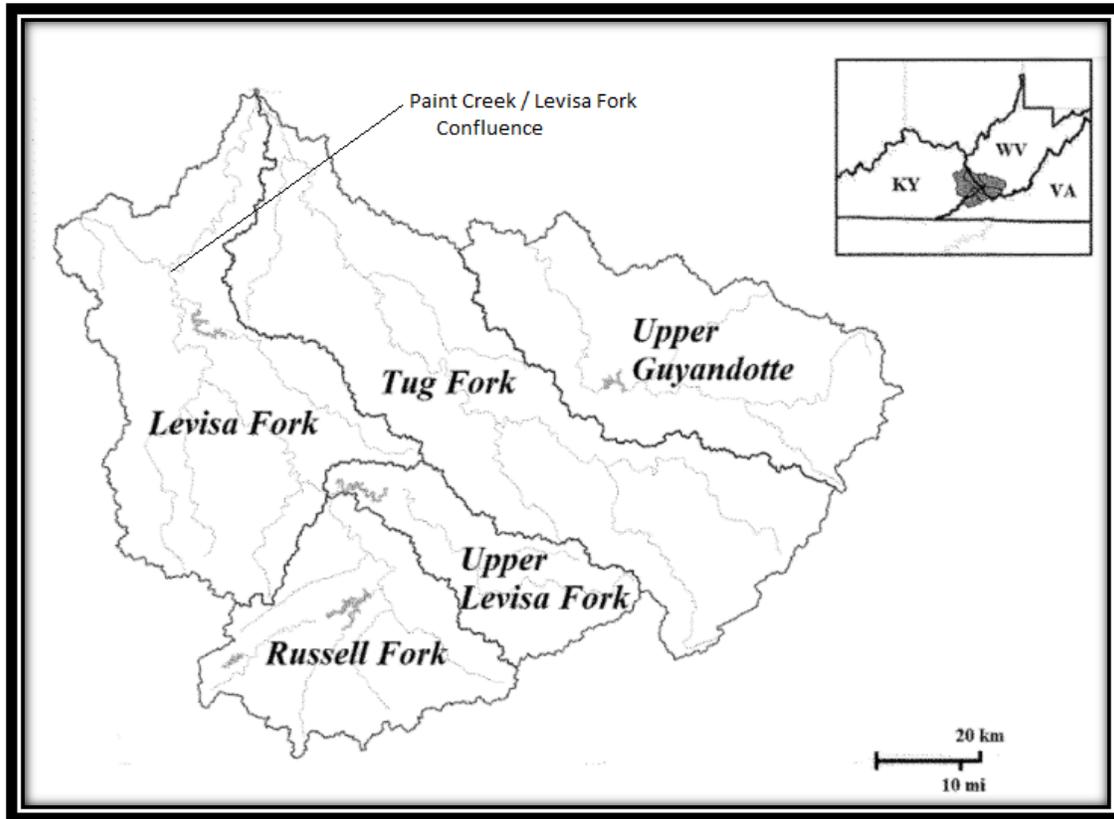


Figure 1. Study Area Location Map

A number of significant water resource projects have already been constructed or implemented in the Levisa Fork watershed under various authorities provided by Congress including Section 202. Since the Levisa Fork is within the geographic boundaries of Huntington District (LRH), LRH had the implementation lead for these prior projects. A listing of major such projects is shown in Section 1.7 below.

1.6. PROJECT AREA

The project area is Johnson County, Kentucky, estimated population of 22,386 (U.S. Census Bureau July 2018). For purposes of this evaluation Johnson County was split into two focus areas: the City of Paintsville and the area of Johnson County outside of the City. (See **Figure 2.**)

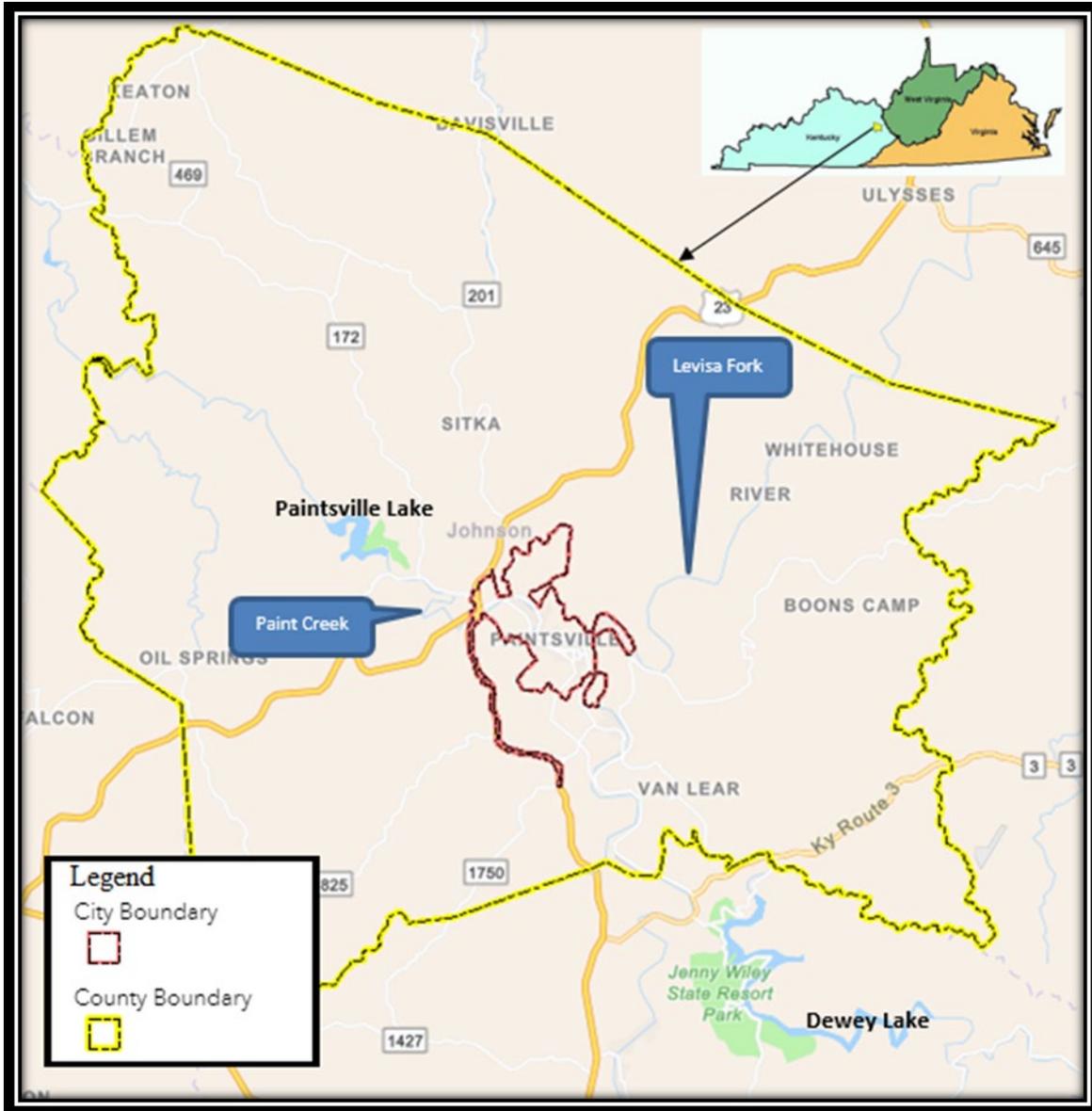


Figure 2. Project Area.

Levisa Fork passes through Johnson County and the City of Paintsville collecting rainfall from Paint Creek, Little Mudlick Creek and other small tributaries in Johnson County. Paintsville Lake, a USACE constructed and operated project, is located approximately eight miles upstream of the Levisa Fork along Paint Creek and controls nearly 60 % of flows in the Paint Creek watershed.

The City of Paintsville is the Johnson County seat, and is located at the confluence of Levisa Fork and Paint Creek (Figure 3). It is the largest community in Johnson County with a population of 4,037 (U.S. Census Bureau 2018) and contains critical infrastructure for the region such as the Big Sandy Rural Electrical Cooperative Company (RECC), Paintsville Fire Department, and the Paul B. Hall Regional Medical Center.

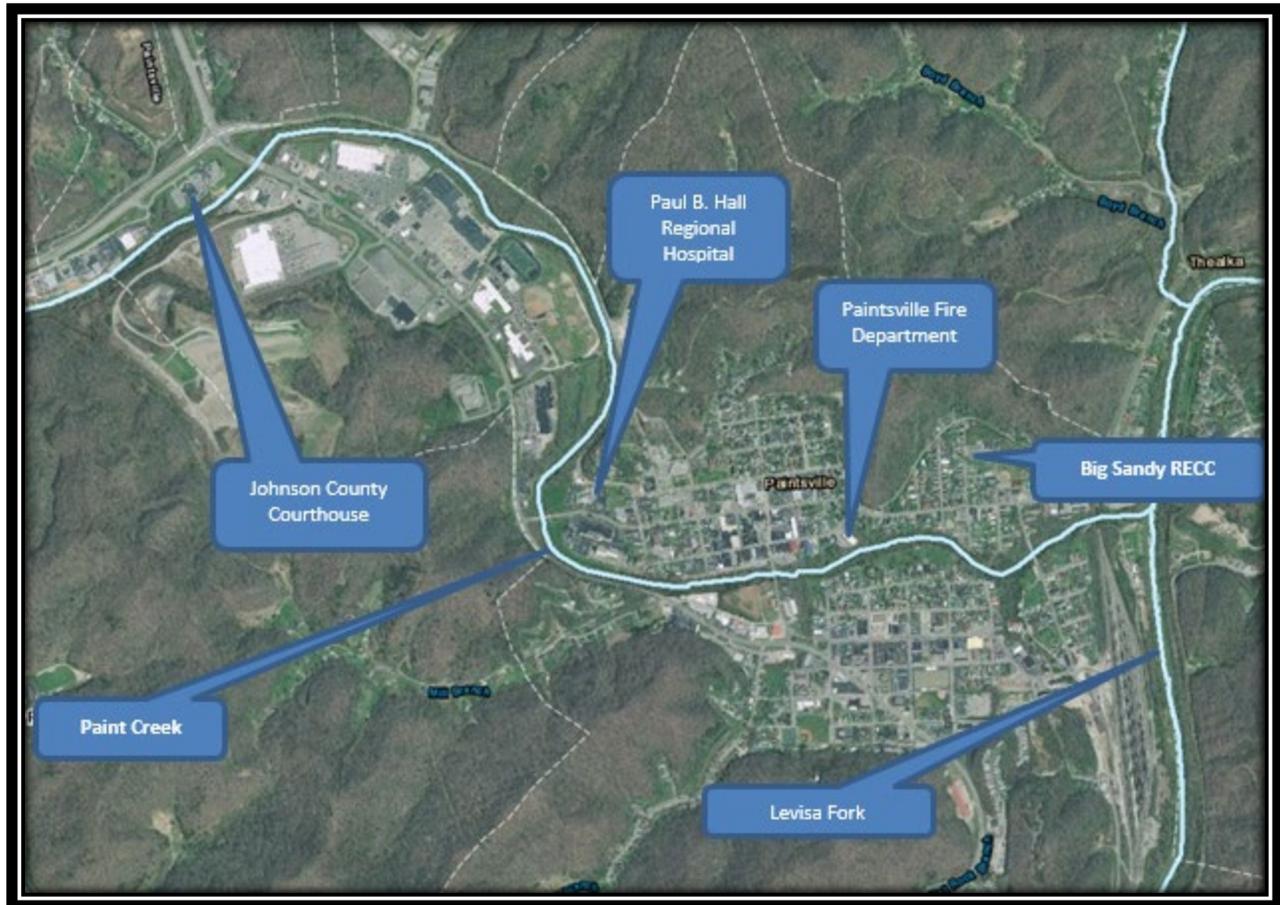


Figure 3. City of Paintsville

The City of Paintsville was founded, and developed, on land that is susceptible to backwater flooding from the Levisa Fork below the 1% (100-year) annual exceedance probability (AEP) event. The April 1977 flood event was not as devastating to the City of Paintsville as it was to surrounding areas in the basin. Based on existing hydrologic data, it is estimated that the April 1977 flood event, or its reoccurrence, would be consistent with a 5% AEP (20-year) flood event in the City, producing flows of 43,700 cubic feet per second (cfs). The flood of record for the City of Paintsville occurred on January 31, 1957, producing flows at the Levisa Fork and Paint Creek confluence of 69,700 cfs. The City also experiences headwater flood events from Paint Creek, and flash flooding that is a result of flows from heavy rainfalls coming off of the surrounding ridges into local tributaries of Paint Creek. Headwater flood events along various other tributaries primarily effect the surrounding communities in Johnson County, outside of Paintsville, but can worsen existing flood conditions in the City. Of the 1,558 structures within Paintsville, 635 are listed as located in the FEMA floodplain. Based on first floor surveys and hydrologic modeling, it is estimated that a recurrence of the April 1977 flood would result in damages to approximately 323 structures within the Paintsville city limits. Of those eligible for flood risk management under Section 202 program, 124 structures have finished first floors and 258 structures have low ground entrance points below the 1977 flood elevation (608.6' NAVD 88). Some structures have both finished first floors and low ground entrance points below the 1977 flood elevation. Structures with low ground entrance points below would sustain flood damages during a 1977 flood event reoccurrence; including, but not limited to, HVAC units, water heaters, basements, insulation, housing façade, foundations, etc.

In the other areas of Johnson County excluding the City of Paintsville, 387 residences and 60 businesses are currently identified by FEMA as in the 1% AEP floodplain. Ten of the major streams in the county were modeled to estimate the extent of the 1977 floodplain and that model showed approximately 125 structures in the surrounding Johnson County as flooded in the recurrent 1977 flood event. Flooding in the county was different from the flooding in the City during this event because the flooding resulted from headwater flood and had very different stages in different locations depending on local rainfall patterns. The models of the 10 streams showed that 124 structures would be damaged but many in the FEMA's identified 1% AEP floodplain were shown as not flooded. On the contrary 48 structures that were modeled to have received flooding were above the FEMA 1% floodplain. Modeling required to estimate the 1977 floodplain on all structures in Johnson County would be extensive and would be likely the push out any study completion date considerably.

1.7. PRIOR STUDIES AND EXISTING PROJECTS

1.7.1. PRIOR STUDIES

- A. General Plan for Section 202 Program Implementation (April 1982) - Based upon Section 202, the USACE submitted to the ASA(CW) for his approval of the "Section 202 General Plan for Project Implementation," covering the proposed program and project plans for flood damage reduction measures for the entire Section 202 project area (consisting of the Levisa and Tug Forks of the Big Sandy River Basin and the Upper Cumberland River Basin).
- B. General Planning Memorandum - The Levisa Fork Basin "Draft" General Planning Memorandum was completed in 1986. This report, prepared by USACE, included a detailed formulation and evaluation of both structural and non-structural measures in the Levisa Fork Basin. This report did not address flooding problems at Levisa Fork tributary areas (such as Paint Creek) experiencing headwater flooding during the April 1977 flood event.
- C. Levisa Fork Basin General Planning Supplement (June 1991) - This report was submitted to facilitate the requirements of Action Point 2, Select Alternative Plans, as outlined in CEORDR 1105-2-4. It states that in areas where the 100-year frequency elevation exceeds the elevation of the April 1977 flood event, the 100-year frequency event was to be used as the target for flood risk reduction. Table 5-1 of this Planning Supplement ("Specific Project Elements") identifies Johnson County and, specifically Paintsville, Kentucky, as areas subject to this 100-year minimum level target.
- D. Haysi Dam Preliminary Draft General Plan - The *Levisa Fork Basin/Haysi Dam Preliminary Draft General Plan Supplement* was completed in May 1995. This report developed a detailed, cost-effective plan to reduce flood damages in the Town of Haysi, Virginia, and other communities downstream. The plan involved constructing Haysi Dam at river mile 29.2 of the Russell Fork near the Buchanan/Pike County border. The total plan including downstream non-structural measures to supplement the dam, was estimated to cost \$652.3 million. The least cost option featured a \$105.6 million dry dam at the same location. An alternative featuring a \$118.1 million dam that included additional storage for downstream whitewater recreation was also developed. While Section 353 of WRDA of 1996 authorized the construction of Haysi Dam for flood control and whitewater recreation, the project has yet to be constructed.

1.8. LEVISA FORK BASIN STRUCTURAL PROJECTS.

Five USACE flood control dams and a cut through project have been constructed at or upstream of Johnson County on the Levisa Fork and its tributaries for multiple purposes including flood control, water-supply, low-flow augmentation, and recreation. See **Figure 4**.



Figure 4. USACE Dam Projects in Region

The John W. Flannagan Dam and Reservoir and the North Fork of Pound River Lake are located upstream of the project area in the Russell Fork basin near the Kentucky/Virginia border. They provided flood risk reduction in the study area in April 1977 for structures on the Russell and Levisa Forks and reduced flood damages basin-wide.

- A. The North Fork of Pound River Lake was authorized by the Flood Control Act of 1960 (PL 86-645) and completed in January 1966. The reservoir provides minimum winter flood control storage of 9,300 acre-feet and summer flood control storage of 8,100 acre-feet with a maximum surface area of 349 acres.
- B. The John W. Flannagan Dam and Reservoir was authorized by the Flood Control Act of 1938 (PL 75-761) as amended by the Federal Water Pollution Control Act, Amendments of 1961 (PL 87-88) and completed in December 1963. The reservoir provides minimum winter flood control storage of 94,700 acre-feet and summer flood control storage of 78,200 acre-feet with a maximum surface area of 2,098 acres. The reservoir became operational in 1964.

- C. Fishtrap Lake was authorized in the Flood Control Act of 1938 (PL 75-761) and completed in February 1969. The reservoir provides minimum winter flood control storage of 153,800 acre-feet and summer flood control storage of 126,600 acre-feet with a maximum surface area of 2631 acres.
- D. Dewey Lake was authorized in the Flood Control Act of 1938 (PL 75-761) and placed in operation in July 1949. The reservoir provides winter flood control storage of 81,000 acre-feet and summer flood control storage of 76,100 acre-feet with a maximum surface area of 3,340 acres.
- E. Paintsville Lake is within the project area. It was authorized in the Flood Control Act of 1965 (P.L. 89-298) and placed in operation in September 1983. The reservoir provides flood control storage of 32,800 acre-feet with a maximum surface area of 1,861 acres and controls 60 % of the flow from the Paint Creek basin.
- F. The Pikeville Cut-Through Project was constructed under the Appalachian Regional Commission's Model Cities Program, with USACE technical and construction management assistance, between 1973 and 1987. The project created a 0.75 mile channel through Peach Orchard Mountain to bypass a section of the Levisa Fork which frequently flooded Pikeville. Two flood gates were installed after the April 1977 flood to prevent backwater flooding from the Levisa Fork into downtown Pikeville.

1.9. LEVISA FORK NON-STRUCTURAL PROJECTS:

- A. The Grundy, Virginia, project of the Section 202 program was the first approved non-structural project in the Levisa Fork basin. The project included: 48 structures eligible for flood proofing; acquisition of 48 structures on a voluntary basis; mandatory acquisition of 69 structures under eminent domain as part of the associated US 460 highway improvement; construction of a flood-safe commercial redevelopment site; and flood risk reduction for 17 structures by a ringwall/levee (low height standalone barrier encircling the structures). The non-Federal co-sponsors are the town of Grundy and the Virginia Department of Transportation.
- B. The Town of Martin, Virginia, project of the Section 202 program was approved in March 2001 and is currently being implemented. The plan calls for flood proofing of eight residential and four nonresidential structures, floodplain evacuation of 116 residential and 85 nonresidential structures, as well as development of residential and commercial redevelopment sites. Total project cost was estimated to be \$97.5 million (fully funded) and would be carried out over a 10-year implementation period. The Floyd County Fiscal Court served as the non-Federal sponsor for the project.
- C. The Buchanan County, Virginia project of the Section 202 program had an estimated total project cost of \$118.6 million with a Federal share of \$112.7 million and a non-Federal share of \$5.9 million. The project included 730 structures eligible for voluntary flood proofing or acquisition and would be implemented over a six-year period. The non-Federal sponsor is Buchanan County.
- D. The Dickenson County, Virginia project of the Section 202 program was approved in July 2004 and the PCA was signed in January 2006. The plan calls for flood proofing one public, 71 residential, and 17 nonresidential structures; acquisition of 91 residential and 37 nonresidential structures; and relocating 16 public structures. The total project cost was estimated to be \$103.8

million (fully funded) and would be carried out over a nine year period. The Dickenson County Board of Supervisors serves as non-Federal sponsor for the project.

- E. The Levisa Fork Flood Warning System project includes installation of 11 stream gages and nine computer workstations to receive and disseminate stream data. Two of the stream gages are located in Pike County (Pikeville and Elkhorn City) and computer stations are located in Pikeville and Elkhorn City. This equipment was designed and installed in December 2000. The Pikeville gage was upgraded as part of the warning system and is maintained by an existing agreement between the USACE and U.S. Geological Survey (USGS). A gage in Elkhorn City was installed for the project and is maintained by agreement with the Kentucky Division of Emergency Management. Nine existing rain gages are also operational in Pike County's Levisa Fork watershed. The Integrated Flood Observing and Warning System (IFLOWS) communications system is maintained by the Virginia Department of Emergency Services, the Kentucky Division of Emergency Management, and the National Weather Service. The system is designed to provide a basin-wide detection and notification system.

1.10. PROJECT SPONSOR

The Johnson County Fiscal Court is the non-Federal sponsor for this project.

2. PURPOSE AND NEED

The purpose of this Federal action is to provide recommendations that reduce flood risks and associated damages to residential, commercial and public property in Johnson County, Kentucky, and the City of Paintsville within the floodplain of the Levisa Fork and its Johnson County tributaries. Section 202 defines the specific need to "afford" the project area "...a level of protection against flooding at least sufficient to prevent any future losses to these communities from the likelihood of flooding such as occurred in April 1977..."

2.1. PLANNING PROCESS

The principal objective for most Federal water resource feasibility studies is to identify the plan that maximizes net National Economic Development (NED) benefits as described in the Principles and Guidelines (P&G), published in 1983 by the U. S. Water Resources Council. In other words the plan that has the highest remaining net annual benefits after accounting for the annualized project implementation costs (including those to mitigate/account for environmental, social, and other impacts) would be recommended. However, while this DPR still follows the general planning process laid out in the P&G and USACE policy, language in Section 202 alters the cost/benefit methodology for project recommendation. Through Section 202, Congress directed USACE to plan, design, and construct flood projects that would prevent losses from, at a minimum, a repeat of the 1977 flood event. Further, Congress determined that the benefits of Section 202 projects satisfy the Congressional objectives required by 42 U.S.C. § 1962-2 (which was implemented by the P&G), and therefore such benefits "exceed the costs of the flood control measures authorized." Under this framework, the formulation of the project is based on cost effectiveness, which is usually the least-cost method. Consequently, an analysis that considers the greatest net economic benefits will not be undertaken.

In response to the Section 202 legislation, USACE prepared its report titled "Section 202 General Plan for Project Implementation," (hereafter referred to as the General Plan). The General Plan discussed potential flood damage reduction for the Levisa Fork Basin but did not recommend specific measures or projects within Johnson County. However, the later Levisa Fork Basin "Concept" Main Report General Plan

Supplement did include recommendations for Johnson County. In the Specific Project Elements table of this document, the minimum level of protection considered for the City of Paintsville was the “100-year” (1% AEP) level of flood damage reduction.

Subsequent to the authorizing legislation, another major flood occurred in the Levisa Fork and Tug Fork Basins in May 1984, resulting in damages of approximately \$417 million (2019 price level). As a result, P.L. 98-332 was passed directing USACE to "...implement immediately non-structural flood control measures such as relocation sites, flood proofing and floodplain evacuation as described in the General Plan..."

Given Congressional intent, the following six-step planning process as prescribed in the P&G, as well as the Planning Guidance Notebook [PGN ER 1105-2-100, 22 April 2000], is still applicable to the specific water resource problems in this study area:

Step 1: Identification of water resources problems in the study area.

Step 2: Collection of data on the problems identified.

Step 3: Development of alternatives to solve the problems.

Step 4: Evaluation of the effects by the alternatives.

Step 5: Comparison of alternatives.

Step 6: Selection of a plan for recommendation.

According to the P&G, the evaluation of alternative plans under this process consists of four major tasks:

The first task is to forecast the most likely with-project condition expected under each alternative plan.

The second task is to compare each with-project condition to the without-project condition and document the differences between the two.

The third task is to characterize the beneficial and adverse effects by magnitude, location, timing and duration.

The fourth task is to identify the plans that will be further considered in the planning process, based on a comparison of the adverse and beneficial effects and the evaluation criteria.

Under the P&G, NEPA, and other regulations governing the formulation of water resources projects, USACE is required to consider potential impacts of the “Proposed Action” or Recommended Plan on not only technical and economic factors, but also the environmental, and health and welfare aspects of the affected communities and residents in the project study area.

Criteria to evaluate the alternative plans include: all significant resources, outputs and plan effects; contributions to the study planning objectives; compliance with environmental protection requirements; other criteria deemed significant by participating stakeholders; and the P&G’s four evaluation criteria (completeness, effectiveness, efficiency, and acceptability). The four PGN evaluation criteria are explained below:

1. **Completeness** is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.
2. **Effectiveness** is the extent to which the alternative plans contribute to achieving the planning objectives.
3. **Efficiency** is the extent to which an alternative plan is the most cost effective means of achieving the objectives.
4. **Acceptability** is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies.

2.2. PROBLEMS

The 1977 flood event, the basis for the authorization of this project, resulted in a Presidential Disaster Declaration for 15 Kentucky counties, including Johnson County. While there were no casualties in Johnson County, the flood reportedly killed 10 people in east Kentucky and 22 people in a four state area. Damages in all of the affected basins were estimated at \$175 million at the time, or roughly \$743 million in 2019 dollars. A recurrence of the April 1977 flood would result in damages to over 4,770 structures in the Levisa Fork basin, approximating \$384 million in 2019 dollars. In addition to structural damages, flooding damages to transportation facilities within the Levisa Fork basin would approach approximately \$14.7 million in 2019 dollars. Additional damages to infrastructure such as sewage and water treatment facilities, airports, substations, and railroads, have not been quantified.

However, the 1977 flood event was not as devastating to the City of Paintsville as it was to the surrounding areas in the basin. Based on existing hydrologic data, it is estimated that the 1977 flood event, or its reoccurrence, would be consistent with a 5% AEP (20-year) flood event in the City, producing flows of 43,700 cubic feet per second (cfs). Based on data gathered for previous USACE studies conducted in the Levisa Fork basin the PDT estimated that Johnson County would incur \$180 million in structural damages (2019 dollars) in a repeat of the 1977 flood event. While the flood of record for the City of Paintsville occurred on January 31, 1957, producing flows at the Levisa Fork and Paint Creek confluence of 69,700 cfs, this event occurred prior to completion of several large upstream USACE flood projects. When the potential impacts of these USACE flood projects are factored into the 1957 event, the flow at the Levisa Fork/Paint Creek confluence would be reduced to an estimated 42,800 cfs. This would be just marginally less than the event of April 1977. The PDT performed an evaluation of the more than 100 years of flow data recorded at the Levisa Fork/Paint Creek confluence and normalized the record to account for the implementation of the USACE upstream flood projects. The PDT concluded that under this scenario the April 1977 event would be ranked as the highest flood event to date.

As previously stated for the City of Paintsville, the flood damages in surrounding Johnson County that resulted from the 1977 flood event were not as extensive as in other portions of the Levisa Fork basin, and varied based on location and stream course. A recurrence of the 1977 flood event today would result in damages and increased risk to approximately 124 structures in the Paintsville City limits and somewhere between 125 and 447 structures in Johnson County (outside of the Paintsville City limits). This number is approximate because all creeks and streams were not modeled to estimate the 1977 flood event.

Historic rainfall data gathered for this project and the results of hydraulic modeling performed by USACE, indicate that the April 1977 flood event reached an elevation of 608.6 feet (ft) North American Vertical Datum of 1988 (NAVD88 in the City of Paintsville at the Levisa Fork gauge. This would be the equivalent

of a 20-year event or a 5% AEP. **Figure 5** shows the areas of inundation for the 1977 and 1% AEP (100-year) flood events.

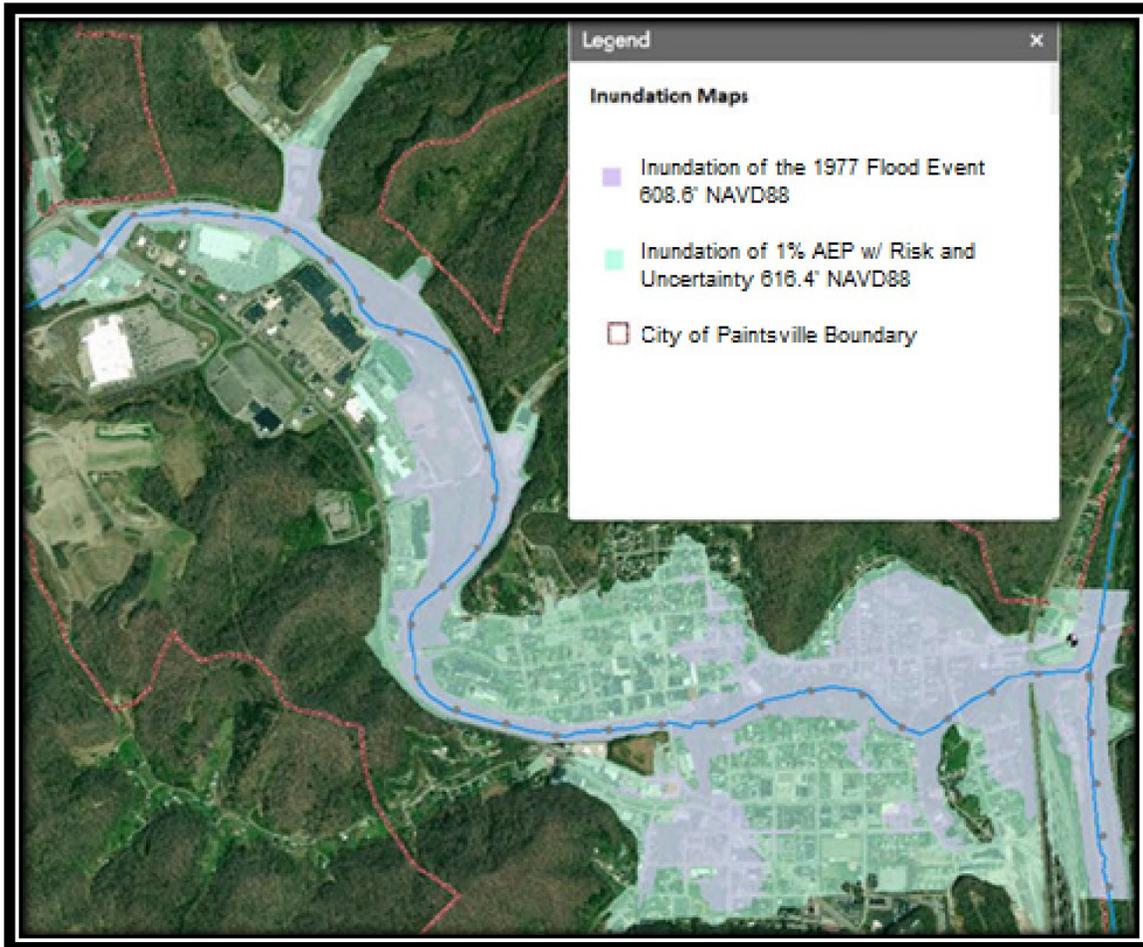


Figure 5. Inundation Map

Various factors contribute to the consequences of the flooding in the City of Paintsville and Johnson County:

- Land ownership patterns concentrate private residential, commercial, and emergency services structures, along with public transportation modes other critical infrastructure in the high-hazard floodplains. The terrain bordering the floodplain is very mountainous and much of it is owned by land holding companies.
- Steep topography with limited ability for percolation through soils and mountainous terrain, with shallow forest soils is conducive to excessive rates of runoff. In addition, any type of land use conversion that changes the soil's ability to absorb water, inhibits percolation of rainfall into the mountains and floodplains and decreases the amount of vegetation cover (limits transpiration), which contributes to runoff in excess of what would occur normally.
- Climatic and weather related rainfall events. Frequent and rapid weather changes occur due to the passages of frontal systems associated with general low-barometric pressure areas that are relatively common occurrences in this portion of the United States. The occasional stagnation and

stationary nature of these frontal systems sometimes causes prolonged precipitation, leading to storm water runoff in excess of stream channel capacities (USACE 1998a).

- Concentrated land development in the narrow floodplain of Paint Creek and the Levisa Fork and resulting addition of impermeable surfaces add to high rates of storm water runoff and contribute to increased flood events.

Emergency and recovery costs from the recurring flooding drain county and state resources. Loss of residential structures and businesses due to flooding further strains the tax base of the county, making recovery more difficult with each event. Frequent and severe flooding in the City of Paintsville's downtown also presents a significant problem for the rest of the county population because of its concentration of public services, governmental offices and commercial core that supports a much larger service area.

In addition to the severe financial losses caused by the frequent flood events noted above, there are adverse social, physical, and psychological effects on the human population. The prospect of future flooding can discourage proper maintenance and repair of buildings and investment in such property by lending institutions. This in turn can cause early deterioration of dwellings and business structures and helps account for a large number of structures in the floodplain not considered to be decent, safe and sanitary (DSS) as defined by C.F.R. Title 24 Part 5 Subpart G 5.703.

Often floods can sever access to a community or neighborhood, effectively isolating elements of the population. Complete isolation from public services (police, fire, health care, etc.) during any extreme weather event could be dangerous in a community or neighborhood even for a relatively short period of time. During extreme events, human lives are often negatively impacted when common utilities such as water, gas, and electricity are lost for days. Subsequent impacts to local economies due to business closures and loss of taxable property could further strain a community's ability to recover from repetitive flooding. All of this results in significant trauma and hardship for the people residing in and around the area and reinforces their strong concern and interest in developing and implementing effective flood damage reduction measures. In addition to this USACE effort, non-Federal interests in the project area have also been pursuing Federal assistance from FEMA and other agencies that have programs that address severely and/or repetitively damaged structures in the floodplain. Even if implemented, the work proposed under these programs would have had minimal, if any, impact on the basic recommendations of this USACE project. As of the time of this report there have been no recent Federal funds provided for proposals in the project area under these other programs.

2.3. OPPORTUNITIES

In addition to lessening the persistent problems discussed, the proposed project could provide several opportunities for improving other aspects of the City of Paintsville and Johnson County. Reducing the risk of regular reoccurring flooding may incentivize property owners to repair years of deferred maintenance to structures of various classes. Construction of a structural flood risk management project may result in improvements to local housing and commercial quality and that could add stability to the county's property tax base.

Implementation of non-structural measures and a permanent floodplain evacuation program would reduce flood damages and provide opportunities to:

- Upgrade housing stock through demolition of deteriorated floodplain units and rehabilitation or construction of new units out of the floodplain.

- Reduce the 100-year frequency flood elevation for surrounding structures and facilities by clearing floodway properties.
- Restore the riparian and bottomland habitat resources through undisturbed vegetation growth by clearing floodway properties.
- Reduce floatable debris through removal of floodplain and floodway structures and the material stored in them.

2.4. PLANNING OBJECTIVES

The USACE developed specific planning objectives for the project based upon the identified problems and opportunities within the study area, local concerns, and the intent of the aforementioned project authorization. They include:

Planning Objective 1: To provide flood risk reduction measures for the City of Paintsville and Johnson County, Kentucky that comply with Section 202, and related laws, and USACE policies and technical guidance.

Planning Objective 2: To reduce, to the extent possible, the financial and/or personal losses of flooding within the City of Paintsville and Johnson County, Kentucky.

Planning Objective 3: To maintain, to the extent possible, the social, cultural and economic cohesion of the communities within the City of Paintsville and Johnson County, Kentucky.

2.5. NEPA OBJECTIVES

NEPA established a national environmental policy and goals for the protection, maintenance and enhancement of the environment. It also provides a process for implementing these goals within Federal agencies. NEPA requires all Federal agencies to incorporate environmental considerations in planning and decision-making. NEPA also established the President's Council on Environmental Quality (CEQ) and empowered it to develop regulations by which all Federal agencies would comply with NEPA. These regulations are published in 40 C.F.R. §§ 1500-1508.

USACE has promulgated its own procedures to provide guidance for the procedural provisions of NEPA. These procedures are published as USACE ER 200-2-2 (33 C.F.R. Part 230) and are used in conjunction with the CEQ regulations. Specific guidance for planning USACE Civil Works water resource projects is also provided in ER 1105-2-100.

NEPA regulations establish a process where all agencies must assess the environmental impact of proposed Federal actions and consider reasonable alternatives to their proposed actions. For those actions with the greatest potential to create significant environmental effects, the consideration of the proposed action and alternatives are presented in an EA.

The USACE Environmental Operating Principles provide an approach to implementing NEPA that integrates the concept of environmental sustainability into the protection of the human and natural environment. The seven principles are:

1. Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

2. Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of USACE programs and act accordingly in all appropriate circumstances.
3. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
4. Continue to accept corporate responsibility and accountability under the law for activities and decisions under USACE control that impact human health and welfare and the continued viability of natural systems.
5. Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of USACE processes and work.
6. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts to USACE work.
7. Respect the views of individuals and groups interested in USACE activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment (USACE 2003b).

In accordance with ER-200-1-5 and USACE Environmental Operating Principles, USACE has incorporated environmental considerations throughout the project decision-making process. The information gathered during the development of this DPR with integrated EA has led to changes in project design, incorporation of environmental mitigation measures and provided an opportunity for the public and resource agencies to provide input into the planning process. This process has also allowed the USACE to address compliance with other environmental laws as part of a single review rather than through separate reviews, thereby reducing paperwork while ensuring comprehensiveness.

2.6. PUBLIC CONCERNS

Public participation is a significant component of the NEPA process. USACE carefully considers public comments before making a decision. This section summarizes key public notification and participation events that have occurred as part of this process, and summarizes key issues identified during the public scoping process for this DPR and EA.

USACE issued letters requesting information about the study area and environmental resources were sent to Federal, state, and local agencies on February 26, 2019 (See Volume 7). In compliance with Section 106 of the National Historic Preservation Act (NHPA), consultation with the Kentucky Heritage Council (KHC), the review entity for the State Historic Preservation Office (SHPO), Federally-recognized Tribal Nations, and the public was initiated on October 18, 2018 and is ongoing. In addition, a public meeting will be held with the general public, local officials, property owners, and local businesses during the public comment period for this project.

To date SHPO and the Tribal Nations have acknowledged the possible existence of resources of interest to them in the project area. They have provided generic requests to be kept informed as the project proposals become better developed, but did not express any specific concerns. An evaluation of the comments received thus far suggest a range of needs and concerns, including:

- Economic relief to businesses and property owners in the City of Paintsville through reduction or elimination of flood insurance that is required by structures in the floodplain that are under the lean of a mortgage.
- Increased property values from improvements made by owners once the project is operational.
- Relocation of residences and businesses out of the floodway.
- Loss of cultural, social and economic cohesion for the Paintsville community due to a comprehensive floodplain evacuation or “buy-out” program.
- Induced flooding from local tributary streams caused by implementation of a structural measure on Levisa Fork.
- Impacts to streams, including the Levisa Fork and Paint Creek from implementation of a structural measures.
- Reduced access to the Levisa Fork and Paint Creek.

2.7. CONSTRAINTS

Unlike planning “Opportunities” that represent desired positive future conditions in the community, planning constraints represent restrictions that must not be violated. Universal constraints like complying with applicable law and policy are a given for all USACE studies/projects. (Section 7.4 contains the status of compliance with such applicable universal constraints.) Planning constraints identified in this study are described in this section.

1. **Hazardous, Toxic, and Radioactive Waste (HTRW)/ Contaminated soils:** Given the nature of the commercial and industrial activities that have been part of the economic past and present of the project area, brownfield sites with varying degrees of soil contamination were expected to exist within the potential project corridors. Properties that had, or could conceivably have, severe contamination issues were to be avoided when formulating project alternatives.
2. **Existing Utilities and Infrastructure:** Underground utilities are known to exist within the project area, and project alternatives that caused major disruptions of these facilities would have significantly higher costs and increased construction schedules. Additionally, the surface elevation of existing evacuation routes out of the community essentially dictated the practical maximum of top elevations for floodwall and/or levee measures when formulating project alternatives.
3. **Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) costs for the non-Federal sponsor:** Per the requirements of a Project Partnership Agreement (PPA), the non-Federal sponsor would be responsible for the OMRR&R once the project is completed. Consideration must be given in the development of the Recommended Plan as to the capabilities and resources of the non-Federal sponsor to fulfill its responsibilities.

3. AFFECTED ENVIRONMENT – EXISTING CONDITIONS

3.1. HISTORY OF FLOODING

Flooding along Levisa Fork and Paint Creek is not limited to any month, although winter and spring floods are more frequent than summer floods. Local flooding over the basin produced by summer-type storms has occurred without affecting adjacent areas. Paint Creek basin is characterized by deep narrow valleys and narrow crested ridges, which result in rapid concentrations of runoff. Floods on Paint Creek are generally of relatively short duration and seldom remain above flood stage more than one and one half days.

Major floods in Johnson County occurred in 1918, 1937, 1939, 1945, 1955, 1957, 1963, 1968, 1972, 1974, 1977, 1985, 2003 and 2015, and include both backwater events from the Levisa Fork and headwater events from Paint Creek. Headwater flooding risks characteristic of the basin are illustrated by the list of high-water data from the gauge at Staffordsville, Kentucky presented in **Table 1**. Staffordsville is located on Paint Creek between USACE's Paintsville Lake project and the City of Paintsville.

Besides the previously discussed 1957 and 1977 flood events, other notable storm events in the county and region are described in detail below.

Storm and Flood of January 1937. The unprecedented flood of 4-10 January 1937 in the Ohio Valley resulted from moderately heavy rains which occurred in the latter part of December followed by excessive rains during January which covered the entire Ohio River watershed. The flood occurred as a series of moderate rises on the tributaries but the timing was such that continuously increasing accumulations of runoff in the lower Ohio and mid-Mississippi Rivers culminated in record-breaking stages in those reaches. Although heavy rainfall occurred during the early part of January, the main disturbances occurred during the period of January 13-25. The flood flows on Levisa Fork and Tug Fork did not exceed flood stage, however, the lower portion of Big Sandy River experienced maximum stages of record due to backwater from the Ohio River. The estimated peak natural flow at what is now the site of the current Paintsville Dam was 1,836 cfs. The volume of runoff from the area above the dam site during the period of January 13-27 was approximately 4.2 inches.

Storm and Flood of February 1939. There were three periods of from 4 to 11 inches of rainfall which contributed to the storm of February 1939. The first period fell during January 29-31 with a total of 1.26 inches. The second period caused a flood wave to arrive at what is now the site of the current Paintsville Dam with a maximum flow of approximately 7,930 cfs on February 3rd. The rainfall during the second period was large with 2.5 inches falling on the 3rd and 1.02 inches on the 4th. The final period of rainfall was during February 10-11 when 1.19 inches fell.

Storm and Flood of March 1945. The storm of February 1945 was caused by four distinct periods of rainfall. Almost 0.9 inches fell on February 13-14 followed by heavy rains during the 16th through the 18th. The third period of rain was a series of light showers which continued during the 21st and 22nd. The main rainfall lasted from February 27 through March 7 with constant showers and several periods of intense precipitation. The period was punctuated by three intense rainfalls on the 27th of February and the 3rd and 6th of March. The estimated peak natural flow at what is now the Paintsville Dam site was 2,070 cfs.

Table 1. High-water data for Paint Creek.

High Water Data Paint Creek at Staffordsville, Kentucky		
Date	Gage Height in Feet	Discharge in cfs*
20-Sep-50	24.07	11,700
1-Feb-51	21.38	8,520
22-Mar-52	24.07	11,700
8-Jan-53	15.2	3,450
8-May-54	6.6	920
22-Mar-55	15.48	3,590
18-Feb-56	20.33	7,360
14-Dec-57	20.9	7,990
7-May-58	19.19	6,210
11-Apr-59	11	1,970
11-Feb-60	9	1,440
30-Jul-61	31.41	17,400
27-Feb-62	28.6	14,700
12-Mar-63	17.77	5,030
9-Mar-64	14.21	3,100
26-Mar-65	19.25	6,320
13-Feb-66	18.37	5,530
14-May-67	23.55	10,200
12-Mar-68	20.07	7,060
18-Apr-69	9	1,480
28-Apr-70	18.31	5,480
5-Feb-71	17.8	5,050
26-Feb-72	20.4	7,360
9-Dec-73	14.67	3,290
27-Nov-74	21.41	8,270
12-Mar-75	21.7	7,810
1-Mar-76	16.95	4,750
4-Apr-77	17.77	5,220
26-Jan-78	19.95	6,400
9-Dec-79	18.53	5,690
13-Dec-80	10.97	2,160
5-Jul-81	11.05	2,190
* Values based on ratings in use at time of event		

Storm and Flood of March 1955. The storm period began during the latter part of February and was characterized by unseasonable warmth, thunderstorms and general rains. This activity had been preceded by intermittent rains since mid-month which had thoroughly saturated the soil and filled the streams. Three separate bursts of intense rainfall, each separated by approximately 24 hours, fell over the Big Sandy Basin between February 26 and March 1st. Rainfall from these storms totaled about 3.8 inches and produced

flows in excess of flood stage throughout the Big Sandy River Basin. Crest stage at Louisa was the third highest of record. Before the flood water from this storm had fully receded, another storm system moved over the area and during the period March 4-6, produced an additional 3.0 inches of rainfall. Once again the Big Sandy and its tributaries spilled over their banks with crest stages at many places equaling the preceding rise. Runoff from the area above what is now the current Paintsville Dam site for the period February 26 to March 8 was approximately 5.1 inches and a peak natural flow of 3,227 cfs.

Storm and Flood of March 1963. The month of March was unusually warm and wet after the previous months of abnormally cold, dry weather. Rainfall for the month was 4 inches above the normal in eastern Kentucky. A succession of storms moved over the Big Sandy Basin during the first few days of March, saturating the soil and filling the streams, thus setting the stage for the intense storm that was to move into the area on March 11th. During a 22-hour period on the 11th, rainfall amounts as high as 3.9 inches were recorded in the upper Levisa and Tug Fork Basins. Flood crests on Tug Fork were the maximum of record. Runoff from the area above what is now the current Paintsville Dam site for the period March 11-14 was 2.2 inches with a peak natural flow of 3,403 cfs.

Storm and Flood of November-December 1985. The storm of November-December 1985 was caused by two distinct periods of rainfall. From the first of November until the 5th, 2.9 inches of rain fell followed by heavy rains during the 21st through the 30th in the Paintsville Lake Basin. During the second period of rain, over five inches fell. Estimated peak inflow at what is now the current Paintsville Dam site was 2,998 cfs.

Storm and Flood of November 1986. The storm of November 1986 came into the Paintsville Lake Basin on the 5th of November bringing 0.21 inches of rainfall to the Lake and 1.10 inches to the nearby town of Staffordsville. From the 6th to the 12th, 2.5 more inches of rain fell and later in the month beginning the 20th through the 26th, another 1.3 inches fell. Estimated peak inflow at Paintsville Lake was 5,807 cfs.

3.2. CLIMATE

According to the NRCS Soil survey, Johnson County climate is characterized as the following: “summers are hot in the valleys and slightly cooler at the higher elevations. Winters are moderately cold. Rains are fairly heavy and well distributed throughout the year. Snow falls nearly every winter, but snow cover usually lasts only a few days.

In winter, the average temperature is 33 degrees F, and the average daily minimum temperature is 20 degrees. The lowest temperature on record, which occurred at Tomahawk on January 21, 1985, is -18 degrees. In summer the average temperature is 72 degrees. The highest recorded temperature, which occurred on August 21, 1983, is 102 degrees. The total annual precipitation is 49 inches. Of this, 27 inches, or 55 %, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 23 inches. The heaviest one-day rainfall during the period of record was 3.93 inches at Tomahawk on August 8, 1969. Thunderstorms occur on about 54 days each year, and most occur in summer.

Average seasonal snowfall is 25 inches. The greatest snow depth at any time during the period of record was 16 inches. On average, 17 days have at least one inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 %. Humidity is higher at night, and the average at dawn is about 80 %. The percentage of possible sunshine is 70 % in summer and 50 % in winter. The prevailing wind is from the south. Average wind speed is 10 miles per hour and is highest in the spring. Heavy rains can occur at any time of the year, and severe thunderstorms in summer sometimes cause flash flooding, particularly in narrow valleys.”

In compliance with USACE policy an assessment of the potential for climate change impacts was conducted as part of this study. In summary the Big Sandy River Basin flood risk management reservoirs, local levee projects, and this related Johnson County Feasibility Study operate to reduce risks and associated damages of flooding for the City of Paintsville, Kentucky. Based on the literature review and observed trends as well as an analysis of locally observed data, there is little evidence of significant temperature or precipitation changes in the Big Sandy River Basin Region. There is, however, a general consensus of a moderate upward trend in precipitation. This is likely due to the region being a “transition zone” within the Appalachian mountain region, where the northern and southern Appalachian regions are being impacted by climate change in different, almost opposite, ways. There is also a general consensus of an increasing trend in the number and intensity of extreme precipitation events occurring in the region.

Regarding projected future trends, there is generally a consensus of increasing temperatures, precipitation, and stream flow. These changes will likely vary seasonally, with greater increases in the winter and spring months. Additionally, the frequency of intense storms and rainfall is projected to increase. It should be noted that substantial uncertainty exists within future climate projections. It is recommended that stage-frequency, flow-frequency, and precipitation-frequency for Paint Creek and Levisa Fork be reevaluated periodically in the future to determine how projected trends manifest themselves in future observations.

Based on this assessment, it is recommended that the potential, future effects of climate change be treated as occurring within the uncertainty range calculated for the current hydrologic analysis. If this assumption proves to be inadequate when future observations or more refined projections become available, then a quantitative evaluation and revision of these results may be required. The detailed analysis can be found in Volume 2, Tab 7 – *Climate Change*.

3.3. SOILS AND GEOLOGY

3.3.1. GEOLOGY AND PHYSIOGRAPHY

According to the soil survey of Floyd and Johnson Counties, Johnson County covers approximately 167,916 acres of land and 1,000 acres of water. Located in the Cumberland Plateau and Mountains Land Resource Area, the county has its highest elevation at approximately 2,300 feet to about 550 feet at its lowest. Johnson County topography is described as steep, rugged, sharp-crested mountains separated by deep coves and narrow valleys. The soils of Johnson County, “formed in material weathered from interbedded sandstone, shale, and siltstone.” Johnson County is part of the Mountains and Eastern Coalfields Physiographic Region.

According to the report: “Steep slopes and high, sharp-crested ridges change into lower, less steep, more rounded forms. The geology of the survey area lies almost entirely within the Pennsylvanian-age Breathitt Formation. The exception is Paint Creek Valley where the Lee Formation crops out. The Breathitt Formation consists of interbedded sandstone, shale, siltstone, and coal beds with varying degrees of erodibility.”

3.3.2. SOIL ASSOCIATIONS

According to the NRCS Soil Survey, the City of Paintsville lies in the Udorthents-Allegheny-Nelse map unit. The Udorthents-Allegheny-Nelse map unit is characterized as, “Very deep, gently sloping to steep, well drained soils that have underlying layers of loamy material or that have a loamy subsoil; in reconstructed valleys and on stream terraces, colluvial fans, and streambanks. This map unit makes up about 3 % of Johnson County. It is about 44 % Udorthents, 18 % Allegheny soils, 16 % Nelse soils, and 22 % soils of minor extent.”

Udorthents are very deep and well drained. They are in reconstructed valleys. About 20 % of Udorthents are in built-up, urban areas. These soils formed in mixed soil and rock material brought in from areas of road construction. The properties of Udorthents are well varied.

Allegheny soils are very deep and well drained. They are on stream terraces and alluvial fans. They formed in mixed alluvium from sandstone, siltstone, and shale. Typically, the surface layer is dark yellowish brown loam. The subsoil is yellowish brown loam in the upper part, yellowish brown mottled loam and fine sandy loam in the middle part, and yellowish brown fine sandy loam in the lower part. The substratum is yellowish brown mottled sandy loam.

Nelse soils are very deep and well drained. They are on riverbanks. They formed in sandy alluvium. Typically, the surface layer consists of dark brown loam and strata of loamy fine sand. In the upper part the underlying material is brown and dark brown fine sandy loam that has sand bedding planes. In the lower part it is dark grayish brown and dark brown loamy fine sand that has sand bedding planes.

The soils of this map unit are used mainly for residential and commercial development. Some areas are used for cultivated crops, hay, and pasture. Small tracts of woodland are in wet areas and on steep riverbanks.

The nearly level and gently sloping areas of Allegheny soils are well suited to cultivated crops. The in the more sloping areas are best suited to hay, pasture, or woodland. The main limitations are slope, the erosion hazard, and flooding in low areas.

Nelse and Allegheny soils are well suited to woodland. On Nelse soils, the equipment limitation, seedling mortality, and plant competition are management concerns. These soils are suited to habitat for open land wildlife.

These soils are moderately well suited to some urban uses. Flooding is a limitation. In the steeper areas of Nelse and Allegheny soils slope is a limitation. Udorthents are contrasting and variable in this map unit. They are subject to irregular settling. Because of Udorthents, onsite investigation is needed to determine the suitability and limitations for any proposed use of this map unit.”

3.3.3. HYDRIC SOILS

Hydric soils have not been identified in the project area.

3.4. SURFACE WATER AND OTHER AQUATIC RESOURCES

3.4.1. SURFACE WATER

Many streams in Johnson County are designated as non-supporting based on the Kentucky 303 (d) list (**Figure 6**). There are two prominent streams within the study area of the City of Paintsville, Kentucky; Levisa Fork and its tributary, Paint Creek.

The Levisa Fork drains 2,326 square miles of Virginia and Kentucky. The stream originates in Buchanan County in southwest Virginia and flows in a northwesterly direction to Prestonsburg, Kentucky. From Prestonsburg it flows nearly due north to its junction with Tug Fork at Louisa, Kentucky. The total length of Levisa Fork is approximately 164 miles, of which 34 miles are in Virginia and the balance in Kentucky. The Levisa Fork within Johnson County is from river mile 49 to 70. From mile 49 to 55 and mile 65 to 70, Levisa Fork is identified as non-supporting on the 303 (d) list for fecal coliform and E. coli.

Paint Creek drains 169 square miles of Johnson, Magoffin and Morgan Counties, Kentucky. The basin is roughly rectangular in shape, about six miles wide by 24 miles in length. Paint Creek is formed by the confluence of Little Paint Creek and Open Fork Paint Creek. Paint Creek flows east through the center of the City of Paintsville. Paint Creek is approximately 20 miles and is a tributary draining into the Levisa Fork at the Eastern side of Paintsville near river mile 62.7. Total elevation fall from the head of Little Paint Creek to the mouth of Paint Creek is 510 feet in 34.9 miles. According to Kentucky Division of Water, Paint Creek is listed as non-supporting on the 303(d) list for fecal coliform and E. coli from mile 0.0 to 8.3, which is found entirely within the Paintsville City limits. Sections of Paint Creek are impounded by the Paintsville Lake Dam which was constructed by USACE in 1983.

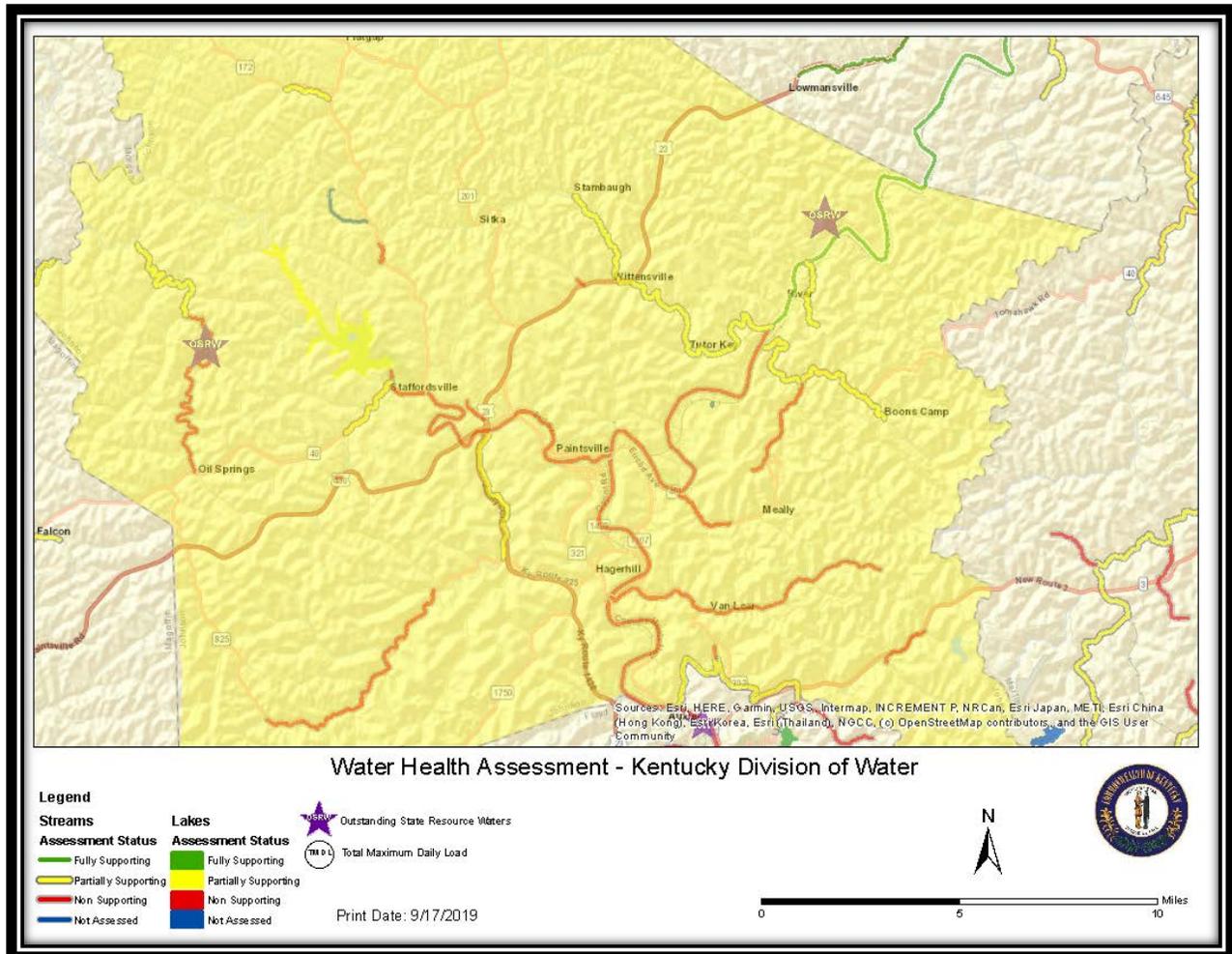


Figure 6. Johnson County Streams 303 (d) Status (Streams appearing orange are assessed as “Non Supporting”)

3.4.2. GROUNDWATER

According to the University of Kentucky and the Kentucky Geological Survey, approximately 9,500 people in Johnson County (approximately 40 % of the population) use wells for their potable water use. Terraces and narrow floodplains containing alluvium soil typically yield approximately 100 gallons per day to most dug wells and water is considered soft to moderately hard. Valleys and rugged hillside containing the Breathitt Group of soils typically yield more than 500 gallons per day from dug wells. Water quality is

highly variable and salty water can be found at depths of less than 100 feet below the principal valley bottoms. Grundy soil type usually yields more than 500 gallons per day in valley bottoms and less on hilltops. Water from these wells is soft or moderately hard and below the drainage level may be salty (KGS, 2019).

3.4.3. FLOODPLAINS

The floodplain region of the Levisa Fork Basin is narrow, averaging 1,200 feet in width along the rivers and streams (Evans 1996). This is due to the steep hills which border the rivers on either side. Because of the steep hills, the floodplain is the only area available for development in the region. The majority of the floodplain consists of riparian habitat, but the floodplain also extends further up the slope of the hills to include upland areas.

3.4.4. WETLANDS

According to the US Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) Maps, there are approximately 559 freshwater emergent wetlands throughout the county, totaling 373 acres. Within the Paintsville vicinity, there is only one freshwater emergent wetland identified by the NWI maps, totaling 0.79 acres in size; however, there has been a baseball field constructed over its footprint and the wetland no longer exists (**Figure 7**). Site visits by USACE biologists were conducted and no additional wetlands were observed.

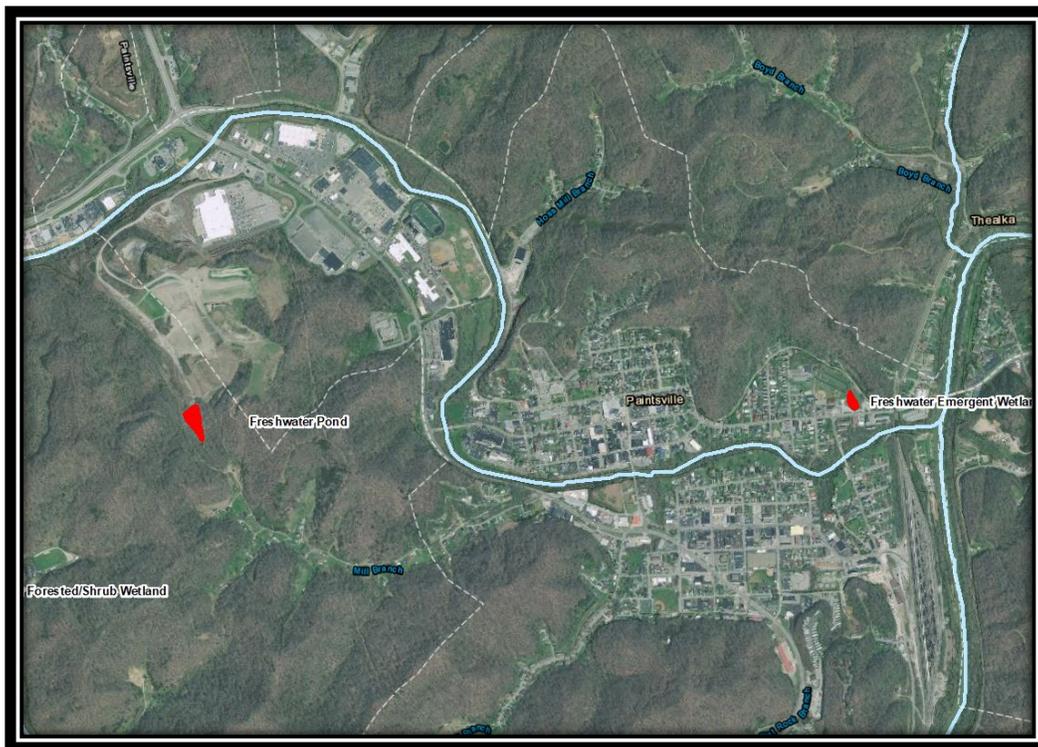


Figure 7. Emergent wetland found in study area.

3.4.5. FISH AND WILDLIFE HABITATS

3.4.5.1. Fish

Fish habitat in Johnson County includes one major stream (Levisa Fork), many small tributaries, the Paintsville Lake impoundment, and according to the NWI maps, a significant number of farm ponds. According to the NRCS Soil Survey, fish species stocked in Paintsville Lake include: largemouth bass, channel catfish, bluegill, walleye, striped bass, and rainbow trout.

Paint Creek has been highly effected by the development of the City of Paintsville. Below the dam, Kentucky Department of Fish and Wildlife Resources (KDFWR) stock Paint Creek monthly from April to November with rainbow trout. Paint Creek is the only stream designated as a trout stream within Johnson County. Other fish species found in Paint Creek include largemouth bass, smallmouth bass, channel catfish, walleye, and redbreast sunfish.

3.4.5.2. Wildlife

Johnson County provides a diverse mosaic of habitats for wildlife. Game species that are known to occur in Johnson County include: white-tailed deer, gray squirrel, cottontail rabbit, ruffed grouse, raccoon, gray and red fox, bobwhite quail, mourning dove, and Eastern turkey. Waterfowl are also common in the county during migration periods, including: mallards, teal, widgeon, Canada geese, and wood ducks.

The City of Paintsville has been significantly developed and has had an effect in the number and types of wildlife species that occur there. Generalist species that have become accustomed to urban activity can be found using riparian corridors along Paint Creek and other tributaries.

3.4.6. TERRESTRIAL VEGETATION

A large portion of Johnson County is woodland, in private ownership, and considered rural. According to the Floyd and Johnson County Soil Survey, before settlement, 20 forested tree species were present including: yellow polar, American chestnut, red oak, white oak, American beech, and yellow buckeye.

The Paintsville area can be described as an urban city with varying amounts of sparse forested riparian habitat. Paint Creek flows through the center of town with a number of connecting tributaries. Most of Paint Creek contains a mosaic of 30-50 feet wide areas of riparian habitat on each side of the river. Many areas are also maintained in turf grasses or sparse vegetation right up to the top of bank.

Riparian areas that contain mature trees are made up of approximately 15 % trees that 15-22 inches in diameter at breast height (DBH), 50 % trees 8 to 10 inches DBH, and 35 % trees less than 8 inches DBH.

Species include mixed hardwoods such as oak species (*Quercus spp.*), American sycamore (*Platanus occidentalis*), and yellow poplar (*Liriodendron tulipifera*). Mountain laurel (*Kalmia latifolia*), and Chinese privet (*Ligustrum sinense*), an invasive, exotic species is also present. Additionally, multiple areas were covered in kudzu (*Pueraria montana*).

3.5. THREATENED AND ENDANGERED SPECIES

3.5.1. FEDERAL

USACE biologists checked the USFWS Information for Planning and Consultation (IPaC) database for federally listed species and critical habitat in the study area. **Table 2** is a list of species which were listed as potential occurrence within Johnson County.

Table 2. Federally Listed Species

Species	Scientific Name	Federal Status
Mammals		
Gray bat	<i>Myotis grisescens</i>	Endangered
Indiana bat	<i>Myotis sodalist</i>	Endangered
Northern long-eared	<i>Myotis septentrionalis</i>	Threatened
Mussels		
Snuffbox Mussel	<i>Epioblasma triquetra</i>	Endangered
Crustaceans		
Big Sandy Crayfish	<i>Cambarus callainus</i>	Threatened

A survey of the Paintsville area for potential bat summer roosting habitat was completed by USACE biologists in September 2019. Various snags and trees were identified. See Volume 3 for information from that survey.

In a letter dated March 18, 2019, the USFWS stated that the big sandy crayfish, may occur in the project area in the Levisa Fork or just in the mouth of Paint Creek where there is suitable habitat. According to the USFWS, the crayfish needs “clean, medium-sized streams and rivers for its social reproductive, and energetic needs. They are usually found in faster moving sections of the water, in areas with large boulders and rocks, and little sedimentation or pollution. The stream reaches are at higher elevations in the Appalachian mountain region, in areas with steep hills and ridges that are dissected by a network of deeply cut valleys.” The section of Paint Creek in the project area is regulated by the upstream Paintsville Lake project. As discussed in Section 3.4.1 its water quality and other physical characteristics are also highly impacted by the urban environment of the City of Paintsville through which it flows. Based on USACE biologist observation, chances of the occurrence of the crayfish in that section of Paint Creek is highly unlikely due to these habitat alterations.

3.5.2. STATE

According to the KDFWR, **Table 3** shows the Commonwealth of Kentucky list of endangered, threatened, special concern species believed to be in Johnson County:

Table 3. State Listed Species.

Species	Scientific Name	State Status
Birds		
Sharp-Shinned Hawk	<i>Accipiter striatus</i>	Special Concern
Northern Shoveler	<i>Anas clypeata</i>	Endangered
Blue-Winged Teal	<i>Anas discors</i>	Threatened
Northern Harrier	<i>Circus cyaneus</i>	Threatened
Common Raven	<i>Corvus corax</i>	Threatened
American Coot	<i>Fulica Americana</i>	Endangered
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Threatened
Dark-Eyed Junco	<i>Junco hyemalis</i>	Special Concern
Osprey	<i>Pandion haliaetus</i>	Special Concern
Double-Crested Cormorant	<i>Phalacrocorax auritus</i>	Threatened
Pied-Billed Grebe	<i>Podilymbus podiceps</i>	Endangered
Red-Breasted Nuthatch	<i>Sitta Canadensis</i>	Endangered
Golden-Winged Warbler	<i>Vermivora chrysoptera</i>	Threatened

Amphibians		
Eastern Hellbender	<i>Cryptobranchus alleganiensis Alleganiensis</i>	Endangered
Mammals		
American Black Bear	<i>Ursus americanus</i>	Special Concern
Fish		
Northern Brook Lamprey	<i>Ichthyomyzon fossor</i>	Threatened
Trout-Perch	<i>Percopsis omiscomaycus</i>	Special Concern
Reptiles		
Scarlet King Snake	<i>Lampropeltis triangulum</i> <i>Elapsoides</i>	Special Concern

*As provided by Kentucky Department of Fish and Wildlife Resources (KDFWR)

3.5.3. CRITICAL HABITAT

Although Johnson County is listed as within the range of the above listed species, according to the IPaC, there is no critical habitat identified in all of Johnson County.

3.6. RECREATIONAL, SCENIC, AND AESTHIC RESOURCES

3.6.1. LOCAL RESOURCES

The City of Paintsville offers many local resources such as a community pool. There is an 18-hole golf course, a recreation center which includes a number of different sized rooms and a playground, available for rent for parties, wedding receptions, showers, etc. (Paintsville, 2019). Paint Creek is the only stream in Johnson County labeled as a trout stream by KDFWR and is likely used by locals for fishing and boating recreation.

3.6.2. REGIONAL RESOURCES

Paintsville Lake State Park covers a 242-acre area and offers activities such as boating, camping, horseshoes, pedal boating, picnicking, hiking, etc. (Kentucky State Parks, 2019). Paintsville Lake itself was opened to the public in 1984 and has 1,100 acres of surface water and is 26 miles long.

3.6.3. CULTURAL RESOURCES

A number of steps were taken in an effort to identify any cultural resources within the footprints of the potential structural and non-structural measures within the City of Paintsville, and the non-structural measures within Johnson County, Kentucky. (This became the Area of Potential Effects (APE) for the potential FRM project.) These steps included a background check of the National Register of Historic Places (NRHP), USACE Geographic Information System (GIS), Kentucky Office of State Archaeology (OSA) records, the KHC records; as well as research at the Johnson County public library, and previous cultural resource survey reports that have occurred near the vicinity of the APE. The purpose of this records search was to identify and locate any cultural resources or historic properties that could be potentially impacted by the proposed undertaking within the APE. Twenty archaeological investigations have occurred within the APE (**Table 4**).

The NRHP online database was used to collect information on historic properties within a two kilometer project radius of the APE on October 4, 2018. Four NRHP listed historic properties and two historic properties that meet the NRHP criteria could be impacted by non-structural plans in Johnson County, Kentucky (**Table 5**). Twenty NRHP listed properties could be affected by alternatives within the City of Paintsville (**Table 6**). In addition to the 20 NRHP listed properties, one property that meets the NRHP

criteria, one property that is eligible for listing in the NRHP but not listed, and another property that has been delisted from the NRHP could also be affected by these alternatives. Altogether, within the APE, 23 NRHP listed properties and four properties that either meet the NRHP criteria or are eligible for listing in the NRHP were identified during the KHC records review (**Tables 5 and 6**). However, the overall number of NRHP eligible properties may change once the cultural historic survey of the APE is completed.

An archaeological report covering the excavations at the clean water treatment and borrow area is currently in-progress and will be coordinated with the SHPO and Tribal Nations once it is complete.

Table 4. Previous Archaeological Investigations that occurred within the APE of the City of Paintsville and Johnson County (within 250 feet).

Previous Archaeological Investigations		
Year	Report Title	Author
1942	<i>The C and O Mounds at Paintsville: Sites Jo2 and Jo 9 Johnson County, Kentucky.</i>	William Webb
1977	<i>An Archaeological Survey of Three Proposed Johnson County Water Supply System Facilities, Kentucky</i>	Robinson, Ken; Christopher Turnbow, and Roger Allen
1978	<i>An Archaeological Survey and Assessment of the Proposed KY 40 Alignment, Johnson and Martin Counties, Kentucky</i>	Christopher Turnbow, Robert Allen, and Michael Collins
1984	<i>A Phase I Archaeological Assessment of the Proposed Improvements to the Paintsville Wastewater Treatment Plant, Johnson County, Kentucky.</i>	Charles Niquette
1987	<i>A Phase I Archaeological Assessment of a Proposed Borrow Pit Near Paintsville, Johnson County, Kentucky.</i>	Charles Niquette and Robert Hand
1989	<i>An Archaeological Survey of Approximately 17 miles for a Proposed Powerline from Prestonsburg to Paintsville in Floyd and Johnson Counties, Kentucky</i>	Jack Schock
1996	<i>An Archaeological Survey Report of the Proposed River View Village Housing Project in Paintsville, Johnson County, Kentucky.</i>	Kurt Fiegel
2000	<i>An Archaeological Survey of the Proposed Paintsville Lake/Cross Creek Project Along Paint Creek, Johnson County, Kentucky</i>	Michael Tuma
2001	<i>Phase I archaeological Survey of the Greasy Creek-Offutt Abandoned Mine Lands Reclamation Project, Johnson County, Kentucky.</i>	John Carter and Tom Sussenbach
2006	<i>Final Phase I Archaeological Survey Report Big Sandy Pipeline Project, Carter, Lawrence, Johnson, and Floyd Counties, Kentucky.</i>	Douglas MacDonald
2006	<i>Draft Phase I Addendum Report I Big Sandy Pipeline Project Supplemental Archaeological Survey, Carter, Lawrence, Johnson, and Floyd Counties, Kentucky.</i>	Brent Shreckengost and Matthew Hyland
2008	<i>A Cultural Resources Survey for the Proposed Paintsville Lake Water Storage Tank and Transmission Main, Johnson County, Kentucky.</i>	Matthew McMahan
2008	<i>Phase I Archaeological Survey of the Proposed Paintsville Cellular Tower Site, Johnson County, Kentucky.</i>	Jared Barrett
2009	<i>A Cultural Historic Resource Evaluation for the Proposed Construction of a Cellular Communications Tower at the Mayo Hill Site in Johnson County, Kentucky</i>	Preservation Services and Technology Group, LLC
2009	<i>An Archaeological Survey of Approximately 4,600 feet of Force Main in Johnson County, Kentucky.</i>	Jack Schock
2009	<i>Abbreviated Phase I Archaeology Report for the Wittensville Cellular Tower in Stambaugh, Johnson County, Kentucky</i>	Jason Goldbach
2010	<i>An Archaeological Survey of 48 Locations for Water Lines in Johnson County, Kentucky</i>	Jack Schock
2011	<i>An Archaeological Survey of 11,500 Feet of Sewer Lines for Powell Addition in Johnson County, Kentucky</i>	Jack Schock

2013	<i>An Abbreviated Format “No Finds” Report Detailing Phase I Archaeological Survey of Five Trailheads Parking Facilities in Support of the Dawkins Line Rails to Trail Projects, Johnson and Magoffin Counties, Kentucky. Report Registration No. FY13-7521</i>	James Pritchard
2017	<i>Cultural Historic Overview Survey of the Proposed Thelma-Redbush 69 KV Transmission Line Relocation Project, Johnson County, Kentucky.</i>	Elizabeth Heavrin

Table 5. Historic structures within the 100 year floodplain/floodway eligible for voluntary buyout in Johnson County, Kentucky.

Historic Structures within the 1% AEP In Johnson County			
Resource Number	Historic Name	Site Type	NRHP Status
JO 74	Oil Springs High School Gymnasium	Historic	Listed
JO 77	Oil Springs Methodist Church	Historic	Listed
JO 90	Consolidation Coal Co. Office	Historic	Meets NRHP criteria
JO 43	Mine #5 Store	Historic	Listed
JO 34	Woods Joseph House	Historic	Meets NRHP criteria
JO 32	Meade Memorial Gymnasium	Historic	Listed

Table 6. Historic Structures within the footprint of Paintsville alternatives.

Historic Structures within Alternative #2			
Resource Number	Historic Name	Site Type	NRHP Status
JOP 40	Patterson House - early 20 th century	Historic	Listed
JOP 28	Tom Mayo House - 19 th century	Historic	Meets NRHP criteria
JOP 39	Tom Mayo House - 19 th century	Historic	Listed
JOP 1	John C Mayo Mansion & Office - 20 th century	Historic	Listed
JOP 38	First Baptist Church - 20 th century	Historic	Listed
JOP 4	Mayo Methodist Church - 20 th century	Historic	Listed
JOP 5	Judge Jim Turner House - 20 th century	Historic	Listed
JOP 100	Commercial BLDG-	Historic	Eligible-not listed
JOP 10	First Methodist Church - 20 th century	Historic	Listed
JOP 12	Foster Hardware - 20 th century	Historic	Listed
JOP 31	Paintsville High School - 20 th century	Historic	Listed
JOP 33	Paintsville Public Library - 20 th century	Historic	Listed
JOP 13	H.B. Rice Insurance BLDG/ H.M. Stafford Grocery - 20 th century	Historic	Listed
JOP 7	1 st National Bank BLDG (Paintsville National Bank) - 20 th century	Historic	Listed
JOP 21	Webb House - 20 th century	Historic	Listed
JOP 20	Webb House - 19 th century	Historic	Listed
JOP 22	Wiley House - 20 th century	Historic	Listed
JOP 23	Archer House - 20 th century	Historic	Listed
JOP 9	U.S. Post Office Paintsville	Historic	Listed
JOP 18	Paintsville City Hall - 20 th century	Historic	Listed
JOP 3	Thomas Akers House	Historic	Removed from listing
JOP 6	Stafford House - 19 th century	Historic	Listed

JO 1	Daniel Davis House - 19 th century	Historic	Listed
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Currently, USACE is working closely with the SHPO to develop a Programmatic Agreement (PA) outlining both a phased approach to the project and the mitigation stipulations to resolve adverse effects to historic properties. USACE is waiting for Rights of Entry (ROE) from the local landowners before a subsurface archaeological and cultural historic survey can be completed in the City of Paintsville.

3.7. AIR QUALITY

According to the Environmental Protection Agency, Johnson County is in attainment for all criteria air pollutants. There are no known air quality problems in the area.

3.8. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

The initial environmental database records to perform Phase I Environmental Site Assessments for the Project alternatives were obtained from Environmental Database Resources (EDR®). A corridor search was conducted one mile upstream/downstream of the intersection of Paint Creek with the Levisa Fork, in Paintsville, Kentucky, and then upstream along Paint Creek to the location the Project Lead Engineer had determined the proposed project alignment may be required. The corridor search also encompassed a one-mile distance on each side of the corridor to assure any potential areas of concern would be provided in the EDR® report.

Environmental professionals then compiled the database records in a spreadsheet and performed a HTRW risk-ranking of the results. This effort determined 23 Low, 57 Medium and 45 High risk-ranked sites within the corridor search which could affect the Project alternatives. This information was then compiled on site plans, with the property tax map for Paintsville superimposed, to determine properties which could be affected by the project alternatives. The information was provided to the Project Lead Engineer for design team decisions. Once Project Alternatives 2 and 3 were determined, environmental professionals conducted site reconnaissance of both alternatives on March 19, 2019 to identify potential recognized environmental conditions (REC) associated with the medium and high risk-ranked sites which could impact whether or not an alternative would move forward.

Twenty-one (21) properties were identified as having RECs within, on or outside but near the construction work limits (CWL) for Alternatives 2 and 3, Interior Floodwalls, which could affect the alternatives. Two (2) properties were identified as having RECs within the CWL for Alternative 2 Short Walls which could affect the project alternative. Three (3) properties were identified as having RECs within the CWL for Alternative 3 Short Walls which could affect the project alternative.

3.9. SOCIOECONOMIC AND ENVIRONMENTAL JUSTICES

3.9.1. EXECUTIVE ORDER (EO) 12898 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. The order focuses Federal attention on the relationship between the environment and human health conditions of minority communities and calls on agencies to make achieving environmental justice part of their mission. The order requires the U.S. Environmental Protection Agency (USEPA) and all Federal and state agencies receiving Federal funds to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. It also requires the agencies to develop strategies to address this problem.

3.9.2. MINORITY POPULATION

As defined in Executive Order 12898 and the CEQ guidance, a minority population occurs where one or both of the following conditions are met within a given geographic area:

- The American Indian, Alaskan Native, Asian, Pacific Islander, Black, or Hispanic population of the affected area exceeds 50 %.
- The minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

A minority population also exists if more than one minority group is present and the aggregate minority percentage meets one of the above conditions. The selection of the appropriate unit of geographic analysis could be a governing body’s jurisdiction, a neighborhood, census tract, or other similar unit. Note that the Hispanic population is a multi-racial group which may overlap with other minority groups. A summary of the population demographics is shown in **Table 7**. Based on the demographics in the study area and Executive Order 12898 guidance, a minority population does not exist in the study area.

Table 7. Summary of population demographics.

Demographic Summary			
Population	Johnson County (%)	Kentucky(%)	United States(%)
White	97.9	87.8	76.6
Black or African American	0.4	8.4	13.4
American Indian or Alaska Native	0.2	0.3	1.3
Asian	0.4	1.6	5.8
Pacific Islander	0.1	0.1	0.2
Hispanic or Latino	1.0	3.7	18.1
* Data source: United States Census Bureau, QuickFacts, Group populations may not add exactly to 100 % due to rounding and other groups not included.			

3.9.3. LOW-INCOME POPULATION

EO 12898 does not provide criteria to determine if an affected area consists of a low-income population. For the purpose of this assessment, the CEQ criteria for defining a minority population has been adapted to identify whether or not the population in an affected area constitutes a low-income population. An affected geographic area is considered a low-income population (i.e., below the poverty level, for purposes of this analysis) where one or both of the following conditions are met within a given geographic area:

- The percentage of low-income persons is at least 50 % of the total population.
- The percentage of low-income persons is meaningfully greater than the low-income population percentage in the general population or other appropriate unit of geographic analysis.

Based on the 2013-2017 United States Census Bureau data, about 23.3 % of households in Johnson County, Kentucky can be considered to be in poverty status, compared to 17.2 % in Kentucky. The study area does not meet either criterion as the percentages of low-income persons are substantially less than 50 % and are not meaningfully greater than in the State of Kentucky as a whole.

In summary, the study area does not constitute an environmental justice community based on the minority, or low-income populations.

3.9.4. EO 13045 PROTECTION OF CHILDREN

On April 23, 1997, President Clinton issued E.O. 13045, Protection of Children from Environmental Health Risks and Safety Risks. The order focuses Federal attention on the relationship between the environment and human health conditions that may disproportionately affect children and ensures all policies, programs, activities, and standards address risks to this vulnerable segment of the population. The age distribution is summarized in **Table 8**.

Table 8. Age Distribution Summary.

Age Distribution Summary			
Population	% of Johnson County Population	% of Kentucky Population	United States
Persons under 5 years	5.7	6.2	6.1
Persons under 18 years	22.0	22.7	22.6
Persons between 18 and 64 years	54.4	55.1	55.7
Persons 65 years and over	17.9	16.0	15.6
* United States Census Bureau, QuickFacts.			

4. PLAN FORMULATION

This section presents the measures and alternatives developed by USACE to address flood risks and associated damages within the City of Paintsville and Johnson County, Kentucky. The formulation process was conducted in two phases. The first phase evaluated a preliminary but broad array of alternatives with the purpose of identifying a focused array of alternatives to be given detailed evaluations. The second phase of formulation would optimize and evaluate the alternatives in the focused array to aid in comparison of the alternatives and ultimate selection of a Recommended Plan. Phase 1 produced a preliminary array of three alternatives with structural and non-structural measures for the City of Paintsville, and one non-structural alternative for Johnson County, Kentucky, in areas outside of the flood prone locations in the City of Paintsville. The focused array contained only two of the alternatives within City of Paintsville along with the non-structural plan for surrounding Johnson County. In Phase 2 a comparison of these alternatives using the project planning objectives and four PGN evaluation criteria resulted in the identification of a Recommended Plan for the project that is within the budget and scope requirement for the Section 202 study authority.

4.1. FLOOD RISK REDUCTION AREA

The flood risk reduction for this project was guided by a variety of statutes, policies, regulations, plans, and memorandum for the Section 202 program. Relevant authority, decisions and guidance for this project are summarized below:

- Under Section 202, the Secretary of the Army was directed to provide flood damage reduction "...to a level of protection against flooding at least sufficient to prevent any future losses from the likelihood of flooding as occurred in April 1977."
- Section 105 of EWDA 1997 states that "...non-structural flood control measures implemented under Section 202...shall prevent future losses that would occur from a flood equal in magnitude to the April 1977 level by providing protection from the April 1977 level or the 100-year frequency event whichever is greater."
- Fiscal Year 1982 Supplemental Appropriations Act (PL 97-257) directed that "high levees and floodwalls" in urban areas provide for "standard project flood level" (SPF) of risk reduction "where the consequences from overtopping caused by large floods would be catastrophic." (SPF – the discharge expected to result from the most severe combination of meteorological and hydrologic conditions which are reasonably characteristic of the geographic region involved, excluding extremely rare combinations.)

The January 16, 2019 Memorandum thru CELRD, included in Volume 7, states that if the overtopping evaluation determined that the consequences of overtopping for a levee and/or floodwall project designed to the 1977 flood elevation in the City of Paintsville were not catastrophic, then the conditional language within the 1982 Supplemental Appropriations Act was not triggered and the USACE was under no legal obligation to consider SPF level of risk reduction. However, the agency would still be allowed to explore project options that would exceed the elevations of the 1977 flood event as the appropriate level of risk reduction, if justified by detailed analyses comparing and documenting hazards at various risk reduction levels. Conversely, if the USACE overtopping evaluation determined that the incremental consequences of a levee and/or floodwall project designed to the 1977 flood elevation would be catastrophic (triggering the conditional language in the 1982 Supplemental Appropriations Act), the USACE could still deviate from the SPF level of risk reduction so long as the determination was justified with adequate documentation containing a detailed analysis that compares hazards at various risk reduction levels. An overtopping analysis was performed for the proposed structural measures and concluded that SPF levels of risk reduction were not appropriate for the City of Paintsville. A specific overtopping analysis to meet this requirement was initially completed to ensure compliance and is included in Volume 7 of this report.

- Section 4 Planning Objectives Part B of the Levisa Fork Basin General Plan Supplement Main Report states that "...in those areas where the 100-year frequency (*sic: 1% AEP*) elevation exceeded the elevation of the April 1977 flood, the 100-year frequency event was used as a target level of protection. Adoption of this criteria ensured that any plan developed for purposes of flood damage reduction would be commensurate with the objectives of the NFIP." In addition Table 5-1 of the Levisa Fork Basin General Plan Supplement identifies Johnson County and the City of Paintsville specifically to receive 100-year minimum level of risk reduction.

Vertical Team (VT) coordination was necessary to determine the 1% AEP for the project. The vertical team consisted of members from the Louisville District (LRL), Huntington District, Ohio River and Great Lakes Division, and HQUSACE. The team utilized previous reports and studies that calculated the 1%

AEP flows and elevations, then presented the vertical team's 1% AEP flow. This flow of 55,000 cfs represented the upper values for the 90% confidence limit based on the Louisville District's Bulletin 17B Analysis. The flow of about 54,500 cfs corresponds to an elevation of 612.8 ft NAVD88, at the mouth of Paint Creek and Levisa Fork, obtained from the Huntington District's HEC-RAS model. The risk and uncertainty increment of 3.6 feet was calculated using HEC-FDA. Based on this analysis the elevation for the 1% AEP on Levisa Fork at Paintsville including risk and uncertainty is 616.4 ft. NAVD88. This is discussed in detail in the Volume 2 Engineering Appendix Tab 1 H&H analysis.

The PDT estimated that a project formulated and designed to a 1% AEP flood event (612.8 ft NAVD88) would result in benefits and a reduction to flood risks to approximately 508 structures in the Paintsville City limits. With risk and uncertainty, the level of flood risk management increases by 3.6' (616.4 ft NAVD88) and the number of structures in the City of Paintsville receiving flood risk management benefits increases to 785 structures.

The SPF level of flood risk reduction was established based upon data developed in the Haysi Dam Study dated April 1997 and was jointly agreed to be correct by the USACE VT as being 618.1 ft NAVD88. A height beyond this elevation would require additional road and railroad closures that would limit egress for the City of Paintsville and could induce consequences that could be catastrophic due to the potential life loss associated with the inability to evacuate. Communication with the non-Federal sponsor and City officials also indicated a project constructed to the SPF elevation would not be acceptable to the community due to the floodwall height and length required. The overtopping analysis, in volume 7, shows that SPF-level of flood risk reduction is not required for this project.

As discussed in Section 2.2, the City of Paintsville primarily experiences backwater flooding from the Levisa Fork; but headwater flooding by way of Paint Creek, its tributaries, and the surrounding hillsides, compounds this flood risk. This complex and dynamic hydrologic condition required additional evaluations to determine the flood risks associated with this interior ponding within the City of Paintsville.

According to the hydrologic modeling for this project, a floodwall constructed along Levisa Fork with an associated closure structure across Paint Creek would reduce the effective 1% AEP for the City of Paintsville from 612.7 ft to 585 ft NAVD88 (the gate's closure stage) when considering only flooding from Levisa Fork. However, USACE analysis showed that with a barrier in place across Paint Creek to prevent backwater flooding from Levisa Fork, interior flows would produce an interior stage that would require mitigation via pumping, storage of water, or a combination of both. Therefore, the PDT determined that additional flood risk reduction measures would need to be considered to address interior ponding within the City.

Structural and non-structural measures were identified and combined into alternatives to address the above conditions, meet the planning objectives, avoid constraints, and take advantage of opportunities. Given the above analyses and coordination with the USACE VT and non-Federal sponsor, the level of flood risk management for the City of Paintsville from the Levis Fork was established as the 1% AEP with risk and uncertainty (616.4 ft. NAVD88). The level of flood risk management for Johnson County, KY, outside of the Paintsville City limits, is also determined to be 1% AEP.

4.2. MEASURES TO ACHIEVE PLANNING OBJECTIVES

A management "measure" is a feature or activity at a site which addresses one or more of the planning objectives. A wide variety of management measures were considered for this project, some of which were found to be infeasible due to technical, economic, or environmental constraints. Each measure was assessed and a determination made regarding whether it should be retained in the formulation of alternative plans using on-site field visits, previous Section 202 and FRM projects in the region, limited data gathering and development, and professional expertise and judgment.

Initial structural and non-structural measures were developed by the PDT on October 9-11, 2018 in Paintsville, Kentucky with the non-Federal sponsor, local emergency response agencies, and City officials. The results of this formulation are presented below.

4.2.1. STRUCTURAL MEASURES

As previously mentioned, the project area is typical of other areas located along the Levisa Fork and the Cumberland Plateau, characterized by rugged topography, narrow floodplains, low-density development scattered throughout the floodplain with commercial and residential centers located along the US 23 corridor and other highways (see **Figures 2 and 3** in Section 1). This development pattern, in combination with the very limited availability of suitable redevelopment sites for relocated properties, limits the number of cost effective structural measures that can be formulated to provide flood risk reduction for the entire study area.

The City of Paintsville is the county seat for Johnson County and is recognized as an economic and social center for eastern Kentucky. Downtown Paintsville has a concentration of public services, governmental offices and a commercial core that supports a regional service area. Approximately 635 structures, or 41 % of the City's total structural inventory, are currently located in FEMA's 1% AEP floodplain. The project formulation includes flood risk reduction to all of the structures in FEMA's designated 1% AEP floodplain based on the revised 1% AEP and risk and uncertainty totaling 785 structures or 50% of the City's total structural inventory.

The PDT developed an array of structural measures that would reduce damages by a future flood equal in magnitude to the 1% AEP (plus risk and uncertainty) flood event, in this case elevation 616.4 ft NAVD88. They are described below:

- a. Floodwalls and levees - Floodwalls and levees provide the structural alignment for flood risk reduction as defined in Engineering Manual (EM) 1110-2-1413, to a group of homes and businesses. The objective of this alignment is to reduce the hazard to, and therefore lessen the risk of, direct flooding of an interior area due to elevated water levels on the river side of the levee and floodwall alignments. Floodwalls are advantageous because they require relatively narrow right-of-ways for construction, and they could be used where properties are closer in proximity to the source of flooding. Levees are typically less expensive but require increasingly more right-of-way as they get taller. Floodwalls and levees are particularly effective in reducing flood damages to major community centers where maintaining the social and economic function of the community is vital.

Floodwalls and levees would create a clear alignment for flood risk reduction for the City of Paintsville from backwater flooding along the Levisa Fork and reduce flood risks for the community. A constraint for the floodwalls and levees is that the impacts to environmental resources and on community cohesion can be significant depending on their design and alignment.

- b. Pump stations - Pump stations are facilities with pumps and equipment used to transport water from interior areas behind a structural alignment for flood risk reduction to the exterior areas. Pump stations are typically used to maintain or lower the water level of a drainage area. They can vary in size depending on the capacity of the pumps and the available interior storage behind the project alignment.

Pump stations on the Paint Creek and/or Levisa Fork can help maintain water levels behind a project floodwall system and reduce interior ponding for the City of Paintsville, depending on its capacity.

A primary constraint of this measure, as mentioned in Section 2.7, is the ability of the non-Federal sponsor to complete required OMRR&R of the facility once the project is completed.

- c. Closure structures - Closure structures are temporary structures used to complete the project alignment during periods of flooding. During periods of non-flooding, the closures are removed to provide access through the project alignment. Closures are associated with roads, railroad tracks, and other locations of egress. Types of closures depend largely on the size of the opening needed and their purpose. In the City of Paintsville, closure structures would be used where the project alignment crosses roads or access points at higher elevations.
- d. Gravity outlet - Gravity outlets are culverts, conduits, and other openings that permit gravity discharge of interior waters through the project alignment. In most cases these outlets include some form of backflow prevention in the event of a flood event higher than the outlet elevation. A large gravity outlet with a moveable gate could be used to prevent backwater flooding from Levisa Fork, while still allowing normal stream flow along Paint Creek. A constraint to this measure is its potential impact to aquatic resources.
- e. Interior floodwalls and levees - Interior floodwalls and levees along interior streams (i.e. Paint Creek) may be implemented as local complements to the primary flood risk reduction system features. These barriers to stream channel overflow are commonly lower in height than the main project alignment and separate the interior floodplain from the exterior channel (i.e., Levisa Fork). Consequently, capacity exceedance or failure is less likely to cause catastrophic loss of life or damage to property. An analysis of the effectiveness, including the residual risk associated with these features, must be completed as a component of planning and design studies.

Interior floodwalls and levees can increase the storage of interior drainage and lower the required capacity of any pump station. As mentioned before, a constraint for the floodwalls and levees is that the impacts to environmental resources and community cohesion can be significant depending on their design and alignment.

- f. Detention areas and basins - Detention may be provided by natural or excavated sumps, vacant lots or areas, streets, and parks. In some cases they can be a large standalone FRM measure, while in others they can be used in conjunction with a gravity outlet or pumping station. They may be adjacent to these facilities, or remotely connected by appropriately sized channels. Topography, geology, existing conveyance patterns, and land use govern choice of their locations. Detention basins may be dry, storing water only during floods, or wet, with a permanent pool.

Detention basin are effective at increasing storage and reducing flood risks in connection with interior floodwalls and levees, since they may be incorporated with lower consequences.

- g. Interceptor sewers and pressurized pipes – Intercepting pipes (sewers) or channels are measures that connect two or more existing pipes or channels and convey flows from behind the project alignment to gravity outlets, pumping stations, or pressure conduits for exterior discharge. Interceptor systems must be planned and designed to reduce the cost of gravity outlets, pumping stations, and/or pressure conduits that force interior flooding from the project area into the stream without adversely affecting the flood risk reduction provided by the interior drainage system.

This measure can be effective in addressing the headwater flooding and interior ponding issues behind interior floodwalls and levees.

- h. Stream channel modifications – Stream channel modifications involve widening, deepening and/or straightening a stream to increase its hydraulic carrying capacity. Widening, deepening, and other channel modifications are generally most effective on small to medium sized streams and where adjacent developments are located an adequate distance from the banks to avoid mandatory structure acquisitions due to construction. Straightening occasional meanders to increase channel hydraulic capacities and velocities can sometimes provide significant reductions in flood heights in areas subject to headwater flooding.

Within the City of Paintsville, most of the flat floodplain along Paint Creek and the Levisa Fork is currently occupied by rail, highway, residential and community facilities. Some portions of the Paintsville Business District would need to be modified in order to accommodate an adequately-sized channel. Other constraints associated with this measure include the disposal of dredge material, high maintenance costs, and impacts to the riparian and aquatic ecosystems.

- i. Diversion channels – Diversion channels are man-made structures built to offer an alternative route for excess water to flow, mitigating the effects of flooding and restoring rivers to their natural water level. Typically, diversion channels are built around communities or economic centers to reduce flood damages and risks. Control structures may be located at the head of the diversion channel to divert flows during periods of high water and return flows during low water. Some diversion channels bypass the flood flows into an adjacent waterway, while others return the flows back into the same stream a distance downstream from the point of the diversion. A downstream diversion channel along the Levisa Fork consisting of a large tunnel through the hills between Thealka and Thelma, Kentucky, was briefly considered. An upstream diversion channel along the Levisa Fork consisting of a large cut-through channel, generally in the path of Kentucky State Highway 1107 through West Van Lear, Kentucky, was also considered.

Diversion channels generally require a large construction footprint and a significant taking of real estate. They also could cause adverse environmental impacts to threatened and endangered species within the study/project area (see Section 4.6), and be expensive to operate and maintain.

- j. Changes to the operation of existing upstream flood control dams – This measure would require a change in the operation of one or more flood control dams upstream from the project, specifically the John W. Flannagan Dam and Reservoir, Fishtrap Lake, Dewey Lake, and Paintsville Lake projects. Changes of operation to these projects to reduce the stream flows through Johnson County would require modifications to the operation manual of each impacted flood control project. Under current law such changes to these project operations manuals would require a separate feasibility level study with public participation for each project. If the proposed changes would affect the authorized lake levels at one or more of these existing projects, additional Congressional authority might be required. The actual efficacy of changes at these existing projects to the flooding at Paintsville would be difficult to be determine without considerable additional H&H analysis.
- k. Dam structure – Dam structures are permanent barriers constructed across rivers and streams to hold back and contain water in a lake or reservoir. Specifically this measure would involve a large dam structure built upstream of Paintsville to retain and control stream flows along the Levisa Fork. It would require a large construction footprint and a significant taking of real estate within the inundation limits. A project of this magnitude could exceed the implementation authority granted under Section 202 and would require preparation of a full Environmental Impact Statement (EIS).

4.2.1.1. Screening of Structural Measures PGN Criteria, Constructability, and Environmental Impacts

The structural measures array were then evaluated against the criteria provided in the PGN and in Section 2.1 of this report. Since the formulation of these measures were preliminary at the time, the array of structural measures were compared and examined for only two of four PGN criteria: effectiveness and acceptability.

Two relevant, but non-PGN, criteria were used to facilitate the analysis of the structural measures array: constructability and environmental impacts. Constructability is a project management technique that identifies the obstacles and degree of risk within the construction process for each measure during the pre-construction phase to reduce or prevent errors, delays, and cost overruns. The analysis of environmental impacts examined anticipated effects to natural and cultural resources and HTRW, required level of resource agency coordination, and anticipated mitigation from implementation of each measure. These two criteria were given low/medium/high designations based on potential scope requirements for the project, previous regional FRM projects (Section 1.7) and professional judgment. A summary of this evaluation is presented in **Table 9**.

Table 9. Screening of formulated structural measures to project planning objectives.

Screening of Structural Measures Against Planning Objectives				
	Effectiveness	Acceptability	Constructability	Acceptability
Floodwalls and Levees	Meets criteria	Meets criteria	Medium	Medium
Pump Stations	Meets criteria	Meets criteria	Medium	Medium
Closure Structures	Meets Criteria in partnership with another measure	Meets criteria	Low	Low
Gravity Outlets	Meets Criteria in partnership with another measure	Meets criteria	Medium	Medium
Interior Floodwalls and Levees	Meets Criteria in partnership with another measure	Meets criteria	Medium	Medium
Detention Basins	Meets Criteria in partnership with another measure	Meets criteria	Medium	Medium
Interceptor Sewers and Pipes	Meets Criteria in partnership with another measure	Meets criteria	Low	Low
Stream Channel Modifications	Meets Criteria in partnership with another measure	Meets criteria	Medium	Medium
Diversion Channels	Meets Criteria in partnership with another measure	Meets criteria	High	High

Operational Changes	Meets Criteria in partnership with another measure	Meets criteria	High	High
Dam Structure	Meets Criteria in partnership with another measure	Meets criteria	High	High

Effectiveness: The PDT determined that all of the proposed individual structural measures would provide at least some level of reduction in economic losses and potential life risks for the City of Paintsville, as well as opportunities to improve local housing quality and commercial development. Floodwalls, levees, and pump stations were considered to be the most reliable engineering solutions at addressing the backwater flood conditions, while interior floodwalls and levees, detention basins, interceptor sewers and pipes, and stream channel modifications would be the most reliable at addressing headwater flooding and any interior ponding. Several measures – closure structures, gravity outlets, interior floodwalls and levees, detention basins, interceptor sewers and pipes, stream channel modifications, diversion channels, operational changes, and dam structures – would need to be implemented in partnership with another measure to be fully successful.

Acceptability: The PDT determined that while changes to the operation of existing upstream flood control dams or construction of a new dam could not be implemented under the authority of Section 202, and related laws, they and all of the remaining proposed structural measures could be implemented in compliance with other applicable laws such as NEPA, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and the National Historic Preservation Act of 1966 (NHPA), USACE regulations, policies and technical guidance, and public policy.

Constructability: The PDT determined that three of the structural measures – diversion channels, operational changes, and dam structure on the Levisa Fork - have a high level of risk for errors, delays, and cost overruns in terms of their construction. Six other measures – floodwalls and levees, pump stations, gravity outlets, interior floodwalls and levees, detention basins, and stream channel modifications - have a medium level of risk for errors, delays, and cost overruns in terms of their construction. Only closure structures and interceptor sewers and pipes were determined to have a low level of risk for errors, delays, and cost overruns in terms of their construction.

Environmental Impacts: The PDT determined that three of the structural measures – diversion channels, operational changes, and dam structure on the Levisa Fork – would have a high level of environmental impacts, requiring extensive coordination with resource agencies and the public. Diversion channels or a new dam on Levisa Fork would most likely have significant mitigation requirements. Six other measures – floodwalls and levees, pump stations, gravity outlets, interior floodwalls and levees, detention basins, and stream channel modifications - have a medium level of environmental impact requiring coordination with resource agencies and the public, and an acceptable level of mitigation. Only closure structures, interceptor sewers, and pipes were determined to have a low level of environmental impacts requiring an acceptable level of coordination with resource agencies and the public, and little to no mitigation.

4.2.1.1.1 Planning Objectives

The structural measures array was first evaluated by the PDT against the Project Planning Objectives listed in Section 2.4. This evaluation was made using knowledge on potential scope requirements for the project, previous Section 202 and FRM projects (see Section 1.7) and professional expertise and judgment. The structural measures considered are evaluated in **Table 10**.

Planning Objective 1: Provide flood risk reduction measures that comply with Section 202, and related laws, and USACE policies and technical guidance.

Two measures, operational changes to existing upstream flood control dams, and a new dam structure along Levisa Fork, were of such potential scope and scale they would be beyond the programmatic limits allowed under Section 202 and would require additional individual implementation authority from Congress. The remaining structural measures could be implemented under the umbrella of the Section 202 authority. However, when compared to the rest of the remaining structural measures, diversion channels would likely require an additional level of documentation such as an EIS with a Record of Decision (ROD) in order reach compliance with NEPA and USACE policy.

Planning Objective 2: Reduce, to the extent possible, financial and/or personal losses due to flooding.

The PDT determined that all of the proposed structural measures would to some extent provide a reduction in economic losses and life risks for the City of Paintsville. Floodwalls, levees, and pump stations were considered to be the most reliable engineering solutions at addressing the backwater flood conditions, while interior floodwalls and levees, detention basins, interceptor sewers and pipes, and stream channel modifications would be the most reliable at addressing headwater flooding and any interior ponding in Paintsville. Several measures – closure structures, gravity outlets, interior floodwalls and levees, detention basins, interceptor sewers and pipes, stream channel modifications, diversion channels, operational changes, and dam structures – would need to be implemented in partnership with another measure to be successful at reducing the level of flood risks to the 1% AEP level.

Planning Objective 3: Maintains, to the extent possible, the social, cultural and economic cohesion of the communities within Paintsville and Johnson County.

The PDT determined that three of the structural measures considered – diversion channels, operational changes, and a dam structure - did not meet this objective due to their potential cultural, social and economic impact to the Paintsville community and the study area.

Six measures – floodwalls and levees, pump stations, closure structures, interior floodwall and levees, detention basins, stream channel modifications – can meet this objective depending on their scope, location and cost. The remainder – gravity outlets and interceptor sewers and pipes – would maintain the City of Paintsville’s overall social, economic and cultural cohesion.

Considerable discussion centered on stream channel modification. Given the dynamic hydrologic conditions within Paintsville, the PDT determined that additional storage along Paint Creek in the form of a widened channel would require significant changes to the roads, bridges, commercial buildings and homes in the downtown Paintsville area. Both the non-Federal sponsor and the City of Paintsville expressed their desire to maintain this area of the community and encouraged the use of other measures to achieve a reduction in flood risks for the City.

Table 10. Screening of formulated structural measures to PGN evaluation criteria, constructability, and environmental impacts.

Structural Alternatives Measures compared to Planning Objectives			
	Objective #1	Objective #2	Objective #3
Floodwalls and Levees	Meets objective.	Meets objective.	Meets objective with additional effort.
Pump Stations	Meets objective.	Meets objective.	Meets objective with additional effort.
Closure Structures	Meets objective.	Meets objective with additional effort.	Meets objective with additional effort.
Gravity Outlets	Meets objective.	Meets objective with additional effort.	Meets objective.
Interior Floodwalls and Levees	Meets objective.	Meets objective with additional effort.	Meets objective with additional effort.
Detention Basins	Meets objective.	Meets objective with additional effort.	Meets objective with additional effort.
Interceptor Sewers and Pipes	Meets objective.	Meets objective with additional effort.	Meets objective.
Stream Channel Modifications	Meets objective.	Meets objective with additional effort.	Meets objective with additional effort.
Diversion Channels*	Meets objective with additional effort.	Meets objective with additional effort.	Does not meet objective.
Operational Changes*	Meets objective with additional effort.	Meets objective with additional effort.	Does not meet objective.
Dam Structure*	Meets objective with additional effort.	Meets objective with additional effort.	Does not meet objective.
<p>Objective 1: Provides flood risk reduction measures that comply with Section 202 and other applicable laws.</p> <p>Objective 2: Reduces, to the extent possible, financial and personal losses due to flooding.</p> <p>Objective 3: Maintains, to the extent possible, the area’s social, economic and cultural cohesion for the City of Paintsville and Johnson County.</p> <p>*Measure Screened</p>			

4.2.1.1.2 Selected Structural Measures

The PDT analysis concluded that seven structural measures should be used for development of project alternatives. They included:

- floodwalls and levees
- pump stations
- closure structures
- gravity outlets

- interior floodwalls and levees
- detention basins
- interceptor sewers and pipes

The remainder – stream channel modification, diversion channels, operational changes to existing dams, and a new dam structure on Levisa Fork– were screened and therefore not retained for further evaluation.

4.2.2. NON-STRUCTURAL MEASURES

Those portions of the project that are not behind the proposed alignment of a structural measure or alternative would be eligible for a voluntary non-structural county-wide program. The scattered, low-density flood-prone development that is prevalent in Johnson County, Kentucky, calls for solutions beyond the traditional structural approach of diverting floodwaters from the floodplain. Non-structural measures have proven to be a cost-effective approach in reducing flood damages in such situations.

Per P.L. 104-206 “...non-structural flood control measures implemented under Section 202...shall prevent future losses that would occur from a flood equal in magnitude to the April 1977 level by providing protection from the April 1977 level or the 100-year frequency flood event whichever is greater.”

Based on previous hydrologic modeling data, the impact of the 1977 flood event was greater in Johnson County, than it was in the City of Paintsville itself. A reoccurrence of the 1977 flood event was estimated to impact approximately 125 structures in Johnson County outside the proposed leveed area in Paintsville on creeks and streams that were modeled as part of this study. All creeks and streams were not modeled in the interest of time but rather conclusions were based upon risk informed decisions.

The non-structural measures developed and evaluated for this project include flood proofing, elevation, permanent floodplain and floodway evacuation, and implementation of a flood warning system and emergency evacuation plan (FWEEP). Based on Huntington District non-structural projects, participation rates for the Section 202 program are typically high (approximately 80 %) for residential structures but low (less than 5 %) for business structures.

1. *Flood proofing*: This measure consists of altering individual structures or their sites so that flood waters either do not enter a structure (dry flood proofing) or are allowed to enter and exit the structure (wet flood proofing) without producing significant damages. Specific measures evaluated for this project include raising-in-place, sealing exterior surfaces, and installing bulkheads in doorways or gate valves in drains. They are described below:
2. *Wet Flood proofing by Raising-In-Place*: Determination of this measure is dependent upon the construction of the structure, its size and functional use. Access for the physically challenged (e.g., ramps), if required, would be provided for any nonresidential structure found to be eligible. The flood proofing of commercial structures is primarily applicable in those instances where residential type structures are used for commercial purposes or sufficient ceiling clearance exists in the structure to construct a raised floor which would not restrict business activities.
3. *Dry Flood proofing by Veneer Wall*: This measure is typically costly and only proves cost effective for very high value structures. Evaluating the feasibility of using a veneer wall for an individual structure requires extensive engineering analysis. For this reason, the USACE evaluates individual structure feasibility during project implementation when owners elect to participate in the voluntary program. Flood proofing may not be eligible for some structures within the project due to their location in the regulatory floodplain, their type of construction, or prohibitively high floodwater velocities. Other factors specific to the individual structure may include:

- Depth of flooding experienced
- A residential structure meeting the DSS threshold
- Its structural stability
- The functional use of the structure

Structures eligible for flood proofing would be evaluated during the implementation phase of the project to determine their structural integrity. If the structure could not be raised and remain in a structurally sound condition, or if eliminating structural deficiencies increases the total cost to greater than 100 % of the total acquisition cost, the structure would become eligible for acquisition only.

All flood proofed structures must have a potable water system. If an approved potable water source could not be provided on site, the structure would be considered ineligible for flood proofing and the structure owner would be offered an acquisition option. All flood proofed structures would also be connected to a State/County/Public Service Authority (PSA) approved sewage disposal system. If an acceptable system could not be provided on the lot or an alternative treatment system could not be provided, the structure owner would be offered an acquisition option. Preliminary analysis of flood proofing eligibility is discussed in Volume 6.

4. *Elevation:* This measure would raise residential and other structures (where practicable) to reduce damages from flood events. This measure could also be considered in combination with a structural solution.
5. *Permanent Floodplain Evacuation:* This measure, also known simply as “buy-outs”, involves the acquisition and removal of real property in the floodplain, as well as assistance in the relocation of occupants affected by frequent flooding to acceptable DSS housing. Permanent evacuation of structures within the regulatory floodway zone has been shown to reduce the base flood elevation within a river or stream reach by removing obstructions to the base hydraulic flow. Floodway evacuation therefore generates secondary benefits to surrounding structures and facilities and are an effective method for reducing flood damages.

Floodplain evacuation may also include acquisition only or acquisition and relocation to a constructed housing and community development (H&CD) site. In accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646), as amended, residential and nonresidential property owners determined to be eligible only for floodplain evacuation would be offered the fair market value for their property (structure and land). In addition to the fair market value of the property, residential owners are offered standard relocation benefits under P.L. 91-646 to assist in the purchase of a comparable replacement dwelling located out of the April 1977 floodplain area. Displaced persons, including those who rent, would also be compensated for eligible moving expenses. These individuals could relocate to similar housing within Johnson County, if available. If comparable replacement dwellings are not available in the implementation area, the last resort housing provisions of Section 206, P.L. 91-646 would be implemented on a case-by-case basis, utilizing the most feasible, cost-effective method available. This provision could include making payments in excess of those authorized by Sections 203 and 204 of P.L. 91-646.

Land acquired through a permanent floodplain evacuation program would subsequently become available for purposes not subject to substantial flood damages, such as preserves, parks, or open land. Property acquired and evacuated by this measure would be acquired in the local sponsor’s name, belong to the local sponsor, and if sold by the sponsor, would have appropriate deed

restrictions recorded on those lands to ensure appropriate land use and either restrict or prevent development in the floodplain. In addition, the local sponsor would retain sufficient rights to ensure compliance with such restrictions. Acquired and cleared tracts that have areas suitable for home sites located out of the floodway and of suitable ground elevation could be used as recycled lots or resettlement sites on an as-needed basis. The USACE would designate the lots or blocks of lots which could be used. The non-Federal sponsor would convey this land for project use as determined necessary by the Government.

6. Flood Warning and Emergency Evacuation Plan (FWEEP): The development, installation and operation of an effective flood warning system and a well-coordinated and efficient emergency evacuation program would help reduce life safety risk.

While a FWEEP may only have limited effect in reducing flood damages, it could be beneficial when used in combination with other flood damage reduction methods. One of the biggest benefits of a FWEEP is the reduction of potential life loss from flood events. Owners of flood proofed structures are strongly urged to evacuate their structures during a flood event due to a variety of hazards. Certain damageable assets within the project area such as vehicles and other movable items could be spared from flooding through the effective warning and response provided by the system. This measure would best be used in combination with other damage reduction methods and is retained for further consideration. While the FWEEP is listed as a measure it is also required by policy and will be include in the Recommended Plan. During the development of the FWEEP, the City of Paintsville's existing Flood Management Plan, located in Volume 7, will be updated.

4.2.2.1. Initial Screening of Non-structural Measures

4.2.2.1.1. Planning Objectives

The non-structural measures array were first evaluated against the Project Planning Objectives listed in Section 2.4. This evaluation was conducted using data derived from Johnson County Property Value Assessor's office, a structural survey of the City of Paintsville by the PDT, previous Section 202 and FRM projects (see Section 1.7) and professional expertise and judgment. A summary of this evaluation is presented in **Table 11**.

Table 11. Comparison of formulated non-structural measures to project planning objectives.

Non-Structural Alternatives Measures compared to Planning Objectives				
Planning Objectives	Dry Flood proofing	Raise In- Place	Buy Outs	FWEEP
Objective 1: Provides flood risk reduction measures that comply with Section 202 and other applicable laws.	Meets objective.	Meets objective.	Meets objective.	Meets objective.
Objective 2: Reduces, to the extent possible, financial and personal losses due to flooding.	Meets objective.	Meets objective.	Meets objective.	Meets objective.
Objective 3: Maintains, to the extent possible, the area’s social, economic and cultural cohesion for the City of Paintsville and Johnson County.	Meets objective.	Can meet objective depending on its scope, location, and cost.	Meets objective.	Meets Objective.

Planning Objective 1: Provides flood risk reduction measures that comply with Section 202 of PL 96-367 and other applicable laws and regulations.

The PDT determined that all of the proposed non-structural measures for Johnson County, Kentucky would comply with the authorizing legislation, applicable laws and regulations, and agency policy.

Planning Objective 2: Reduce, to the extent possible, financial and/or personal losses due to flooding.

The PDT determined that all of the proposed non-structural measures provide a reduction in economic losses for Johnson County, Kentucky to the 1977 flood event.

Planning Objective 3: Maintains, to the extent possible, the social, cultural and economic cohesion of the communities within Paintsville and Johnson County.

The PDT identified four measures – dry flood proofing, raise in-place, buyouts and FWEEP– that would meet the objective and maintain the social, cultural, economic cohesion for communities in Johnson County, Kentucky.

Considerable discussion centered on the potential impact of a non-structural plan in the City of Paintsville. Structures eligible for non-structural measures require flood proofing up to 1’ above the 1% AEP flood stage. The PDT utilized data from a detailed first floor survey performed by the Huntington District in 2003, and formulated a total non-structural plan for the City of Paintsville. The total non-structural plan consisted of dry flood proofing, raising in place and buyouts. Eligibility was cut and dry because the entire town flooded in the back water of Levisa Fork so the flood elevation was 608.6 NAVD88. With this known stage and detailed information on structures in Paintsville from the first floor survey, eligibility only required a two-step test. The first step was to identify all structures with first finished floors below the flood stage. In addition to those structures the PDT identified structures with low ground elevations below the 1977 flood stage. These structures were only included if the first finished floor was below the FEMA 1% AEP stage. The structures with low ground elevations below the flood stage were included because those structures could have received damages to their structure including but not limited to, basements, structure façade, air-conditioning units, crawl space utilities, and mold from flooding could have caused damage. Due to these impacts, these structures are eligible per the Section 202 regulation.

Based on the process above there are 326 eligible structures in the City of Paintsville including 79 businesses. With this dataset, the inundation depths were used to estimate the most appropriate method of

non-structural flood risk management. It was assumed that dry flood proofing will always be the cheapest non-structural measure followed by raising in place, followed by buyouts. As we evaluated each structure the square footage of each structure, the depth of inundation, foundation type, and the PVA total structural values, were utilized to determine the cheapest measure for each structure. In addition, any structure in the floodway is only eligible for buyout. For commercial properties, dry flood proofing was considered a lower cost option compared to buy out - raising businesses in place was not considered due to access requirements for the business patrons.

Non-structural measures including buyout, dry flood proofing, and raising in place can still be beneficial to the Paintsville community in conjunction with a structural project. This ensures individual structures not receiving benefits from the structural project are eligible to receive risk reduction up to 1' above the 1% AEP in City of Paintsville.

A total Paintsville non-structural plan is estimated at \$98 million and would include 96 buyouts, 71 of which are commercial structures. Paintsville is the economic hub of Johnson County, along with being a significant regional services center. Much of its economic and services infrastructure is located along Paint Creek within the limits of a reoccurrence for the 1977 flood event. There is very limited available land that could be used for relocation of major properties. A buy-out plan would have major social, cultural, and economic impact upon Paintsville and the surrounding region. As a result, both the non-Federal sponsor and the City of Paintsville expressed their desire to maintain the existing Paintsville downtown area under this project and encouraged the use of measures other than buy-outs as necessary to achieve a reduction in flood risks within the City. However, they did support the use of buy-outs in the surrounding Johnson County, where required or needed. For this reason the raise in place/buy-out total non-structural FRM in Paintsville was screened out at this stage. The non-structural only plan was screened out for the City of Paintsville but to ensure that the team was being diligent a buyout plan for Paintsville was evaluated next to the other structural plans to show that this was not the most cost effective path forward.

4.2.2.1.2. PGN Evaluation Criteria

The non-structural measures array was evaluated with the PGN criteria provided in Section 2.1 of this report. Since the formulation of these measures were preliminary at the time, the array of non-structural measures was evaluated using only two of four PGN criteria: effectiveness and acceptability. A summary of this evaluation is presented in **Table 12**.

Table 12. Comparison of formulated non-structural measures to PGN evaluation criteria.

Non-Structural Alternatives Measures Compared to the PGN Evaluation Criteria				
Evaluation Criteria	Dry Flood proofing	Raise In-Place	Buy Outs	FWEEP
Effectiveness: the extent to which the measure alleviates the specified problems and achieves the specified opportunities.	Meets criteria	Meets criteria	Meets criteria	Meets criteria
Acceptability: the extent to which the measure is acceptable in terms of applicable laws, regulations and public policies.	Meets criteria	Meets criteria	Meets Criteria	Meets Criteria

Effectiveness: The PDT determined that all of the proposed non-structural measures provide to some degree a reduction in economic losses for Johnson County and Paintsville, Kentucky, and opportunities to improve local housing quality and commercial development. Johnson County currently participates in the NFIP and

has used this approach to address risks to flooding and life loss. Adding a modern FWEEP was considered to be the non-structural measure with the greatest effect for reducing residual life safety flood risks for Johnson County. Flood proofing, elevation, and buy-outs, though more expensive, can also be used to reduce flood risks throughout Johnson County.

Acceptability: The PDT determined that all of the non-structural measures were considered acceptable in terms of applicable laws, regulations, and public policy.

4.2.2.2. Selected Non-structural Measures

The PDT forwarded the non-structural measures flood proofing, floodplain evacuation or “buy-outs”, raise-in-place, and FWEEP for development into project alternatives with some restrictions. Within the City of Paintsville these non-structural measures would only be considered as supplementary components of a more comprehensive structural plan. Within the surrounding portions of Johnson County a stand-alone non-structural plan would be developed.

4.3. ALTERNATIVE PLAN FORMULATION

The structural and non-structural measures developed in Section 4.2 (**Figure 8**) were assembled into alternative plans by USACE, the non-Federal sponsor, local emergency response agencies, and Paintsville City officials (**Figures 9 and 10**).

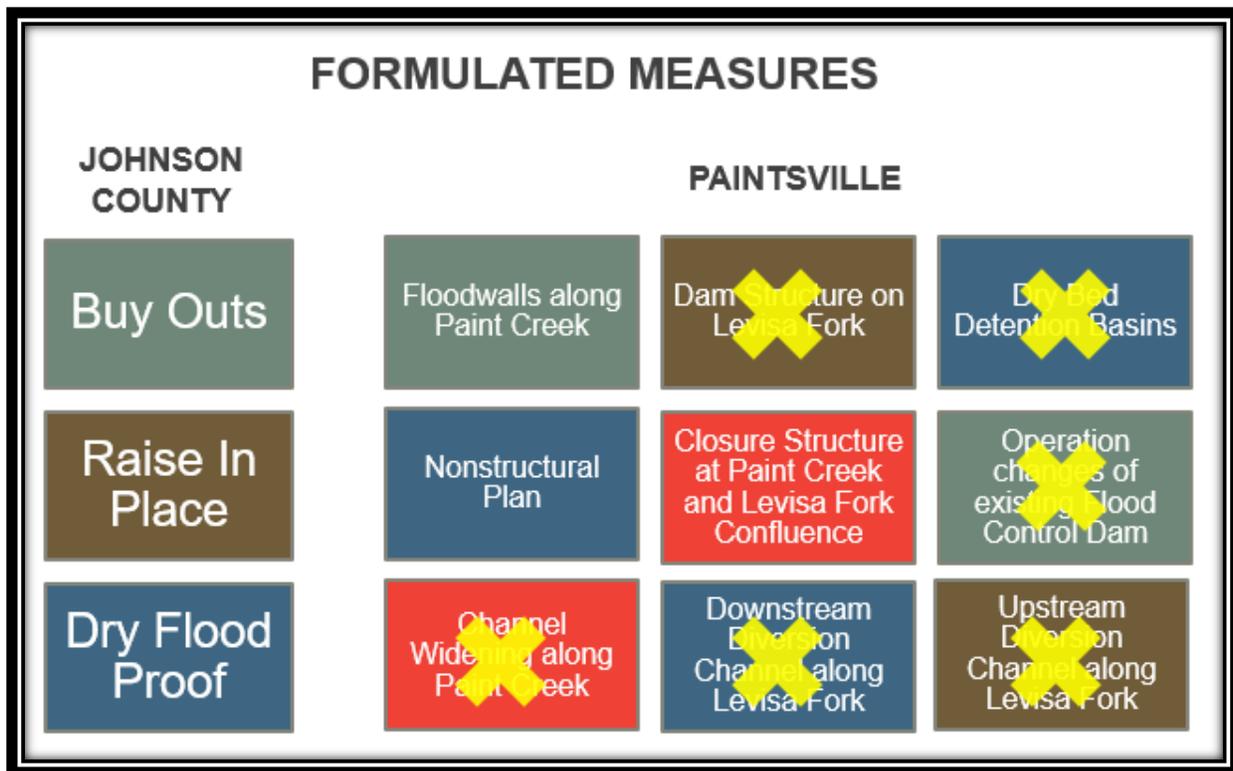


Figure 8. Structural and Non-Structural Measures Formulated

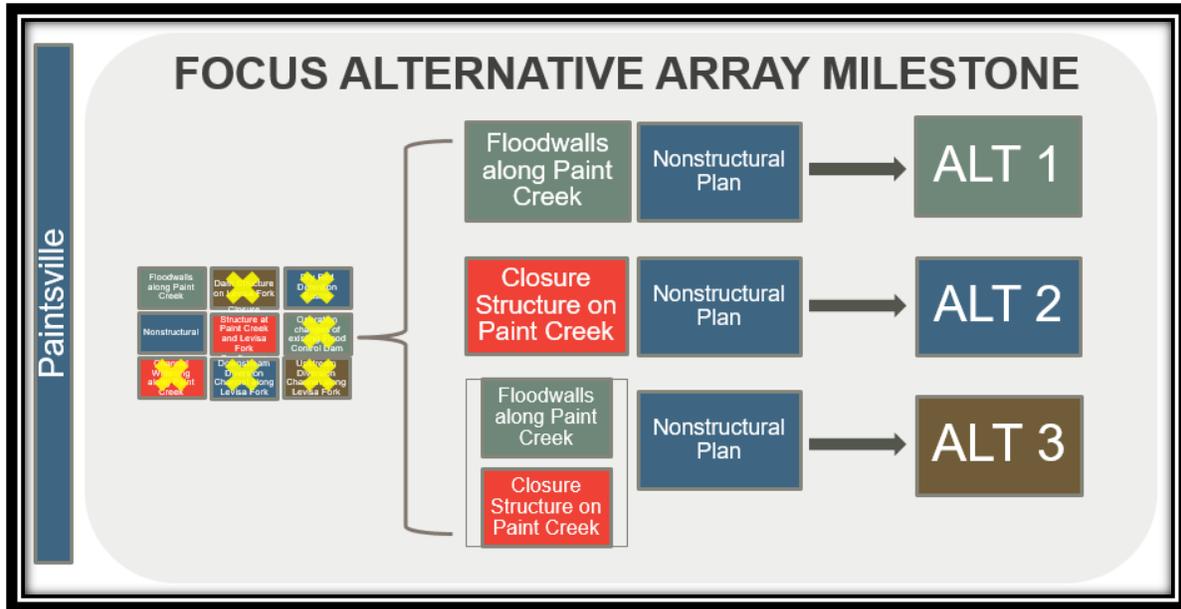


Figure 9. Structural Measures Combined Into Alternatives

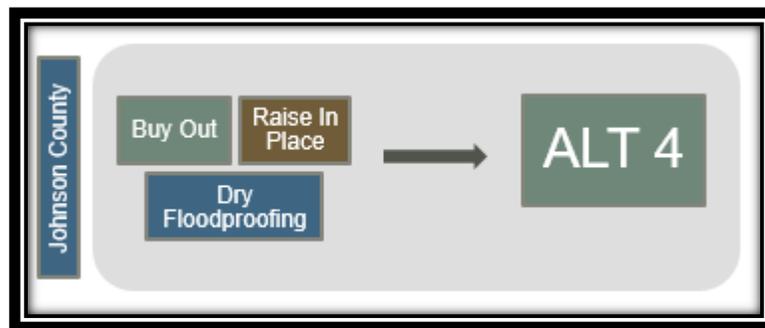


Figure 10. FAAM Johnson County Non-Structural Measures Considered For Alternative 4

These alternatives were compared and evaluated for screening purposes against the Project Planning Objectives stated in Section 2.4 and PGN evaluation criteria stated in Section 2.1. An initial array of alternatives was presented by the PDT to the Vertical Team as well as the non-federal sponsor on December 19, 2018 during the project’s Focused Alternatives Array Milestone (FAAM) and are described below.

4.3.1. NO FEDERAL ACTION

Consideration of the “No Federal Action” option is required as one of the alternatives in order to comply with NEPA requirements and must be evaluated among the candidate plans in the final array of alternatives. The No Federal Action Plan assumes the Federal Government would not implement any type of comprehensive flood risk reduction program for the project. It reflects continuation of existing economic, social, and environmental conditions and trends in the study area as described in Section 4. Paintsville and Johnson County, Kentucky would continue to endure frequent floods, economic loss, and potential loss of life.

Inherent with this plan would be the continuation of Federally-subsidized flood insurance coverage for property owners that is currently available through the NFIP and the enforcement of local floodplain zoning

ordinances. This plan would result in no expenditure of Federal funds to implement a comprehensive flood risk management program in the study area. However, any federal funding currently subsidizing the FEMA flood insurance program is assumed to continue.

4.3.2. ALTERNATIVE PLAN 1.

This alternative plan was originally proposed by the USACE as part of the agency's work plan submittal for appropriations under the Supplemental Appropriation to the Bipartisan Budget Act of 2018, P.L 115-123, Div. B, Subdiv. 1, tit. IV (2018).

The focus of this alternative plan was to prevent the backwater flows along the Levisa Fork from entering the City of Paintsville equal to the 1% AEP and to maintain the headwater flows from Paint Creek and its tributaries at an elevation that would minimize flood-related damages and risks. At the time this alternative was formulated the hydrologic and hydraulic analysis for the project was incomplete. Existing conditions were primarily derived from FEMA and previous agency models. This plan also would not include measures that reduce the flood damages and risks in the surrounding Johnson County.

The plan combined a number of structural measures - floodwalls, pump stations, and closures – with non-structural measures – flood proofing and buy-outs. The layout and location of these measures are shown in **Figure 11** and are listed below:

1. Dual floodwalls on each side of Paint Creek comprising of approximately 18,800 linear feet (lf) of sheet I-Wall and T-wall. The northern wall would start at Highland Avenue near the CSX Railroad track and end at U.S. Highway 23. The southern wall would start at the CSX Railroad yard in the City of Paintsville south of Paint Creek and end behind Mayo Plaza.
2. Five pump stations along Paint Creek with submersible column pumps ranging in size from 100 to 400 cfs.
3. Approximately 10 swing gates for road closures.
4. Approximately 30 pedestrian closures.
5. 29 property acquisitions
6. 7 structures eligible for non-structural measures
7. FWEPP

A major concern for this plan was the height of the floodwalls (ranging from 5 to 20 feet above the ground surface) and their length (approximately 3.5 miles upstream from its confluence with the Levisa Fork on both sides of Paint Creek). Such a plan would effectively bisect the City of Paintsville and limit egress during a major flood event creating a life safety concern for the community, because the floodwalls associated would have road closures on all bridges and roadway egress routes from north Paintsville. Another concern was the amount of real estate required for this project. Although the work plan cost estimate valued this alternative at \$118,000,000, the PDT estimated the project costs at \$203,000,000.

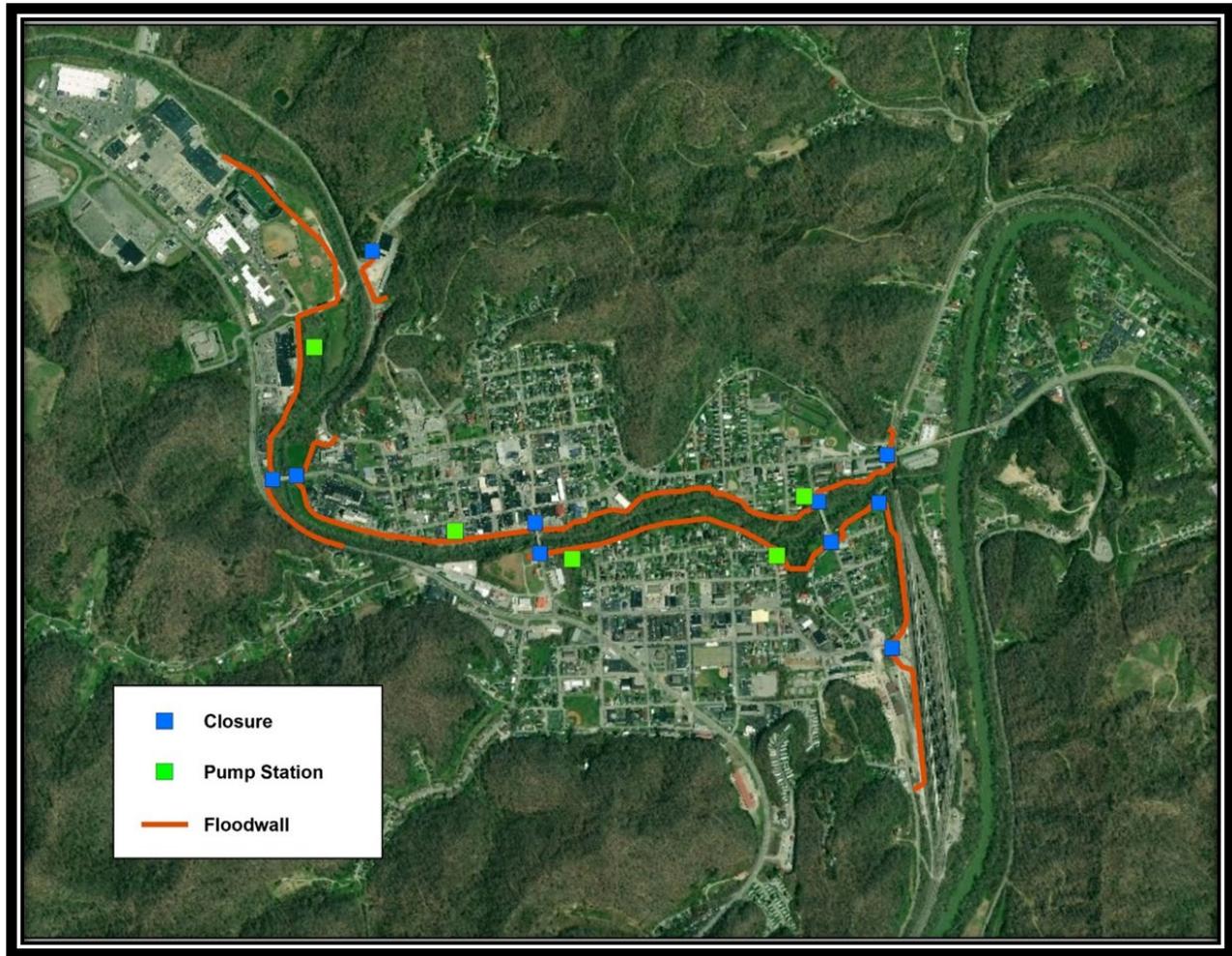


Figure 11. Alternative Plan 1

4.3.3 ACHI ALTERNATIVE PLAN 2

The focus of this alternative plan was to prevent the backwater flows along the Levisa Fork from entering the City of Paintsville equal to the 1% AEP with risk and uncertainty, and to maintain the headwater flows from Paint Creek and its tributaries at an elevation that would minimize flood-related damages and risks. At the time of the FAAM, the hydrologic and hydraulic coincident frequency analysis for the project was incomplete but conservative estimates were utilized. This plan would not include measures that reduce the flood damages and risks in surrounding Johnson County. This plan was developed by combining a number of structural measures - floodwalls, a pump station, and closures – with non-structural measures – flood proofing and buy-outs. The layout and location of these measures are shown in **Figure 12** and are listed below.

1. 3,400 lf of floodwall on the west bank of the Levisa Fork
2. A 4,000 cfs pump station near the confluence of the Levisa Fork and Paint Creek
3. A closure structure on Paint Creek with Tainter gates
4. A road closure
5. 3 pedestrian closures
6. 4 property acquisitions
7. 9 structures eligible for non-structural measures
8. FWEPP

This alternative had a much smaller footprint to construct and fewer land acquisitions than Alternative Plan 1, though a segment of the project would cross over onto property belonging to the CSX Railroad Company. At 4,000 cfs, the size of the pump station could easily maintain the 1% AEP behind the floodwall below the stage of consequences (Elev. 600), but the potential cost to operate and maintain the facility was a concern for the non-federal sponsor. Subsurface conditions along the length of the proposed floodwall were unknown at the time of the FAAM. Subsurface exploration data performed during this study can be found in the engineering technical appendix, in the geotechnical tab. The preliminary cost for this alternative was \$140,000,000.

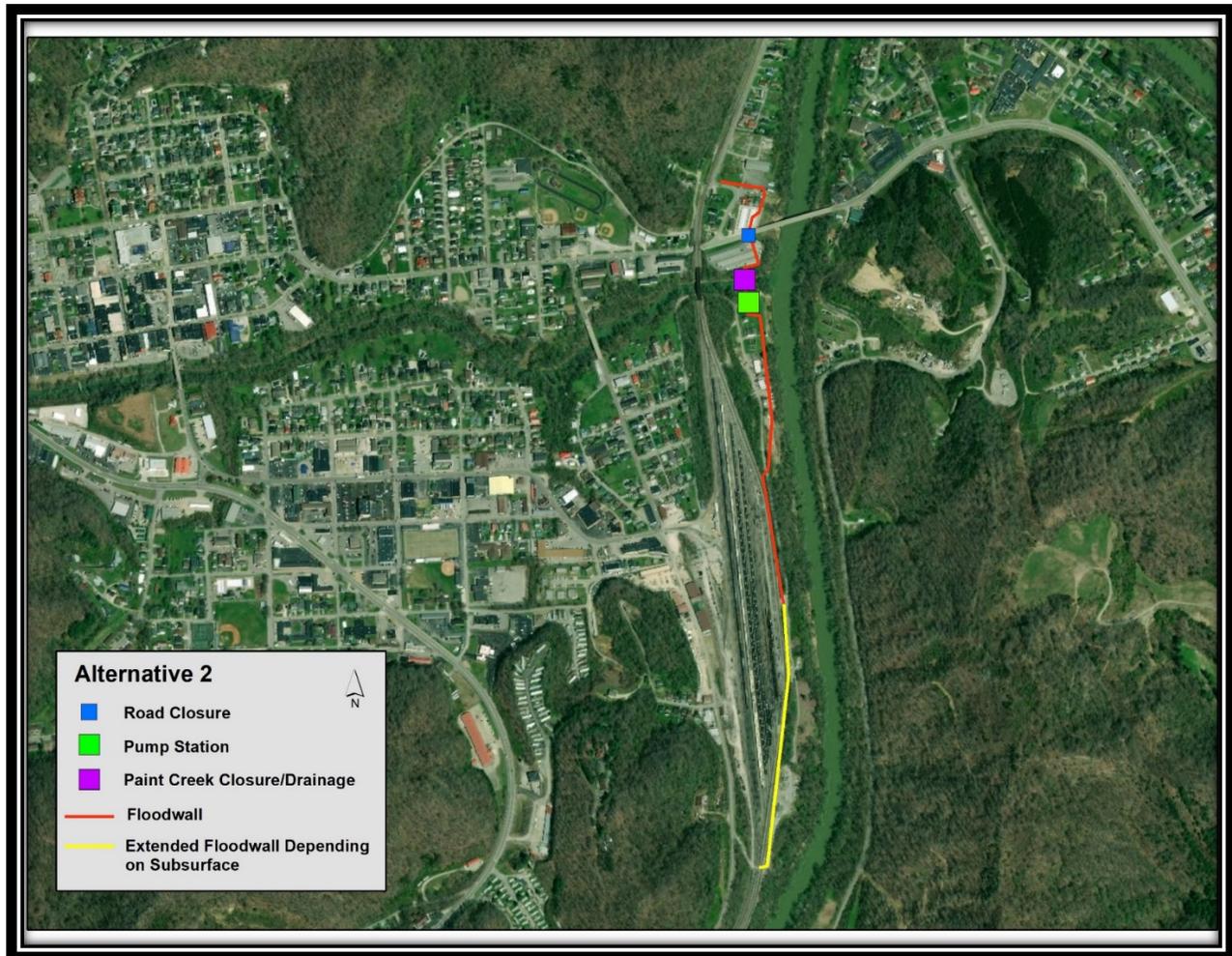


Figure 12. Alternative Plan 2.

4.3.3. ALTERNATIVE PLAN 3

The focus of this alternative plan was to prevent the backwater flows along the Levisa Fork from entering the City of Paintsville equal to the 1% AEP with risk and uncertainty, and to maintain the headwater flows from Paint Creek and its tributaries at an elevation that would minimize flood-related damages and risks. At the time of the FAAM, the hydrologic and hydraulic coincident frequency analysis for the project was incomplete but conservative estimates were utilized. This plan was developed by combining a number of structural measures - floodwalls, a pump station, and closures – with non-structural measures – flood proofing and buy-outs. The layout and location of these measures are shown in **Figure 13** and are detailed below.

1. 3,400 lf of floodwall on Chessie Lane and Depot Avenue just west of the CSX Railroad yard.
2. Additional 5,000 lf of shorter, interior floodwalls along Paint Creek.
3. A 1,000 cfs pump station near the confluence of the Levisa Fork and Paint Creek
4. A closure structure on Paint Creek with Tainter gates.
5. 4 road closures.
6. 5 pedestrian closures.
7. 23 property acquisitions.
8. 9 structures eligible for non-structural measures
9. FWEPP

This alternative reduced the size of the pump station and increased the capacity of storage for Paint Creek through shorter, interior floodwalls to a height of Elev. 609' NGVD88. The plan also avoided CSX Railroad property, but required a significant acquisition of real property to construct. The size of the pump station would be sufficient to maintain the 1% AEP behind the floodwall and interior floodwalls and levees constructed to elevation 609' NGVD88. Subsurface conditions along the length of the floodwall were unknown at the time, but several significant resources and potential HTRW sites were identified as constraints to this plan. The preliminary cost for this alternative was \$143,000,000.



Figure 13. Alternative Plan 3.

4.3.4. ALTERNATIVE PLAN 4

This alternative plan is a separable plan focused on a voluntary program of non-structural measures for Johnson County, Kentucky that were outside the areas flood risk for Alternatives 1, 2, and 3.

In early formulation the structural inventory for the City of Paintsville and Johnson County, Kentucky had not been fully assessed. It was estimated that approximately 466 structures would be eligible for the voluntary non-structural program. Field confirmation of this inventory and their first floor elevations, particularly for the surrounding county, would be needed. The non-structural measures eligible for this program include dry and wet flood proofing, elevation, and permanent floodplain evacuation (i.e. buy-out). The preliminary cost for this alternative, \$110,305,000, was primarily drawn from data provided by the Johnson County PVA database, and focused on buy-out costs only. For the purposes of estimating, it was assumed that 100% of the eligible structures within the City of Paintsville and Johnson County, Kentucky would participate in the program.

4.3.5. COMPARISON OF INITIAL ALTERNATIVES ARRAY

Because the primary goal of this project was to formulate a plan that would address the flood risks identified for the City of Paintsville, Alternatives 1, 2 and 3 were compared to each other as well as the project planning objectives and PGN criteria. Alternative 4 was compared to the project planning objectives and the PGN Criteria only.

4.3.5.1. Planning Objectives

The initial alternatives array was compared and evaluated against the Project Planning Objectives listed in Section 2.4. This comparison was made using knowledge on potential scope requirements for each alternative plan, limited data gathering and development, preliminary costs and professional expertise and judgment. Summaries of this evaluation are listed in **Table 13**.

Table 13. Comparison of initial alternatives array to project planning objectives.

Alternatives Array compared to Planning Objectives			
Alternative	Objective #1	Objective #2	Objective #3
No Action Alternative	Does not meet objective.	Does not meet objective.	Meets objective.
Alternative Plan 1	Meets objective.	Meets objective.	Does not meet objective.
Alternative Plan 2	Meets objective.	Meets objective.	Meets objective, but needs further development.
Alternative Plan 3	Meets objective.	Meets objective.	Meets objective, but needs further development.
Alternative Plan 4	Meets objective.	Meets objective.	Meets objective.
<p>Objective 1: Provides flood risk reduction measures that comply with Section 202 and other applicable laws.</p> <p>Objective 2: Reduces, to the extent possible, financial and personal losses due to flooding.</p> <p>Objective 3: Maintains, to the extent possible, the area’s social, economic and cultural cohesion for the City of Paintsville and Johnson County.</p>			

Planning Objective 1: The PDT determined that all alternatives comply with Section 202, and related laws, and USACE policies and technical guidance; however, the No Action Alternative does not provide risk reductions measures.

Planning Objective 2: The PDT determined that all, but the no action alternative, provide a reduction in economic losses and/or life loss for the residents of City of Paintsville and Johnson County, KY.

Planning Objective 3: The PDT determined that no action alternative and Alternative Plan 4 maintain the social, cultural, and economic cohesion for City of Paintsville and Johnson County, KY. Alternative Plans 2 and 3 also meet the objective, but the presence of long floodwalls and closures throughout Paintsville could be disruptive for the downtown area. Additional formulation and design would be needed to minimize the disruption to the social, cultural and economic cohesion of downtown City of Paintsville. Alternative Plan 1, with its tall and long floodwalls was considered to be disruptive for the downtown Paintsville community and thus did not meet the planning objective.

4.3.5.2. PGN Criteria

The array was then compared against the evaluation criteria provided in the PGN and in Section 2.1 of this report. Summaries of this evaluation are listed in **Table 14**.

Table 14. Comparison of initial alternatives array to PGN evaluation criteria.

Alternatives Array Compared to Evaluation Criteria				
Alternative	Effectiveness:	Acceptability:	Completeness:	Efficiency:
No Action Alternative	Does not meet criteria.	Meets criteria	Does not meet criteria.	Does not meet criteria.
Alternative Plan 1	Meets criteria	Meets criteria	Meets Criteria, but needs further development.	Does not meet criteria.
Alternative Plan 2	Meets criteria	Meets criteria	Meets Criteria, but needs further development.	Meets Criteria, but needs further development.
Alternative Plan 3	Meets criteria	Meets criteria	Meets Criteria, but needs further development.	Meets Criteria, but needs further development.
Alternative Plan 4	Meets criteria	Meets criteria	Meets Criteria, but needs further development.	Meets Criteria, but needs further development.

Effectiveness: the extent to which the alternative plan alleviates the specified problems and achieves the specified opportunities.

Acceptability: the extent to which the alternative plan is acceptable in terms of applicable laws, regulations and public policies.

Completeness: the extent to which the alternative plan provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.

Efficiency: the extent to which an alternative plan is the most cost effective means of achieving the objectives.

Effectiveness. The PDT determined that all, but the no action alternative, provide a reduction in economic losses and/or potential life risks for the City of Paintsville and Johnson County, Kentucky and opportunities to improve local housing quality and commercial development.

Acceptability. The PDT determined that all alternatives, are acceptable in terms of applicable laws, regulations, and public policy for the City of Paintsville and Johnson County, KY

Completeness. The PDT determined that all, but the no action alternative, account for the necessary investments and other actions to address the flooding problems, achieve the project planning objectives, minimize the impact of planning constraints, and capitalize on project opportunities, for Paintsville and Johnson County, KY. However the focus and scope of Alternatives 1, 2, and 3 is limited to structural measures within the City, while Alternative 4 is limited to non-structural measures in Johnson County that lie outside of the area providing flood risk reduction in Paintsville. Additional formulation would be needed to address all areas in the county.

Efficiency. The PDT determined Alternative Plans 2, 3, and 4 were cost effective means at achieving the project planning objectives, but needed additional scope development and data to determine which plan is the least-cost effective. Alternative Plan 1 was the most expensive plan formulated and did not meet this criteria

4.3.5.3. Selected Alternatives

Results of this evaluation identified Alternative Plans 2, 3, and 4 as candidates for further analysis and development. All three were determined to be viable plans that would address the flood damages and risks impacting the City of Paintsville and Johnson County, KY. They also met the project planning objectives and PGN evaluation criteria. Conversely, Alternative Plan 1 did not meet the project planning objectives and PGN evaluation criteria and was not carried forward for further analysis and development

4.4. ALTERNATIVE PLAN REFORMULATION AND ANALYSIS

An intense period of data-gathering, model development, field investigations, agency coordination, analysis and design work followed the presentation of the initial alternatives array at the December 2018 FAAM. This resulted in a refinement of the scope and scale for Alternatives 2, 3, and 4. A meeting with the USACE VT on July 30, 2019 presented the outcome of this effort and all three reformulated alternatives are discussed below.

4.4.1. GENERAL REFORMULATION ISSUES

Alternative Plans 2, 3, and 4 were reformulated and optimized, and as result these reformulated plans were re-designated as 2R, 3R, and 4R. Results of the modeling efforts for this project identified a complex and dynamic hydrologic condition in the City of Paintsville ranging from backwater flooding along the Levisa

Fork to interior ponding from uncontrolled headwater flows along Paint Creek, its tributaries and the surrounding hillsides. Both alternatives 2R and 3R utilize a main floodwall equivalent in height to the 1% AEP flood event from the backwater of Levisa Fork. Both alternatives include a series of identical interior floodwall and levee alignments. The location and height of the floodwalls were evaluated with varying sized pump stations that serve to decrease the interior ponding elevation behind the main floodwall. Three variations of interior floodwalls and pump station capacity were considered. In each variation, the top elevation of the interior walls correspond to a pump station capacity that would be effective in keeping the 1% AEP ponding elevation within the channel and between the interior floodwalls. Alternatives 2R and 3R were compared using an identical combination of interior walls and pump station capacity that was deemed to be the most effective at reducing risk to the community and lowering construction cost, while remaining in the sponsor’s ability to Operate, Maintain, Repair, Replace, and Rehabilitate (OMRR&R). The alternatives and variations are further discussed below.

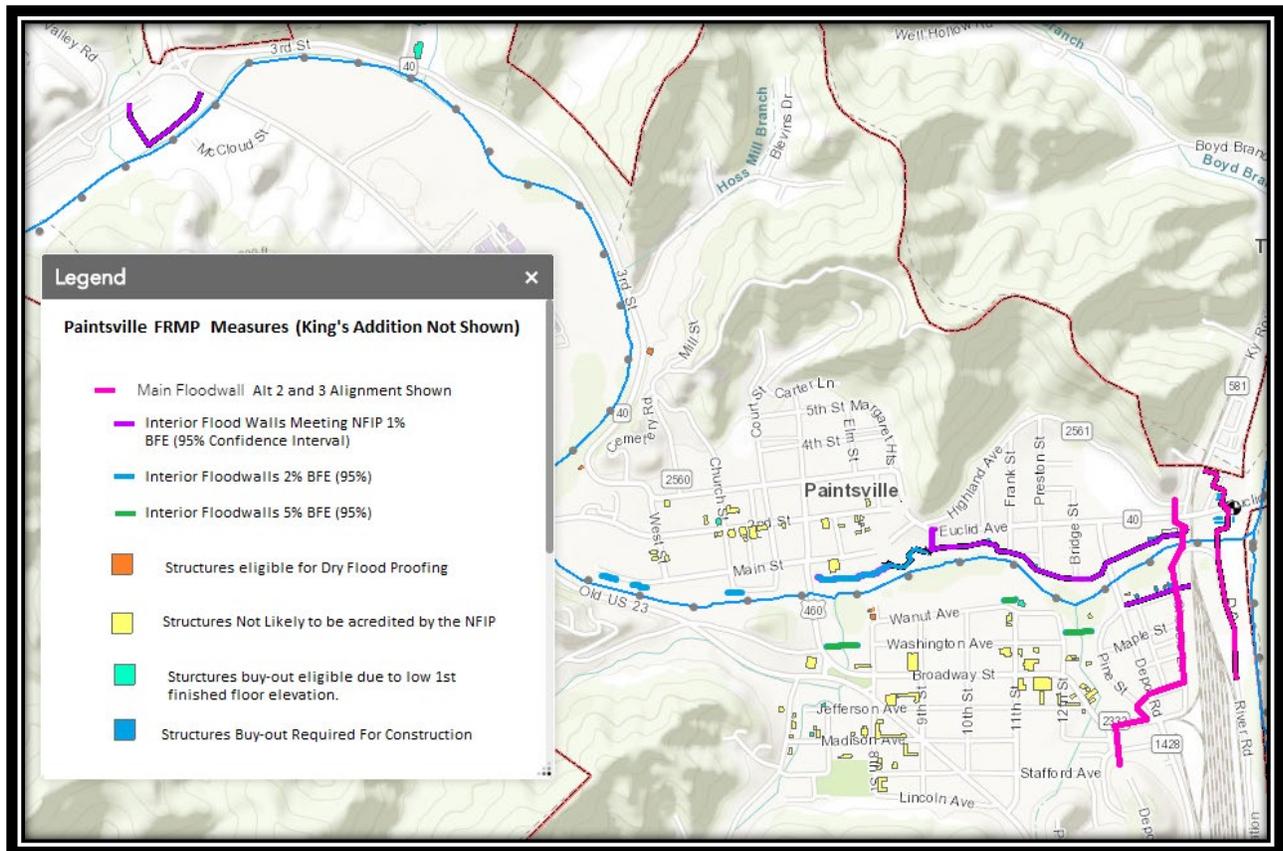


Figure 14. Interior Flood Wall Alignments

4.4.2. PAINTSVILLE FRM PROJECT INTERIOR FLOODWALL VARIATIONS

The interior walls serve the same function on both alternatives 2R and 3R. When the main flood wall gravity gates are closed during a flood event on Levisa Fork, Paint Creek will not have the same ability to drain freely into Levisa Fork. The interior walls greatly increase the storage for Paint Creek during that time of closure and also allow the gravity drainage gates to freely drain significantly longer, reducing the total amount of time that gates will be closed. See the Hydrology & Hydraulics (H&H) Tab for more detail concerning the Coincident Frequency Analysis. Three variations were evaluated targeting an interior ponding elevation of 609.7, 608, and 606 (NAVD88). Each variation effects the community differently and were evaluated by homes removed from the floodplain, overall cost of the project, and estimated cost of

pump replacement after 50 year life cycle; The capacity of the pump station was found to be by far the biggest driver for both the cost of the project and the cost of OMRR&R, however the larger the pump station the more structures were removed from the floodplain. The structures not likely to be accredited under the NFIP would provide a similar level of risk reduction as dry flood proofing which would also not be accredited under the NFIP. The variations are summarized in **Table 15**.

Table 15. Alternative Pump Variation Comparison

	Variation 1 (Elev. 609.7)	Variation 2 (Elev. 608)	Variation 3 (Elev. 606)
# of total structures removed from the floodplain.	804	872	893
% of structures removed from the floodplain.	81.5%	88.4%	90.6%
% of structures protected from the reoccurrence of 1977 flood.	100%	100%	100%
# of structures flooded in 1977, not likely to be accredited by the NFIP.	77	32	20
Required pump station Capacity. Cubic Feet / Second (CFS)	0	500	1300
Estimated annualized 50 year pump replacement cost	0	305,000	610,000
Estimate of the Sponsor’s annualized ability to pay	80,000		

As seen in **Table 15**, the annualized cost to replace the pumps for Variation 2 and 3 exceed the sponsor’s ability for all OMRR&R efforts.

For these three variations construction cost was not the only limiting factor. The sponsor would not be able to afford OMRR&R on Variations 2 and 3. Because of this, a fourth variation was considered that targeted the largest pump station that could theoretically be affordable to the Sponsor for OMRR&R. A 100 CFS station is estimated to fall into the range of maximum cost for the sponsors’ ability to pay.

After evaluating this variation the interior ponding was only lowered to elevation 609.4 ft NAVD88, down only 0.3 ft from Variation 1 with no pump. There are only 20 structure’s first floor elevations fall in that range. Further due to the exterior lowest grades surrounding these structures, only 2 additional properties would be removed from the NFIP’s floodplain map.

This study does evaluate a concept plan for a 100 CFS pump station, but the pump station is not included in the Recommended Plan.

While Variation 1 leaves the most structures in the floodplain, measures will be taken to reduce the risk of flooding even in cases that do not achieve NFIP accreditation. For example, the Flat Rock Branch Levee can prevent the backwater ponding up to elevation 610’ NAVD88 for areas of the community below the expected 1% flood elevation of 609.7’ NAVD88 that it serves, however at 610’ the Flat Rock Branch Levee would not be tall enough to satisfy the risk and uncertainty of over topping and therefore would not be recommended for certification. The levee still has the potential to reduce risk, consequences, and could help lower insurance rates through the City of Paintsville’s membership in the NFIP Community Rating System.

Alternatives 2R and 3R were evaluated using the Variation 1 series of interior walls and levees, no pump station, and base flood ponding elevation of 609.7.

4.4.3. DESCRIPTION OF FLOOD WARNING EMERGENCY AND EVACUATION PLAN (FWEEP)

The selected structural alternative will include the development of a FWEEP. The Johnson County watershed directly impacts the inflow to Paint Creek in the downtown area, because of this an Automatic Flood Warning Systems (AFWS), and a warning dissemination system that operates county wide will be incorporated into the Flood Risk Management project for the City of Paintsville. The (AFWS) system will include stream and rain gages, data communication and processing, and a flood warning system such as sirens, auto dialers, and a web based platform. This will be very important to provided needed information in operating the Paint Creek closure structure. The FWEEP will also be a supporting component for alternative 4R.

4.4.4. KING'S ADDITION LEVEE

The King's Addition Neighborhood Levee Area was not flooded in 1977 and is not expected to flood in a reoccurrence of a similar event. The area has 30 homes in the FEMA 1% AEP floodplain, after field investigation and discussions with the local sponsor, it was determined that as little as 100 feet of levee and gravity drainage structure could provide enough risk reduction to be consistent with the national flood insurance program. A levee with a gravity drain and flap gate would intersect flow through Preston Branch which could reduce the risk of backwater flooding to 30 homes in the region. The levee alignment would extend from the end of Kentucky Lane to the end of Auxier Avenue. The location of this levee alignment can be seen in **Figure 15** below.

The structures in King's Addition did not flood in the 1977 flood but are identified in the NFIP's floodplain map. While Section 202 policy typically only provides flood reduction measures to structures flooded in 1977 or structures that would be flooded by the reoccurrence of the 1977 flood, this community seems to be a good fit for a policy exception to that standard practice. All other properties in the floodplain of the City of Paintsville will receive significant flood risk management, and if the King's Addition area is implemented would provide high opportunity at very low cost. The King's Addition Levee is among the Recommended Plan, but requires further evaluation of eligibility criteria. Alternatives 2R and 3R both include the King's Addition Levee.

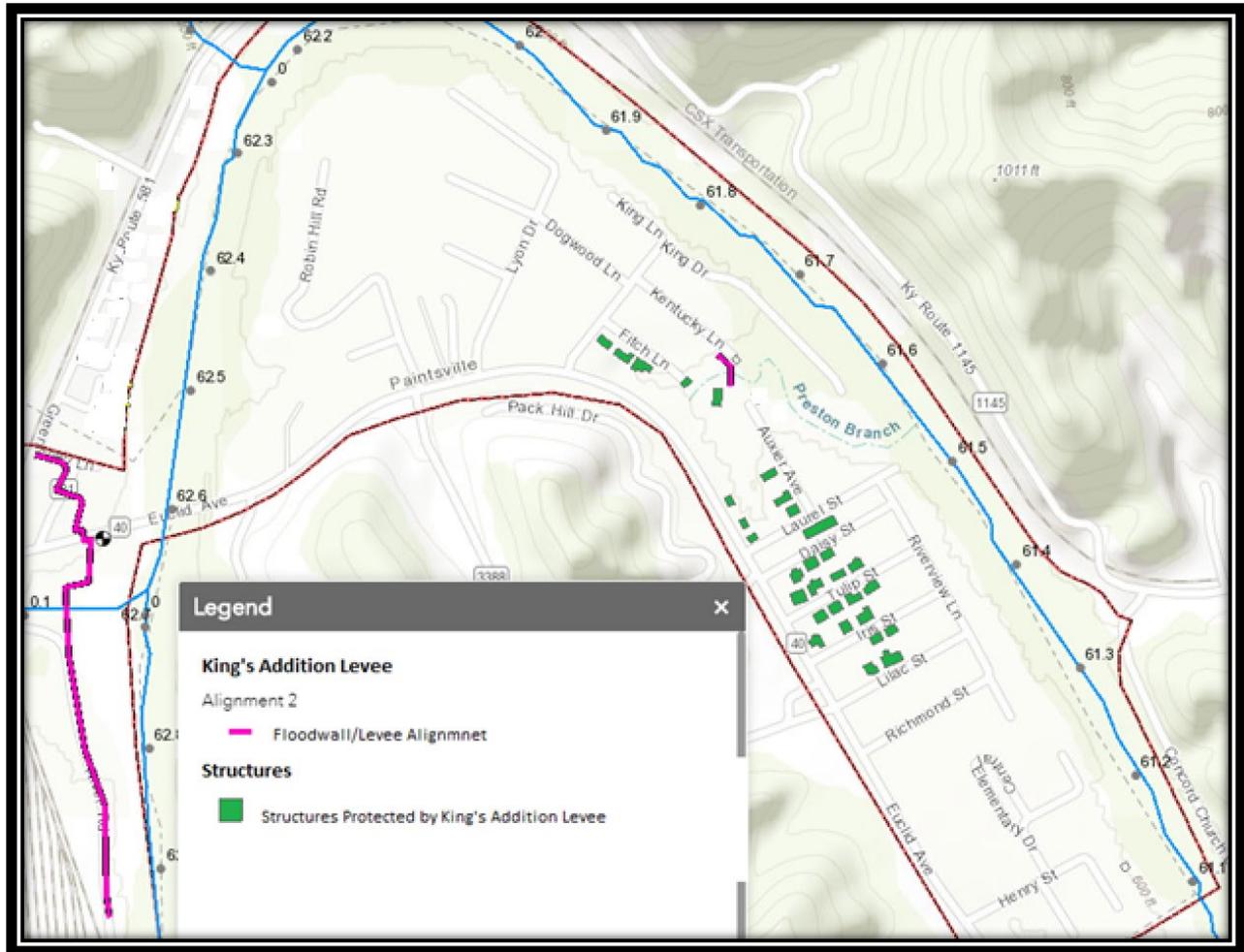


Figure 15. King's Addition Levee

4.4.5. ALTERNATIVE 2R

The OMRR&R costs for maintaining a 4,000 cfs pump station near the confluence of the Levisa Fork and Paint Creek was beyond the financial capabilities of the non-Federal sponsor and City to support. These factors forced a change in the design and scope of Alternative Plan 2. Alternative 2R includes same main floodwall alignment located between Levisa Fork and the CSX Railroad yard as identified in alternative 2. This alignment has the shorter length, takes less residential properties and reduces flood risk to more structures than the main floodwall alignment of Alternative 3R, and preserves the evacuation route on Route 40 which would otherwise inundate in very early flood stages, limiting evacuation. Alternative 2R also includes interior floodwall/levees and the King's Addition levee, both as discussed previously, as well as gravity outlets, interceptor sewers and pressurized pipes. The interior floodwalls and levees would be designed near the 1% interior ponding elevation stated above. Interceptor sewers and pressurized pipes would also be used to address the hillside run-off, catching and transferring these flows through the project alignment. To reduce the overall cost of the alternative plan, and the OMRR&R burden to the non-Federal sponsor, the 4,000 cfs pump station was removed from the plan. Alternative 2R does, however, require the acquisition of CSX property, which has the potential to cause scheduling risks. Voluntary buyouts and voluntary dry flood proofing are included in the project for homes with finished first floors projected to remain in the 1% base flood ponding area or floodway after the completion of the FRM Project.

4.4.5.1 Description of Alternative 2R Main Floodwall

Beginning at a point near Tutor Key Road and Greentown Loop, the main flood wall (see **Figure 16**) is located between Levisa Fork and the CSX Railroad yard. The alignment crosses both Tutor Key and Route 40, requiring two road closures, then crosses Paint Creek about 250 feet from the Levisa Fork confluence. The alignment passes the abandoned water treatment facility on its west side as well as two maintenance facilities and parking areas. In general, the alignment follows the east shoulder of River Road until high ground is met. Subsurface investigation continued beyond high ground to ensure that the existing rail yard was an acceptable tie in point. This was confirmed and is documented in the Geotechnical tab.

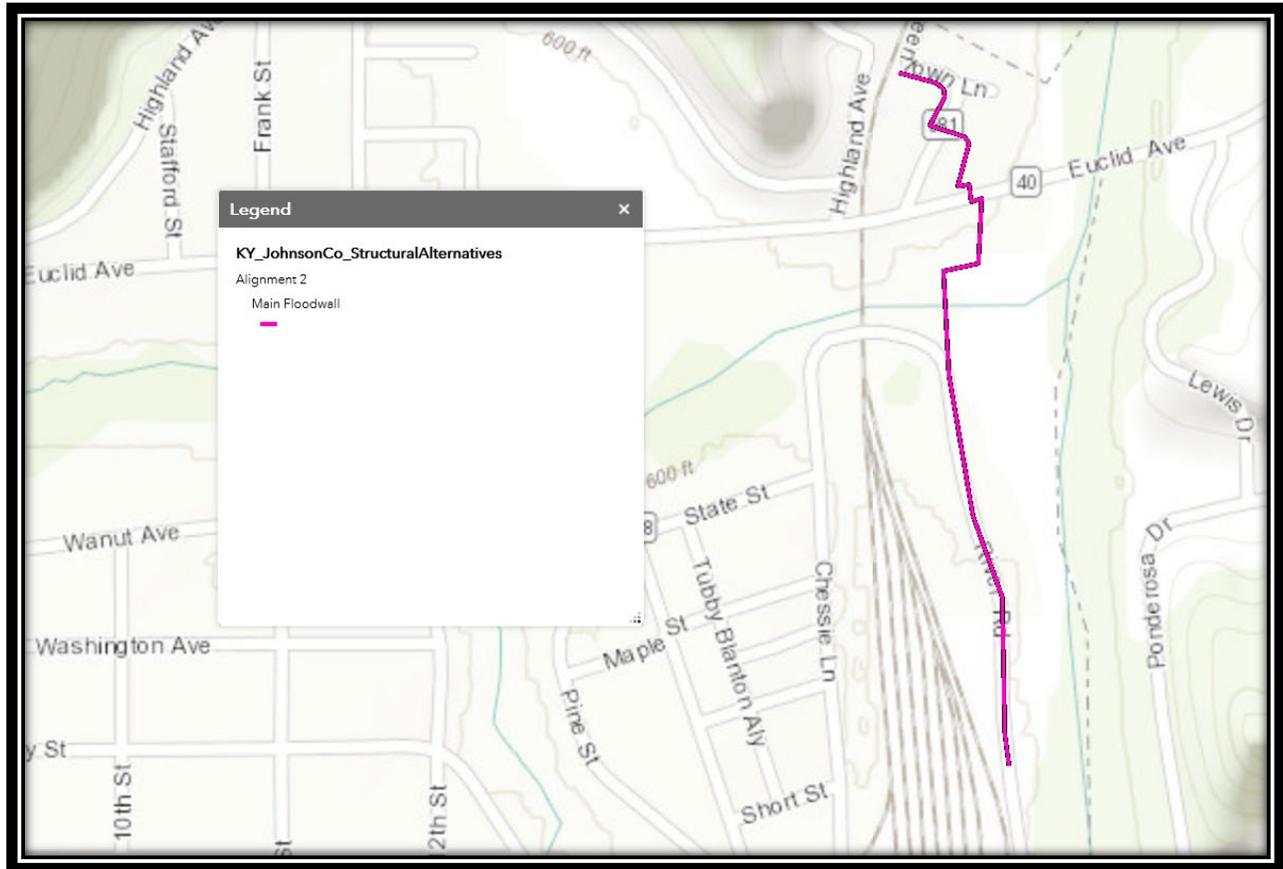


Figure 16. Alternative 2R Main Floodwall Alignment

The floodwall alignment will be designed to force an overtopping event to occur at a location identified to best withstand the high velocity and plunge cutting from the overtopping water. For this alignment, the overtopping event will be forced at the upstream end of the floodwall. While this is contrary to typical design goals, it has been deemed appropriate for this project as the South side of the alignment is void of any structures or residents and the CSX Railroad yard would separate the floodwall overtopping area from the rest of the community. The design will include very resilient features to ensure that an overtopping event would not undermine or erode the protected side of the floodwall. The overtopping area will also be designed to convey water flow back to Paint Creek which will allow an event that exceeds the design floodwall height to rise from the creek banks in the same fashion as a similar event occurring without a project.

The structural elements of Alternative 2R will require the acquisition of 11 identified structures and portions of property from 83 property owners along the project’s alignment. In addition, approximately 31.6 acres of real property would need to be acquired along the Levisa Fork and Paint Creek to construct the project, including property owned by the CSX Railroad Company. Additional acreage would be needed for locations of access, borrow, staging, and laydown, and are discussed in Volume 2.

4.4.5.2. Description of Alternative 2R Non-structural Component

Alternative 2R includes measures to address flood risk reduction for the entire City limits of Paintsville; however, the structural alternative only addresses part of the community. Areas that are within the floodplain or floodway not addressed with the structural plan will have a voluntary opportunity to take advantage of non-structural measures including dry flood proofing, raise-in-place, and buyouts. Businesses and residences that are currently in the floodplain but will be removed upon completion of the Letter of Map Revision to the Federal Insurance Maps will not be eligible to apply for non-structural measures. The locations of these structures eligible for voluntary flood proof and buy out, and those structures that will require acquisition for construction are also shown below on **Figure 17**.

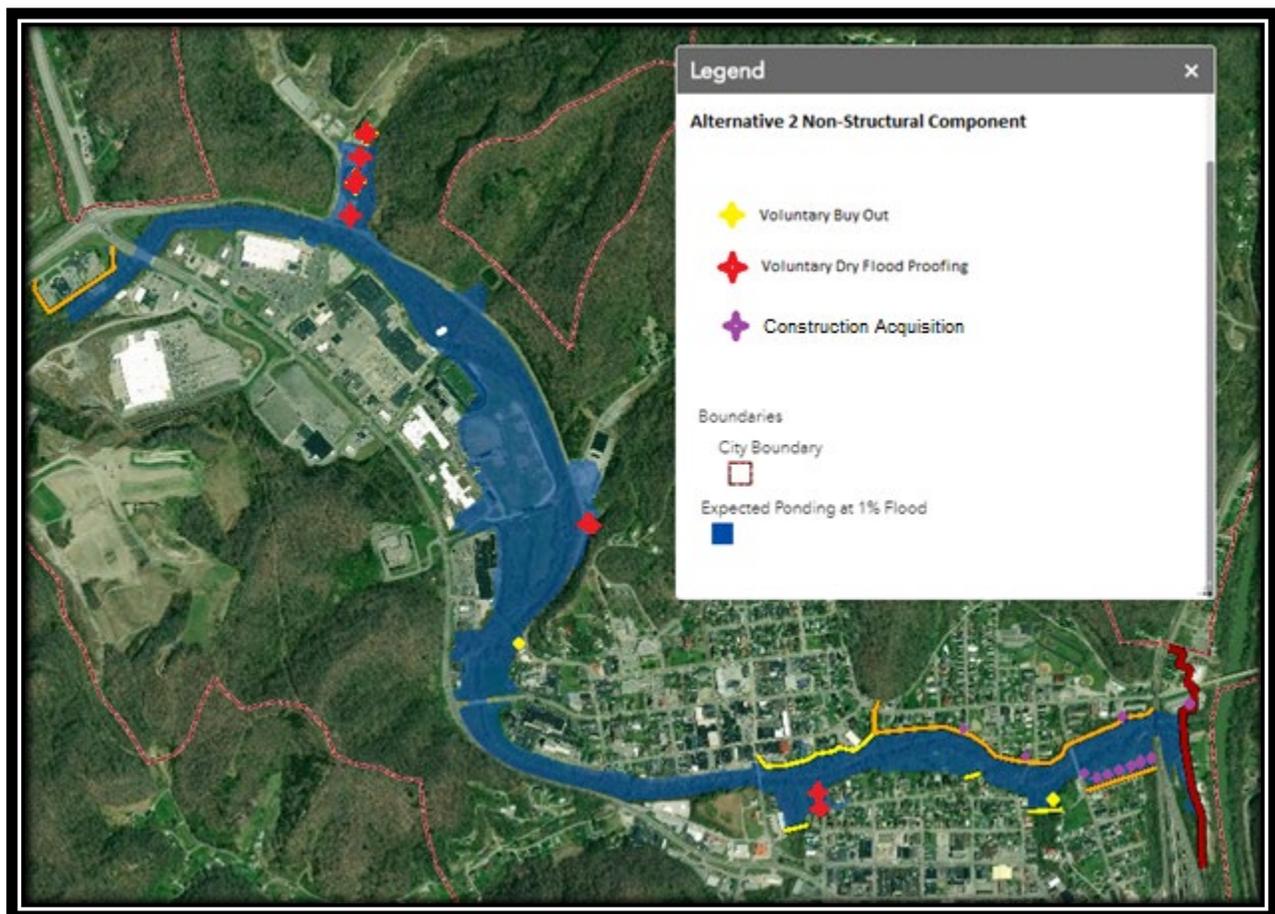


Figure 17. Alternative 2R Non-Structural Component

While the City of Paintsville has an emergency flood management plan already in place, Alternative 2R would include efforts that would update and revise the current plan and would contain Automatic Flood Warning Systems (AFWS) including but not limited to additional stream gages, rain gages, data collection

systems, and information dissemination features like real-time internet based flood inundation predictions and evacuation notifications as well as auto dialers and sirens.

Table 16 summarizes the component parts of Alternative 2R. The preliminary first cost for this alternative is \$110,305,000.

Table 16. Summary of Alternative 2R

Alternative 2R:	Plan Type: Structural + Non-structural
Structural Protective Works	Main Floodwall, series of interior walls and levees, gravity drainage structure including automatic flap gates and swing or sluice gates.
<u>Floodwalls:</u>	
<u>Quantity:</u>	
Levees	2,570 LF of levee, 45,400 CY of impervious suitable material from the main borrow site.
Cut and Fill take off	17,440 CY of cut and haul. 45,400 CY of fill placement. For levee and inspection trench construction Average 2.5 mile haul. Paint Creek structure 41,110 CY of cut stockpile and reuse.
6' I-Walls	3,730 lineal ft.
10' T-Walls	2,000 lineal ft.
15' T-Walls	1,100 lineal ft.
28' T-Walls	165 lineal ft.
<u>Design:</u>	
Levee	10' wide crown, 3:1 side slopes, minimum 6' deep inspection trench.
I-Walls	Sheet pile I-wall, minimum 30' embedment, maximum 6' stick-up, concrete encased.
Floodwall	Cast-in-place reinforced concrete T-wall; 30' sheet piling seepage cutoff wall everywhere, remove and recompact bank random fill, stone slope protection on new ground below the ordinary high watermark, topsoil, height varies.
<u>Openings:</u>	Number – 4 Vehicular, 0 Pedestrian
Floodwall	Depot Rd, Route 40, Route 40, and Greentown Road
<u>Gates:</u>	

Alternative 2R:	Plan Type: Structural + Non-structural
Bridge St.	Swing gate, 35 ft. wide x 5 ft. high.
Route 40	Swing gate, 40 ft. wide x 3.5 ft. high.
Route 40	Swing gate, 45 ft. wide x 5.5 ft. high.
Tutor Key Road	Swing gate, 40 ft. wide x 6 ft. high.
<u>Gravity Drainage Facilities:</u>	
<u>Paint Creek Gravity Gate</u>	3 – 25’x25’ Tainter Gates
<u>Flap gates</u>	6 – 60” diameter flap gates. With headwall structure 2 – 30’ diameter flap gates. With headwall structure 6 – 24’ diameter flap gates. With headwall structure
Non-structural	
<u>Scope</u>	Voluntary dry flood proofing and mandatory acquisition of eligible structures along the project alignment.
<u>Dry flood Proofing</u>	7
<u>Voluntary Buy-Out</u>	2
LEERDS	
<u>Construction Acquisition</u>	11

Figure 18 is an aerial photo of the City of Paintsville showing the locations of the proposed major features of Alternative 2R. As formulated, this Recommended Plan would reduce the risk of flooding and related damages to approximately 774 businesses and residences. Of the Current 635 structures that are currently in the FEMA 1% AEP floodplain, 100% of the 635 structures will receive a reduction in flood risk and over 500 of these structures upon the completion of a Letter of Map Revision (LOMR) would no longer be shown as located in the floodplain as defined under the NFIP.

The advantages of this plan are that it avoids locations known to contain HTRW and minimizes impacts to the cultural, social and economic aspects to the City of Paintsville. It also provides better internal storage with an area able to withstand high volume and velocity water associated with overtopping events along the Levisa Fork. Some risks with this plan were also identified, including effects to known cultural and environmental resources, the necessary real estate to construct the project, and proximity to CSX Railroad Company property.

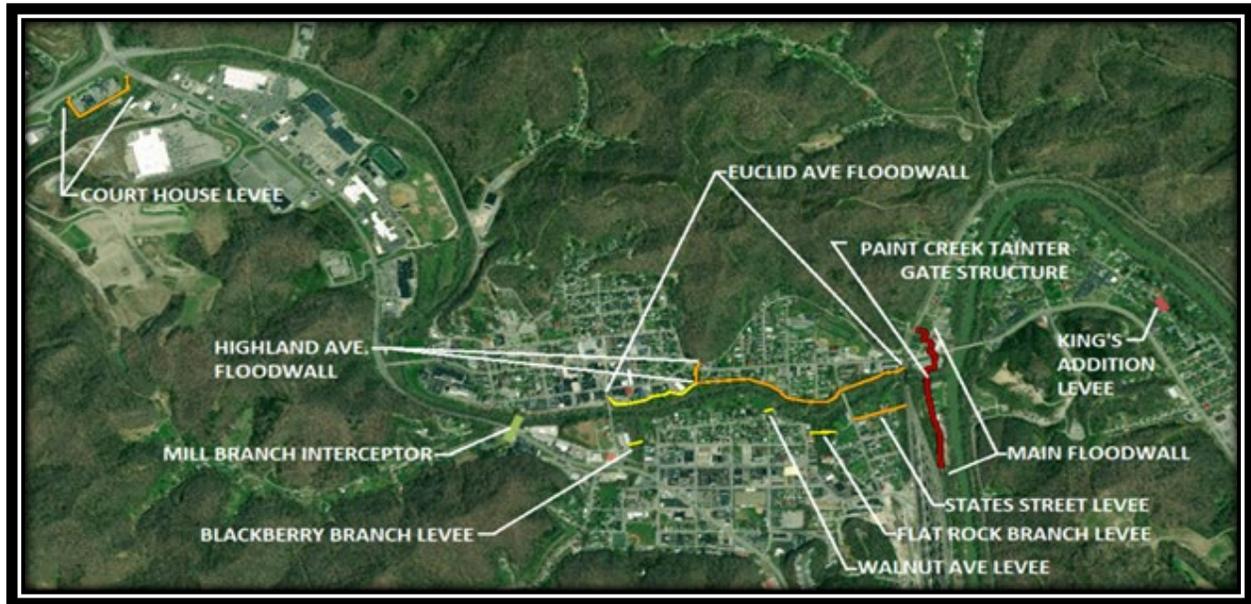


Figure 18. Alternative Plan 2R Major Features

4.4.6. ALTERNATIVE 3R

The OMRR&R costs for maintaining a 1,000 cfs pump station near the confluence of the Levisa Fork and Paint Creek was beyond the financial capabilities of the non-Federal sponsor and City to support. In addition to cost, a number of cultural resources and potential HTRW sites were identified within the path of the original Alternative Plan 3. Consequently, these factors informed a change in the design and scope of original Plan 3.

Alternative 3R includes a main floodwall alignment located west of the CSX Railroad yard but does not include the acquisition of any property from the CSX Railroad Company. This alternative was sought as a way to avoid the scheduling risks of CSX property acquisitions. Avoiding CSX property is a benefit to this alternative but conversely Alternative 3R requires the acquisition of 14 additional structures and has several sites that have the potential to uncover contamination, the risk of uncovering contamination on the Alternative 3R alignment is assumed to be greater than the risks on Alternative 2R main floodwall. Alternative 3R includes the Variation 1 interior floodwalls and the King's Addition levee, both as discussed previously as well as interceptor sewers and pressurized pipes to address the hillside run-off, catching and transferring these flows through the project alignment. To reduce the overall cost of the alternative plan, and the OMRR&R burden to the non-Federal sponsor, the 1,000 cfs pump station was removed from the plan. Alternative 3R also includes voluntary buyouts of residential property located in the floodway and voluntary dry flood proofing to structures with finished first floors in the 1% chance exceedance floodplain, all within the City limits.

4.4.6.1 Description of Alternative 3R Floodwall

The main flood wall of Alternative 3 (see **Figure 19**) is primarily located west of the CSX Railroad yard property line and begins at a point near Highland Avenue's intersection with the CSX Railroad line before moving south to intersect Highland Avenue and Route 40. The Route 40 road closure would be approximately 18 feet tall and would have an early closure time in a flood event. The alignment crosses Paint Creek approximately 750 feet from the confluence with Levisa Fork and then follows the west side of Chessie Lane until the point the alignment crosses Short Street. Moving West the alignment would enter

high ground after crossing Depot Road and would pick up at Pine Street and Broadway Street, still moving west. The alignment would cross Broadway prior to the Woodland Court intersection and turn south following the east shoulder of Woodland Court. After crossing Woodland Drive the alignment would terminate into high ground.

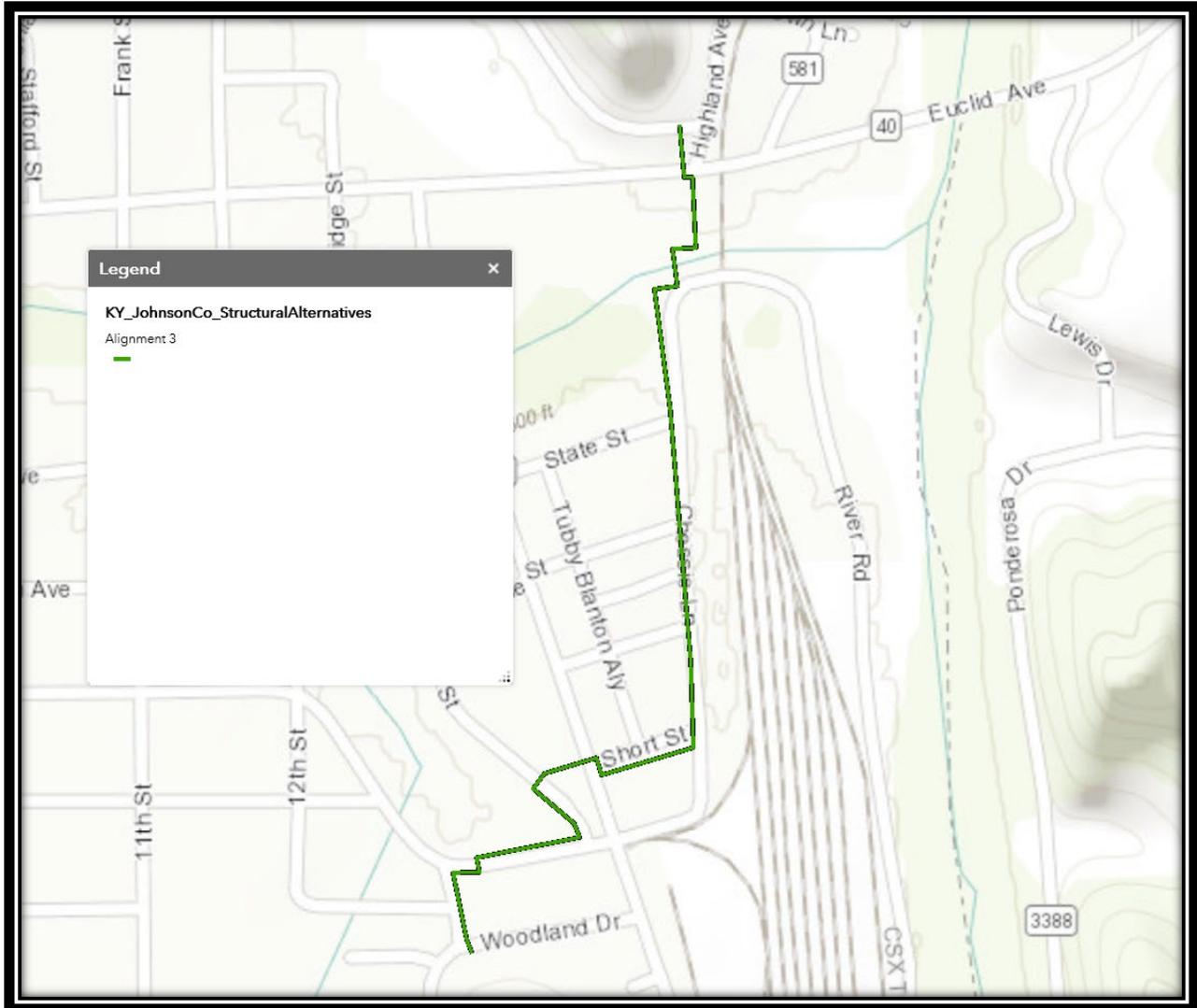


Figure 19. Alternative 3R Main Floodwall Alignment

This alignment is designed to force an overtopping event to occur at a location identified to best withstand the high velocity and plunge cutting from the overtopping water. For this alignment, that location is in the center of the main wall occurring between Paint Creek’s south bank and the State Street and Chessie Lane intersection. This is the most appropriate location for this project because this area would flow to the Paint Creek Floodway and would not initially inundate the areas protected by interior walls. The design will include very resilient features to ensure that an overtopping event would not undermine or erode the protected side of the flood wall. The overtopping area also will be designed to convey water flow back to Paint Creek which will allow an event that exceeds the design to rise from the creek banks in the same fashion as a similar event occurring without a project.

Alternative 3R will require construction acquisitions of 22 identified structures. In addition, approximately 40.3 acres of real property would need to be acquired along the Levisa Fork and Paint Creek to construct

the project. Additional acreage would be needed for locations of access, borrow, staging, and laydown, and are discussed in Volume 2.

4.4.6.2. Description of Alternative 3R Non-structural Component

Alternative 3 includes measures to address flood risk reduction for the entire City limits of Paintsville; however, the structural alternatives only address part of the community. Areas that are within the floodplain or floodway will have voluntary opportunities to take advantage of non-structural measures including buyouts and dry flood proofing. Structures and residences that are currently in the floodplain but will be revised upon completion of the Letter of Map Revision to the Federal Insurance Maps will not be eligible to apply for non-structural measures. The locations of these structures eligible for voluntary flood proof and buy out, and those structures that will require acquisition for construction are shown below on **Figure 20**.

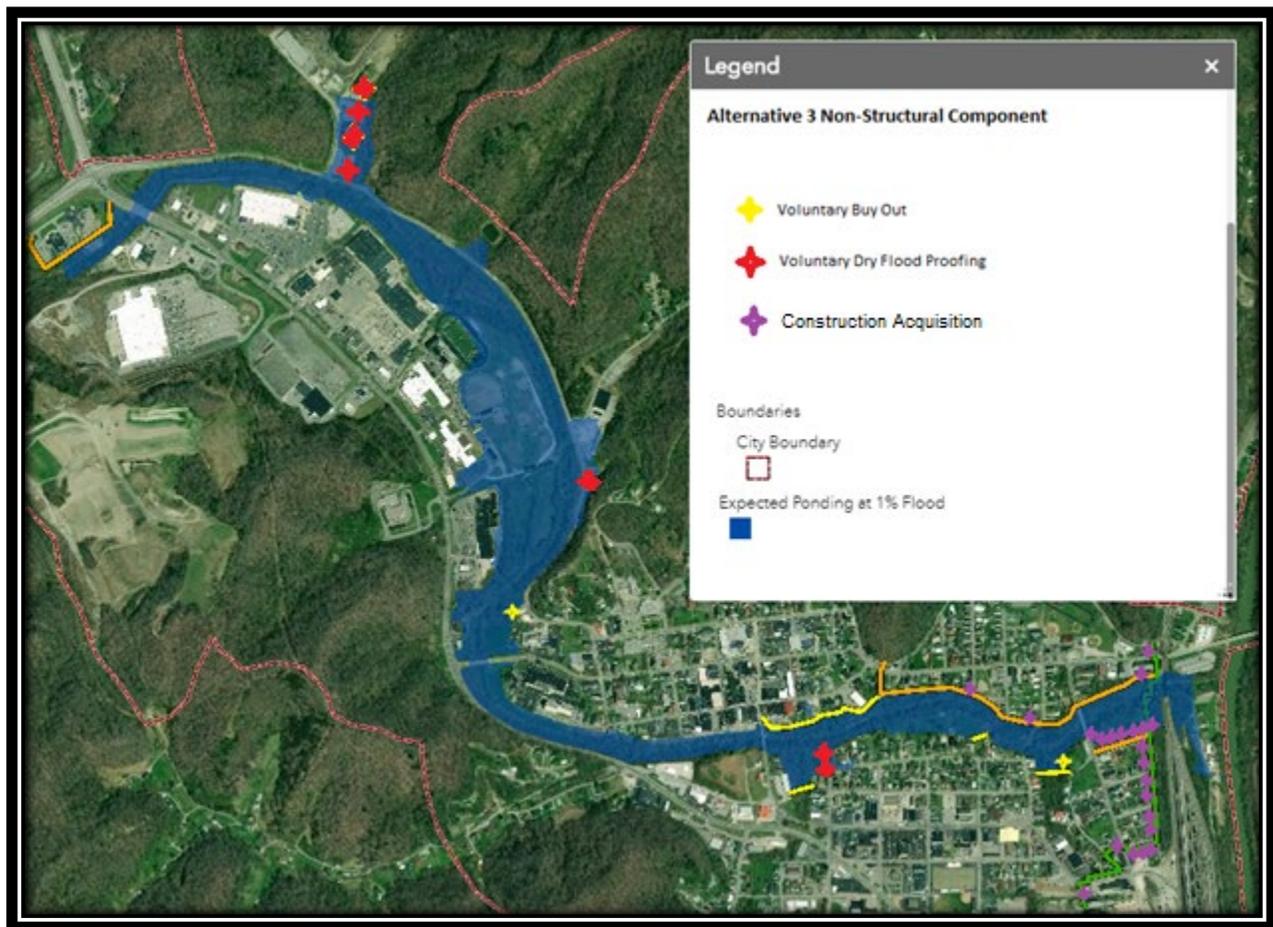


Figure 20. Alternative 3R Non-Structural Component

While the City of Paintsville has an emergency flood management plan already in place, Alternative 3R would include efforts that would update and revise the current plan and would contain Automatic Flood Warning Systems (AFWS) including but not limited to additional stream gages, rain gages, data collection systems, and information dissemination features like auto dialers and sirens.

Table 17 summarizes the component parts of Alternative 3R. The preliminary first cost for this alternative is \$119,980,000.

Table 17. Summary of Alternative 3R

Alternative 3R:	Plan Type: Structural + Non-structural
Structural Protective Works	Main Floodwall, series of short walls, gravity drainage structure including automatic flap gates and swing or sluice gates.
<u>Floodwalls:</u>	
<u>Quantity:</u>	
Levees	2,570 LF of levee, 45,400 CY of impervious suitable material from the main borrow site
Cut and Fill take off	17,440 CY of cut and haul. 45,400 CY of fill placement. For levee and inspection trench construction Average 2.5 mile haul. Paint Creek structure 41,110 CY of cut stockpile and reuse.
6' I-Walls	2,590 lineal ft.
10' T-Walls	2,700 lineal ft.
15' T-Walls	920 lineal ft.
18' T-Walls	760 lineal ft.
28' T-Walls	330 lineal ft.
<u>Design:</u>	
Levee	10' wide crown, 3:1 side slopes, minimum 6' deep inspection trench.
I-Walls	Sheet pile I-wall, minimum 30' embedment, maximum 6' stick-up, concrete encased.
Floodwall	Cast-in-place reinforced concrete T-wall; 30' sheet piling seepage cutoff wall everywhere, remove and recompact bank random fill, stone slope protection on new ground below the ordinary high watermark, topsoil, height varies.
<u>Openings:</u>	Number – 6 Vehicular, 0 Pedestrian
Floodwall	Chessie Lane, Route 40, and Greentown Road
<u>Gates:</u>	
Bridge St.	Swing gate, 35 ft. wide x 5 ft. high.
US 40	Swing gate, 40 ft. wide x 18 ft. high.

Alternative 3R:	Plan Type: Structural + Non-structural
US 40	Swing gate, 40 ft. wide x 3.5 ft. high.
Depot	Swing gate, 40 ft. wide x 2 ft. high.
Broadway	Swing gate, 40 ft. wide x 9 ft. high.
Chessie Lane	Swing gate, 40 ft. wide x 12 ft. high.
<u>Gravity Drainage Facilities:</u>	
<u>Paint Creek Gravity Gate</u>	3 – 25’x25’ Tainter Gates
<u>Flap gates</u>	6 – 60” diameter flap gates. With headwall structure 2 – 30’ diameter flap gates. With headwall structure 6 – 24’ diameter flap gates. With headwall structure
Non-structural	
<u>Scope</u>	Voluntary dry flood proofing and mandatory acquisition of eligible structures along the project alignment.
<u>Dry flood Proofing</u>	7
<u>Voluntary Buy-Out</u>	2
LEERDS	
<u>Construction Acquisition</u>	22

Figure 21 is an aerial photo of the City of Paintsville showing the locations of the proposed major features of Alternative 3R. As formulated, this Recommended Plan would reduce the risk of flooding and related damages to approximately 763 businesses and residences. Of the Current 635 structures that are currently in the FEMA 1% AEP floodplain, 100% of the 635 structures will receive a reduction in flood risk and over 500 of these structures upon the completion of a Letter of Map Revision (LOMR) would no longer be shown as located in the floodplain as defined under the NFIP.

The advantages of this plan is the avoidance of CSX property. The disadvantages include greater risk of encountering contamination, provides slightly less internal storage, has a less robust and resilient overtopping zone as compared to Alternative 2R, and requires the acquisitions of 11 more structures as compared to alternative 2R.



Figure 21. Alternative Plan 3R Major Features

4.4.7. REFORMULATED ALTERNATIVE PLAN 4R.

This alternative plan is a separable plan focused on a volunteer program of non-structural measures for Johnson County, Kentucky for structures that are located within the areas impacted by the 1977 flood event, but outside the City limits.

The starting point for alternative 4 was a structural inventory for the entire county. This inventory came from a Bing Data set. Each structure identified by the Bing data set was georeferenced to a topography map to determine low ground elevation. Next, each structure was compared to the FEMA floodplain and assigned a 1% AEP stage elevation. With the 1% AEP stage elevation and the low ground elevation, each structure was visited and the first finished floor was estimated in six inch increments. With this data the depth of inundation for each structure was determined for the 1% AEP event.

This information was utilized to eliminate structures that appear to be in the floodplain but have finished first floors above the floodplain 1% AEP stage. Results of this windshield first floor elevation survey resulted in eliminating 129 residential structures and 26 businesses. Approximately 446 structures in Johnson County outside of the City limits are located in the FEMA 1% floodplain or floodway. Section 202 policy specifically identifies structures that flooded or would flood in the reoccurrence of the 1977 flood event and because of this not all structures in the FEMA floodplain are eligible. To determine eligibility in the county H&H modeling of the 1977 flood was performed on the streams where the majority for the structures reside. These are the same areas that received further study in the FEMA Flood Insurance study. The 1977 flood was modeled on the areas surrounding the following creeks and forks:

Bear Hollow, Jenny's Creek, Joe's Creek, Blaine Creek, Levisa Fork, Lick Fork, Little Mudlick Creek, Little Paint Creek, Miller Creek, Mudlick Creek, and Paint Creek.

In the areas surrounding these creeks and forks there is sufficient data to determine which homes were flooded in 1977 or would be in the reoccurrence. These areas have a total of 125 structures including 99 residential and 26 businesses. In this same area FEMA's floodplain and floodway contains 231 structures

including 206 residential and 25 businesses. The floodplain elevation for each structure is important because per policy, each eligible structure will receive flood risk reduction up to 1' above the FEMA 1% AEP stage.

While the PDT has sufficient modeling on 10 of the main Levisa Fork tributaries in Johnson County, 52 other creeks, branches, and forks remain in the county unmolded for the 1977 flood event. Based on the GIS exercise and windshield survey discussed above the PDT has determined that there are 321 structures in the FEMA 1% AEP area that have first finished floors below the 1% flood stage. Of the 321 structures there are 34 business and 161 residences. There is not sufficient data on these 52 flooding sources to determine which ones flooded and which ones did not. The PDT feels that the time and money associated with performing the additional modeling would not be consistent with the risk informed decision process that is currently being embraced by the USACE.

In lieu of additional modeling, the PDT is utilizing the ratio of flooding that occurred on the known streams and applying that to the unknown streams. On the 10 modeled streams, 100% of the structures in the FEMA Floodway flooded. Given that information, the PDT assumed all 20 structures in the FEMA floodway on the unmolded streams also flooded or would flood in the reoccurrence of the 1977 event. Also on the 10 modeled streams, 38% of the structures in the floodplain flooded in 1977. Of the structures that flooded on those 10 streams, the structures that had the deepest inundation depths were among those that flooded in 1977. Based on this information the PDT has determined that the best path forward utilizing risk informed decision making is to utilize the flood ratio on the modeled streams and apply it to the un-modeled streams. With this logic, the PDT assumed that 38% of the 195 structures that are in the FEMA 1% floodplain on streams that aren't modeled would have flooded during the 1977 flood event. That ratio gives the team a targeted number of 74 structures. When looking at the inventory of structures in the floodplain on the un-modeled streams the team has identified 74 structures in the FEMA floodplain that have the highest inundation depths and included them in the eligibility of the Alternative 4R non-structural plan.

The sum of the modeled and interpolated structures flooded in 1977 is 219 structures. During the implementation of this non-structural program, anyone property owner not identified as eligible for this voluntary program that believes they should be, will be given the opportunity to provide sufficient evidence that their residence or business structure flooded or would flood in a reoccurrence of the 1977 flood.

Once the eligibility is determined the method must also be determined. The inundation depths were used to estimate the most appropriate method of non-structural flood risk management. As we evaluated each structure the square footage of each structure, the depth of inundation, foundation type, and the PVA total structural values, was utilized to determine the least cost measure for each structure. In addition to the above process, any structure in the floodway is only eligible for buyout. This method can be used to determine the most likely lowest program cost for 100% participation in the program. The study also provides an upper boundary cost by assuming that all eligible are buy outs. This is considered the upper bound cost of the non-structural program.

The non-structural measures eligible for this program included dry flood proofing, raise in place and permanent floodplain evacuation (i.e. buy-out). The preliminary first cost for this alternative is \$28,125,000. Further detailed discussion of this analysis and cost estimate is provided in Volume 6.

Table 18. Comparison of revised alternative 4 measures to project Planning Evaluation Criteria.

Non-Structural Measures For Alternatives 4 Compared to Evaluation Criteria				
Alternative	Effectiveness:	Acceptability:	Completeness:	Efficiency:
Buy Outs	More Effective	Acceptable For All Structures	Complete	Most Efficient Plan
Raise In Place	Less Effective	Max 8-10 feet raised	Not Complete	Less Efficient
Dry Flood Proof	Least Effective	Max 3' raised	Not Complete	Not Efficient

Effectiveness: the extent to which the alternative plan alleviates the specified problems and achieves the specified opportunities.
Acceptability: the extent to which the alternative plan is acceptable in terms of applicable laws, regulations and public policies.
Completeness: the extent to which the alternative plan provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.
Efficiency: the extent to which an alternative plan is the most cost effective means of achieving the objectives.

4.4.8. COMPARISON OF REFORMULATED ALTERNATIVES ARRAY

The Paintsville total non-structural alternative along with Alternatives 2R and 3R were compared against the project planning objectives and the PGN evaluation criteria. Per authorization, the deciding criteria for the Recommend Plan is *feasibility and cost effectiveness*.

The alternatives were updated from the FAAM through hydrologic modeling, a coincident frequency analysis, an overtopping analysis, a topographic survey, geotechnical investigations, cultural resource and environmental resource surveys, a HTRW records review and site inspection, a 30% project design, and a Cost Schedule Risk Analysis. Summaries of this evaluation are listed in **Tables 19** and **20**.

Because the primary goal of this project was to formulate a plan that would address the flood risks identified for the City of Paintsville, Alternatives 2R and 3R were compared to each other as well as the project planning objectives and PGN criteria. Alternative 4R was compared to the project planning objectives and the PGN Criteria only. In accordance with authorizing language to provide a solution for the entire County, Alternative 4R was *combined* with each alternative 2R and 3R as well as non-structural for Paintsville.

4.4.8.1. Alternative Feasibility Comparison

Feasibility of each alternative is justified by comparing the performance of each alternative to planning objectives. **Table 19** shows how the Alternatives perform using a simple rating system to differentiate feasibility of each alternative. This rating is designed to illustrate whether an alternative has a positive, negative or no influence on a planning objective. A description of alternative feasibility follows.

Table 19. Comparison of revised alternatives array to project planning objectives.

	Paintsville NS / 4R	2R / 4R	3R / 4R	No Action
Obj1: Provides flood risk reduction measures that comply with Section 202 of PL 96-367 and other applicable laws and regulations.	3	3	3	1
<i>Obj2: Reduce, to the extent possible, financial and personal losses due to flooding.</i>	3	3	3	1
<i>Obj 3: Maintains, to the extent possible, the social, cultural and economic cohesion of the communities within Paintsville and Johnson County.</i>	3	3	3	1
Total Score	9	9	9	3

Note: A rating “3” indicates that the alternative improves the corresponding objective, a “2” denotes no effect, and a “1” indicates there is a negative effect.

Planning Objective 1: Provides flood risk reduction measures that comply with Section 202 and other applicable laws and regulations.

Reformulated Alternatives 2R/4R, 3R/4R and Paintsville NS/4R provide flood risk reduction measures, structural and non-structural, for the City of Paintsville and Johnson County, KY per the authorizing legislation, and other applicable laws and regulations and therefore meets the planning objective.

Planning Objective 2: Reduce, to the extent possible, financial and personal losses due to flooding.

The number of structures receiving a reduction in flood damages and risks by Alternatives 2R/4R and 3R/4R is approximately 785 minus construction acquisitions. Approximately 500 of these structures would also be removed from FEMA’s current 1% AEP floodplain. A modern FWEPP provides reduced life safety risks for Johnson County. In addition approximately 192 structures affected by the 1977 flood event and/or a reoccurrence of the 1977 flood event in Johnson County, Kentucky would be eligible for the voluntary non-structural program in Paintsville NS/Alternative 4. Therefore, all of the alternatives meet this objective.

Planning Objective 3: Maintains, to the extent possible, the social, cultural and economic cohesion of the communities within Paintsville and Johnson County.

Reformulated Alternatives 2R/4R, 3R/4R and Paintsville NS/4R would maintain the social, economic and cultural cohesion of communities in Paintsville Kentucky and Johnson County, Kentucky. Reformulated Alternative 2R/4R would require the acquisition of 11 residences and buildings in the City of Paintsville and relocation of its residents to construct (1% of the total occupied structures) while Alternative 3R/4R would require 22 residences and buildings. (2% of the total occupied structures). Paintsville NS/Alternative 4R would maximize cohesion, but would have the greatest affect compared to the other alternatives. Therefore, all of the alternatives meet this objective.

All three alternatives, Paintsville NS/4R, Alternative 2R/4R and Alternative 3R/4R are considered *feasible*.

4.4.8.2. Alternative Cost Effectiveness Comparison

Cost effectiveness of each alternative is justified by comparing the performance of each alternative compared to risk reduction per structure expressed in first cost dollars. **Table 20** shows how each

alternative performs as cost of risk reduction per structure - project first cost divided by number of structures protected by each alternative. This is a common metric used in previous Section 202 projects. A description of alternative cost effectiveness follows.

Table 20. Alternative Comparison by Cost Effectiveness

Plan Comparison Summary						
	# Of Non-Structural	# Of Structural	Project First Cost (million)	Total Structures w/ Reduced Flood Risk	Total First Cost (million)	Cost of Risk Reduction Per Structure (RRPS) (\$ dollars)
Paintsville NS* / 4R	323/192	0/0	(98)/(28)	323 + 192 = 515 structures	(98)+(28) = (126)	126(mil)/515 = \$ 244,660
2R* / 4R	9/192	765/0	(110)/(28)	9+192+765 = 966 structures	(110)+(28) = (138)	138(mil)/966 = \$142,860
3R* / 4R	9/192	754/0	(117)/(28)	9+192+754 = 955 structures	(117)+(28) = (145)	145(mil)/955 = \$151,830
No Action	0	0	0	0	0	0

Note: (*) The non-structural only plan in City of Paintsville has RRPS cost of \$303K per structure. For comparison 2R RRPS = \$144K, 3R RRPS = \$155K.

Number of structures with reduced flood risk: Both non-structural and structural have been compared. Alternative 2R/4R will reduce risk for the most structures (966) and alternative 3R/4R (955) is very similar. The non-structural plan Paintsville NS/4R reduced risk for the fewest structures (515).

Total cost: The cost for Paintsville NS/4R is the lowest at (~\$126 million). 2R/4R is second at (\$138 million.), and Alternative 3R/4R (~\$145 million) has the highest cost.

Cost of risk reduction per structure: Used as the main evaluation criteria for *cost effectiveness* – Alternative 2R/4R is the clear winner at a cost of \$142,860 per structure. Next best performers are alternative 3R/4R (\$151,830) and Paintsville NS/4R by far the least cost effective at \$244,660 per structure.

4.4.8.3. PGN Criteria

Each alternative must meet PGN criteria before final selection of the Recommended Plan.

Table 21 shows how each Alternative meet the PGN criteria with a discussion as follows:

Effectiveness. Alternatives 2R, 3R, and 4R are considered to be effective in reducing the economic losses and/or potential life risks for the City of Paintsville and Johnson County, Kentucky, avoiding identified constraints, and providing opportunities to improve local housing quality and commercial development. Alternative 2R is considered to be more effective based on the following:

- Improved overtopping section. Alternative 2R includes a long overtopping section with a short spill height, the overtopping water would be automatically diverted back to Paint Creek by flowing down the river road adjacent to the CSX Railroad. This overtopping area is separated from residential and business by the CSX Railroad embankment.
- Greater interior storage as well as more efficient channel flow will be provided by Alternative 2R when compared to Alternative 3R.

- Alternative 2R results in less impact to road closures and egress in the City of Paintsville because the main floodwall alignments are located, on average, higher elevation existing conditions. The road closures required are not as tall and therefore necessitate much later closing requirements.

Acceptability. Alternatives 2R, 3R and 4R are acceptable in terms of applicable laws, regulations, and public policy. Alternative Plan 2R is preferred by the non-Federal sponsor above the others, as it requires less property acquisitions. More specifically alternative 2R will require a total of 11 construction acquisitions of residential and business structures while alternative 3R would require a total of 22 construction acquisitions of mostly residential structures. Each project allows for identical voluntary non-structural solutions on 9 structures in the City of Paintsville. It is recognized, however, that there will be some public opposition with respect to any floodwall and levee construction in Paintsville. All measures and alternatives sought to minimize required construction acquisitions.

Completeness. Alternatives Plans 2R, 3R, and 4R are considered to be complete plans that account for all of the necessary investments or other actions by the USACE and non-Federal sponsor to ensure the realization of the above planning objectives, capitalize on opportunities, and minimize constraints. There were no quantitative means to separate alternative 2R and 3R based on completeness.

Efficiency. Results of this evaluation determined that Alternative Plan 2R was the least-cost plan that reduced the flood damages and risks for the City of Paintsville. See volume 5 for detailed cost estimates of alternative 2R and 3R. Alternative 2R is approximately 10 million dollars cheaper in upfront costs and provide flood reduction to 11 additional structures. Due to lower cost and flood risk reduction to more structures, Alternative 2R is more efficient when compared to alternative 3R. Non-structural measures for Alternative 4R may also be addressed for all of Johnson County as funding allows.

Table 21. Comparison of the USACE Evaluation Criteria to Reformulated Alternatives Array.

Reformulated Alternatives Array Compared to Evaluation Criteria				
Alternative	Effectiveness:	Acceptability:	Completeness:	Efficiency:
Alternative Plan 2R/4R	More Effective	More Acceptable	Equally Complete	Most Efficient Plan
Alternative Plan 3R/4R	Meets criteria, Less effective than 2R	Meets Criteria, Less Acceptable than 2R.	Equally Complete	Less Efficient
Alternative Plan Paintsville NS* 4R	Meets criteria	Meets criteria	Meets criteria	Less Efficient.
<p>Effectiveness: the extent to which the alternative plan alleviates the specified problems and achieves the specified opportunities.</p> <p>Acceptability: the extent to which the alternative plan is acceptable in terms of applicable laws, regulations and public policies.</p> <p>Completeness: the extent to which the alternative plan provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.</p> <p>Efficiency: the extent to which an alternative plan is the most cost effective means of achieving the objectives.</p>				

4.5. PROJECT RISK

4.5.1. RISK MATRIX

Table 22 summarizes the known risks associated with the alternatives array, the consequence associated with each plan and their likelihood to occur, and recommendations to mitigate these risks.

Table 22. Risk matrix for the Johnson County, KY Section 202 project alternatives array.

RISK/OPPORTUNITY EVENT	CONSEQUENCE OF EVENT	LIKELIHOOD OF OCCURRENCE	RISK LEVEL	UNCERTAINTY	RISK RESPONSE STRATEGY
Negative public response to the project.	Marginal	Seldom	Moderate	High	Reduction
Delays in the acquisition of real estate needed for the project and the relocation of effected residents and property.	Marginal	Likely	Moderate	Medium	Prevention
Utility relocations.	Marginal	Likely	High	Medium	Mitigation
Lack of subsurface information.	Critical	Likely	High	Low	Avoidance
CSX Railroad Property issues	Marginal	Frequent	High	Medium	Mitigation
HTRW present within the alternatives	Critical	Seldom	Moderate	Medium	Avoidance
Historic properties present within the project.	Marginal	Seldom	Low	Medium	Mitigation
Endangered species present within the project.	Marginal	Seldom	Low	Medium	Mitigation

4.5.2. SEMI-QUANTITATIVE RISK ASSESSMENT

Planning Bulletin (PB) 2019-04, dated June 20, 2019, discusses tolerable risk guidelines and how they will be considered in flood risk management studies. ER 1105-2-101, dated July 15, 2019, discusses Risk Assessments during flood risk management studies. *ECB Risk Informed Decision Making for Engineering Work during planning Studies*, dated March 6, 2019, is specifically applicable to the 2018 supplemental bill that provides appropriations for the study, design and construction of this project.

All of the guidance above was published as the study formulation was in process. As a result of the published guidance the PDT has taken each document into the process and included the risk framework into the formulation and decision making process.

The primary principles of risk-informed design are as follows:

- a. Hold life safety paramount, as defined by the TRGs as defined in draft EC 1165-2-218 (Levee Safety Program – Policy and Procedures).
- b. Corporately manage risk by analyzing the levee system risk in a consistent manner to other levee systems
- c. Ensure open and transparent engagement by engaging local sponsors in all design activities.
- d. Learn and adapt by evaluating if design standards need to be up-scaled or down-scaled.
- e. Do no harm by not increasing the risk to population and property above existing risk levels.

In addition to following these principles, it is important that the risk team, made up of personnel from the PDT but led by an experienced facilitator and co-facilitator, also followed the process as it is laid out in the related policies mentioned above. It is not the goal of the team to enter into “reformulation” of the planning study. For example, increasing the levee height to provide a different frequency of flood risk management is beyond the limit of the authorized project. However, incorporating resiliency features so that levees perform adequately for events that exceed the authorized level may be a cost-effective measure to reduce risk.

The risk assessment consisted of a facilitated Potential Failure Modes Analysis (PFMA) and an assessment of the potential failure modes judged to be risk drivers. The project design is in draft stage, and the risk assessment team understands that the final project design may differ from what was assumed in this risk assessment. The PDT will work with the risk assessment facilitators to revisit the risk assessment as the design and construction progresses.

For this study the early formulation that took place in late 2018 did not officially produce individual risk assessments for each measure and alternative but various types of risk were considered throughout the process. As the formulation reached the point of evaluating final alternatives and further investigating the Recommended Plan, the PDT moved forward with a semi-quantitative risk assessment (SQRA) looking specifically at the Recommended Plan. The SQRA is being performed concurrent with the review of the feasibility study. In this SQRA the cadre is assessing the specific Recommended Plan in its roughly 30% design and will be essential for guiding the design team in efforts to address any areas that could reduce risk through robust, resilient, and redundant methods, as the project delivery team takes the Recommended Plan from the 30% concept to the final ready to advertise flood risk management project. One key benefit of the SQRA will be the development of tolerable risk guidelines for the Recommended Plan.

Tolerable Risk Guidelines (TRG) are used for risk-informed decision making within the USACE Levee Safety Programs. These guidelines are the criteria USACE uses to determine if the risks associated with dams and levee systems are “tolerable.” The TRGs were considered as part of this report’s risk assessment process. The four TRGs are provided below.

- TRG 1 (Understanding the Risk): Society is willing to live with the risk associated with the levee to secure the benefits provided by the levee or living and working downstream or in the leveed area.
- TRG 2 (Building Risk Awareness): There is a continuation of recognition and communication of the levee risk.
- TRG 3 (Fulfilling Daily Responsibilities): The risks associated with the levee system are being properly monitored and managed by those responsible for managing the risk.

- TRG 4 (Actions to Reduce Risk): There are no cost-effective, socially acceptable, or environmentally acceptable ways to reduce risks.

The following will be performed and documented as the project moves from study to design to construction to meet and minimize risk associated with the TRGs above:

TRG 1: The risk assessment will inform the designers and recommend methods to reduce risk during design, the risk assessment will be updated at the completion of design incorporating any changes. The revised risk assessment will inform construction division's oversight of the projects construction. Key construction features will be identified for focused oversight in areas that are subject to the most risk. The risk assessment will again be revised as the project completes the construction phase and is turned over to the non-federal sponsor for OMRRR. This risk assessment revision will be completed as a project cost and may be provided to the sponsor and utilized by the sponsor for NFIP accreditation purposes. As required by the USACE levee safety program guidance, the risk assessment will be periodically updated based on the current status of the project, years after construction.

TRG 2: Throughout the life of the study, design, and construction public meetings will be held as needed and a focal point of each meeting will be the reality that flood risks will always be present in the City of Paintsville. More specifically, discussions of transformed risk, residual risks, and the risk of interior flooding will be discussed with the sponsor and the public. The FWEEP development and construction will be a key part of the project that provides awareness day to day for flood risks and the need and timing of evacuation.

TRG 3: The risks associated with managing the levee system are hard to estimate because it is hard to know how well the non-federal sponsor will prioritize the operation and maintenance of the system. As part of the construction contract, the contractor will be required to provide operation training of the newly constructed system to the non-federal operation staff. Since there is no history of OMRRR for the Non-Federal sponsor and the risk in the community if great, it is assumed that the responsibility will be held in high regard and in high priority. In addition to assuming the non-federal sponsor will perform these tasks, the USACE Levee Safety Program will annually inspect the system with surficial periodic inspections and on 5 year intervals more detailed inspections will take place to ensure these responsibilities are being fulfilled.

TRG 4: This FRM project is utilizing the risk assessment to inform the design because of this the design team opens up much more potential for making changes to the design than would be possible after construction. For example, if extending a sheet pile cutoff wall 10' is found to considerably reduce risk to under seepage failure, the design would include that change at a rather insignificant cost increase, however if the project was constructed and the same recommendation was made that change would be impractical and unfeasible. In order to ensure the team meets TRG 4 the following questions will be asked as the team moves through the design process:

1. Have appropriate actions been taken to reduce risks?
2. Could any actions reasonably be taken that would reduce risks further?
3. What is the cost to reduce the risk and how much is the risk reduced?
4. Should actions be evaluated in a detailed study?
5. Is there demonstrated progress towards implementing risk reduction measures?

4.6. RECOMMENDED PLAN

4.6.1. RECOMMENDED PLAN DESCRIPTION

Given the array of alternatives considered, a comparison with the project’s planning objectives and the USACE evaluation criteria, the preferences of the non-Federal sponsor, and estimated costs of the plans, a plan consisting of the separable elements of Alternate 2R and Alternate 4R is the Recommended Plan for this project. This plan will address flood risks for the City of Paintsville and provides a comprehensive flood risk management strategy for Johnson County.

The Alternative 2R element of the Recommended Plan addresses flood risks in the City of Paintsville and estimated the first cost to be \$110,305,000. Alternative 2R can be implemented immediately using currently appropriated funds. The Alternative 4R element of the Recommended Plan – a voluntary non-structural program involving flood proofing, raise-in-place, and buy-outs for all eligible structures in Johnson County, Kentucky – has an estimated first cost of **\$32,502,000** and will be implemented as funding allows.

Table 23 shows the projects first costs and prioritization of the two separable elements. Using Cost of Risk Reduction per Structure as a metric, it is clear Alternative 2R is the more cost effective of the two major components. As funds allow and participants identified/engaged, Alternative 4R will be completed.

Table 23. Recommended Plan

The Recommended Plan					
	Residential	Commercial	Total	Project First Cost	Cost of Risk Reduction Per Structure (RRPS) (\$ dollars)
City of Paintsville (2R)			774	\$110,305,000	\$143,000
Levee/Floodwall	664	101	765	\$109,720	
Dry Flood Proof	0	5	5	\$421,000	
Buyout	4	0	4	\$165,600	
Johnson County (4R)			192	\$28,125,000	\$146,000
Buy Out (floodway)	39	6	45	\$12,452,600	
Most Effective Non-Structural	119	28	147	\$15,673,000	
Total Recommended Plan First Cost	826	140	966	\$135,530,000	

4.6.2. ESTIMATED PROJECT COSTS AND SCHEDULE.

Table 24 shows a breakdown of the costs associated with the Recommended Plan 2R separable element. Additional information on these cost estimates are provided in Volume 5 shows the tentative implementation schedule for Alternative 2R.

Table 24. Project First Costs for the Recommended Plan.

Johnson County, Kentucky Section 202 Project Plan element 2R Project First Cost Estimate	
Construction	\$81,862,000
Lands and Damages	\$6,643,000
Preconstruction, Engineering & Design	\$12,980,000
Construction Management	\$8,820,000
Total:	\$110,305,000

Table 25. Remaining schedule element 2R.

Johnson County, Kentucky Section 202 Project Project Schedule	
MSC Decision Milestone	December 2019
Public Review	February 2020
Start Project Design	February 2020
MSC Validation of Detailed Project Report	May 2020
Director's Report	August 2020
Execute Project Partnership Agreement	September 2020
BCOES Certified	August 2021
Plans and Specifications Approval	September 2021
Construction Contract Advertisement	October 2021
Construction Contract Award	December 2021
Begin Project Construction	January 2022
Project Physically Complete	April 2024

4.6.3. IMPLEMENTATION REQUIREMENTS – RECOMMENDED PLAN

The project components (2R & 4R) that are recommended for implementation require the cooperation and coordination of Federal, state and non-Federal agencies to be successful. The following paragraphs summarize the operation, maintenance, and management responsibilities of the non-Federal sponsor (Johnson County Fiscal Court) that are expected to be contained in the PPA.

- a. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocation determined by the Federal Government to be necessary for the construction, operation, and maintenance of the project. Per Supplemental Guidance, LERRDS are included as a project cost and reimbursable to the non-federal sponsor;

- b. Provide, during implementation, any additional costs as necessary to make its total contribution to the total project costs allocated to flood control.
- c. For so long as the project remains authorized; operate, maintain, repair, replace, and rehabilitate the completed project or functional portion of the project, at no cost to the Federal Government except as authorized by P.L. 84-99, in accordance with applicable Federal and State laws and any specific directions prescribed by the Federal Government in accordance with C.F.R. Title 33, Part 208.10.
- d. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon land that the non-Federal sponsor owns or controls for access to the project for the purpose of inspection and, if necessary after failure to perform by the non-Federal sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.
- e. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.
- f. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 C.F.R., Section 33.20.
- g. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under CERCLA, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the operation, maintenance, repair, replacement and rehabilitation of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction.
- h. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the operation, maintenance, repair, replacement, or rehabilitation of the project.
- i. As between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practical, operate maintain, repair, replace, and rehabilitate the project in a manner that would not cause liability to arise under CERCLA.
- j. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (P.L. 100-17), and the Uniform Regulations contained in 49 C.F.R. Part 24, in acquiring lands, easements, and rights-of-way required for the operation maintenance repair, replacement, and rehabilitation of the project, including those necessary for structure acquisitions, borrow materials, and dredged or excavated

material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

- k. Comply with all applicable Federal and State laws and regulations including, but not limited to, Section 601 of the Civil Rights Act of 1964, P.L. 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army, and Section 402 of the WRDA of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans.
- l. Provide a share of the total cultural resources preservation, mitigation and data recovery costs attributed to flood control that are in excess of one % of the total amount authorized to be appropriated for flood control.
- m. Participate in and comply with applicable Federal floodplain management and flood insurance programs.
- n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of flood risk it affords or that would hinder operation and maintenance of the project.
- o. Not less than once each year, inform affected interests of the extent of the flood risk reduction afforded by the project.
- p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with flood risk reduction levels provided by the project.
- q. Comply with Section 221 of P.L. 91-611, as amended, and Section 103 of P.L. 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.
- r. Provide and maintain necessary access roads, parking areas and other public use facilities, open and available to all on equal terms.
- s. Not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

4.6.4. LOCAL BETTERMENTS

A betterment is an improvement made to a piece of property that increases its value, rather than a repair that simply maintains its current value. No betterments are included in the Recommended Plan. The sponsor has not indicated an interest in such betterments.

4.6.5. FULLY FUNDED ESTIMATED COST

The fully-funded project cost for Alternative 2R is estimated to be **\$116,997,000**. See Volume 5 Cost Estimating Appendix for a detailed description of each Work Breakdown Structure feature. The fully

funded project cost for Alternative 4R is estimated to be \$33,694,000. See Volume 6 Non-structural Plan Appendix for a structure-by-structure breakdown with assumptions utilized to determine the most cost effective non-structural measure as well as the buy-out cost per structure. Benefits were developed using a method utilized by the Dickerson County, VA Levisa Fork Basin 202 project in 2003.

This project utilized historical regional project benefit calculations by using the average annual benefit of commercial and residential structures. It used three separate projects as a proxy to develop the average. Those projects were the Pike County, KY 202, Martin County, KY 202 and Wayne County, WV 202. This method took the per-structure AAB from multiple similar projects in the region and applied the average value to the inventory list. Per-structure AAB was broken down into Residential and Commercial structures. The historical per-structure AABs were indexed up using the Engineering New Records Construction Cost Index. The index period price increase can be seen in **Table 26**.

Table 26: ENR Construction Cost Index.

ENR Construction Cost Index	
Oct. 2002	6589
Oct. 2019	11326
Price Increase	1.718925

The Dickenson County 202 average annual benefit per-commercial-structure was estimated to be \$1,494 and the per-residential-structure was estimated to be \$691. When indexed up to current price levels those values are \$2,568 and \$1,188, respectively. Of the 517 structures, 131 are commercial and 386 are residential. This method estimates the AAB to be around \$795,000. **Table 27** shows the AAB for the Historical Regional Project Method.

Table 27. AAB for the Historical Regional Project Method.

	COM	RES	Total
Alternative 2	251	514	
Alternative 4	34	158	
Historical AAB	\$1,494	\$691	
Inflation %	172%	172%	
Indexed AAB	\$2,568	\$1,188	
Total AAB	\$ 731,901	\$ 798,186	\$ 1,530,088

Based on this benefit calculation method the expected average annual benefits are \$1,503,088. The AAB per alternative is presented in **Table 28**.

Table 28. Average Annual Benefits per Separable Element.

	AAB
Element 2R	\$ 1,255,104
Element 4R	\$ 274,983
Total	\$ 1,530,088

Alternative 2R costs \$144,000 per structure protected based on the 1977 flood conditions. Alternative 4R costs \$172,000 per structure protected based on the 1977 flood conditions. Alternative 2R does provide a positive externality benefit of some level of flood risk reduction to an additional 471 structures which are outside the 1977 flood conditions.

4.6.6. TOTAL ECONOMIC COSTS OF PLAN ELEMENTS 2R AND 4R

Table 29. Alternative 2R Economic Cost.

Element 2R First Costs	
Contractors Earning Plus Contingencies	\$ 81,862,429
Planning, Engineering & Design	\$ 12,980,000
Supervision & Administration	\$ 8,820,000
Total First Costs	\$ 103,662,429
LEERDs	\$ 6,642,750
Investment Costs	
Total First Costs	\$ 103,662,429
Interest During Construction	\$ 5,208,600
Investment Costs	\$ 108,871,029
Total Costs	\$ 115,513,779
Average Annual Costs	
Total Costs	\$ 115,513,779
Partial Payment Factor	0.03704092
Average Annual Costs	\$ 4,279,000
Annual Maintenance	\$ 436,000
Total Average Annual Costs	\$ 4,715,000

Table 30. Alternative 4R Economic Cost.

Element 4R First Costs	
Contractors Earning Plus Contingencies	\$ 28,125,265
Planning, Engineering & Design	\$ 960,000
Supervision & Administration	\$ 960,000
Total First Costs	\$ 30,045,265
LEERDs	\$ -
Investment Costs	
Total First Costs	\$ 30,045,265
Interest During Construction	\$ 14,316
Investment Costs	\$ 30,059,581
Total Costs	\$ 30,059,581
Average Annual Costs	
Total Costs	\$ 30,059,581
Partial Payment Factor	0.03704092
Average Annual Costs	\$ 1,113,435
Annual Maintenance	\$ 192,000
Total Average Annual Costs	\$ 1,305,435

Table 31. Combined Economic and Average Cost.

Total First Costs	
Total Element 2R Costs	\$ 115,513,779
Total Element 4R Costs	\$ 30,059,581
Total Combined Costs	\$ 145,573,360
Total Element 2R AAC	\$ 4,715,400
Total Element 4R AAC	\$ 1,305,435
Total Average Annual Costs	\$ 6,020,835

4.6.7. BENEFIT COST RATIO

Table 32. Benefit to cost Ratio Calculations by plan element.

	AAB	AAC	BCR
Element 2R	\$ 1,255,104	\$ 4,715,400	0.27
Element 4R	\$ 274,983	\$ 1,305,435	0.21
Complete Plan	\$ 1,530,088	\$ 6,020,835	0.25

The AAB per alternative is based on the greatest benefit value of either method. This is done given the uncertainty around each valuation and its impact to ability to pay.

4.6.8. ABILITY TO PAY

The Johnson County, Kentucky, 202 project is subject to the cost-sharing requirements outlined in the Water Resources Development Act of 1986 (P.L. 99-662). According to Section 103(m) of this Act, an "Ability-to-Pay" determination is required for any flood control project or separable element covered by the terms of Section 103(a) or Section 103(b). This analysis will employ Economic Guidance Memorandum (EGM) 14-04, Current State and County Income Index Data, Current Eligibility Factor Formula (Ability to Pay).

This project received supplemental funding after project study initiation. All funds provided by supplemental accounts are 100% covered by the Federal government and are not subject to cost share. Only funds spent before the allocation of supplemental funding is subject to standard non-Federal cost share. The amount is \$1,929,994.

An "Ability-to-Pay" determination is based on two separate tests – benefits and income. As outlined in ER 1165-2-121, the benefits test is the first step in determining if a project may be eligible for a reduction in the non-Federal cost share. The project’s eligibility for a reduction is verified by conducting an income test, which also governs the magnitude of an applicable reduction.

In order to determine the project’s eligibility for a non-Federal cost share reduction, the Benefits Based Floor (BBF) must first be calculated. The BBF is equivalent to the project’s benefit-to-cost ratio (BCR) divided by four.

$$BBF = (BCR) / 4$$

The calculation of the Benefits Based Floor is referred to as the benefits test. If the result of this calculation, when expressed as a percentage, is greater than or equal to the standard non-Federal cost share, the project is not eligible for a reduction. Consequently, the project is subject to the standard non-Federal cost share

required under the provisions of Section 103 within P.L. 99-662. In contrast, if the Benefits Based Floor (BBF), when expressed as a percentage, is less than the standard non-Federal cost share, the project may be eligible for a reduction.

4.6.8.1. Element 2R Ability to Pay

Using the Alternative 2 BCR of 0.29 the benefits based floor was calculated as 6.75%.

$$BBF = (BCR) / 4 = 0.27 / 4 = 6.75\%$$

Since the calculated BBF of 6.75% is less than the standard level of cost-sharing, the amount of the non-Federal share to be applied to the Alternative 2 cost will be determined by the income test.

The income test as outlined in ER 1165-2-121 determines the fraction of reduction in cost sharing depending on the current economic resources of the state and county in which the project is located.

It is first necessary to calculate the Eligibility Factor (EF) for the project area according to the following formula:

$$EF \text{ (Eligibility Factor)} = a - b1 \text{ (State income index)} - b2 \text{ (County income index)}$$

Where a = 18.22

b1 = 0.079

b2 = 0.158

For each of the three latest calendar years for which information is available, determine the level of per capita personal income in the State and County in which the project beneficiaries are located, and compare this to the national average of per capita personal income. Source: Department of Commerce, Bureau of Economic Analysis. Determine the State's per capita personal income as an index number in comparison to the national average (US = 100), and calculate the three year average of the State's index number.

Table 33. Per Capita Personal Income Comparison, 2015-2017.

Per Capita Personal Income by County, 2015 – 2017							
	Per Capital Personal Income (1.)				% change from preceding period		
	Dollars			State Rank	% Change		State Rank
	2015	2016	2017	2017	2016	2017	2017
United States	48,940	49,831	51,640	--	1.8	3.6	--
Kentucky	38,978	39,452	40,597	--	1.2	2.9	--
Johnson County	31,255	31,127	32,255	80	-0.4	3.6	36
(1.) Per capital personal income was computed using Census Bureau midyear population estimates. Estimates reflect county population estimates available as of March 2018. Source: U.S. Bureau of Economic Analysis – Most recent data as of Sept. 9, 2019.							
(2.) State factor = 79.13, County Factor = 62.92							

$$EF = 18.22 - (.079 * 79.13) - (.158 * 62.92) = 18.22 - 6.25 - 9.94 = 2.03$$

Based on the EF being greater than one the non-federal share equals the BBF.

Non-Federal share = Alternative 2 BBF = 6.75%

The total non-Federal share is determined as follows:

Non-Federal Share = 6.75% (Fully Funded Total Project Cost to be cost shared)

$$= 0.0675 (\$1,929,994)$$

$$= \$ 130,275$$

Federal Share = \$ 1,799,719

Therefore, the non-Federal share is 6.75% or approximately \$130 thousand. The Federal share is 93.25% or approximately \$1.8 million.

4.6.8.2. Element 4R Ability to Pay

Using the Alternative 4 BCR of 0.21 the benefits based floor was calculated as 5.25%.

$$\text{BBF} = (\text{BCR}) / 4 = 0.21 / 4 = 5.25\%$$

Since the calculated BBF of 2.75 percent is less than the standard level of cost-sharing, the amount of the non-Federal share to be applied to the Alternative 4 cost will be determined by the income test.

The income test as outlined in ER 1165-2-121 determines the fraction of reduction in cost sharing depending on the current economic resources of the state and county in which the project is located.

It is first necessary to calculate the Eligibility Factor (EF) for the project area according to the following formula:

$$\text{EF (Eligibility Factor)} = a - b1 (\text{State income index}) - b2 (\text{County income index})$$

Where a = 18.22

$$b1 = 0.079$$

$$b2 = 0.158$$

For each of the three latest calendar years for which information is available, determine the level of per capita personal income in the State and County in which the project beneficiaries are located, and compare this to the national average of per capita personal income. Source: Department of Commerce, Bureau of Economic Analysis. Determine the State's per capita personal income as an index number in comparison to the national average (US = 100), and calculate the three year average of the State's index number. See **Table 33**.

$$\text{EF} = 18.22 - (.079 * 79.13) - (.158 * 62.92) = 18.22 - 6.25 - 9.94 = 2.03$$

Based on the EF being greater than one the non-federal share equals the BBF.

Non-Federal share = Alternative 4 BBF = 5.25%

The total non-Federal share is determined as follows:

$$\begin{aligned}\text{Non-Federal Share} &= 5.25\% \text{ (Fully Funded Total Project Cost to be cost shared)} \\ &= 0.0525 (\$1,929,994) \\ &= \$ 101,325 \\ \text{Federal Share} &= \$ 1,828,669\end{aligned}$$

Therefore, the non-Federal share is 5.25% or approximately \$101 thousand. The Federal share is 94.75% or approximately \$1.829 million.

4.6.8.3. Combined Plan Ability to Pay

Using the combined alternative 2 and 4 BCR of 0.25 the benefits based floor was calculated as 6.0 percent.

$$\text{BBF} = (\text{BCR}) / 4 = 0.25 / 4 = 6.25\%$$

Since the calculated BBF of 6.25 percent is less than the standard level of cost-sharing, the amount of the non-Federal share to be applied to the combined alternative cost will be determined by the income test.

The income test as outlined in ER 1165-2-121 determines the fraction of reduction in cost sharing depending on the current economic resources of the state and county in which the project is located.

It is first necessary to calculate the Eligibility Factor (EF) for the project area according to the following formula:

$$\text{EF (Eligibility Factor)} = a - b1 (\text{State income index}) - b2 (\text{County income index})$$

$$\text{Where } a = 18.22$$

$$b1 = 0.079$$

$$b2 = 0.158$$

For each of the three latest calendar years for which information is available, determine the level of per capita personal income in the State and County in which the project beneficiaries are located, and compare this to the national average of per capita personal income. Source: Department of Commerce, Bureau of Economic Analysis. Determine the State's per capita personal income as an index number in comparison to the national average (US = 100), and calculate the three year average of the State's index number.

$$\text{EF} = 18.22 - (.079 * 79.13) - (.158 * 62.92) = 18.22 - 6.25 - 9.94 = 2.03$$

Based on the EF being greater than one the non-federal share equals the BBF.

$$\text{Non-Federal share} = \text{Combined alternative BBF} = 6.25\%$$

The total non-Federal share is determined as follows:

$$\text{Non-Federal Share} = 6.25\% \text{ (Fully Funded Total Project Cost to be cost shared)}$$

= 0.0625 (1,929,994)

= \$ 120,625

Federal Share = \$ 1,809,369

Therefore, the non-Federal share is 6.25% or approximately \$121 thousand. The Federal share is 93.75% or approximately \$1.809 million.

4.6.8.4. Risk and Uncertainty in Benefits and Ability to Pay

The method utilized in developing benefits is non-conventional to Corps benefit guidance methods. It was utilized due to several factors that included speed of analysis, available information and risk in outcome. This project is fully funded and pre-authorized. As a result, benefits were only required to determine the ability to pay calculation. Since the project was fully funded with supplemental funds, ability to pay is only measured against the funds spent before supplemental funds were allocated. This was a value of \$1,929,994. Given that the maximum cost share for these funds is 50%, or just under \$1 million, risk based policy focused on speed of analysis over a more rigorous benefit calculation. Since the project only focused on structures impacted by the 1977 flood and providing mitigation to the 1% ACE, other hydraulic profiles needed to develop benefits following Corps guidance were not constructed. Additionally, the project needs to be studied, planned, designed and constructed within a five year window. This led to a focus on speed over completeness. It should be noted that the maximum cost share of \$1 million represents less than 1% of the total funds provided for this project.

5. ENVIRONMENTAL EFFECTS

This section will identify potential environmental effects of the No Action alternative, the Recommended Plan (Alternative 2R & 4R), and Alternative 3R. Alternative 2R and 3R both include – a floodwall and gravity gate structure near the confluence of the Paint Creek and Levisa Fork in downtown Paintsville with interior floodwall, levees, closures, interceptor sewers, pressurized pipes and a FWEEP and as appropriations allow. While 3R is not included in the Recommended Plan it is still considered a reasonable plan and therefore its effects are considered. Alternative 2R and 3R are so similar that the impacts discussed in the following subsections apply to both alternatives except where specifically noted.

5.1 FLOODING

As formulated, this Recommended Plan would reduce the risk of flooding and related damages to approximately 774 businesses and residences. Of the 635 structures that are currently in the FEMA 1% AEP floodplain, 100% of the 635 structures will receive a reduction in flood risk and over 500 of these structures upon the completion of a Letter of Map Revision (LOMR) would no longer be shown as located in the floodplain as defined under the NFIP.

Under the No Action Alternative, no Federal action would be taken to address flooding. Flood damages, and associated risks, would be expected to continue to occur as seen in historic floods.

5.2 CLIMATE

Carbon emissions would only be increased temporarily during construction from equipment. These emissions would be negligible in comparison to the total constant output of the surrounding urban area. Therefore, the Recommended Plan, Alternative 3R, and the No Action Alternative would not have a measurable adverse effect on the local and/or global climate.

5.3 SOILS AND GEOLOGY

The Recommended Plan and Alternative 3R would necessitate the use of machinery to excavate, fill and grade soils underneath and along the footprint of the project structures. In situ soil would be excavated and removed. Additional fill material would be needed to construct the proposed project structures. The project should not yield any direct or indirect adverse effect to soils within the project area. As a result of the project, depositing of soils upstream of the closure structure in upland areas would likely be temporarily increased during closure events and require occasional maintenance and removal in the future. These effects would not be considered significant. Best management practices will be utilized for erosion control.

Under the no action alternative, flooding downstream of the structure would continue at the current rates. Some erosion and sedimentation would likely continue to occur. No significant adverse effects would be expected.

5.4 SURFACE WATERS AND OTHER AQUATIC RESOURCES

5.4.1. SURFACE WATER

USACE analyzed the effects of the proposed structure to hydrology and hydraulics for Paint Creek including its floodplain. Approximately 450 linear feet of Paint Creek will be permanently impacted by the foot print of the structure. During operation, the closure structure would be used to actively manage Paint Creek flows in conjunction with backwater flows from the Levisa Fork. The structure would be designed to not alter the substrate elevation and therefore allow migration of aquatic species. Stream depths, inundation, and velocities would be similar with or without the structure. Therefore, very little changes in hydraulic stream characteristics would be expected. Some length of intermittent tributaries to Paint Creek would be placed in culverts with some type of closure to prevent back flow during flood events for the placement of levees and floodwalls adjacent to paint creek. These culverts would be designed to allow existing flows. Non-structural measures (buy-outs/structure removals from floodplain or wet flood proofing) would have temporary minor increases in sedimentation during construction. By the reduction of flooded structures and the related sedimentation/pollution of waters, buy-outs/removals would result in minor positive long-term benefits to water quality and aquatic habitat, because with less structures and roadways being flooded, less pollution would be suspended in runoff.

The No Action Alternative would allow existing conditions to continue during future storm events, and heavy runoff from pollution and sedimentation will remain the same.

5.4.2. GROUNDWATER

The Recommended Plan and Alternative 3R would have a potential, positive impact on groundwater in the region.

The No Action Alternative would continue with current conditions of direct runoff during flood events due to flooded homes and limited infiltration due to impervious surfaces and soil characteristics.

5.4.3. FLOODPLAINS

Temporary impacts from construction in the form of ground disturbance in the floodplain, sedimentation, and erosion would be caused by construction of the Recommended Plan and Alternative 3R. Long term minor benefits would be realized by allowing additional waters to be stored/conveyed on the floodplain during major events reducing impacts to commercial and residential structures.

No Action would continue with existing floodplain storage capacity and continued flood damage risk.

5.4.4. WETLANDS

No wetlands have been identified inside the limits of the Recommended Plan or Alternative 3R. Therefore, no adverse impacts to wetlands are anticipated to occur as part of the Recommended Plan or the No Action Alternative.

5.5 FISH AND WILDLIFE HABITATS

5.5.1. FISH

There would be temporary minor sediment and erosion impacts to the immediate adjacent stream reach during construction, however, they would be kept to a minimum with proper construction best management practices. These minor negative impacts would be temporary in nature for aquatic populations such as fish, amphibians, and invertebrates. Mobile species would have the ability to relocate to upstream and downstream refugia, and return to the area following completion of construction. The closure structure would maintain existing substrate elevation and would be designed as to not cause a migration barrier for aquatic species while not in active operation. Some migration on the small tributaries would be lost to aquatic species due to the culverts placed for the floodwalls and earthen levees. Small tributaries affected by this are intermittent streams and therefore the impacts would be considered minor.

Some effects from flooding could include various forms of urban pollution such as trash, untreated sewer, industrial run-off, etc. Under the no action alternative, this urban pollution would continue in the same manner it currently has.

During construction, wildlife species utilizing the urban riparian habitat or the borrow site would be temporarily displaced. Once construction is complete, areas would be stabilized using native plant species and wildlife could return. In areas where non-structural structure buy-outs/removals occurred, local ordinances would be required to restrict redevelopment. These areas would be reverted to green space and may be additional wildlife use areas.

No Action would have no changes from existing conditions, including the potential benefit from additional green space that would likely occur with the non-structural measures.

5.5.2. TERRESTRIAL AND AQUATIC VEGETATION

The closure structure proposed across Paint Creek could permanently impact up to 1.25 acres of the riparian vegetation and excavation of upland soils adjacent to streams. The additional short wall levees placed parallel to the stream could also impact up to an additional 7.4 acres from the approximate 8,321 lf of levee footprint. It is unknown, how much of that area will require tree clearing due to existing data. A topographic survey of the area scheduled to begin prior to design will provide clarity.

The borrow area could require up to approximately 11.6 acres of clearing; however, the area is only partially forested (**Figure 22**). Once the construction was completed, the area would be replanted in native grasses and forbs and hardwood trees to revert back to existing habitat.



Figure 22. Proposed Borrow Area.

Local ordinances for both Johnson County and the City of Paintsville would be required to restrict redevelopment of the vacated lands from non-structural measures. Intended use of vacated lands would be green space, such as urban farms, greenways, parks, restoration of riparian zones, and/or natural regeneration of the area.

Based on the urban setting of Paintsville, the permanent clearing and structure footprint effects would be considered minor. Upon completion of the design, a mitigation plan will detail any project-related mitigation with respect to these areas.

There would be no changes to habitat from the No Action Alternative, however, there would be no addition of vacated lands that could be used for green space.

5.6 ENDANGERED AND THREATENED SPECIES

5.6.1. FEDERAL

The federally-listed Indiana bat and/or Northern long-eared bat could occur within the proposed project area. Based on site assessments by USACE biologists, potential summer roost habitat for the two bat species does exist. Clearing activities would likely remove some minor amount of summer roosting habitat. Any tree removal would be conducted during winter months in order to reduce potential negative impacts. Based on the amount of time likely required until potential construction, USACE would propose to conduct additional habitat assessment after project designs were finalized to determine the exact clearing requirements.

Additional correspondence would then be conducted with USFWS. Based on tree clearing being restricted to winter, and insuring that additional coordination with the Service occurs in the future, USACE finds that the recommended action “may affect, but would not adversely affect” the Indiana bat and the Northern long-eared bat.

Based on the habitat conditions described earlier in the document and that the closure structure will be designed to allow existing normal flows and as not to impede species movement from upstream and downstream, USACE finds that the recommended action “may affect, but would not adversely affect” the big sandy crayfish. Upon completion of the design, a mitigation plan will detail any project-related mitigation with respect to this habitat.

In a letter dated March 18, 2009, the USFWS did not indicate there were any records of the snuffbox mussel or the gray bat located in the study area, therefore USACE finds there would be no effect to either of these species.

No effects are expected from the No Action Alternative.

5.6.2. STATE

It is unknown if any of the state listed species in section 4.6.2, occur in the project footprint, however, if they did they would only be temporarily displaced while construction occurred. After construction completion, all wildlife would be permitted to use the areas again. Impacts from the Recommended Plan would be considered minor and temporary.

No effects are expected from the No Action Alternative.

5.6.3. CRITICAL HABITAT

No critical habitat is known to occur in the study area.

5.7 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

Under the Recommended Plan and Alternative 3R, a closure structure would be built across Paint Creek near it’s mержence with Levisa Fork. Paint Creek is the only stream identified as trout waters and is stocked by KDFWR. Wading fisherman and boaters using Paint Creek may be inconvenienced by the structure or negatively impacted by the change of aesthetics from the concrete structure. Similarly, in addition to the closure structure, the floodwalls placed in various locations upstream of the closure structure may also negatively affect aesthetics for boaters and fisherman. However, the floodwalls would be located on the outer edges of the riparian habitat, outside of the stream channel. Fishing and boating would still be able to

occur after the completion of the proposed project, therefore, these negative effects would still be considered minor. Potential structure removal that may occur under the non-structural alternative, may provide green space that could be converted to recreating facilities such as parks and greenways. Therefore, the non-structural measure of the recommended alternative would potentially provide a positive benefit to recreation and aesthetics.

Current recreation and aesthetics would be maintained with the No Action Alternative.

5.8 CULTURAL RESOURCES

The recommended structural and non-structural plans for the City of Paintsville and Johnson County flood risk management project has the potential to effect archaeological sites and historic properties under 36C.F.R.800.4(d)(2) of the NHPA. The proposed floodwall location and associated non-structural in Paintsville, the non-structural alternative within the City of Paintsville, and the non-structural alternative within Johnson County make up the Area of Potential Effects (APE) for the project. Altogether, within the APE, 23 NRHP listed properties and four properties that either meet the NRHP criteria or are eligible for listing in the NRHP were identified during the KHC records review. However, the overall number of NRHP eligible properties may change once the cultural historic survey of the APE is completed.

Currently, USACE is working closely with the SHPO, Tribal Nations, and consulting parties to develop a Programmatic Agreement outlining the phased approach to identify historic properties and the mitigation stipulations to resolve adverse effects to historic properties and archaeological sites that have either been recommended eligible for the listing to the NRHP or are already listed in the NRHP located within the APE. In addition, a Scope of Work is being developed for a cultural historic survey to identify and evaluate properties that could be eligible for listing in the NRHP that could be impacted by both Alternative 2R and Alternative 4R.

No effects are expected from the No Action Alternative.

5.9 AIR QUALITY

During construction, heavy equipment would cause minor, temporary air quality impacts, however all equipment would comply with federal vehicle emission standards, and dust control measures would be implemented. Temporary equipment emissions from this project would be minimal in terms of the National Ambient Air Quality Standards and as such, a general conformity analysis was not completed. No significant adverse effects are anticipated from the Recommended Plan.

According to the EPA, Johnson County is designated as “in attainment” (maintaining applicable standards) for all criteria pollutants. Therefore, because the project occurs in an attainment area, a conformity determination/analysis is not required.

The No Action alternative would maintain status quo; therefore, it would have no effect on air quality.

5.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Alternative 2R and 3R, Interior Floodwalls - Eight properties have database records regarding underground storage tank (UST) closure; however, it is unknown if any received clean closure from the Kentucky Department for Environmental Protection (KYDEP). There are no current remedial investigations at these sites. Further investigation would be required to determine each sites' UST closure status. Eight properties had historic information regarding past use; however, their waste disposal practice is not documented.

Further investigation would be required to determine if any of these eight sites could affect the project alternatives.

Alternative 2R Main Floodwall - One property has unknown presence of USTs or aboveground storage tanks (ASTs). Additionally, unknown fill material has been placed on the site which could present a risk. Further investigation would be required to determine presence of USTs/ASTs and the presence of any contaminants in the fill material. Environmental database records for the abandoned water treatment facility document presence of a UST; however, there is no information regarding tank removal or site closure. Further investigation would be conducted to identify the location of the UST, if present, and determine if it has a detrimental effect on the alternative.

Alternative 3 Main Floodwall - There are 3 properties that have unknown presence of USTs, aboveground storage tanks (ASTs), and/or a bulk/oil fuel facility. Additionally, unknown fill material has been placed on the site which could present a risk. Further investigation would be required to determine presence of USTs/ASTs and the presence of any contaminants in the fill material. Further investigation would be conducted to identify the location of the UST, if present, and determine if it has a detrimental effect on the alternative.

The No Action Alternative will maintain the status quo. If no project were initiated for flood damage reduction, there will be no impact on HTRW into the environment. Refer to Tab 3 – HTRW in the Engineering Technical Appendix, volume 2, for additional information.

5.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICES

The study area is determined to not contain a minority population or low income population as defined by Executive Order 12898. No negative effects would be borne disproportionately by minority or low-income populations by the proposed action alternative.

For the Recommended Plan, community cohesion could be affected from the removal of homes from the floodplain. Purchasing the structures to be evacuated/removed and costs for moving expenses would be provided to all participants. There is sufficient housing availability within or in proximity of the Recommended Plan footprint such that finding alternative housing would not be a concern. The City of Paintsville and Johnson County could lose property tax revenue from the removed structures; however, there would also no longer be property damages in those affected structures, nor emergency and clean-up costs borne by the owner or City departments.

For Alternative 3R the impacts listed above for the Recommended Plan would be similar but would be more severe because the number of structure acquisitions would be double.

The No Action Alternative would continue to allow the same level of flood damages to occur in the future. This would continue to damage the public's well-being and negatively affect economics in the area.

5.12 CUMULATIVE EFFECTS

USACE must consider the proposed project's cumulative effects on the environment as stipulated in the NEPA. Cumulative effects are "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions". Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 C.F.R. Part 1508.7 Council on Environmental Quality [CEQ] Regulations).

The limits of Johnson County serve as the geographical boundaries for this discussion. Temporal boundaries span from the turn of the 20th century to projections fifty years into the future.

As previously discussed, it is anticipated that the Recommended Plan will only have negligible or temporary impacts on climate, soils, geology, surface waters, fish and wildlife, recreation, cultural resources, and air quality; and therefore such impacts will not contribute to any cumulative environmental impacts in the region. The Recommended Plan, however, will have minor and/or long-term impacts to the floodplain and socioeconomics of the City of Paintsville. These project specific impacts were evaluated further to determine if they could potentially contribute to a cumulative impact on the environment.

5.12.1. PAST AND PRESENT ACTIONS

The steep topography of Johnson County has concentrated development of the area to the floodplain and floodway zones along the rivers, streams, and tributaries. Development of the floodplain and floodway has reduced natural retention capabilities and increased impervious areas, both of which have increases runoff that contributes to flood events. Moreover, coal mining, agriculture, and logging have historically occurred in Johnson County and contributed to runoff. According to a USDA Soil Survey, coal mining was the main industry through the 1990s, agriculture was important up until the 1950s but has been at a steady decline since then, and timber harvesting was a major activity in the county until about the 1950s. Timber harvesting dramatically altered the location and structure of forests in the area.

Since the turn of the 20th Century, communities within Johnson County, especially the City of Paintsville, have been subject to repeated flood events (see Section 3.1) that have damaged homes and properties. Five USACE flood control dams and a cut through project (see Section 1.7.2) have been constructed at or upstream of Johnson County on the Levisa Fork and its tributaries for multiple purposes including flood control, water-supply, low-flow augmentation, and recreation. These projects have impacted the region's floodplain and aid in the control of flood events.

Since 2010, the population of Johnson County has declined by approximately 4.2 %, likely due to a decline in coal operations in the area. Areas similar to Johnson County have seen tourism as a means for revenue.

5.12.2. REASONABLY FORESEEABLE FUTURE ACTIONS

Overall population growth, and consequently the tax base, is not expected to increase in the County. Increased urbanization is not likely over the next 50 years nor are housing constraints/shortages anticipated. This, in turn, will likely ease pressure on floodplain development for residential and commercial purposes. Areas that were once timbered, cleared for coal, or used for agriculture are slowly and naturally being re-vegetated and/or reforested, which will reduce runoff in the area in the future. Moreover, local zoning and floodplain ordinances are anticipated to aid in the reduction of development within the floodplain. The Five USACE flood control dams and cut through project are also expected to be adequately maintained for future flood control operations.

5.12.3. COMBINED EFFECTS ON RESOURCES

When the impacts from the Recommended Plan are combined with similar effects from other past, present, and reasonably foreseeable future actions, the Recommended Plan is not anticipated to contribute to any significant impacts to environmental resources. With regard to the floodplain, impacts are anticipated to decrease over time. For the City of Paintsville, the Recommended Plan alters the floodplain such that structures are removed from the floodplain. For the rest of Johnson County, structures could be removed from the floodplain and deed restricted to prevent future development. These actions in combination with the other past, present, and reasonably foreseeable future actions will be beneficial for the floodplain and the environment. With regard to socioeconomics, the Recommended Plan will displace residents but the

City of Paintsville has sufficient housing stock to relocate citizens within the community without disrupting community fabric or the tax base. There does not appear to be any other large infrastructure projects planned for the area that would have similar impacts in the future. Prior and future shifts within industry or the local economy are also not anticipated to collectively impact the socioeconomics of the region. If anything, additional flood protection could make the Johnson County area more resilient to socioeconomic changes by encouraging maintenance of facilities and infrastructure.

6. MITIGATION OF ADVERSE IMPACTS

Upon completion of the DPR additional information will still be needed to determine a mitigation plan for the proposed project (for example: acres of habitat impacts, number of trees, linear feet of stream impacts, etc.). Riparian habitat will be cleared at some level for this project. There will be a length of Paint creek impacted by the project (up to 450 ft.), and a number of feet of intermittent tributaries to Paint Creek will be impacted by culverts from proposed levees and floodwalls. Detailed designs would be determined in the Project Engineering and Design (PED) phase. A mitigation plan as well as additional environmental permitting (Clean Water Act, etc.) will be determined at that time.

7. IMPLEMENTATION REQUIREMENTS

7.1. PROJECT PARTNERSHIP AGREEMENT

The Johnson County Fiscal Court has expressed support for the project and has agreed to accept the role of non-Federal sponsor in the event of approval of a final Detailed Project Report. A PPA would be signed between the USACE and the Johnson County Fiscal Court prior to the initiation of the Design phase of the project.

7.2. LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS AND DISPOSAL AREAS (LERRD'S)

The LERRD's required in the Recommended Plan are located within the City of Paintsville along the Levisa Fork of the Big Sandy River and Paint Creek. The non-structural measures will be implemented within Johnson County outside of the Paintsville City limits. The following describes the LERRD's required for each measure and presented in detail in Volume 4.

7.2.1. DOWNTOWN PAINTSVILLE FLOODWALL

Approximately 4.8 acres will be needed for the downtown Paintsville floodwall north of Paint Creek. This property is currently occupied by a commercial self-storage facility. Removal of the facility will be necessary to construct, operate and maintain the proposed flood wall. A road closure structure will be located across Highway 40 (Euclid Avenue). Additionally, the wall will terminate on a residential property and tie-in to high ground near the CSX Railroad line and Greentown Lane. A perpetual flood damage reduction easement will be required to construct, operate and maintain the flood wall. The commercial self-storage facility will be acquired in fee.

Approximately 3.5 acres will be needed for the downtown Paintsville floodwall south of Paint Creek. This property is located between the CSX Railroad yard and the left descending bank of the Levisa Fork. The majority of the property in which the wall will be situated is currently a narrow service road (River Road) used to access the south end of the rail yard and additional railroad operations buildings and laydown areas.

The property to the east of the wall alignment is currently occupied by CSX operations and storage buildings.

The northern portion of CSX's property is currently leased by the City of Paintsville as a storage space for municipally-owned vehicles and equipment. The property immediately adjacent to Paint Creek is owned by the City of Paintsville and is the location of the former waste water treatment plant. Upon construction of the flood wall, service and inspection roads will be constructed on the east and west sides of the wall. Construction staging will occur on CSX property and City-owned property. Access to all existing railroad facilities will be available after construction is complete. A perpetual flood damage reduction easement will be required to construct, operate and maintain the flood wall.

7.2.2. LEVISA FORK AND PAINT CREEK GATE CLOSURE STRUCTURE

The Paint Creek closure structure will be located on property currently owned by the City of Paintsville with a tie-in to CSX property on the south bank and the aforementioned storage facility property on the north bank.

7.2.3. EUCLID AVENUE AND HIGHLAND AVENUE INTERIOR FLOODWALL

Approximately 11.2 acres will be needed for the Euclid Avenue and Highland Avenue Interior Floodwall. The proposed interior drainage floodwall will be located along the north bank of Paint Creek between Broadway Street to the west and the CSX Railroad line near its intersection with Hwy 40 (Euclid Avenue) to the east. The wall will range in height from a few feet to near 10 feet above current grade. East of Depot Road, the wall will be located along the rear portion of several commercial properties and an existing apartment complex. It will be necessary to remove one of the four apartment buildings to accommodate construction; the apartment building to be removed contains seven rental units. No damages to the remaining complex will be incurred. West of Depot Road, the remainder of the wall will sever the rear one-third of approximately 19 residential lots, 5 commercial properties and the Paintsville Fire Department, all located along Euclid Avenue and Main Street. The alignment of the wall will require the acquisition of fee due to uneconomic remnants that will result on the Paint Creek side of the proposed wall. Additionally, two residential structures and seven detached garages and storage structures will be required to be removed to accommodate the alignment. The wall will tie-in to high ground along a vacant lot across Euclid Avenue (closure gate structure) to Highland Avenue. The vacant property between Frank Street and Preston Street will be utilized as a construction staging area; a temporary work area easement will be required for the staging site.

7.2.4. STATE STREET INTERIOR LEVEE

Approximately 3.7 acres will be needed for the State Street Interior Levee. The earthen levee will be constructed between State Street and Paint Creek and will tie-in to Depot Road to the west and the main CSX Railroad line to the east. Chessie Lane will be partially rerouted to the north side of the new levee and will connect to State Street at its intersection with Depot Road. Construction of the levee will require the removal of approximately seven residential structures currently located on the north side of State Street. All properties will be acquired in fee along the north side of State Street between Depot Road and Chessie Lane. A perpetual flood damage reduction easement will be required for the portion of the levee situated on CSX property.

7.2.5. KINGS ADDITION NEIGHBORHOOD LEVEE

Approximately 1.0 acres would be needed for the Kings Addition Levee if this area is incorporated into the Recommended Plan. The earthen levee will be constructed across an unnamed drain in the Kings Addition

subdivision east of downtown Paintsville between Auxier Avenue and Kentucky Lane. Construction will likely require the removal of a storage shed and access to the site will be gained from Auxier Avenue. Perpetual flood damage reduction easements will be required for construction, operation and maintenance of the levee.

7.2.6. FLAT ROCK BRANCH INTERIOR LEVEE

Approximately 1.2 acres will be needed for the Flat Rock Branch Interior Levee. The earthen levee will be constructed across Flat Rock Branch between 12th Street and Pine Street south of Paint Creek. The levee will be constructed partially on a vacant residential lot and in the rear portions of five occupied residential properties. Construction is not expected to require the removal of any structures. Site access will be gained directly from 12th Street. Perpetual flood damage reduction easements will be required to construct, operate and maintain the levee.

7.2.7. BLACKBERRY BRANCH INTERIOR LEVEE

Approximately 1.7 acres will be needed for the Blackberry Branch Interior Levee. The earthen levee will be constructed across Blackberry Branch south of Paint Creek and north and east of Broadway Street. The levee will be located behind a commercial office building, a residential property and a church campus. The construction is not expected to require the removal of any existing buildings. Access to the site will be gained from Broadway Street. Perpetual flood damage reduction easements will be required to construct, operate and maintain the levee.

7.2.8. WALNUT AVENUE INTERIOR LEVEE

Approximately 0.5 acres will be needed for the Walnut Avenue Interior Levee. A small earthen levee will be constructed across an unnamed drain between Paint Creek and Walnut Avenue at its intersection with 11th Street. The levee will be located between two residential structures and is not expected to require the removal of any existing buildings. Access to the site will be gained directly from Walnut Avenue. Perpetual flood damage reduction easements will be required to construct, operate and maintain the levee.

7.2.9. COUNTY COURTHOUSE AND JAIL INTERIOR LEVEE

Approximately 4.0 acres will be needed for the County Courthouse and Jail Interior Levee. An earthen levee will be constructed partially around the municipal courthouse and detention center complex west of downtown Paintsville at the southwest corner of the intersection of US-460 (Third Street) and KY-321. Access to the construction site will be gained from US-460 via Detention Center Road. The site is owned by the local government; no acquisitions are anticipated to be required.

7.2.10. STORM SEWER INTERCEPTORS, PRESSURIZED PIPES, HEADWALLS AND FLAP GATES

Interceptor pipes will be installed at various locations in the City of Paintsville (see **Figures 7 and 8**). All work will be conducted within existing City-owned rights-of-way. No additional real estate interest are expected to be required.

7.2.11. PROJECT BORROW AREA AND DISPOSAL SITE

The borrow area and disposal site identified to support the project is located on the west side of Paintsville on vacant property at the northwest corner of the intersection of US 460 and KY 321. The property has been previously utilized as a borrow site for non-Federal projects and has sufficient access from Hidden

Valley Road. The site is located approximately 3 miles from the State Street Interior Levee, the largest earthwork measure of the project. A temporary work area easement will be required to accommodate use of the site for borrow and spoil. The site of a landslide that occurred in the Spring of 2019 on the north side of 5th Street has been identified as a secondary borrow site. If the landslide material is utilized during construction, a temporary work area easement will be required to be obtained.

7.3. OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

Subject to the terms of the PPA, the sponsor is required to provide an annual report to the USACE on the compliance with the flood risk management goals. This would require the Johnson County Floodplain Coordinator to complete the report on behalf of Johnson County.

Annual OMRR&R costs for the floodwall are estimated at \$436,000. This estimate includes labor costs for maintaining new facilities, miscellaneous and contingency. The costs for the Johnson County Floodplain Coordinator are minimal since the Coordinator was previously tasked with inspection requirements for the county's participation in the NFIP. Johnson County recognizes its responsibility to prepare the report and has agreed to furnish this report to the USACE on an annual basis.

Each flood proofed structure would have a Flood Proofing Agreement recorded in Johnson County land records including provisions for the prohibition of living space development in flood prone spaces created by the flood proofing process. Johnson County would assume the responsibility to assure that each structure owner properly maintains the flood proofing features of the structure and also complies with all requirements of the county floodplain ordinances. Johnson County would provide annual certification to the USACE that the items of O&M regarding flood proofed structures have been addressed per the PPA and the flood proofing agreements.

It would be the responsibility of the non-Federal sponsor to determine the appropriate use of lands evacuated as a part of the floodplain acquisition program in its floodplain management program. Appropriate deed restrictions would be recorded on those lands deemed to be excess to the project purposes and sold by the local sponsor. These deed restrictions would restrict development in the floodplain and prevent development in the floodway of the April 1977 or 1% AEP event, whichever is higher.

7.4. COMPLIANCE WITH STATUTES, EXECUTIVE ORDERS AND EXECUTIVE MEMORANDUM

7.4.1. Clean Water Act

7.4.1.1. Clean Water Act, Section 404/401

Impacts to streams and wetlands associated with flood control measures were evaluated for compliance with Section 404 of the Clean Water Act administered by USACE. See Volume 3 for a 404 (b) (1) guidelines analysis of the recommended alternative. Additional details developed in later phases of project implementation would be developed and used for determining CWA requirements. A 401 Water Quality Certification would be obtained prior to contracting advertisement for construction.

Best Management Practices would be implemented during construction to address erosion and sediment control as work was performed adjacent or near watercourses.

7.4.1.2. National Pollution Discharge Elimination System (NPDES)

A National Pollutant Discharge Elimination System (NPDES) permit for storm water discharge is required when construction or land disturbance exceeds one acre. This permit would be requested and received prior to construction where necessary.

7.4.2. FISH AND WILDLIFE COORDINATION ACT

USACE is required to coordinate water resource project proposals with the USFWS and the KDFWR under the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. §§ 661, et seq.). Coordination with USFWS and KDFWR was initiated through a scoping letter submitted February, 26, 2019. Comments were received from the USFWS (see chapter 8 for summary). No comments were received from KDFWR. Comments are incorporated in this document and included in Volume 7. Coordination will continue with the review of this draft report.

7.4.3. ENDANGERED SPECIES ACT

The Endangered Species Act requires the determination of possible effects on, or degradation of, habitat critical to federally listed endangered or threatened species. In a letter dated March 18, 2019, the USFWS stated that the big sandy crayfish, may occur in the project area in the Levisa Fork or just in the mouth of Paint Creek where there is suitable habitat. They also stated, “There are records of the federally threatened northern long-eared bat (*Myotis septentrionalis*) near the proposed project area. The federally endangered Indiana bat (*Myotis sodalis*) may also be present. Both of these species could potentially utilize forested habitat in the action area of the proposed project and may potentially be affected by the removal of this habitat.” As stated in section 5.6.1, based on restricted tree removal to the winter months and insuring that additional coordination with USFWS occurs before construction, USACE finds that the recommended action “may affect, but would not adversely affect” the Indiana bat and the Northern long-eared bat. Also, based on the habitat conditions described earlier in the document and that the closure structure will be designed to allow existing normal flows and as not to impede species movement from upstream and downstream, USACE finds that the recommended action “may affect, but would not adversely affect” the Big Sandy Crayfish.

7.4.4. NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the NHPA, as amended, requires federal agencies to consider the effects of their undertakings on historic properties. The implementing regulations at 36 C.F.R. 800 detail the process that requires consultation with the SHPO, Tribal Nations, local governments, the public, and others. Suitable efforts to identify historic properties must be taken and consulting parties afforded an opportunity to comment on the affects to these historic properties by the proposed undertaking. Only sites, building structures, objects, or landscapes listed on or determined eligible for listing in the NRHP are afforded the safeguards of the NHPA. Archival research for this project involved consulting the SHPO, a review of the OSA, KHC and the NRHP databases, as well as research at the Johnson County public library. USACE coordination with the SHPO and Tribal Nations is ongoing. USACE has coordinated with the following Tribal Nations: Eastern Band of Cherokee Indians, Cherokee Nation, United Keetoowah Bands of Indians, Absentee-Shawnee Tribe of Oklahoma, Shawnee Tribe of Oklahoma, and the Eastern Shawnee Tribe of Oklahoma. All correspondence related to this consultation is included in the Volume 8.

USACE is currently in the process of evaluating the significance of historic properties and archaeological sites located within the APE to determine whether they are eligible for listing in the NRHP in accordance with 36 C.F.R. 800.4(c) of the NHPA. Once the process is complete, USACE would need to make a determination if there would be an adverse effect to any NRHP listed or NRHP-eligible historic properties

or archaeological sites under 36 C.F.R. 800.4(d). It is anticipated that the PA will be drafted and signed before the FONSI. The PA will recommend future NHPA activities required to comply with SHPO concerns.

7.4.5. FLOODPLAIN MANAGEMENT

Executive Order (EO) 11988 (May 24, 1977) outlines the responsibilities of Federal agencies in the role of floodplain management. In accordance with this EO, USACE is required to evaluate the potential effects of actions on floodplains, and does not undertake actions that directly induce growth in the floodplain, unless no practical alternative exists. Construction of structures and facilities on floodplains must incorporate flood proofing and other accepted flood risk reduction measures. Agencies must attach appropriate use restrictions to property proposed for lease, easement, right-of-way, or disposal to non-Federal public or private parties.

The eight steps associated with the decision making process in EO 11988 were considered in the evaluation of the selected alternative. Error! Reference source not found. **Table 34** provides more detail on how each step was considered. Based on the findings and determination discussed in this report, the selected alternative is in compliance with EO 11988. The Proposed Action would serve to reduce the damaging effects of flooding and improve the overall quality of the floodplain; it would not be directly encouraging growth within the floodplain.

8. PUBLIC INVOLVEMENT, REVIEW, AND COORDINATION

Public participation is a significant component of the NEPA process. The USACE considers public comments before making a decision on a Recommended Plan. This section summarizes key public notification and participation events that have occurred as part of this process, thus far.

8.1. PUBLIC VIEWS AND COMMENTS

No comments have been received from the general public to date. A public meeting is scheduled for March 2020.

8.2. STAKEHOLDER/AGENCY COORDINATION

8.2.1. STAKEHOLDERS

An initial scoping meeting with stakeholders was held between October 9-11, 2018 at the Ramada Hotel and Conference Center in Paintsville, KY. Participants included the USACE, the Johnson County Fiscal Court, the City of Paintsville, and the Johnson County/Paintsville Emergency Management Agency. A number of topics were discussed and developed including the development of the problems, objectives, constraints and opportunities, an initial array of management measures and alternatives, discussion of project risks, and an initial project schedule. The Johnson County Fiscal Court and the City of Paintsville did not support an alternative involving dual floodwalls along Paint Creek (Initial Alternative Plan 1), or a voluntary buy-out program for the City as it would severely affect its social, economic, and cultural cohesion.

Table 34. Eight Steps of Decision Making Process in EO 11988.

Eight Step Decision Making Process. EO 11988		
1.	Determine if a proposed action is in the base floodplain.	Yes, the proposed alternatives are within the base floodplain.
2.	Conduct early public review, including public notice.	A scoping letter was posted in August 2017. Initial comments were received and logged as Volume 8. Additional Draft EA Review to be conducted.
3.	Identify and evaluate practicable alternatives to locating in the base floodplain, including alternative sites outside of the floodplain.	See Section 3, Plan Formulation, for description and evaluation of each alternative considered.
4.	Identify impacts of the proposed action.	See Section 5 for description of impacts related to the selected alternative.
5.	If impacts could not be avoided, develop measures to minimize the impacts and restore and preserve the floodplain, as appropriate.	The selected alternative would create additional water storage in the floodplain above the dry dam. The addition of flooding frequency and duration would likely benefit riparian and limited wetland habitat. Potential sources of debris/wastes that follow floods would be reduced downstream of the project.
6.	Reevaluate alternatives.	See Section 3.
7.	Present the findings and a public explanation.	This document would serve as a tool to present the findings and would provide the public a detailed explanation of how the selected plan was chosen. Upon approval to release the draft report, the NEPA public comment period would occur and include additional public input.
8.	Implement the action.	This action would follow final approvals of the selected alternative.

8.2.2. FEDERAL AGENCIES

An initial scoping letter requesting information about the study area and environmental resources were sent to Federal agencies on February 26, 2019. Responses were received on March 6, 2019 from the EPA and on March 18, 2019 from the U.S. Fish and Wildlife Service (USFW). See Volume 7 for correspondence.

8.2.2.1. EPA Response

Comments received from the EPA suggested that USACE integrate into their formulation active and passive flood controls, to consider potential impacts associated with the hydraulic and hydrology fluctuations on aquatic species resulting from the Recommended Plan, and to coordinate with the Kentucky Division of Water (KDOW) when evaluating stream impacts under CWA Section 401 water quality certification.

8.2.2.2. USFWS Response

Comments received from the USFWS identified three federally-listed endangered species within the study area: Big Sandy crayfish (*Cambarus callainus*), northern long-eared bat (*Myotis septentrionalis*), and

Indiana bat (*Myotis sodalis*). They encouraged a habitat assessment and/or species survey to determine the potential for the presence of these species in the action area of the project.

8.2.3. FEDERALLY RECOGNIZED TRIBAL NATIONS

Tribal consultation was initiated on October 18, 2018 and again in August, 2019 with the Recommended Plan and currently is on-going with the following Tribal Nations: Eastern Band of Cherokee Indians, Cherokee Nation, United Keetoowah Bands of Indians, Absentee-Shawnee Tribe of Oklahoma, Shawnee Tribe of Oklahoma, and the Eastern Shawnee Tribe of Oklahoma.

8.2.4. STATE AGENCIES

An initial coordination letter requesting information about the study area and environmental resources were sent to state and local agencies on February 26, 2019. Responses were received on April 12, 2019 from the Kentucky Department for Environmental Protection, the state clearinghouse for the Energy and Environmental Cabinet, and on October 18, 2018 and August 27, 2019 from the KHC, the review agency for the SHPO.

8.2.4.1. Kentucky Heritage Council (KHC)

Consultation under Section 106 of the NHPA with the KHC was initiated in August 2019 regarding the Recommend Plan. Currently, USACE is working closely with the SHPO, Tribal Nations, and consulting parties to develop a PA outlining a multiphase approach to identify historic properties within the APE and to address the mitigation stipulations to resolve adverse effects to historic properties.

8.2.4.2. Kentucky Department of Environmental Protection (KDEP)

Consolidated comments were received from the KDOW, the Kentucky Division of Waste Management (KDWM), and the Kentucky Division for Air Quality (KDAQ). The KDOW emphasized water quality certification requirements per 401 Kentucky Administrative Record 10:031 Section 4(2) and the need for an application permit to construct across or along a stream. KDWM identified underground storage tanks near the Recommended Plan. KDAQ offered suggestions to reduce emissions during the project.

8.2.5. LOCAL AGENCIES

No comments have been received from local agencies to date.

8.2.6. NON-GOVERNMENTAL ORGANIZATIONS

No comments have been received from non-governmental organizations to date.

9. FINDING OF NO SIGNIFICANT IMPACT

The FONSI reflects all agency coordination and public comments that are drawn and can be found in Volume 3.

10. RECOMMENDATION

After considering the engineering, economic, environmental, and social aspects relative to the identified flood damages and risks associated with the 1977 event in Johnson County, Kentucky, it is recommended that a plan consisting of two separable elements, Alternative 2R – a floodwall and gravity gate structure near the confluence of the Paint Creek and Levisa Fork in downtown Paintsville with interior floodwall, levees, closures, interceptor sewers, pressurized pipes and a FWEPP – and Alternative 4R – a voluntary non-structural program in Johnson County, Kentucky involving – be constructed by USACE under authority granted by Section 202. Alternative 2R can be implemented immediately using appropriations provided under Supplemental Appropriation to the Bipartisan Budget Act of 2018, P.L.115-123, Div. B, Subdiv. 1, tit. IV (2018). Additionally, all or a portion of Alternative 4R may also be implemented using either any remaining available appropriations from this appropriation or subsequent Congressional appropriations. Also, based on the effects of the project documented previously in the report (Section 5), the Recommended Plan would not be expected to have significant impacts on the human environment.

11. LIST OF PREPARERS

Table 35. Johnson County, Kentucky Section 202 Project Delivery Team.

Johnson County, Kentucky Section 202	
Role	Team Member
Project Manager	Michael Moore
Lead Planner	Roger Setters
Planners	Keith Keeney and Chris Wernick
Project Engineer	Jacob Sinkhorn
NEPA Specialist	Charles "Chip" Hall
Real Estate Specialist	Jason Meyer
Cost Estimator	S. Taylor Canfield
Economist	Nate Pfisterer
HTRW	Jo Huff and Frank Albert
Cultural Resources	Jennifer Guffey
Geotechnical Engineering	Megan Jones and Samantha Schardein
Hydraulics and Hydrology	Eric Allen
GIS Specialist	Paul Deatrick and Lance Filiatreau
Structural Engineering	Coty Young
Mechanical Engineering	Keenan Burns
Electrical Engineering	Ricky Morrison

12. REFERENCES

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U.S.D.A., Natural Resources Conservation Service. Soil Survey of Floyd and Johnson Counties, Kentucky. 1991.

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