City of St. Marys
Technical Assistance Report

PREPARED FOR:

Kansas Department of Agriculture

Division of Water Resources

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benesch

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1 INTRODUCTION

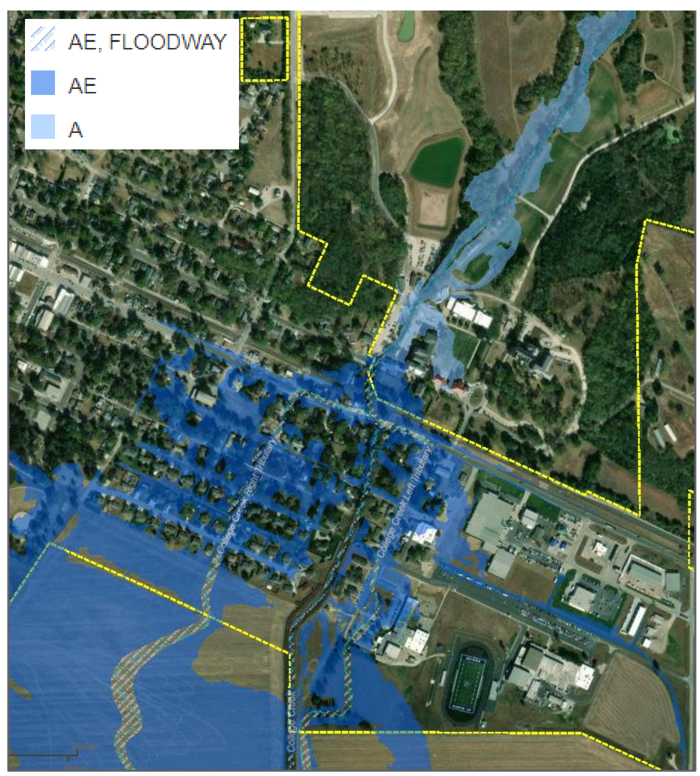
The Kansas Department of Agriculture (KDA) received funding from FEMA to complete a technical assistance project for the City of St. Marys to assist with the advancement of flood mitigation efforts for College Creek. The city recently underwent a flood mapping update, as part of the Middle Kansas mapping project that impacted portions of Pottawatomie County, KS. The Physical Map Revision for Pottawatomie County went effective in November 2022. One of the primary flooding issues for St. Marys is flooding along College Creek. Figure 1 shows the Special Flood Hazard Area for College Creek. Over the past few decades, this area has experienced flooding on multiple occasions due to large rainfall events. St. Marys previously engaged the services of Benesch to assist them in evaluating flood reduction alternatives and developing a solution for the flooding.

Benesch previously developed conceptual plans and cost estimates to construct a detention basin upstream of St. Marys and within the College Creek watershed, and complete limited channel improvements at identified restrictions within the town. While there is some support in the community to complete this project, there are also concerns with respect to the cost of the solution, the city's ability to fund it, and the project's ability to provide flood reduction benefits and flood resiliency over an extended period of time. Therefore, this technical assistance project focused on providing additional information needed for the decision-makers and general public to better understand the impacts and benefits of the project. This project includes the identification and evaluation of potential cost savings associated with the proposed dam to better refine the project costs, the evaluation of project benefits, and completion of a multi-frequency benefit-cost analysis. Also included is the identification of potential cost-share funding opportunities, and evaluation of the project's flood benefits and resiliency over time with respect to future development, climate change and other potential factors based on sensitivities to the modeling.

This technical assistance project is intended to expand upon the alternatives analysis and preliminary improvement design project that was previously completed for the City of St. Marys by Benesch. It includes the following scope of work items:

1. **Conceptual Engineering Enhancements** – Evaluate and identify specific cost savings that could be recognized in the design.
2. **Benefit-Cost Analysis** – Define benefits, refine costs, and develop multi-frequency benefit cost analysis (BCA).
3. **Resilience and Future Climate Change** – Evaluate model sensitivity to changes in flood frequency and overall project resiliency.
4. **Evaluate Potential Funding** – Identify potential funding sources based on the BCA.

FIGURE 1- SPECIAL FLOOD HAZARD AREA FOR COLLEGE CREEK

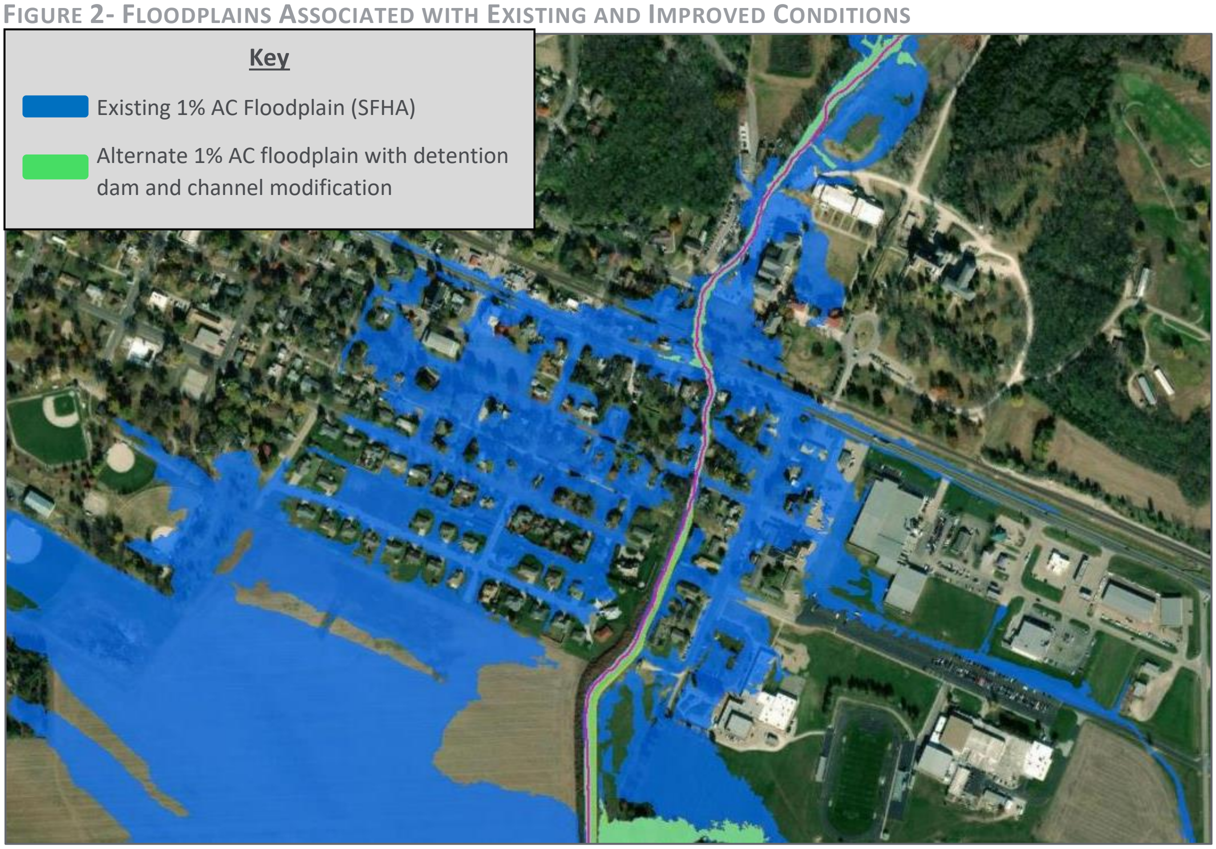


2 PROJECT BACKGROUND

St. Marys initiated a project in 2018 to determine mitigation options for reducing flood risk associated with College Creek for the citizens of St. Marys. The city retained the services of Benesch to complete this work. As part of that evaluation, several alternatives we evaluated including the construction of upstream detention in multiple configurations, upsizing of bridges and culverts along the College Creek channel, increasing the College Creek channel capacity, and reconstructing the spoil bank levee-like structure into a levee system that could be certified and accredited by FEMA as providing 100yr flood protection. In general, construction of a levee that could be accredited by FEMA, along with replacement of bridge and culvert structures were determined to have limited benefits in reducing flood risk. After consideration of numerous alternatives, the selected alternative was the construction of an upstream detention dam with limited channel improvements.

As part of the alternatives analysis, a revised 1% annual chance (AC) or 100yr floodplain was developed to determine the benefits of the proposed project. Figure 2 shows the proposed benefits, with the revised floodplain being shown in green, which would essentially keep the flooding contained within the College Creek channel. The estimated project cost for this project, assuming 2024 construction, was estimated at $5.74 million.

FIGURE 2- FLOODPLAINS ASSOCIATED WITH EXISTING AND IMPROVED CONDITIONS



While the city recognizes the benefits of the proposed project, they also have several questions that need to be answered before they can decide whether to move forward with the construction of the proposed mitigation project. Therefore, the City and KDA decided to pursue this technical assistance project to answer questions such as the impacts of future development and climate change, value engineering to potentially reduce overall project costs, quantifying the overall benefits of the project, and potential funding and cost share opportunities.

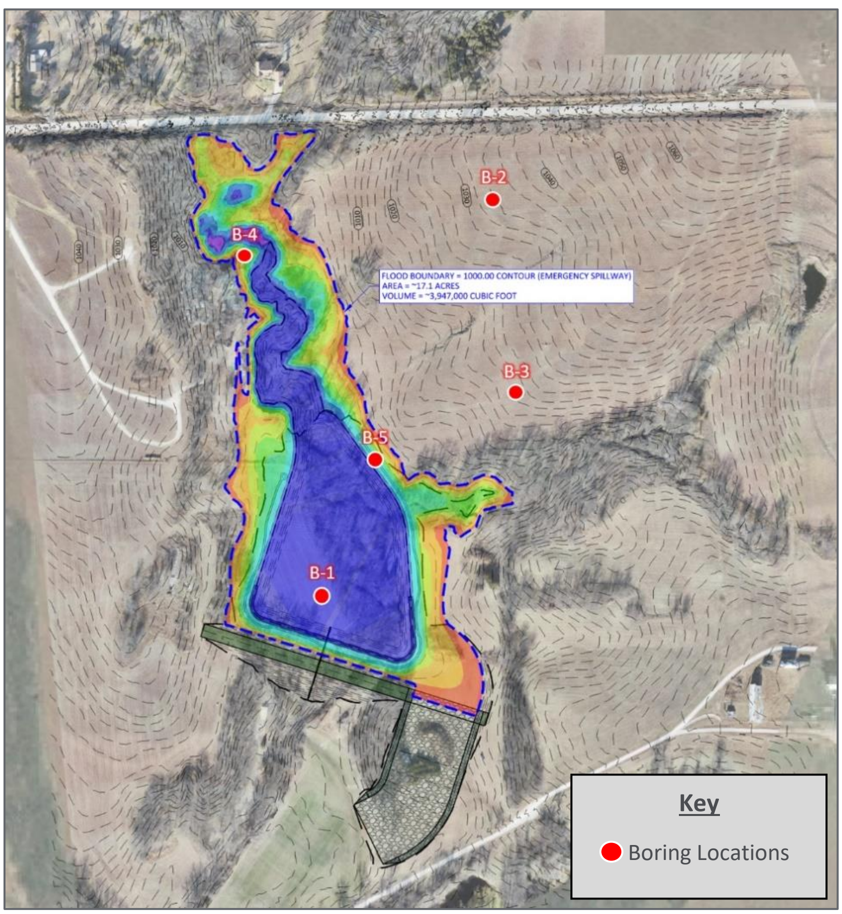
3 CONCEPTUAL ENGINEERING ENHANCMENTS

Two of the largest costs associated with the proposed project are a rock lined spillway and the seepage protection provided by the blanket drain. This task evaluates conceptual engineering enhancements to the previous engineering that was performed, to evaluate and identify specific cost savings that could be recognized. Specifically, the use of a vegetated spillway was analyzed to determine if it's feasible in lieu of a rock lined spillway to reduce costs. Also, the use of a cutoff trench was modeled to determine if it could reduce the overall size and costs of the blanket drain and under seepage controls.

3.1 Vegetated Spillway Adequacy

A USDA-NRCS SITES Model analysis was competed to analyze the suitability of using a vegetated spillway, rather than a rock lined spillway, in order to reduce costs. There was limited geotechnical information to complete this analysis, but there were a few soil borings available that were taken during the first phase of the design project. While there were no borings in the proposed centerline of the spillway, there were a few borings taken in the general vicinity of the dam, which were used to establish geological parameters for the study. Figure 3 shows the location of the borings.

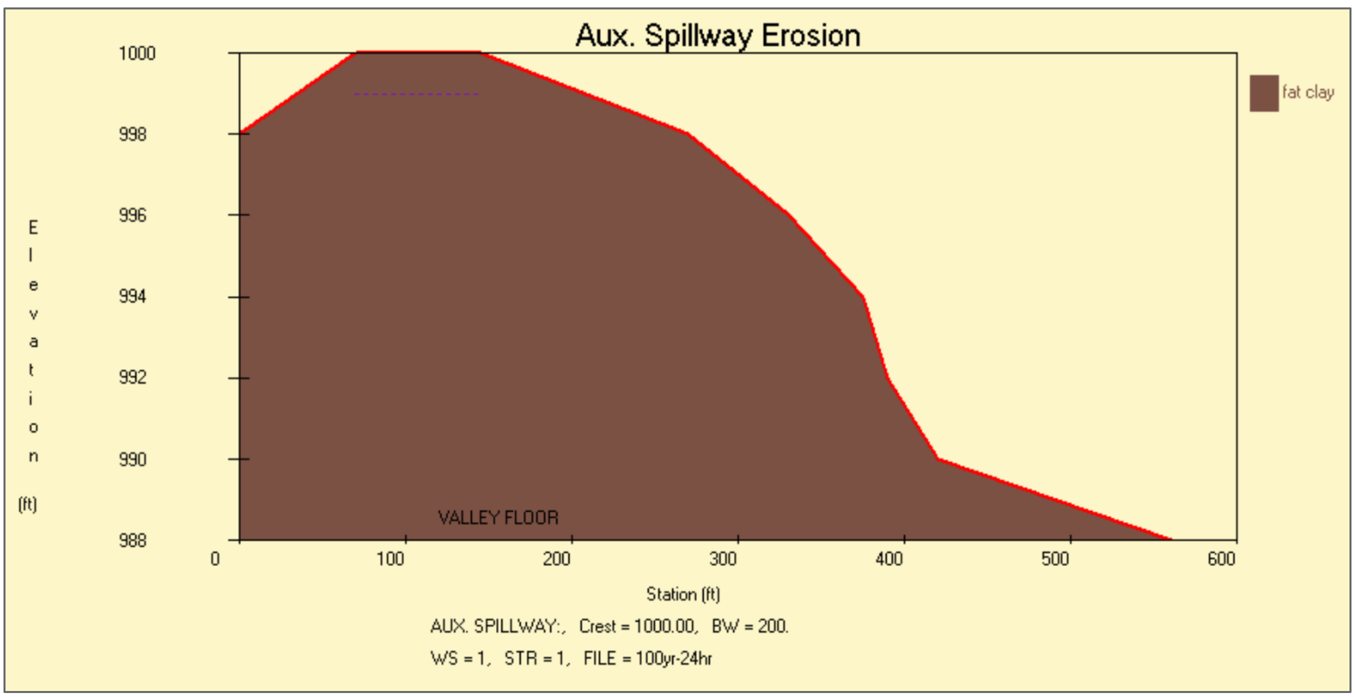
FIGURE 3- BORING LOCATIONS USED TO ESTABLISH GEOLOGIC PARAMETERS FOR THE ANALYSIS



The SITES analysis generally evaluates spillway performance based upon two factors, stability and integrity. The first is stability (lack of sod stripping), which is generally evaluated against the 1% annual chance, or 100yr, flood discharge requirements. Since this dam is designed to have 24-hour, 100yr detention without auxiliary spillway flow, then it meets the stability requirements for the 1% annual chance storm event as there is no flow in the spillway channel. Secondly, spillway integrity (presence of spillway head cutting) is evaluated for a minimum of the 0.40 Probable Maximum Precipitation (PMP) event, with considerations up to the PMP event. For this analysis, it was determined that a head cut did not develop for the 0.40 PMP event in the earthen spillway. In addition, in our analysis a head cut did not develop for the PMP event, when ran through the spillway. Therefore, while there is no boring in the spillway that can be used to run a final SITES analysis at this preliminary phase, surrounding soils indicate that there is a high probability that an earthen vegetated spillway will be sufficient for the performance of the dam.

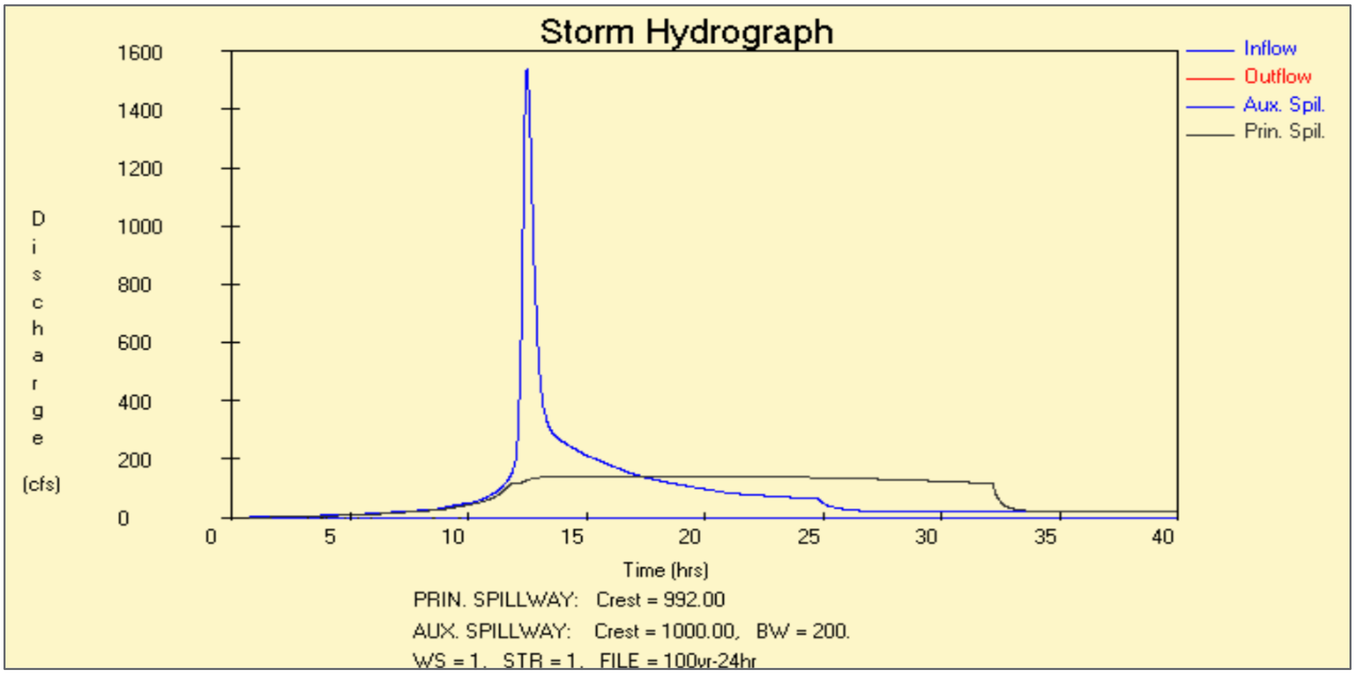
Therefore, for the purpose of this technical assistance project, our conclusion is that a vegetated spillway is likely to perform adequately for the construction of this dam, and it is appropriate to adjust construction costs to this spillway design configuration. In addition, while it is not appropriate to make additional geometric adjustments at this time, absent of additional geotechnical data, it is very likely that additional savings can be recognized in the future, cutting the overall width and the amount of excavation for the auxiliary spillway, to potentially cut costs further.

FIGURE 4- SPILLWAY EROSION RESULTS FROM SITES ANALYSIS



The SITES analysis also provided more accurate discharge information for the proposed dam, which was then incorporated into the HEC-RAS modeling. This allowed us to verify all other design parameters, including 100yr, 24-hour detention, and passing the 0.40 PMP flooding event with 3 feet of freeboard. Therefore, we believe all other geometric design assumptions in the original conceptual design and cost estimate are reasonable for the use of the budget level cost estimate.

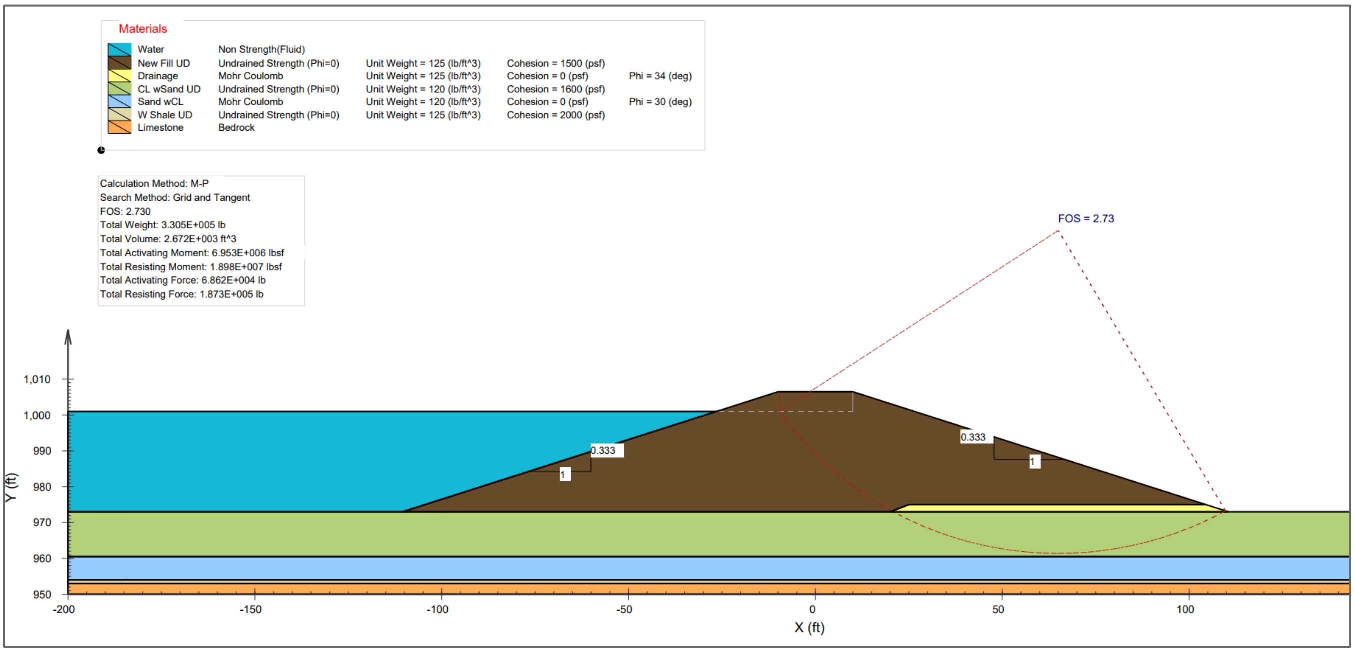
FIGURE 5- STORM HYDROGRAPH RESULTS FROM SITES ANALYSIS



3.2 Blanket Drain Analysis

In addition to the evaluation of the auxiliary spillway analysis, Benesch updated the design assumptions associated with the blanket drain. The original analysis had relatively simplified geometry in the under seepage and slope stability model. For this analysis, we added additional geometry for a cutoff trench and updated additional design parameters. Based on conservative assumptions associated with the limited soils information available at this time, our analysis indicated that a blanket drain is still required to achieve slope stability of the downstream slope of the dam. However, we were able to reduce the size of the blanket drain, reducing the overall cost of the project. If the project goes to construction, we believe that it is possible for a blanket drain to be fully eliminated with additional soils data and associated analysis. However, given the absence of soils data for the borrow material and borings along the dam centerline, we believe it's necessary to leave a blanket drain in place for the budget level cost estimate provided at this time.

FIGURE 6- CROSS SECTION FOR BLANKET DRAIN ANALYSIS



4 UPDATED PROJECT COSTS

The original budget level project cost estimate to design and construct the detention dam, along with the limited channel modifications in the downstream channel of College Creek, to provide a 100yr level of flood reduction was approximately $5,743,000. Based on the analyses discussed in Section 3 of this report, we updated the budget level cost estimate for the reduced size of the blanket drain and modified the auxiliary spillway to a vegetated grass spillway. The updated quantities for the cost estimate are highlighted in yellow in Figure 7.

In addition to updating quantities for the auxiliary spillway and the blanket drain, a few additional adjustments were made to the cost estimate. This included updating the proposed construction year from 2024 to 2025, based on the timing of this technical assistance project. It also included a change in the inflation rate from 4%, which was the original assumption, to 5% to be more in line with inflation rate increases since the original study was completed. Design costs and utility relocate costs were reduced, based upon the overall reduction in construction costs. Permitting costs were slightly increased, based on recent complexities to the environmental permitting processes. Finally, construction engineering costs were reduced accordingly based on the overall changes to construction costs.

Based on these updates, the updated budget level project cost estimate for a 100yr detention facility with a wet pond, along with the limited channel modifications, is now approximately $5,117,000. This provides an overall cost reduction to the project of approximately $626,000, which is a cost reduction of approximately 11%.

FIGURE 7- UPDATED PROJECT COST ESTIMATE (WITH 100YR WET DETENTION DAM)

City of St. Marys - Flood Mitigation Improvements

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ENGINEER'S OPINION OF PROBABLE PROJECT COST

ITEM	DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT PRICE		TOTAL
General						
1	Mobilization	1	LS	$160,000.00	$	160,000.00
2	Construction Staking	1	LS	$60,000.00	$	60,000.00
3	Clearing and Grubbing	30	AC	$1,500.00	$	45,000.00
4	Temporary Traffic Control	1	LS	$8,500.00	$	8,500.00
				Subtotal	$	*273,500.00*
Embankment						
5	Common Excavation (Rural Large)	75,300	CY	$6.50	$	489,450.00
6	Compaction of Earthwork (Type AA)(MR-3-3)(EarthFill)	39,575	CY	$2.00	$	79,150.00
7	Drainage Blanket (KDOT PB-1)	2,425	CY	$20.00	$	48,500.00
8	Drainage Blanket Filter Layer (KDOT U-1)	1,200	CY	$15.00	$	18,000.00
9	Drainage Blanket Drains (4" Perforated PVC)	1,400	LF	$25.00	$	35,000.00
10	Common Excavation (Unstable)(Subgrade Stabilization)	12,650	CY	$8.00	$	101,200.00
11	Compaction of Earthwork (Type AA)(MR-3-3)(Subgrade Stabilization)	12,650	CY	$2.00	$	25,300.00
12	Riprap (KDOT Light 200 lb)(Bank Erosion Protection)	600	CY	$65.00	$	39,000.00
13	Benchmark Monument	2	EA	$1,600.00	$	3,200.00
				Subtotal	$	*838,800.00*
Primary Spillway						
14	Weir Structure with Trash Rack	1	LS	$25,000.00	$	25,000.00
15	Overflow Drainage Structure	1	LS	$50,000.00	$	50,000.00
16	Sluice Gate	2	EA	$12,000.00	$	24,000.00
17	Lowlevel Draw Down Pipe (8")(DIP)	100	LF	$250.00	$	25,000.00
18	Primary Spillway Pipe (36")(DIP)	200	LF	$650.00	$	130,000.00
19	Drainage Diaphragm	1	LS	$4,000.00	$	4,000.00
20	Drainage Diaphragm Conduit (4" Perforated PVC w/Granular Encasement)	150	LF	$50.00	$	7,500.00
21	Concrete Collar, Anchor, and Deadman	5	EA	$5,000.00	$	25,000.00
22	Outfall Headwall	1	LS	$40,000.00	$	40,000.00
23	Outfall Pipe Support	1	LS	$20,000.00	$	20,000.00
24	Riprap (KDOT Heavy 1/2 Ton)(Plunge Pool)	750	CY	$70.00	$	52,500.00
25	Riprap (KDOT Light 200 lb)(Stormwater Outfall)	150	CY	$65.00	$	9,750.00
				Subtotal	$	*412,750.00*
Secondary Spillway						
26	Riprap (KDOT Light 200 lb)(Secondary Spillway)	0	CY	$70.00	$	-
27	Non-Woven Geotextile	0	SY	$3.00	$	-
				Subtotal	$	-
Channel Modifications and Realignment						
28	Common Excavation (Rural Large)	100,000	CY	$6.50	$	650,000.00
29	Turf Reinforcement Mat	4,850	SY	$20.00	$	97,000.00
30	Riparian Stream Buffer	8	AC	$6,500.00	$	52,000.00
31	Drop Structure	1	LS	$35,000.00	$	35,000.00
				Subtotal	$	*834,000.00*
Erosion Control						
32	Silt Fence	8,000	LF	$4.40	$	35,200.00
33	Inlet Protection	5	EA	$850.00	$	4,250.00
34	Permanent Seeding	19.5	AC	$2,000.00	$	39,000.00
35	Hydro-Mulch	19.5	AC	$3,000.00	$	58,500.00
				Subtotal	$	*136,950.00*
	ESTIMATED CONSTRUCTION COST (FY 2022) - BASE BID				**$**	***2,496,000.00***
	ESTIMATED CONSTRUCTION COST (FY 2025)(5% Yearly Growth Rate)				$	2,889,400.00
	Contingencies (20%)				$	577,880.00
	ESTIMATED CONSTRUCTION COST (FY 2025) - BASE BID				**$**	***3,467,280.00***
	Design Engineering				$	350,000.00
	Geotechnical Investigation				$	200,000.00
	Utility Relocates				$	35,000.00
	Easement Negotiation & Acquisition				$	100,000.00
	Permitting Coordination and Fees				$	25,000.00
	Stream Mitigation				$	660,000.00
	Construction Engineering				$	280,000.00
	Project Total (FY 2025) Base Bid				***$***	***5,117,280.00***

4.1 Dry Detention Pond Alternative

Benesch wanted to evaluate the potential cost savings associated with modifying the conceptual design to a dry detention dam. This would allow the dam to still provide 100yr level of flood reduction, while reducing the overall height of the dam and volume of fill required, since the wet pool storage could be reduced significantly. This would lower the required top of dam elevation by 1.8 feet and the auxiliary spillway elevation by 1.9 ft. Additionally, this design has less impact on the native stream channel, reducing the impacts significantly. This has a significant reduction on the amount of stream mitigation required. This cost estimate includes all of the value engineering alternatives discussed in Section 4 of this report, with the additional savings discussed above.

FIGURE 8- COST ESTIMATE FOR PROJECT WITH 100YR DRY DETENTION DAM

City of St. Marys - Flood Mitigation Improvements — benesch

ENGINEER'S OPINION OF PROBABLE PROJECT COST

ITEM	DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT PRICE	TOTAL
General					
1	Mobilization	1	LS	$160,000.00	$ 160,000.00
2	Construction Staking	1	LS	$60,000.00	$ 60,000.00
3	Clearing and Grubbing	30	AC	$1,500.00	$ 45,000.00
4	Temporary Traffic Control	1	LS	$8,500.00	$ 8,500.00
				Subtotal	*$ 273,500.00*
Embankment					
5	Common Excavation (Rural Large)	37,290	CY	$6.50	$ 242,385.00
6	Compaction of Earthwork (Type AA)(MR-3-3)(EarthFill)	37,290	CY	$2.00	$ 74,580.00
7	Drainage Blanket (KDOT PB-1)	2,304	CY	$20.00	$ 46,075.00
8	Drainage Blanket Filter Layer (KDOT U-1)	1,140	CY	$15.00	$ 17,100.00
9	Drainage Blanket Drains (4" Perforated PVC)	1,401	LF	$25.00	$ 35,023.75
10	Common Excavation (Unstable)(Subgrade Stabilization)	12,018	CY	$8.00	$ 96,140.00
11	Compaction of Earthwork (Type AA)(MR-3-3)(Subgrade Stabilization)	12,018	CY	$2.00	$ 24,035.00
12	Riprap (KDOT Light 200 lb)(Bank Erosion Protection)	570	CY	$65.00	$ 37,050.00
13	Benchmark Monument	2	EA	$1,600.00	$ 3,200.00
				Subtotal	*$ 575,588.75*
Primary Spillway					
14	Weir Structure with Trash Rack	1	LS	$25,000.00	$ 25,000.00
15	Overflow Drainage Structure	1	LS	$50,000.00	$ 50,000.00
16	Sluice Gate	2	EA	$12,000.00	$ 24,000.00
17	Lowlevel Draw Down Pipe (8")(DIP)	95	LF	$250.00	$ 23,750.00
18	Primary Spillway Pipe (36")(DIP)	190	LF	$650.00	$ 123,500.00
19	Drainage Diaphragm	1	LS	$4,000.00	$ 4,000.00
20	Drainage Diaphragm Conduit (4" Perforated PVC w/Granular Encasement)	143	LF	$50.00	$ 7,125.00
21	Concrete Collar, Anchor, and Deadman	5	EA	$5,000.00	$ 25,000.00
22	Outfall Headwall	1	LS	$40,000.00	$ 40,000.00
23	Outfall Pipe Support	1	LS	$20,000.00	$ 20,000.00
24	Riprap (KDOT Heavy 1/2 Ton)(Plunge Pool)	750	CY	$70.00	$ 52,500.00
25	Riprap (KDOT Light 200 lb)(Stormwater Outfall)	150	CY	$65.00	$ 9,750.00
				Subtotal	*$ 404,625.00*
Secondary Spillway					
26	Riprap (KDOT Light 200 lb)(Secondary Spillway)	0	CY	$70.00	$ -
27	Non-Woven Geotextile	0	SY	$3.00	$ -
				Subtotal	*$ -*
Channel Modifications and Realignment					
28	Common Excavation (Rural Large)	100,000	CY	$6.50	$ 650,000.00
29	Turf Reinforcement Mat	4,850	SY	$20.00	$ 97,000.00
30	Riparian Stream Buffer	8	AC	$6,500.00	$ 52,000.00
31	Drop Structure	1	LS	$35,000.00	$ 35,000.00
				Subtotal	*$ 834,000.00*
Erosion Control					
32	Silt Fence	8,000	LF	$4.40	$ 35,200.00
33	Inlet Protection	5	EA	$850.00	$ 4,250.00
34	Permanent Seeding	24.2	AC	$2,000.00	$ 48,400.00
35	Hydro-Mulch	24.2	AC	$3,000.00	$ 72,600.00
				Subtotal	*$ 160,450.00*
	ESTIMATED CONSTRUCTION COST (FY 2022) - BASE BID				***$ 2,248,163.75***
	ESTIMATED CONSTRUCTION COST (FY 2025)(5% Yearly Growth Rate)				$ 2,602,500.00
	Contingencies (20%)				$ 520,500.00
	ESTIMATED CONSTRUCTION COST (FY 2025) - BASE BID				***$ 3,123,000.00***
	Design Engineering				$ 320,000.00
	Geotechnical Investigation				$ 200,000.00
	Utility Relocates				$ 35,000.00
	Easement Negotiation & Acquisition				$ 100,000.00
	Permitting Coordination and Fees				$ 25,000.00
	Stream Mitigation				$ 303,600.00
	Construction Engineering				$ 250,000.00
	Project Total (FY 2025) Base Bid				***$ 4,356,600.00***

The budget level cost estimate for the construction of a dry detention facility, rather than a wet detention facility, is approximately $4,357,000, as shown in Figure 8. This results in an overall reduction of approximately 24% from the original cost estimate and an overall reduction of approximately 15% from the updated cost estimate for the wet detention facility. While there are a number of advantages in going with a dry detention dam such as reduced costs, reduced environmental impacts, and reduced overall project area; the potential disadvantage is associated with easement negotiations. Since there would not be a wet pond that could be used for recreation, the project may be less desirable to the existing landowner. However, we believe that the project could still contain a number of potential amenities to the landowner, including wetlands, walking trails, and park benches for wildlife viewing, with the additional wildlife habitat. Ultimately, the tradeoffs in cost and easement acquisition will have to be weighed by the City of St. Marys.

5 EVALUATION OF PROJECT WITH 50YR DETENTION DAM

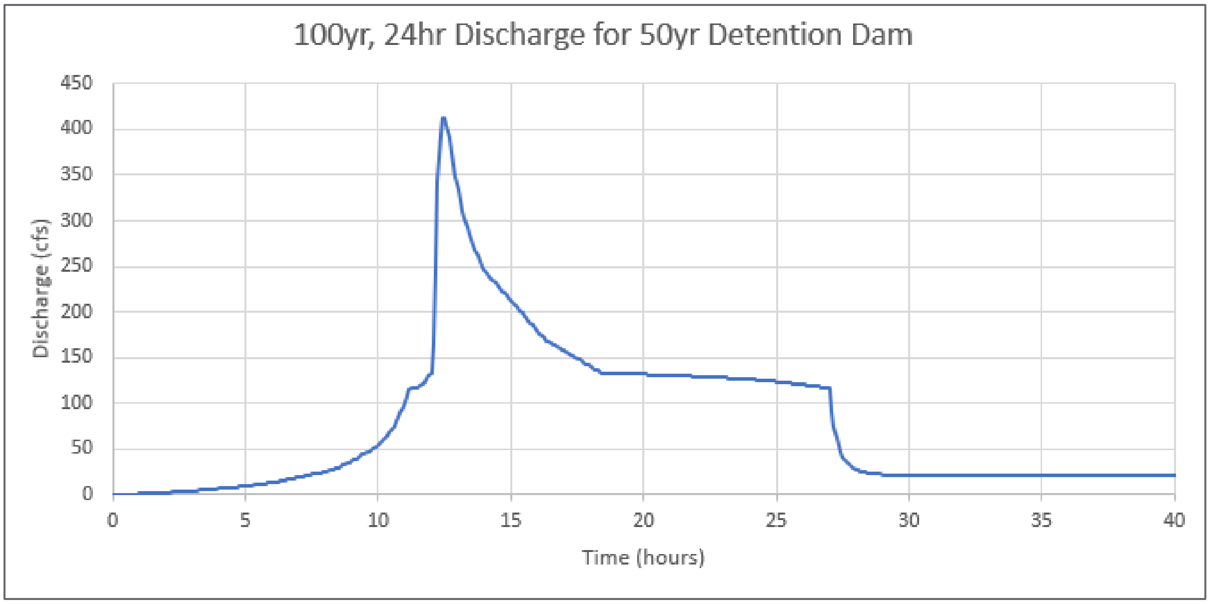
Benesch evaluated the potential cost savings of a 50yr detention dam, to try and further reduce costs. However, the tradeoff to a 50yr detention dam is that additional flows would pass downstream during a storm event that exceeds the 2% annual chance (50yr) storm event. If the level of service were reduced for the detention dam, the benefits would also be reduced. Figure 9 shows the flooding associated with the 1% annual chance (100yr) storm event for the 50yr flood detention dam with the channel modifications, which shows that the floodplains would no longer be contained within the channel.

FIGURE 9 - DOWNSTREAM FLOODING ASSOCIATED WITH 50YR FLOOD DETENTION DAM

High hazard potential (Class C) dams are required to have a minimum detention storage that is associated with the 50yr, 6-hr storm event. Figure 10 shows the associated storm hydrograph for the 1% annual chance (100yr) storm event and a detention dam designed for the 50yr, 6-hr storm event. The peak discharge is approximately 420 cfs, compared to a peak discharge of approximately 150 cfs for a 100yr flood detention dam.

As shown in Figure 9, if the level of service were reduced from a 100yr detention dam to a 50yr detention dam, some flooding would occur downstream during the 1% annual chance (100yr) flood event. In this scenario, seven buildings would be in the 1% annual chance floodplain, of which four are homes that would be required to purchase flood insurance if they have federally backed mortgages. The other three structures are auxiliary structures. Therefore, this level of service still provides a significant benefit to the City if costs can be further reduced.

FIGURE 10- STORM HYDROGRAPH RESULTS FOR 50YR DETENTION DAM DURING 1% AC STORM EVENT



5.1 50yr Wet Detention Dam Alternative

Figure 11 shows the cost estimate associated with the construction of a wet, 50yr detention facility, which is $4,510,000. While it is less than the cost of a 100yr wet detention facility, by approximately $608,000, it also provides less benefits. The wet, 50yr detention facility would have an auxiliary spillway elevation that is 2.9 feet lower than the auxiliary spillway elevation of the wet, 100yr detention facility and a top of dam elevation that is 2.4 feet lower than the top of dam elevation of the wet, 100yr detention facility. It should be noted that the cost estimate for the wet, 50yr detention facility is higher than the cost of a 100yr, dry detention facility.

FIGURE 11- COST ESTIMATE FOR PROJECT WITH 50YR WET DETENTION DAM

City of St. Marys - Flood Mitigation Improvements

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ENGINEER'S OPINION OF PROBABLE PROJECT COST

ITEM	DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT PRICE		TOTAL
General						
1	Mobilization	1	LS	$160,000.00	$	160,000.00
2	Construction Staking	1	LS	$60,000.00	$	60,000.00
3	Clearing and Grubbing	30	AC	$1,500.00	$	45,000.00
4	Temporary Traffic Control	1	LS	$8,500.00	$	8,500.00
				Subtotal	*$*	*273,500.00*
Embankment						
5	Common Excavation (Rural Large)	30,640	CY	$6.50	$	199,160.00
6	Compaction of Earthwork (Type AA)(MR-3-3)(EarthFill)	30,640	CY	$2.00	$	61,280.00
7	Drainage Blanket (KDOT PB-1)	2,183	CY	$20.00	$	43,650.00
8	Drainage Blanket Filter Layer (KDOT U-1)	1,080	CY	$15.00	$	16,200.00
9	Drainage Blanket Drains (4" Perforated PVC)	1,260	LF	$25.00	$	31,500.00
10	Common Excavation (Unstable)(Subgrade Stabilization)	11,385	CY	$8.00	$	91,080.00
11	Compaction of Earthwork (Type AA)(MR-3-3)(Subgrade Stabilization)	11,385	CY	$2.00	$	22,770.00
12	Riprap (KDOT Light 200 lb)(Bank Erosion Protection)	540	CY	$65.00	$	35,100.00
13	Benchmark Monument	2	EA	$1,600.00	$	3,200.00
				Subtotal	*$*	*503,940.00*
Primary Spillway						
14	Weir Structure with Trash Rack	1	LS	$25,000.00	$	25,000.00
15	Overflow Drainage Structure	1	LS	$50,000.00	$	50,000.00
16	Sluice Gate	2	EA	$12,000.00	$	24,000.00
17	Lowlevel Draw Down Pipe (8")(DIP)	90	LF	$250.00	$	22,500.00
18	Primary Spillway Pipe (36")(DIP)	180	LF	$650.00	$	117,000.00
19	Drainage Diaphragm	1	LS	$4,000.00	$	4,000.00
20	Drainage Diaphragm Conduit (4" Perforated PVC w/Granular Encasement)	135	LF	$50.00	$	6,750.00
21	Concrete Collar, Anchor, and Deadman	5	EA	$5,000.00	$	25,000.00
22	Outfall Headwall	1	LS	$40,000.00	$	40,000.00
23	Outfall Pipe Support	1	LS	$20,000.00	$	20,000.00
24	Riprap (KDOT Heavy 1/2 Ton)(Plunge Pool)	750	CY	$70.00	$	52,500.00
25	Riprap (KDOT Light 200 lb)(Stormwater Outfall)	150	CY	$65.00	$	9,750.00
				Subtotal	*$*	*396,500.00*
Secondary Spillway						
26	Riprap (KDOT Light 200 lb)(Secondary Spillway)	0	CY	$70.00	$	-
27	Non-Woven Geotextile	0	SY	$3.00	$	-
				Subtotal	*$*	*-*
Channel Modifications and Realignment						
28	Common Excavation (Rural Large)	100,000	CY	$6.50	$	650,000.00
29	Turf Reinforcement Mat	4,850	SY	$20.00	$	97,000.00
30	Riparian Stream Buffer	8	AC	$6,500.00	$	52,000.00
31	Drop Structure	1	LS	$35,000.00	$	35,000.00
				Subtotal	*$*	*834,000.00*
Erosion Control						
32	Silt Fence	8,000	LF	$4.40	$	35,200.00
33	Inlet Protection	5	EA	$850.00	$	4,250.00
34	Permanent Seeding	19.5	AC	$2,000.00	$	39,000.00
35	Hydro-Mulch	19.5	AC	$3,000.00	$	58,500.00
				Subtotal	*$*	*136,950.00*
	ESTIMATED CONSTRUCTION COST (FY 2022) - BASE BID				***$***	***2,144,890.00***
	ESTIMATED CONSTRUCTION COST (FY 2025)(5% Yearly Growth Rate)				$	2,483,000.00
	Contingencies (20%)				$	496,600.00
	ESTIMATED CONSTRUCTION COST (FY 2025) - BASE BID				***$***	***2,979,600.00***
	Design Engineering				$	300,000.00
	Geotechnical Investigation				$	170,000.00
	Utility Relocates				$	35,000.00
	Easement Negotiation & Acquisition				$	100,000.00
	Permitting Coordination and Fees				$	25,000.00
	Stream Mitigation				$	660,000.00
	Construction Engineering				$	240,000.00
	Project Total (FY 2025) Base Bid				***$***	***4,509,600.00***

5.2 50yr Dry Detention Dam Alternative

Figure 12 shows the cost estimate associated with the construction of a dry, 50yr detention facility, which is $4,108,000. While this cost estimate is less than the cost estimate of a dry, 100yr detention facility, by approximately $249,000; the cost reduction is only 6% when compared to the dry, 100yr detention facility.

FIGURE 12- COST ESTIMATE FOR PROJECT WITH 50YR DRY DETENTION DAM

City of St. Marys - Flood Mitigation Improvements benesch

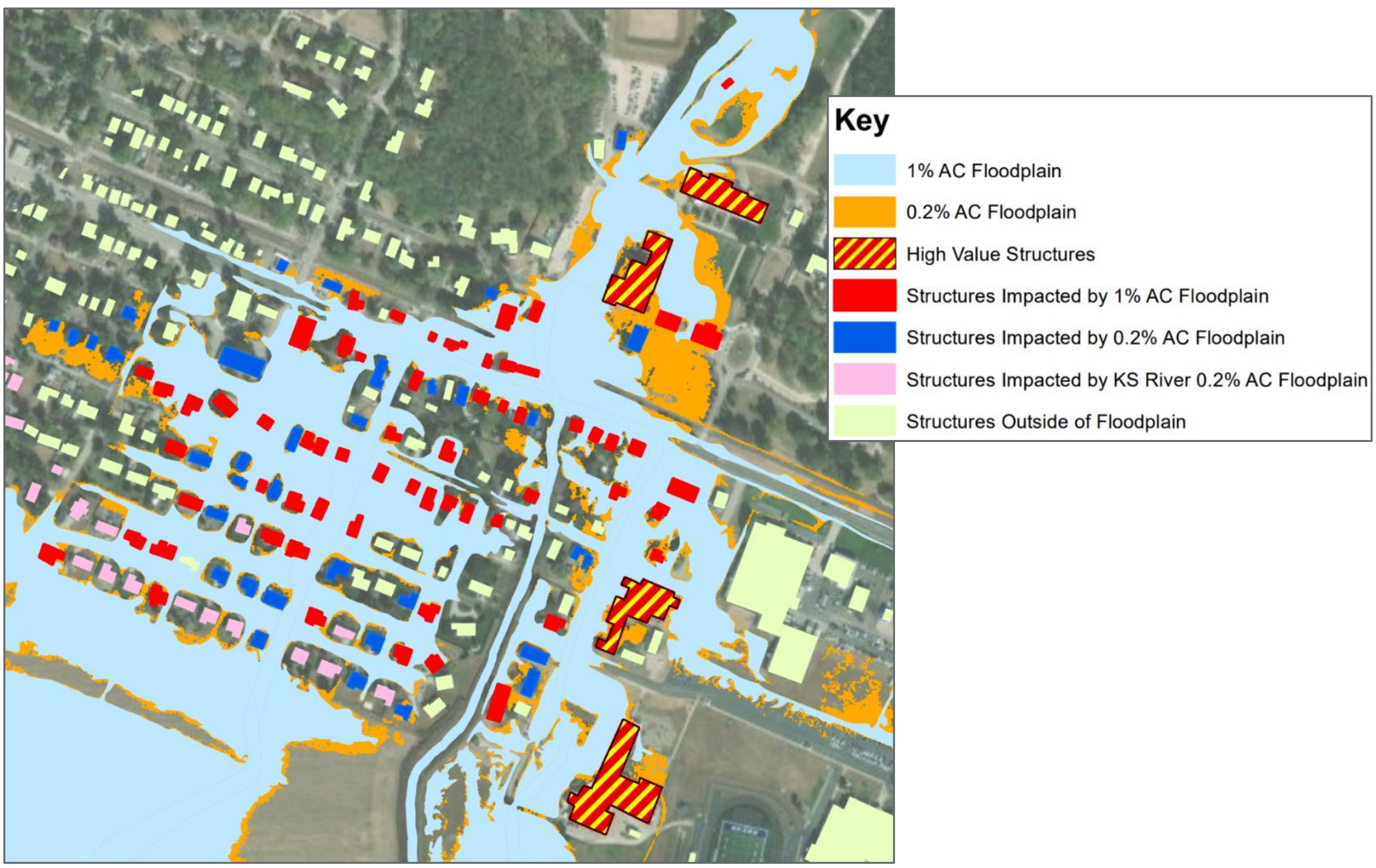
ENGINEER'S OPINION OF PROBABLE PROJECT COST

ITEM	DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT PRICE		TOTAL
General						
1	Mobilization	1	LS	$160,000.00	$	160,000.00
2	Construction Staking	1	LS	$60,000.00	$	60,000.00
3	Clearing and Grubbing	30	AC	$1,500.00	$	45,000.00
4	Temporary Traffic Control	1	LS	$8,500.00	$	8,500.00
				Subtotal	*$*	*273,500.00*
Embankment						
5	Common Excavation (Rural Large)	27,420	CY	$6.50	$	178,230.00
6	Compaction of Earthwork (Type AA)(MR-3-3)(EarthFill)	27,420	CY	$2.00	$	54,840.00
7	Drainage Blanket (KDOT PB-1)	1,940	CY	$20.00	$	38,800.00
8	Drainage Blanket Filter Layer (KDOT U-1)	960	CY	$15.00	$	14,400.00
9	Drainage Blanket Drains (4" Perforated PVC)	1,120	LF	$25.00	$	28,000.00
10	Common Excavation (Unstable)(Subgrade Stabilization)	10,120	CY	$8.00	$	80,960.00
11	Compaction of Earthwork (Type AA)(MR-3-3)(Subgrade Stabilization)	10,120	CY	$2.00	$	20,240.00
12	Riprap (KDOT Light 200 lb)(Bank Erosion Protection)	480	CY	$65.00	$	31,200.00
13	Benchmark Monument	2	EA	$1,600.00	$	3,200.00
				Subtotal	*$*	*449,870.00*
Primary Spillway						
14	Weir Structure with Trash Rack	1	LS	$25,000.00	$	25,000.00
15	Overflow Drainage Structure	1	LS	$50,000.00	$	50,000.00
16	Sluice Gate	2	EA	$12,000.00	$	24,000.00
17	Lowlevel Draw Down Pipe (8")(DIP)	80	LF	$250.00	$	20,000.00
18	Primary Spillway Pipe (36")(DIP)	160	LF	$650.00	$	104,000.00
19	Drainage Diaphragm	1	LS	$4,000.00	$	4,000.00
20	Drainage Diaphragm Conduit (4" Perforated PVC w/Granular Encasement)	120	LF	$50.00	$	6,000.00
21	Concrete Collar, Anchor, and Deadman	5	EA	$5,000.00	$	25,000.00
22	Outfall Headwall	1	LS	$40,000.00	$	40,000.00
23	Outfall Pipe Support	1	LS	$20,000.00	$	20,000.00
24	Riprap (KDOT Heavy 1/2 Ton)(Plunge Pool)	750	CY	$70.00	$	52,500.00
25	Riprap (KDOT Light 200 lb)(Stormwater Outfall)	150	CY	$65.00	$	9,750.00
				Subtotal	*$*	*380,250.00*
Secondary Spillway						
26	Riprap (KDOT Light 200 lb)(Secondary Spillway)	0	CY	$70.00	$	-
27	Non-Woven Geotextile	0	SY	$3.00	$	-
				Subtotal	*$*	*-*
Channel Modifications and Realignment						
28	Common Excavation (Rural Large)	100,000	CY	$6.50	$	650,000.00
29	Turf Reinforcement Mat	4,850	SY	$20.00	$	97,000.00
30	Riparian Stream Buffer	8	AC	$6,500.00	$	52,000.00
31	Drop Structure	1	LS	$35,000.00	$	35,000.00
				Subtotal	*$*	*834,000.00*
Erosion Control						
32	Silt Fence	8,000	LF	$4.40	$	35,200.00
33	Inlet Protection	5	EA	$850.00	$	4,250.00
34	Permanent Seeding	24.2	AC	$2,000.00	$	48,400.00
35	Hydro-Mulch	24.2	AC	$3,000.00	$	72,600.00
				Subtotal	*$*	*160,450.00*
	ESTIMATED CONSTRUCTION COST (FY 2022) - BASE BID				***$***	***2,098,070.00***
	ESTIMATED CONSTRUCTION COST (FY 2025)(5% Yearly Growth Rate)				$	2,428,800.00
	Contingencies (20%)				$	485,760.00
	ESTIMATED CONSTRUCTION COST (FY 2025) - BASE BID				***$***	***2,914,560.00***
	Design Engineering				$	295,000.00
	Geotechnical Investigation				$	200,000.00
	Utility Relocates				$	35,000.00
	Easement Negotiation & Acquisition				$	100,000.00
	Permitting Coordination and Fees				$	25,000.00
	Stream Mitigation				$	303,600.00
	Construction Engineering				$	235,000.00
	Project Total (FY 2025) Base Bid				***$***	***4,108,160.00***

6 BENEFIT ANALYSIS

The benefits associated with a flood mitigation project are directly correlated to the reduction of flood-related impacts that are gained by the subject project. An analysis was performed to determine the flooding impacts of both before and after project construction, for both the 100-yr detention facility alternatives and the 50yr detention facility alternatives, for multiple flooding events. HEC-RAS hydraulic modeling was performed for the various flood scenarios to develop floodplains and associated water surface elevation grids for the existing conditions and both sets of mitigation projects, including the 100yr and 50yr detention facilities. The modeling was performed for the 2yr, 5yr, 10yr, 25yr, 50yr, 100yr, and 500yr storm events. The results from each modeling scenario were used to identify the structures impacted by the associated flooding. The benefit analysis that was performed provides a probabilistic analysis of the flooding issues and identified solutions. As an example, Figure 13 shows the buildings that are impacted by the 1% annual chance (100yr) and 0.2% annual chance (500yr) floodplains in existing conditions.

FIGURE 13- BUILDINGS IMPACTED BY EXISTING FLOODPLAINS



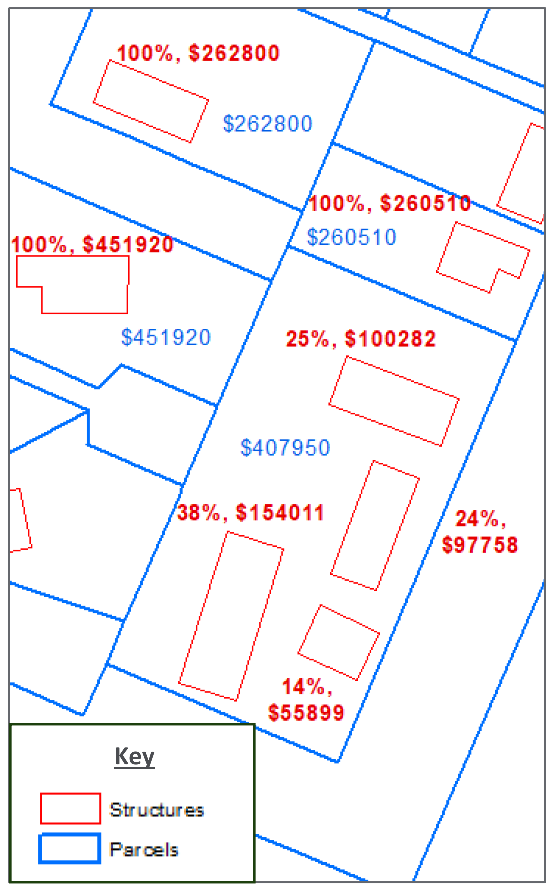
6.1 Considerations for High Value Buildings

There are four buildings that we have identified as high dollar value structures. These four large buildings, which are shown as the hatched structures in Figure 13, have a combined assessed property value of 18.3 million dollars. These structures include the St. Marys Grade School, the St. Marys Manor/Community Health Center, the Main Halls at St. Marys College, and the Auditorium at St. Marys College. The total assessed value for all of the buildings within that 1% annual chance (100yr) floodplain is about 30.4 million. Therefore, about 60% of the estimated property value impacted by the 1% annual chance floodplain are from those four buildings. This is important to be mindful of as the benefits are evaluated for the different mitigation options.

6.2 Damage Estimates

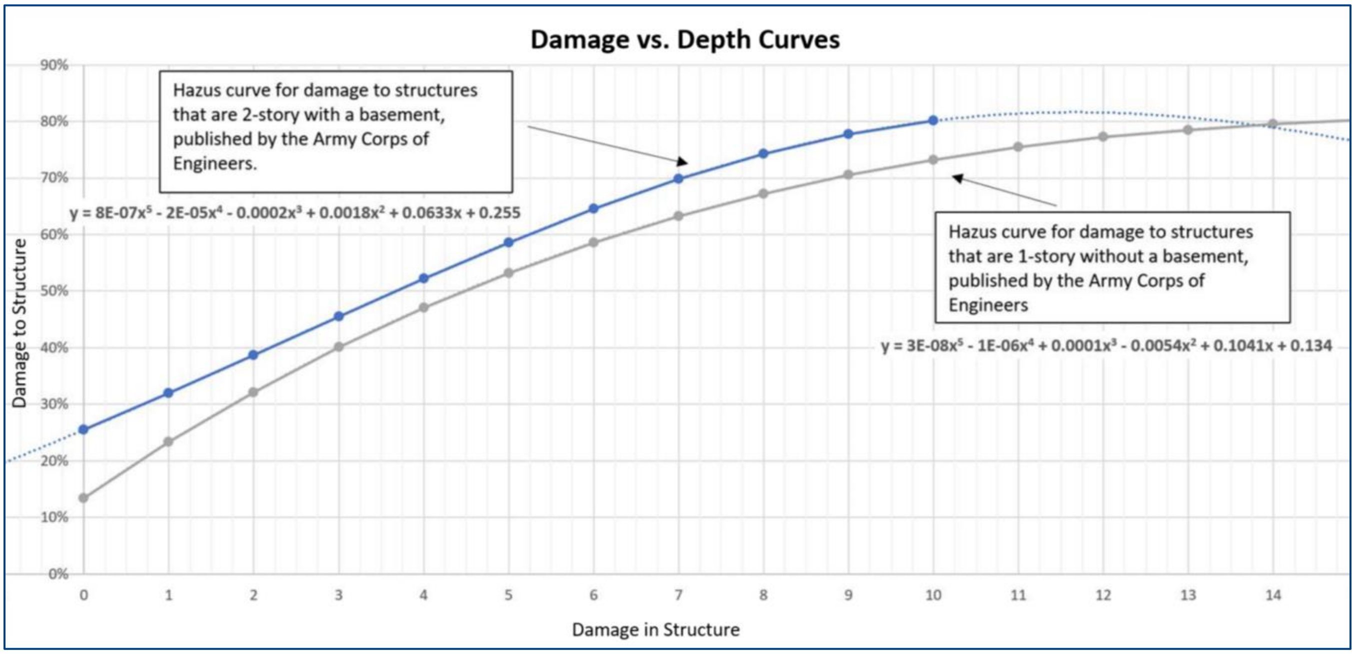
Parcel data, including assessed property values, was provided by the Pottawatomie County appraiser's office. Building footprints were obtained from the 2019 Microsoft building footprints dataset. To evaluate flood damages, each building footprint was first correlated with an assessed property value. Since multiple buildings can exist within one parcel, an analysis was done to proportionally attribute all buildings in a parcel with assessed value information. Assessed value information was assigned to buildings relative to the proportional amount of footprint space they take up in the parcel compared to the other buildings. Figure 14 provides an example of how this was done. The parcel valued at $407,950 has four buildings. Each building was assigned an estimated value that is based on the percentage of the total building space occupied by the associated building. The lower right building occupies 14% of the total building space and is thus valued at 14% of the total assessed property value.

FIGURE 14 – PROPERTY VALUE ATTRIBUTION EXAMPLE



Each building was then correlated with a maximum flood depth for each storm frequency (2yr, 5yr, 10yr, 25yr, 50yr, 100yr, 500yr) based on the associated water surface elevation grid. Surveyed lowest adjacent grade values were available for many buidlings in the study area. The buildings without survey information were assigned an assumed lowest adjacent grade based on bare-earth Lidar information. A building is considered impacted by the associated flood event when the water surface elevation is greater than the lowest adjacent grade of the building. Depth grids were produced from the water surface elevation grids and terrain data (Lidar data). For impacted structures, the maximum depth intersecting the structure was attributed as the flood depth. A curve was developed to quantify the damage associated with varying flood depths at existing building structures. Depth versus damage curves developed by the US Army Corps of Engineers were utilized. There are two curves that represent different building types. The lower curve, or the gray curve in Figure 15, represents estimated damages, on a percentage basis, for one-story buildings that do not have a basement. The top curve, or the blue curve in Figure 15, represents estimated damages, on a percentage basis, for buildings that do have a basement. As you can see in the graph, expected damages are slightly higher for those buildings that have basements. The building type, with or without a basement, was assigned using parcel information, imagery and Google Earth Streetview.

FIGURE 15- DAMAGE CURVES



A damage estimate was then determined for each building for each storm event using (a) the associated maximum depth of flooding for the associated storm event, (b) the assessed property value for the building, and (c) the equation associated with the depth-damage curve shown in Figure 15.

A damage estimate was then determined for each College Creek storm event by taking a sum of the building damages associated with each event. Using the determined damage estimates, an average annualized loss, specific to damage costs associated with flooding, was determined for College Creek based on the probabilities of recurrence, from the 2-yr event up to the 500-yr event. Figure 16 shows an example of how the average annualized loss is calculated. The probability interval between each storm event (or flood return interval) is calculated. The internal average damages column is an average between the damages associated with the two storm events of interest. The interval damage calculation column multiplies the probability interval by the interval average damages. The average annualized loss, shown in green, is a sum of all the interval damage calculation values and is used to compare the potential for damages in each evaluated scenario.

FIGURE 16- ANNUALIZED DAMAGES EXAMPLE

Flood Damage Estimates for Existing Conditions A						
Flood Return Interval	Probability	Probability Interval	Damages ($)	Interval Average Damages ($)	Interval Damage Calculation ($)	Summary Expected Annual Damages ($)
2-YR	0.5		$0.00			
		0.3		$0.00	$0.00	$0.00
5-YR	0.2		$0.00			
		0.1		$44,430.00	$4,443.00	$4,443.00
10-YR	0.1		$88,860.00			
		0.06		$2,021,804.50	$121,308.27	$125,751.27
25-YR	0.04		$3,954,749.00			
		0.02		$4,020,044.00	$80,400.88	$206,152.15
50-YR	0.02		$4,085,339.00			
		0.01		$6,545,141.50	$65,451.42	$271,603.57
100-YR	0.01		$9,004,944.00			
		0.008		$10,557,114.00	$84,456.91	**$356,060.48**
500-YR	0.002		$12,109,284.00			
* Includes four large buildings in flood area						

Table 1 describes the average annual damages for the six different scenarios, which includes the three modeling scenarios, being the existing conditions, the 100yr detention dam alternative, and the 50yr detention dam alternative, all with all the buildings included and with the four high dollar-value buildings excluded. It should be noted that the average annual damages are similar for a dry and wet detention dam that is designed for the same storm event, as the discharges from the dam are essentially the same in both situations. As indicated below, there is some flooding for storm event frequencies in excess of the 1% annual chance flood event, therefore there are still average annual damages for those scenarios with the 100yr detention dam.

TABLE 1- AVERAGE ANNUAL DAMAGES

Scenario	Average Annual Damages
Existing *(all buildings included)*	$356,068
Existing *(4 large buildings excluded)*	$140,719
100-yr Detention Upstream and channel modifications *(all buildings included)*	$15,766
100-yr Detention Upstream and channel modifications *(4 large buildings excluded)*	$7,914
50-yr Detention Upstream and channel modifications *(all buildings included)*	$33,970
50-yr Detention Upstream and channel modifications *(4 large buildings excluded)*	$17,053

7 BENEFIT-COST ANALYSIS

The benefits of a mitigation project equate to the reduction in average annual damages. Therefore, the average annual damages in each project scenario is compared to the average annual damages for the existing conditions to determine an estimated annual damage benefit. For this benefit-cost analysis, the benefits and costs are analyzed over a 50-year period. The Office of Management and Budget (OMB) revised Circular A-94, published in December 2022 by the Office of Economic Policy, was used to obtain a nominal discount rate of 4.2%. This rate is a forecast of market interest rates based on economic assumptions and is intended for use in evaluating cost-effectiveness. The document specifies rates from 3-year to 30-year periods; therefore, the documented 30-year rate was used in our analysis. The discount rate was used to determine a present value coefficient for the 50-year analysis period, which was then used to determine a present value benefit.

For this benefit-cost analysis, a number of items are factored into the project costs. The project cost estimates previously presented in the report include the costs associated with engineering design, geotechnical investigation, easement negotiation and acquisition, permitting coordination and fees, stream mitigation, utility relocates and construction costs. The costs used in the benefit-cost analysis also includes administrative costs of $1,000 annually, on-going inspection costs of $1,500 annually, operational costs of $2,000 annually, maintenance costs of $6,000 annually, and replacement costs of $50,000 every ten years. The nominal discount rate was utilized to calculate a discount factor for every year. A present value total cost was then determined for each project. A benefit-cost ratio was then calculated for each project scenario, including wet and dry detention dams that control the 1% annual chance (100yr) storm event and wet and dry detention dams that control the 2% annual chance (50yr) storm event, factoring in all the buildings and excluding the four high dollar value buildings. Table 2 provides a summary of the benefit-cost analysis for all eight project scenarios. The benefit-cost ratios are largely impacted when the four large buildings are excluded. This differentiation is being provided in the event that a separate alternative to floodproof those four buildings were to be implemented in the future, as discussed in Section 9 of this report. The dry detention dam projects have slightly higher benefit-cost ratios than the wet detention dam projects.

TABLE 2- BENEFIT-COST ANALYSIS SUMMARY

Project Scenario	Est. Annual Damage Benefit	Present Value Benefit	Present Value Total Cost	B/C Ratio
100-yr Wet Detention Dam Project *(all buildings included)*	$340,302	$7,066,740	$5,166,841	1.37
100-yr Wet Detention Dam Project *(4 large buildings excluded)*	$132,805	$2,757,840	$5,166,841	0.53
100-yr Dry Detention Dam Project *(all buildings included)*	$340,302	$7,066,740	$4,428,486	1.60
100-yr Dry Detention Dam Project *(4 large buildings excluded)*	$132,805	$2,757,840	$4,428,486	0.62
50-yr Wet Detention Dam Project *(all buildings included)*	$322,098	$6,688,714	$4,590,636	1.46
50-yr Wet Detention Dam Project *(4 large buildings excluded)*	$123,666	$2,568,059	$4,590,636	0.56
50-yr Dry Detention Dam Project *(all buildings included)*	$322,098	$6,688,714	$4,193,374	1.60
50-yr Dry Detention Dam Project *(4 large buildings excluded)*	$123,666	$2,568,059	$4,193,374	0.61

**All projects include the proposed channel modification*

8 ANALYSIS OF THE IMPACTED POPULATION

In an effort to evaluate the impact of the various mitigation alternatives to the community in an equitable way that goes beyond dollar amounts, an analysis was performed to compare the average annual number of residents impacted from flooding for the existing conditions versus the alternative scenarios. This provides an equitable component to the analysis, ensuring that each impacted person is represented in the same way, regardless of the home's value. This was done by determining an annualized number of impacted residents for each scenario based on the probability of flood occurrence, similar to the approach that was taken for the average annual damages.

Population was assigned at the building footprint level. First, statewide census block population information from 2020 was obtained. A census block usually contains multiple parcels and buildings. The population for each parcel was estimated based on the proportional area the subject parcel occupies within the census block. For the purpose of this evaluation, it was estimated that the percentage of the area occupied by a parcel within the census block was equivalent to the percentage of the total population for the associated parcel. For example, if a parcel occupies 40% of a census block that has 100 people, it was assumed that the associated parcel has 40 people. The populations assigned to each parcel were then correlated to the associated building footprints within the parcel, using the same proportional methodology. A determination was then made for the buildings impacted, specifically the population of those buildings, for each storm event frequency (2yr, 5yr, 10yr, 25yr, 50yr, 100yr, 500yr). Using the impacted population estimates, an average annualized number of impacted residents was determined for each modeling scenario based on the probabilities of occurrence. This was applied in a similar way to the Average Annualized Damages estimates. Figure 17 provides an example of how the annualized number of impacted residents is calculated.

FIGURE 17- EXAMPLE OF PARCELS WITHIN CENSUS BLOCKS

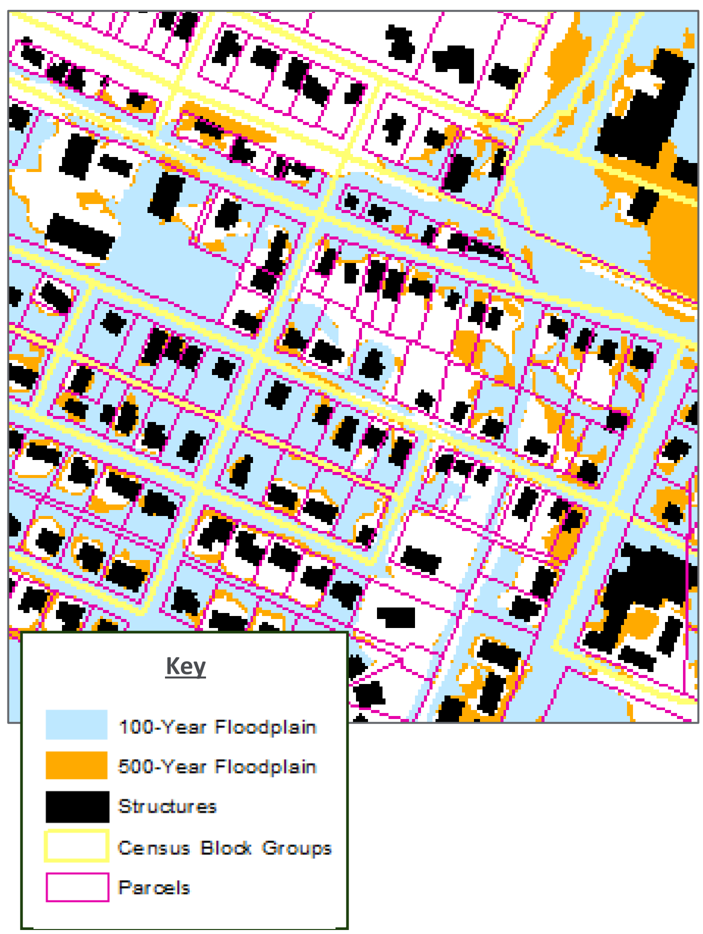


Figure 18- Annualized Number of Impacted Residents Example

Impacted Population Estimates for Existing Conditions A						
Flood Return Interval	Probability	Probability Interval	Impacted Population	Interval Average Impacted Population	Interval Impacted Population Calculation	Summary Expected Annual Impacted Population
2-YR	0.5		0			
		0.3		0	0	0
5-YR	0.2		0			
		0.1		3	0	0
10-YR	0.1		5			
		0.06		48	3	3
25-YR	0.04		90			
		0.02		93	2	5
50-YR	0.02		95			
		0.01		166	2	7
100-YR	0.01		236			
		0.008		287	2	**9**
500-YR	0.002		338			
* Includes four large buildings in flood area						

Table 3 describes the average annual population impact for the six different scenarios, which includes the three modeling scenarios for the existing conditions, the 100yr detention dam alternative, and the 50yr detention dam alternative, all with all the buildings included and with the four high dollar-value buildings excluded. It should be noted that the average annual impacts are similar for a dry and wet detention dam that is designed for the same storm event, as the discharges from the dam are essentially the same in both situations.

Table 3- Average Annual Population Impact

Scenario	Average Annual Number of Impacted Residents
Existing *(all buildings included)*	9
Existing *(4 large buildings excluded)*	7
100-yr Detention Upstream and channel modifications *(all buildings included)*	0
100-yr Detention Upstream and channel modifications *(4 large buildings excluded)*	0
50-yr Detention Upstream and channel modifications *(all buildings included)*	1
50-yr Detention Upstream and channel modifications *(4 large buildings excluded)*	1

9 ADDITIONAL ALTERNATIVES CONSIDERED

We recognize that the mitigation alternatives previously discussed, which include the construction of an upstream detention dam and channel modifications, are sizeable projects that may be difficult to implement. In the previous study that was completed by Benesch for the City of St. Marys, additional alternatives were evaluated in addition to the proposed detention dam and limited channel improvements. These included levee improvements, upsizing roadway and railroad bridges, and extensive channel improvements that captured bridge improvements. All of these alternatives were previously determined to be significantly more costly and offering less benefits than the proposed detention dam with limited channel improvements project. For this technical assistance project, several other additional alternatives for flood mitigation were considered. These alternatives include floodproofing a number of buildings, an alternative upstream mitigation/detention project, an alternative diversion channel project, and buy-out opportunities.

9.1 Floodproofing High Value Buildings

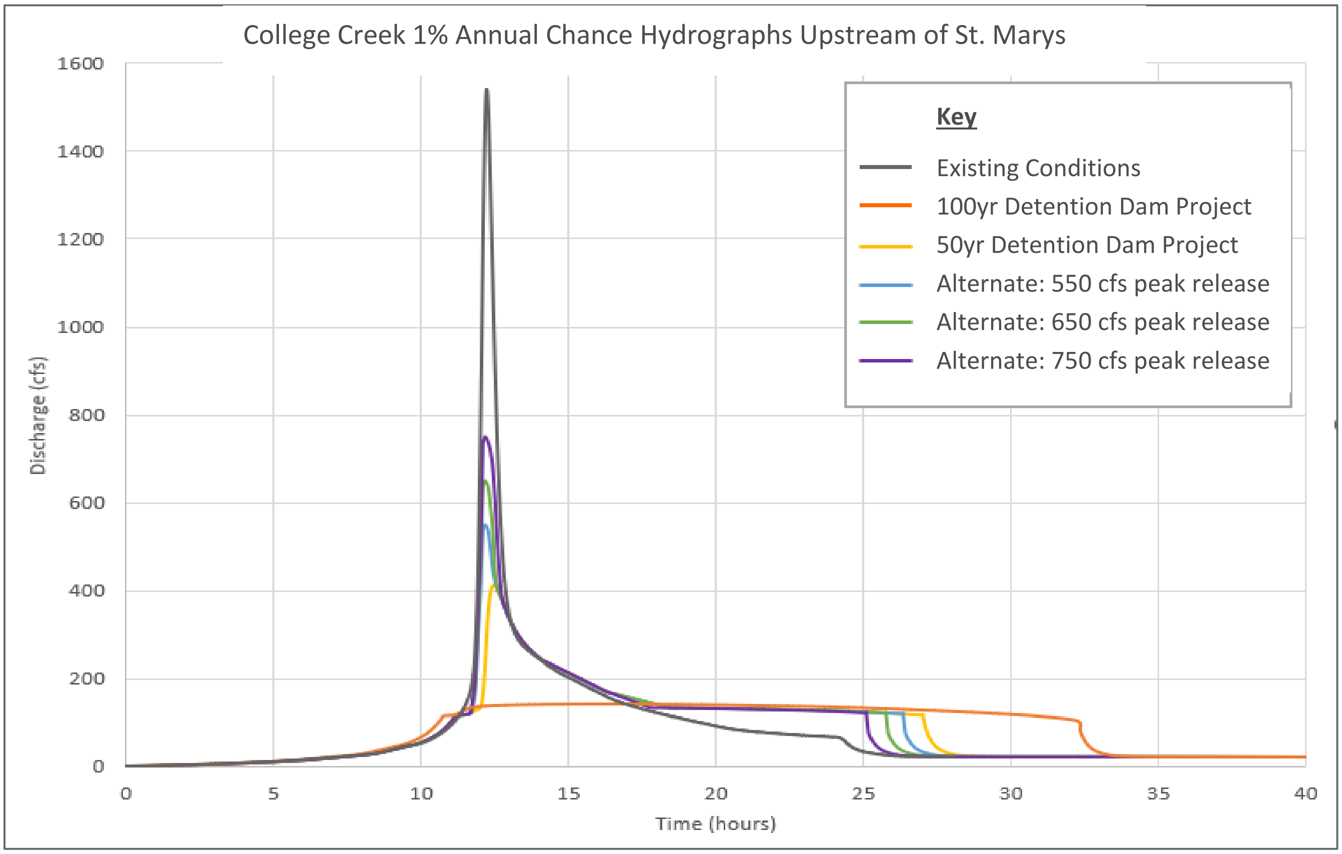
An alternative that could be considered from an economic standpoint, to significantly reduce the overall financial impact from a large flood along College Creek, would be to floodproof the four buildings with the high assessed property values. These buildings include the St. Marys Grade School, which has an assessed property value of approximately $7.3 million; the St. Marys Manor/Community Health Center, which has an assessed property value of approximately $1.9 million; the Main Halls at St. Marys College, which has an assessed property value of approximately $4.9 million; and the Auditorium at St. Marys College, which has an assessed property value of approximately $4.2 million. There may also be consideration and justification to floodproofing some of those buildings, but not all four. The total assessed property values within the 1% annual chance floodplain for College Creek totals approximately $30.4 million. The total assessed property value of the four large buildings previously described totals approximately $18.3 million, which equates to about 60% of the assessed property value within the 1% annual chance floodplain. Floodproofing efforts could prove to be a more cost effective option, if simply looking to reduce the potential costs associated with damages from a large flood. This would have a substantial reduction on the overall economic impacts of a large flooding event.

Floodproofing could include any combination of structural and non-structural additions or modifications which reduce or eliminate flood damage. This would likely require the building to be watertight; the building’s utilities, including heating, air conditioning, electrical, and water supply services, to be located above the base flood elevation (BFE); and the building’s structural components to be capable of resisting hydrostatic flood forces. The costs associated with a floodproofing project could be evaluated and compared against the costs and benefits of a flood mitigation project.

9.2 Alternative Upstream Mitigation Projects

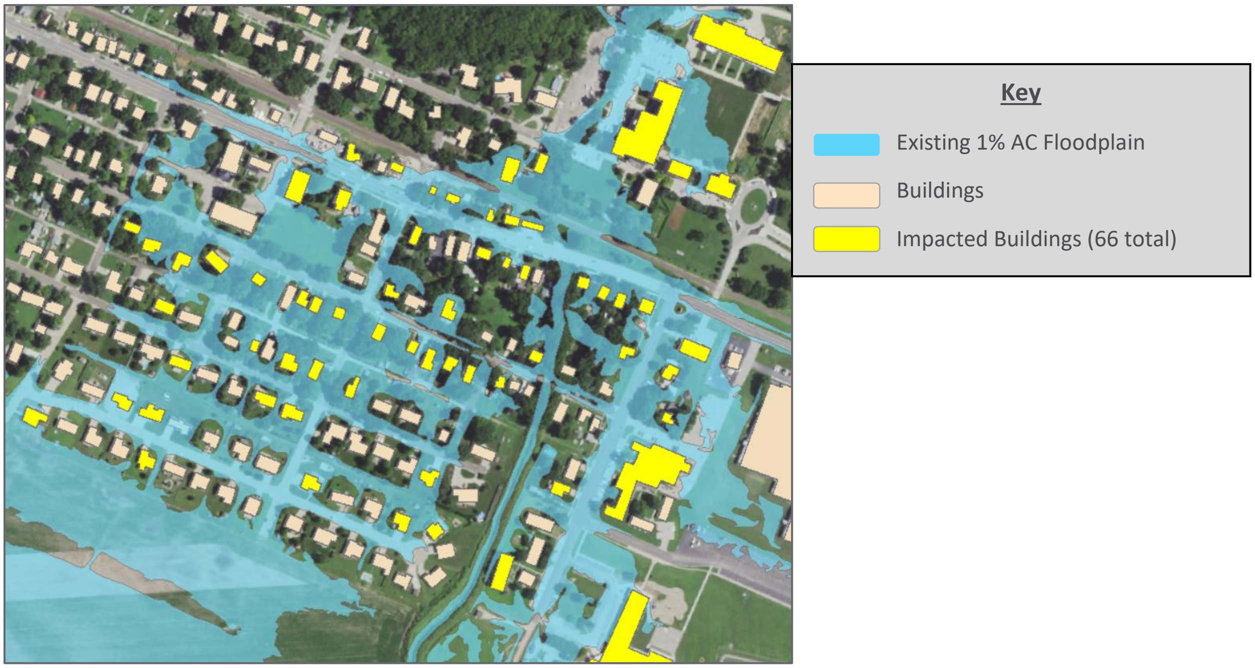
It is recognized that the costs associated with construction of an upstream detention dam are rather high. The project team considered the possibility of an alternative upstream mitigation project, such as a wetland scenario or an offline structure that would reduce discharges downstream, but not to the magnitude of the large detention dams. To evaluate the effectiveness of alternative upstream mitigation projects on the downstream flooding, a sensitivity analysis was performed for the 1% annual chance storm event, utilizing scaled upstream release rates. This was done to evaluate the sensitivity to the 1% annual chance flooding from a variety of releases from an upstream mitigation project. The flow hydrograph for the College Creek existing conditions upstream of St. Marys were compared to the discharge hydrographs from the 100yr detention dam and the 50yr detention dam and were then used to help scale alternate discharge hydrographs for three alternative mitigation project scenarios. The existing conditions hydrograph has a peak discharge of 1,540 cfs. The 100yr detention dam alternative has a peak release of approximately 150 cfs. The 50yr detention dam alternative has a peak release of approximately 420 cfs. The three alternate hydrographs used in this sensitivity analysis have peak releases of 550 cfs, 650 cfs, and 750 cfs. These six hydrographs are shown in Figure 19. These flow hydrographs were then incorporated into the effective HEC-RAS hydraulic model to determine the associated flood extents.

FIGURE 19- COMPARISON OF COLLEGE CREEK FLOW HYDROGRAPHS UPSTREAM OF ST. MARYS



The peak 1% annual chance discharge in College Creek under existing conditions is approximately 1,540 cfs, which results in 66 buildings in the 1% annual chance floodplain as shown in Figure 20.

FIGURE 20- IMPACTED STRUCTURES FOR EXISTING CONDITIONS (1% AC STORM)

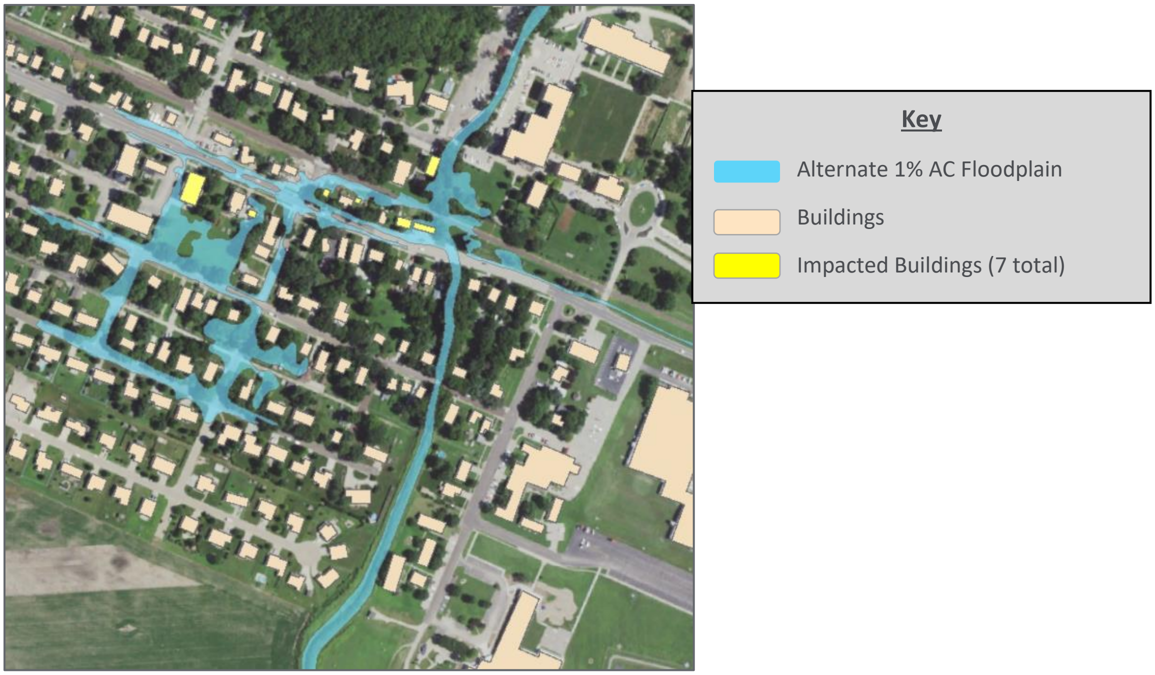


The detention dam designed for the 1% annual chance (100yr) storm event results in a peak 1% annual chance discharge of approximately 150 cfs, which results in 0 buildings in the 1% annual chance floodplain, as shown in Figure 21. Note that this alternative includes the previously proposed channel modifications.

FIGURE 21- IMPACTED STRUCTURES FOR 100-YR DETENTION DAM ALTERNATIVE (1% AC STORM)

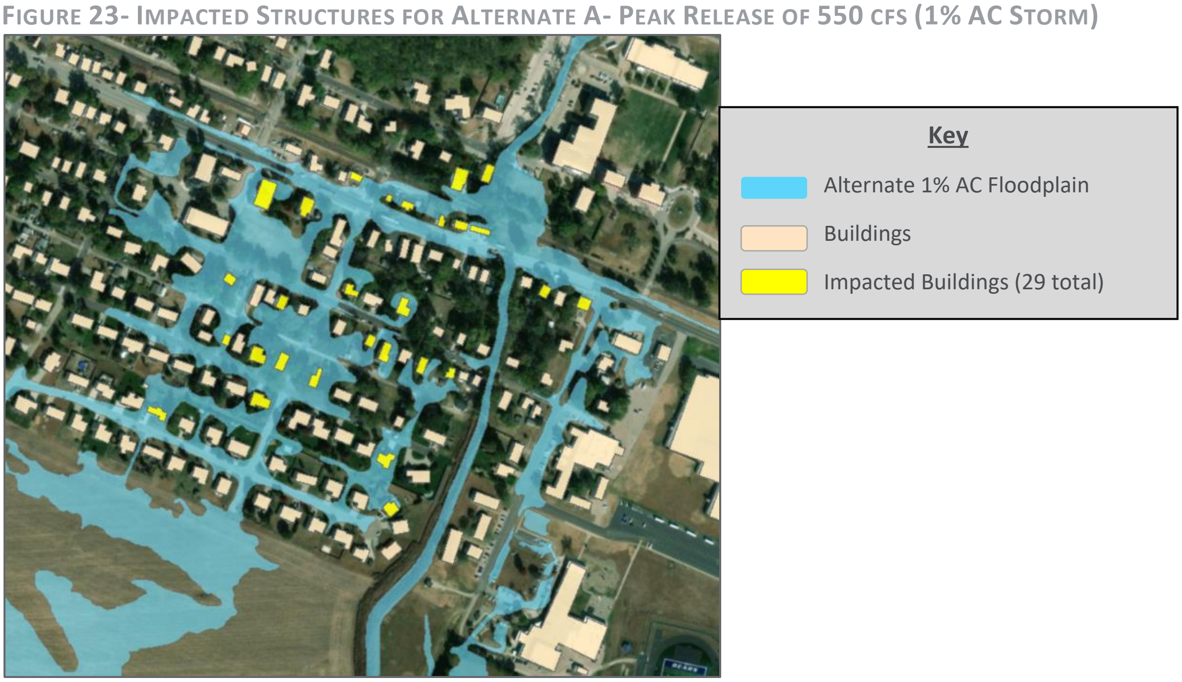
The detention dam designed for the 2% annual chance (50yr) storm event results in a peak 1% annual chance discharge of approximately 420 cfs, which results in 7 buildings in the 1% annual chance floodplain, as shown in Figure 22. Note that this alternative includes the previously proposed channel modifications.

FIGURE 22- IMPACTED STRUCTURES FOR 50-YR DETENTION DAM ALTERNATIVE (1% AC STORM)



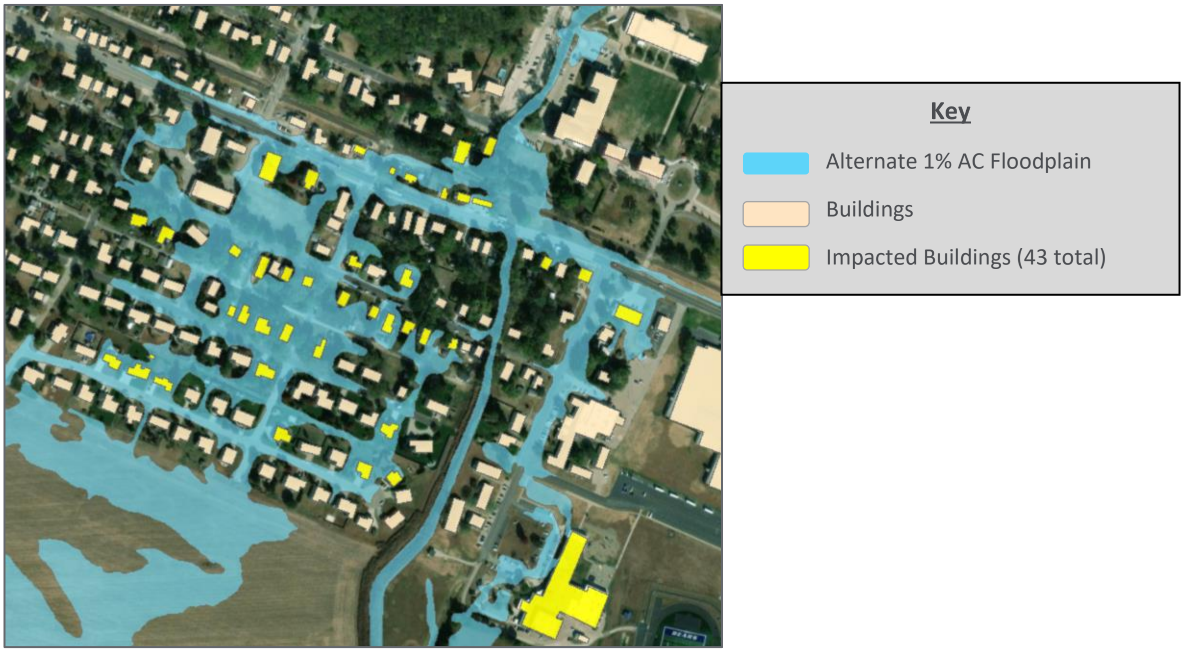
The alternate release with a peak 1% annual chance discharge of approximately 550 cfs results in 29 buildings in the 1% annual chance floodplain, as shown in Figure 23. Note that this alternative includes the previously proposed channel modifications.

FIGURE 23- IMPACTED STRUCTURES FOR ALTERNATE A- PEAK RELEASE OF 550 CFS (1% AC STORM)



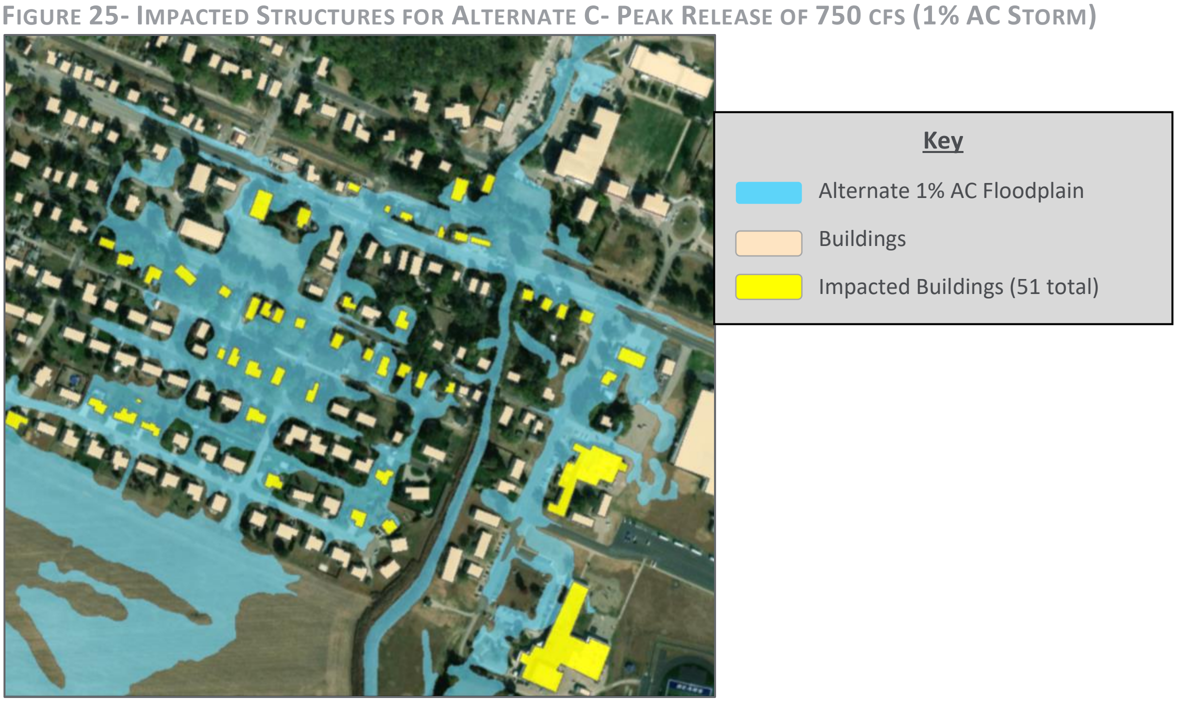
The alternate release with a peak 1% annual chance discharge of approximately 650 cfs results in 43 buildings in the 1% annual chance floodplain, as shown in Figure 24. Note that this alternative includes the previously proposed channel modifications.

FIGURE 24- IMPACTED STRUCTURES FOR ALTERNATE B- PEAK RELEASE OF 650 CFS (1% AC STORM)



The alternate release with a peak 1% annual chance discharge of approximately 750 cfs results in 51 buildings in the 1% annual chance floodplain, as shown in Figure 25. Note that this alternative includes the previously proposed channel modifications.

FIGURE 25- IMPACTED STRUCTURES FOR ALTERNATE C- PEAK RELEASE OF 750 CFS (1% AC STORM)

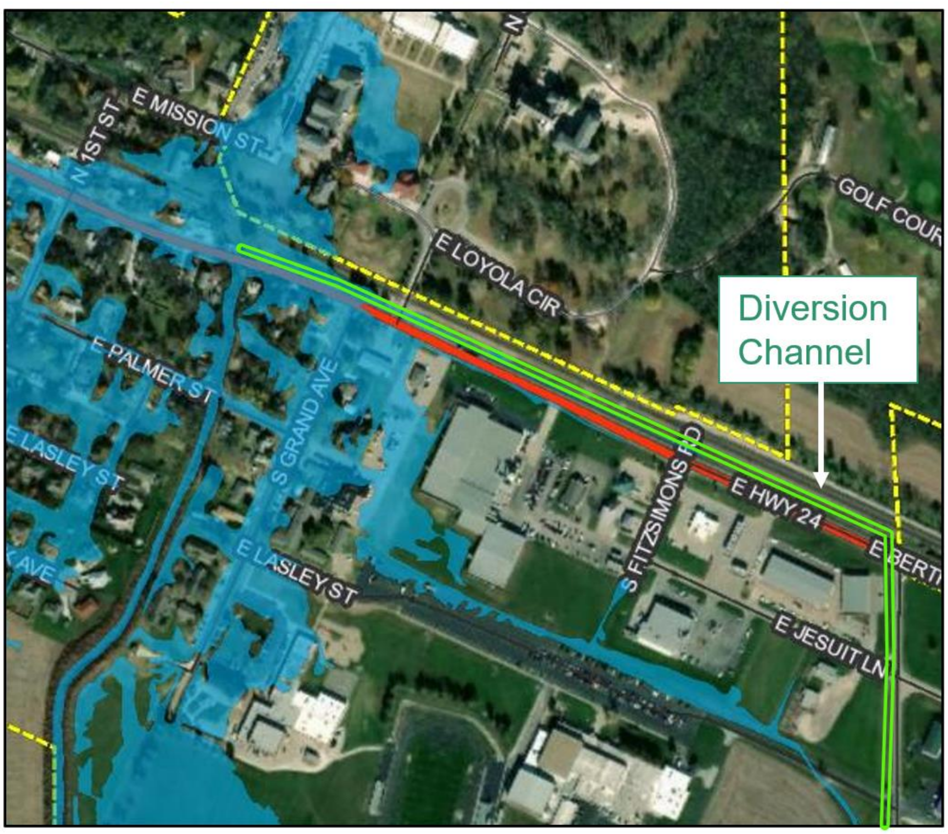


The sensitivity analysis indicates that an alternate upstream mitigation project would likely not result in enough improvement to the 1% annual chance floodplain to warrant such a project, as projects providing this level of detention would still be very costly. While a wetland or offline detention facility could provide some storage volume during a rainfall event, the system would not be able to trim enough off the peak release during a large storm event, such as the 1% annual chance, to have significant improvements downstream. Therefore, these alternative upstream mitigation projects are not considered to be valuable opportunities for flood reduction along College Creek.

9.3 Alternative Diversion Channel Project

The team took an additional look at a potential diversion channel that would be located between Highway 24 and the railroad, which would convey flood waters from the College Creek channel to the east and then south, across Highway 24 and along Maple Hill Road. The channel would enter open space, ultimately flowing toward the Kansas River. Figure 26 shows the location of this alternative diversion channel. The available space between Highway 24 and the Union Pacific Railroad is limited. Not only would this limit the available footprint for a diversion channel, but this alternative would require coordination, and ultimately agreements, with the Kansas Department of Transportation and the Union Pacific Railroad to perform work within both of the right-of-ways. We would expect difficulties in getting approval to work within those right-of-ways and thus have determined this project to be a non-viable option.

FIGURE 26- LOCATION OF ALTERNATIVE DIVERSION CHANNEL



9.4 Buy-Out Opportunities

When evaluating the potential options for reducing the flood risk and associated impacts to buildings and residents, buy-out opportunities should be considered. The total assessed property value within the 1% annual chance (100-yr) floodplain is approximately $30.4 million. As previously mentioned, the four large buildings in the floodplain have a combined assessed property value of $18.3 million. Therefore, the other buildings in the floodplain, mostly residential and some commercial, have a combined assessed property value of $12.1 million. Not only would buy-outs significantly change the landscape of St. Marys and likely be undesirable by the community, but the high costs associated with the buy-outs make this an impractical solution.

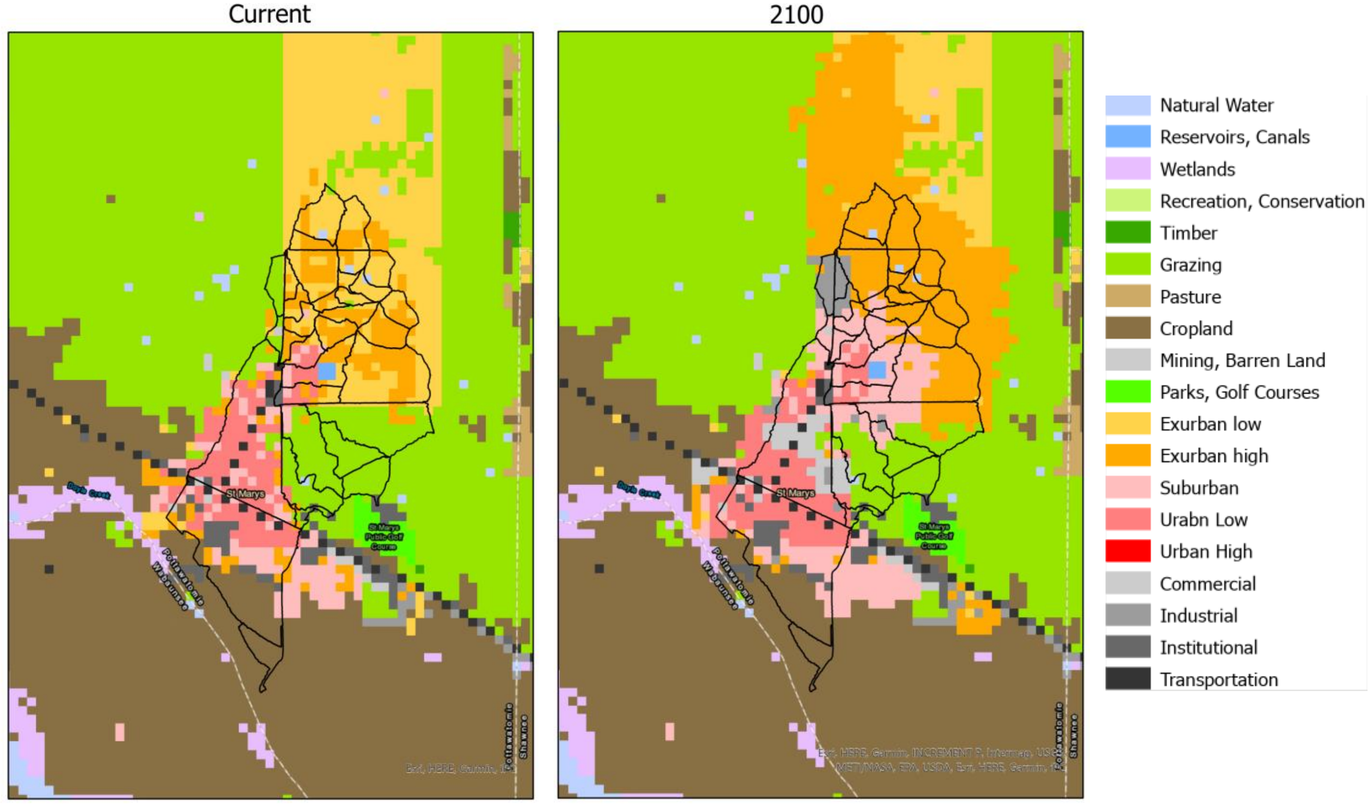
10 PROJECT RESILIENCY

There are a number of factors that could impact a project's effectiveness into the future and overall resiliency to changes that could occur over time. When considering whether to move forward with a mitigation project, there is often the question of whether the project will provide the expected benefits if climate change, development, or watershed changes were to alter the future rainfall, runoff, and ultimately discharges for a subject stream. As part of this project, a review of the mitigation project's resiliency was completed to gain a general understanding of potential impacts to flood risk along College Creek.

10.1 Future Land Use Changes

The project team researched available future land use data sets that extend well into the future. Many future land use plans that are developed by and for communities are short to mid-range plans. We were interested in looking at long range potential changes from a theoretical perspective. EPA has developed demographic and spatial allocation models to produce integrated climate and land use scenarios that project population and land use changes. This illustrates potential population shifts in the future. This data is available for 10-year spans, all the way to the year 2100. Figure 27 shows a high-level comparison of land use classifications at the current/present time and those anticipated land use classifications in the year 2100. The comparison shows potential urban and suburban and growth of St. Marys particularly to the north, which would fall within the College Creek watershed. These types of land use changes would increase runoff within the watershed.

FIGURE 27- COMPARISON OF FUTURE LAND USE TO CURRENT CONDITIONS



10.2 Future Climate Change

Climate change typically refers to changes in weather patterns that could change the amount of rainfall as well as the rainfall intensity. There are a number of publications available on climate change that have interesting information. However, there are no publications or information available that can definitely describe how future climate change will occur. There are many models and climate change forecasts, but there are still a large number of unknowns regarding this topic, resulting in predictions that are still subjective and often describe large ranges to the potential changes.

There is currently no specific information related to climate change in Kansas at this time. However, we found examples of climate change studies that have been performed in other areas that describe potential impacts to NOAA Atlas 14 precipitation values. Figure 28 provides an example of modeling sensitivity within climate change scenarios that have been developed for Boston, Houston, and Chicago as part of the University of Illinois Urbana-Champaign and University of Wisconsin-Madison study. This information can be extrapolated for Midwest areas, such as Kansas. To test the sensitivity of the climate model results based on areal reduction factors (ARF), three different climate scenarios were evaluated (0.67, 0.80 and 0.90). The evaluation included two different representative constriction pathway (RCP) emission scenarios. RCP 4.5 is a medium greenhouse gas emission scenario. RCP 8.5 is a high greenhouse gas emission scenario. The evaluation also included two different time spans, a span that extends to 2053 and a longer range span that extends from 2054 to 2100. The modeling sensitivity is shown as percent reduction (PR) values, which illustrates the impacts on standard deviation of the model results.

FIGURE 28- ANALYSIS OF IMPACT OF NONSTATIONARY CLIMATE ON NOAA ATLAS 14 ESTIMATES

APPENDIX A-2. The University of Illinois Urbana-Champaign and the University of Wisconsin-Madison Final Report

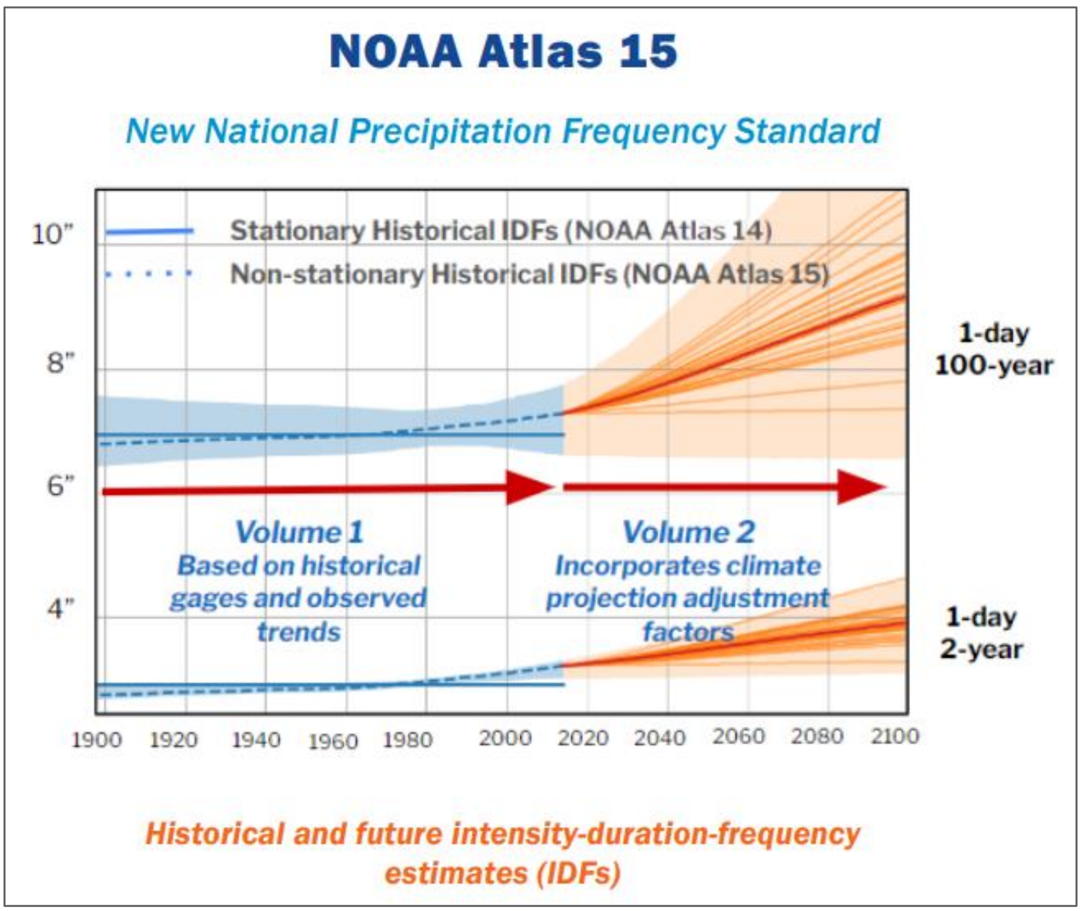
Table I.9. PR values (%) for all cases in the experiment

		Boston				Houston				Chicago			
		2006-2053		2054-2100		2006-2053		2054-2100		2006-2053		2054-2100	
Climate Scenario		RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
ARF=0.90 Return Period (years)	2	-41.0	-29.4	-37.7	-39.8	-54.1	-28.2	-41.8	-47.9	-21.2	-16.2	-25.6	-8.2
	5	-40.9	-32.6	-38.8	-33.6	-59.8	-35.2	-49.5	-55.8	-24.6	-20.2	-28.3	-15.2
	10	-39.5	-31.9	-38.1	-27.6	-61.6	-41.3	-53.5	-59.1	-27.0	-23.9	-29.5	-20.2
	25	-36.5	-28.4	-35.7	-19.1	-60.4	-48.6	-56.8	-57.9	-30.0	-29.1	-30.0	-26.8
	50	-33.6	-24.8	-32.9	-12.7	-57.2	-52.2	-57.9	-53.4	-32.1	-33.1	-29.6	-31.7
	100	-30.4	-20.8	-29.8	-6.7	-52.8	-53.6	-57.9	-47.0	-33.9	-37.0	-28.6	-36.4
ARF=0.80 Return Period (years)	2	-21.7	-43.2	-22.1	-46.0	-42.0	-24.7	-32.6	-36.8	-43.3	-40.1	-36.7	-22.6
	5	-22.9	-44.6	-25.4	-47.5	-47.4	-30.9	-39.2	-44.0	-42.6	-41.1	-36.8	-25.9
	10	-23.9	-45.3	-27.8	-48.6	-49.4	-36.4	-43.0	-47.8	-41.6	-41.7	-35.6	-28.9
	25	-24.8	-45.0	-30.6	-48.9	-49.1	-42.6	-46.6	-48.7	-40.1	-42.6	-32.9	-33.2
	50	-25.1	-43.8	-32.4	-47.8	-47.0	-45.6	-48.3	-46.3	-38.9	-43.1	-30.3	-36.3
	100	-25.0	-41.9	-33.8	-45.8	-43.7	-46.7	-49.1	-41.9	-37.7	-43.5	-27.5	-38.9
ARF=0.67 Return Period (years)	2	-41.6	-33.6	-37.8	-40.6	-51.3	-27.6	-39.9	-45.3	-24.1	-19.5	-26.2	-9.8
	5	-40.2	-34.8	-37.3	-35.0	-56.8	-34.3	-47.3	-52.9	-26.5	-22.7	-28.1	-15.7
	10	-38.3	-32.9	-36.1	-30.0	-58.5	-40.2	-51.1	-56.2	-28.1	-25.8	-28.5	-20.3
	25	-34.9	-28.3	-33.6	-23.1	-57.4	-47.0	-54.4	-55.6	-30.1	-30.3	-28.0	-26.5
	50	-31.9	-24.0	-31.1	-18.1	-54.5	-50.4	-55.6	-51.5	-31.4	-33.8	-26.9	-31.2
	100	-28.9	-19.5	-28.4	-13.5	-50.3	-51.7	-55.8	-45.6	-32.6	-37.1	-25.3	-35.6

The study shows a large amount of model uncertainty with the various climate change scenarios that are available. Precipitation increase predictions can range anywhere between 10% to nearly 50%. This is a very large range, which indicates that while climate experts have made determinations that over time there will be shifts in precipitation patterns, the magnitude of those shifts is still unknown.

The rainfall information that was used in the modeling for this project and is used in general practice by the industry for obtaining rainfall totals for different frequency storm events is NOAA Atlas 14 rainfall information. While there are a lot of climate impact studies being done around the country, none have been officially adopted at this time by NOAA. However, NOAA has piloted several projects that are focused on climate change and is in the process of developing some new publications that are expected to provide some information on climate projection adjustment factors for those piloted areas. This information is expected to be published within the next few years, and likely coupled with the release of NOAA Atlas 15. Volume 1 of NOAA Atlas 15 will be similar to past releases of new data, in which future assessments are made on actual statistics associated with rainfall depths and rainfall intensities at various rainfall gauges. Volume 2 of NOAA Atlas 15 is expected to include components of rainfall depth and volume which is intended to incorporate climate projections. At some point in the future, likely in 10 to 15 years, projection adjustment factors will become an industry standard and FEMA will likely have additional requirements to incorporate climate projection factors. While the industry anticipates precipitation adjustments in the future, nobody knows exactly what that will look like at this time.

FIGURE 29- HISTORICAL AND FUTURE INTENSITY-DURATION FREQUENCY ESTIMATES



10.3 Precipitation Sensitivity Analysis

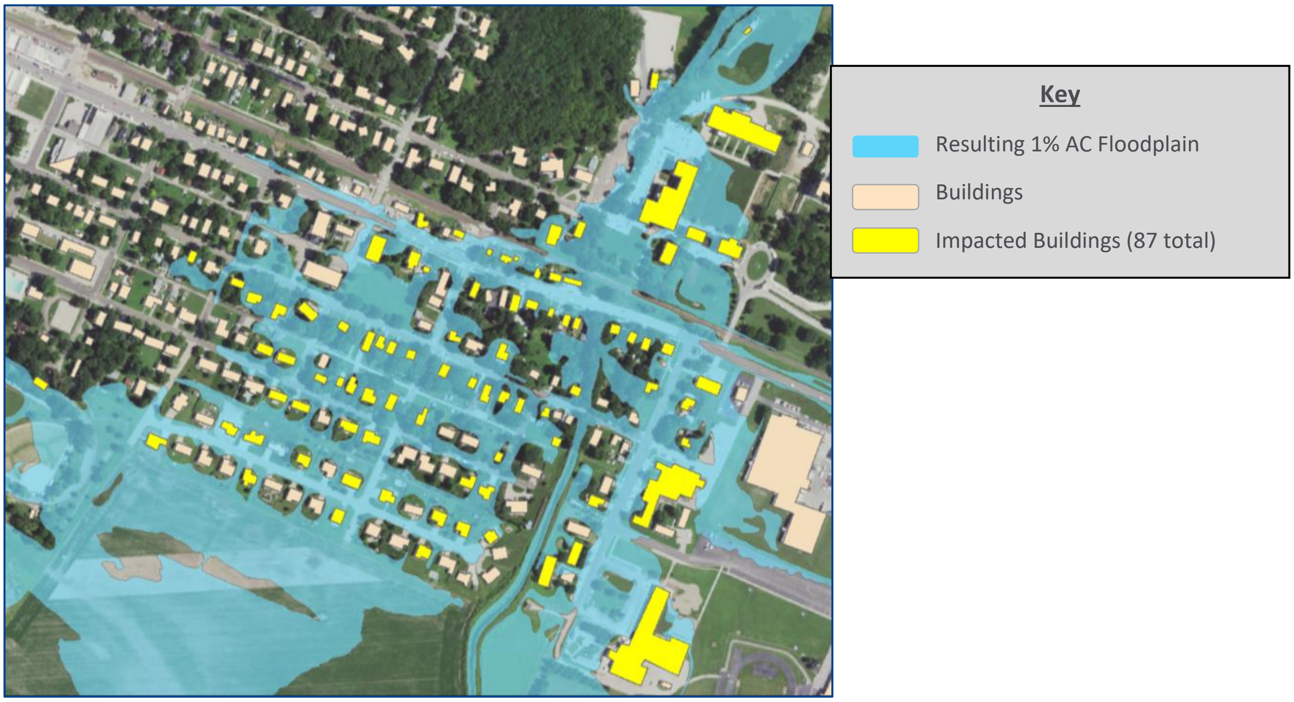
As part of this project, a precipitation sensitivity analysis was performed to gain some understanding of the potential impacts from future changes in land use, climate, or other factors that could increase precipitation or excess runoff in the area. While nobody is able to definitively predict future changes to the frequency or intensity of storm events, we are able to provide some insight into a mitigation project's value in providing flood risk benefits into the future; which could account for potential changes in weather patterns, population growth, land use changes in the watershed and so forth. The analysis evaluates the impacts to flood risk, for non-mitigated conditions and mitigated conditions, associated with potential increases in rainfall and/or runoff that would result in an increase to the 1% annual chance precipitation by 10%, 20% and 30%. This analysis was performed using the flood mitigation project that includes a detention dam sized for the current 100-year, 24-hour flood event and College Creek channel modifications.

The current effective HEC-HMS hydrologic model was used to develop flow hydrographs for this sensitivity analysis. Precipitation values were increased by 10%, 20%, and 30% in the HEC-HMS model. The resulting flow hydrographs were then incorporated into the effective HEC-RAS hydraulic model to determine the associated flood extents. The assessed property value for the impacted structures was obtained using parcel data provided by the County's appraiser's office, in a similar method as what was described in Section 6.2 of this report. Population associated with each impacted structure was obtained using the Census block data, in a similar method as what was described in Section 8 of this report.

As a baseline for comparison, it should be noted that 68 structures are currently impacted by the current 1% annual chance storm event for College Creek. The flood mitigation project results in no impacted structures for the current 1% annual chance storm event for College Creek.

Based on the modeling performed, a 10% increase in precipitation would result in a non-mitigated 1% annual chance floodplain that impacts 87 structures, with an assessed property value totaling approximately $35.0 million and a population of approximately 280. The impacted structures are shown in Figure 30.

Figure 30- Impacted Structures with 10% increase in Precipitation and No Mitigation Measures

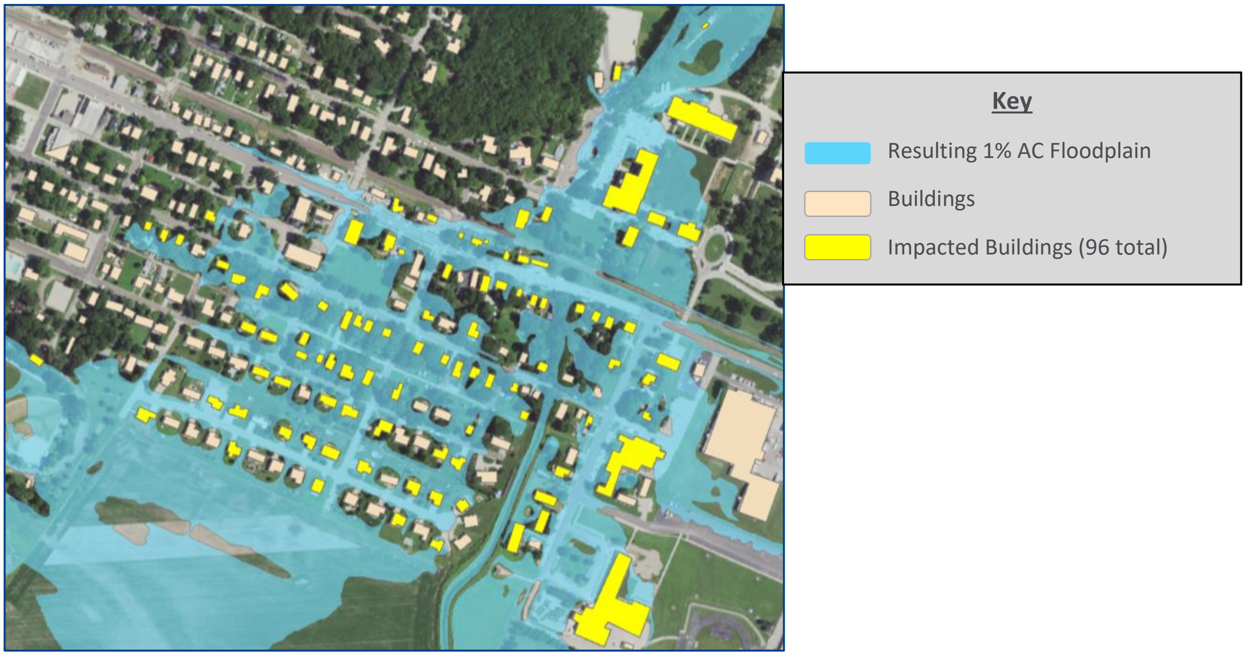


With the flood mitigation project in-place, a 10% increase in precipitation would result in a 1% annual chance floodplain that impacts 8 structures, with an assessed property value totaling approximately $990 thousand and a population of approximately 15. The impacted structures are shown in Figure 31.

Figure 31- Impacted Structures with 10% increase in Precipitation and Mitigation Measures In-Place

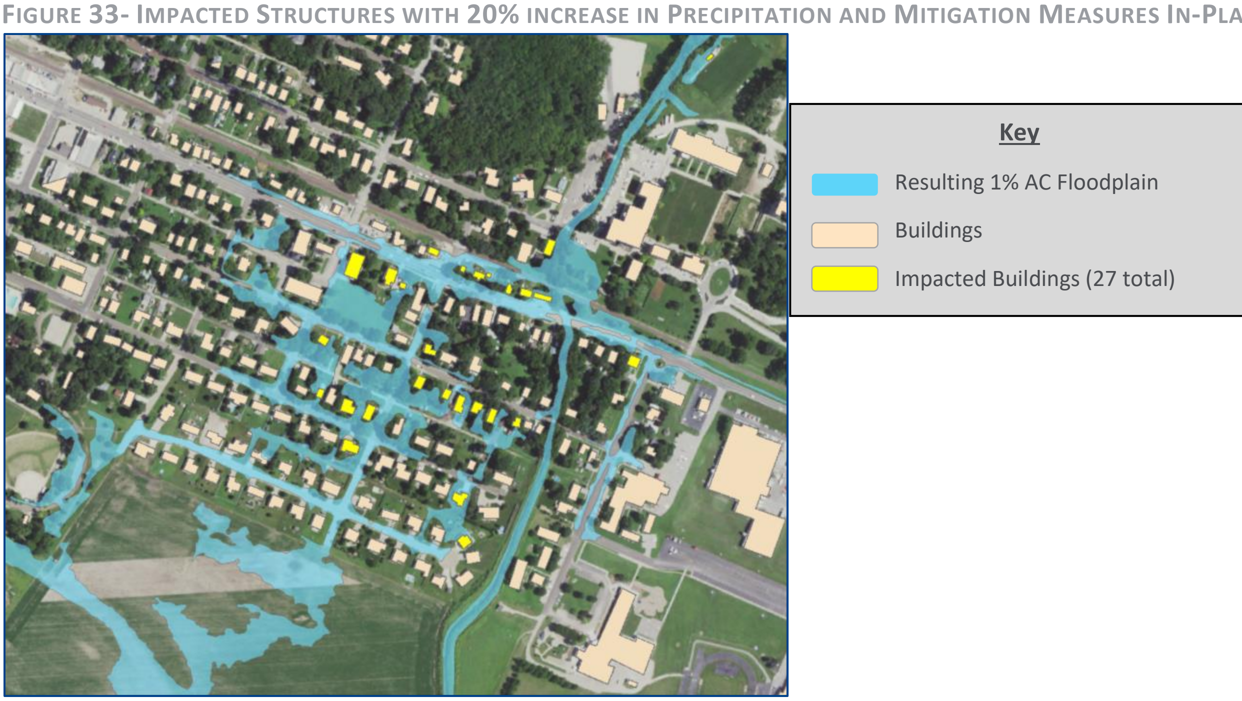
Based on the modeling performed, a 20% increase in precipitation would result in a non-mitigated 1% annual chance floodplain that impacts 96 structures, with an assessed property value totaling approximately $36.8 million and a population of approximately 308. The impacted structures are shown in Figure 32.

FIGURE 32- IMPACTED STRUCTURES WITH 20% INCREASE IN PRECIPITATION AND NO MITIGATION MEASURES



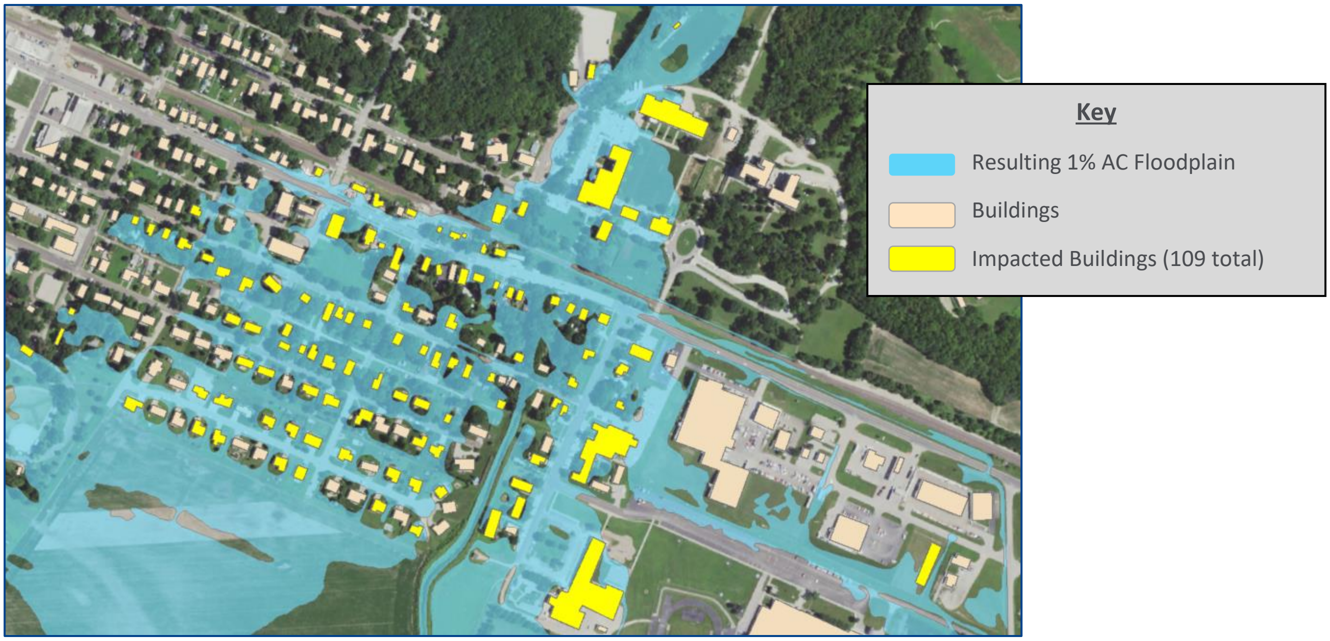
With the flood mitigation project in-place, a 20% increase in precipitation would result in a 1% annual chance floodplain that impacts 27 structures, with an assessed property value totaling approximately $3.9 million and a population of approximately 64. The impacted structures are shown in Figure 33.

FIGURE 33- IMPACTED STRUCTURES WITH 20% INCREASE IN PRECIPITATION AND MITIGATION MEASURES IN-PLACE



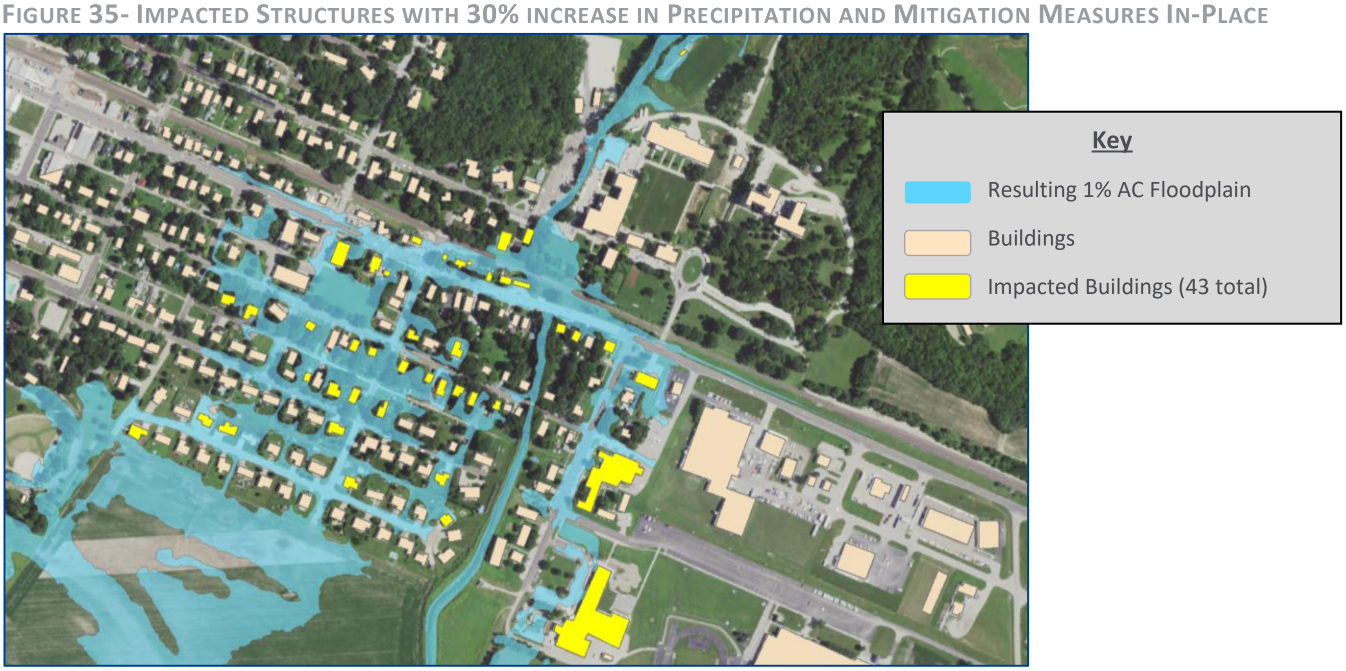
Based on the modeling performed, a 30% increase in precipitation would result in a non-mitigated 1% annual chance floodplain that impacts 109 structures, with an assessed property value totaling approximately $38.8 million and a population of approximately 348. The impacted structures are shown in Figure 34.

FIGURE 34- IMPACTED STRUCTURES WITH 30% INCREASE IN PRECIPITATION AND NO MITIGATION MEASURES



With the flood mitigation project in-place, a 30% increase in precipitation would result in a 1% annual chance floodplain that impacts 43 structures, two of which are the high-value structures. Therefore, the assessed property value of these impacted structures totals approximately $16.2 million and the impacted population totals approximately 130. The impacted structures are shown in Figure 35.

FIGURE 35- IMPACTED STRUCTURES WITH 30% INCREASE IN PRECIPITATION AND MITIGATION MEASURES IN-PLACE



The sensitivity analysis indicates that the mitigation solution would result in some structures being back into the floodplain for the 1% annual chance event if future changes to rainfall or landuse would occur to the magnitudes shown. Note that two of the high-value structures are shown as being back within the floodplain by a 30% increase in precipitation. Nonetheless, the project would still have significant benefits when compared to the impacts from flooding if precipitation increases by this magnitude and no mitigation solutions are in-place.

There is certainly an opportunity to overdesign the mitigation solution in an attempt to account for some future precipitation or runoff changes, to provide some additional resiliency into the project. An analysis could be done during the design phase of a mitigation solution to identify the ideal amount to overdesign to, in terms of benefits versus impacts. However, there is no way to provide a solution at this time that would definitively protect all structures from being in a future 1% annual chance floodplain and being required to purchase flood insurance if the have a federally backed mortgage, largely given the many unknowns associated with climate change predictions.

11 POTENTIAL FUNDING

There are a number of funding programs that exist for flood mitigation projects. The proposed projects that are described in this report are still sizeable projects from a cost perspective. Therefore, it may be advantageous for the City to seek funding opportunities that are available from outside sources. However, it is important to be aware of some important details and potential drawbacks from these various programs. None of the funding programs would pay 100% of the project costs. There would be a certain amount of cost-share associated with them. Essentially all of the funding programs have application requirements and are competitive in nature, meaning there is a selection process, and the project may not be awarded the funding. The applications may require some additional work to be completed, which would add some cost to the project. An awarded grant would likely have reporting requirements, which would add some cost to the project. Due to the timelines associated with the application and selection process, along with steps needed to initiate such a grant, the overall timeline for the project would likely be extended. Federal grant programs often require extra layers of inspection and reporting and would also impact overall project cost. Plus, contractors may bid such a project higher because of the requirements for them to comply with particular program requirements. Therefore, there are certainly some advantages and disadvantages with outside funding sources, which should be considered.

As part of a Technical Assistance project with another consultant, the Kansas Department of Agriculture-Division of Water Resources developed a Funding Resource Evaluation Tool that is intended to assist in the evaluation of potential funding resources for various infrastructure projects. The tool is available to all Kansas communities. The project categories that are applicable to a particular improvement project are simply checked and the tool generates a report that summarizes the funding opportunities. The report includes information on the purpose of the funding program, the eligibility requirements, the funding priorities, the funding levels, the cost share requirements, the period of performance, the application period, the benefit-cost requirements, the environmental reviews and other application details for each identified funding option. Appendix B includes the reports generated by the funding tool for the potential funding sources identified for College Creek. The potential funding sources identified include the FEMA Building Resilient Infrastructure and Communities (BRIC) program, the FEMA Flood Mitigation Assistance (FMA) program, the FEMA Hazard Mitigation Grant Program (HMGP), the USDA-NRCS Watershed and Flood Prevention Operations (WFPO) program, the KDA Watershed Dam Construction Program, and the Water Infrastructure Finance and Innovation Act (WIFIA).

The BRIC program is administered by the Kansas Division of Emergency Management (KDEM) and makes federal funds available for pre-disaster mitigation activities. Local governments must apply through their state and must have a current FEMA-approved Hazard Mitigation Plan at time of application and award. Notices of intent are required by interested applicants and must be submitted to KDEM, followed by grant sub-application. The funding priorities incentivize public infrastructure projects, adoption and enforcement of modern building codes, incorporation of nature-based solutions, and mitigating risk to one or more lifelines. Typical cost-share requirements include 25% of non-federal funding. A benefit-cost analysis is required. The state submits the final application.

The FMA program is administered by KDEM and is limited to flood-related mitigation that reduces the risk of properties that repetitively flood. Local governments must apply through their state and must have a current FEMA-approved Hazard Mitigation Plan at time of application and award. Notices of intent are required by interested applicants. Typical cost-share requirements include 25% of non-federal funding. A benefit-cost analysis is required.

The HMGP is administered by KDEM and makes federal funds available for mitigation projects that reduce risk to individuals and property. Local governments must apply through their state and must have a current FEMA-approved Hazard Mitigation Plan at time of application and award. Notices of intent are required by interested applicants. Priorities vary by state discretion. Typical cost-share requirements include 25% of non-federal funding. A benefit-cost analysis is required. The state submits the final application.

The WFPO program is administered by the USDA-NRCS and provides technical and financial assistance for watershed projects. Eligible projects include facilities for flood prevention and erosion reduction. All costs related to construction for flood control purposes are paid. Local sponsors must agree to operate and maintain the completed project. A benefit-cost analysis may be required based on the financial amount of the project.

The Watershed Dam Construction Program is administered by the KDA-DWR and provides state financial assistance to organized Watershed, Drainage, or other Districts for implementation of flood control structural and non-structural practices. Construction and rehabilitation of flood control and/or grade stabilization dams are the main practices and components of the program. The intent of the program is to achieve flood reduction benefits to agricultural land, roads, bridges, utilities, and urban areas. Typical cost-share requirements include 20% of non-state funding. A team of designees from water related agencies evaluate the applications and recommend a priority order for funding.

The WIFIA program is administered by the EPA and provides loan assistance for water infrastructure projects, including measures to manage, reduce, treat, or recapture stormwater, including flood resilience and risk reduction benefits. EPA solicits letters of intent from prospective borrowers. Loan assistance is generally limited to 49% of eligible costs.

While much of the analysis has been done and much data is available for the grant applications, there may be some additional engineering and/or GIS requirements to fulfill some of the application requirements, depending on the specific grant program. Also, there may be specific formatting or writing nuances to be aware of. While this information gives some general information about the various funding opportunities, we would recommend additional research and follow-up into particular funding programs, if it becomes of interest to the City of St. Marys.

12 FINAL RECOMMENDATIONS AND CONCLUSION

The intent of this technical assistance project is to provide the City of St. Marys with additional information needed for the decision-makers in the community and the general public to better understand the impacts and benefits of a flood mitigation project on College Creek. Information in this report can be used to weigh the advantages and disadvantages of moving forward with a particular upstream detention dam, such as a wet or dry dam as well as a dam that is designed for the 1% annual chance (100yr) storm event or the 2% annual chance (50yr) storm event. The analysis also provides some insight into the resiliency of a potential mitigation project.

Our recommendation is to move forward with a mitigation project that incorporates a dry 100yr detention dam with channel modifications. A dam designed for the 1% annual chance storm event will provide the most protection for the community and residents at this time. The project as proposed, which also incorporates the channel modifications, would remove all buildings from the special flood hazard area and 1% annual chance floodplain. The additional cost associated with construction of a dam designed for the 1% annual chance storm event is not significantly higher, when looking at the big picture and when compared to a dam designed for the 2% annual chance storm event. While the difference is around $250,000, it is only an increase of 6% over the 50yr detention dam and the additional benefits associated with initially removing all structures from the 1% annual chance floodplain, eliminating the mandatory flood insurance purchase requirements for structures with federally backed mortgages, is a significant benefit to those in the community. It is acknowledged that there is no solution that will protect all structures from all flooding events, but this alternative significantly reduces the risk of flooding for present conditions and into the future.

The dry 100yr detention dam also has the highest benefit-cost ratio. The cost associated with a dry detention dam are significant less than the cost associated with the wet detention dam, while achieving the same downstream benefits. The tradeoff is that easement acquisition may be more difficult for a dry detention dam, since the property owner will not be gaining water amenities. However, there are other amenities that could be implemented in a fairly cost-effective way, such as wetland-type features, nature trails, gardens and so forth that could still result in a multi-use function for the pond and surrounding areas. The dry detention pond is also the more environmentally friendly option, as it has less overall impact on the stream channel.

If a structural flood mitigation project is completed, a Letter of Map Revision (LOMR) should be pursued to update the FEMA floodplain maps to reflect the reduced flood risk associated with the College Creek improvements. Alternatively, KDA may have an opportunity to assist in the re-mapping efforts for College Creek with a Physical Map Revision (PMR) project to update the FEMA floodplain maps accordingly.

As an alternative recommendation, if the city decides not to move forward with an upstream detention dam, we recommend that the City consider options to floodproof as many buildings in the 1% annual chance floodplain as possible. From an economic or social perspective, some of the large high value buildings may warrant floodproofing. This should be evaluated by the City, based on the desires and outcomes of such a project.

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14 APPENDIX A- BENEFIT-COST ANALYSIS DATA

Scenario	Est. Annual Damage	Est. Annual Damage Benefit	PV Benefit	PV Total Cost Wet Dam (50 Year Span)	PV Total Cost Dry Dam (50 Year Span)	B/C Ratio Wet Dam (50 Year Span)	B/C Ratio Dry Dam (50 Year Span)
Existing *(all buildings included)*	$356,060						
Existing *(4 large buildings excluded)*	$140,719						
100-yr Detention Dam Project *(all buildings included)*	$15,766	$340,294	$7,066,574	$5,166,841	$4,428,486	1.37	1.60
100-yr Detention Dam Project *(4 large buildings excluded)*	$7,914	$132,805	$2,757,840	$5,166,841	$4,428,486	0.53	0.62
50-yr Detention Dam Project *(all buildings included)*	$33,970	$322,090	$6,688,548	$4,590,636	$4,193,374	1.46	1.60
50-yr Detention Dam Project *(4 large buildings excluded)*	$17,053	$123,666	$2,568,059	$4,590,636	$4,193,374	0.56	0.61

**All projects include the proposed channel modification*

Analysis Period	50 years
Discount Rate	0.42 *
Present Value (PV) Coefficient	20.77

* OMB A-94 nominal discount rate (Dec 2022: 30-year rate)

15 APPENDIX B- FUNDING RESOURCE EVALUATION REPORTS

Program Name	Building Resilient Infrastructure and Communities (BRIC)	**Agency**	DHS-FEMA
Purpose	The Building Resilient Infrastructure and Communities (BRIC) program makes federal funds available to states, U.S territories, Indian tribal governments, and local communities for pre-disaster mitigation activities. The guiding principles of the program are to: (1) support state and local governments, tribes, and territories through capability- and capacity-building to enable them to identify mitigation actions and implement projects that reduce risks posed by natural hazards; (2) encourage and enable innovation while allowing flexibility, consistency, and effectiveness; (3) promote partnerships and enable high-impact investments to reduce risk from natural hazards with a focus on critical services and facilities, public infrastructure, public safety, public health, and communities; (4) provide a significant opportunity to reduce future losses and minimize impacts on the Disaster Relief Fund (DRF); and (5) support the adoption and enforcement of building codes, standards, and policies that will protect the health, safety, and general welfare of the public, take into account future conditions , and have long-lasting impacts on community risk-reduction, including for critical services and facilities and for future disaster costs.		
Eligibility Requirements	State governments Native American tribal governments (Federally recognized) District of Columbia; U.S. Territories. Additional Information on Eligibility: Local governments must apply through their state or territory. Applicants and subapplicants required to have a current FEMA-approved Hazard Mitigation Plan at time of application and award. States have requirements and deadlines for Notices of Intent by interested subapplicants.		
Funding Priorities	incentivize public infrastructure projects; incentivize projects that mitigate risk to one or more lifelines; incentivize projects that incorporate nature-based solutions; and, incentivize adoption and enforcement of modern building codes.		
Funding Level	In FY20 BRIC, FEMA will provide State/Territory allocations of $500M to states and territories and a Tribal Set-Aside of $20M for Indian tribal governments (federally-recognized) for mitigation projects and capability- and capacity-building (C&CB) activities. Any funds which are not awarded from the State/Territory Allocation or Tribal Set-Aside will be re-allocated to the national competition for mitigation projects.		
Pre-award costs Eligible?	Yes subject to approval		
Cost Share Requirements	75% federal/25% non-federal Potential for 90%/10% for small impoverished communities	**Period of Performance**	36 months from the date of the Award
Benefit Cost Analysis Requirements	Applicants and subapplicants applying for mitigation projects must provide a BCA or other documentation that validates cost-effectiveness	**Pre-award costs Eligible?**	Yes subject to approval
Environmental Review Requirements	Applicants and subapplicants applying for mitigation projects must provide information needed to comply with the National Environmental Policy Act (NEPA) and related DHS and FEMA instructions and directives		
Program Trigger	Annual appropriations. BRIC receives funding through an offsetting of annual presidential disaster declarations nationwide.		
Action Needed to Access Program	Notice of Intent submitted to State Emergency Management. Grant subapplication. State submits final application.		
Application period	FY20 opens September 30, 2020; State application due January 29, 2021; Notice of Intent and subapplication deadlines vary by state. Kansas Division of Emergency Management NOI due date is September 30. Pre-Award Selection Notice: Anticipated in June 2021		
Maximum Project Assistance	$50M		
Type of Assistance	Grant		
Application Submittal	FEMA Grant Outcomes (FEMA GO) system: https://go.fema.gov		
Website	www.fema.gov/bric hhttps://www.fema.gov/media-collection/resources-building-resilient-infrastructure-communities-program-bricttps://www.fema.gov/sites/default/files/2020-08/fema_mitigation-action-portfolio-support-document_08-01-2020_0.pdf https://www.fema.gov/media-collection/resources-building-resilient-infrastructure-communities-program-bric		
Contact	Kansas Division of Emergency Management State Hazard Mitigation Officer Stephanie Goodman: Stephanie.Goodman@ks.gov		

Program Name	Flood Mitigation Assistance (FMA)	**Agency**	DHS-FEMA
Purpose	Program is limited to flood-related mitigation that reduces the risk of properties that repetitively flood and to lessen future insurance claims for the NFIP		
Eligibility Requirements	State governments Native American tribal governments (Federally recognized) District of Columbia; U.S. Territories. Additional Information on Eligibility: Local governments must apply through their state or territory. Applicants and subapplicants required to have a current FEMA-approved Hazard Mitigation Plan at time of application and award. States have requirements and deadlines for Notices of Intent by interested subapplicants. Subapplicants must also participate in the National Flood Insurance Program (NFIP) (Not on probation or suspended). All structures included in the project subapplications must be insured under the NFIP (Before, During, and After).		
Funding Priorities	FY20 Priorities: 1. Project scoping (previously Advanced Assistance) 2. Community Flood Mitigation Projects 3. Technical Assistance 4. Flood Hazard Mitigation Planning 5. Individual Flood Mitigation Projects with emphasis on repetitive loss properties		
Funding Level	FY20 $160M		
Pre-award costs Eligible?	Yes subject to approval		
Cost Share Requirements	For NFIP insured properties and planning grants: 75%/25%. For repetitive loss property with repetitive loss strategy: 90%/10%. For severe repetitive loss property with repetitive loss strategy: 100%/0%.	**Period of Performance**	36 months from the date of selection.
Benefit Cost Analysis Requirements	Applicants and subapplicants applying for mitigation projects must provide a BCA or other documentation that validates cost-effectiveness	**Pre-award costs Eligible?**	Yes subject to approval
Environmental Review Requirements	Applicants and subapplicants applying for mitigation projects must provide information needed to comply with the National Environmental Policy Act (NEPA) and related DHS and FEMA instructions and directives		
Program Trigger	Annual appropriations. FMA receives funding through an offsetting collection of NFIP premiums in annual appropriation acts.		
Action Needed to Access Program	Notice of Intent submitted to State Emergency Management. Grant subapplication. State submits final application.		
Application period	FY20 opens September 30, 2020; State application due January 29, 2021; Notice of Intent and subapplication deadlines vary by state. Pre-Award Selection Notice: Anticipated in June 2022		
Maximum Project Assistance	$30M. Various restrictions exist on maximum awards depending on the type of activity funded		
Type of Assistance	Grant		
Application Submittal	FEMA Grant Outcomes (FEMA GO) system: https://go.fema.gov		
Website	https://www.fema.gov/grants/mitigation/floods		
Contact	Kansas Division of Emergency Management State Hazard Mitigation Officer Stephanie Goodman: Stephanie.Goodman@ks.gov		

Program Name	Hazard Mitigation Grant Program (HMGP)	Agency	DHS-FEMA
Purpose	To reduce risk to individuals and property while reducing reliance on future federal disaster response and recovery funds. Eligible projects may include, but are not limited to, property acquisition, structure demolition, floodproofing of structures, structure relocation, structure elevation, mitigation, and localized and nonlocalized flood risk reduction projects. In late 2018 in Section 1210(b) of P.L. 115-254, Congress authorized that HMGP funds could be used toward the federal share of construction for authorized U.S. Army Corps of Engineers water resource projects if such activities are eligible under HMGP. On June 27, 2014, FEMA issued new policy guidance for eligible projects including major flood control projects (dams, levees, etc.), provided there is not duplication with another federal program.		
Eligibility Requirements	Funding is provided to all 50 states, Indian reservations, DC, American Samoa, Guam, Northern Marianas, Puerto Rico, and Virgin Islands. Grants to state agencies, federally recognized tribes, local governments, and certain private nonprofit organizations for mitigation projects as well as mitigation planning. Applicants and subapplicants required to have a current FEMA-approved Hazard Mitigation Plan at time of award. States have requirements and deadlines for Notices of Intent by interested subapplicants. Subapplicants must also participate in the National Flood Insurance Program (NFIP) (Not on probation or suspended).		
Funding Priorities	Varies by disaster and state discretion. States may prioritize projects within the declared counties, though typically the funding is open to all eligible subapplicants. Other priorities might be associated with the type of disaster, e.g. flood mitigation projects for a flood-related disaster.		
Funding Level	The total amount of HMGP funding is derived from a formula in law based on the total amount of other grant assistance provided through the Stafford Act (§404(s) of the Stafford Act, 42 U.S.C. §170c). In summary, it is as follows: 15% for amounts not more than $2 billion; 10% for amounts of more than $2 billion and not more than $10 billion; and 7.5% on amounts of more than $10 billion and not more than $35.333 billion of the estimated aggregate amount of grants to be made (less any associated administrative costs). States that have an Enhanced State Hazard Mitigation Plan under Section 322(e) of the Stafford Act receive 20% of the total amount.		
Pre-award costs Eligible?	Yes subject to approval		
Cost Share Requirements	75% federal/25% non-federal	Period of Performance	36 months from the close of the application period.
Benefit Cost Analysis Requirements	Applicants and subapplicants applying for mitigation projects must provide a BCA or other documentation that validates cost-effectiveness	Pre-award costs Eligible?	Yes subject to approval
Environmental Review Requirements	Applicants and subapplicants applying for mitigation projects must provide information needed to comply with the National Environmental Policy Act (NEPA) and related DHS and FEMA instructions and directives		
Program Trigger	Triggered by a Stafford Act major disaster declaration by the President.		
Action Needed to Access Program	Notice of Intent submitted to State Emergency Management. Grant subapplication. State submits final application. Funds are typically made available statewide in the state that received the declaration, not just in the declared counties.		
Application period	Applications are due within 1 year of disaster declaration. Application period begins when HMGP is authorized, typically the date of the disaster declaration.		
Maximum Project Assistance	Varies depending on the type of activity funded, extent of total funding available from the disaster, and state priorities/limits.		
Type of Assistance	Grant		
Application Submittal	Follow guidelines by State Emergency Management.		
Website	https://www.fema.gov/hazardmitigation-grant-program https://www.fema.gov/grants/mitigation/floods/fma-resources		
Contact	Kansas Division of Emergency Management State Hazard Mitigation Officer Stephanie Goodman: Stephanie.Goodman@ks.gov		

Program Name	Watershed and Flood Prevention Operations (WFPO) Program	Agency	USDA NRCS
Purpose	WFPO provides technical and financial assistance to states, Indian tribes or tribal organizations, and local organizations to plan and install watershed projects. WFPO can include other water quality and water resources purposes.		
Eligibility Requirements	Projects in all 50 states, Indian Reservations, DC, American Samoa, Guam, Northern Marianas, Puerto Rice, and Virgin Islands		
Funding Priorities	Eligible projects include land treatment, and nonstructural and structural facilities for flood prevention and erosion reduction. Structural measures can include dams, levees, canals, and pumping stations.		
Funding Level	Annual appropriations typically are provided in annual Agricultural and Related Agencies appropriations acts.		
Pre-award costs Eligible?			
Cost Share Requirements	The federal government pays all costs related to construction for flood control purposes only. Costs for nonagricultural water supply must be repaid by local organizations; however, up to 50% of costs for land, easements, and right-of-way allocated to public fish and wildlife and recreational developments may be paid with program funds. Local sponsors agree to operate and maintain completed projects.	**Period of Performance**	NA
Benefit Cost Analysis Requirements	Principles and Requirements for Federal Investments in Water Resources (P&R) and Interagency Guidelines (IAG) or collectively PR&G analysis, applies on a project basis if meets financial threshold for required analysis.	**Pre-award costs Eligible?**	NA
Environmental Review Requirements	Yes		
Program Trigger	Program appropriations in enacted legislation and permanently authorized mandatory funding.		
Action Needed to Access Program	Authorization of approved watershed plans can be (1) requested from sponsoring organization; (2) congressionally directed; or (3) authorized by the Chief of NRCS. After approval, technical and financial assistance can be provided for installation of works of improvement specified in teh plans, subject to annual appropriations.		
Application period	NA		
Maximum Project Assistance	No project may exceed 250,000 acres, and no structure may exceed more than 12,500 acre-feet of floodwater detention capacity or 25,000 acre-feet of total capacity without congressional approval. Congressional approval is also required when a project includes an estimated federal contribution of more than $25 million for construction, or includes a storage structure with a capacity in excess of 2,500 acre-feet. There are no population or community income-level limits on applications for WFPO; however, at least 20% of the total benefit of the project must directly relate to agriculture (including rural communities).		
Type of Assistance	Grant; technical advisory services		
Application Submittal	NA		
Website	https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/north-dakota/watershed-protection-and-flood-prevention		
Contact	See website		

Program Name	Watershed Dam Construction Program	**Agency**	KDA
Purpose	The Watershed Dam Construction Program provides state financial assistance to organized Watershed, Drainage or other Special Districts for the implementation of flood control structural and non-structural practices. These practices provide protection of agricultural land, urban areas, roads, bridges and utilities, in addition to providing water for livestock and in some instances for rural fire departments, enhancing wildlife and trapping sediment and pollutants. Construction and rehabilitation of flood control and/or grade stabilization dams are the main practices and components of this program.		
Eligibility Requirements	Any organized watershed district, drainage district or other special purpose district, interested in state assistance, may apply for state cost-share assistance funds appropriated for construction of detention and grade stabilization dams.		
Funding Priorities	The objective is to achieve flood reduction benefits to agricultural land, roads, bridges, utilities, and urban areas. In 2007, the WDCP was amended to include the rehabilitation of existing flood control structures. Rehabilitation is the necessary work to bring a structure to applicable safety and performance standards. An evaluation team consisting of designees from state and federal water related agencies shall evaluate applications and recommend a priority order for funding. In addition, an amount will be recommended for construction of detention dams in drainage or other special purpose districts		
Funding Level	Annual appropriations		
Pre-award costs Eligible?			
Cost Share Requirements	80% state / 20% non-state	**Period of Performance**	
Benefit Cost Analysis Requirements	None	**Pre-award costs Eligible?**	
Environmental Review Requirements			
Program Trigger	Since 1977, the Legislature has annually appropriated funds for cost-share assistance for the construction of flood control detention and grade stabilization dams. The Watershed District Act, K.S.A. 24-1201 et seq. and the Watershed Dam Construction Program rules and regulations K.A.R. 11-3-1 to 11-3-12 provide guidance for the administration of the state cost-share funding.		
Action Needed to Access Program	Organized Watershed and Drainage Districts are encouraged to apply for the rehabilitation of any of their flood control structures.		
Application period	Applications shall be due at the commission office by April first to be included in the evaluation process for possible funding during the next fiscal year. Dam rehabilitation are due on or before July 1 each year		
Maximum Project Assistance	The maximum cost-share level for construction costs including engineering and inspection shall be 80 percent. The maximum annual assistance per structure or district shall be $90,000, except when uncommitted funds are available after all eligible structures have been funded. In which case, the funds may be used to provide additional cost-sharing above the maximum limit. Assistance funds shall not be used for land rights or administrative costs		
Type of Assistance	Cost share		
Application Submittal	Applications for state assistance shall be on forms supplied by the commission. Applications shall be due at the commission office by April first to be included in the evaluation process for possible funding during the next fiscal year. The district submitting the application shall employ or acquire the services of a person knowledgeable of watershed dam construction administrative procedures, who shall be known as the contracting officer for the proposed site.		
Website	https://agriculture.ks.gov/divisions-programs/division-of-conservation/flood-control-and-lakes-programs		
Contact	Steve Frost (785) 564-6622, steve.frost@ks.gov		

Program Name	Water Infrastructure Finance and Innovation Act (WIFIA)	Agency	EPA
Purpose	Program helps finance water infrastructure projects, including projects to build and upgrade wastewater and drinking water treatment systems. WIFIA provides credit assistance to large water projects that may otherwise have difficulty obtaining financing. Eligible projects include (among others) all categories eligible for State Revolving Fund assistance, including measures to manage, reduce, treat, or recapture stormwater, which may provide flood resilience and risk reduction benefits.		
Eligibility Requirements	In general, project costs must be $20 million or larger to be eligible for WIFIA credit assistance, and WIFIA loan assistance is generally limited to 49% of eligible costs. Eligible entities include a corporation; partnership; joint venture; trust; or a federal, state, local, or tribal government (or consortium of tribal governments). Projects in all 50 states, the District of Columbia, Indian lands, and U.S. territories.		
Funding Priorities	EPA announces the amount of funding it will have available and solicits letters of interest from prospective borrowers. In their letters of interest, prospective borrowers demonstrate their project's eligibility, creditworthiness, engineering feasibility, readiness to proceed, and alignment with EPA's policy priorities. Based on this information, EPA selects projects which it intends to fund and invites the prospective borrowers to continue to the application process.		
Funding Level	For FY 2020, EPA has approximately $6 billion in WIFIA loans to finance approximately $12 billion in water infrastructure investment. Authorized by Water Resources Reform and Development Act of 2014, Title V, codified in 33 U.S.C. §§3901-3914. America's Water Infrastructure Act of 2018, Title IV, included additional authorization. Regulations are codified at 40 C.F.R. §35.10000.		
Pre-award costs Eligible?	NA		
Cost Share Requirements	WIFIA loan assistance is generally limited to 49% of eligible costs.	Period of Performance	Variable
Benefit Cost Analysis Requirements	NA	Pre-award costs Eligible?	NA
Environmental Review Requirements			
Program Trigger	Credit assistance awarded by EPA on competitive basis.		
Action Needed to Access Program	Eligible entities submit credit assistance application to EPA. Phase 1: Project Selection: EPA announces the amount of funding it will have available and solicits letters of interest from prospective borrowers. In their letters of interest, prospective borrowers demonstrate their project's eligibility, creditworthiness, engineering feasibility, readiness to proceed, and alignment with EPA's policy priorities. Based on this information, EPA selects projects which it intends to fund and invites the prospective borrowers to continue to the application process. Phase 2: Project Review, Negotiation, and Closing: Each invitee must apply for its WIFIA loan. The WIFIA program conducts a detailed financial and engineering review of the project. Based on that review, the WIFIA program proposes terms and conditions for the project and negotiates them with the applicant until they develop a mutually agreeable term sheet and loan agreement.		
Application period	Letter of Interest for FY202 WIFIA due October 15, 2020. EPA will invite each prospective borrower whose project proposal is selected for continuation in the process to submit a final application. Final applications should be received by EPA within 365 days of the invitation to apply but EPA may extend the deadline on a case-by-case basis if the LOI schedule signals additional time may be needed.		
Maximum Project Assistance	No maximum cost per project, but loan amounts generally are limited to 49% of eligible project cost; total amount of federal assistance (i.e., WIFIA and other federal sources) may not exceed 80% of total project cost.		
Type of Assistance	Credit assistance (e.g., loans or loan guarantees)		
Application Submittal	See website.		
Website	https://www.epa.gov/wifia		
Contact			