US Army Corps of Engineers®

DETROIT DISTRICT

JEFFERSON CHALMERS FLOOD PLAIN MANAGEMENT SYSTEMS STUDY DETROIT, MICHIGAN

Appendix A: Cost Estimate

JULY 2022

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1 Introduction

The purpose of this appendix is to summarize the assumptions and basis of the cost estimate for the different proposed plans and features of the project. This includes the costs of the construction, contingency and non-construction costs such as Planning, Engineering, and Design (PED) and Construction Management (CM).

2 Alternatives

Three major base alternatives were considered for this study which are defined as a series of levees, floodwalls, seawalls and interior drainage upgrades. In addition to the base alternatives there are 3 different types of optional closure structures that can be incorporated into the alternatives in a mix and match fashion.

2.1 Alternative 1: Closed canal, levees and floodwalls outside of wave run up zone

Alternative 1 includes the following features (see figure 1):

- upland steel sheet pile floodwall (shown in purple)
- earthen levee (shown in yellow)
- 3 canal closure structures (shown in red)
- 6' stop log closure or gate at KAM Marine/ Bayview Yacht Club

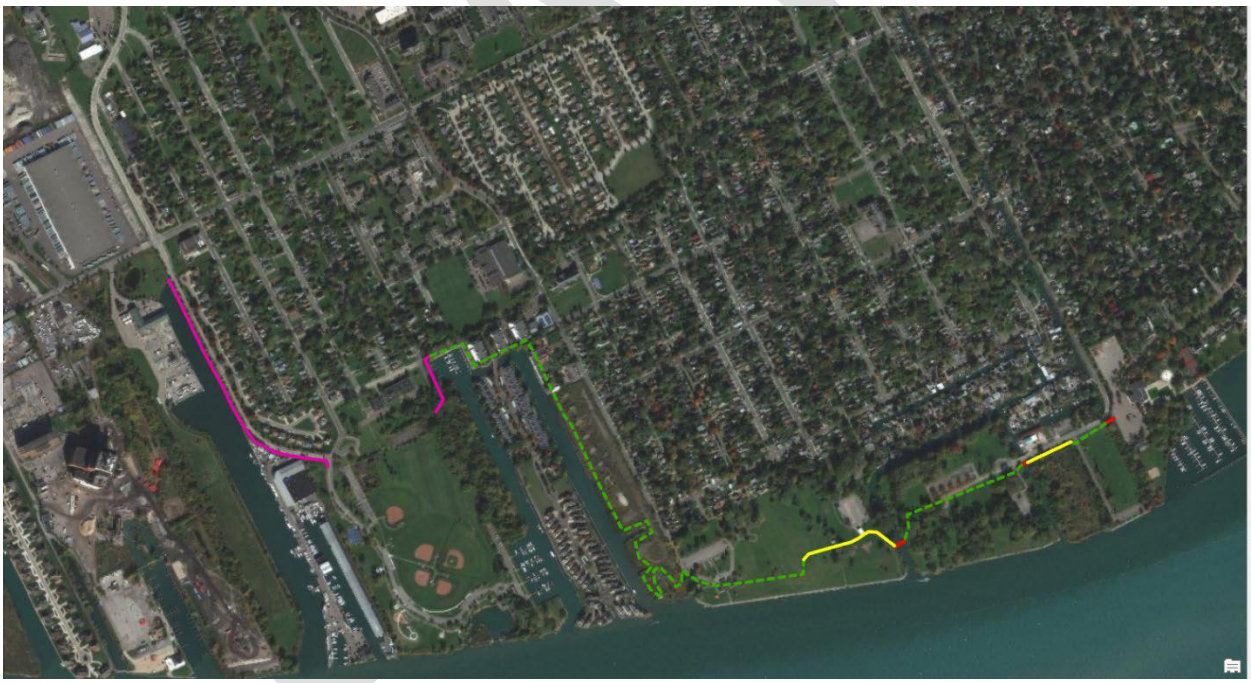

Figure 1

2.2 Alternative 2: Open Canal with Extensive Floodwalls

Alternative 2 includes the following features (see figure 2):

- steel sheet pile seawalls along *all properties* along the canals between Fox that are within the FEMA base flood hazard area (between Alter Road and Lenox Road). Walls would function as both seawalls and floodwalls and would be constructed to an elevation of 580' NAVD88.
- earthen levee
- No canal closure structures
- 6' stop log closure or gate at KAM Marine/ Bayview Yacht Club

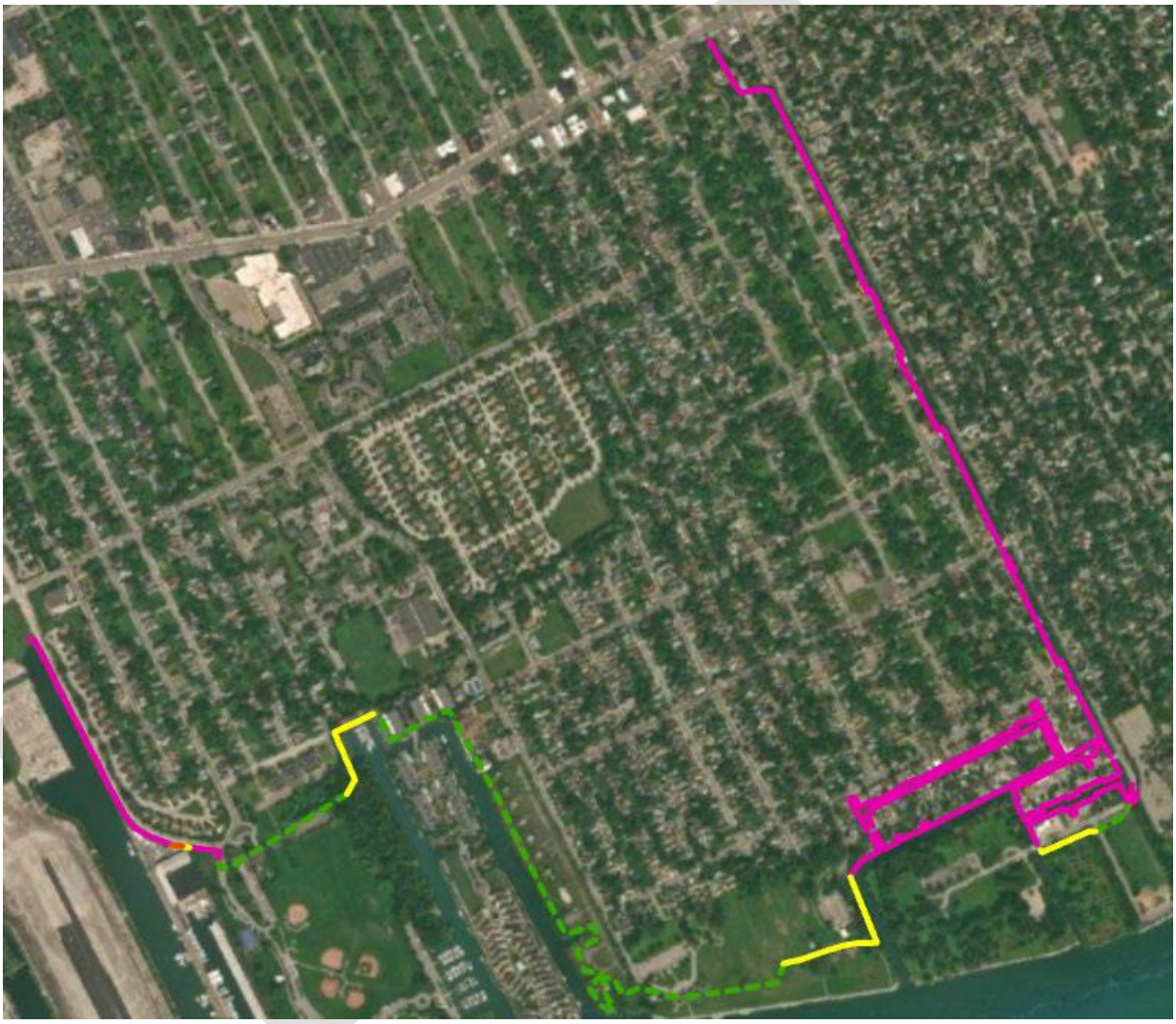

Figure 2

2.3 Alternative 3: Closed Canal, levees & floodwalls WITHIN wave run up zone

Alternative 3 includes the following features (see Figure 3):

- upland and canal steel sheet pile floodwalls (shown in purple)
- earthen levee (shown in yellow)
- 3 canal closure structures (shown in red)

• 6’ stop log closure or gate at KAM Marine/ Bayview Yacht Club

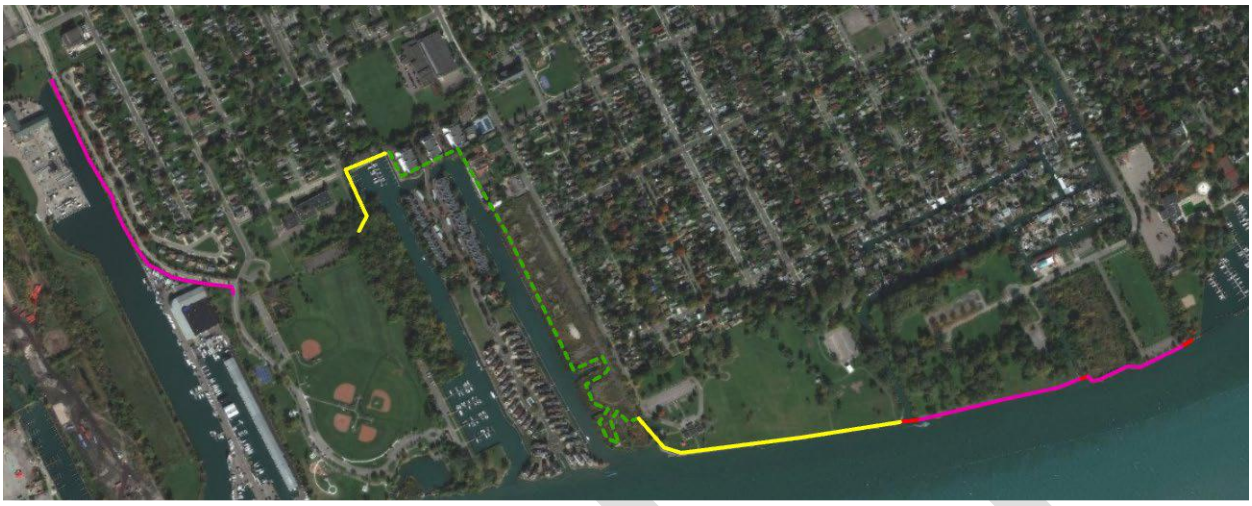

Figure 3

2.4 Canal Closure Options

Canal closures can be used to reduce the likelihood of high-water levels and storm surges from Lake St. Clair/ Detroit River from entering the Jefferson Chalmers neighborhood. There are several options for the type of structure that can be used. The key factors separating the options are cost and impact to the use of the canal.

2.4.1 Permanent canal closure (earth/rock dam fill)

Under this option, a portion of the canal would be filled with earthen materials (soil, rock) to create a permanent damming structure that would prevent high lake levels or storm surges from entering the canal. The exact dimensions and requirements would be determined in design. Under this partial fill option, consideration would need to be given to maintaining sufficient flow to prevent the canals from becoming stagnant and maintaining requirements for any discharges for interior drainage and pumping systems. This would be determined during design phase but could include a drainage structure with a flap gate.

2.4.2 Stop Log Structures

If permanent closure of the canal is not desirable, a more costly option is to install a structure that can be closed during high water. A stop log structure, such as the one shown in Figure 2, can be used. A stop log closure system would require manual installation of the stop logs into recessed areas during high water periods and would require removal of stop logs when water levels return to an acceptable range.

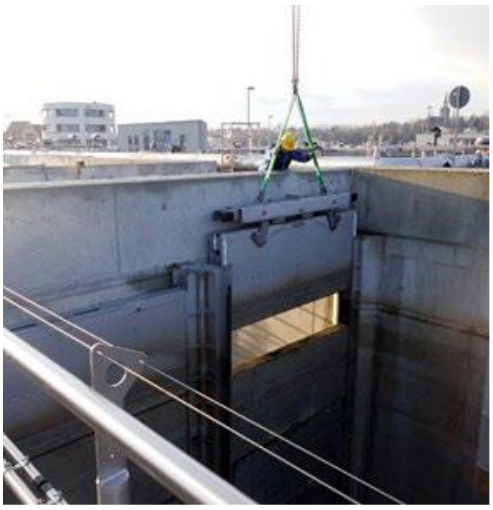

Figure 4. stoplog structure

2.4.3 Lock Structures

Permanent closure of the canal to resident boaters will likely be extremely unpopular. The closure of the canals during high lake level events that may stretch months at a time will also have impacts to the use of the canal for recreational activities and have impacts to water quality and interior drainage that would have to be mitigated.

A lock system would have the benefit of maintaining use of the canal system continuously but comes at a much higher price tag. Miter gate lock systems are common for smaller locks and can be either manually or remotely operated. Either system will likely require permanent staff to operate and maintain the lock system. During water levels within an acceptable range, the gates could be maintained in an open position. During higher water levels, the double gate system would be utilized to transport recreational watercraft from the canal system to Lake St. Clair/ Detroit River.

3 Cost Summary

Summary of alternative and closure structure costs in present dollars:

Summary	Alternative 1	Alternative 2	Alternative 3
Construction Cost	$ 19,983,500	$ 54,125,250	$ 27,599,650
Contingency	$ 4,995,875	$ 13,531,313	$ 6,899,913
Non-Construction Cost	$ 7,485,000	$ 20,268,000	$ 10,336,000
Total Project cost	$ 32,464,375	$ 87,924,563	$ 44,835,563

The closure structure costs varied due to the canal widths at 3 separate locations so a range of cost is shown:
Earthen dam closures:
Construction cost: $196k - $608k
Total project cost: $320k - $987k

Stop log structure closures:
Construction cost: $1.2M - $2.6M
Total project cost: $1.9M - $4.2M

Lock structure closures:
Construction cost: $30M - $75M
Total project cost: $49M - $122M

Non-construction cost includes Planning, Engineering, and Design (PED) and Construction Management (CM) cost.

Total project cost includes contingency and non-construction costs.

4 Basis of Estimate

4.1 Basis of Design

4.1.1 Levee design assumptions

- Levees constructed of compacted clay.
- Total cubic yards of clay were roughly approximated from xxx LiDAR data values. No detailed CADD models were developed to calculate required quantities.
- Crest width: 10 feet
- Levee slopes: 1V: 3H. levee slopes assumed to be 1V:3H (33% grade).
- Inspection trench included
- Potential utility modification/relocation included (rough approximation)
- No seepage cutoff included (this will be determined in design phase)

4.1.2 Inland floodwall design assumptions

- PZ-27 Steel sheet pile floodwall assumed. Material requirements/ preferences would be determined during design phase.
- "I-wall" type floodwall assumed. I-walls do not have foundations and are limited to walls less than 6' in stick up height. Requirements will be determined in design phase.

4.1.3 Interior drainage design assumptions

This study did not include an interior drainage study although the existing interior drainage system would need to be upgraded to allow for the increased drainage requirement. The interior drainage cost provided in this report used a previous cost from 2005 and was escalated to 2022 dollars using Civil Works Construction Cost Index System (CWCCIS) values.

4.1.4 Earthen dam closure design assumptions

Design & construction requirements need to be determined to create a permanent damming surface across the canal. The following was assumed to get a rough cost for comparison:
• Rock and/or earth fill construction, likely in a zoned construction.
• Length of 25 feet, width = approximate width of canal.
• Assumed height of 13 feet for Alternative 1, and 16' for Alternative 3.

4.1.5 Stop log closure assumptions

- Design/ use requirements to be determined in design phase. Assumed opening for small watercraft to pass.

- A portage system around the structure when closed may be desired but is not included in this estimate.
- Assume steel stop log structure with concrete abutment and base.
- The canal widths were roughly estimated from ArcGIS base map images.

4.2 Basis of Quantities

Quantities provided by the technical team.

4.3 Construction Estimate

Due to the level of design for this study (conceptual) the estimate falls into a Class 5 category, based on ER 1110-2-1302. There is still substantial lack of technical information and scope clarity resulting in major estimate assumptions in technical information and quantities especially for the canal closure stop log structures and lock structures. Broad based assumptions, costs from comparable projects and data, cost book, cost engineering judgment and historical parametric data were heavily relied on. While certain construction elements such as the base alternatives can be estimated in better detail, there is still a great deal of uncertainty relative to major construction components. For the corollary cost data, recent projects in the Great Lakes region with similar scope were used when possible to give the most reasonable similar costs. Typical contingency range for this class of estimate could be 25% to 200%.

Costs in this Appendix cover construction of project items with a markup to cover Planning, Engineering, and Design (PED) as well as Construction Management (CM). These items are covered by percentages uniformly applied to the construction costs. These costs are conservative estimates and a detailed breakdown of the costs for these items will need to be more fully developed during the next phase of design.

The alternative analysis included unit costs of all project features and contrasted the options in order to scale relative differences.

All items in this cost estimate are presented in 2022 dollars.

Major Construction Features for the alternatives were estimated as follows:

Compacted Clay Levee: cubic yard cost was developed using MCACES Second Generation (MII) software. Cost was then inflated to capture any miscellaneous associated sight work not captured in the scope of this study.

Inspection Trench: cubic yard excavation cost was developed in MII software. Cost was then inflated to capture an un-estimated amount of various utility closures not captured in the scope of this study.

Interior drainage cost: derived from a report prepared by NTH Consultants in 2005; cost was escalated to present day value using CWCCIS.

River and upland SSP: developed using MII software and then contrasted the different sheet lengths and land vs marine construction techniques in order to estimate appropriate differences relative to one another.

Upland stoplog closure: Developed using MII software from a conceptual design from a previous flood control project. Includes concrete work, H pile and extruded aluminum panels.

Earthen dam closure structures: developed using MII software and inflated for potential costs such as additional unidentified site work, water control, etc. The closures are specific to 3 separate locations of varying widths and the cost reflects the different level of effort for each location.

Stop log closure structures: This cost was developed parametrically based on a recent similar project Au Sable river sea lamprey trap. Only relevant portions of the lamprey trap cost were utilized such as the water control, stop log structure and any SSP placement to narrow the channel towards the stop log structure. The cost was then scaled for the various widths of the 3 separate location to reflect the different level of effort associated with each location.

Lock closure structures: this cost is based on a very broad based assumption along with recent cost data for construction of much larger lock structures than these canal locations. Engineering judgement was used to develop what seemed a reasonable cost for locations of this size and then the cost was further scaled for the widths of the 3 different locations.

Operations and Maintenance cost for the levees and floodwalls: these costs are based on an estimated level of effort to perform annual inspections, mowing, brush removal, monitoring, etc.

Operations and Maintenance for all other features: based on percentages using engineering judgement to determine a value that seemed reasonable.

5 References

U.S. Army Corps of Engineers, 1993, *Engineering and Design Cost Engineering Policy and General Requirements, Engineering Regulation 1110-1-1300,* Department of the Army, Washington D.C., 26 March 1993.

U.S. Army Corps of Engineers, 2016, *Civil Works Cost Engineering, Engineering Regulation 1110-2-1302,* Department of the Army, Washington D.C., 30 June 2016.

U.S. Army Corps of Engineers, 2019, *Civil Works Construction Cost Index System (CWCCIS), Engineering Manual 1110-2-1304,* Department of the Army, Washington D.C., 31 March 2020.