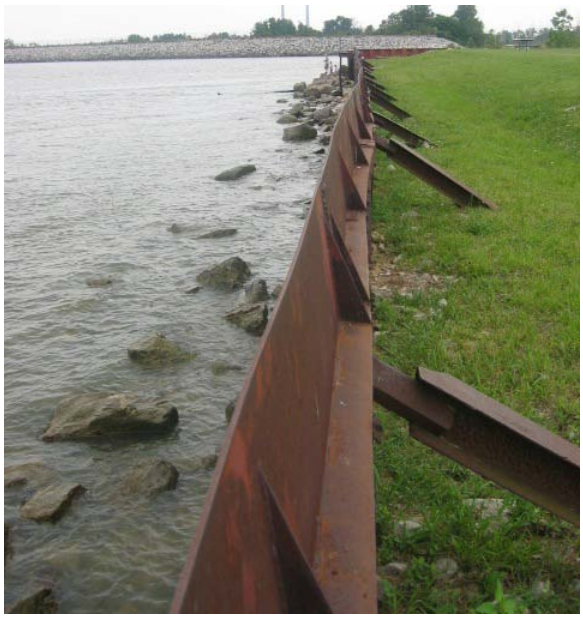
May 2010

Draft Detailed Project Report and Environmental Assessment

Detroit Beach
Frenchtown Township, Michigan

Section 205 – 1948 Flood Control Act



US Army Corps
of Engineers ®
Detroit District

EXECUTIVE SUMMARY

This report presents the feasibility study for the proposed work to provide new, permanent flood protection for Frenchtown Township, located on the west shore of Lake Erie in Michigan. The study was conducted as part of the Continuing Authorities Program (CAP), under the authority of Section 205 of the 1948 Flood Control Act, as amended.

Officials of Detroit Beach, a shoreline community in Frenchtown Township, desire a Federal project to provide permanent flood protection (the existing protection was considered temporary when installed) for the Detroit Beach study area. Lake Erie has the highest vulnerability to storm rises of all the Great Lakes as the lake surface may differ 12 feet or more between Toledo and Buffalo, with the east end of the lake sustaining the largest rises. During the high water periods of the 1970's, 1980's and 1990's on Lake Erie, large storm rises were commonly experienced on western Lake Erie. Detroit Beach residents regularly braced for flooding as storm-driven waves overtopped and breached flood protection structures.

The Detroit District of the U.S. Army Corps of Engineers (USACE) initiated a Project Information Report under the Advanced Measures authority in 1998 for Frenchtown Township Michigan. The work for this study was no longer eligible to be implemented under Advance Measures authority when the Lake Erie water level receded away from near record highs in 1998-99 and below emergency criteria. However, it was determined in that report that over $9 million in annual net benefits would be derived from total flood protection measures (new and permanent).

Under Section 205 authority, the permanent protection would have to produce benefits that exceed the cost of implementing that protection. The recommended alternative is normally the National Economic Development (NED) Plan and will have the greatest net benefits of all of the evaluated alternatives. Although the flood threat has lessened somewhat in recent years by lower water levels on Lake Erie, lake levels will likely increase again in time and reintroduce a serious flood threat at Detroit Beach.

The study area concerns approximately 381 structures located adjacent to the mouth of Sandy Creek on Lake Erie and 435 additional structures in the surrounding area resulting in 816 structures in the evaluation. Of the 816 structures evaluated, 758 were subject to damages. In the past, the Operation Foresight and Advance Measures construction program has provided Detroit Beach with various forms of flood protection. Since 1973, the Corps has designed and installed additional steel sheet pile (SSP) walls and flap gates, dikes, riprap toe protection and stone and sand cribs. Currently the temporary SSP is showing various signs of distress and is no longer straight; flap gates are damaged or missing; riprap toe protection has washed away and settling/washout areas behind the SSP require additional backfill. A redesigned, permanent system approximately 3800 feet in length along the Lake Erie shore would significantly ease the maintenance burden on the non-Federal sponsor while providing the substantial protection desired by the township.

Frenchtown Township has requested that Section 205 Federal assistance be provided to evaluate the current flood protection and to provide protection in areas that have become vulnerable to flooding because of erosion of flood barriers.

It is recommended, after careful inspection by the team, that the existing temporary SSP be replaced with a concrete panel/H-pile with renewed toe protection to produce a longer design life, at a total project cost of $8,697,994.

The existing flanking dikes would be rehabilitated to provide Detroit Beach, Frenchtown Township with reliable flood protection, as mandated under Section 205. Economic analysis of the alternatives results in a NED Plan (justifiable) of *Alternative 5 – Construct New Flood Protection Structure – Concrete Panel/H-Pile Wall* to 581 feet IGLD (International Great Lakes Datum) 1985, with a benefit-cost ratio (BCR) of 5.8 and positive average annual net benefits of nearly $2,102,000. An Environmental Assessment of the proposed action was completed and is included as a separate document following Appendix E of this Detailed Project Report (DPR).

- **NOTE -** The real estate credits for easements that will be afforded to the Township toward the local cost-share of the project may change based on local ordinances 207 and 208. The term LERRD's (Lands, Easements Rights-of-Way, Relocations and Disposal Areas) represents the value of real estate throughout all portions of this report.

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1. STUDY AUTHORITY

The Detroit Beach feasibility study is being conducted under the authority of Section 205 of the Flood Control Act of 1948, as amended (which is also a Continuing Authority) in response to requests for Federal assistance from officials of Frenchtown Township by a letter dated October 27, 1999. Section 205 authorizes the United States Army Corps of Engineers (USACE) to develop and construct small flood control projects. Each project is limited to a Federal cost of $7,000,000, and must be economically justified, environmentally sound, and engineeringly feasible.

Flood protection work at Detroit Beach has been constructed, retrofitted and expanded upon by USACE under "Advance Measures" authority. The Advance Measures Congressional Authorization is under Public Law 84-99, *Flood and Coastal Storm Emergencies* (33 U.S.C. 701n, 69 Statute 186). This law authorizes the USACE to provide emergency or disaster assistance to communities along coastal shores that often experience flooding due to storms and/or during periods of high water levels. This authority is designed for emergency implementation under riverine or coastal high water threat, and, in 1999 when Great Lakes water levels receded below what was considered emergency-threatening levels, a project could not continue to be implemented using the Advance Measures authority. The Detroit Beach community then proceeded to request permanent flood reduction be implemented under Section 205 of the Flood Control Act of 1948, the flood damage reduction authority of the USACE Continuing Authorities Program (CAP).

2. STUDY PURPOSE AND SCOPE

The purpose of the feasibility study is to investigate and recommend solutions to flooding problems at Detroit Beach, Frenchtown Township, Monroe County, Michigan. On October 27, 1999, Frenchtown Township requested the Detroit District to study, under the Section 205 authority, a replacement to the existing temporary flood protection project. The Detroit District, along with the non-Federal sponsor, will determine the most feasible measures to replace the protection in the most engineeringly effective and fiscally-responsible way. "Federal Interest" would be reviewed to determine an updated cost/benefit ratio. Federal Interest requires that replacement of a flood damage reduction project would be economically feasible and in compliance with current regulations and policies, and that a willing and financially capable local sponsor be found.

Frenchtown Township is located in the northeast portion of Monroe County, on Brest Bay along the eastern shore of Lake Erie (see map next page). The Township is approximately 32 miles south of Detroit, Michigan and 16 miles north of Toledo, Ohio. The Detroit Beach community was primarily constructed between the 1920's and 1940's, a period of largely below average water levels on Lake Erie. This probably gave Detroit Beach residents a false sense of security from the threat of lake-origin flooding. Water levels rose for a period in the late 1940's and into the 1950's, causing the first early concerns of community flooding. Lake Erie water levels

receded between the mid 1950's and 1969, and then remained above average for the next 30 years – a period that saw the most significant flooding in Detroit Beach History.

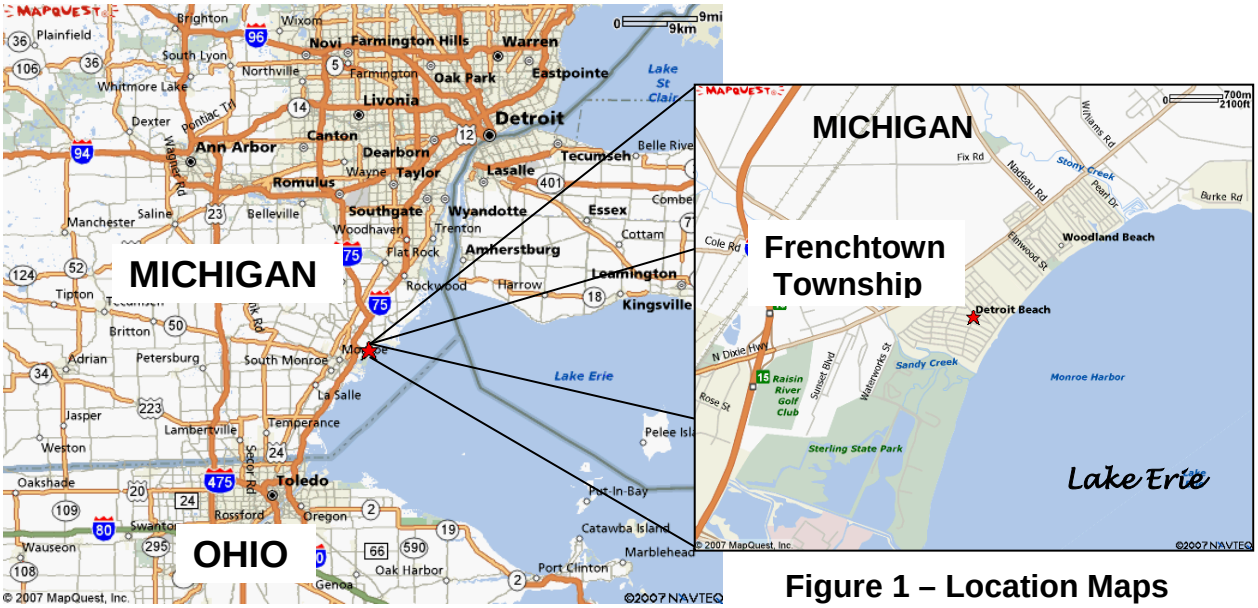


Figure 1 – Location Maps

The request for a Section 205 flood damage reduction project from Frenchtown Township is for the residential community of Detroit Beach, at the mouth of Sandy Creek. The eastern portion of Detroit Beach faces Lake Erie (see Figure 2 below).

Figure 2 – Detroit Beach

Study Participants and Coordination

The USACE, Great Lakes and Ohio River Division, Detroit District is responsible for the overall study management and report preparation. The Detroit Beach Resort Authority, Frenchtown Township, Monroe County, Michigan has come forth as a willing non-Federal local sponsor for the project. Frenchtown Township also provided input and participation at the local level of Government. Additionally, the study is coordinated with select Federal and state agencies, tribal interests, and other interested parties through the National Environmental Policy Act (NEPA) documentation process.

In the past, the Advance Measures Construction Program has provided Detroit Beach with various forms of temporary flood protection. In 1973, under the Operation Foresight authority, the USACE constructed emergency flood control structures to prevent backwater flooding. In 1986, the USACE provided additional protective works at Detroit Beach to protect residential structures, along with the city infrastructure.

Although the township maintains the existing temporary steel sheet pile (SSP) wall, there is a need to replace the interrelated components of the existing system. The city infrastructure and private structures experienced accelerated degradation, due to past high water levels of Lake Erie that resulted in frequent inundations.

During a 1997 site inspection by USACE Detroit District personnel, Frenchtown Township indicated a willingness to enter into a Project Cooperation Agreement under a then-existing Advance Measures Authority. The Township also stated a willingness to provide 25% of the cost of the construction and construction supervision and administration (S&A) of the flood protection measures rehabilitation.

3. PRIOR STUDIES AND REPORTS

Previously, an After Action Report, dated May 1989, was published with Flood Response and Advance Measures projects undertaken by Buffalo, Chicago and Detroit Districts between March 1985 and April 1989. The report accounts where flood protection projects were built, basic history, including cost and significant events protected against. It also includes information about, and summaries of, work performed at Detroit Beach, Frenchtown Township.

In conjunction with a request for Advance Measures Project approval and funding of May 1998, a USACE Project Information Report was prepared for a request submitted by Frenchtown Township regarding upgraded flood protection. This report contained a Project Funding Summary, an Economic Determination, Project Information Data and a Project Cost Estimate, however, work was slowed due to real estate acquisition issues. As these issues were being resolved, the project became no longer eligible to be funded under the Advance Measures program.

Finally, the 1986 USACE Operation and Maintenance Manual for Local Flood Protection for the Advance Measures Flood Control Program was revised in 1992 for Detroit Beach to incorporate “as-built” conditions.

4. PLAN FORMULATION AND THE STUDY PROCESS

CAP Section 205 projects have two phases: the Detailed Project Report (DPR) or feasibility study phase and the implementation phase (detailed project design and construction). The first $100,000 of Feasibility Phase costs are funded 100% Federal. All feasibility phase costs above $100,000 are cost-shared 50% Federal and 50% non-Federal in accordance with a Feasibility Cost-Sharing Agreement (FCSA) prepared for the study. If the project advances to the implementation phase all costs are shared 65% Federal and 35% for non-structural measures and 50/50 for structural remedies, in accordance with a Project Cooperation Agreement (PCA) prepared for the project.

This DPR phase primarily considers various options to replace the flood protection at Detroit Beach. A flood warning system will also be considered as a supplemental measure. However, advance flood warning to the owners of the structures in the project study area will not result in significant flood damage reductions. The DPR provides an assessment of environmental, social, and local economic effects of those improvements determined to be most viable from the national economic perspective. Results of this study form the basis for a decision on project implementation.

For quality control purposes, an Agency Technical Review (ATR) was conducted on this feasibility study. Legal certification is also accomplished during this ATR of the feasibility study and also during ATR of the plans and specs.

The study process provided for a systematic preparation and evaluation of alternative plans that address study area problems and opportunities. The 1998 Project Information Report identified the problems and recommended alternatives and remediations. The feasibility phase evaluates alternatives and remediations more thoroughly, assesses environmental and social impacts, and determines economic benefit.

4.1 Policy Regarding Flood Protection

Section 205 projects are small flood control projects. The measures investigated usually include either structural or non-structural measures or a combination of both. Overland flooding caused by a stream or major drainage must cause the flood damages being investigated. Watercourses that are causing overland flood damages must have flows that are at least 800 cubic feet per second (cfs) for the 10-year frequency flow and have a drainage area of least one square mile to qualify for Section 205 investigations. Although Section 205 policy does not specifically address use of this authority due to overland flooding caused on or by the Great Lakes, Lake Erie is considered a “major drainage” of over 1 square mile and experiences storm surges that exceed 800 cubic feet per second (cfs). A legitimate flood threat has been occurring on the order of every 11 years or so since the mid 1970’s and occurs for longer duration during periods of above-average water levels on Lake Erie.

4.2 Problem Identification

This section of the report addresses the national objectives; planning constraints; planning objectives; problems, needs, and opportunities; existing conditions and future "Without Project Conditions".

4.3 Project Goals

The primary goals of this project are to provide permanent and reliable flood control (flood risk management) to the Detroit Beach community, while employing the least costly but most-effective measure(s) to serve this purpose.

4.4 National Objectives

The fundamental national objective of Federal participation in water resource development projects is to ensure that an optimum contribution is made to the welfare of all people. This requires contributing to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

The plan that reasonably maximizes net NED benefits, consistent with the national objective is to be identified as the NED plan. National objectives are designed to ensure systematic interdisciplinary planning, assessment and evaluation of plans addressing environmental concerns that will be responsive to Federal law and regulations.

5. EXISTING CONDITIONS

A thin, 3,800 foot long steel sheet pile (SSP) flood reduction structure supplements a flood protection system that has existed in the Detroit Beach area since circa 1954. The original flood protection system was constructed by Monroe County. Also installed at the time was a flanking clay dike perpendicular to the shoreline, extending from the wall to the higher ground west of the shoreline.

Figure 3 – Temporary Steel Wall

In 1973, the USACE constructed additional emergency flood damage reduction structures, which consisted of SSP that was installed across the southern end of the area and up a short distance of Sandy Creek. Further, 50 linear feet of rock and sand cribs were constructed on the northeast extent of Detroit Beach.

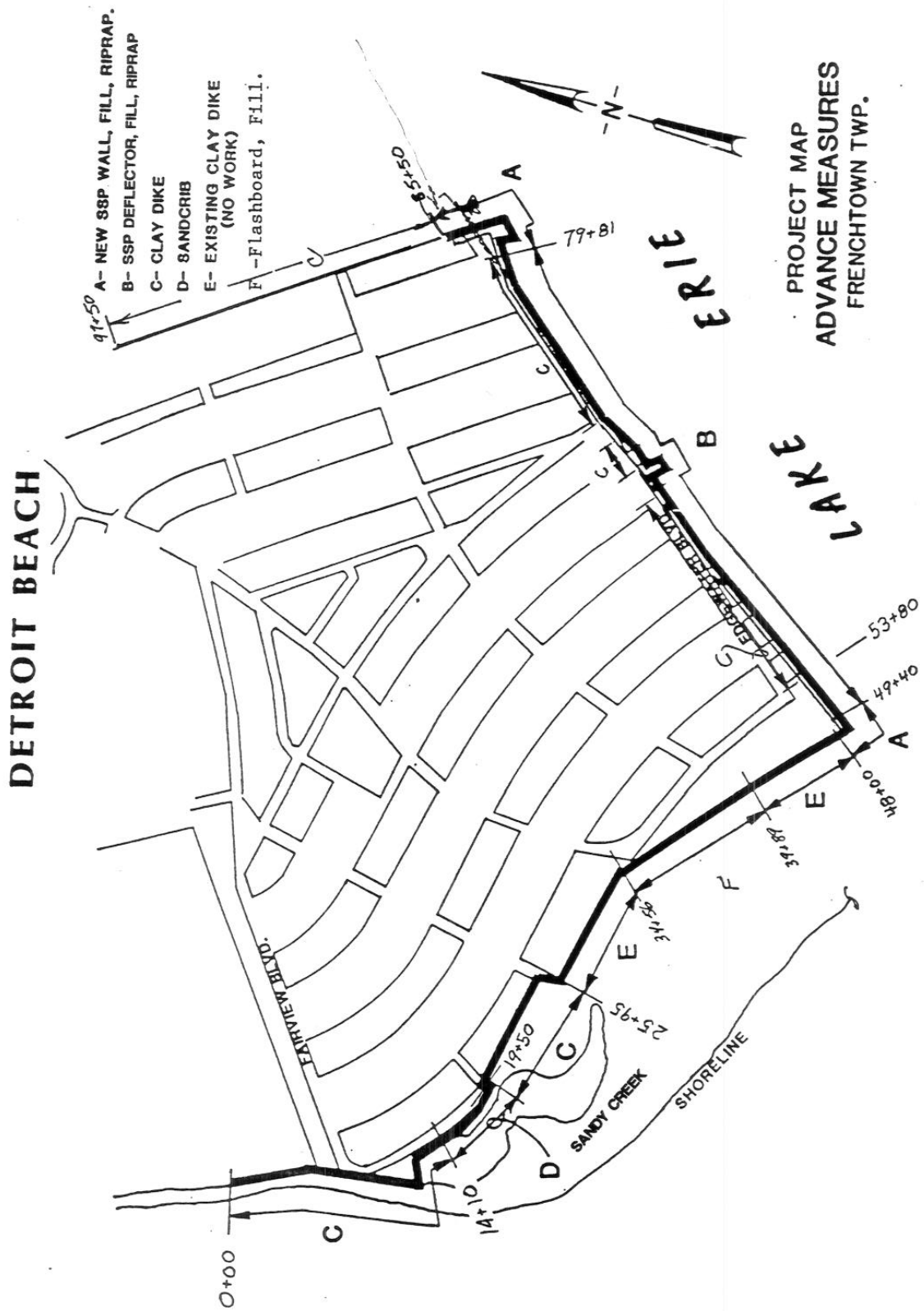


Figure 4 – Corps of Engineers "Advance Measures" Project Map

In 1986, the USACE provided additional protective works including, but not limited to, three-foot high clay dikes approximately 15 feet landward of the SSP wall; new SSP walls; SSP wall extensions which raised the elevation of protection to 581 feet IGLD85; standard flap gates to allow for drainage from overtopping; stone and clay fill behind existing SSP wall; and riprap at the toe of the new and existing SSP walls to an elevation of 574 feet IGLD85. The modern mean lake elevation is 571 feet IGLD 85.

Fig. 5 - Advance Measures Clay Dike

Figure 6 - Exposed Tie-backs

The 1986-installed SSP wall bows outward at the toe and some of the tiebacks are tearing through the steel. The alignment of the wall is wavy. The land elevation directly behind the flood protection structure is approximately four feet below the top of the wall, with indications of settling and washout. The clay dikes have been lacking maintenance to various degrees; encroachments will have to be remediated by Frenchtown Township.

Figure 7 - Sandy Creek Pump Station

Another facet of the protection system is the Sandy Creek Pump Station (see below right). The pump station is approximately 650 feet from the mouth of Sandy Creek on Lake Erie. This facility, constructed by the Detroit Beach Resort Authority, came in service in 1987. The station's system automatically engages when stormwater fills float-monitored holding tanks and a series of four pumps alternate to empty the tanks. The station is capable of pumping 80,000 gallons per minute during a flood event. A back-up diesel generator protects against system failure during a power outage. The pump station is monitored continuously by the Monroe County Drain Commission and is rigorously maintained.

Although the station is protected by rip-rap, additional stone may be needed to tie into upgraded shore protection downstream to Lake Erie.

5.1 Economic Impacts

Many of the approximately 816 structures in the Detroit Beach study area are single-family units with a mean depreciated value of $83,300 in 2009. It is a mix of single and multiple story residential structures, and a combination of prefab and standard construction homes. Detroit Beach also maintains a community center and other common properties. Surveys of estimated future damages to residential and commercial properties are anticipated to be significant based on site visits and historic flood events that have occurred in the area.

The needs of the study area related to flood protection have been estimated, and it is demonstrated that flood protection maintenance and improvements to protect the 758 structures that sustain damages, would be justified as a National Federal interest. The equivalent damages for the "without project" condition (i.e. without the Government or Township doing anything to the existing project) are estimated to be $2,540,460 in the Detroit Beach area, based on current structures and existing content. Flood damages to any new development should be moderated by participation in the National Flood Insurance Program, which requires the construction of new structures above the 100-year base flood elevation.

5.2 Physical Setting

5.2.1 Physical Geography

Detroit Beach is located on the west shore of Lake Erie in Monroe County, Michigan. Monroe County lies entirely in the Erie-Huron lowland, a relatively flat clay plain that was once the post-glacial floor of receding western Lake Erie. The modern mean lake elevation is 571 feet IGLD 85. The elevation of the eastern 1/3rd of the Detroit Beach community (east of Bronson Road) is below 575 feet. West of Bronson Road, the elevation increases more rapidly to above 585 feet by Dixie Highway.

Figure 8 - Transitional Shoreline Wetland along Sandy Creek

Much of the area landscape is common of rich lowlands – agriculture, stands of deciduous forest, agricultural orchards, grassy fields and urban grassland. Because of the shallow relief along the shoreline, marsh and other wetlands are located along the shoreline to the north and south of the Detroit Beach area.

5.2.2 Geology and Soils

Glacial deposits superimposed on underlying bedrock establish the overall topography of Monroe County. The present surface consists mainly of lake bottom clays and sands that led to the development of sandy, silty clay loams, loamy sands and sands throughout much of the area. Muck and peat are present in scattered patches and alluvial soils are associated along streams. Some earlier beach ridges and shorelines of pro-

glacial lakes are evident, though they are difficult to find and discontinuous. The mouths of the local streams have been inundated by Lake Erie and are mostly drowned river valleys.

5.2.3 Topography

The topography of Monroe County is relatively flat, descending gradually in a southeasterly direction from an elevation of 730 feet at its northwest corner to 571 feet at Lake Erie. This gradual decline in elevation of 159 feet over approximately 28 miles, results in stream velocities that are very low. To improve drainage, numerous ditches were created to handle runoff and prevent flooding. Although the land area is part of the Ottawa-Stoney watershed in southeast Michigan, the Detroit Beach community is classified as a "direct drainage area" into Lake Erie.

5.2.4 Groundwater

The area of Detroit Beach in Monroe County, Michigan, is underlain with Paleozoic era rocks consisting mainly of carbonate rocks with some shale and sandstone. This carbonate layer acts as the aquifer for most of the County. Monroe County is a predominately agricultural region and domestic wastes are deposed in septic tanks. The domestic water supply in the area is obtained primarily from wells completed in the bedrock. The groundwater resource therefore is particularly vulnerable to contamination.

5.3 Local Climate

5.3.1 Climate

Monroe County, Michigan resides in the mid-latitudes, at approximately 41.5 degrees north latitude. The region is subjected to bitter "continental polar" air masses from the Arctic regions during the winter, and warm, humid "maritime tropical" air masses during the summer. During the spring and fall transitional seasons is typically when the strongest storms and heaviest rain and snow falls. Much of the year, this lakeside location is considered "temperate". Breezes off of Lake Erie on warm summer days may lower coastal temperatures 10 degrees or more; early fall cold snaps are tempered by the stored heat from Lake Erie's water.

5.3.2 Wind

Wind data observations from nearby Detroit Metropolitan International Airport (DTW) are used to aid in describing the study area. The average annual wind speed for western Lake Erie is between 8-10 miles per hour (mph). The greatest monthly mean wind speed on western Lake Erie is generally in April (~12.5 mph) while the lowest monthly mean wind speed occurs in July (~ 8.5 mph). On an annual basis, the prevailing winds are from the southwest.

5.3.3 Lake Elevation and Storm Rise (Wind Set-Up)

Lake Erie has an annual mean lake surface elevation of 571 feet IGLD 85. However, the lake levels experience an annual rise and fall that corresponds with the fluctuation in annual water supplies. The average annual fluctuation in Lake Erie's water level is about 1 foot, with the

highest annual average level occurring in June and the lowest usually occurring in February. More or less rain or snow during a particular season may disrupt these rises and falls. The record range of water levels on Lake Erie (between record highest and record lowest mean monthly water levels) is approximately 6.2 feet. During the high water period of the mid 1980's, the modern record high average monthly water level was set in June of 1986 at 574.4 feet IGLD 85. This level was 3.4 feet above the annual mean level and 2.1 feet above the average annual peak level.

Storm rises or "wind set-up" occurs as a response to influences of wind and barometric pressure changes over a water surface. Sustained strong winds across a water body will push the surface water down wind and cause the lake surface to "tilt" by piling the water up toward the downwind shore.

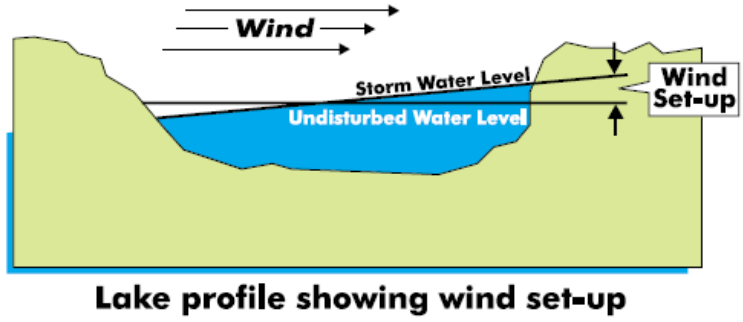


Figure 9 – Wind Set-Up or Storm Rise

Wind set-up amounts are on top of the "still water" lake level, and "wave run-up" is added to that level. Because of physical effects that cause this energy to spread vertically through the water, the wind set-up effect is inversely proportional to depth (shallower water creates higher wind set-up/greater storm rises). Western Lake Erie has an average depth of 18 feet, which aids in the creation of significant storm rises. Storm rises occurring during the period of high water in the 1980's and 1990's were particularly noteworthy.

For example, on a storm-rise table for western Lake Erie, there is a 20% chance of an increase in water levels of at least 1.3 feet in June every year (or a 1 in 5-year probability of this occurrence). This storm rise would equal a mean total elevation increase of 4.7 feet during high water periods (totaling 575.7 feet) above the average annual Lake Erie water level. If a strong storm generates 6-foot waves, this elevation would increase by ½ the wave height (3 feet) to about 578.7 feet. The top of the SSP flood structure at Detroit Beach is 581.0 feet. That 2.3-foot difference would allow for ample splash-over during a moderate to strong easterly wind event.

5.3.4 Floods and Storms of Record

Flooding, in various degrees, is a common occurrence in the western Lake Erie basin. Because of the long, narrow and relatively shallow configuration of Lake Erie, almost all of the flooding along the western shore occurs due to wind set-up/storm rise from strong spring or autumn storms traversing through the Ohio Valley. Resultant northeast winds, sometimes reaching greater than 50 knots, may be sustained for 12-36 hours. This causes dramatic wind set-up of the Lake Erie surface, and has accounted for some astonishing rises in water elevations. Water levels

may rise several feet in just a few hours and, with the storm waves on top of the increased levels, total rises may be in excess of ten feet above still water level.

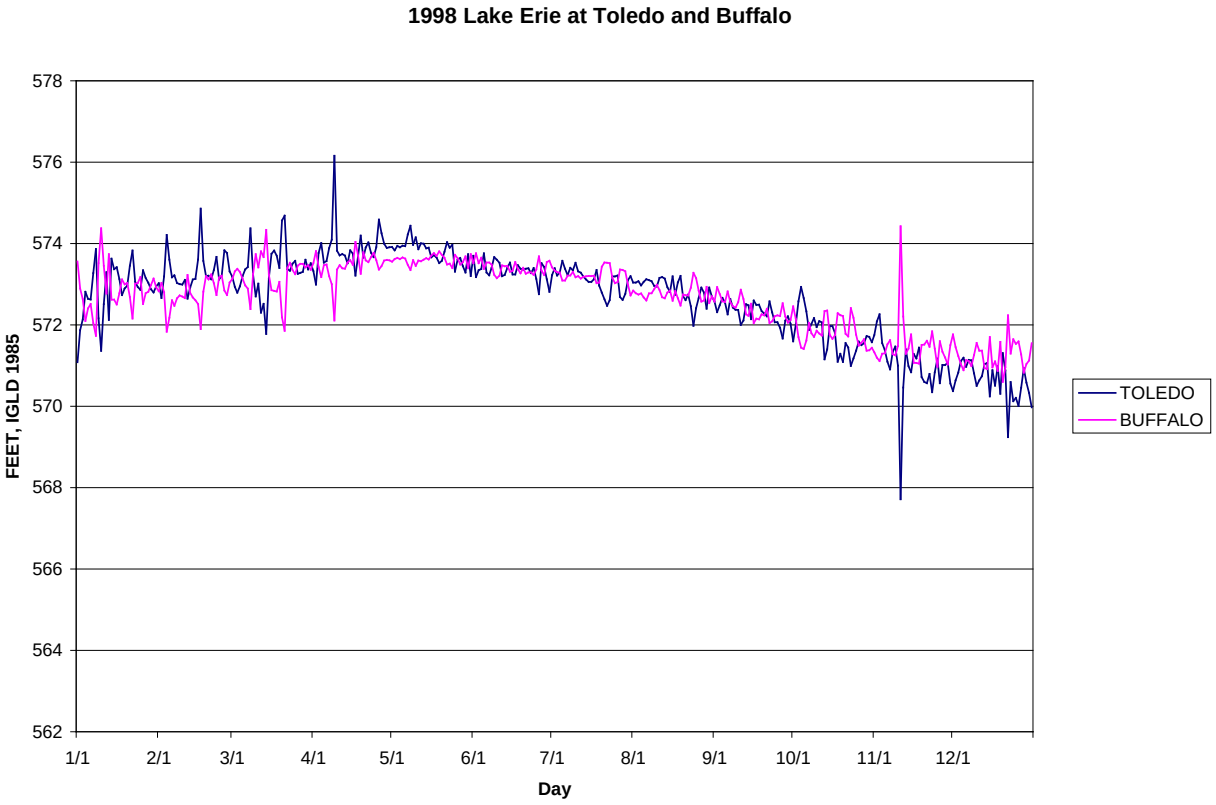


Figure 10 – Hydrograph of Wind Set-Up Events

This 1998 early April storm raised the "still water" surface elevation of Lake Erie to above 576 feet IGLD85 through wind set-up at the Toledo, Ohio NOAA gage (blue plot line). Toledo is south of Detroit Beach by about ten miles. The northeast wind from this storm likely produced large wind-driven waves (total rise above 1 meter/3 feet) that would easily overtop a floodwall of 578 feet.

—Evening News ph

PR 2 1985

Water still high

Floodwaters on Sixth St. in Detroit Beach came in so fast early Sunday morning that many residents didn't have time to move their vehicles to higher ground. The level of the water rose to 4-5 feet portions of the beach and had receded only about foot since then as of this morning.

Figure 11 – April 1985 Flood Event at Detroit Beach

2A

APR 2 1985

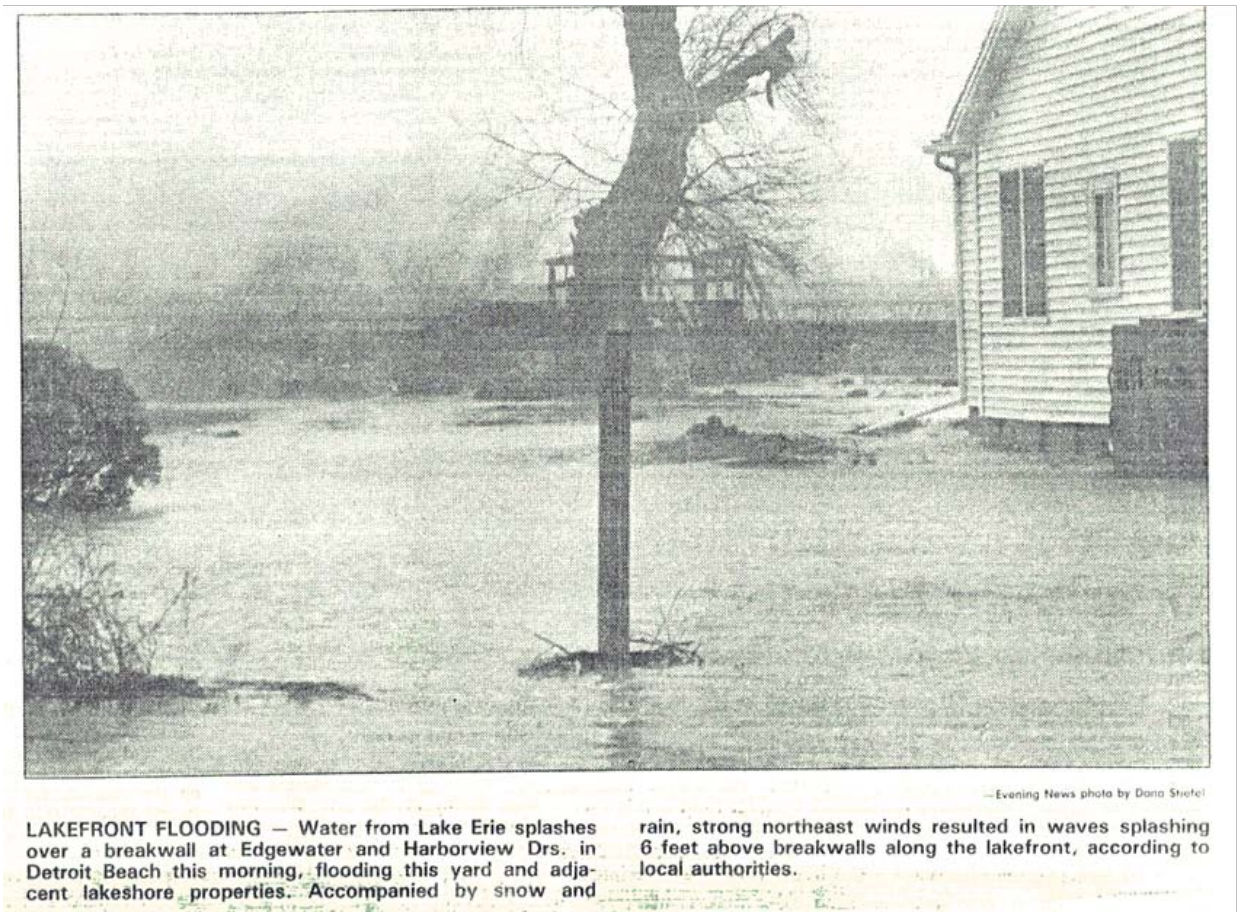
Good samaritan

—Evening News Photos

R.E. (Mickey) McBride (above) steers his 14-foot power boat through 3-4 feet of water covering Lakeview St. in Detroit Beach Sunday while assisting his neighbors in evacuating their homes. The beach area was the lone Monroe County spot still inundated this morning due to floodwaters trapped behind a dike. Mr. McBride, who also transported evacuees during the 1973 flood, drove to Toledo Monday to buy a new hot water tank to replace one that was knocked out. Below, breakers from waves pound a two-foot shorewall Sunday behind this Grandview Beach home looking south towards North Shores.

Figure 12 – April 1985 Flood Event at Detroit Beach

The pictures above of Detroit Beach flooding appeared in the Monroe Evening News on April 2, 1985. Strong northeast winds during a period of high water on Lake Erie resulted in a rapid "wind set-up" (storm rise) that raised the water level several feet higher than the already high levels. Storm waves exceeding four feet added to the wind set-up to result in flooding. The top of the floodwall in the picture above is estimated to be at the 25-year level of exceedance; after this event, flood protection was increased to 581 feet along the Lake Erie shoreline.



—Evening News photo by Dana Stiefel

LAKEFRONT FLOODING — Water from Lake Erie splashes over a breakwall at Edgewater and Harborview Drs. in Detroit Beach this morning, flooding this yard and adjacent lakeshore properties. Accompanied by snow and rain, strong northeast winds resulted in waves splashing 6 feet above breakwalls along the lakefront, according to local authorities.

Figure 13 – December 1990 Wave Overtopping

On December 3, 1990, another storm with strong northeast winds combined with high water levels to drive water up and over the flood protection walls at Detroit Beach. The flood walls were increased in height in the mid 1980's to 581 feet (IGLD85) under operation foresight.

5.4 Biological and Natural Resources

5.4.1 Terrestrial Habitat

Terrestrial habitat at the site consists of urban landscapes fringed by wooded wetlands on the north, Lake Erie on the east, and Sandy Creek on the south. Wildlife typical of urban areas would be common, but because of the proximity of wetlands, wooded areas, and the lakeshore, a variety of other species are also present in the area. To the northeast of the Detroit Beach community is a Michigan Department of Environmental Quality conservation easement which includes wooded wetlands with some created open water/marsh areas.

5.4.2 Coastal Wetlands

Coastal wetlands exist around the inner mouth of Sandy Creek and south along the Lake Erie shore. These coastal wetlands are dominated by cattails, arrowhead, American lotus, water lily, bulrush and several species of pondweed. Phragmites, an invasive species, is also present in the wetlands. Of note is the large amount of American lotus present, which is listed as "threatened" by the State of Michigan. The American lotus has become abundant in southeast Michigan in recent years, providing fishery and water quality benefits.

Coastal wetlands and other coastal fish habitat have been declining in extent and quality since European settlement in the region in the 1800's. Drainage, shoreline modification, filling and armoring of the shoreline and inlets for agricultural, commercial, and recreational purposes are factors which have contributed to the population decline of wetland and coastal marsh/inlet dependant species in western Lake Erie.

Coastal wetlands provide habitat for feeding and resting for migratory waterfowl in the spring, particularly for mallards, teal, wood ducks, Canada geese and ring necks. The coastal wetlands provide nesting areas for red winged-blackbirds and a variety of song birds. The emergent wetlands are resting and feeding areas for waterfowl and members of the heron family during the summer and fall migration. Small mammals such as muskrats, skunks, opossums, fox and birds such as pheasants and raptors use the wetlands for habitat and feeding.

5.4.3 Fisheries

In 2005 the Michigan Department of Natural Resources (MDNR) sampled four coastal marshes in the lower Detroit River and western Lake Erie and documented 47 species (from 15 families) of fish in the catch from all sites combined. [1] Bluegill, pumpkinseeds and gizzard shad were some of the species collected most commonly among the sites. In addition, another 18% of the catch was made up of shiners and minnows and are forage fish. Game fish species comprised 26% of the catch including bluegill, pumpkinseed, large and small mouth bass and yellow perch. A total of 25% of the catch was comprised of species tolerant of turbidity including gizzard shad, carp and goldfish. While coastal marshes are important to various life stages of fish, many species use the marshes only on a seasonal basis. Adult largemouth bass, smallmouth bass, northern pike, walleye, carp and yellow perch are found in these emergent wetlands during portions of the year. Project effects on fisheries are minor and temporary. Fish would temporarily avoid the immediate work area because of the noise, turbidity, and activity, but have plenty of other available habitat in the project vicinity.

5.4.4 Other Aquatic Habitat

Other aquatic habitat along the Lake Erie shore at Detroit Beach includes the remnants of stone/rubble shore protection and the adjacent lake bottom. Much of the existing stone is either

1 Francis, J. and J Boase. A Fisheries Survey of Selected Lake Erie Coastal Marshes in Michigan, 2005. Michigan Department of Natural Resources, March 1, 2007.

buried or has been washed away by storms. The remaining stone provides some aquatic habitat in an area that, because of high wave energy, would have limited aquatic habitat. Richer aquatic habitat would likely occur in Sandy Creek, though the area with stone shore protection would be more disturbed because it is open to the forces of Lake Erie storms.

5.4.5 Endangered and Threatened Species

Federal listings under the Endangered Species Act for Monroe County, Michigan, include Indiana bat ("endangered"), Karner blue butterfly ("endangered"), northern riffleshell mussel ("endangered"), rayed bean mussel ("candidate for listing"), and eastern prairie fringed orchid ("threatened"). Habitat for the Indiana bat does not occur within the area of potential effects for the proposed flood control project. Suitable nesting trees for Indiana bat have not been observed on the site. The project site also does not include habitat suitable to the Karner blue butterfly or the eastern prairie fringed orchid. In water habitat is potentially suitable for either mussel species; however, these mussels are not known to occur at Detroit Beach. Therefore, the project would have no effect on Federally Listed species. The US Fish and Wildlife service has also reviewed the project for Federally Listed species and concluded that "listed species or potential habitat would not be impacted".

5.4.6 Water Quality

Lake Erie was one of the most polluted and damaged lakes in the world until the Great Lakes Water Quality Agreement signed in 1972 by former President Richard Nixon and former Canadian Prime Minister Pierre Trudeau. The 1972 U.S.-Canada accord led to billions of dollars of improvements at sewage treatment plants, factories, and other point sources of pollution. The lake has been responding very favorably to this effort. One reason for the turnaround was a dramatic reduction in phosphorus, a common farm fertilizer and component of human waste. Its abundance was blamed for much of the algae that plagued the lakes in the 1960s and 1970s. Improved sewage controls achieved much of the reduction, but so did farming practices aimed at curbing erosion and keeping more of the nutrient on land.

As of 2000, the water quality of western Lake Erie had improved to the point of being able to sustain ample populations of fish and other aquatic organisms. Dissolved oxygen content is seldom limiting to fish and is often near saturation by midday in near shore and coastal areas. Although suspended solids reduce visibility in near shore areas due to runoff and watercraft-caused turbidity, overall water clarity and quality is good.

No significant adverse effects on water quality are anticipated to occur from construction activities. Standard erosion control measures would be used, as necessary, to prevent soil releases into the waterway during construction. Sediments in the proposed in-water work area along the Lake Erie shore are generally sandy with sediments along the protected reach on Sandy Creek being more fine grained. Disturbances by wall construction activities would be limited to the immediate work area. Any turbidity generated would be minimal and short term.

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5.4.7 Recreation

The southwestern side of Detroit Beach borders Sandy Creek; on the opposite shore of the creek is the State of Michigan's Sterling State Recreation Area. Sterling provides camping, swimming, boating and fishing areas. Birds and wildlife watching areas are set up near the park's lagoons and marshes. Area recreation is predominantly water-based; however, hunting is very popular in the area with land-based game and waterfowl the main prey.

A small sandy beach area occurs about midway along the Lake Erie-facing flood protection during years of lower water levels. This area is used for water oriented recreation, such as swimming and sunbathing, by some of the local residents.

Figure 14 – Beach in Front of Flood Wall

5.4.8 Hazardous, Toxic, and Radioactive Wastes

A review of the Environmental Protection Agency (EPA) National Priorities List (NPL - Superfund Sites) of the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Facility Data base and a site inspection have been accomplished to assess the potential for hazardous, toxic, and radioactive wastes (HTRW) within the project area. No sites of environmental concern were found within the project area.

5.5 Cultural Resources

French missionaries came to this western Lake Erie shoreline territory as early as 1634. They named the main river flowing through the area *Riviere Aux Raisins* (Raisin River) because of the many grapes in this locality. A trading post and fort were established here in 1778. Francois Navarre was the first white settler in 1780. The first settlement was called Frenchtown when about 100 French families came here from Detroit and Canada. The American Flag was first raised in Michigan in 1796 at Frenchtown. Frenchtown was later named the City of Monroe in honor of President James Monroe.

Monroe County was established in July 1817 as one of the first steps in the organization of the Michigan territory after the War of 1812. The old settlement of Frenchtown, which centered upon the square of the present Courthouse, took the name of Monroe and became the County

Seat in September 1817. There are no historic properties located within the area of potential effects of the flood damage reduction project

5.6 Economic Resources

5.6.1 Population and Land Use

The study area is entirely within the 551 square-mile Monroe County, Michigan. The 2000 population of the county is estimated as 146,000, or 1.5% of the total Michigan population. During the 2000-2001 period, the Monroe County population rose 1.4%, which is nearly a full percent faster than the Michigan population growth. The 2000 Monroe County population density is 279 persons per square mile, while the population in the typical urbanized areas is 4,500 persons per square mile.

The City of Monroe, which is southwest of the Detroit Beach location by approximately 3 miles, reported a population of 22,076 in 2000, which is 15.1% of the Monroe County population. The Detroit Beach Authority reported that Detroit Beach community and adjacent Woodland Beach area (just northeast of Detroit Beach) had a combined 2000 population of 2,289 residents.

As shown in the Economic Appendix, in 2000 the county had a relatively high median household income of $64,840 compared to the City of Monroe at $52,393 and the state of Michigan at $51,621.

The City of Monroe and Detroit Beach is located within the greater Detroit Metropolitan Area. As such, its economic base cannot be easily differentiated from that of the greater Detroit areas. In 2000, most of the county employment was in the Services (33%), Manufacturing (23%) and Retail (21%) trades. Agriculture accounted for only 5% of the county employment in 2000.

The Monroe County land use in 1995 was about 15% urban and 85% rural. Of the total urban area classified, 73% of that was residential land, 20% was commercial, industrial, communication and utilities acreage, and the remaining 7% was classified as cultural and recreational use. The rural areas were also subdivided; 86% was classified as agriculture, grassland and shrub; woodlands and wetlands comprised 11.5% of the rural land use, and surface waters covered the remaining 2.5% of county lands.

5.6.2 Businesses and Employment

The businesses and related employment within the incorporated limits of the City of Monroe include the markets and services traditionally required for maintaining a smaller suburban community in close proximity to a much larger urban center. Businesses include such things as retail stores that sell food, clothing, medical supplies, home furnishings, automobiles, trucks, and boats; and various service establishments providing health care, sanitation, legal services, and automobile and boat maintenance and storage.

5.6.3 Structure Inventory and Contents Valuation

Structure and content values are major elements impacting depth-damage relationships and the magnitude of flood damage to urban structures. For the purposes of estimating urban flood damages, a structure is defined as a building and any attached components, such as built-in appliances, shelves, carpeting, etc. Contents represent furnishings and equipment, or all items within the structure that are not permanently attached. The value of land is excluded in the determination of urban structure values.

Figure 15 – Some Houses Sit Very Close to the Shoreline - *Many structures at Detroit Beach are vulnerable to flooding from Lake Erie.*

A Structure Inventory was conducted for Frenchtown Township to determine an estimate of the number, value, and elevation of all structures. First floor elevations above natural ground were estimated using a survey of the first floor doorstep. A reconnaissance site visit was made to each of the structures to inventory exterior features of each structure and to evaluate potential damages due to flooding. Since specific information on local depth-damage relationships was not available, structure and content depth-damage curves used are Corps developed relationships presented in Economic Guidance Memorandum (EGM) 04-01. More on this topic is in Section *5.4.2 Structure/Contents Depth-Damage Curves* in the Economic Appendix of this DPR. Depreciated replacement values were provided by Frenchtown Township.

In the current economic evaluation 758 structures were identified as being vulnerable to flood damages. According to information provided by the Frenchtown Charter Township Assessors Office, the depreciated mean replacement value of the structures in the threatened area is $83,300. A survey in December 2007 by Detroit District determined structure, ground and first floor elevations.

Figure 16 – Exposed Tie-Backs - *This tie-back has been exposed due to washout behind the flood protection structure.*

5.6.4 Damage Evaluation

The selected flood frequency data was obtained by comparing hydrologic profile data, structure locations, first floor elevations, depth-damage relationships, and structure and contents values to compute the depth of flooding for each structure based on past flood events. Resulting damage estimates were calculated in this study using data and guidance provided from the Frenchtown Charter Township Assessors Office.

6. FUTURE WITHOUT PROJECT CONDITIONS

Having examined the past and present condition of Detroit Beach, the next step is to anticipate future conditions if no permanent project is pursued by the Federal government. This forecast of conditions under the "No (Federal) Action" scenario will provide the basis for analysis of project improvements. This does not exempt the non-Federal sponsor from maintenance responsibilities on the existing project

Flood Protection

Historical evidence of past flood events at Detroit Beach Association reveals that most common flooding that occurs is due to storm conditions during high water periods on Lake Erie. Periods

of high water on the Great Lakes have been more frequent during the latter half of the 20th century; especially considering that most of time during the past 40 years (1965-2005) Lake Erie's water level has been significantly above its long-term average water level. Incidentally, peak levels have occurred approximately every 11-12 years during that period.

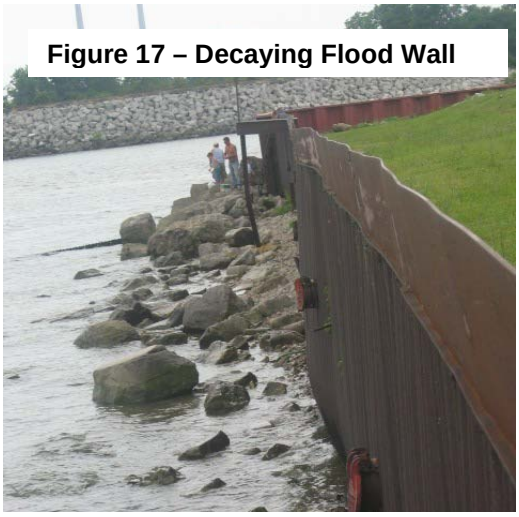

Figure 17 – Decaying Flood Wall

Without any Corps involvement, it is likely that the existing project will continue to degrade and Detroit Beach will become increasingly vulnerable to flood damages again when high water levels return to Lake Erie. In the meantime, the local sponsor has been actively refurbishing the fronting floodwalls and other flood protection in adjoining areas, such as Grand Beach and Woodland Beach.

Currently, the adjacent community to the northeast of Detroit Beach (Woodland Beach) is constructing a concrete floodwall along the Lake Erie shoreline that would partially rely on a clay dike that extends from the Lake Erie shore landward into higher ground, parallel to Monrona Street. After inspecting this dike, the USACE has concluded that clearing the extensive growth of vegetation off this dike would virtually destroy it. If the USACE continues with this project, a concrete "L" wall would be installed on the east side of the existing dike to provide permanent protection, while allowing a 15-foot easement from the residential property lines.

Without USACE participation, the non-Federal sponsor would need several more years to raise the necessary additional funds to solely finance a new flood protection wall at Detroit Beach. Given the lack of funds, the project area would likely suffer large amounts of damage prior to securing funding. Thus, the current flood protection wall would continue to degrade and become less reliable. The municipal water intake facility and wastewater lift station would also be left vulnerable to damage from flooding.

Figure 18 – Overgrowth on Flanking Dike

7. PROBLEMS AND OPPORTUNITIES

7.1 Problems

The problems and opportunities identified in this study relate to the need for permanent flood damage protection for Detroit Beach.

The existing SSP wall is exhibiting signs of failure, such as bulging, tie-rod failure and rotation. Approximately one third of the flap gates are broken or missing due to ice flows. A majority of the gates do not have chains, which serve to limit the gate opening. Frenchtown Township has requested advice from the Detroit District on keeping flap gates functional and other repairs needed to stand up to the powerful natural forces that batter the original projects.

As flap gates malfunction or are stripped away, lake water enters through the flap gate openings, causing inundation during storms and periods of high water.

Figure 19 – Flap Gates - *Flap Gates cover drainage tubes to dewater catchment areas behind SSP walls.*

If the existing floodwall is replaced, the toe protection riprap is in need of replenishment (the estimated current top elevation of riprap is 569 feet IGLD85. Also, berms constructed behind the SSP wall for structural integrity have washed out. The area of concern includes the original SSP wall structure, included flap gates and riprap at the toe of the SSP. While the existing SSP wall provides protection above the 1% chance of exceedance ("100-year flood" elevation) from the long-term average water level, a flood damage/cost curve is used to determine the optimal flood risk reduction elevation of any implemented protection.

7.2 Opportunities

Opportunities of the project include the placement of permanent flood protection that will provide reliable and effective flood protection that will reduce the risk of flood damages to property and infrastructure. Overall the project will reduce maintenance costs and provide for a more appealing view that will reduce or eliminate the risk of injuries from currently-existing sharp edges and exposed tiebacks. The addition of riprap toe protection will provide supplemental or restored habitat for aquatic species.

8. PLANNING CONSTRAINTS

This study was conducted within the constraints described by the *Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies*, and by applicable Department of the Army regulations and other documents, which provide guidance pertaining to the implementation of these principles and guidelines. Plans were developed with due regard to the benefits and costs, both tangible and intangible, as well as associated effects on the ecological, social and economic well-being of the region. Federal participation in developments should also ensure that any plan is complete in itself, efficient and safe, economically feasible in terms of current prices, environmentally acceptable, and consistent and acceptable in accordance with local, regional, and state plans and policies, As far as practical, plans should be formulated to maximize the beneficial effects and minimize the adverse impacts and costs.

Prior to implementation of a flood protection project, watershed planning must address future flood problems that could occur as a result of continued urbanization of the local area. The Planning Constraints identified for Detroit Beach/Frenchtown are:

- The Detroit Beach community is a concentrated urban community of established homes and cottages which may make acquiring additional land (easements) needed for the project very difficult and/or expensive.

- The dense development of this area also leaves very little leeway in the placement of permanent protection, considering the adjacent wetland conservation easement on the northeast, and backwater wetlands on Sandy Creek on the southwest periphery of the community.

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9. PLANNING OBJECTIVES

The following planning objectives were established in response to the identified problems and opportunities:

- To perpetuate reduced flood damage threat to nearly 760 residential and commercial structures located in the Detroit Beach community adjacent to Lake Erie.

- To minimize project costs, as much as practical, by utilizing existing materials and structures.

- To reduce maintenance costs to the non-Federal sponsor.

- To minimize environmental impacts associated with the implementation of permanent flood risk reduction measures

- To construct a project that blends into the surroundings and does not look out of place.

10. DEVELOPMENT OF ALTERNATIVE PLANS

The Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100) requires the systematic development of alternative plans that contribute to the Federal objective. The objective of this study is the development of an economically feasible and environmentally acceptable permanent flood protection plan that will enable the area to continue to adequately withstand future storm events without substantial residual flooding.

In the development of plans for addressing the problems and needs of the existing flood protection, mostly structural alternatives were considered because temporary structural measures already exist that require replacement. Non-structural measures (primarily developing a flood warning system) also are required to be considered. A civil defense system is operated by Monroe County and may become part of any recommended alternative.

Other non-structural measures, such as flood protection planning and participation in the national flood insurance program, are currently being employed in the study area and will continue to be employed, with or without further Federal action. Structural measures in the project area requiring inspection and possible replacement include dikes, flood protection walls and riprap toe protection, flap gates, rock cribs and pumping stations. Additional measures were considered during Plan Formulation and are summarized in the following sections.

Also, regardless of which alternative is chosen (aside from the **No Action** alternative) the flanking dikes that complete a reliable risk-reduction system will need to be cleared and grubbed, or supplemented with a steel sheetpile or concrete wall in locations where a minimum 15-foot permanent easement has to be provided.

11. ALTERNATIVE PLANS

To conduct comprehensive planning, a wide range of alternative plans were considered during the plan formulation process. Several diverse preliminary plans were formulated to determine the most logical, fiscally-responsible and practical courses of action to pursue. Some plans were discarded during the initial assessment process as being impractical, too costly, engineeringly infeasible or environmentally-unacceptable. The nomination, assessment and evaluation of the remaining options are listed as follows:

11.1 Alternative 1 – No Action

Under the “No Action” alternative, the Corps would not participate in constructing permanent protective structures in the Detroit Beach community. This would not preclude the non-Federal sponsor from constructing their own flood protection. Until then, the non-Federal sponsor would be required to continue bi-annual inspections and maintenance on the existing works. During the planning process, the Federal Government is required to consider the option of “No Action” as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA).

With this alternative, it is expected that the existing degradation trend of the temporary flood protection will continue on an accelerated basis. Ongoing loss of floodwall backfill and toe-protection washout will increase the chances of flood control structure failure once high Lake Erie water levels return. The temporary wall is currently buckling and wavy and will continue to tear and list, rendering it ineffective in a flood event.

The existing earth dike located behind and parallel to the Lake Erie SSP wall is dependant on that wall for protection. This dike serves as interior flood protection. If the SSP fails during a storm event, the earth dike will be directly exposed to wave energy, which will result in rapid erosion and deterioration of this dike. If the dike fails, there is the likely result of flooding nearby homes.

The non-Federal sponsor has committed to remediating the protection whether or not the Corps is involved in the project. The question remains whether the non-Federal local sponsor group could raise the funding before the existing protection fails entirely.

11.2 Alternative 2 – Rehabilitate the Existing Flood Protection Wall

Under this alternative, the SSP fronting wall along the Lake Erie shoreline would be rehabilitated with new tie-backs and re-welding of seams and additional toe-protection riprap would be placed. The flap gate system would be redesigned and improved.

11.3 Alternatives 3 through 8 – Construct New Flood Protection Structure

Under these alternatives, the existing temporary SSP wall would be replaced with a permanent wall and additional toe-protection riprap would be placed. The optimal elevation for flood protection would be determined such that it provides the greatest amount of net benefit. This elevation may be at or below the existing 100-year level (1% chance of exceedance) of protection. The flap gates would be repositioned or redesigned to allow for the drainage of any overtopping water. The following options would be considered under the new wall alternatives:

11.3.1 Alternative 3 - Replace Existing Flood Protection with a Cantilever Steel Sheet Pile Wall

This option proposes to replace the existing SSP flood protection wall with a cantilever steel sheet pile wall and place additional riprap for toe-protection. (See discussion above for determining optimal elevation.).

11.3.2 Alternative 4 - Replace Existing Flood Protection with an Anchored Steel Sheet Pile Wall

This option proposes to replace the existing SSP wall with an anchored steel sheet pile wall and place additional riprap for toe-protection.

11.3.3 Alternative 5 - Replace Existing Flood Protection with a Concrete Panel/H- Pile Wall

This option proposes to replace the temporary SSP wall with a concrete panel/H-pile wall and place additional riprap for toe-protection.

11.3.4 Alternative 6 - Replace Existing Flood Protection with a Steel Sheet Pile/H-Pile Wall

This option proposes to replace the temporary SSP wall with an all steel sheet pile wall, with support from driven vertical H-piles. The alternative would also require renourishment of riprap for toe-protection.

11.3.5 Alternative 7 - Replace Existing Flood Protection with a Concrete Gravity Wall

This option proposes to replace the existing SSP wall with a concrete gravity wall and place additional riprap for toe-protection.

11.3.6 Alternative 8 – Rehabilitate and Replace Existing Flood Protection – Gabion Wall

This alternative consists of placing stacked rock filled baskets, or gabions, along the shoreline. Along with riprap stone at the toe of the structure, this alternative would minimize erosion along the shoreline but it would not provide any flood protection in the event of high water. A splash apron at the top and an excavated key for scour protection would be required. This would increase construction costs considerably as well as increase O&M costs due to the typically shorter life span of the wire mesh baskets and replacement of lost stone fill due to wave and ice action. Therefore, this alternative will no longer be considered.

11.3.7 Alternative 9 – Armor the Existing Fronting Dike

This alternative would involve complete removal of the temporary SSP wall and re-grading of the slope of the existing dike between the water's edge and the crest of dike. Geotextile and riprap stone would be placed on the lakeward side of the dike to prevent wave run-up.

The optimal elevation for flood protection was determined such that it provides the greatest net benefits. The existing crest elevation of the dike was compared to the optimal elevation to ensure sufficiency. In addition, the dikes were analyzed to determine their integrity and if they can be modified to withstand storm events. A life cycle cost was considered versus the steel or concrete wall.

11.3.8 Alternative 10 - Activate the Flood Warning System

This alternative is a "non-structural" solution that utilizes an existing civil defense system that is activated by Monroe County Emergency Management, at no cost to the community. The nearest speakers are located at Fermi Nuclear Power Plant, and are audible at Detroit Beach. The system

can be activated to send voice messages to residents along western Lake Erie and throughout Monroe County. Also, a newly-installed high water warning system has been placed at Stoney Point channel gate, which automatically notifies the Monroe County Drain Commissioner when water levels reach a critical elevation. This provides for direct, real-time flood monitoring capability to the county for civil defense system activation.

11.3.9 Alternative 11 – Conduct Buyouts

This "non-structural" alternative would involve the demolition and removal of many of the approximately 760 structures located in the Detroit Beach Area. This would entail buying out each of the residents in the area of greatest flood threat, which may cost in excess of $60 million.

12. EVALUATION OF ALTERNATIVE PLANS:

The initial Evaluation of Alternatives compared costs of a single elevation (to have a basis for equivalent cost analysis) that any structural protection would possibly be constructed (581 feet, IGLD85), which is the height of the existing temporary floodwall along Lake Erie. This was done to provide an equal assessment of the costs of using different materials (concrete, stone or sheetpile) and measures (wall vs. armored dike). Costs were then further refined at three elevations for Alternatives 3, 5, 6, 7, and 9, since they were relatively close in cost and fluctuations in construction material costs could influence the ranking of these alternatives. These costs are presented below in Tables 1 – 5. Once the least-costly alternative (materials and construction) was chosen from the initial Evaluation of Alternatives, a rough cost for an additional elevation for the selected alternative was evaluated to determine where the net benefits to Detroit Beach are maximized. The evaluations also considered the differing costs of modifications to the flanking dikes that are required to tie in to each of the Lake Erie-facing alternatives.

The results of the economic analysis show that the maximum net benefit (also called the National Economic Development or "NED Plan") is achieved at an elevation of approximately 581 feet.

The Planning Process requires that the analyzed alternatives also meet all of the following criteria: economically-justifiable, engineeringly feasible, and environmentally and socially acceptable. If an alternative does not meet one or more of these criteria, the alternative is eliminated from further consideration. There are certain policies and circumstances that allow justification of alternatives outside of these guidelines if there is supporting rationale.
The construction cost estimates with each alternative represent the cost of that particular protection at the evaluated elevations along Lake Erie including the clearing, grubbing and supplemental construction along the north and south flanking dikes to create a complete flood damage reduction project. The estimates also include contingencies determined through a risk assessment.

The construction costs are listed as well as the "implementation" costs. The construction costs include the cost to construct the Lake Erie-facing protection and to rehabilitate the flanking dikes to create a permanent flood protection system. Implementation costs include the construction costs plus the estimated sponsor-borne costs for obtaining easements and other real estate based on the footprint of each alternative. Also included in implementation is the cost-shared

engineering and design of the selected alternative, supervision and administrative costs and contracting costs of each constructed alternative.

12.1 Alternative 1 - No Action

Estimated construction cost - $0; implementation - $0.

As stated earlier in this report, the study area would continue to be threatened from flooding due to the increasing deterioration of the temporary flood protection project. The project is already beyond its design life and should have been replaced during the last decade. The flap gates that are part of the drainage system for water overtopping the lake-facing flood protection wall have to be repaired or replaced annually due to ice damage. Engineers that are familiar with the project have stated that the system needs redesign to eliminate the flap gates, which would increase the integrity of the project and considerably reduce maintenance effort and cost. Considering the condition of the severely degraded state of the temporary flood protection system, this alternative is not a viable option.

12.2 Alternative 2 – Rehabilitate the Existing Flood Protection Wall

Estimated (Federal) construction cost - Undetermined

This alternative would involve an upgrade of the temporary flood protection system at Detroit Beach, including the repair of the existing floodwalls and replenishment of toe riprap. However, an October 2006 site visit by the lead structural engineer resulted in the recommendation of replacement of the SSP wall because of the current failing state of the temporary flood protection structure. There is concern that, even with rehabilitation, the flood protection wall would fail during a sustained flood threat. As a result, this alternative will no longer be considered.

12.3 Alternatives 3 through 7 – Construct New Flood Protection Structure

These alternatives would involve replacement of the temporary SSP flood protection system at Detroit Beach, including replenishment of toe riprap. The new flood protection would be elevated to at least the optimal elevation as determined by a Stage-Damage analysis conducted by the Detroit District. An October 2006 site visit by the lead structural engineer for the project resulted in the recommendation of replacement of the SSP wall because of failure indicated by bowing, tie-rod failure and rotation of the wall. In addition, in consideration of the increasing value of the properties in this location and the decayed state of the existing SSP, this is the recommended alternative.

12.3.1 Alternative 3 - Replace Existing Flood Protection with a Cantilever Steel Sheet Pile Wall

Table 1 – Alternative 3 - Costs (2010$)			
Alternative 3	**Elevation 576.6'**	**Elevation 578'**	**Elevation 581'**
Construction	$4,926,000	$5,524,000	$7,706,000
***Implementation**	$6,606,540	$7,287,578	$9,775,352

* See p. 27 for definition of Implementation Costs

This alternative would require that new, thicker SSP that would be driven down to bedrock, with stone toe protection added lakeward from the foot of the wall. This option would require a significant amount of steel. Because of the relatively high cost of steel and combined high cost of construction (pile driving), this option will no longer be considered.

12.3.2 Alternative 4 - Replace Existing Flood Protection with Anchored Steel Sheet Pile Wall

Estimated total construction costs - $9,900,000; implementation costs - $13,406,000 (581')

Under this alternative, a cantilevered SSP wall would be supplemented with tie-backs to add additional stability to the SSP wall. Stone toe protection would be added lakeward from the foot of the wall However, the geotechnical analysis of the shoreline soils indicates that the wall would not be stable enough using a straight cantilever wall approach. Because of this, Alternative 4 will no longer be considered.

12.3.3 Alternative 5 - Replace Existing Flood Protection with a Concrete Panel/H-Pile

Table 2 – Alternative 5 - Costs (2010$)			
Alternative 5	**Elevation 576.6'**	**Elevation 578'**	**Elevation 581'**
Construction	$3,536,000	$4,112,000	$5,974,000
***Implementation**	$5,021,858	$5,678,216	$7,800,490

* See p. 27 for definition of Implementation Costs

This option would also employ driven piles for stability, but use less-costly precast concrete panels as wall sections, which may be stamped or tinted. The panels would be set in a trench to reduce undermining, and be provided stone toe protection. Because concrete panels are generally less watertight than steel, caulking or fabric may be required at the concrete-steel joints.

12.3.4 Alternative 6 - Replace Existing Flood Protection with Steel Sheet Pile/ H-Pile Wall

Table 3 – Alternative 6 - Costs (2010$)			
Alternative 6	**Elevation 576.6'**	**Elevation 578'**	**Elevation 581'**
Construction	$4,532,000	$5,152,000	$7,505,000
***Implementation**	$6,156,690	$6,863,479	$9,546,372

* See p. 27 for definition of Implementation Costs

Under this option, only the pile posts would be driven well into the ground, while the SSP panels would be seated in a trench a few feet deep between piles. Stone toe protection would be added lakeward from the foot of the wall. However, since the high cost of steel is causing this option to be less cost effective, this option will no longer be considered.

12.3.5 Alternative 7 - Replace Existing Flood Protection with a Concrete Gravity Wall

Table 4 – Alternative 7 – Costs (2010$)			
Alternative 7	**Elevation 576.6'**	**Elevation 578'**	**Elevation 581'**
Construction	$4,271,000	$4,841,000	$6,939,000
***Implementation**	$5,858,952	$6,509,600	$8,900,542

* See p. 27 for definition of Implementation Costs

This alternative would involve constructing a concrete “L” or “T” wall to replace the temporary SSP wall. Because of the footings required to create a stable wall in such an environment, significant excavation would be required, along with considerably more concrete than any other option that uses concrete. Because of the significant cost of this alternative, this option will no longer be considered.

12.3.6 Alternative 9 – Armor the Existing Fronting Dike

Table 5 – Alternative 9 - Costs (2010$)			
Alternative 7	**Elevation 576.6'**	**Elevation 578'**	**Elevation 581'**
Construction	$4,431,000	$4,953,000	$6,694,000
***Implementation**	$6,042,291	$6,636,860	$8,621,254

* See p. 27 for definition of Implementation Costs

As with many other construction materials, the cost of stone has seen a tremendous increase over the last few years, and would require the use of 1400 to 2800 pound armor stone to ensure adequate armoring against the forces of wind-driven ice and large waves. This alternative would also require the re-grading of several acres of shoreline land and layering of various sizes of stone, clay and Geotextile. In addition, the project was designed to protrude farther into the lake and there remains specific real estate issues, including the cost of purchasing and demolishing some homes in the project path ("takes", such as the house below).

Figure 20 - Some homes are built close to the shore.

Also, during a site inspection in 2008 by Corps, State of Michigan Department of Natural Resources, Department of Environmental Quality, and US Fish and Wildlife personnel, the topic of the armored slope alternative was addressed, including the real estate issues associated with the alternative. Corps project personnel asked the other agency attendees their opinion on moving the armored slope lakeward to avoid real estate issues. It was unilaterally agreed by the non-Corps agencies that encroachment into the lake to avoid "takes" was environmentally-unacceptable, considering the amount of encroachment into the lake and coverage of stone of nearshore lake-bottom habitat that would be required in certain locations along the shoreline. Therefore, considering the higher cost of this alternative and the environmental and real estate issues, it will no longer be considered.

12.3.7 Alternative 10 – Activate the Flood Warning System

Estimated construction cost- $0

A flood warning would be triggered when a flood threat at Detroit Beach is imminent. This system would be workable because of the generally greater advanced warning that occurs with wind set-up related flooding than stormwater flooding. Generally, lake levels would have to be above to well above average and combined with strong east to northeast winds before significant Lake Erie flood threat to Detroit Beach would occur.

Such a system allows up to several hours of advanced warning to residents, enabling removal of portable property to avoid damages. However, this system will not afford any additional protection to residential structures than is currently existent. Because of this, a flood warning system (as a stand-alone system) would not offer much benefit. As such, this alternative will no longer be considered as a stand-alone system, but may be paired with the recommended alternative.

12.3.8 Alternative 11 – Conduct Buyouts

Estimated cost- $63,141,400

This alternative - acquisition and removal of residential structures – would be the most invasive and expensive of all the alternatives. If all of the 758 structures were bought out, the price would be approximately $63,141,000. Due to the estimated extreme cost of this alternative, it will no longer be considered.

13. COST COMPARISON OF ALTERNATIVES

The table below is the direct cost comparison of the alternatives carried forth in this analysis:

Table 6- Comparison of Alternatives
Total Costs
(2010$)

Alt.		Elevation 576.6'	Elevation 578'	Elevation 581'	Considered Further
1	No Action				N
2	Rehab Existing Flood Protection Wall				N
3 thru 7	Construct New Flood Protection Structure				
3	Cantilever SSP Wall	$6,606,540	$7,287,578	$9,775,352	N
4	Anchored SSP Wall				N
5	Concrete Panel/H-Pile Wall	$5,021,858	$5,678,216	$7,800,490	Y
6	SSP/H-Pile Wall	$6,156,690	$6,863,479	$9,546,372	N
7	Concrete Gravity Wall	$5,858,952	$6,509,600	$8,900,542	N
9	Armor Fronting Dike	$6,042,291	$6,636,860	$8,621,254	N
10	Install Flood Warning System				Exists
11	Conduct Buyouts				N

Table 7
Annual Maintenance Cost
(2010$)

Alternative	Annual Maintenance	Flanking Dikes	Total Annual Maintenance
3	$6,000	$1,000	$7,000
5	$4,000	$1,000	$5,000
6	$6,000	$1,000	$7,000
7	$5,000	$1,000	$6,000

14. TRADE-OFF ANALYSIS:

14.1 Alternative 1 - No Federal Action

Advantages: There would be no additional costs to the Federal government involving this Section 205 project.

Disadvantages: The temporary Advance Measures floodwall continues to deteriorate and is costly to maintain.

14.2 Alternative 2 – Rehabilitate the Existing Flood Protection Wall

Advantages: Much of the property and material obtained and utilized under the Advance Measures projects can be used under this alternative, reducing the total project cost to the benefit of both the Federal government and the non-Federal sponsor.

Disadvantages: Implementation of this alternative will still be problematic due to some easement encroachments that may have been inherited from the original Advance Measures work that have reverted back to private property. In addition, some residents (at considerable expense) have altered, breeched or removed the Advance Measures dikes on their properties. This may result in resistance in cooperating with the Federal government and non-Federal sponsor in constructing this project.

14.3 Alternatives 3 through 7 – Construct New Flood Protection Structure

Advantages: Much of the property and some earth material utilized under the Advance Measures projects can be used under this alternative, reducing the total project cost to the benefit of both the Federal government and the non-Federal sponsor. The replaced floodwall will provide a minimum of 50 years of substantial protection to the community.

Disadvantages: Implementation of this alternative will still be problematic due to some easement encroachments that will have to be worked through. In addition, some residents (at considerable personal expense) have altered, breeched or removed the Advance Measures dikes on their properties. This may result in resistance in cooperating with the Federal government and non-Federal sponsor in constructing this project. This alternative contains options that are the costliest of any Alternative.

14.3.1 Alternative 9 – Armor the Existing Fronting Dike

Advantages: This alternative would be less inhibiting to the "viewscape" than a wall and would provide a more natural look to the shoreline, while providing habitat in the rock crevasses. This alternative would be the best at reducing wave energy attacking the shoreline.

Disadvantages: This alternative would require a very large quantity (~ 80,000 cubic yards) of armorstone, plus significant gradework. Armorstone would need to be replaced or maintained mainly because of ice scour, which would result in more maintenance issues than a wall. In

addition, because of the rapid increase in the cost of stone and fuel, this alternative has become quite costly.

14.3.2 Alternative 10 – Activate the Flood Warning System

Advantages: This alternative would be the simplest and least expensive alternative to implement, aside from the "No Action" alternative. This alternative would also be effective in saving portable property. This alternative could be combined with any recommended alternative(s) to provide more comprehensive flood risk management for the Detroit Beach community.

Disadvantages: This alternative as a stand-alone solution would provide no more protection to fixed property than the existing project affords to the residents of Detroit Beach.

Alternative 11 – Conduct Buyouts

Advantages: This alternative would be the most effective alternative in terms of removing structures and reducing damages from the prevailing flood threat.

Disadvantages: This alternative would be (by far) the most expensive alternative, at a total project cost in excess of $63 million. This is also not the non-federal sponsor's preferred alternative.

15. SELECTION OF THE RECOMMMENDED ALTERNATIVE (BASE PLAN)

Since each of the alternatives was evaluated to produce the same protection at given elevations, the selected alternative is the one providing the protection with the maximum net benefit. *Alternative 5 – Construct New Flood Protection Structure – Concrete Panel/H-Pile Wall* to 581 feet IGLD85, paired with *Alternative 10 – Activate the Existing Flood Warning System* provides the solution with the highest net benefits, which is referred to as the National Economic Development (NED) Plan. The NED Plan is also the "Base Plan" or the default "Recommended Plan". A summary of the net benefits and corresponding benefit-cost ratios for each evaluated elevation for alternative 5 are presented in Table 8 – Net Benefits of Evaluated Elevations for Alternative 5. In order to determine the maximization of net benefits, incremental average annual benefits of $1,550 were determined for a wall height of 582 feet and incremental average annual costs were determined to exceed $55,600. Thus, it was established that increases in construction costs would outweigh the additional annual benefits if the wall height were increased over 581.0'. A rough estimate for a wall height of 582.0' is provided in Table 8. The greatest average annual net benefits are achieved at a floodwall height of 581 feet.

This combined solution is selected for several reasons beyond having the greatest net benefit. Primarily, the concrete panels are durable and effective in such applications, may be tinted with color or painted and will not rust like the existing steel sheet pile. Additionally, concrete panels may be replaced relatively easily and inexpensively. The civil defense system should be maintained and activated when potential overtopping threats exist, to further assist in reducing potential property damages.

Figure 21 – Concrete Panel Wall with H-Piles in Virginia

Another consideration is the geotechnical aspect of the project site. Bedrock depth is irregular along the Detroit Beach shoreline, which makes driving sheetpile of any substantial depth difficult. By driving pile posts, the difficulty is less likely continuous, as trenches of only a few feet of depth would be dug to place the concrete panels between posts. This should make construction less difficult and faster than continuous vertical trenching or pile-driving.

The overall benefit of this solution offers multiple advantages, such as providing a quick, effective, economical and aesthetic solution. Other benefits of these types of walls are:

- Reduces permanent easement requirements – pile and panel walls can be placed on the property line and only require a few feet of access for final backfilling.

- Minimizes cuts and fills – a smaller footprint is required to install the posts and panels to minimize the cut and fill.

- Better aesthetics – facings of precast concrete panels are available that have optional form finishes and stains. Likewise, posts can vary from galvanized or stained H-piles to form finished concrete posts.

Table 8 – Net Benefits of Evaluated Elevations for Alternative 5 (2010$)

Seawall Height	Without Project Annual Damages	With Project Annual Damages (Residual Flood Damage)	Reduced Damages (Average Annual Benefits)	Total Cost	Average Annual Costs	Average Annual Net Benefits
576.6'	$2,540,000	$1,014,000	$1,526,000	$5,022,000	$263,000	$1,264,000
578'	$2,540,000	$265,000	$2,275,000	$5,678,000	$296,000	$1,979,000
***581'**	**$2,540,460**	**$1,610**	**$2,538,850**	**$7,800,490**	**$405,300**	**$2,134,550**
582'	$2,540,000	$60	$2,540,000	>$8,820,000	>$458,000	<$2,083,000

Average annual calculations are based on the FY10 interest rate of 4.375% and a 50-year project life.
* - National Economic Development (NED) Plan

Once the determination for Alternative 5 at an elevation of 581' was made, Detroit District Team members met for a risk assessment evaluation. Costs were then prepared for the selected alternative utilizing the contingencies determined through the risk assessment. **Table 9** presents a cost summary for the NED plan utilizing the risk-adjusted cost for the selected alternative.

Table 9 – Economic Summary of Alternative 5, 581' floodwall (2010$)

Total Construction Cost	$8,424,000
Interest During Construction	$294,800
Total Investment Cost	$8,718,800
Average Annual Expenditure	$432,300
Annual Operations and Maintenance Cost	$5,000
Total Average Annual Cost	$437,300
Average Annual Benefits	$2,538,900
Net Annual Benefits	$2,101,600
Benefit-Cost Ratio	5.8

Interest During Construction based on 18 month construction period at an interest rate of 4.375%
Average annual calculations are based on the FY10 interest rate of 4.375% and a 50-year project life.

The NED plan is a seawall height of 581' with a benefit-cost ratio (BCR) of 5.8 and positive average annual net benefits of nearly $2,102,000. The Base Plan (recommended alternative) of a concrete panel floodwall including the rehabilitation of the flanking clay dikes and the use of the supplemental flood warning system, will provide reliable flood protection for Detroit Beach.

Environmental review of the recommended alternative indicates that it would not result in significant adverse environmental effects, nor would it be expected to result in any significant cumulative or long-term adverse environmental effects. Adverse effects would be minor,

including short-term noise and air emissions from equipment operation; temporary turbidity from riprap placement; temporary displacement of fish; and possible destruction of any bottom-dwelling organisms in the immediate work area. Fish would return upon completion of construction and the area eventually would be re-colonized by bottom-dwelling organisms. Riprap placed along the lake bottom in front of the flood wall will provide additional support to the wall, will minimize scour in front of the wall, will dissipate some wave energy, and will provide aquatic habitat. Except for minimal encroachments water-ward necessary for project construction, project effects would be temporary.

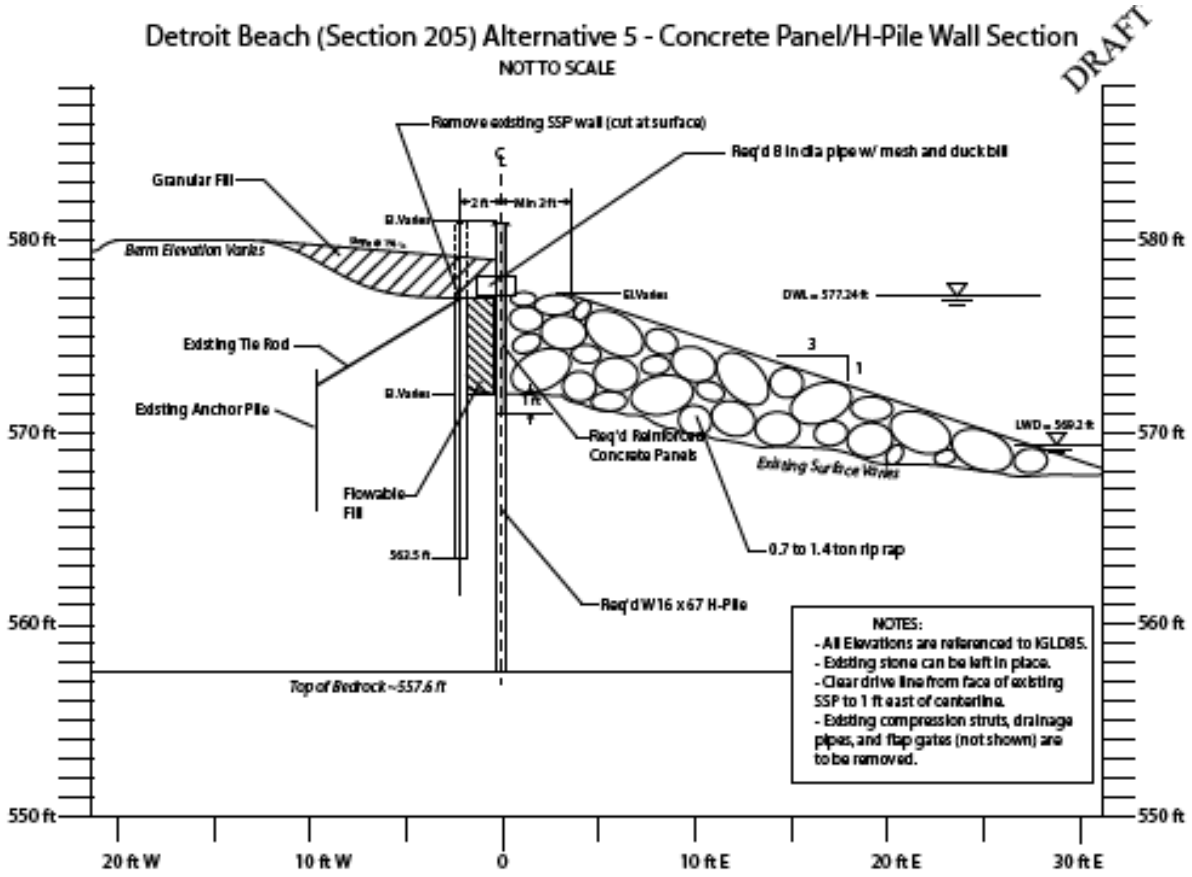
16. DESCRIPTION OF THE NATIONAL ECONOMIC DEVELOPMENT PLAN

Steel H-Piles would be driven 10 feet apart, lakeward of the existing temporary SSP. The old decayed SSP wall would be cut off at ground level. A 2 to 3-foot deep trench would be excavated (lakeward of the location of the old wall) between the piles, which would be driven 25-30 feet deep, or until bedrock. 10 foot x 5 foot x 6 inch reinforced concrete panel\s would be placed vertically in the grooves of the H-pile and stacked 2-3 panels high to an elevation of 581 feet IGLD85 to match the elevation of the existing protection.

Approximately 3000 linear feet of toe-protection riprap would be replenished. Backfill of clay and stone would be provided landward, and a reconfiguration of the diked catchment area would be constructed to drain more efficiently. Larger direct-drain tubes would be installed that would drain to the side of the reconfigured catchment area. Any direct-drain system would be fitted with a new ice-resistant flap gate design.

Additional riprap protection may also be needed on the southwest shore of Detroit Beach, to protect the pumping station along Sandy Creek, which is 1500 feet from the mouth of the river on Lake Erie. The clay dikes that were constructed in the 1950’s would be rehabilitated to meet design function and elevation requirements. Such upgrades would also involve the construction of a poured concrete wall parallel to the existing degraded earthen dike along Monrona Street that tie in to the existing Lake Erie SSP wall on the northeast corner of the existing project. This wall would extend northeast along the existing dike and tie in to higher ground as does the existing dike.

Figure 22 – Cross- Section of the Selected Alternative



16.1 Project Advantages

The greatest advantage to choosing *Alternative 5 – Construct Concrete Wall to Optimal Elevation - Concrete Panel/H-Pile Wall* is that it will provide for a significant upgrade in flood protection at a lower cost than that of other similar alternatives. In addition, Detroit Beach has easements on a significant portion of the property that will be needed to add permanent flood protection, which will reduce the overall Real Estate costs.

16.2 Real Estate

Although the Township already owns many easements, obtaining additional Real Estate as required under Section 205 policy may be problematic to the execution of the project. Many of the properties obtained during the Operation Foresight and Advance Measures works were narrower temporary easements. Some of these original property owners may not be interested in permanently selling part of their property to the Township. In addition, the State of Michigan Department of Environmental Quality has discussed the possibility of requiring mitigation (undeveloped land), if the final project extends the wall lakeward to bypass dwellings too close to the current wall.

The complete Real Estate Appendix (Appendix F) is attached to this report.

16.3 Project Design and Construction

As discussed earlier in this report, most of the construction surrounding this project will consist of installing a permanent flood protection structure, re-grading the catchment area and renourishing riprap protection along the toe of the wall. Lastly, riprap protection may be supplemented at the Sandy Creek pumping station.

The complete Design Appendix (Appendix A - Engineering Report and Appendix B - Geotechnical Information (boring data)) is attached to this report.

16.4 Operation and Maintenance (O&M)

One of the primary goals of the project is to significantly reduce the O&M costs and work for the non-Federal sponsor from what was experienced by trying to maintain temporary protection. A common problem, the lake-facing flap gates, will be replaced with duck bill covers to reduce or eliminate damage from ice flows.

Properly constructed precast concrete panel systems require little maintenance. The most probable maintenance item for the system is the neoprene joint seals, which would need to be replaced should the concrete panel need to be replaced.

16.5 Hydraulics and Hydrology

The Study of Risk and Uncertainty, pertaining to water levels and a frequency analysis, was performed to determine the return period water levels at Frenchtown Township. The results of this analysis are presented in Appendix D.

16.6 Cost Engineering

The Cost Engineering Appendix (Appendix C) shows the estimated costs with contingencies for the project. The Cost Engineering Appendix includes a narrative, cost summary table, and a detailed cost estimate. *Section 13 - COST COMPARISON OF ALTERNATIVES* shows a cost summary for each of the alternatives associated with the project.

16.7 Environmental Considerations

An Environmental Assessment (EA) of the potential impacts of constructing this project is attached to this report. The EA will be made available to the public for a 30-day review period. Following this period and a review of the comments received, a final determination will be made by the District Engineer regarding the necessity of preparing an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI) for the proposed Section 205 work at Detroit Beach.

16.8 Other Social Effects

Providing permanent flood protection also helps to reduce the risk of negative social effects at Detroit Beach, such as the spread of waterborne disease, the probability of accidents or injuries and infection. It may also reduce the occurrence of insurance fraud.

17. PLAN IMPLEMENTATION

The feasibility study is 100% federally funded up to $100,000. Costs over $100,000 are shared equally with the non-federal sponsor. Up to one-half of the non-federal share can be in the form of in-kind services. Costs for preparation of plans and specifications and construction are shared at 65 percent federal/35 percent non-federal. Once the Detailed Project Report and Recommended Alternative (NED Plan) is endorsed and approved by the non-Federal sponsor and the US Army Corps of Engineers, the Detroit District will request funding for the "Implementation Phase". This phase encompasses the development of the final plans and specifications for the recommended alternative, the cost of which is shared with the non-Federal sponsor, 65% Federal, 35% non-Federal. Upon approval of the final plans and specs, a solicitation for bid is issued for the construction of the selected alternative. Construction of the project is also cost-shared at 65% Federal, 35% non-Federal. The non-federal share of construction consists of provision of any necessary lands, easements, rights-of-way, relocations and disposal areas (LERRD). Since the value of LERRD's plus 5% cash does not equal at least 35% of the total project cost, the non-federal sponsor must contribute additional cash to equal 35%.

Cost Share Apportionment			
	Cost	Federal	Non-Federal
Study Costs (50/50)	$273,994	$100,000	
		$86,997	$86,997
Total Construction Costs (65/35)	$8,424,000	$5,475,600	$2,948,400
	$8,697,994	$5,662,597	$3,035,397

* Construction costs include risk assessment contingencies

18. SUMMARY OF COORDINATION, PUBLIC VIEWS AND COMMENTS

The work conducted with the development of this DPR has been thoroughly coordinated with the non-Federal sponsor group (Detroit Beach and Frenchtown Township officials), US Fish and Wildlife Service, the Michigan Department of Environmental Quality and the Michigan Department of Natural Resources. Detroit District personnel have walked the project site several times with representatives from the above agencies and Detroit Beach representatives to discuss issues and formulate resolutions for agreed problem areas (easements, encroachments, and wetland and nature preserve issues). Further agency coordination occurred with the execution of the Environmental Assessment, as required under NEPA.

19. CONCLUSION AND RECOMMENDATION

As described in Section 15, Alternative *5 – Construct New Flood Protection Structure – Concrete Panel/H-Pile Wall to 581 feet IGLD85*, paired with *Alternative 10 – Activate the Existing Flood Warning System*, provides the solution with the highest net benefits, which is the National Economic Development (NED) Plan, or the Base Plan.

Thus, it is determined that the best course of action for the Detroit Beach community in Frenchtown Township, Michigan, is selection of the NED plan. The NED plan is *Alternative 5 – Construct New Flood Protection Structure – Concrete Panel/H-Pile Wall to 581 feet IGLD*, combined with *Alternative 10 – Activate the Existing Flood Warning System*.

I hereby recommend that the Detroit District proceed with detailed Plans and Specifications to construct the NED Plan presented in this report. The non-Federal representative (Detroit Beach Resort Authority) has also committed to develop a formal flood warning system and evacuation plan for the community. With the high concentration of people in the community, combined with the current and anticipated growth of long-term property values at Detroit Beach, this project is proven to be justified. As such, I recommend this project be implemented as described above.

JAMES B. DAVIS Date_____
LTC, EN
Commanding