FEDERAL INTEREST DETERMINATION
CONTINUING AUTHORITY PROGRAM SECTION 205
FLOOD RISK MANAGEMENT STUDY

Chelsea Heights
Atlantic City, New Jersey

PREPARED BY:
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
PHILADELPHIA DISTRICT

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CAP SECTION 205
CHELSEA HEIGHTS
ATLANTIC CITY, NEW JERSEY

FEDERAL INTEREST DETERMINATION

1. Project Name: Chelsea Heights, Atlantic City, New Jersey, Continuing Authority Program (CAP) Section 205 Flood Risk Management Study (P2# 406513).

2. Congressional Delegation: Senators Robert Menendez and Cory Booker (NJ), Representative Frank LoBiondo (NJ-2).

3. Project Purpose and Description:

The Chelsea Heights flood risk management study area is located in Atlantic City, Atlantic County, New Jersey (Figure 1). The study area is located on the southwest side of the city between the New Jersey Intracoastal Waterway (NJIWW) and a back bay channel known as Beach Thorofare (Figure 2). The study area encompasses the entire Chelsea Heights neighborhood that lies between (clockwise) North Albany Avenue, South Boulevard, North Raleigh Avenue, and West End Avenue. The area is approximately 0.2 square miles in size and is primarily composed of low lying residential city streets. The area has historically experienced flooding problems which are increasing in frequency, duration, and intensity and are caused by the combined effects of tidal events and heavy precipitation during hurricanes and major nor'easters. The City of Atlantic City submitted a letter (Attachment) to the Philadelphia District requesting that a study be conducted to determine potential flood risk management solutions following the severe flooding which occurred during Hurricane Sandy.

Hurricane Sandy made landfall just south of Atlantic City on October 29, 2012 as a "post-tropical cyclone" with wind speeds of 90 mph. The Atlantic City tide gage recorded Sandy water level maximums as the third highest on record. The storm surge plus simultaneous spring astronomical tides resulted in extensive back bay flooding within Atlantic City and significant city-wide damages to homes, businesses, and public infrastructure. An assessment prepared by local agencies in the wake of Sandy has estimated that the storm caused $24 million in damages to private homes and $10 million in damages to public buildings.

The objectives of this determination were to identify whether there is at least one policy consistent solution of a scope appropriate for CAP to manage flood risk in this area and to determine whether further Federal interest in a feasibility study is warranted. This Federal Interest Determination was funded under Public Law (PL) 113-2, the "Disaster Relief Appropriations Act, 2013". The authority for this project is Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended. Under this authority, the USACE is authorized to plan, design, and construct small flood control projects.

The potential non-Federal sponsors for this study are the City of Atlantic City and/or the New Jersey Department of Environmental Protection.

Figure 1: Location of Atlantic City within New Jersey.

Figure 2: Location of the Chelsea Heights Study Area within Atlantic City.

4. Existing Conditions:

Atlantic City is located on Absecon Island, which is a barrier island in New Jersey located approximately 60 miles southeast of Philadelphia, PA. Absecon Island also contains the municipalities of Ventnor, Margate City and Longport Borough. Absecon Island is one of eight barrier islands that lie between the Atlantic Ocean and the salt marsh complex that borders the southern coast of New Jersey. These barrier islands are separated by inlets which connect the ocean to the inland waterways.

The Chelsea Heights study area is located within the back bay of Absecon Island. The New Jersey Intracoastal Waterway (NJIWW) is located to the southeast and the Beach Thorofare channel is located to the northwest. The NJIWW is a navigable waterway route behind the New Jersey barrier islands that is used to reduce the risk and hazards associated with open sea travel. A large tidal wetland complex, approximately 0.5 miles in area, is located directly to the southwest of the study area. A former airport facility, known as Bader Field, is located to the northeast.

Properties in the Chelsea Heights study area are predominately primary residences with some interspersed commercial and recreational structures. Of the three sides of Chelsea Heights that are exposed to open water or wetlands, only South Boulevard is partially protected from flooding by a bulkhead. An existing bulkhead runs along half of South Boulevard for approximately 1,100 feet. The remainder of South Boulevard, as well as North Raleigh Avenue and West End Avenue, are unprotected from tidal storm events (Photographs 1 and 2).

Photograph 1: View looking northeast along the unprotected section of South Boulevard.

Photograph 2: View looking northwest along North Raleigh Avenue.

All of the buildings in the study area are susceptible to flooding from a 1% annual chance event according to the Atlantic City Flood Insurance Rate Maps (FIRM). Most of the structures in the area have first floor elevations that are at, or slightly above, the existing grade. Flooding in this low-lying area has been historically problematic during hurricanes and nor'easters. During storm events, rising water levels in the back bay have come over the existing banks of the NJIWW, the Beach Thorofare, and the wetland complex. Roadway elevations are approximately 3 to 5 ft NAVD 88 in the project area, which allows water that enters Chelsea Heights to quickly inundate larger areas. Water elevations in the back bay during Hurricane Sandy were approximately 7.7 ft NAVD 88 and the area was largely inundated.

Ocean water levels recorded at the National Oceanic and Atmospheric Administration (NOAA) Atlantic City, NJ Tide Gage (Station ID 8534720, located at Steel Pier) serve as the most complete record of historical storm surge conditions in the area. The top ten highest water levels recorded since the Atlantic City Tide Gage was established in 1911 are listed in Table 1. No adjustment to water surface elevation has been made for sea level rise or fall in this table.

Water levels recorded at the Atlantic City Tide Gage have been used to estimate an annual exceedance probability for water levels within the study area for the purpose of developing a relationship between historical damages and recurrence interval. However, actual water surface elevations are likely to differ between the open ocean and back bay depending on factors such as wind, wave set-up, wave set-down, and storm track.

Table 1: Top Ten Highest Water Levels at Station 8534720

Rank	Elevation (Ft NAVD 88)*	Storm	Return Period (Years)	Date
1	6.37	Nor'easter	50	12/11/1992
2	6.23	Great Atlantic Hurricane	41	9/14/1944
3	6.15	Hurricane Sandy	36	10/29/2012
4	5.96	Hurricane Gloria	27	9/27/1985
5	5.85	Halloween Nor'easter	23	10/31/1991
6	5.83	Ash Wednesday Storm	22	3/6/1962
7	5.83	Hurricane Belle	22	8/9/1976
8	5.63	Great Appalachian Storm	16	11/25/1950
9	5.38	Nor'easter	11	3/29/1984
10	5.21	Nor'easter	9	10/25/1980

*Adjusted from MHHW to NAVD 88 in feet.

Two United States Geological Survey (USGS) tide gages are located along the back-bay in the vicinity of Chelsea Heights (USGS 01410600 Absecon Channel at Atlantic City NJ and USGS 01410560 Inside Thorofare at US Route 40 at Atlantic City NJ). These gages have a much shorter period of record than the NOAA-operated Atlantic City Tide Gage and were not in operation during the majority of the most destructive storms impacting the Atlantic City area, with the exception of Hurricane Sandy. During Hurricane Sandy, water levels at gages 01410560 and 01410600 were estimated to peak at 7.6 ft NAVD 88 and 7.8 ft NAVD 88, respectively. Comparing these water levels to coastal storm flood frequencies calculated by FEMA using the Advanced Circulation Hydrodynamic Surge (ADCIRC) Model, Hurricane Sandy is estimated to have an annual exceedance probability between 0.020 and 0.023. Because of the magnitude of destruction that occurred as a result of Hurricane Sandy, the elevations recorded by the USGS gages along the back bay served as a guide for the minimum level of protection to be provided by the proposed project.

Numerous buildings in the vicinity are classified as Repetitive Loss (RL) properties according to the National Flood Insurance Program (NFIP). This means that they have had two or more flood claims over $1,000 paid by the NFIP within any 10 year period. During Hurricane Sandy, approximately 52 buildings in the study area were substantially damaged, with repair costs exceeding $4,000,000.

5. Problems and Opportunities:

There is significant flood risk and associated damages in the study area due to development on flat, low-lying topography with exposure to tidal flooding from Absecon Island back bay. The likelihood of future storms with intensities similar to Sandy, along with sea level rise, is placing this section of Atlantic City at increasing risk for more frequent flooding. Given these conditions, flood damages predicted for the 50 year planning horizon in the Chelsea Heights study area are likely to be substantial. Opportunities for flood risk management through a combination of structural and non-structural measures exist in the study area.

6. Plan Formulation:

This initial appraisal of Federal interest was performed in accordance with Appendix F (Amendment #2) of the Planning Guidance Notebook (ER-1105-2-100). This study involved reviewing existing conditions, communicating with local stakeholders, proposing an alternative, preparing a preliminary design, and conducting a cost and benefits analysis to determine the feasibility of a Federal flood risk management project for the Chelsea Heights study area. A site inspection was performed on 11 February 2014 with the project delivery team (PDT).

For the purposes of this Federal Interest Determination, one structural measure to manage flood risk in the study area was evaluated. Further investigation under the CAP Section 205 will address other possible alternatives. These alternatives will include structural and non-structural measures. Coordination with the regulatory agencies and National Environmental Policy Act (NEPA) compliance will also occur during further study.

The existing Federal Hurricane and Shore Protection Project (HSPP) (Brigantine Inlet to Great Egg Inlet, Absecon Island, NJ) that is located on the ocean side of the island does not provide flood risk management benefits to the Chelsea Heights study area. The back bay flooding solutions and associated benefits which were examined during this initial appraisal are located outside of the HSPP project area.

7. Alternative Plan:

The alternative plan presented in this section provides a basis for the cost estimate and economic analysis discussed in Section 8. This design is at a preliminary level of detail, using data collected from the City of Atlantic City and the PDT site inspection. A more detailed analysis will be conducted should the project proceed to the Feasibility Phase.

The alternative consists of bulkhead construction along portions of South Boulevard and West End Avenue and sand berm construction along Raleigh Avenue and another portion of West End Avenue (Figure 3). The bulkhead would be constructed with 30 feet long, steel PZ22 sheet pile and have a total length of approximately 2,335 feet. The sand berm would be approximately 3,187 feet long and would have a crest height of 5.5 feet above the existing grade and a crest width of 10 feet. The top of the bulkhead and the berm would be at elevation 8 ft. NAVD 88 and help to prevent overland coastal flooding of streets and structures during hurricanes and nor'easters. Existing land elevations at Bader Field are approximately 8 ft. NAVD, which prevents overland coastal flooding on the northeast side of Chelsea Heights. Therefore, the design does not include any protective structures on that side of the study area.

This alternative is not expected to result in any major environmental impacts. The bulkheads would be constructed along existing roadways that have been previously disturbed and are not likely to have high ecological sensitivity. The sand berms would be constructed in the transition area between the existing roadways and the adjacent tidal wetlands. Impacts associated with the construction process, such and noise and air quality issues, would be temporary in nature. Any impacts from alternatives considered during the feasibility study would be fully evaluated in the associated NEPA document.

Figure 3: Location of proposed steel sheet pile bulkhead and sand berms.

8. Economic Assessment:

This preliminary economic assessment examined the potential economic benefits of constructing a flood risk management project that would reduce flood risk to public health, safety, and property in the vicinity of Chelsea Heights associated with coastal flooding from storm events. This economic assessment was conducted at a preliminary level of detail using data provided by Atlantic City and FEMA. A more detailed analysis will be conducted should the study proceed to the feasibility phase. This assessment follows USACE guidance for estimating National Economic Development benefits as contained in ER 1105-2-100, April 2000, Appendix E, Section III – Flood Damage Reduction. All benefits are estimated in annual terms. All costs and benefits are in fiscal year (FY) 2014 price levels.

Project Costs

The project construction cost and annual costs of the proposed improvement plan, as designed for a 50-year storm event, are shown in Tables 2 and 3. The cost estimate considered planning, engineering, and design (PED), project construction, and construction management (S&I). The cost of the project over a 50 year period of analysis is annualized, with payment occurring at the end of the year immediately preceding the base year. Construction costs are estimated to be $8,797,856. Annual costs were determined using the FY 2014 Federal interest rate for water resources projects of 3.50 percent.

Table 2: Alternative Plan Cost Estimate

Description	Estimated Amount*	Federal	Non-fed
Planning, Engineering and Design (PED)	$588,128	$382,283	$205,845
Construct 2,335 LF Steel Sheet Pile Bulkhead and 3,187 LF Sand Berm	$7,841,713	$5,097,113	$2,744,600
Construction Supervision &Administration (S&A)	$368,015	$239,210	$128,805
Total Estimated Amount**	$8,797,856	$5,718,606	$3,079,250

*A 20% contingency was applied to cost estimates.
**LERRD costs will be developed in a Real Estate Plan during the continuation of the feasibility study.
(Feasibility study costs are not included in table. Total feasibility study costs are estimated at $600,000 and includes IEPR costs estimated at $110,000.)

Table 3: Project Costs

Annualized Cost Calculation	**Proposed Alternative**
First Cost of Construction*	$8,797,900
Capital Recovery Factor (CRF)	0.04263371
Average Annual Costs	$375,100
Interest During Construction (IDC)	$6,900
Operation and Maintenance Cost (O&M)	$1,000
Total Annual Cost of Proposed Alternative	**$382,000**

*2014 Price Levels

Project Benefits

The primary category of benefits for this project is reduction of inundation damages. Due to lack of accurate historical damage data and time constraints, these benefits were based on the expected annual damages prevented that are reflected through the development of a damage-frequency model and weighted at 2014 price levels. First, tax assessed structure value data was sampled for the delineated project area. Next, inundation maps at the 5, 10, 25, 50 and 100 year storm frequencies were developed and analyzed to identify susceptible structures with 95% confidence given the over-lap of inundation depths per storm frequency. Structures outside this confidence interval were neglected from the damage pool to minimize uncertainty in damage assumptions. A generic depth-damage curve was developed to analyze the percentage of damage with uncertainty to be assigned on a per structure basis. A probability distribution was developed to fit the tax assessment sample data. Then, each susceptible structure was assigned a value based off the probability distribution and distributed through monte-carlo simulations. Probability modeling, statistical goodness-of-fit, and hypothesis testing were processed using the @Risk version 6 software package. After applying the depth-damage relationship to the output data, damages per storm frequency were generated creating the damage-frequency relationship for existing conditions of the project area. Table 4 describes the output relationship and the expected annual damages. Results are sensitive to the zero-damage frequency that has been applied in the economic analysis.

Table 4: Expected Annual Damages–Existing Conditions

Frequency (Year Event)	Frequency Interval	Damages*	Average Damages*	Weighted Damages*
100		$1,917,591.80		
	0.0100		$1,835,429	$18,350
50		$1,753,266.61		
	0.0200		$1,623,063	$32,460
25		$1,492,860.10		
	0.0600		$1,225,502	$73,530
10		$958,143.44		
	0.1000		$749,988	$75,000
5		$541,831.72		
	0.8000		$270,916	$216,730
1		$0		
Expected Annual Damages = $416,070				

*2014 Price Levels

This analysis focused only on the physical damages to private and public buildings. Not included are non-physical damages, location benefits, intensification benefits, or employment benefits. These additional benefit categories will be further evaluated should the study proceed to the feasibility phase. Table 5 lists the respective benefits for the single alternative with values rounded to the thousands place holder and the benefit-to-cost ratio (BCR).

Table 5: NED Benefits and BCR

Calculation of NED Annual Benefits	**Proposed Alternative**
Annual Without-Project Damages	$416,000
Annual With-Project Damages	$15,000
Annual Benefits	**$401,000**
Annual Costs	**$382,000**
Annual Net Remaining Benefits	$19,000
Benefit-to-Cost Ratio	**1.05**

*2014 Price Levels

Annual With-Project Damages

Because the proposed project will be designed to protect against the 50-year flood, the annual damages reduced by the project will be equal, at the limit, to the difference between the estimated annual damages and the expected benefits at each frequency interval analyzed. The annual with-project damages are then calculated to be the difference between the expected annual damages and the expected annual benefits summed at each evaluated flood frequency interval. When rounded to the nearest hundreds place holder, the total is $15,000. The slight difference of $3,350 between the weighted damages for the 100-year with project residual frequency event displayed in Table 4 of $18,350 as compared to the annual with project residual damage estimate of $15,000 in Table 5, reflects a normal statistical variation to be expected with the application of the @Risk statistical model.

9. Study Findings:

This Federal Interest Determination has identified at least one potential solution to reduce the coastal flooding risk to public health, safety, and property in the vicinity of Chelsea Heights in Atlantic City, NJ. The economic analysis of the identified alternative, steel sheet pile bulkhead and sand berm construction, has resulted in a benefit-to-cost ratio that is greater than one.

10. Recommendations:

It is in the Federal interest to pursue a feasibility study for flood risk management at Chelsea Heights. The study should be performed under the authority of CAP Section 205.

11. Independent External Peer Review (IEPR):

NAP has coordinated with the USACE National Planning Center for Coastal Storm Risk Management to discuss a risk-based decision analysis. At this initial level of investigation, it will be assumed that Type 1 IEPR will occur. Upon continuation of the feasibility study and further gathering of information, a risk-based decision analysis will be prepared to determine whether or not IEPR is applicable. Should it be concluded that IEPR is not applicable, a waiver will be requested at that time. The costs associated with a Type I IEPR have been included with the estimated feasibility costs.

12. Views of the Non-Federal Sponsor:

It is anticipated that the non-Federal sponsor will be the City of Atlantic City or the New Jersey Department of Environmental Protection (NJDEP), or some combination thereof. Both the City and the NJDEP support further investigation for the flood risk management for Chelsea Heights. This has been demonstrated through coordination of this initial investigation with the City of Atlantic City, and existing design work completed by the city.

13. Views of Federal and State Agencies and Interested Organizations:

The views of Federal and state agencies will be solicited during the feasibility study.

14. Conclusion/Determination of Federal Interest:

Based on the cost estimates and economic analysis provided in Section 8 of this report, there are sufficient benefits to warrant Federal interest in the continuation of a feasibility study. In order to proceed with the study, the Federal government and the non-Federal sponsor will need to execute a Feasibility Cost Sharing Agreement (FCSA) which will designate the funding responsibilities for completion of the study. The costs of the feasibility study above the first $100,000 (full-Federal) would be cost shared 50/50 between the Federal government and the non-Federal sponsor.

ATTACHMENT

REQUEST FOR ASSISTANCE LETTER FROM THE CITY OF ATLANTIC CITY

CITY OF ATLANTIC CITY

Lorenzo T. Langford
Mayor

Telephone: (609) 347-5400
Fax: (609) 347-5638

November 6, 2013

Peter R. Blum, PE
Chief, Planning Division
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107

Re: Request for Assistance for Areas Impacted by Hurricane Sandy
U.S. Army Corps of Engineers Continuing Authorities Program
City of Atlantic City, Atlantic County, New Jersey

Dear Mr. Blum:

This letter requests assistance from the U.S. Army Corps of Engineers (Corps) under the Continuing Authorities Program (CAP).

Atlantic City is an internationally known resort with over 24 million visitors annually and almost 40,000 year-round residents. The City was severely damaged by Hurricane Sandy with hundreds of substantially damaged buildings, infrastructure destroyed and the City was shut down for seven days resulting in over $215 million in lost revenues.

The Atlantic County Hazard Mitigation Plan documents that the Annual Loss Estimates in Atlantic City for the period of 1993 to 2008 from flooding was $4,027,013 and the total county wide loss was $5,862,000 for the same period. A total of 69% of the county-wide loss occurred in Atlantic City. These projects will help to reduce flooding in the Atlantic City and thereby reduce flood insurance losses, where the majority of the County's flood claims originate.

The City of Atlantic City is requesting assistance in evaluating alternatives for flood risk management to prevent future flood damage in our community. We understand that if the Corps determines there to be a Federal interest, a non-Federal sponsor must agree to cost-share the feasibility study and construction. We respectfully request that the Corps evaluate the following projects which are presented in order of priority.

1. North Inlet Flood Control Improvements.

The North Inlet Project includes projects at Massachusetts Avenue and Historic Gardner's Basin. The Massachusetts Avenue area floods on a frequent basis due to a deteriorated bulkhead, sea level rise,

and the naturally low elevation of the area. This neighborhood was severely impacted by Hurricane Sandy. The solution includes a combination of installing a new bulkhead and a stormwater pump station. By installing these improvements, the flooding of this area will be reduced, thereby reducing flood damage to the City's infrastructure and homes in the area.

Gardner's Basin is a City Park and a major destination in the City of Atlantic City located on New Hampshire Avenue. The Gardner's Basin project also includes bulkheading a section of Gardner's Basin where no bulkhead exists and severe erosion occurs. This bulkhead will protect critical public infrastructure and reduce erosion and flooding.

The Massachusetts Avenue Stormwater System serves an area of Massachusetts Avenue and Carson Avenue in the Bungalow Park Neighborhood of Atlantic City. This project includes 160 lf of vinyl/timber bulkhead, a storm water pump station, 50 lf of piping and two inlets. The Massachusetts Avenue project has been the topic of many public meetings. The Gardner's Basin portion of this project includes 190 lf of vinyl/timber bulkhead to protect public property from flooding and erosion.

This project will protect public infrastructure (Massachusetts Avenue and Gardner's Basin) and protect the life and property of those who live in this neighborhood. Projected Project Cost - $1,073,120.

2. Chelsea Heights Flood Control Improvements.

The Chelsea Heights Neighborhood is located on the west side of Atlantic City and is bounded by US Route 40/322 and the Intracoastal Waterway. The Chelsea Heights Flood Control Improvements will help to address many repetitive loss and substantially damaged properties, sea level rise, and the naturally low elevation of the area. This project will also protect public infrastructure (City streets, South Boulevard Promenade, Chelsea Heights Recreational Center and waterfront walkways) and protect the life and property of those who live in this neighborhood. This area sustained significant damage during Superstorm Sandy.

The solution consists of the installation of new bulkheads and earthen berms. By installing these improvements the flooding of this area will be reduced; thereby, reducing flood damage to the City's infrastructure, South Boulevard Promenade, Chelsea Heights Recreational Complex, Chelsea Heights School, public walkways, and homes in the area. Hence, this project will promote disaster resistant development and reduce the possibility of damage and losses due to flooding.

More specifically, the project includes the construction of 1,000 ft. of bulkhead adjacent to Beach Thorofare adjacent to City property along with the installation of stormwater systems and check valves to help control flooding in the neighborhood. These improvements will stabilize the South Boulevard Promenade, a City open space parcel that has been eroding into the Intracoastal Waterway. These improvements will also help to protect South Boulevard, a City street, and the Chelsea Heights neighborhood. In addition, an earthen berm with a walkway is proposed along Raleigh Avenue from the new Bulkhead to West End Avenue. Projected Project Cost - $4,785,000.

According to FEMA records of flood insurance claims there are at least two severe repetitive loss properties and 20 repetitive loss properties that will be affected by this project. Two properties in this area were substantially damaged by Superstorm Sandy.

3. Sunset Avenue Flood Control Improvements.

The Sunset Avenue Bulkhead Improvements will address a deteriorated bulkhead, sea level rise, and the naturally low elevation of the area. This area sustained significant damage during Superstorm Sandy. The solution consists of the installation of new bulkheads. By installing these improvements the flooding of this area will be reduced; thereby, reducing flood damage to the City's infrastructure, the Atlantic City Boat House, Pete Pollitto Field, public walkways, City streets and homes in the area. According to FEMA records of flood insurance claims there are at least seventeen repetitive loss properties that will be affected by this project.

The Sunset Avenue Flood Control Improvements includes 2,650 lf of new bulkhead serving an area from Albany Avenue to Morris Avenue, as well as the street end of Brighton, Iowa, California, Arizona and Texas Avenues in the Chelsea Neighborhood of Atlantic City. The Sunset Avenue Bulkhead is in an advanced state of decay and is a priority project for the City. This project will protect critical public infrastructure (street ends, City Parks, City streets and water front walkways) and protect the life and property of those who live in this neighborhood. These bulkheads are in disrepair and the total deterioration of the structure has already occurred at Texas Avenue. The street is eroding into the waterway at Texas Avenue. Projected Project Cost - $5,282,000.

We look forward to working with you in the future. Should you need additional information, please do not hesitate to contact Jim Rutala at 609.743.0354.

Sincerely,

Lorenzo T. Langford
Mayor
City of Atlantic City

cc: Jane L. Jablonski, USACE
Erik J. Rourke, USACE
Ron Cash, Business Administrator
William England, PE, City Engineer
James M. Rutala, Rutala Associates