

**Flood Damage Reduction  
Preliminary Alternatives  
for the Belle Haven Watershed  
Fairfax County, Virginia**

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**March 2008**

# Purpose of Meeting

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- **Provide overview of preliminary flood damage reduction study that was conducted**
  - Provide information on the 5% concept level alternative plans, costs and benefits
- **Inform and involve the communities**
- **Receive valuable input including resident's issues and concerns so we can include them in the process**

# Agenda

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- **Presentation by the U.S. Army Corps of Engineers (Corps)**
  - Background Information
  - Previous Studies
  - Flood Damage Reduction Study Results
- **Next Steps**
- **Summary/Conclusions**
- **Question and Answer Period**

# Background

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- **Area has a history of flooding problems**
- **Average elevation is less than 3 feet above mean high tide**
- **Most recent flood event was Hurricane Isabel – September 2003**
  - Flood elevation = 9.6 ft (NGVD29)
  - Over 200 structures damaged

# Hurricane Isabel Flooding Elevation 9.6 ft (NGVD29)

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# Previous Flood Studies

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- **1963 – Hurricane Survey (by Corps of Engineers)**
  - Investigated constructing a 12,400-foot levee along east side of GW Parkway up to elevation 15 NGVD29
  - Was not cost effective so construction was not recommended
- **1978 – Immediate Action Plan (by PBQ&D)**
  - Preliminary flood investigation
  - Recommended culvert at Belle View Blvd and installation of floodwall, tide gates and pumping station be investigated further

# Previous Flood Studies (Cont.)

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- **1980 – New Alexandria Flood Relief Study (by Urban Engineering and Assoc)**
  - This detailed study was a follow-up to 1978 study
  - Proposed solution included improvements to channels, installation of tide gate and pump station, and installation of extensive storm sewer system in areas north of I Street
  - Fairfax County implemented recommended solutions



# Previous Flood Studies (Cont.)

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- **2006 – Floodplain Mapping for Belle Haven Watershed (*by Corps*)**
  - Purpose of study was to develop up-to-date floodplain mapping that incorporated the probability of both storm surge and riverine flooding occurring jointly
  - Study showed 100-yr joint probability flood levels range from 11.1-11.9 feet

# 100 Year Floodplain\* Based on Storm Surge Elevation 11.2 ft (NGVD29)



\*100 year flood is the flood that has a 1% chance of occurring in any given year

# Current Study

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- **Initiated 2006/Completed Feb 2008 – Flood Damage Reduction Analysis for Belle Haven Watershed (*by Corps*)**
  - Fairfax County requested that Corps conduct a study to evaluate various flood damage reduction alternatives to determine if they are technically feasible
  - Conducted under technical services program; was not a Corps project study authorized by Congress
  - County asked Corps to conduct preliminary economic analysis to determine if a project might meet the federal economic justification requirements
  - Evaluated alternatives to protect entire study area, and New Alexandria/Belle View independently

# Project Goals, Objectives and Opportunities

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- **Goal**

- Provide adequate flood damage reduction measures that are technically feasible and financially prudent for the safety of the New Alexandria and Belle View Communities

- **Objectives**

- Examine various alternatives for reducing flood damages – primarily from storm surge
- Minimize risk to the community
- Minimize environmental impacts
- Incorporate needs/desires of the community for flood damage reduction as much as possible

# **Preliminary Alternatives**

# Elevation Data

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- Many low openings/first floors: elevation **6-11 feet** (do not have elevations for all structures)
- 50 year (2% chance) storm surge: **9.6 feet**
- 100 year (1% chance) storm surge: **11.2 feet**

# Preliminary Alternatives

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- **Plan 1a** – Levee/floodwall surrounding entire study area to el. 11'
- **Plan 1b** - Levee/floodwall surrounding entire study area to el. 12'
- **Plan 2a** – Levee/floodwall surrounding New Alexandria to el. 11'
- **Plan 2b** - Levee/floodwall surrounding New Alexandria to el. 12'
- **Plan 3a** – Flood Proof New Alexandria by filling basements and adding living space
- **Plan 3b** – Flood Proof New Alexandria by raising houses and adding living space
- **Plan 4** – Flood Proof Belle View area

# FLOOD WALLS

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# FLOOD WALLS

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- **Can be a steel sheetpile driven into the ground with a concrete cap or a concrete T-wall**
- **Pros**
  - Take up less space than a levee
- **Cons**
  - More expensive than a levee
  - Visual impact; façade can match surrounding architecture
  - Reduces access; may need closure structures at roadways
  - Require regular maintenance
- **Potential Issues**
  - Soils must be suitable for foundation
  - Interior drainage – may need pump station(s)
  - Complex design – seepage, water pressure

# LEVEES



# LEVEES

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- **Earthen berm covered with grass**
- **Pros**
  - Cost less than a floodwall
  - Can blend with landscape
- **Cons**
  - Take more space due to width
  - Visual impacts
  - May need closure structures at roadways
  - Require regular maintenance
- **Issues**
  - Soils must be suitable
  - Interior drainage – may need pump station(s)
  - Complex design – seepage, water pressure

# CLOSURE STRUCTURES

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# Preliminary Costs and Benefits are Based on 5% Level Design

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- **Total Project Costs include:**
  - Design, construction management, escalation and contingency
  - Does not include cost to acquire necessary lands (does include few buy-outs as needed)
- **Annualized Benefits include:**
  - Prevention of future damages to structures, contents, vehicles
  - Prevention of future emergency services and cleanup costs
  - Prevention of temporary housing/food costs
- **To meet requirements for Corps' projects, benefit-to-cost ratio (BCR) > 1.0; however, due to limited funding, only those with the highest BCR's are being included in the Corps' budget**

# Plan 1a/b - Levee/Floodwall Alternative



# Plan 1a

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- 5% concept plan assumes top of levee/floodwall **at elevation 11.0' (1.4' above 50-year profile)**; no risk and uncertainty analysis was conducted; cannot say will provide “50-year protection”)
- Approx. 6600 feet long; 3000' levee and 3600' floodwall; 3-5 feet above ground
- Levee approx. 40' wide at base plus 15' easements on both sides
- 2 closure structures – along Belle Haven Road and Belle View Blvd

## Plan 1a (cont.)

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- **Current alignment minimizes impacts to wetlands**
- **Current alignment impacts trees**
- **Interior drainage calculation performed to determine pumping capacity to keep 50-year ponding elevation below 7.5'**
  - will need pumping station on west channel
  - no pump needed for east channel; will need to operate existing tide gate and pump station to keep water from backing up into New Alexandria

# Plan 1a - Levee/Wall 11'

## Estimated Costs and Benefits

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- **Construction Cost = \$11.7M**
- **Operation and Maintenance Cost = \$150,000 annually**
- **Benefit-to-Cost Ratio (BCR) = 2.34**

# Plan 1b

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- 5% concept plan assumes top of levee/floodwall **at elevation 12.0' (0.8' above 100-year profile**; no risk and uncertainty analysis was conducted; cannot say will provide “100-year protection”)
- Same description as Plan 1a except will be 4-6 feet above ground

# Plan 1b - Levee/Wall 12'

## Estimated Costs and Benefits

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- **Construction Cost = \$12.7M**
- **Operation and Maintenance Cost = \$150,000 annually**
- **BCR = 2.52**

# Plan 2a/b - Levee/Floodwall Alternative



## Plan 2a

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- 5% concept plan assumes top of levee/floodwall **at elevation 11.0' (1.4' above 50-year profile)**; no risk and uncertainty analysis was conducted; cannot say will provide “50-year protection”)
- Approx. 5700 feet long; 2400' levee and 3300' floodwall; 3-5 feet above ground
- Levee approx. 40' wide plus 15' easements on both sides
- 5 closure structures

## Plan 2a (cont.)

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- **Current alignment impacts trees**
- **Interior drainage calculation performed to determine pumping capacity to keep 50-year ponding elevation below 6’;**
  - will need pumping stations on west and east channels; may be able to modify existing pump station on west channel
- **Abandoned structure / land along I Street would need to be purchased**

# Plan 2a - Levee/Wall 11'

## Estimated Costs and Benefits

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- Construction Cost = **\$13.1M**
- Operation and Maintenance Cost = **\$150,000 annually**
- BCR = **1.16**

# Plan 2b - Levee/Wall 12' Estimated Costs and Benefits

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- Construction Cost = **\$14.8M**
- Operation and Maintenance Cost = **\$150,000 annually**
- BCR = **1.15**

## Plan 3a – Flood Proofing New Alexandria Basement Fill & Addition

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- Fill-in basement and provide addition
- Relocate heating/cooling equipment, water heater and electric panel to 1<sup>st</sup> floor
- Level of Protection
  - Varies with each home



## Flood Proofing Plan 3a

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- **Voluntary program**
- **Occupant/Community impact during construction – concept plan assumes residents would need to relocate during construction**
- **Other structures, vehicles, infrastructure, etc. are not protected**

## Plan 3a - Fill Basement/Addition Estimated Costs and Benefits

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- **Construction Cost = \$4.9M**
- **Operation and Maintenance Cost = \$0M**
- **BCR = 0.96**

## Plan 3b – New Alexandria Raise, Basement Fill & Addition

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- Raise first floor above 100-yr elevation, fill basement, and provide addition
- Relocate heating/cooling equipment, water heater and electric panel to 1st floor
- Level of Protection
  - 100-yr + 18 inches



## Flood Proofing Plan 3b

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- **Voluntary program**
- **Occupant/Community impact during construction – concept plan assumes residents would need to relocate during construction**
- **Other structures, vehicles, infrastructure, etc. are not protected**

## Plan 3b - Raise, Fill Basement, Addition Estimated Costs and Benefits

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- **Construction Cost = \$25.5M**
- **Operation and Maintenance Cost = \$0M**
- **BCR = 0.82**

## **Plan 4 – Flood Proof Belle View Area**

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- **Purchase Belle View Condo Basement Units (J-Units)**
  - J-units begin to flood when water reaches approx. elev. 8'
  - First floor elevation is approx. 11'
  - Fill J-units and basements; relocate utilities and storage above ground
  - No damages would be incurred until water reaches elev. 11'
- **Fill Belle View Townhouse basements; relocate utilities and storage above ground**
- **Construct ring wall around shopping center to elevation 10.8 feet**



Figure 5.8: Belle Haven Watershed  
Belle Haven Shopping Center  
Ring Wall Alternative Plan (Part of Plan 4)

## Plan 4 – Flood Proof Belle View Estimated Costs and Benefits

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- **Construction Cost = \$7.25M**
- **Operation and Maintenance Cost = assumed \$0 for analysis (but additional bldgs would require maintenance)**
- **BCR = 0.1**

# Summary of Preliminary Alternatives

<b>Alternative Plan</b>	<b>Estimated Cost</b>	<b>Benefit-Cost-Ratio</b>
<b>1a - Levee/Wall entire study area; elev. 11'</b>	<b>\$11.2M</b>	<b>2.34</b>
<b>1b - Levee/Wall entire study area; elev. 12'</b>	<b>\$12.7M</b>	<b>2.52</b>
<b>2a - Levee/Wall New Alexandria; elev. 11'</b>	<b>\$13.1M</b>	<b>1.16</b>
<b>2b - Levee/Wall New Alexandria; elev. 12'</b>	<b>\$14.8M</b>	<b>1.15</b>
<b>3a - Flood Proof New Alex.; fill basements</b>	<b>\$4.9M</b>	<b>0.96</b>
<b>3b - Flood Proof New Alex; raise houses</b>	<b>\$25.5M</b>	<b>0.82</b>
<b>4 - Flood Proof Belle View Area</b>	<b>\$7.25M</b>	<b>0.1</b>

# Next Steps

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- **Concept level plans and report have been completed**
- **Further investigation/design is needed for the various flood damage reduction plans**
- **Some of preliminary BCRs currently meet federal economic justification requirement, however, funds are extremely limited for federal projects**
- **County is considering options on how to proceed with further study/design of project**

# Critical Future Tasks Related to a Flood Damage Reduction Project

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- **Involve public**
- **Conduct survey to obtain first floor and low opening elevations for all structures**
- **Evaluate higher levels of protection and conduct risk and uncertainty analysis**
- **Further evaluate interior drainage and pumping station needs**
- **Conduct foundation investigations (poor soils is concern)**
- **Coordinate with National Park Service**
- **Evaluate environmental resources and impacts**

# Discussion