PUBLIC INFORMATION MEETING
Rahway River Basin Flood Risk Management Feasibility Study

COL Paul E. Owen
District Engineer
U.S. Army Corps of Engineers
New York District

New Jersey
Department of Environmental Protection
Non-Federal Sponsor

29 May 2014

US Army
Corps of Engineers

Photo By The Cranford Chronicle

Rahway River Basin Flood Risk Management Feasibility Study - Outline

- Background/History
- Flood Risk Management
- Alternative Formulation Process
- Alternatives Description
- Cost Estimates
- Economics Analysis Overview
- Questions?

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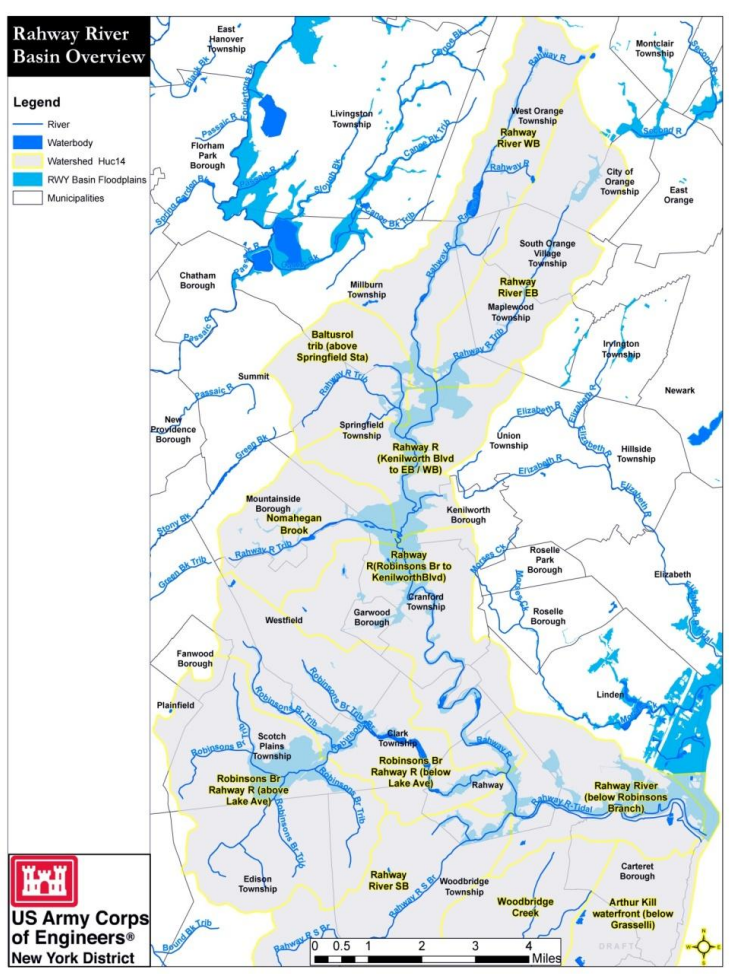
Rahway River Basin Flood Risk Management Study
Study Area



- The Rahway River Basin has a drainage area of approximately 82 square miles and encompasses Essex, Union, and Middlesex counties.
- The Rahway River consists of four branches: West Branch and East Branch originate in West Orange. They merge in Millburn to form the Rahway River which travels through Springfield, Cranford, and Clark into Rahway. The river receives water from Robinson's Branch and South Branch in the City of Rahway and enters into Linden and Carteret before flowing into Arthur Kill.
- Study focus areas are in Township of Cranford and City of Rahway along Robinson's Branch.

Rahway River Basin Flood Risk Management Study
Background

- The most recent damaging floods of record within the Rahway River Basin were Tropical Storm Floyd in September 1999, the April 2007 Nor'easter, and Hurricane Irene in August 2011.
- 1999: USACE completed a Reconnaissance Report recommending a feasibility study to develop flood risk management alternatives within the Rahway River Basin.
- 2002: Feasibility Study Cost Share Agreement executed between the USACE and New Jersey Department of Environmental Protection (NJDEP) as the Non-federal sponsor. (50% Fed and 50% Non-Fed)
- 2006: Completion of an Initial Screening Report identifying Cranford Township and a portion of the City of Rahway along Robinson's Branch having greatest potential for Federal Interest.

Rahway River Basin Flood Risk Management Study

Hurricane Irene– August 2011

Rahway River Basin Flood Risk Management Study

Hurricane Irene – August 2011

Rahway River Basin Flood Risk Management Study

Flood Risk Management (FRM)

- No Flood Risk Management project can eliminate the risk of flooding. Given a long enough period of time, most projects will experience an event that is larger than the event which they were designed.
- Flood Risk Management (FRM) projects can only reduce the frequency and/or severity of flooding and provide additional time to respond.
- Physical features are only a single component of a flood risk management approach. Insurance, zoning and Emergency Action Plan (EAP) are some other important aspects of Flood Risk Management.
- Communication of accurate and timely information about the risk of living in a flood prone area is critical and best implemented at the local level.
- Flood safety is a shared responsibility and a collaborative approach is required to effectively manage the risk of flooding and to save lives. (Corps, FEMA, State, County, Local Gov., Emergency Personnel, Residents)

Rahway River Basin Flood Risk Management Study
USACE Alternative Formulation Process for Feasibility Studies

- Identify Flood Risk Management (FRM) Alternatives
- Screen FRM Alternatives for Effectiveness
- Evaluate Alternatives
  - Compare reduced damages of proposed alternatives against Without Project conditions at different flood stages.
  - Perform Initial evaluation of Environmental Impacts
- Select & Optimize Plan – Establish Tentatively Selected Plan (TSP)
- Determine National Economic Development Plan (NED)

Rahway River Basin Flood Risk Management Study

USACE Alternative Formulation Process – Cont.

No alternative's analysis is complete until the following evaluations are conducted:

1. Hydrology & Hydraulics - Completed
   - Model existing and improved conditions of the project area, including flows and water surface elevations
   - Perform Risk and Uncertainty Analysis
2. Cost Estimates - Completed
   - Screening based on quantities and cost estimates
3. Economic Justification for Plan Selection - Completed
   - Benefit Cost Ratio >1, maximum net benefits
4. Environmental Impacts
   - Cultural Resources, HTRW, Biological and Habitat considerations
5. Social Consequences
   - Community impacts (e.g. displacement, recreational feature/business loss or gains)

Rahway River Basin Flood Risk Management Study
Township of Cranford & the City of Rahway

- **Township of Cranford:**
  - Completed work includes surveys, existing conditions analyses including hydrology and hydraulics, initial environmental and cultural resources investigations.
  - Formulation of ten flood risk management alternatives for Cranford and upstream communities.
  - Completed cost estimate for all the alternatives.
  - Completed economic analysis and developed Benefit to Cost Ratios (BCR).

- **City of Rahway along Robinson's Branch:**
  - Completed work includes surveys, existing conditions analyses including hydrology and hydraulics, initial environmental and cultural resources investigations.
  - The Corps met with the City of Rahway officials to discuss possible alternatives for the Robinson's Branch.
  - Formulating flood risk management alternatives for the Robinson's Branch

Photo By The Cranford Chronicle

Alternatives

Rahway River Basin Flood Risk Management Feasibility Study

Summary of Damages, Benefits, and BCRs

Alternative	Flood Damages		Annual Benefits	Total First Cost	Total Annual Cost	Net Excess Benefits	BCR
	Without Project	With Project					
1. Channel work in and modification to Lenape Park	$9,459,920	$6,857,920	$2,602,000	$91,123,800	$4,395,000	-$1,785,200	0.59
2. Channel work and modification to the Nomahegan levees and Lenape Park	$9,459,920	$6,856,170	$2,603,750	$90,816,400	$4,371,900	-$1,768,200	0.60
3. Channel work dredging Orange Reservoir	$9,459,920	$4,724,560	$4,735,360	$230,303,500	$11,532,400	-$6,797,000	0.41
4. Channel work and new outlet at Orange Reservoir	$9,459,920	$5,018,850	$4,441,070	$68,871,200	$3,343,800	**$1,097,300**	**1.33**
5. Channel work and South Mountain Regional Detention Basin	$9,459,920	$2,830,780	$6,629,140	$164,005,100	$8,229,400	-$1,600,300	0.81
5a. Channel work and South Mountain Regional Detention Basin with relocation of Brookside Dr.	$9,459,920	$2,830,780	$6,629,140	$174,019,275	$8,655,100	-$2,025,900	0.77
6. South Mountain Regional Detention Basin	$9,459,920	$3,948,960	$5,510,960	$108,472,500	$5,202,500	**$308,500**	**1.06**
6a. South Mountain Regional Detention Basin with relocation of Brookside Dr.	$9,459,920	$3,948,960	$5,510,960	$115,724,023	$5,527,000	-$16,000	0.99
7a. Nonstructural - 10-yr floodplain in Cranford	$9,459,920	$8,472,270	$987,650	$15,543,000	$667,400	**$320,300**	**1.48**
7b. Nonstructural - 100-yr floodplain in Cranford	$9,459,920	$7,248,320	$2,221,600	$188,344,100	$8,157,800	-$5,946,200	0.27

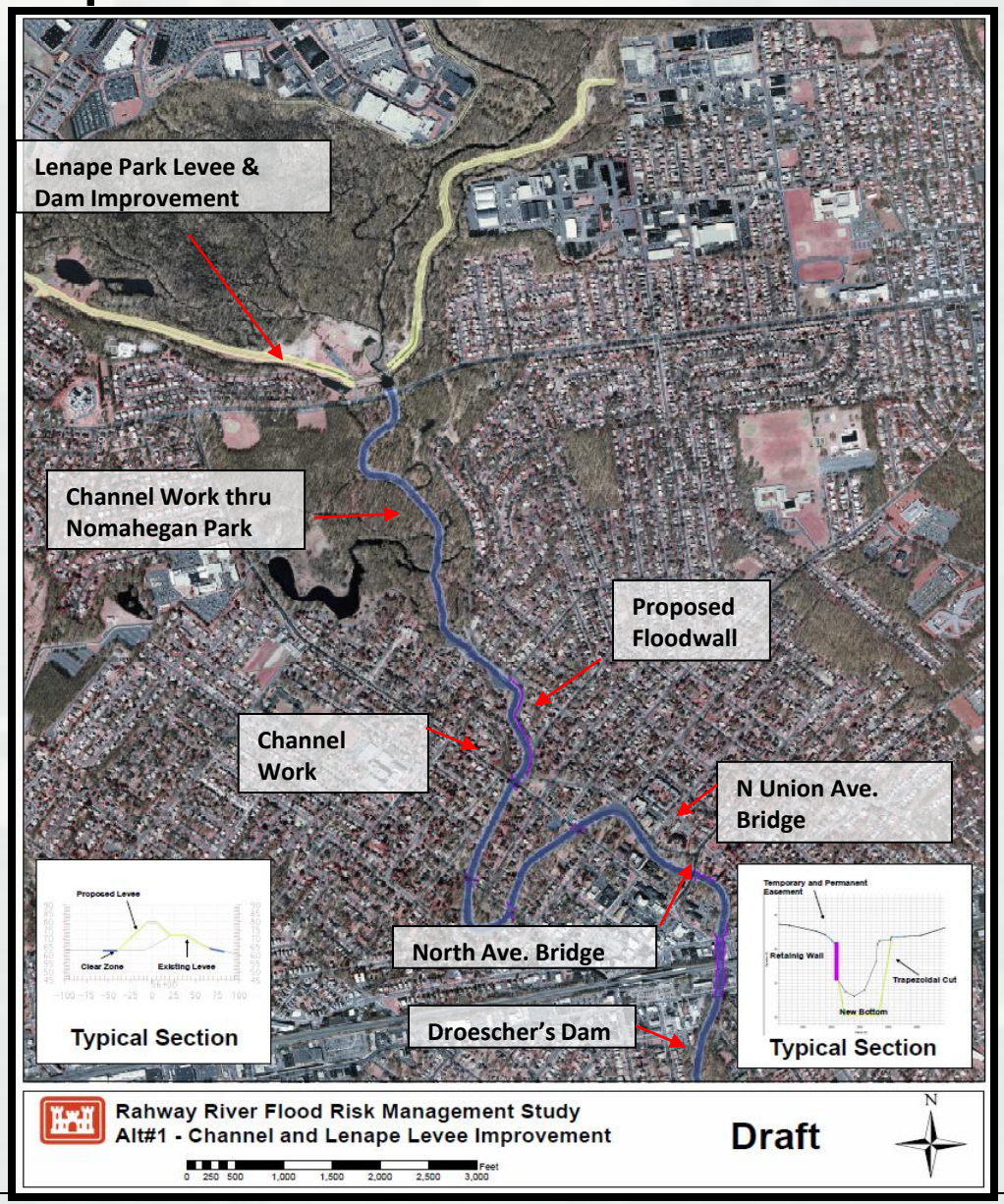
Rahway River Basin Flood Risk Management Feasibility Study – Alternatives (Cranford)

- Alt. 1 - Lenape Park Detention Basin with Channel Improvements
- Alt. 2 - Lenape Park Detention Basin, Nomahegan Park Levee Modification with Channel Improvements
- Alt. 3 - Channel Improvements and Dredging of Orange Reservoir
- Alt. 4 - Channel Improvements and minor modification to Orange Reservoir
- Alt. 5 - South Mountain Dry Detention Basin and Channel Improvements
- Alt. 5a – Modified South Mountain Dry Detention Basin and Channel Improvements (relocation, road work, bridge)
- Alt. 6 - South Mountain Dry Detention Basin (stand alone)
- Alt. 6a – Modified South Mountain Dry Detention Basin (relocation, road work, bridge)
- Alt. 7a – Non-Structural Plan 10-year floodplain
- Alt. 7b – Non-Structural Plan 100-year floodplain

Rahway River Basin Flood Risk Management Study
Alternative #1: Lenape Park Detention Basin & Channel Improvements

- Description:
  - Modification Lenape Park dam/levee system. Approximately 9,500 ft of levee will be raised by 6 ft.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.
- This plan has a 1% chance of annual exceedance (100 yr) in Cranford Township and a minimal reduction in water surface elevations (WSEs) for towns downstream of Cranford.
- Potential Environmental Considerations:
  - Rahway River Parkway/North Cranford/Union County Park System Historic District
  - Wetlands
  - Green Acres
  - Riverine and Riparian Habitat

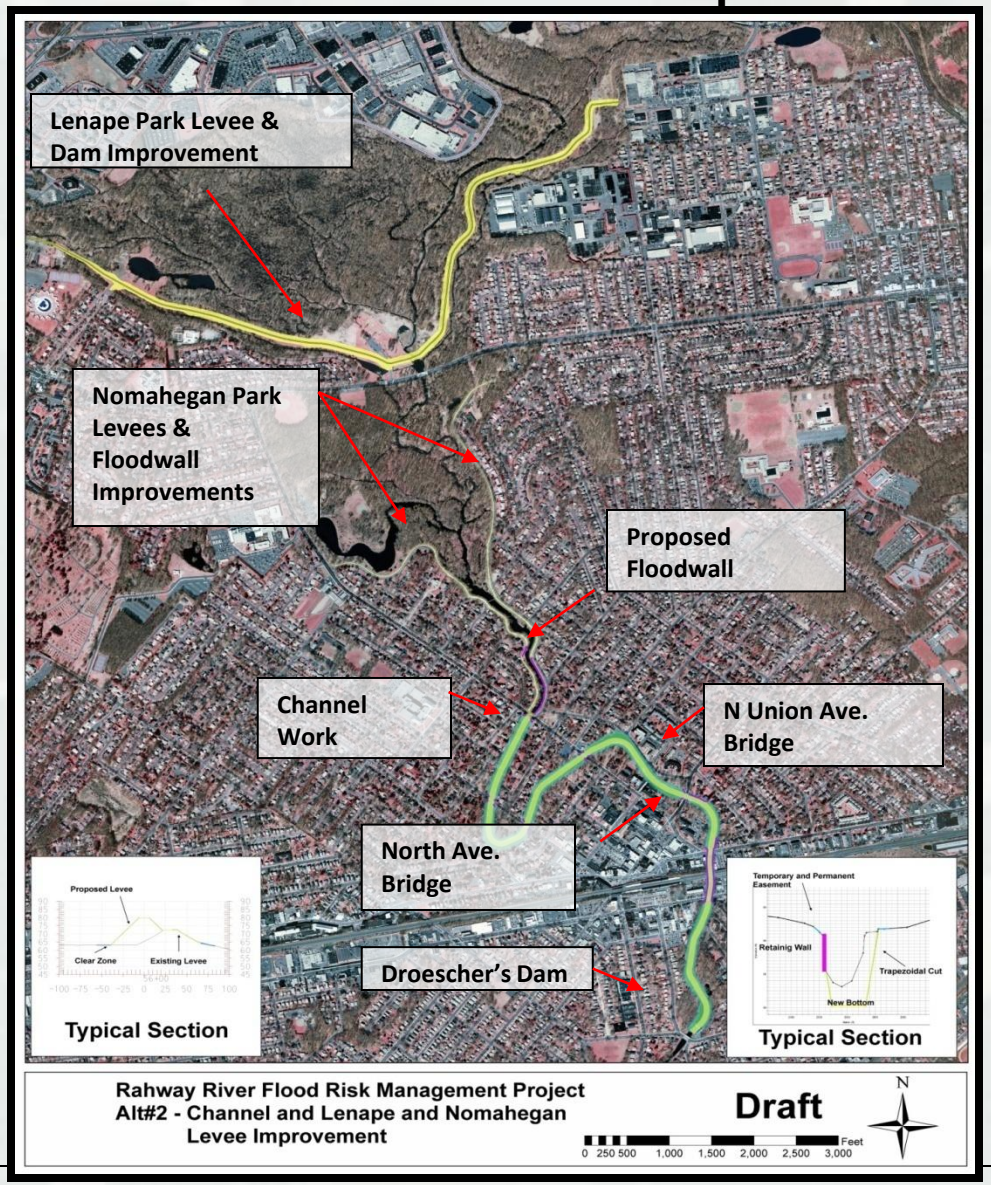
Rahway River Basin Flood Risk Management Study
Alternative #1: Lenape Park Detention Basin and Channel Improvements



Rahway River Basin Flood Risk Management Study
Alternative #2: Lenape Park Detention Basin and Nomahegan Park Levee Modifications and Channel Improvements

- Description:
  - Modification Lenape Park dam/levee system. Approximately 9,500 ft of levee will be raised by 6 ft.
  - Modification to Nomahegan levees, raising approximately 9,300ft of levee and adding approximately 900 ft of floodwalls.
  - Approximately 9,700 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.
- This alternative is likely to contain the 1% chance of annual exceedance flood (100yr event) in Cranford Township.
- Potential Environmental Considerations:
  - Rahway River Parkway/North Cranford/Union County Park System Historic District
  - Wetlands
  - Green Acres
  - Riverine and Riparian Habitat

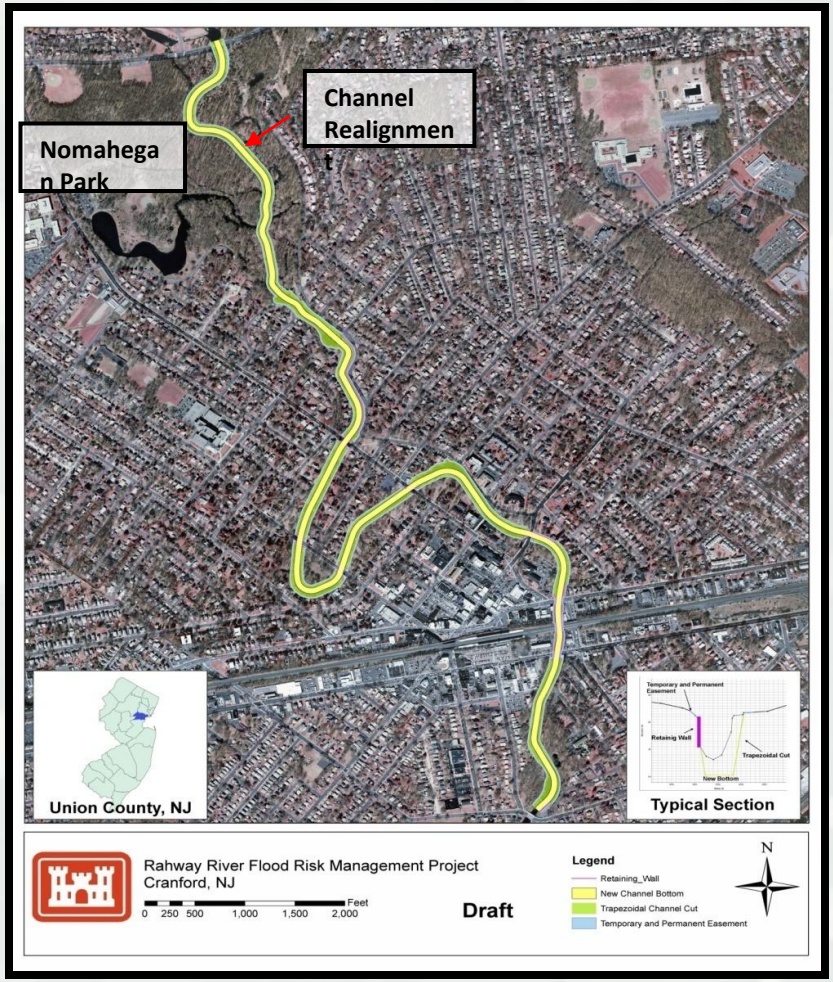
Rahway River Basin Flood Risk Management Study
Alternative #2: Lenape Park Detention Basin and Nomahegan Park Levee Modifications and Channel Improvements

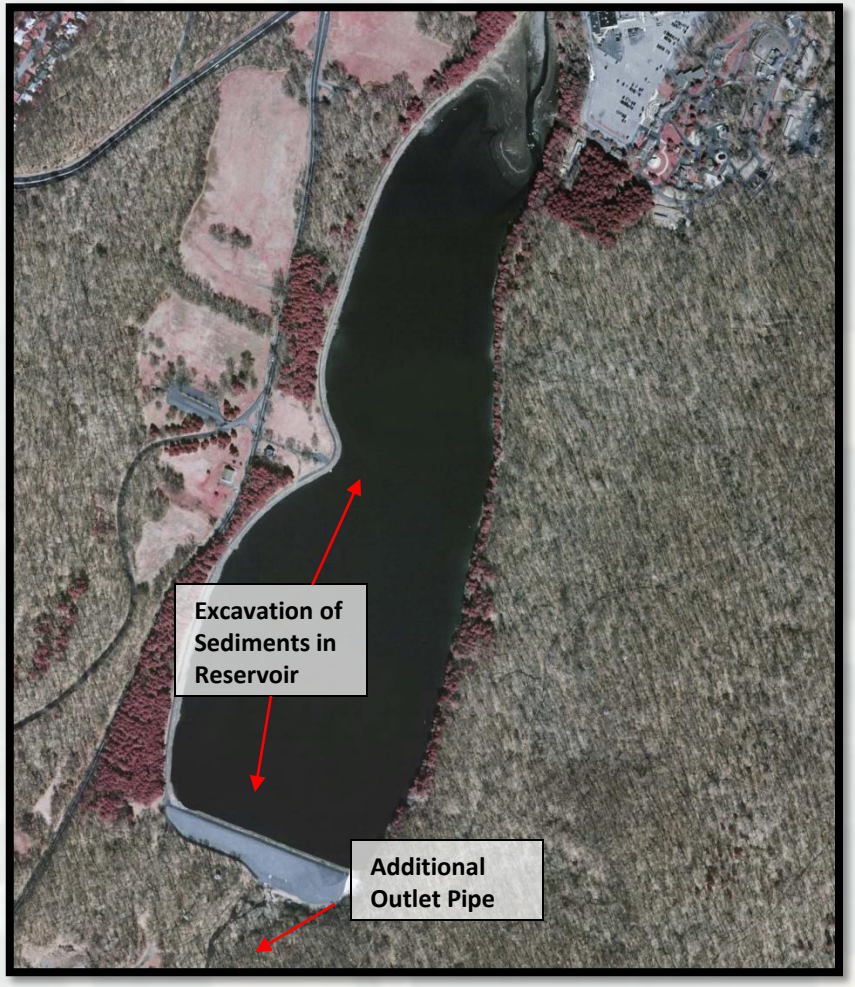


Rahway River Basin Flood Risk Management Study
Alternative #3: Channel Improvements and Deepening Orange Reservoir

- Description:
  - Dredging Orange Reservoir to increase storage capacity and add outlets.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.
- This alternative is likely to contain the 1%-2% chance of annual exceedance flood in the Cranford Township.
- Potential Environmental Considerations:
  - Rahway River Parkway/North Cranford/Union County Park System Historic District
  - Wetlands
  - Green Acres
  - Aquatic and Riparian Habitat

Rahway River Basin Flood Risk Management Study
Alternative #3: Channel Improvements and Deepening Orange Reservoir





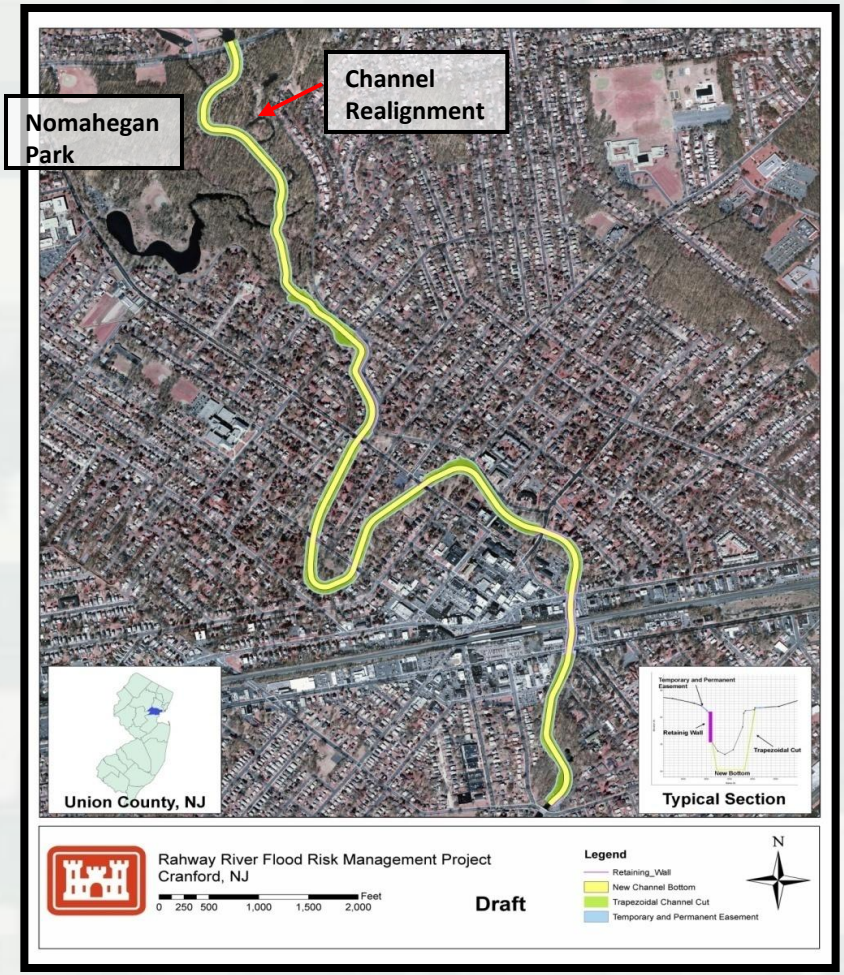
Rahway River Basin Flood Risk Management Study
Alternative #4: Channel Improvements and Modifying Orange Reservoir Outlet

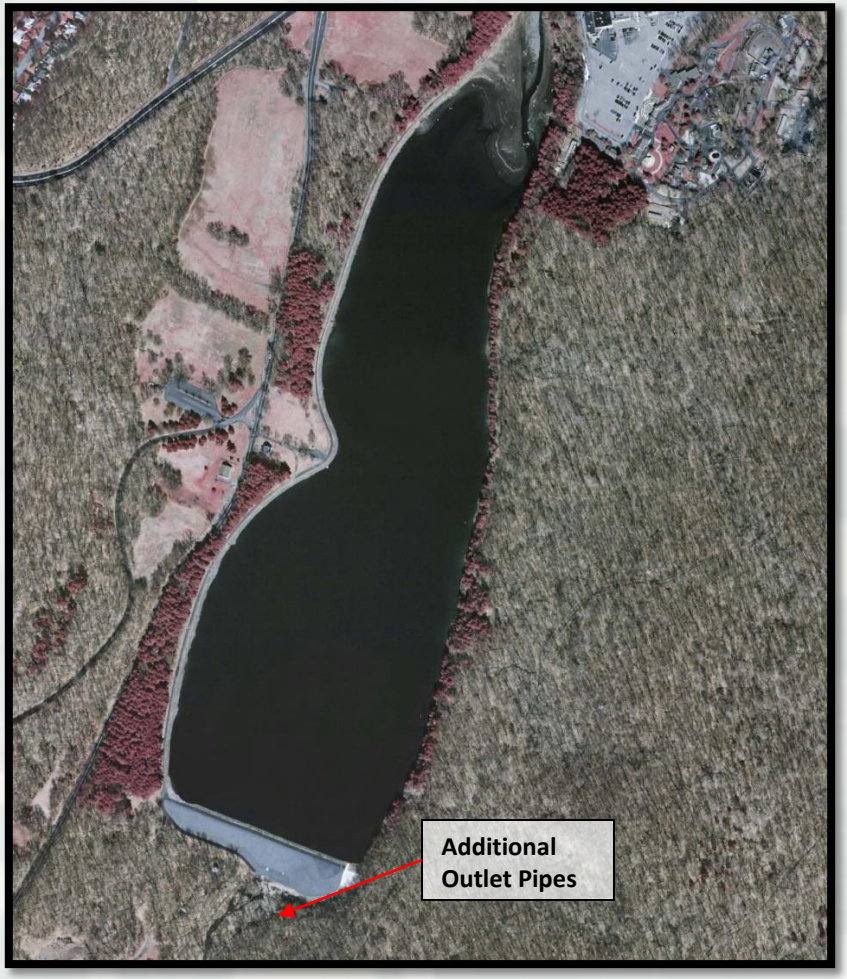
- Description:
  - New outlet 2- 30” pipes at Orange Reservoir, with manual operation.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher’s and Hansel Dam.
  - Utility relocation.
- This alternative is likely to contain the 1%-2% chance of annual exceedance flood in Cranford Township. The flow detention capacity of the Orange Reservoir will mitigate the increase in flow conveyance capacity obtained by deepening and widening the channel.
- Potential Environmental Considerations:
  - Rahway River Parkway/North Cranford/Union County Park System Historic District
  - Wetlands
  - Green Acres
  - Aquatic and Riparian Habitat

*Events	Time
Drawdown	2 days
Re-fill - (25 yr event)	30 hrs
Re-fill - (1 yr event)	One week
Maximum re-fill	Two weeks

*Drawdown and refill depth = 15ft.

Rahway River Basin Flood Risk Management Study
Alternative #4: Channel Improvement and Modifying Orange Reservoir Outlet





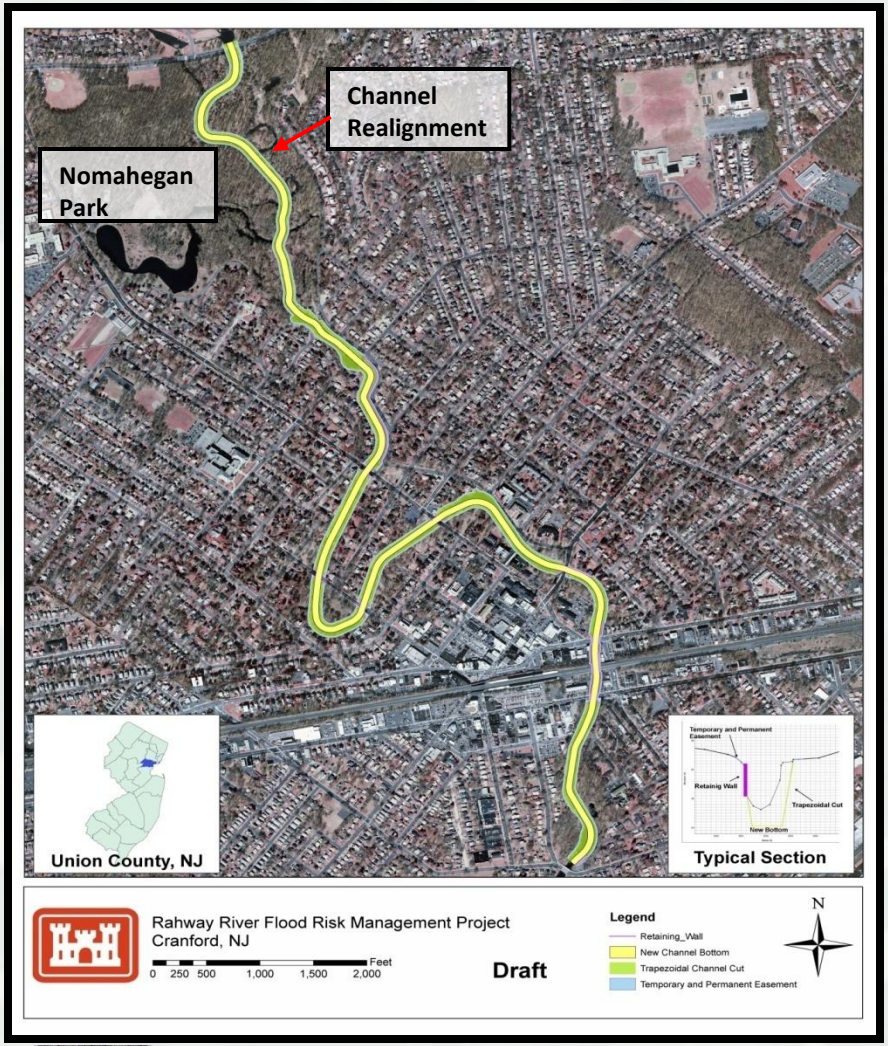
Rahway River Basin Flood Risk Management Study Alternative #5: Channel Improvement with South Mountain Reservoir (dry detention basin)

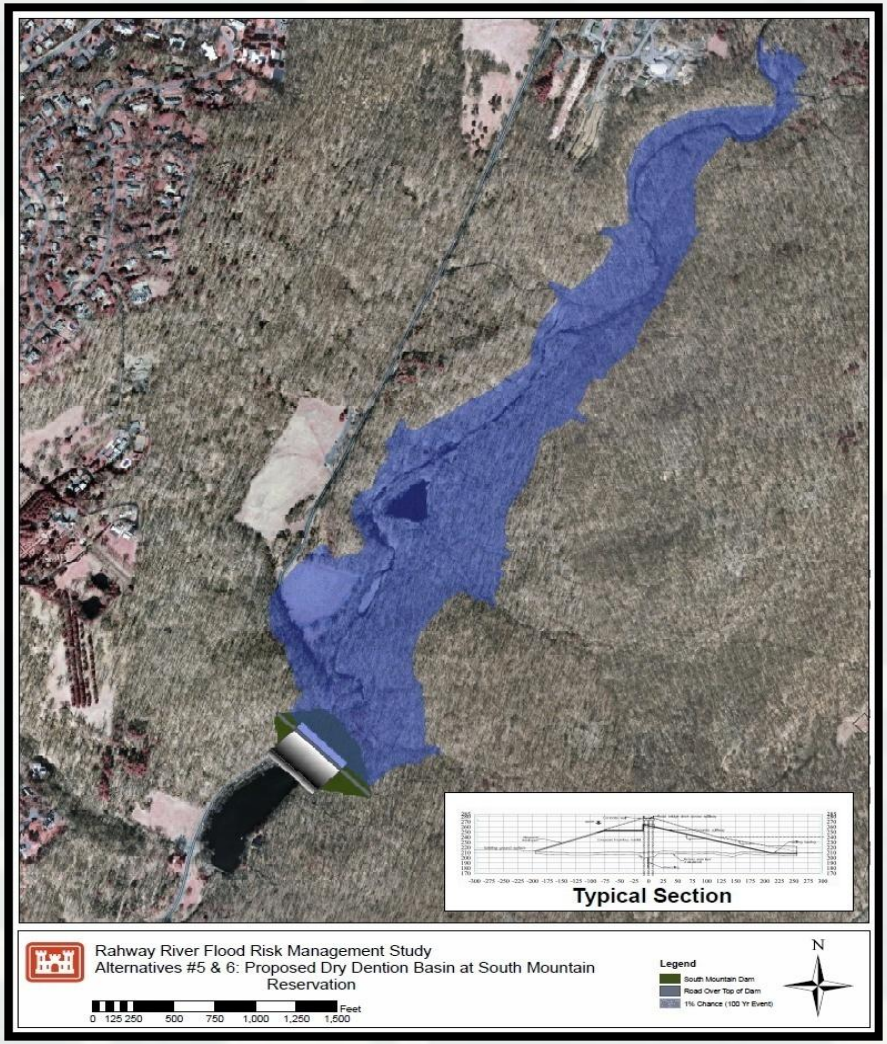
- Description:
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township
  - Two bridge replacements
  - Removal of Droescher's and Hansel Dam
  - Utility relocation
  - This plan includes a new dry detention structure in South Mountain Reservation just upstream of Campbell's Pond. The structures will be approximately 810 ft long by 75 ft high.
  - A steel truss maintenance bridge across the spillway of the dam.

Annual Chance	Storage Capacity (acre-ft / Mgal)	Drawdown Time (days)	Impacted Area (acre)
100.0% (1yr)	265 / 85	0.25	25
10.0% (10yr)	750 / 245	0.75	45
2.0% (50yr)	1500 / 490	1.25	70
1.0% (100yr)	2000 / 650	1.50	80
2.0% (500yr)	2350 / 765	1.75	90

- This alternative is likely to contain the 1% chance of annual exceedance flood in Cranford Township. Additional benefits to municipalities upstream.
- Potential Environmental Considerations:
  - Rahway River Parkway/North Cranford/Union County Park System Historic Districts/South Mountain Reservation Historic District
  - Wetlands
  - Green Acres
  - Aquatic, Riparian and Upland Forest Habitat

Rahway River Basin Flood Risk Management Study
Alternative #5: Channel Improvement with South Mountain Reservoir

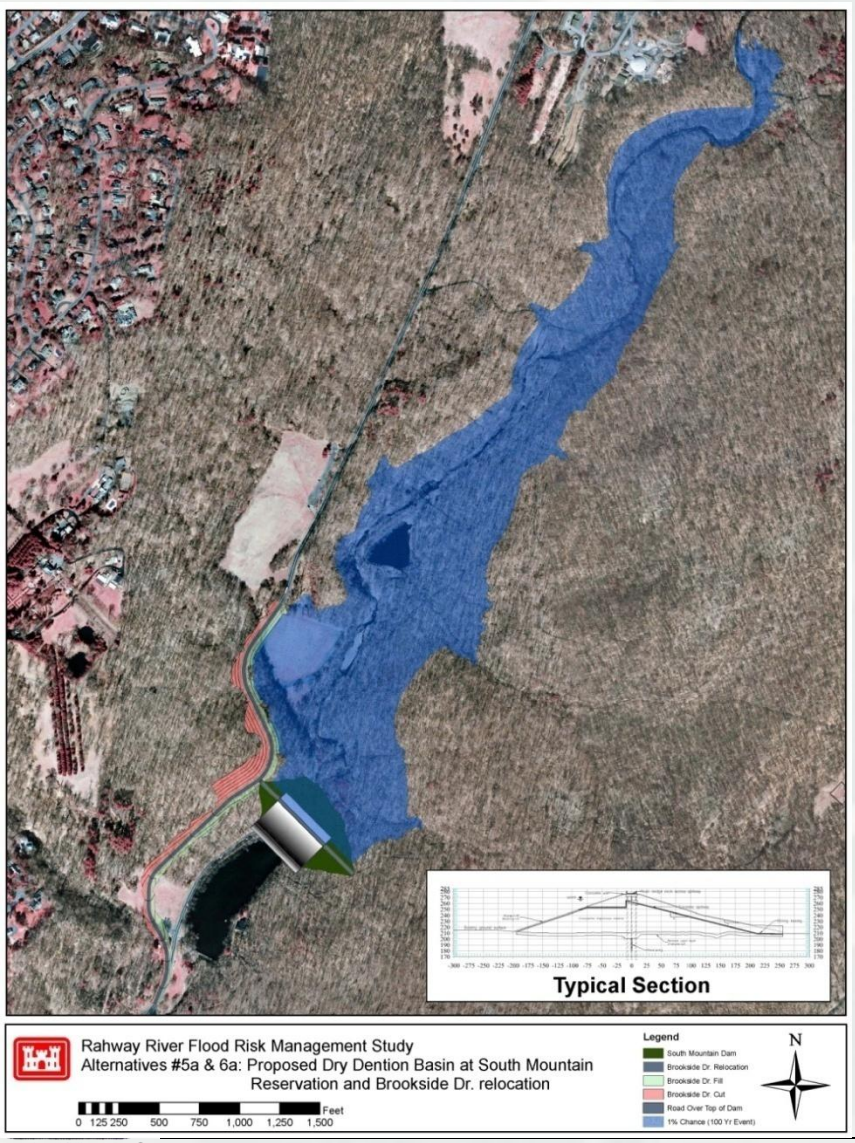




Rahway River Basin Flood Risk Management Study
Alternative #5a: South Mountain Detention Basin (relocation, road and bridge modifications) and Channel Improvements

- Description
  - ► Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township
  - ► Two bridge replacements
  - ► Removal of Droescher's and Hansel Dam
  - ► Utility relocation
  - ► This plan includes a new dry detention structure in South Mountain Reservation just upstream of Campbell's Pond. The structure will be approximately 810 ft long by 75 ft high.
  - ► Relocation of approximately 3,000 ft of Brookside Drive and a steel truss maintenance bridge across the spillway of the dam.
- The alternative is likely to have a 1% chance of annual exceedance (100-yr event) in Cranford Township.
- Potential Environmental Consideration
  - ► Rahway River Parkway/North Cranford/Union County Park System Historic Districts/South Mountain Reservation Historic District
  - ► Wetlands
  - ► Green Acres
  - ► Aquatic, Riparian and Upland Forest Habitat

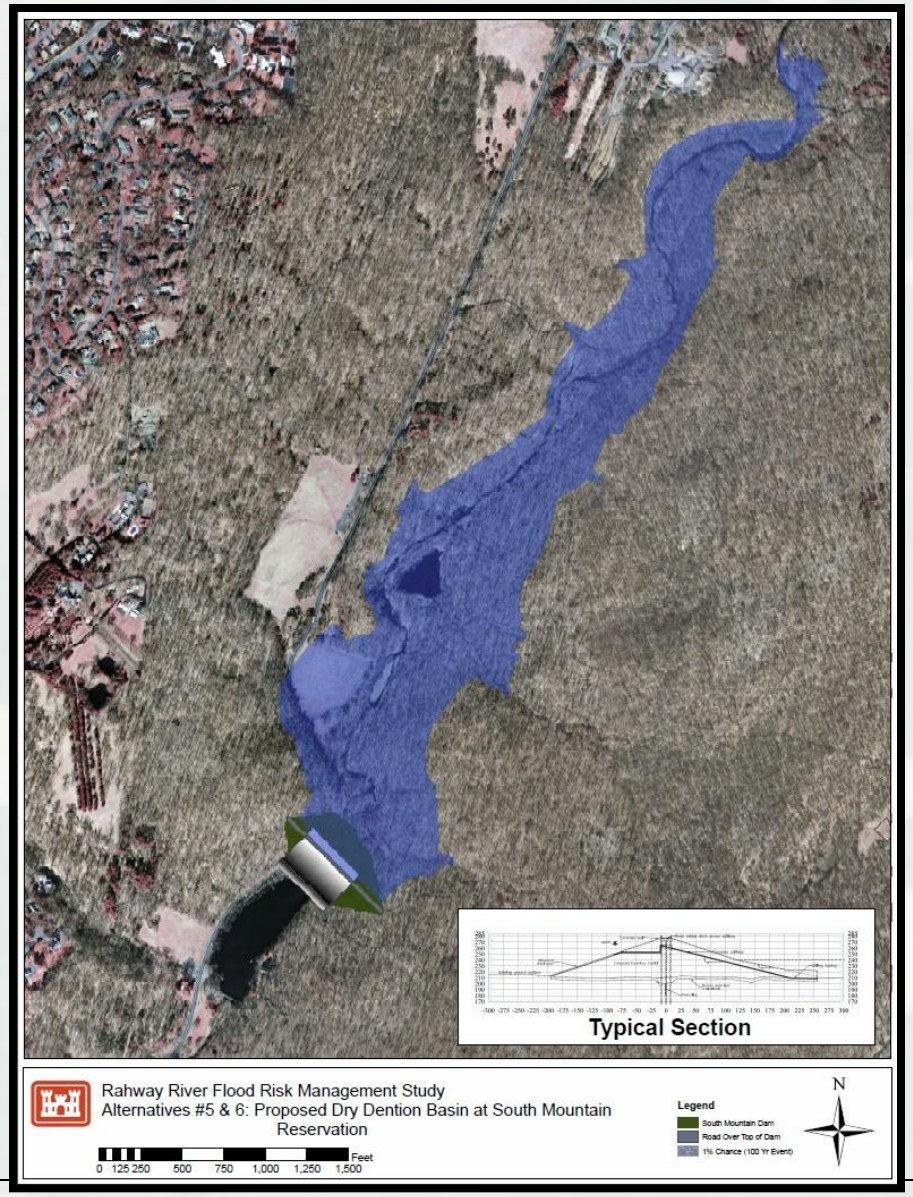
Alternative #5a: South Mountain Detention Basin (relocation, road and bridge modifications) and Channel Improvements



Rahway River Basin Flood Risk Management Study
Alternative #6: South Mountain Reservoir Standalone

- Description:
  - This plan includes a new dry detention structure in South Mountain Reservation just upstream of Campbell's Pond. The structure will be approximately 810 ft long by 75 ft high.
  - A steel truss maintenance bridge across the spillway of the dam.
- This alternative is likely to contain the 2% chance of annual exceedance flood (50yr-event) in Cranford Township. Additional benefits to municipalities upstream.
- Potential Environmental Considerations:
  - South Mountain Reservation Historic District
  - Wetlands
  - Green Acres
  - Aquatic and Upland Forest Habitat

Rahway River Basin Flood Risk Management Study
Alternative #6: South Mountain Reservoir Standalone

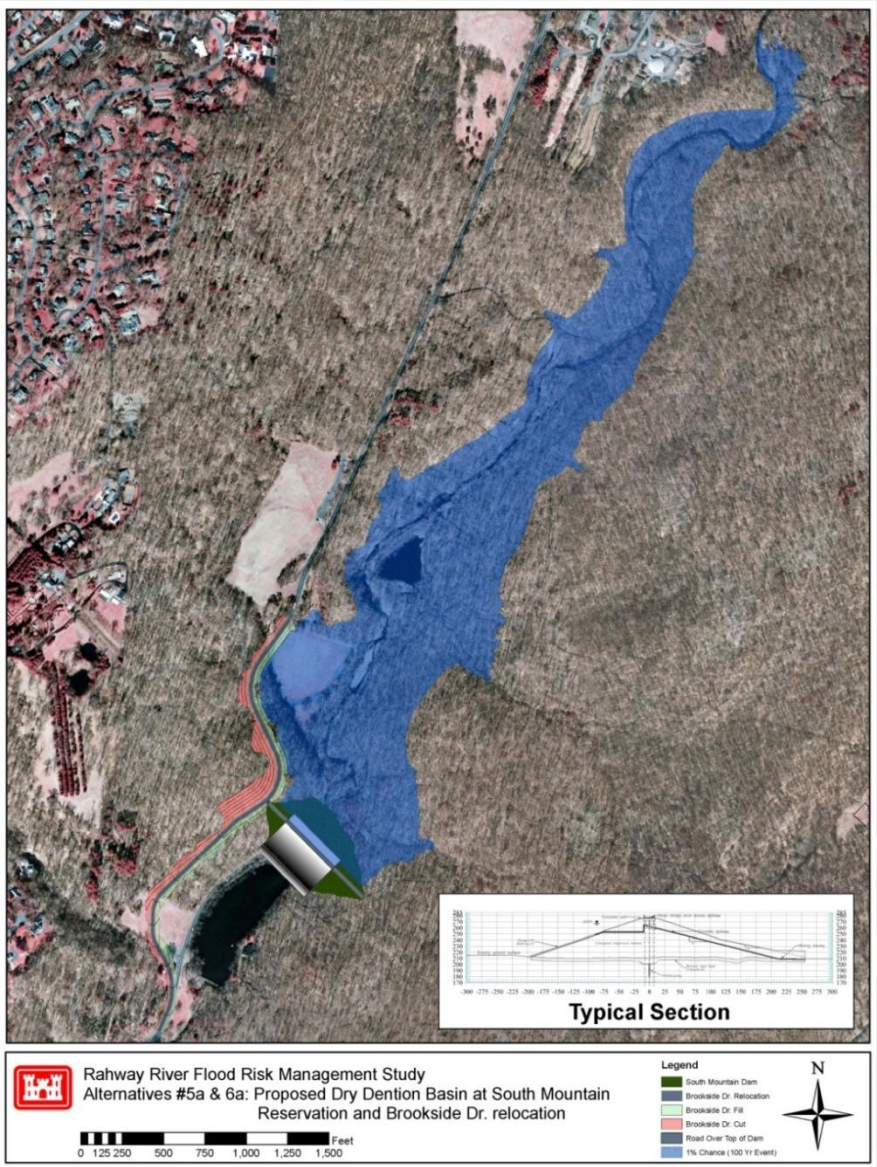


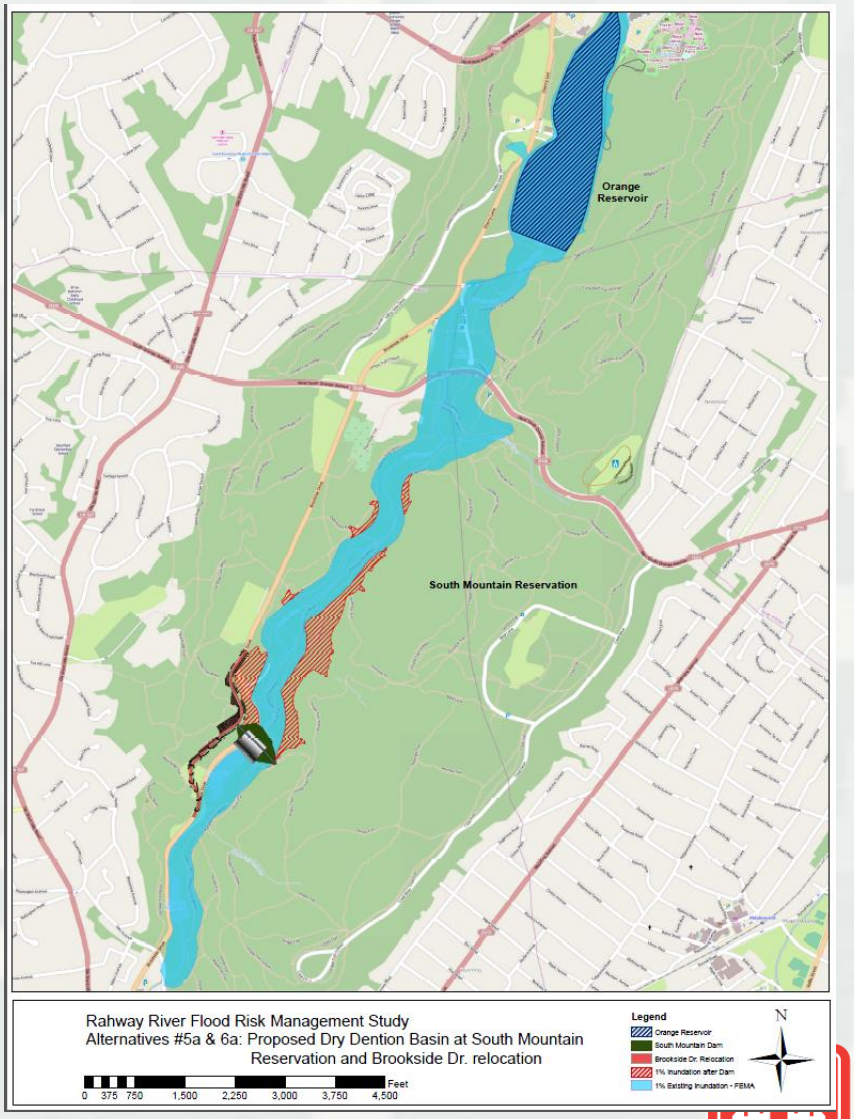
Rahway River Basin Flood Risk Management Study
Alternative #6a: South Mountain Detention Basin (relocation, road and bridge modification)

- Description:
  - This plan includes a new dry detention structure in South Mountain Reservation just upstream of Campbell's Pond. The structure will be approximately 810 ft long by 75 ft high.
  - Relocation of approximately 3,000 ft of Brookside Drive and a steel truss maintenance bridge across the spillway of the dam.
- This alternative is likely to have a 4% chance of annual exceedance flood (25-yr event) in Cranford Township.
- Potential Environmental Considerations:
  - South Mountain Reservation Historic District
  - Wetlands
  - Green Acres
  - Aquatic and Upland Forest Habitat

Rahway River Basin Flood Risk Management Study

Alternative #6a: South Mountain Detention Basin (relocation, road and bridge modification)





Rahway River Basin Flood Risk Management Study
Alternative #7a & 7b: Non-Structural 10-yr and 100-yr Plan

- Description: Non-structural measures are being finalized for approximately 700 structures contained in the 1% annual exceedance (100-yr event) and approximately 100 structures contained in the 10% annual exceedance (10-yr event) flood inundation areas for the Rahway River in Cranford.

- All structures will be treated to an elevation of one foot above the 1% annual exceedance event (100 year).

Non-structural Measures	Floodplain	
	10-yr	100-yr
Dry Flood proofing	0	11
Wet Flood proofing	1	326
Ringwall	1	37
Raise	62	311
Buyout	2	41
Total of Structures	66	726

- Potential Environmental Considerations:
  - Individual structures contributing Rahway River Parkway, Union County Park System and South Cranford Historic Districts

Rahway River Basin Flood Risk Management Feasibility Study

Typical Channel Improvement

South Orange, NJ, 30‘ wide, + retaining walls

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Rahway River Basin Flood Risk Management Feasibility Study

Typical Dry Detention Basin
Vermont, 65’ high, 1,500’ long, 80 years old

Rahway River Basin Flood Risk Management Feasibility Study

Typical Dry Detention Basin
Lenape Park, Springfield/Cranford, NJ

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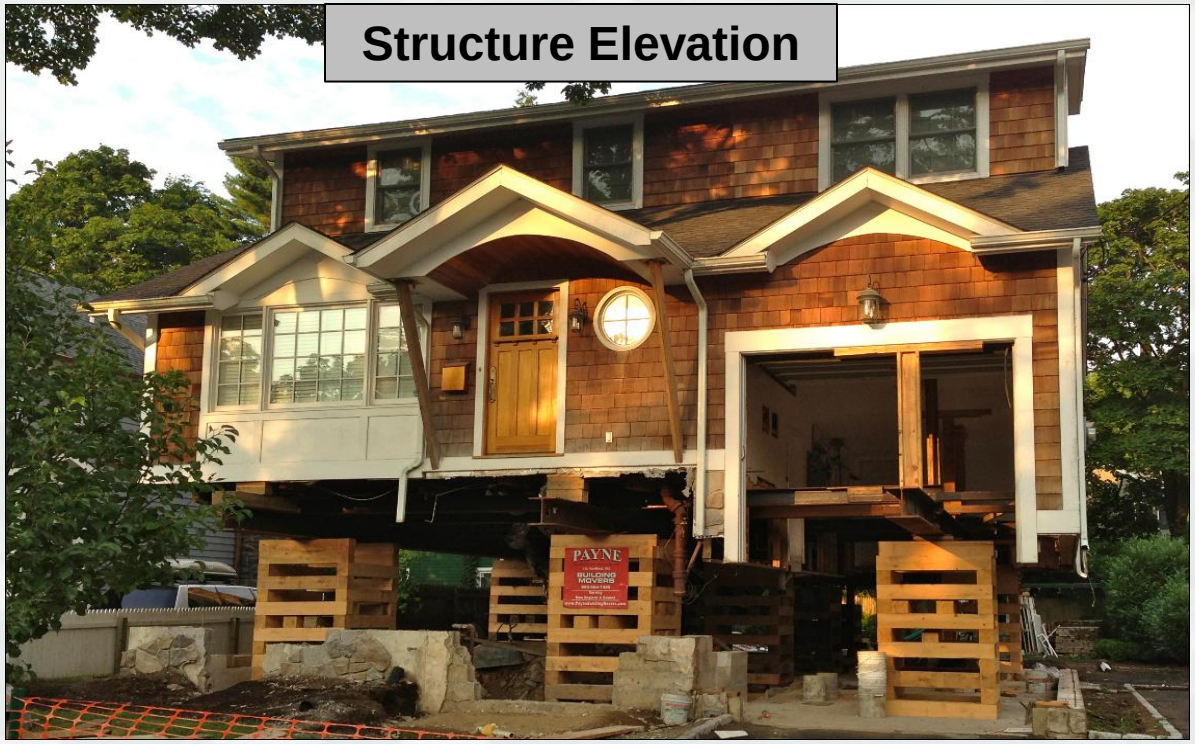
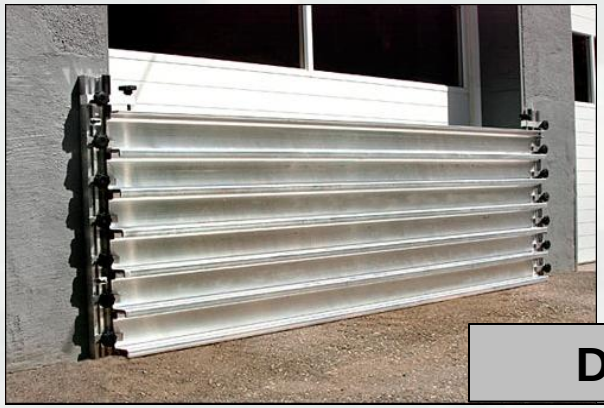
Rahway River Basin Flood Risk Management Feasibility Study

Typical Non-structural Measures



Structure Elevation

Wet Proof



Dry Proof

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Cost Estimates

Rahway River Basin Flood Risk Management Study
Screening Level Cost Estimates – Feasibility Study

1. At Feasibility level, Cost Engineering produces screening level estimates for each of the alternatives. These estimates include the following:

- Construction cost including:
  - materials
  - labor
  - equipment
  - cultural resource and environmental mitigation
- Lands and Damages (Real Estate)
- Planning, Engineering, & Design (PED)
- Construction Supervision and Administration (S&A)

2. The estimates also include contingency percentages from an Abbreviated Risk Analysis (Per ER 1110-1-1300, 26 Mar 93, Section 9.d.(3))

Rahway River Basin Flood Risk Management Study
Screening Level Costs for Rahway Alternatives

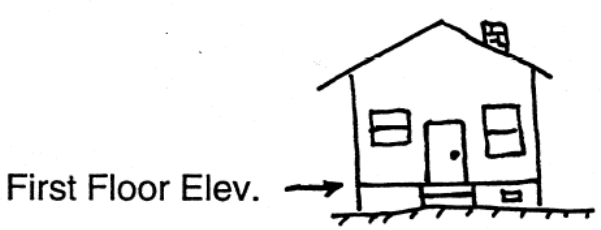
Alternative	Cost
1. Channel work and Lenape modification	$ 91,123,800
2. Channel work and Lenape and Nomahegan modification	$ 90,816,400
3. Dredging Orange Reservoir and Channel work	$ 230,303,600
4. Minor modifications to Orange Reservoir and Channel work	$ 68,871,200
5. South Mountain with Channel work	$ 164,005,100
5a. South Mountain (road relocation) with channel work	$ 174,019,300
6. South Mountain Standalone	$ 108,472,500
6a. South Mountain (road relocation) Standalone	$ 115,724,100
7a. Non-structural 10-yr	$ 15,543,000
7b. Non-structural 100-yr	$ 188,344,100

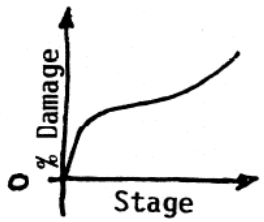
Photo By The Cranford Chronicle

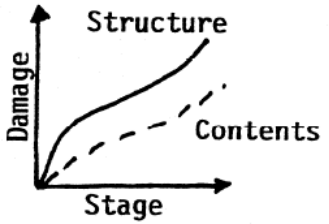
Economic Analysis Overview

Rahway River Basin Flood Risk Management Study
Economic Analysis Overview

- Identify and generate floodplain
- Inventory structures and gather key data
- Valuation of Structures







- Structure ID
- Location/Address
- Structure Value
- Content Ratio
- Damage Category

- Depth-Damage Function
- First Floor Stage
- Ground Stage
- Coordinates
- Stream Station

Rahway River Basin Flood Risk Management Study
Economic Analysis Overview

- Inundation Damages
  - Structure and Content
  - Infrastructure
  - Automobile
- Other Damages
  - Public Emergency Cost
  - Traffic Delay Cost
  - Lost Income

Rahway River Basin Flood Risk Management Study
Economic Analysis Overview

- Costs
  - Initial Construction Costs
  - Annual Operations and Maintenance Costs

- Benefits
  - Annual flood damages reduced

- Benefit-Cost analysis is a comparison of the annual equivalent costs of the project versus the annual equivalent benefits from the project over a 50-yr period of analysis.

- Benefit to Costs Ratio must be greater than one (BCR>1) for a plan to be economically justified for Federal participation.

- A plan with the highest Net Benefits is the National Economic Development (NED) Plan

Rahway River Basin Flood Risk Management Feasibility Study

Summary of Damages, Benefits, and BCRs

Alternative	Flood Damages		Annual Benefits	Total First Cost	Total Annual Cost	Net Excess Benefits	BCR
	Without Project	With Project					
1. Channel work in and modification to Lenape Park	$9,459,920	$6,857,920	$2,602,000	$91,123,800	$4,395,000	-$1,785,200	0.59
2. Channel work and modification to the Nomahegan levees and Lenape Park	$9,459,920	$6,856,170	$2,603,750	$90,816,400	$4,371,900	-$1,768,200	0.60
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5. Channel work and South Mountain Regional Detention Basin	$9,459,920	$2,830,780	$6,629,140	$164,005,100	$8,229,400	-$1,600,300	0.81
5a. Channel work and South Mountain Regional Detention Basin with relocation of Brookside Dr.	$9,459,920	$2,830,780	$6,629,140	$174,019,275	$8,655,100	-$2,025,900	0.77
6. South Mountain Regional Detention Basin	$9,459,920	$3,948,960	$5,510,960	$108,472,500	$5,202,500	**$308,500**	**1.06**
6a. South Mountain Regional Detention Basin with relocation of Brookside Dr.	$9,459,920	$3,948,960	$5,510,960	$115,724,023	$5,527,000	-$16,000	0.99
7a. Nonstructural - 10-yr floodplain in Cranford	$9,459,920	$8,472,270	$987,650	$15,543,000	$667,400	**$320,300**	**1.48**
7b. Nonstructural - 100-yr floodplain in Cranford	$9,459,920	$7,248,320	$2,221,600	$188,344,100	$8,157,800	-$5,946,200	0.27

Rahway River Basin Flood Risk Management Feasibility Study

Approximate 100 year Comparison between Alternatives #4, #6 & #7

	Alt#4: Orange w/ Channel	Alt#6: South Mountain	Alt#7: 10yr Non-Structural
Reduction in Millburn (ft)	2.6	4.0	0.0
Reduction in Springfield (ft)	0.9	1.9	0.0
Reduction in Cranford (ft)	3.3	0.9	0.0
Approx. # of Structures Removed from 100-yr at Main Floor	413	438	66
Total Annual Cost	$68,871,200	$108,472,500	$15,543,000
Net Benefits	$1,097,300	$308,500	$320,300

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Next Steps

Rahway River Basin Flood Risk Management Study
Feasibility Study - Next Steps

- Preliminary Alternatives Analysis including cost estimates for Robinson's Branch measures.
- Economic Analysis, Benefit-to-Cost Ratio for Robinson's Branch measures.
- Basin wide determination and optimization of Tentatively Selected Plan for Cranford measures & Robinson's Branch measures (TSP)
- NEPA Scoping Meetings
- Conduct Environmental and Cultural Resources Field Investigations
- Develop Real Estate Plan
- Prepare a Feasibility Report and NEPA Documentation (Environmental Impact Statement)
- Public and Agency Reviews

Rahway River Basin Flood Risk Management Feasibility Study - Next Steps

- FY14
  - Public Information Session for Cranford Measures
  - Continue existing conditions on Robinson's Branch
- FY15 (contingent upon funding)
  - Alternatives Analysis for Robinson's Branch measures
  - Economic Analysis for Robinson's Branch measure
  - Basin wide determination and optimization of Tentatively Selected Plan (TSP) for Cranford measure & Robinson's Branch measure
  - NEPA Scoping Meetings
  - Conduct Environmental and Cultural Resources Field Investigations
- FY 16 and Beyond
  - Draft Feasibility Report – Recommend a project for construction to USACE HQ and subsequently to Congress
  - Congressional authorization and funding
  - Complete Plans & Specs and initiate construction

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Questions?

Contacts

- Rifat Salim
  Project Manager
  U.S. Army Corps of Engineer, New York District
  917- 790 - 8215
  rifat.salim@usace.army.mil

- John Moyle, P.E.
  Chief of Dam Safety & Flood Control
  NJ Dept of Environmental Protection
  609 – 984 - 0859
  John.Moyle@dep.state.nj.us

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