

Executive Summary

In September 2004, April 2005 and June 2006, three major floods caused devastation along the main stem Delaware River, repeatedly damaging property and disrupting tens of thousands of lives. These were the worst floods to occur on the main stem since the flood of record in 1955. The last occurrence of three main stem floods of comparable magnitude within so short a time span was the period from 1902 to 1904.¹

Thankfully, during the 2004, 2005 and 2006 floods, advances in flood warning technology minimized loss of life. Nine deaths are attributed to these past three events; one was attributed to main stem flooding, whereas the remaining eight were attributed to tributary flooding.² Though tragic, this number compares favorably with the approximately 100 lives lost during the record event a half-century ago. However, encroachments by the built environment into the flood plain continue to create new threats – including the increased potential for property damage, personal injury or death, and an increased potential for harm to the riverine environment.

Over the past fifty years, businesses, industries, residences, roads, and utilities, including public and private water supply and wastewater facilities, have been constructed within the floodplain. One consequence is that our communities and built infrastructure are affected more than ever by floods. Another is that the environmental impacts of flooding are more serious than in the past. Flood waters infiltrate wastewater systems, introducing industrial waste and raw or partially treated sewage into waterways. In addition, debris and contaminants from the built environment are washed downstream, where they may not only cause additional damage to people and property, but potentially may settle on the river bottom and cause ecological harm for years to come. Development within the floodplain is accompanied by diminished vegetation, which leaves waterways more susceptible to stream bank erosion, particularly during floods. Severe erosion can convert a narrow, deep, clear and cold channel that is resistant to flooding, into a wide, shallow, turbid and warm one that is increasingly flood prone.

Reducing flood loss is a responsibility shared by federal, interstate, state, and local agencies throughout our region. Recognizing this, the governors of the four basin states – Delaware, New Jersey, New York and Pennsylvania – directed the executive director of the Delaware River Basin Commission, Carol Collier, to convene an interstate task force to develop a set of recommended measures for mitigating and alleviating flooding impacts along the Delaware and its tributaries. In their September 2006 letter to Ms. Collier, the governors wrote, “Individually, the Basin states can move forward with policies and regulations to reduce and mitigate the impacts of flooding, but we believe that through coordinated effort on a regional basis, we can do more to reduce flood loss within the Basin than we could accomplish acting separately, on our own. The Delaware River Basin Commission is the obvious vehicle for developing flood loss reduction and flood mitigation

¹ Serious floods along the main stem during this period occurred on March 2, 1902, October 11, 1903 and March 8, 1904. Flood stages on the main stem at Trenton during these events reached 23.6 feet (the 7th highest on record), 28.5 feet (3rd highest on record) and 30.6 feet (the highest ever), respectively. The 1904 event was caused by an ice jam at Trenton.

² Mortality data was obtained from the National Weather Service (NWS/NOAA) National Climatic Data Center (NCDC) Storm Event database.

plans that cannot be accomplished by any single state or local government but that require a holistic watershed approach. As much as any time since the Commission was created in 1961, now seems an appropriate moment for coordinated action through the DRBC.”

The Delaware River Basin Interstate Flood Mitigation Task Force was assembled in October 2006. It is comprised of 31 members from a geographically diverse array of government agencies (legislative, executive, federal, state and local) and not-for-profit organizations. The group has identified a total of 45 consensus recommendations for a proactive, sustainable, and systematic approach to flood damage reduction. The recommendations are based upon a set of six guiding principles concerning floodplain restoration, floodplain protection, institutional and individual preparedness, local stormwater management and engineering standards, and the use of structural and non-structural measures. They are grouped within six priority management areas as follows:

- Reservoir operations: Included among the recommendations is a slate of actions for regulation and control of reservoir releases. The Task Force calls for an evaluation of reservoir spill and discharge mitigation programs along with development of a flood analysis model to evaluate alternative reservoir operating plans and to assess the downstream effect of reservoir voids of different magnitudes. These recommendations call for releases that would reduce the likelihood and volume of spills from some basin reservoirs during storm events to help mitigate flooding.
- Structural and non-structural measures: The Task Force calls on policy-makers to assign higher priority and allocate greater funding to the acquisition of property and elevation and/or flood-proofing of structures within the floodplain. It offers strong support for state dam safety programs and recommends improved maintenance of other flood control structures. An evaluation of mitigation measures basinwide by the U.S. Army Corps of Engineers is recommended, to include an analysis of the ecological, economic, long-term operation and maintenance, and social costs and benefits of all flood mitigation options.
- Stormwater management: The Task Force calls for minimizing stormwater runoff from new development and reducing runoff from existing development through the implementation of watershed stormwater management plans, long-term maintenance of stormwater infrastructure (including detention ponds, inlets, catch basins, outfalls and other devices), the use of non-structural stormwater management options, expanded incentives for achieving stormwater management objectives, stronger enforcement of stormwater management regulations, and the development of stream restoration and debris removal guidelines.
- Floodplain mapping: Because the Delaware River is an interstate waterway, coordination is needed for development of a seamless floodplain map that is consistent throughout the basin. The Task Force calls upon the states to coordinate flood study and mapping updates, incorporate existing and planned development and residual risk zones into new maps, and re-define and re-map the floodway along the main stem and its tributaries.
- Floodplain regulation: Currently, the regulations applicable to floodplain areas in the Delaware Basin vary widely. The Task Force urges that existing floodplain regulations be catalogued, evaluated and updated and that uniform regulation of floodplains within the basin be established. It further recommends that a

coordinated education, outreach and training program about floodplain protection and regulation be undertaken, that a flood hazard disclosure requirement be imposed, that a repetitive loss reduction strategy be adopted and that riparian zones be defined in accordance with uniform standards basinwide.

- Flood warning: The task force recommends that development of an advanced basinwide flood warning system proceed in a coordinated fashion. The existing system is comprised of flow gages, flash flood and flood forecasting, and education and outreach components. It is coordinated and funded by multiple organizations at the federal, state and local levels. The Task Force urges that the river gage network and its forecast points be evaluated, that rating tables be extended, that gages be flood hardened (i.e., able to withstand larger flood events), that flash flood forecasting be improved, that flood inundation maps be developed, that up-to-date Dam Emergency Action Plans be maintained, that a coordinated flood education and outreach program be developed and that a comprehensive program be undertaken to address coastal flooding.

During the public review phase of the draft recommendations, there was a broad based request for immediate action to mitigate future flooding impacts. To address this sense of urgency the Task Force has identified several core recommendations to enhance the basin's resiliency—its capacity to prepare for and recover from flooding. The following immediate actions are proposed:

- Establish areas of priority funding for acquisition, elevation, and flood proofing. (*Action S-6*)
- Develop an interoperable reservoir operating plan. (*Action R-2*)
- Develop and implement a consistent set of comprehensive floodplain regulations beyond minimum NFIP standards across the entire Delaware River Basin. (*Action FR-2*)
- Enable stormwater utilities – This approach benefits both water quality and quantity. In addition it reinforces the states' existing momentum for stormwater management and control of nonpoint source pollution. (*Action SM-2.3*)

The Interstate Flood Mitigation Task Force has concluded that no set of mitigation measures will entirely eliminate flooding along the Delaware River or its tributaries. However, the members believe that the combination of measures advocated in this report constitute a significant step in helping the Basin's increasingly vulnerable riverine and coastal communities to prepare for, respond to, and rebound from natural disasters.

An overview of the 45 recommendations is included as Table 1 of this document. Please note that these recommendations are not in any prioritized order, but instead are organized by priority management area. Assuming adequate resources are identified, an implementation matrix, included as Table 4 of this report, organizes the recommendations by anticipated implementation time frame.

**Delaware River Basin Flood Mitigation Task Force
Table 1 - Recommendation Overview**

Recommendation			Ongoing	Short-term (1-3 Years)	Long-term (4+ Years)	Resources Needed	Lead Agency
Reservoir Operations							
#1	R-1	Develop a Flood Analysis Modeling Tool	X			\$\$	DRBC
#2	R-2	Develop an Interoperable Reservoir Operating Plan		X		\$\$	DRBC
#3	R-3	Evaluate Discharge Mitigation Programs for Reservoirs	X			\$	DRBC
#4	R-4	Evaluate Snowpack Based Storage Management	X			\$	DRBC
#5	R-5	Publish Information on the Basin's Existing Major Impoundments		X		\$	DRBC
#6	R-6	Evaluate Availability and Accuracy of Data		X		\$	DRBC
Structural and Non-Structural Measures							
#7	S-1	Fund a Comprehensive Flood Mitigation Study of the Entire Delaware River Basin			X	\$\$\$\$ per state	USACE
#8	S-2	Prioritize the Completion of State and Local Hazard Mitigation Plans	X			\$\$\$	State EMO's
#9	S-3	Ensure Financial Assistance for State, County and Municipal Flood Mitigation Projects	X			\$\$\$\$	State EMO's
#10	S-4	Provide Training for Local Officials to Maximize Use of Available Mitigation Funding		X		\$\$	DRBC
#11	S-5	Create Partnering Programs for Floodplain Acquisition		X		\$\$\$\$	State DEP's
#12	S-6	Establish Funding Priority Areas for Acquisition, Elevation, and Floodproofing		X		\$\$\$	Basin States
#13	S-7	Maintenance of Flood Control Structures, excluding dams		X		\$\$\$\$	State DEP's
#14	S-8	Dam Safety Programs	X			\$\$\$\$	State Dam Agencies
#15	S-9	Evaluate and Coordinate Flood Mitigation Plans and Strategies	X			\$\$\$	DRBC
Stormwater							
#16	SM-1	Develop Regional and Tributary-Based Watershed Stormwater Management Plans		X		\$\$ per 100sq. mi.	Basin States
#17	SM-2	Long-term Management of Stormwater Best Management Practices (BMPs) and Infrastructure	X			\$ per municipality	Basin States
#18	SM-3	Non-Structural Stormwater Management for New and Redevelopment	X			\$	Basin States
#19	SM-4	Enforcement of Existing Stormwater Standards and Regulations		X		\$	Basin States
#20	SM-5	Provide and Promote Incentives to Reduce Stormwater Runoff from Existing Development		X		-\$\$\$\$	Basin States
#21	SM-6	Develop and Maintain Precipitation and Streamflow Data	X			\$	USGS/NWS
#22	SM-7	Stream Restoration and Debris Removal Guidelines		X		\$	DRBC
#23	SM-8	Stormwater Management through Special Protection Waters Designation	X			\$	DRBC

\$ Key: \$ = < \$100,000 \$\$ = < \$500,000 \$\$\$ = < \$1,000,000 \$\$\$\$ = > \$1,000,000

**Delaware River Basin Flood Mitigation Task Force
Table 1 - Recommendation Overview (Continued)**

Recommendation			Ongoing	Short-term (1-3 Years)	Long-term (4+ Years)	Resources Needed	Lead Agency
Floodplain Mapping							
#24	FM-1	Coordinated Flood Study and Mapping Updates	X			\$\$\$\$	Basin States
#25	FM-2	Incorporate Existing and Future Planned Development and Residual Risk Zones into New Mapping			X	\$\$\$\$	Basin States
#26	FM-3	Redefine and Remap the Floodway along the Delaware River Main Stem and its Tributaries			X	\$\$\$\$	Basin States
Floodplain Regulations							
#27	FR-1	Catalog, Evaluate and Update Existing Floodplain Regulations in the Basin		X		\$	DRBC
#28	FR-2	Develop a Coordinated Education, Outreach and Training Program		X		\$	DRBC
#29	FR-3	Repetitive Loss Reduction Strategy for the Basin		X		\$\$	FEMA
#30	FR-4	Flood Hazard Disclosure Requirements		X		\$	DRBC
#31	FR-5	Standardized Riparian Corridors			X	\$	DRBC
Flood Warning							
#32	FW-1	Inventory and Evaluate Precipitation Observing Stations in the Basin		X		\$	USGS
#33	FW-2	Evaluate River Gage Network		X		\$	USGS
#34	FW-3	Extend Rating Tables		X		\$	USGS
#35	FW-4	Flood Harden Gages at Key Forecast Locations			X	\$\$	USGS
#36	FW-5	Improve Flash Flood Forecasting			X	\$\$	NWS
#37	FW-6	Develop an Implementation Plan for the NWS Site Specific Model		X		\$	NWS
#38	FW-7	Evaluate River Forecast Points		X		\$	NWS
#39	FW-8	Provide River Forecasts with Confidence Level Information		X		\$	NWS
#40	FW-9	Develop Flood Forecast Inundation Maps		X		\$\$	NWS
#41	FW-10	Maintain Up-to-Date High Hazard Dam Emergency Action Plan (EAP) Documents	X			\$	DRBC
#42	FW-11	Establish a Coordinated Flood Warning Education and Outreach Program		X		\$	DRBC
#43	FW-12	Develop a Flood Coordination Mechanism		X		\$	DRBC/ Basin States
#44	FW-13	Ice Jam Monitoring and Communications Plan	X			\$	State EMS
#45	FW-14	Coastal Flooding Impacts			X	\$\$\$\$	MACOORA

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