Summary of Findings

The Interagency Waterway Infrastructure Improvement Task Force met in open session a total of seven times. In addition, there were many meetings held involving various committees. The Task Force Staff met often with individuals and dam owners, and groups representing local, county, state and federal agencies. Presentations were made to the public in the impacted areas that outlined various programs and assistance available for dam restoration. These meetings were held in an informal manner, and many issues were discussed. It must be noted that this Task Force had minimal funding and resources, no subpoena power, and no legal authority to compel witnesses to testify under oath.

The Task Force assigned committees to study several issues in an effort to understand the effects of the storm, which occurred on July 12-15, 2004, and the failures of several dams, and the subsequent floods that resulted. These issues are identified in the Table of Contents which follows.

- **The result of committee studies, Task Force meetings, and staff input are reported as follows:**

1. The storm of July 12-15, 2004, was, beyond a reasonable doubt, a 1000-year storm.
2. Several of the dams along the Rancocas waterway did not meet current construction standards.
3. There were no Emergency Action Plans for many of the impacted dams.
4. The Dam Safety Bureau (NJDEP) has inadequate enforcement powers to insure compliance with its rules and regulations.
5. There was no working alarm system to alert the residents along waterways of potential flooding.
6. Local, county, and state emergency workers, both professional and volunteer, did an outstanding job to protect life and property.

Recommendation of the Task Force, are as follows:

1. Legislative action be taken to provide greater enforcement and penalties for lack of compliance to the rules and regulations relating to Dam Safety.
2. Greater emphasis be placed on dam inspection to insure compliance by owner.
3. Consideration be given to installing a state of the art alarm system to warn residents of potential flooding.
4. The Dam Safety Bureau and State and County Offices of Emergency Management provide training in preparing Emergency Action Plans, and exercise development for local Emergency Management personnel.
5. Flood exercises be conducted on periodic basis.
6. Encourage Boy Scouts, Canoe Clubs, and similar groups to keep streams clear of Debris.
7. Continue this Task Force to assure continued interest by all concerned parties.
8. Have Task Force look into the possibility of having insurance made available to dam owners covering liability and property damage.
9. Have Task Force look into the possibility of having dams bonded to guarantee funding is available for continued maintenance.

- **FEMA Recommendations**

    1. Property owners located in a flood prone area, or in close proximity to a flood prone area, should be encouraged to purchased flood insurance
    2. FEMA should continue supporting the use of HMGP funds and Pre-Disaster Mitigation funds for the preparation of countywide emergency mitigation plans.

- **New Jersey State Office of Emergency Management - Emergency and Community Planning Recommendations**

There were many contributing factors with regards to the response activities the night of July 12, 2004. In review of best practices and lessons learned, several areas that need improvement have been identified.

1. Emergency Action Plans (EAP's) are required for all High Hazard and Significant Hazard dams according to the New Jersey Dam Safety Standards (N.J.A.C. 7:20 seq). It was found that many of these EAP's were antiquated or non-existent. Due to the limited requirements imposed on dam owners regarding planning, response activities were never tested to familiarize the emergency response community with notification protocols and proactive response activities.
2. As the Emergency Action Plans are developed, the community should integrate the plan with the municipal Emergency Operations Plan and exercise it annually. It would be strongly suggested the communities arrange a regional planning group to review notification and response protocols.
3. Response activities were hampered by the lack of early warning systems. Burlington County, in concert with NOAA and the USGS should explore possible early warning systems, and methods to fund these systems, in order to alert the surrounding communities in the event of future rain events and dam failures.
4. Continuing education on dam safety is of the utmost importance. This educational initiative should be extended beyond dam owners and emergency management officials to include those residents that live in the floodplain. The New Jersey Office of Emergency Management and the Burlington County Office of Emergency Management conducted an emergency management coordinators workshop on September 13, 2004 and also two Dam Safety Workshops on September 23 & 25, 2004.
5. Low Hazard dams should be incorporated into the planning analysis when updating Emergency Action Plans. As this disaster has demonstrated, the power and pressure of cascading dam failures, and resulting release of impounded water, can adversely affect those Significant & High Hazard dams.
6. The Burlington County Office of Emergency Management in concert with the New Jersey Office of Emergency Management, South Regional Unit, should assist municipalities in the incorporation of dam owner Emergency Action Plans into the municipal Emergency Operations Plan (As required under Emergency Management State Directive 101, the State Emergency Operations Plan Checklist and should include all required annexes and attachments). These plans should be reviewed annually and are required to be submitted for recertification every four years by the State Office of Emergency Management. Every effort should be made to plan and prepare for "all hazards" and incorporating the dam owner into the process will only increase the preparedness level for any future flash flood event.

Major Waterways and Debris in the Flood-Affected Area

Finding 1

Prepared by Interagency Waterway Infrastructure Task Force

Major Waterways

In Burlington County the Rancocas Creek Watershed covers the majority of the flood-affected areas. The Rancocas has three major branches and hundreds of smaller tributaries.

> ***The Northern Branch*** has its origin in the Pine Barrens east of Browns Mills and flows approximately 34 miles westerly to the Delaware River at Delanco. Major dams on the North Branch include Browns Mills, Pemberton, and the only major flood control structure, the Smithville Dam, two miles up stream from Mt. Holly. A dam at Mt. Holly also helps in regulating the riverine flow. Below Mt. Holly, the creek soon becomes tidal.
>
> ***The South Branch*** *of* the Rancocas flows from the south in the center of Tabernacle Township and joins with the North Branch near Rancocas Woods. At the turn of the century, steamships cruised the Rancocas carrying lumber from Lumberton to Philadelphia, PA. Friendship Creek, in the southern sector, had two dams that failed, Camp Inawendiwin's Upper Dam and Lower Dam. These are owned by the Camden County Girl Scouts. It should be noted that Tabernacle reportedly had the heaviest rainfall of the storm, 13.2 inches, and this played an important factor in the dam failure. Two communities that suffered severe flood damage, Vincentown, and Lumberton, are located downstream from these camps.
>
> ***The Southwest Branch*** of the Rancocas has its beginnings in Shamong Township, NJ, and flows northward until it meets the South Branch at Eayrestown just south of Lumberton. In the Medford Township/Medford Lakes area along the Southwest Branch there are approximately 46 lakes of all sizes. On these lakes, 9 dams failed and 13 were damaged.

Many of the dams in the Rancocas Watershed are quite small and are used for agricultural purposes, while a few are rather large, and form the basis for waterfront housing development.

The majority of the homes damaged in this flood were located in the Medford Township/Medford Lakes areas. Medford Lakes Borough as an example, is a 1.2 square mile community of 1500 mainly lakefront homes, 150 of which are log cabins. The community got its start in 1927 when the Medford Lakes Development Company formed the lakes and started building log cabins, with imported cedar logs, as summer homes.

* * *

In neighboring Camden County, the three major streams are the Cooper River, the Pennsauken Creek, and the Timber Creek, each with several tributaries.

> ***The Cooper River*** is 16 miles in length, and has its headwaters in Voorhees Township, and winds it's way thought the City of Camden until it reaches the Delaware River. Moderate flooding was reported as heavier than normal rains overflowed the Cooper River.
>
> ***The Pennsauken Creek*** is approximately 14 miles long and begins in the western portion of Camden County.
>
> ***The Timber Creek*** originates near Folsom, Atlantic County, and it could be considered suburban in nature until it reaches the Delaware near Gloucester City, NJ. After receiving over 5.5 inches of rain, both the Timber and the Pennsauken also overflowed their banks and contributed to the number of flood-damaged homes in the Camden County area.

While admittedly not the largest disaster in the State, the July 2004 storms in New Jersey resulted in FEMA receiving over 5777 disaster registrations, and having disbursed $9,000,000 to survivors by mid September 2004.

* * *

Debris in the Flood Affected Area

On September 30, 2004 a Helicopter Flight was conducted to observe debris in Rancocas Creek Watershed

The helicopter was supplied and piloted by the New Jersey State Police. The flight began at 1:00 PM, from the New Jersey National Guard Armory, Route #38, Mt. Holly, NJ and included representatives from FEMA, NJOEM and Burlington County.

1) The North Branch of the Rancocas from the Delaware River to Mt. Holly, was clear of debris, and was flowing freely.

2) The South Branch of the Rancocas from where it joined the North Branch to Lumberton appeared to be clear of debris and flowing freely. As the creek neared Vincentown, trees began to appear growing along its banks and in spots obscured the view of the creek. By turning the aircraft from left to right, and reducing altitude to approximately 250 feet, the majority of the waterway was visible. There were several trees, and areas of brush in the water, but they did not appear to impede the flow. The creek had several sharp bends in this area, and occasionally, a piece of lumber could be seen on the bank. Two or three other objects, not identifiable, could also be seen. There was no blockage of the water flow, and this area is a nature waterway, with no improvements. At an area where a roadway was being reconstructed, sand was visible in the creek, but this is normally removed after construction is completed.

3) The Southwest Branch of the Rancocas was observed south to Medford Lakes. Each of the dams that failed was easy to identify, as were dry lakebeds. There was no visible debris in the Southwest Branch.

The flight took about one and a half hours. At its conclusion, the consensus of all parties involved was there is no blockage of the waterway by debris created by the storm of July 12-15, 2004, and there is no justification for further involvement by FEMA.

The Permitting and Regulatory Process | Finding 2

Prepared by the FEMA Environmental Officer – FEMA 1530-DR-NJ

Dam Safety Permit

The New Jersey Department of Environmental Protection (NJDEP) Bureau of Dam Safety and Flood Control regulates all dams greater than five (5') feet high, measured from the dam crest to the downstream valley floor. The regulatory instrument is known as a Dam Safety Permit administered through the Dam Safety Section (DSS).

Dams are classified into three categories based on the potential flood hazard that their impoundments would present should the dam fail. The dam classifications are:

Class I	High Hazard Potential
Class II	Significant Hazard Potential
Class III	Low Hazard Potential

Reconstruction of Failed Dams

An earthen dam that has breached within the impact area and is proposed to be reconstructed must fully comply with the Dam Safety permitting process. The applicant shall retain a New Jersey licensed professional engineer familiar with the permitting, design and construction of earthen dams. A pre-application conference may be requested with the Dam Safety Section (DSS) at the discretion of the applicant and his engineer.

Hydraulic and Hydrologic Study

A hydraulic and hydrologic study (H&H) is required prior to final dam design and will be required for repair/replacement or permanent removal of a structure. Upon completion of the hydrologic and hydraulic study the results shall be submitted to DSS for re-evaluation of the dam's hazard classification. The H & H study typically requires about six months for the applicant's engineer to complete. The NJDEP technical review of the H & H analysis is generally a 3 to 4 month process.

Dam Design

Upon approval of the H&H analysis, the applicant's engineer should proceed with final design of the dam along with preparation of construction plans and specifications. This generally will take the design engineer 3 to 6 months to complete. Upon completion, the application can be submitted to the NJDEP for review. The NJDEP review is generally a 3 to 6 month process.

The proposed dam must safely pass the design flood that varies according to the potential hazard classification stated above.

Replacement of dam structures would likely result in a larger structure footprint due to widening and flattening of the slopes to conform to current standards. Smaller or existing footprints of structures could be utilized if appropriate armoring techniques are used or with the use of varying construction materials. However, based on each municipality's local flood plain ordinance, structures would not be permitted to increase upstream or downstream flooding. Cost of the application/design process is estimated in the range of $100,000.

Repair of Damaged Dams

Seriously Damaged Dams

Seriously damaged dams which are ordered by NJDEP to lower their impoundment must follow the same application criteria as failed dams. The applicant must adhere to NJDEP requirements including keeping the impoundment drained until all permits are secured and the engineered repairs are completed.

Damaged Dams

Engineered emergency repairs may be performed on an interim basis but the applicant must submit an H & H analysis to DDS within 6 months of the damage occurrence. The analysis and dam classification will be evaluated and upon approval from Dam Safety, the applicant's engineer shall submit application for rehabilitation. Permanent repairs shall be initiated within 6 months of Dam Safety permit approval.

Land Use Regulation Permits

NJDEP Land Use Regulation Element regulates activities in freshwater wetlands and associated transition areas. Previous to submittal of the final dam design and Dam Safety Permit, or at the same time, the applicant should submit application to Land Use for General Permit No. 18, to authorize activities in freshwater wetlands and transition areas necessary to repair or replace dams. A complete application for the general permit typically requires wetland delineation represented on a plan by a New Jersey Licensed Land Surveyor in addition to the proposed dam design.

Other Land Use permits that may be required to repair or rebuild dams within the DR1530 impact area include:

General Permit No. 1 Authorizes activities in freshwater wetlands and State Open waters required to carry out repair, reconstruction, maintenance or replacement of previously authorized, currently serviceable structure, fill, roadway, drainage or storm water management facility lawfully existing prior to July 1, 1988 or previously permitted by NJDEP.

General Permit No. 10 Authorizes activities in freshwater wetlands, transition areas and State Open waters required to construct one or more stream crossings. Constructing roadway over a re-constructed earthen dam will likely require a General Permit No. 10.

During the general permit review process, applications will be forwarded to the New Jersey Pinelands Commission, New Jersey Division of Parks and Forestry, New Jersey Office of Historic Preservation and the U.S. Fish and Wildlife Service for review of potential impacts to critical areas of special concern. Public notification is required in the Land Use permitting process.

Stream Encroachment: Earthen structures not meeting the definition of dams that require reconstruction or repair will likely need a stream encroachment permit along with a General Permit. A Stream Encroachment permit is generally required for projects proposed on watercourses when the drainage area upstream of the project site is greater than fifty acres. However, all projects should be submitted to the NJDEP for a determination of regulatory jurisdiction. The stream encroachment program is administered by the Land Use Regulation Element - Stream Encroachment section under authorization of the Flood Hazard Control Act.

New Jersey Pineland Commission

If the dam reconstruction project is located in the Pinelands jurisdiction, a development application must be completed with the Pinelands Commission. The likely primary issues of concern in such an application include Wetland protection, minimizing disturbance and vegetation removal for the dam to that required by the Bureau of Dam Safety, protection of threatened and endangered plants and animals, non-degradation of groundwater and surface water, including, if necessary, storm water management, and protection of cultural resources.

A plan showing the location of all existing and proposed development, including the wetlands and limits of clearing and disturbance must be provided to the Pinelands Commission.

If development is proposed by a governmental agency ort on publicly owned land, the application must be formally approved by the Pinelands Commission at its regular monthly meeting. If development is proposed by a private entity on privately owned lands, once an application is completed a Certificate of Filing will be issued by the Commission. A Certificate of Filing denotes the completion of anb application with the Commission and an applicant may use the Certificate of Filing to pursue any necessary state, municipal or county approvals.

Enforcement and Legislation

Finding 3

Existing dam safety laws provide the Department of Environmental Protection with limited administrative enforcement capability to achieve statewide compliance with dam safety standards. Currently the Bureau of Dam Safety's only recourse to enforce Bureau issued orders when a dam owner has not complied is to refer the matter to the Office of the Attorney General to file a complaint with the Superior Court. Once in court the Bureau can seek an order for compliance and possible penalties up to $5,000 a day for violations. By concentrating enforcement efforts and utilization of existing grant and loan programs, the Bureau's engineering and legal resources have been successful in obtaining compliance from owners of high hazard dams. However, in order to address all non-compliant and structurally deficient dams, it was recognized that more effective enforcement power is needed. The Department had been working with the state legislature to revise the existing statue to provide administrative capabilities, such as monetary penalties and the legal authority to lower impoundments, and to enforce orders without involvement of the Office of the Attorney General and the Superior Court. Since the storm event, new legislation has been introduced to address these enforcement deficiencies.

In answer to specific questions posed by the Task Force, DEP responded as follows:

Why did the dams fail?

The inspections undertaken by the NJDEP, Bureau of Dam Safety and Flood Control were done for the purpose of determining the post flood condition of the dams. No detailed forensic investigation was undertaken for determining the exact cause of failure of each dam. However, a majority of the failures appear to have been likely caused by overtopping of the embankment portion of the dams due to inadequacy of the dam's spillway to safely pass the runoff experienced during the flood event.

What were the condition of the dams prior to their failure?

None of the dams which failed were in total compliance with the New Jersey Dam Safety Standards. The primary component of non-compliance was failure to meet spillway adequacy requirements of the Dam Safety Standards. Seven of the failed dams were not previously documented in the Department's database and therefore had no record of previous condition. The owners of nine of the dams which the Department had record of were under order by the Department to undertake corrective measures to bring their dam into compliance with the Standards.

Should every dam be mandated to meet or exceed standards?

Every dam in the State as defined in the Safe Dam Act, N.J.S.A. 58:4, is required to meet State dam safety standards. Owners of all of the failed or damaged dams have been ordered to re-evaluate their hazard classification and to reconstruct or rehabilitate their structures to comply with the standards for the hazard classification which is established.

Legislation

Two Dam Safety bills have been introduced by State Senators Bryant (District 5), Bark (District 8) and Allen (District7):

Senate Bill 1895 Introduced October 4, 2004 Summary Statement (Senator Bryant):

Under current law, the only recourse available to the Department of Environmental Protection to compel dam owners to comply with DEP orders to repair dams, is for the commissioner to request the Attorney General to request a court order to enforce the DEP's orders, and to impose a penalty of not more than $5,000.

This bill would amend the "Safe Dam Act," (C.58:4-8.1 et seq.) to authorize the DEP, in its discretion, to make necessary repairs to dams, and to charge owners for such repairs, whenever any dam is, in the judgment of the

commissioner, in imminent danger of failure, and where the owner has refused to comply with a repair order issued by the department. Further, the bill provides that any owner who fails to comply with such an order would be liable to the department for three times the cost of such repair. This bill would also allow allocation of the cost of repairs among the liable owners in instances where two or more owners are liable and provide that expenditures made by the department shall constitute a debt of the owner to the State. The debt would constitute a lien on all property owned by the owner and the lien would have priority over other liens with regard to the property subject to the repairs.

This bill would also expand the "Safe Dam Act" to allow the commissioner:

1) to issue an order requiring any person in violation of any provision of the act to comply, and to restore any area which is the site of the violation;
2) to institute a civil action for appropriate relief from any violation, including an injunction to secure an area from the danger of a breaking dam, assessment of the violator for the costs of investigation, inspection or monitoring of the site in violation, and the reasonable costs of bringing legal action, assessment of the violator for any costs incurred by the State to remedy any violation for which legal action has been brought, assessment against a violator for compensatory and actual damages caused as a result of a violation, and requiring that a violator restore the site of a violation;
3) to levy a civil administrative penalty of up to $25,000 for each violation of any provision of the act;
4) to bring an action for a civil penalty for any violation of the act; and
5) to petition the Attorney General to bring a criminal action against a dam owner who knowingly, recklessly or negligently violates the "Safe Dam Act." A person so convicted would be guilty of a fourth degree crime, and may be assessed a fine of not less than $2,500 nor more than $25,000 per day of violation, with increasing penalties for subsequent offenses. The bill would also authorize the assessment by the court, upon conviction, of a fine of not more than $10,000 against any person that knowingly makes a false statement, representation, or certification in any application, record, or other document filed as required under the act.

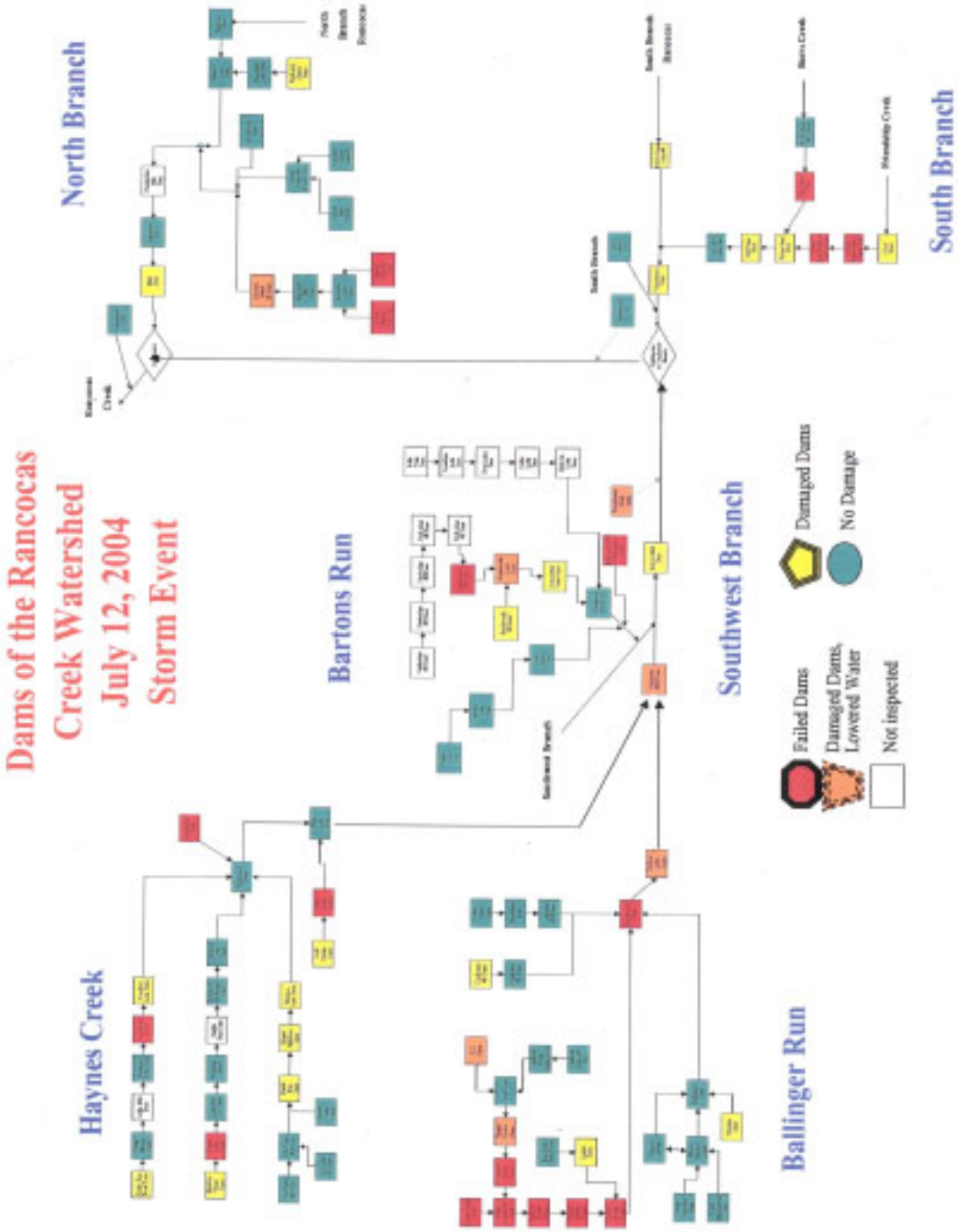
This bill would allow the commissioner to order that violations of any provision of the Safe Dam Act, or any rule, regulation or order issued pursuant thereto, be recorded on the deed of the property wherein the violation occurred, and remain attached thereto until such time as the violation has been remedied. All penalties collected pursuant to this bill would be deposited in the “Environmental Services Fund,” to be kept separate from other receipts deposited therein, and shall be appropriated to the department for the repair and maintenance of dams in the State. The bill would authorize the department to enter any property, facility, premises, or site for the purpose of conducting inspections of dams or to otherwise determine compliance with the provisions of the act.

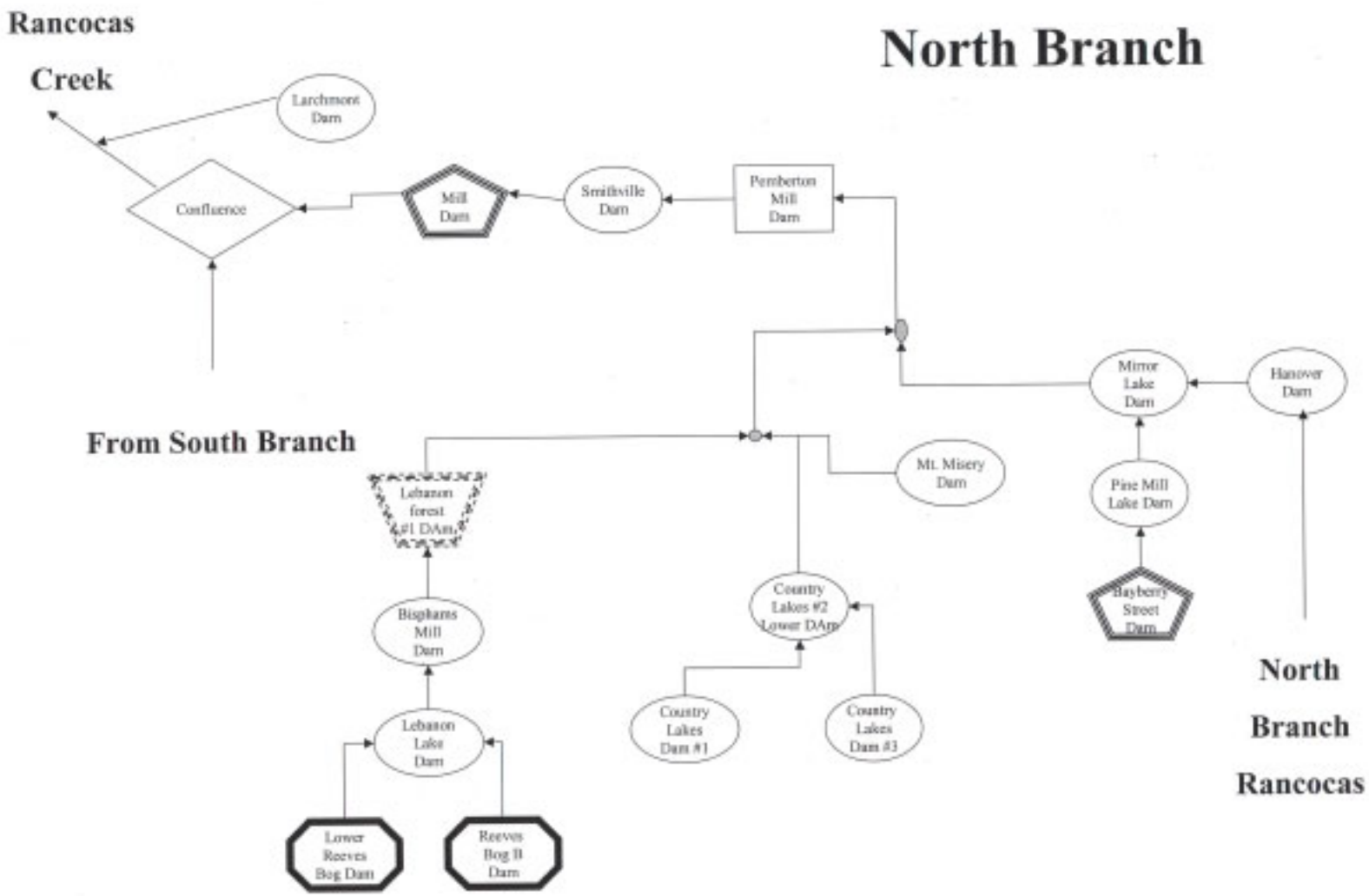
Senate Bill 1880 Introduced October 4, 2004 Summary Statement (Senators Bark & Allen**):**

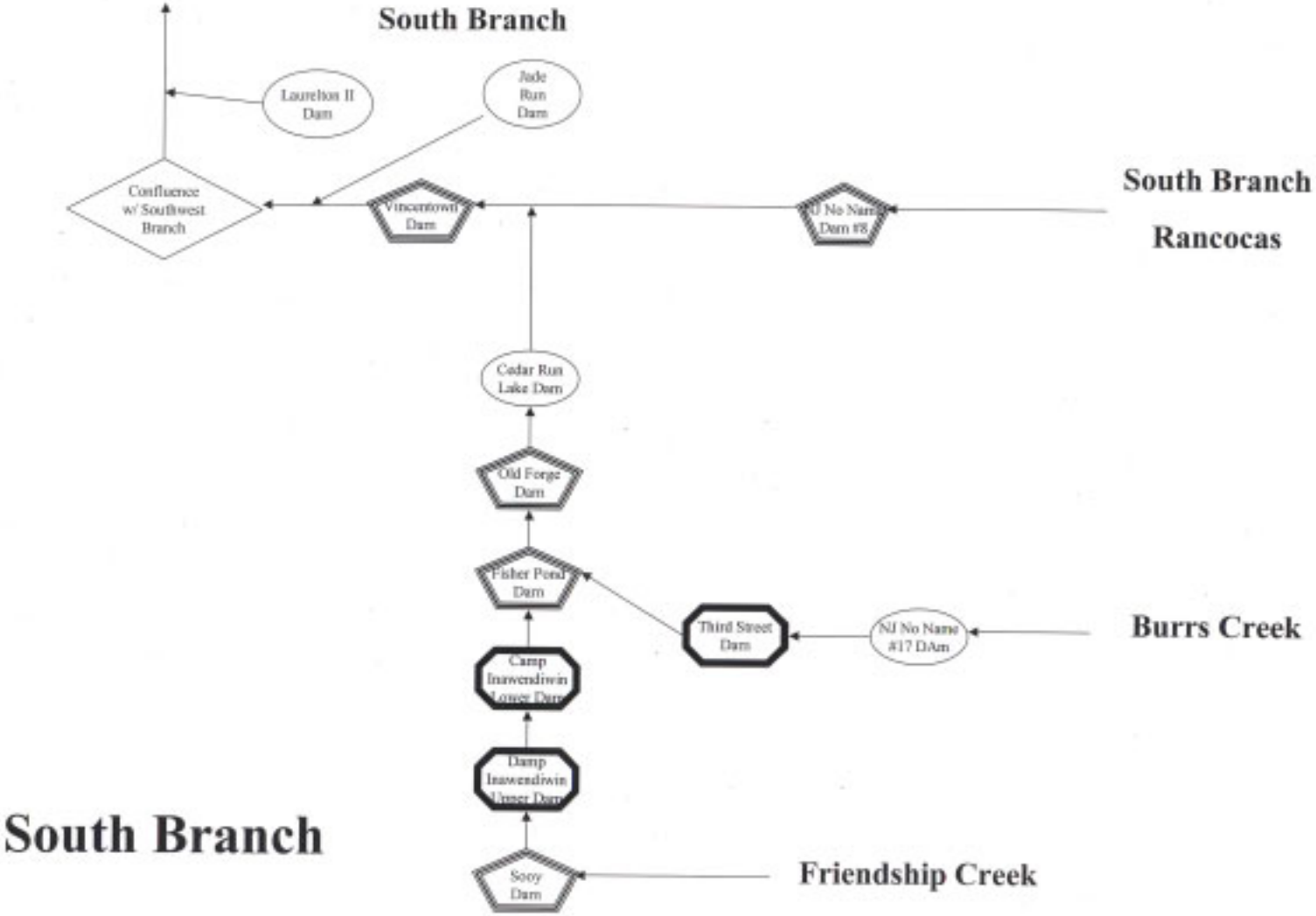
This bill provides a supplemental appropriation of $50 million to the FY 2005 State Budget for the purpose of augmenting State funding targeted for the repair and reconstruction of publicly and privately owned dams adversely affected by the recent severe storm in Burlington County. Although the bond issue authorized by voters in November, 2003, the "Dam, Lake, Stream, Flood Control, Water Resources, and Wastewater Treatment Project Bond Act of 2003" (P.L.2003, c.162), provides $15 million for the restoration of State-owned dams and $95 million in financial assistance to owners of privately-owned dams, more State funding for this purpose.

Dam Flow - Series of Maps of the Rancocas and its tributaries

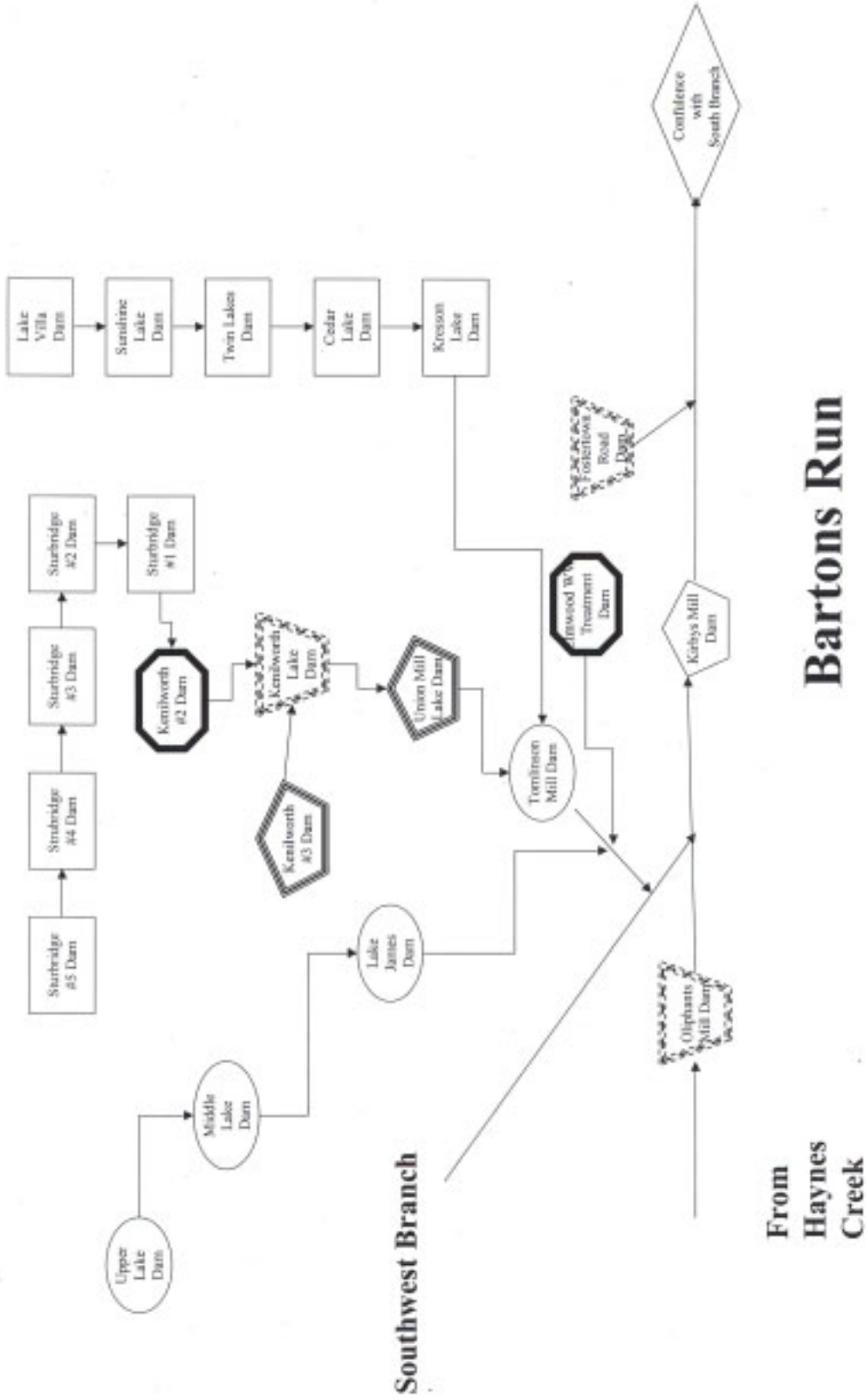
Prepared by NJ Department of Environmental Protection, Bureau of Dam Safety

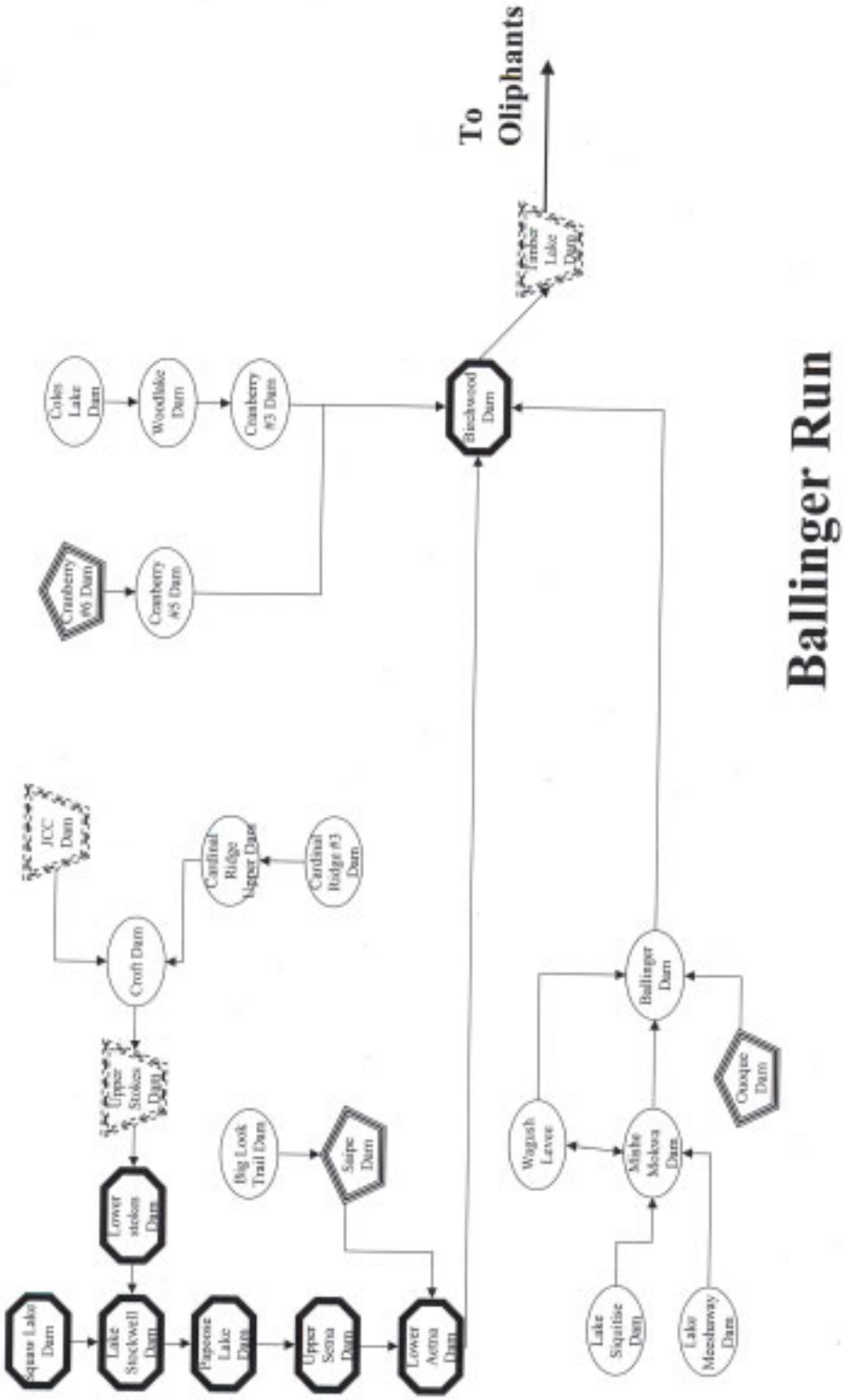


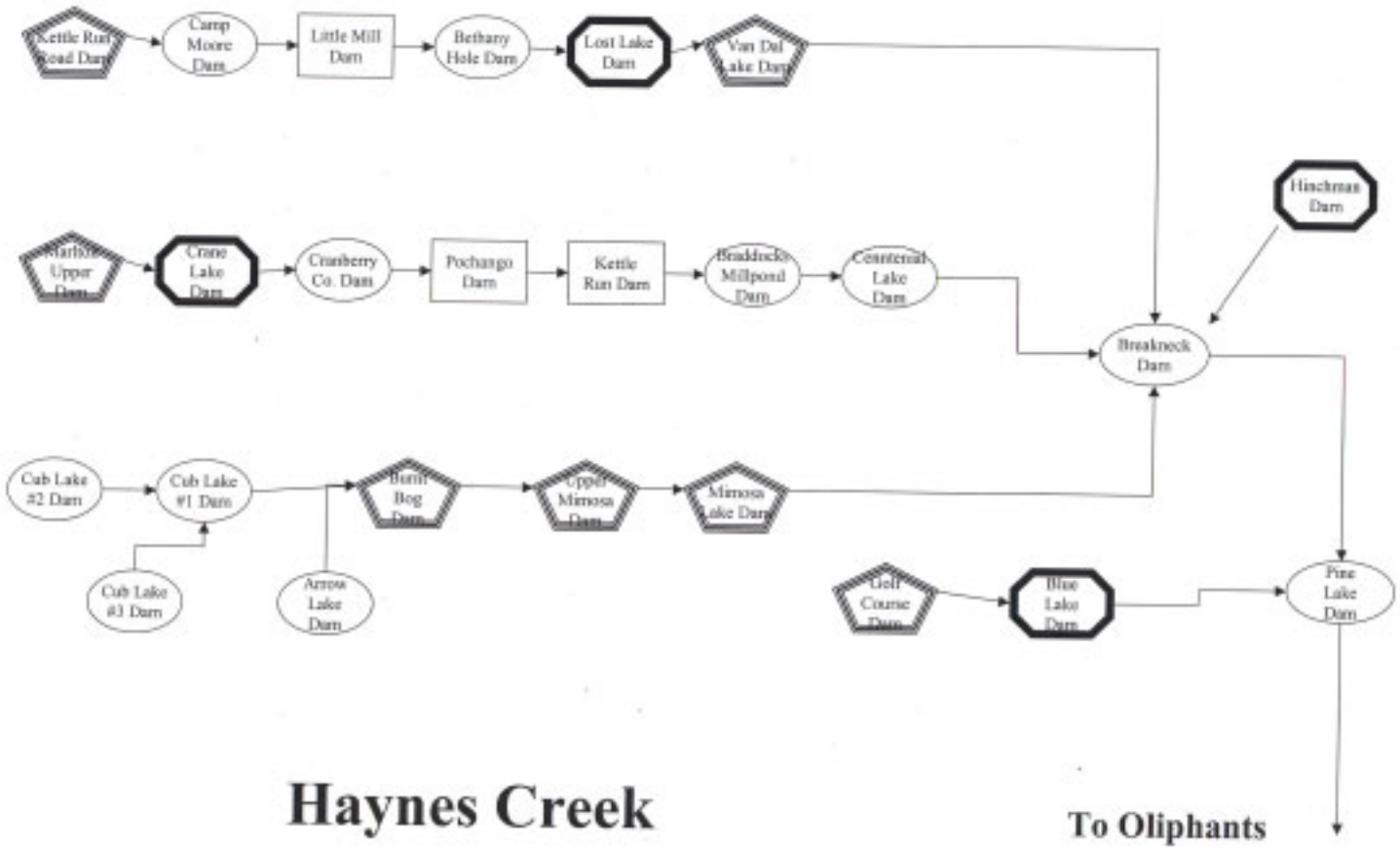

Rancocas
Creek
North Branch
Larchmont Dam
Confluence
Mill Dam
Smithville Dam
Pemberton Mill Dam
Mirror Lake Dam
Hanover Dam
From South Branch
Mt. Misery Dam
Pine Mill Lake Dam
Lebanon forest #1 DAm
Bayberry Street Dam
Country Lakes #2 Lower DAm
Bisphams Mill Dam
Country Lakes Dam #1
Country Lakes Dam #3
Lebanon Lake Dam
North Branch Rancocas
Lower Reeves Bog Dam
Reeves Bog B Dam



South Branch


Lake Villa Dam
Sunshine Lake Dam
Twin Lakes Dam
Cedar Lake Dam
Kroson Lake Dam
Confluence with South Branch
Sturbridge #2 Dam
Sturbridge #1 Dam
Sturbridge #3 Dam
Sturbridge #4 Dam
Sturbridge #5 Dam
Kenilworth #2 Dam
Kenilworth Lake Dam
Union Mill Lake Dam
Kenilworth #3 Dam
Tomlinson Mill Dam
Kirbys Mill Dam
Upper Lake Dam
Middle Lake Dam
Lake James Dam
Bartons Run
Southwest Branch
From Haynes Creek


Ballinger Run
To Oliphants
Timber Lake Dam
Birchwood Dam
Cranberry #3 Dam
Woodlake Dam
Coles Lake Dam
Cranberry #5 Dam
Cranberry #6 Dam
Ballinger Dam
Ouaque Dam
Mahe Mekwa Dam
Wagash Levee
Lake Siquilise Dam
Lake Meechaway Dam
Croft Dam
JCC Dam
Cardinal Ridge #3 Dam
Cardinal Ridge Upper Dam
Upper Stokes Dam
Lower stokes Dam
Big Look Trail Dam
Sarpe Dam
Square Lake Dam
Lake Stockwell Dam
Papoose Lake Dam
Upper Serna Dam
Lower Aerna Dam



Haynes Creek

To Oliphants

James E. McGreevey
Governor

State of New Jersey
Department of Environmental Protection
PO Box 402
Trenton, NJ 08625-0402

Bradley M. Campbell
Commissioner
Tel. # (609) 292-2885
Fax # (609) 292-7695

September 22, 2004

Major Harold Spedding, Co-chair
DR1530 Interagency Waterway
Infrastructure Improvement Task Force
530 Fellowship Road
Mt. Laurel, NJ 08540

Dear Major Spedding:

Thank you for the opportunity to provide you with our approach to the enforcement of dam safety standards in New Jersey and our proposals to increase the effectiveness of our efforts.

Existing dam safety laws provide us with limited administrative enforcement capability to achieve statewide compliance with dam safety standards. The only recourse we have for continued noncompliance is for the Office of the Attorney General to file a complaint in Superior Court seeking a compliance order and penalties of a maximum $5,000 per day. Given this limitation, we have focused our engineering and legal resources to successfully obtain compliance from owners of high hazard dams. However, in order to address all classes of noncompliant and structurally deficient dams, we recognize that more effective and efficient enforcement power is needed. We have been working with the state legislature to revise the existing statute to provide us with the administrative capabilities, such as monetary penalities and the authority to lower impoundments, to enforce our orders without court involvement.

New Jersey's Dam Restoration Loan Program received a substantial boost when Governor McGreevey supported the *"Dam, Lake, Stream, Flood Control, Water Resources and Wastewater Treatment Project Bond Act of 2003."* New Jersey voters approved the Bond Act in November 2003, providing an additional $95 million for low interest loans to rehabilitate dams throughout the State. We initially announced the loan availability in the February 17, 2004 New Jersey Register with an application deadline of May 17, 2004. We recently extended the deadline to September 30, 2004. We are now reviewing and prioritizing the loan applications we have received for submittal to the state legislature in accordance with the Bond Act requirements.

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I appreciate the work the Task Force has performed in response to the South Jersey floods. I am hopeful that this information supplements your review of our program and clearly indicates our intentions to aggressively improve our compliance record. If we can be of further assistance to you, please contact David Rosenblatt, Administrator, Office of Engineering and Construction at (609) 292-9236 or at dave.rosenblatt@dep.state.nj.us.

Sincerely,

Bradley M. Campbell
Commissioner

James E. McGreevey
Governor

State of New Jersey

Department of Environmental Protection
PO Box 402
Trenton, NJ 08625-0402

July 29, 2004

Bradley M. Campbel
Commissioner
Tel. # (609) 292-288
Fax # (609) 292-769

Dear Dam Owner:

The recent extreme rainfall and subsequent flooding experienced in Burlington County on July 12, 2004 resulted in failed and damaged dams. The photos presented in this letter should demonstrate to you the devastating effects of this recent event. Many of the dams classified as significant hazard were impacted due to inadequate spillway capacity, a common deficiency in dams throughout New Jersey. In all dam failure cases during this event, the dams were not in compliance with the New Jersey Dam Safety Standards, N.J.A.C. 7:20-1.1 et seq., which require dams to be able to pass a specific flood event as assigned by the Dam Safety Standards according to hazard classification

Governor James E. McGreevey signed legislation on August 22, 2003 authorizing a ballot referendum to financially assist in the restoration of dams that threaten public safety or are part of other flood control projects. New Jersey voters approved the "Dam, Lake, Stream, Flood Control, Water Resources, and Wastewater Treatment Project Bond Act of 2003" in November 2003, providing $95 million in low interest loans for dam owners. During an initial application period from February 17 to May 17, 2004, we received 50 applications requesting a total of approximately $64 million. In response to the significant flooding in Burlington County, Governor McGreevey has reopened the period for acceptance of loan applications for the restoration of dams, making available an additional $31 million in the program. The notice of extension will be published in the August 16, 2004 New Jersey Register; all applications must be received by September 30, 2004.

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Public and private dam owners, responsible for complying with New Jersey's Dam Safety Standards, are eligible for these restoration loans. Private dam owners requesting these loans must have a local government unit act as co-borrower on the loan. To be eligible for the funding, the dam owner must have a plan and cost estimate prepared by a New Jersey licensed professional engineer identifying the proposed restoration to the dam necessary to bring it into compliance with the Dam Safety Standards. Additional information can be obtained from the Dam Safety Program web page at www.state.nj.us/dep/damsafety.

Please do not miss this opportunity for financial assistance in fulfilling your critical obligations as a dam owner. If you have any further questions, please contact David Rosenblatt, Administrator, Office of Engineering and Construction at (609) 292-9236.

Sincerely,

Bradley M. Campbell
Commissioner

FAQ's New Jersey Dams

Finding 4

Frequently Asked Questions concerning the New Jersey Dam Safety Program

From the NJ Dam Safety Web Site

Q. 1. What is a dam?
A. 1. A dam is any artificial dike, levee or other barrier, together with appurtenant works, which is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of-dam. See the graphical demonstration of the definition of a dam.

Q. 2. How do I measure dam height?
A. 2. Height of dam is the vertical dimension when measured from either the invert of the outlet pipe or, in the absence of an outlet pipe, the lowest point in the stream bed or ground surface at the downstream toe of dam, whichever is lower, to the top-of-dam. See the graphical demonstration of the definition of a dam.

Q. 3. Do I need a permit to work on my dam?
A. 3. If you are performing any work outside of general maintenance (i.e.: light vegetation removal, clearing of debris, and filling of minor erosion and animal burrows) that affects the physical structure or performance of a dam, a permit from this office must be obtained. If you are unsure of whether or not a permit is required for the type of work that you are planning, please contact this office prior to commencement of the activities.

Q. 4. What kind of permit do I need?
A. 4. A Dam Construction Permit Application is required for the following:
- Construction of a new dam.
- Repair, modification or rehabilitation of an existing dam.
- Removal of an existing dam.

Q. 5. What is required for a permit for dam construction, repair or rehabilitation?
A. 5. In addition to a completed Dam Construction Permit Application, the requirements of the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.6 Sections a-c) and (N.J.A.C. 7:20-1.7 Sections a-g) Application Stages must be met.

Q. 6. What is required for a permit for dam removal or decommissioning?
A. 6. In addition to a completed Dam Construction Permit Application, the requirements of the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.7 Sections h-i) Application Stage must be met.

Q. 7. What qualifies as a Class IV dam?
A. 7. A Class IV Dam must meet the following:
- Drainage area must be less than 150 acres.
- Dam Height must be less than 15 feet.
- Dam must not have the potential to impound more than 15 acre-feet of water.
- Dam must pose Low Hazard potential.
- Spillway capacity must safely pass the 24-hour 100-year frequency Type III storm plus 50 percent.

The complete definition of a Class IV dam is listed in the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.8 a-4). You may also see the graphical demonstration of the definition of a dam.

Q. 8. Are trees allowed on dams?
A. 8. No. Significant vegetation impedes the inspection process and can hide serious deficiencies that may be occurring at a dam. Additionally, the root structure of trees affects the structural integrity of the dam, can cause seepage pathways for water through the dam, and can cause significant section loss if uprooted. Any one of these factors alone can contribute to the failure of a dam. For a complete listing of general requirements and design criteria, please refer to the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.4 and1.9).

Q. 9. Are dams in the Pinelands area exempt from state statutes?

A. 9. The Safe Dam Act grants the Department jurisdiction over dams within the pinelands region that meet the following requirements: dam height greater than eight (8) feet, reservoir greater than 100 acres in area or contributing drainage area exceeding 1 square mile. However, the Department does not regulate any dam used for agricultural purposes within the special agricultural production area (SA) within the pinelands region. Please contact this office if you are unsure whether or not a dam meets these specifications.

Q. 10. What do the different classifications of dams mean?

A. 10. There are four hazard classifications of dams in New Jersey. The classifications relate to the potential for property damage and/or loss of life should the dam fail:

- Class I (High-Hazard Potential) - Failure of the dam may result in probable loss of life and/or extensive property damage.
- Class II (Significant-Hazard Potential) - Failure of the dam may result in significant property damage; however loss of life is not envisioned.
- Class III (Low-Hazard Potential) - Failure of the dam is not expected to result in loss of life and/or significant property damage.
- Class IV (Small-Dam Low-Hazard Potential) - Failure of the dam is not expected to result in loss of life or significant property damage. Dam must also meet the requirements of a Class IV dam above.

For a complete description of the Dam Classifications, see the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.8).

Q. 11. What is an Emergency Action Plan (EAP)?

A. 11. The purpose of an EAP is to help save lives and reduce property damage in the event of a dam failure or other uncontrolled release of water. An EAP is a formal document that:

1. Identifies Potential Emergency Conditions and Specifies Pre-Planned Responses.
2. Provides for Early Notification to Local, County and State OEM Officials.
3. Provides Inundation Mapping of Potentially Flooded Areas.

Q. 12. What dams require Emergency Action Plans (EAPs)?

A. 12. All Class I (High-Hazard Potential) and Class II (Significant-Hazard Potential) dams require Department-approved Emergency Action Plans (EAPs). It is the responsibility of the owner of the dam to review and update the EAP annually. See the Guidelines for Developing an Emergency Action Plan for additional information.

Q. 13. What are dam inspections?

A. 13. Dam Safety Inspections are intended to identify conditions that may adversely affect the safety and functionality of a dam and its appurtenant structures; to note the extent of deterioration as a basis for long term planning, periodic maintenance or immediate repair; to evaluate conformity with current design and construction practices; and to determine the appropriateness of the existing hazard classification. For addition information regarding the different types of dam inspections and a standard regular inspection checklist, please see the Inspection Guidelines.

Q. 14. How often are dams required to be inspected?

A. 14. The inspection requirements depend on the size and hazard classification of the dam:

Dam Size/Type	Regular Inspection	Formal Inspection
Class I Large Dam	Annually	Once every 3 years
Class I Dam	Once every 2 years	Once every 6 years
Class II Dam	Once every 2 years	Once every 10 years
Class III Dam	Once every 4 years	Only as required
Class IV Dam	Once every 4 years	Only as required

For complete inspection and operating requirements for dams, see the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.11).

Q. 15. What is an Operation and Maintenance Manual (O&M)?

A. 15. An Operation and Maintenance Manual (O&M) is a formal document that provides guidance and instruction to project personnel for the proper operation and maintenance of the reservoir and dam

National Dam Safety Program

Finding 5

Highlights from A Report To The Congress for Fiscal Years 2000 – 2001 Regarding the National Dam Safety Program Act

Strengthening State Programs

The primary purpose of the National Dam Safety Program Act is to provide financial assistance to the states for strengthening their dam safety programs. In Fiscal Year (FY) 2000 and 2001, FEMA distributed a total of $8 million for dam safely to all of the participating states, including New Jersey, and Puerto Rico.

There have been two notable improvements in the Nation's dam safety as a result of the state assistance funding. In 1998, the National Dam Safety Review Board, which was established by the National Dam Safety Program Act and serves as the leading national advisory group on dam safety, developed performance criteria for the states. The performance criteria are designed to capture information on the number of state-regulated high- and significant-hazard potential dams in each state with an Emergency Action Plan (EAP), the number of dam inspections conducted each year by each state, and the number of dams that have been identified by the states as in need of remediation.

A comparison of baseline data from the states for 1998-1999 and 2000-2001 indicates tangible increases over the past 2 years. On average, the states are reporting a 7 percent increase in the number of EAP's for state-regulated high- and significant-hazard potential dams. The number of dam inspections conducted by the states also increased dramatically since data was first collected for 1998-1999, from a total of approximately 13,000 inspections for 1998-1999 to 16,000 inspections for 2000-2001, an increase of 25 percent.

Advancing the State-of-the-Practice through Research

Research funding addressed a cross-section of issues and needs in FY 2000 and 2001, all in support of ultimately making dams in the United States safer. An important component of the research program is the focus on the sharing of research between the federal, state, and private sectors.

In April 1999, the first full year of Program funding, a list of research needs and priorities for dam safety was developed. Since that time, the Research Subcommittee has sponsored a series of workshops. As information has become available from the workshops, laymen's guides, expert level guides, and research workshop summaries have been produced. An important element of the research program is the integration of research results into training at the FEMA National Emergency Training Center and at other sites.

Over the next 5 years, the partners in the National Dam Safety Program will develop a long-term plan to identify and address research needs; to advance the state-of-the-practice; and to prototype successful activities, such as the research workshops, training, and expert level documentation. A primary strategy for the research program will be to broaden outreach and partnering efforts to agencies such as the United States Geological Survey, the National Science Foundation, and the National Weather Service, and to universities and the private sector.

Training Dam Safety Professionals and Dam Owners

Since the inception of the National Dam Safety Program in 1979, FEMA has supported a very strong, collaborative training program for both dam safety professionals and dam owners. With the training funds provided under the 1996 Act, FEMA has been able to expand existing training programs, begin new initiatives to keep pace with evolving technology, and enhance the sharing of expertise between the federal and state sectors.

Developing Information Technology Tools

A primary objective of FEMA in its leadership of the Program is to identify, develop, and enhance technology-based tools that can help educate the public and assist decision-makers.

The National Performance of Dams Program, the National Inventory of Dams, and the Dam Safety Program Management Tools program have received major emphasis and funding under the National Dam Safety Program and are collecting invaluable data on the status of dams, dam incidents, and dam safety programs in the United States. In turn, these data are assisting Program partners in better documenting failure modes and identifying research and training needs.

Critical to the effective management of the Nation's dams is the need for comprehensive and complete information resources that support day-to-day dam safety activities and the development of effective dam safety policies. To meet these information needs, FEMA created the

National Dam Safety Information Technology Committee (NDSITC) in 2000 and charged the Committee with the task of developing a strategic plan for a national dam safety information technology system. The strategic plan calls for the development of a virtual dam safety information technology network. The network will:

- Provide all basic data information needs for dam safety professionals that relate to the state of dams in the United States.
- Improve the efficiency and effectiveness of data collection, giving data providers the capability for seamless data submittal.
- Provide users with easy access and retrieval capabilities to a variety of distributed digital assets that support dam safety needs.
- Make available to users information on changes in the condition of the Nation's dams that are identified as a result of routine analysis of data from dam inspections and incidents.
- Maintain an awareness of the needs of the dam safety community, updating data accessibility as information needs change.
- Offer the opportunity to capture the explosion of valuable information, which if retrieved in a timely and efficient manner, can support continued developments in dam engineering and safety.

Maintaining Strong Federal Programs

Although the Federal Government owns or regulates only about 5 percent of the dams in the United States, many of these dams are significant in terms of size, function, benefit to the public, and hazard potential. Since the implementation of the *Federal Guidelines for Dam Safety* in 1979, the federal agencies have done a commendable and credible job in ensuring the safety of dams within their jurisdiction.

During this reporting period, there was increased cooperation and coordination between the federal agencies and the states in many areas, such as emergency action planning, inspections, research and development, training, and information exchange. It is evident that the partnerships that have been fostered and enhanced by collaborative activities under the National Dam Safety Program Act are helping to meet the primary goal of the Act: "to reduce the risks to life and property from dam failure in the United States through the establishment and maintenance of an effective national dam safety program to bring together the expertise and resources of the Federal and non-Federal communities in achieving national dam safety hazard reduction."

Additional Reading:

FEDERAL GUIDELINES FOR DAM SAFETY:
Available on the internet or from FEMA Publications: 1 (800) 480-2520

EMERGENCY ACTION PLANNING FOR DAM OWNERS
FEMA Publication # 64, April 2004

SELECTING AND ACCOMMODATING INFLOW DESIGN FLOODS AND DAMS
FEMA Publication # 94, 1998

HAZARD POTENTIAL CLASSIFICATION SYSTEM FOR DAMS
FEMA Publication # 333, 1998

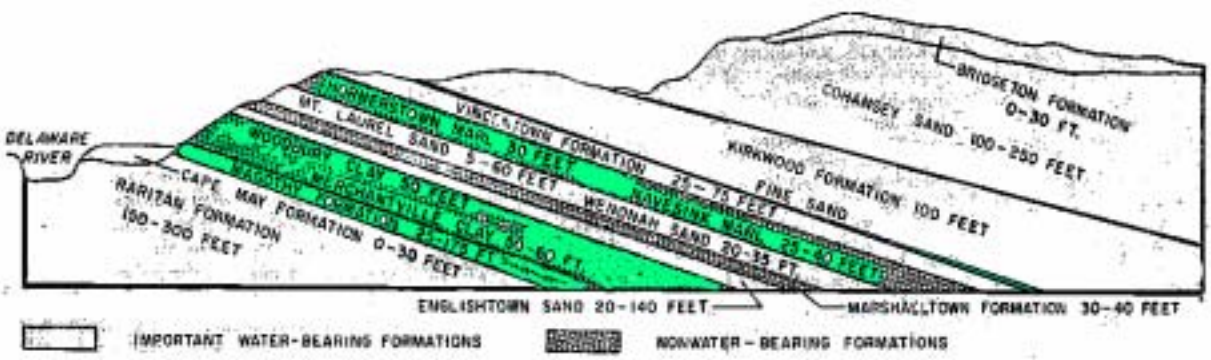
Soil – Water Relationships / Geology

Finding 6

Prepared by FEMA on September 21, 2004

The Rancocas Creek flows west and northwest to the Delaware River, traversing a geologic province known as the Coastal Plain. The Coastal Plain is characterized as a wedge shaped, southeast dipping, sequence of unconsolidated marine-deposited sediments. The sequence is alternating layers of sand, silt and clay deposited by rising and falling sea levels over 145 million years of geologic time.

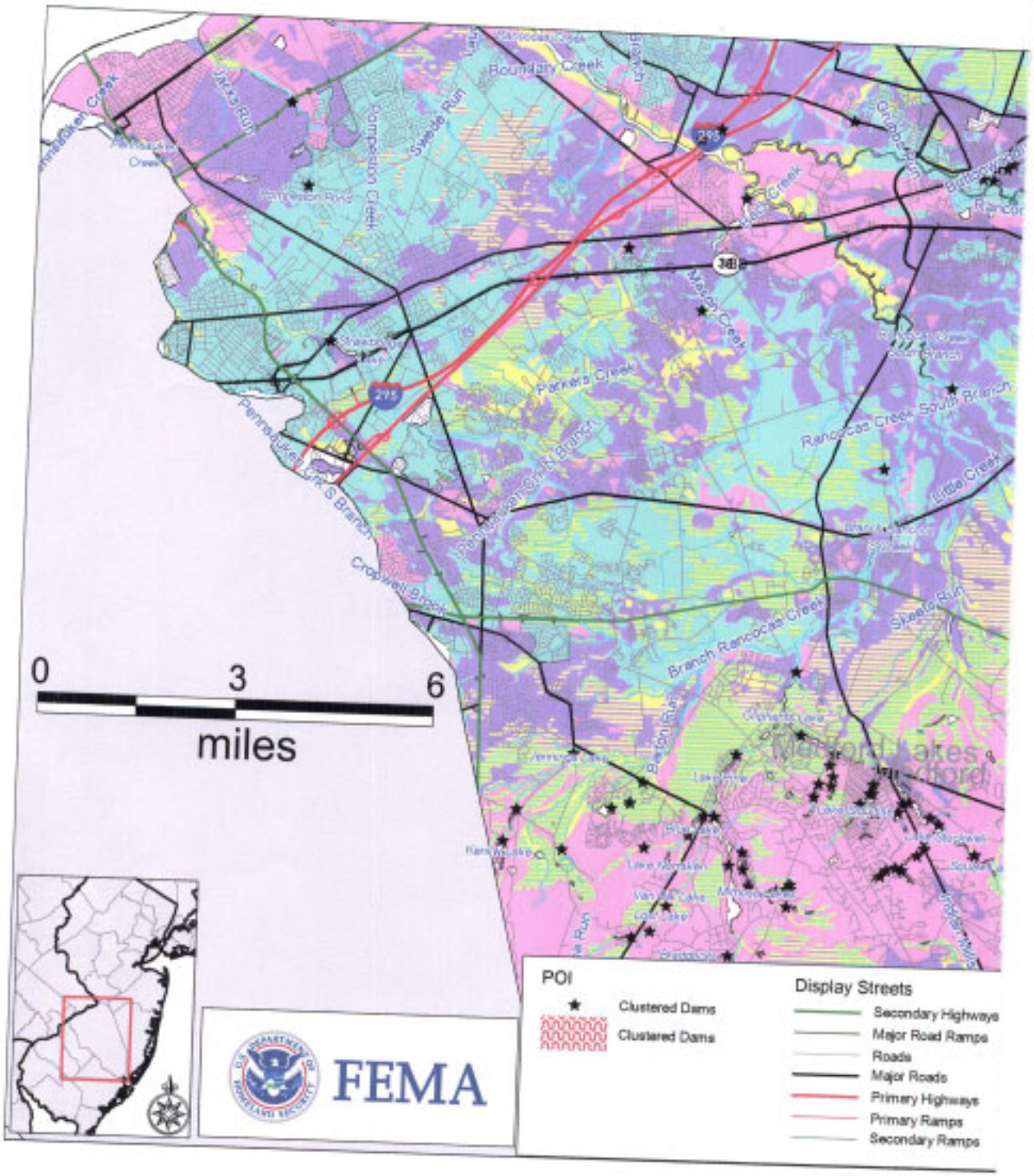
The oldest sediments exist at the Delaware River and extend west into Pennsylvania (Raritan Fm). The depositional wedge becomes progressively younger to the east (Kirkwood- Cohansey Fms). The two formations shown as cap deposits, the Bridgeton and Cape May Formations are regarded as freshwater sediments laid down during the past 1.8 million years. The west-east oriented cross section below demonstrates the Coastal formation sequence. All formations shown in white below are sandy, water bearing aquifers while those shaded layers consist of less permeable, silty and clayey sediments that function as confining layers.



The attached map on the following page titled Hydrologic Soils Group was generated by FEMA from New Jersey G.I.S. data. The map depicts the basin divided into four (4) groups of soils that have similar water infiltration and transmission characteristics based on soil texture and position above the water table. The classifications, known as Hydrologic Soils Groups, are based on the National Soil Survey by the Natural Resource Conservation Service (NRCS). The National Soil Survey defines the classes as follows:

A. (Low runoff potential). The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission. Map Color Code - Pink
B. The soils have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well-drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission. Map Color Code - Purple
C. The soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission. Map Color Code – Green
D. (High runoff potential). The soils have a very slow infiltration rate when thoroughly wetted. They chiefly consist of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface. They have a very slow rate of water transmission. Map Color Code – Yellow

Continued on page 30.



0
3
6
miles
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Clustered Dams
Clustered Dams
Display Streets
Secondary Highways
Major Road Ramps
Roads
Major Roads
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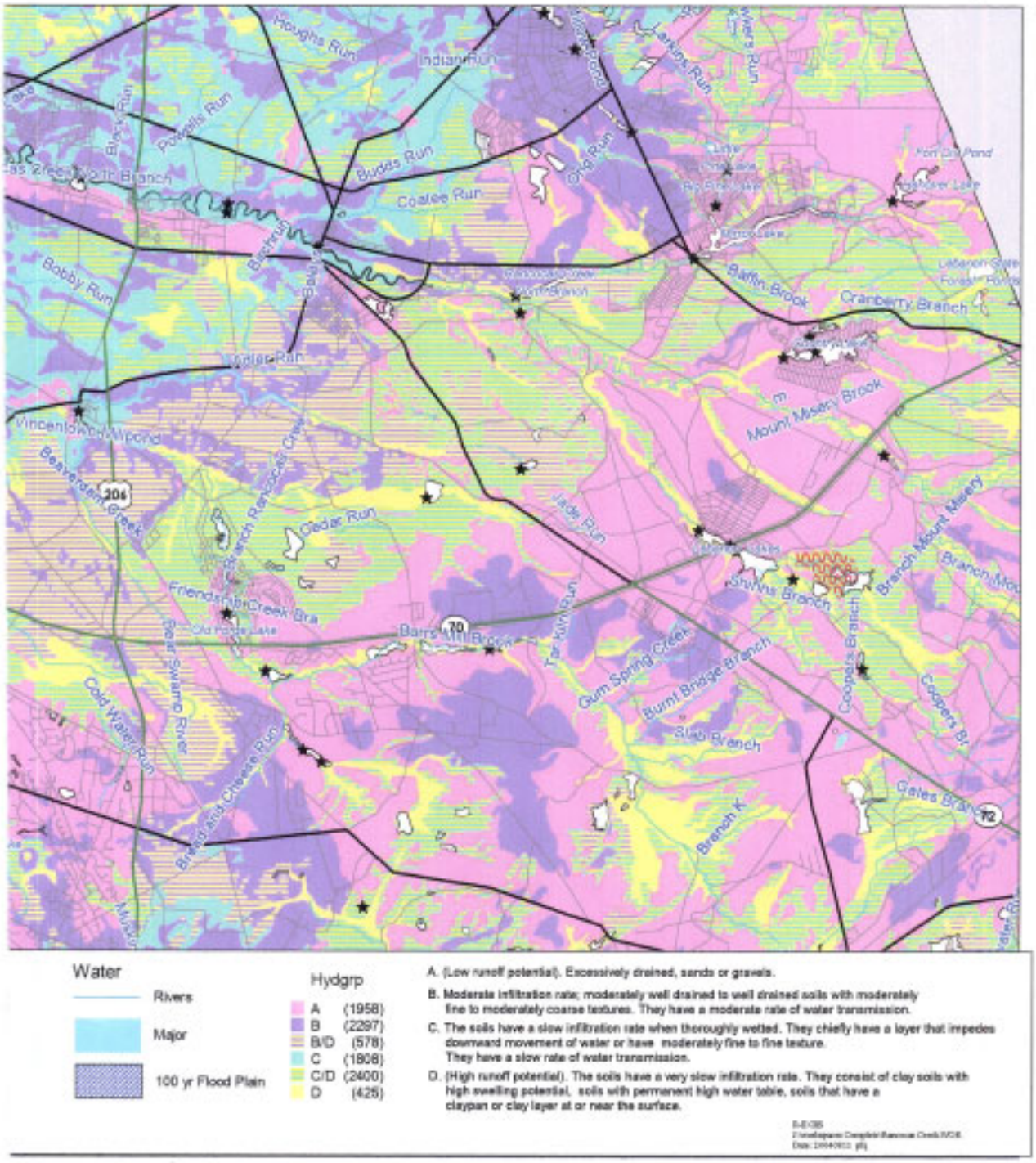
Primary Ramps
Secondary Ramps
FEMA
Boundary Creek
Swede Run
Pompeston Creek
Parkers Creek
Rancocas Creek South Branch
Little Creek
Branch Rancocas Creek
Cropwell Brook
Pennsauken Crk S Branch
Medford Lakes

Hydrologic Soil Groups



The Rancocas Creek headwater areas, some 25 miles east and southeast of the Delaware River, chiefly consist of Class 'A' soils with low runoff potential. Precipitation infiltrates to recharge aquifers. These soils are derived from the Tertiary-aged Cohansey and upper Kirkwood Sand formations shown above on the eastern side of the geologic cross section. Down stream reaches of the Rancocas traverse soil groups and sediments that progressively get finer in texture, slower in permeability and water transmission rates, and generally, will generate more storm water runoff.

Environmental factors such as surface cover, vegetation density, slope and surface soil density contribute significantly to the quantity of surface water runoff generated during a precipitation event. However, addressing only the Hydrologic Soil Group variable, the attached map correlates soil types as generating increasing quantities of runoff from lands on the western, down stream reaches of the Rancocas Creek drainage.

Stream Gage Summary: Burlington and Camden Counties

Finding 7

Prepared by New Jersey Office of Emergency Management September 2004

I. What is a "Flood Warning System"?

There are many configurations for "flood warning systems" that include both manual and automated systems. The type of system a community chooses depends upon variables that include assessed need, costs, existing systems, potential application, and other considerations. There is no single method that suits every community or basin.

For warning capabilities, it is essential that users – emergency managers, for example – are well trained and well versed in the system and can translate data into action. Additionally, gages are not always needed in each community, as well-placed gages in a basin will serve all communities for that area.

To have an efficient, effective system, it is imperative that the Hydrologist for the local National Weather Service Weather Forecast Office and the State's USGS representative be included in assessment, planning and implementation of the system. NOTE: The National Weather Service is the only agency mandated by the Federal Government to have authority to issue Flood Watches and Warnings, thus for the system to be fully effective, all data must be provided to the NWS.

Also of importance is the consideration that warning times must be long enough in advance to provide time for action. In smaller basins, such as found in Burlington and Camden Counties, emergency managers must anticipate gage response to a rising waterway rather than taking action only when a gage reaches flood stage. Actions taken will depend on the severity of rainfall, soil moisture conditions and other variables that contribute to flooding. Decisions should be made in conjunction with forecasts from the NWS.

II. Current Streamflow Gaging of the Rancocas Creek, Cooper River and Pennsauken Creek

The USGS maintains gages along the Rancocas Creek, Pennsauken Creek and Cooper River as follows:

NAME/LOCATION	PURPOSE	FUNDING
S. Branch of the Rancocas/Vincentown	Drought monitoring	DEP
N. Branch of the Rancocas/Pemberton	Water supply monitoring	DEP
Greenwood Branch at New Lisbon	Water supply monitoring	Ft. Dix
Cooper River at Haddonfield	Water supply monitoring	DEP
S. Branch of the Pennsauken at Cherry Hill (data not in real-time)	Water supply monitoring	DEP

Additional gages for the Rancocas basin are to be installed in FY 2005 with funds from the NWS as a pass-through grant to Burlington County via NJOEM. Operations and maintenance funding will be provided by Burlington County. The first two gages listed will transmit hourly stage data to be displayed on the USGS website, and there will be a telephone connection to allow emergency managers to call the gages for current data. Proposed stream gage locations are as follows:

NAME/LOCATION	PURPOSE	FUNDING
N. Branch of the Rancocas, Iron Works Park Dam	Flood monitoring	Burlington Co.
S. Branch of the Rancocas at Kirby's Mill	Flood monitoring	Burlington Co.
Crest stage gage at Smithville	Flood monitoring	Burlington Co.

NOTE: The exact placement of these gages is pending re-assessment since recent flooding.

The addition of rain gages as well as stream gages in the Rancocas is also being evaluated at this time. It is imperative in any basin to monitor rainfall for potential flooding conditions, and this is crucial in smaller basins such as the Rancocas. The NWS and USGS will provide assessment and recommendations and the NJOEM will seek funding for these gages as appropriate. This project will occur during FYs 2005-2006.

III. Options for the Counties and Municipalities

A variety of options exist for potential flood warning system owners and operators. The range of gages spans from simple staff gages to state-of-the-art gages with complex telemetry. Consultation with the local NWS WFO Hydrologist and the State USGS should determine what is needed and what can be afforded. It should not be assumed that placing gages on a stream will "fix" a flooding problem – gages should be placed at appropriate points to enhance forecasts and emergency managers involved must become fully able to interpret and act on information provided by the flood warning system and NWS forecast products.

The National Weather Service Office of Hydrologic Development's "Automated Flood Warning Systems Handbook" (1997) discusses various options for such systems. NOTE: It is recommended that potential owners of a desired flood warning system carefully read this Handbook prior to conferring with the NWS and USGS about customizing a system for their jurisdiction. *They should also be aware that these systems could cost hundreds of thousands of dollars to purchase and install, and tens of thousands to hundreds of thousand of dollars annually to maintain and operate*.

Despite all the equipment, the success of the warning system is essentially what emergency managers do with information. In assessing options, it is of utmost importance to consider how this information will be used and how warnings will be disseminated. If the technical system of gages is improved but notification systems between managers and the public remain the same, the system will not have been improved. Warning procedures must be written, practiced and revised regularly.

IV. The Role of the New Jersey Office of Emergency Management, Recovery Bureau

The Preparedness Unit of the Recovery Bureau, NJOEM can provide guidance, advocacy, information and liaison/coordination services to potential owners of flood warning systems. The Unit currently serves as liaison to the National Weather Service, US Geological Survey, National Hydrologic Warning Council and other relevant agencies, and also coordinates long-term flood warning planning for the State.

The Preparedness Unit also provides guidance in development of formal warning procedures and manages a limited amount of grants based on funding to the State from FEMA, NWS and other sources, as available. The Unit can serve as "one-stop-shopping" for reference and guidance in the process of flood warning system development, making referrals to appropriate agencies and providing answers to frequently asked questions.

Investigations into funding support under FEMA's Hazard Mitigation Grant Program (HMGP) can be directed to the Recovery Bureau's Mitigation Unit as such projects may now be eligible under HMGP programming.

V. For More Information

- National Weather Service Office of Hydrologic Development's "Automated Flood Warning Systems Handbook" (1997) www.nws.noaa.gov/oh/docs/alfws-handbook/
- "Real-time Surface-Water Monitoring in New Jersey, 2003" Schopp, Stedfast and Navoy (USGS). http://nj.usgs.gov/publications/FS/fs-048-03/
- USGS Real-time NJ stream flow data: http://waterdata.usgs.gov/nj/nwis/rt
- Advanced Hydrologic Prediction Service (AHPS) NJ data: http://ahps.erh.noaa.gov/cgi-bin/ahps.cgi?phi
- National Weather Service Weather Forecast Office, Mt. Holly, NJ: www.nws.noaa.gov/er/phi/
- NWS Middle Atlantic River Forecast Center: www.erh.noaa.gov/er/marfc/
- "Working Together to Save Lives": National Weather Service Advanced Hydrologic Prediction Service".

NJOEM Phone contacts:	Recovery Bureau, Preparedness Unit	(609) 882-2000
	Recovery Bureau, Mitigation Unit	(609) 882-2000

USGS Ideas for Improvement

Finding 8

Prepared by USGS

Flood Warning System

In the area with significant flooding during the July 12-14, 2004 storm there are only 2 real-time stream gages and 1 real-time rain gage that were installed and operation and maintenance funded for flood-warning purposes. Three other stream gages and 1 rain gage have real-time telemetry which was installed for purpose of water-supply and drought-monitoring purposes. These gages performed reasonable well during the recent flood. Improvements in these gages and additional gages are needed in the flood area to better respond to floods.

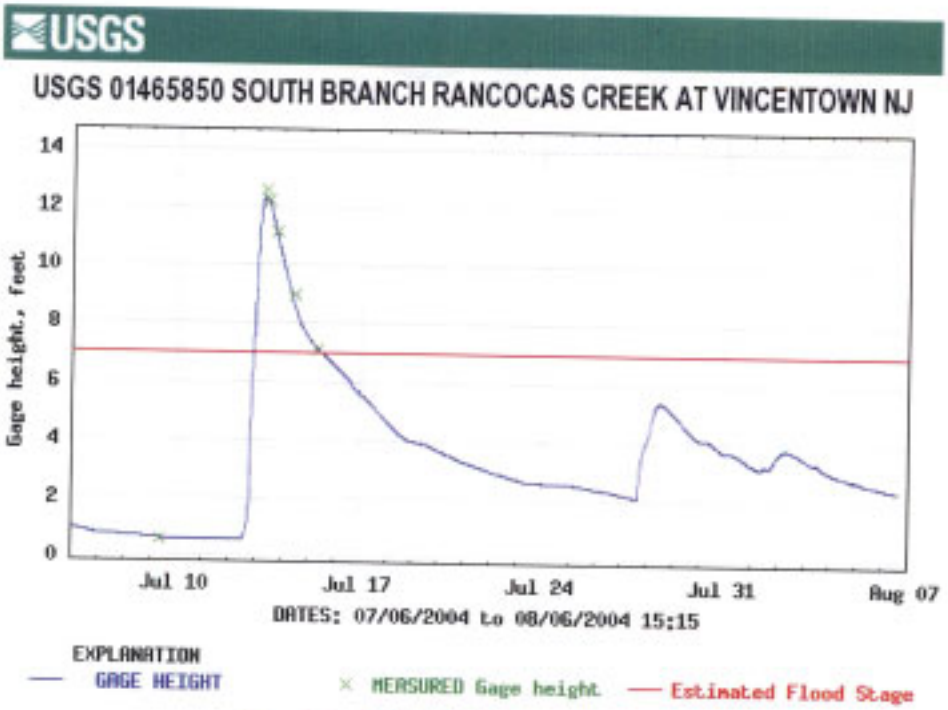
At least 2 or 4 additional real-time rain gages are needed in the area of Burlington County adjacent to Camden County. One additional real-time stream gage is desirable on the Southwest Branch Rancocas Creek at Medford. Several of the existing stream gages needed their satellite telemetry equipment upgraded to give data on a more frequent basis. One existing gage on the South Branch Pennsauken Creek should have satellite telemetry equipment installed.

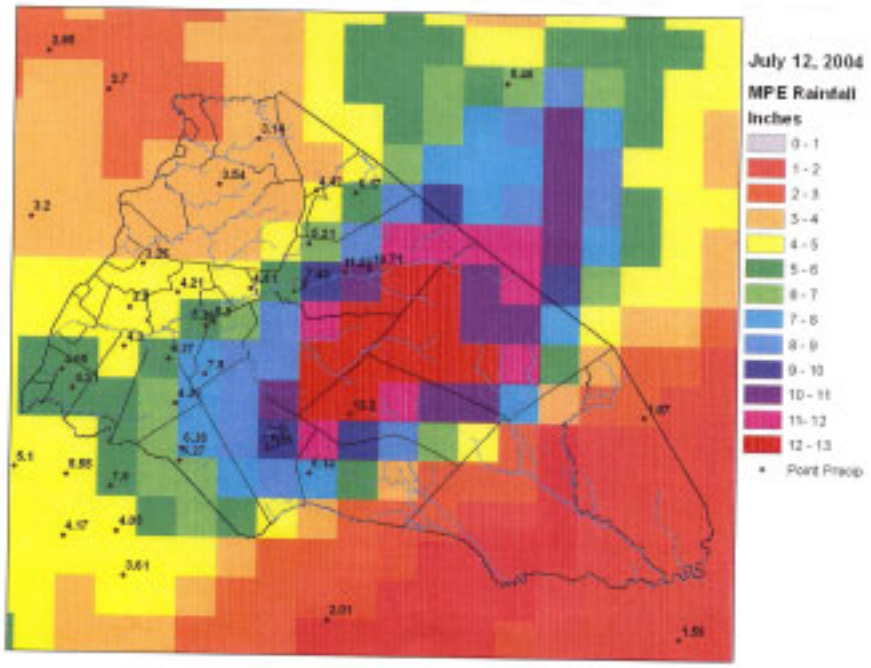
The estimated capital cost of these various upgrades is estimated to be close to $80,000. The recurring annual cost to operate and maintain this equipment is about $32,000. The cost of the upgrades could possibly be funded by grants from the National Weather Service through the New Jersey State Police, Office of Emergency Management or possibly FEMA. The annual operation and maintenance cost might be born by the County of Burlington.

Here is a listing of the proposed upgrades along with their costs:

IDEAS FOR IMPROVING FLOOD WARNING IN VICINITY OF LUMBERTON FLOOD AREA

	Capital Cost $	Annual Operation & Maintenance $
1. Upgrade satellite radio at North Branch Rancocas Creek at Pemberton gaging station to allow transmissions every hour rather than the present four-hour interval	4,800	0
2. Upgrade satellite radio at Greenwood Branch at New Lisbon gaging station to allow transmissions every hour rather than the present four-hour interval.	4,800	0
3. Upgrade satellite radio at Cooper River at Haddonfield (Camden County) gaging station to allow transmissions every hour rather than the present four-hour interval	4,800	0
4. Add a satellite data transmitter to the South Branch Pennsauken Creek at Cherry Hill (Camden County) gaging station.	12,200	3,000
5. Install heated tipping-bucket rain gage connected to South Branch Rancocas Creek at Vincentown gaging station.	5,900	1,400
6. Install gaging station with rain gage on Southwest Branch Rancocas Creek at Medford	24,700	16,000
7. Install two stand-alone tipping bucket rain gages with telemetry in headwater areas of southwestern Burlington County	19,800	10,800
Total	77,000	31,200


USGS
USGS 01465850 SOUTH BRANCH RANCOCAS CREEK AT VINCENTOWN NJ
Gage height, feet
14
12
10
8
6
4
2
0
Jul 10
Jul 17
Jul 24
Jul 31
Aug 07
DATES: 07/06/2004 to 08/06/2004 15:15
EXPLANATION
GAGE HEIGHT
MEASURED Gage height
Estimated Flood Stage
Provisional Data Subject to Revision


July 12, 2004
MPE Rainfall
Inches
0 - 1
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REAL-TIME SURFACE-WATER MONITORING IN NEW JERSEY, 2003

A network of 93 gaging stations that provide surface-water stage, flow (discharge), and tide-level data on a "real-time" basis through satellite, radio, and telephone telemetry is operating (May 2003) in New Jersey through a cooperative effort of the U.S. Geological Survey (USGS) and other agencies. The stream data from these stations are transmitted every 1 to 4 hours and then are immediately posted for viewing on the Internet. This fact sheet describes the "real-time" monitoring network, and the equipment used to measure stage and flow and to transmit the data for viewing on the Internet. Instructions for viewing the data are included. The agencies cooperating in the operation and maintenance of the "real-time" surface-water data network are

U.S. Army Corps of Engineers
U.S. Department of Defense
N.J. Dept. of Environmental Protection
N.J. Dept. of Transportation
Essex County, N.J.
Hunterdon County, N.J.
Somerset County, N.J.
Union County, N.J.
Brick Township Municipal Utilities Authority
Perth Amboy Water Department
Princeton Sewer Operating Committee
Westwood Borough, N.J.
Lake Hopatcong Commission
N.J. Water Supply Authority.

Background

This statewide network consists of several sub-networks that were created to provide time-critical surface-water data as well as information on long-term hydrologic conditions and trends in stream stage, flow (discharge), and tide levels within the State of New Jersey and to make the data available quickly. The gaging stations in these "real-time" networks, located throughout New Jersey (fig. 1), provide time-critical information for the monitoring of floods, droughts, and daily streamflow conditions needed for public safety; water-supply management; and the daily operations of water supply and receiving-water discharges. This combined statewide network, for example, provides data that allow for timely flood warnings to the public and evacuations in flood-prone areas. The system provides up-to-date observations of drought conditions for the optimum management of water supplies and up-to-date information on streamflow conditions for fishermen, canoeists, kayakers, boaters, and other recreational users. In addition, the data from this network can be used to estimate the most recent stream and tide conditions at nearby stations that do not have satellite telemetry.

Surface-water stage and streamflow information typically is used by engineers, planners, water-supply managers, emergency-management personnel, and the general public for a variety of purposes. Some of the uses for this streamflow information include incorporation into the design of bridges, dams, flood detention and control struc-

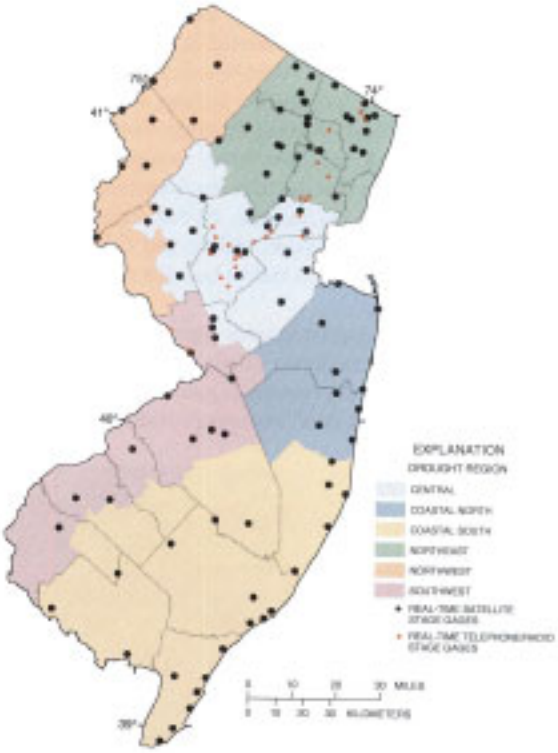


Figure 1. Location of current and planned gages that transmit "real-time" stage data.

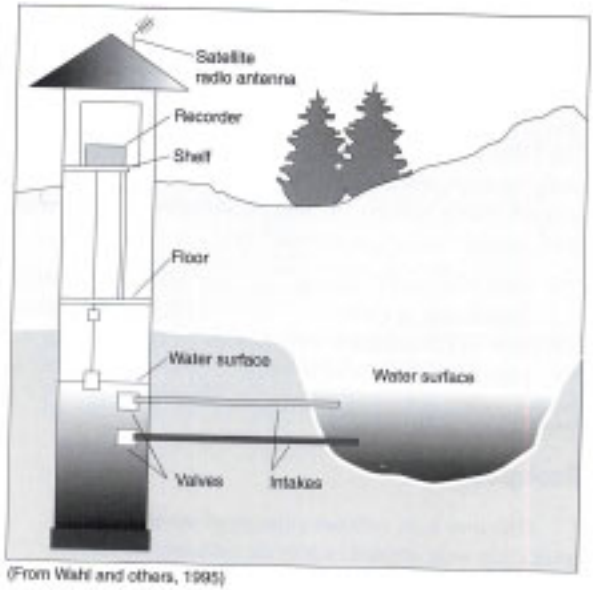
tures, and waterways, and consideration of up-to-date information on river water levels and streamflows for water-supply management, wastewater-treatment plant design and permitting, flood and drought warning and management, and long-term trend analysis. In addition, the general public often finds this information valuable for planning and decision making for outdoor recreational activities involving the State's waterways. The most critical use of "real-time" data are for flood monitoring and the timely evacuation of residents and the general public from flood-prone areas. In addition, during droughts the "real-time" data are used to keep water-supply managers and the general public accurately informed so that sound and timely water-supply management decisions can be made.

Description of the Network

Most continuous recording gaging stations are located on large streams with drainage areas of 10 square miles or more. The "real-time" statewide networks of gaging stations are part of several existing networks established for stream flood warning, coastal tide and storm-surge flood monitoring, and drought warning. Specifically these networks include the Passaic Flood Warning System, Somerset County Flood Information System, Rahway River and Pascack Brook Flood Warning Systems, New Jersey Tide Telemetry System, and New Jersey Drought Monitoring System. Fact sheets that describe the Somerset County Flood Information System (Summer, 1998a), Passaic Flood Warning System (Summer, 1998c), and Tide Telemetry System (Summer, 1998b) can be found at the http://nj.usgs.gov/ web site.

Most "real-time" gaging stations report both current stage and streamflow conditions. Gaging stations located in coastal back-bay areas generally report only tide-stage information. Some "real-time" stations provide information on local weather and water quality. Other characteristics recorded and transmitted at these sites include, but are not limited to, water and air temperatures, wind direction and speed, rainfall, barometric pressure, dissolved oxygen, pH, specific conductance, and turbidity.

Figure 2. Typical "real-time" surface-water gaging station equipped with a data-collection platform and satellite antenna.



(From Wahl and others, 1995)

Figure 3. Schematic drawing of a stilling well and shelter at a stream-gaging station.

Description of Data Collection and Reporting System

The stream stage (the level of the stream typically measured in feet above a datum point) or tide level at each station in the network is automatically measured at 6- or 15-minute intervals, and the value is stored by a data-collection platform (DCP) located on site (fig. 2, fig. 3, and fig. 4).

Every 1 to 4 hours, a burst of data is broadcast from the site to the National Oceanic and Atmospheric Administration's GOES (Geostationary Operational Environmental Satellite) satellite and relayed to a ground station. The data then are retransmitted by the DOMSAT (commercial) satellite to a USGS ground station, decoded, and automatically posted to the USGS, New Jersey District, Internet web page for viewing (fig. 5). Radio and telephone telemetry at some of the surface-water stations provides either an alternate pathway or, for some critical surface-water stations, a more direct pathway for the transmission of "real-time" information. The stage data for most of the stream-gaging stations are used to compute the stream discharge (the flow of the stream, typically measured in cubic feet per second) using an established relation between stage and flow, referred to as a rating curve.

Figure 4. U.S. Geological Survey tide gage at Cape May Harbor in Cape May, N.J., which transmits tide elevation and meteorologic data via satellite and VHF radio for emergency management and other purposes. (Photograph by Peter B. Reilly, U.S. Geological Survey)

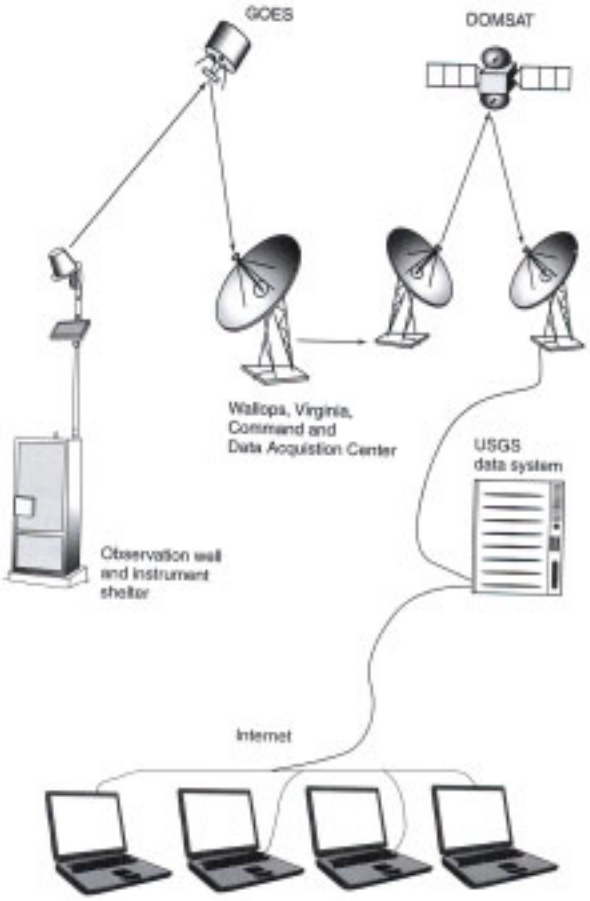


Figure 5. Schematic drawing showing data transmission from a gaging station through satellite telemetry to users on the World Wide Web.

To ensure the accuracy of the data, each station is visited every 6 to 8 weeks by a USGS hydrographer who makes field measurements of stage and discharge, checks the automated systems, and performs maintenance on the equipment. The field measurements of stage and discharge then are used to verify the relation of stage to discharge.

Where to View Data

The surface-water data from this network can be viewed by following these instructions:

1. Attach to the Internet web page, http://waterdata.usgs.gov/nj/nwis/current/?type=flow/ . This page lists each gaging station in the network and indicates the latest reported data.

2. Choose a gaging station by clicking on its Station Number. This leads to a page that contains a hydrograph of the stage and discharge data for the last 7 days (fig. 6) and a summary of the daily mean flow statistics. The hydrograph will have indicators for daily median flow and flood-stage levels, as appropriate.

3. The timeframe for a hydrograph can be modified from the past 7 days up to the past 31 days by changing the value for "Days" in the box located above the hydrograph and then clicking on the "get data" button. A new hydrograph will then be drawn. Note that clicking on the indicated text will draw a presentation-quality hydrograph that can be downloaded easily and printed by the viewer.

The daily mean flow statistics are provided on the web page to put the stage and discharge data in a historical context. The maximum, mean, and minimum flows (discharge) for the period of record for the gaging station are indicated. The 80, 50, and 20 percent exceedence values that are indicated are the flows that were surpassed by 80, 50, and 20 percent, respectively, of all daily mean flows. The latest flow value (obtained from the table or from the hydrograph) can be compared to these statistics.

Because the stage and flow data are shown automatically, the message "Provisional data subject to revision" is

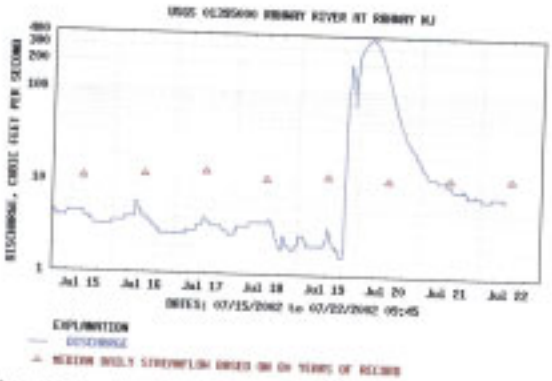


Figure 6. Example of an actual streamflow hydrograph that can be viewed and printed from the "real-time" network web page.

included on the web pages. If problems with the measurement, communication, or storage systems are found, revisions will be made to the USGS database at a later time to provide the corrected values.

The surface-water stations with radio telemetry that are a part of the Passaic Flood-Warning System transmit on an event reporting basis and update as frequently as every 5 minutes. This more frequent "real-time" data can be viewed at http://www.afws.net/ .

USGS, in cooperation with New Jersey Department of Environmental Protection and other agencies, regularly measures stage and flow at 27 other gaging stations in New Jersey. The data from these stations, although not posted on a "real-time" basis, are available on the web site http://waterdata.usgs.gov/nj/nwis/sw/ . Surface-water data for all stations routinely monitored by USGS, including those of the "real-time" network, are summarized in an annually published report (for example, Reed and others, 2002).

The ultimate goal of the USGS and other cooperating agencies is to have all surface-water gaging stations in New Jersey equipped with "real-time" telemetry equipment.

-- Robert D. Schopp, David A. Stedfast, and Anthony S. Navoy

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Reed, T.J., White, B.T., Centinaro, G.L., Dudek, J.F., Spehar, A.B., Protz, A.R., Shvanda, J.C., Watson, A.F., and Holzer, G.K., 2003, Water Resources Data, New Jersey, Water Year 2002, Volume 1. Surface-Water Data: U.S. Geological Survey Water-Data Report NJ-02-1, 364 p.

Summer, W.M., 1998a, Somerset County Flood Information System: U.S. Geological Survey Fact Sheet FS-090-98.

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Summer, W.M., 1998c, Passaic Flood Warning System: U.S. Geological Survey Fact Sheet FS-092-98.

Wahl, K.L., Thomas W.O., Jr., and Hirsch, R.M., 1995, The stream-gaging program of the U.S. Geological Survey: U.S. Geological Survey Circular 1123, 22p.

Related Internet Links

- The home page for the NJDEP is http://www.state.nj.us/dep/ .
- The home page for the NJDEP Water Supply Administration, which has information related to drought policy and declaration, is http://www.state.nj.us/dep/watersupply/ .
- The home page for USGS water-resources information for New Jersey is http://nj.usgs.gov/ .

For additional information contact:
District Chief
U.S. Geological Survey
810 Bear Tavern Road, Suite 206
West Trenton, New Jersey 08628
Telephone number: 609-771-3901
Email: dc_nj@usgs.gov

Options for Financing Dam Maintenance and Compensating Loss Caused by Dam Failure

Finding 9

New Jersey may want to explore methods of assuring the availability of funds to finance dam maintenance and to compensate those who are damaged by a dam failure or malfunction. Here is a synopsis of some ways to provide funds for these purposes.

1. Create one or more "special districts".
   Special districts are created by the State Legislature. A special district would become the owner of one or more dams. Special districts have taxing authority and, in this instance, the revenue generated could pay for maintenance and repair of the district's dams. The revenue might also be designated to compensate others for their losses caused by a dam failure or malfunction. Or revenue might be used to pay for an idea discussed below.

2. Require dam owners to furnish proof of "financial assurance" for dam maintenance.
   A dam owner could be required to purchase a bond, obtain a letter of credit, or create a fully-funded trust that would be available to the State to use to pay the costs of maintaining the owner's dam if the owner failed to maintain the dam. New Jersey's Water Pollution Control Act, N.J.S.A. 58:10A-1, et. seq., specifically N.J.S.A. 58:10A-6.1, and the regulations set forth at N.J.A.C. 7:14-8.3 provide an example of a financial assurance requirement.

3. Require dam owners to purchase liability insurance.
   At this time, New Jersey laws do not require dam owners to purchase liability insurance to compensate those who are damaged by a dam failure or malfunction. If this requirement were imposed, the availability and affordability of liability insurance for dams might become a problem.

   If mandating dam owners' purchase of liability insurance is not viable, the following ideas are alternatives.

4. Create one or more "captive insurance" companies.
   A captive insurance company is owned and controlled by those whom it insures. Although this may sound like self-insurance, an actual insurance company is created. Information is available on the internet using "captive insurance" as a Google search term.

   Under current New Jersey insurance law, there are no special approval procedures for captive insurance companies. Captives are subject to the same approval and operational requirements as any other insurance company.

5. Form "risk retention groups" or "purchasing groups" to purchase liability insurance.
   A risk retention group is an insurance company formed and chartered in a State to provide liability insurance to its members who have similar risk. Generally, a risk retention group is subject to regulation only by its State of domicile. A purchasing group is a group of members who have similar risk and who join together to purchase liability insurance coverage.

6. Ask the New Jersey Department of Banking and Insurance to place liability insurance for dams on the "surplus lines exportable list".
   The New Jersey "surplus lines" insurance market consists of risks for which insurance cannot be readily purchased from the regular market, called the "admitted market". Normally, a risk may be placed on, or "exported" to, the surplus lines market when a person demonstrates and the Department finds that insurance coverage for that risk is not readily available from the admitted market. Placement on the "surplus lines exportable list" streamlines the process of obtaining coverage for that risk from the surplus lines market.

   Proposed rules that will be applicable to surplus lines when the rules are adopted can be found on the Department's website, www.state.nj.us/dobi. On the home page select "Bulletins, Rules, Notices"; next select "Proposed New Rules – Comment Period Expired"; then select "Surplus Lines Insurance: Procurement Procedure".

   Anyone interested in implementing any of these ideas will have to determine the legal parameters, viability, and desirability of the idea. This discussion merely presents preliminary 'food for thought'.

Places to begin research include:

- Department of Banking and Insurance: www.state.nj.us/dobi - General Insurance laws: N.J.S.A. 17:17-1, et. seq.
- Department of Environmental Protection: www.state.nj.us/dep - Dam Safety laws: N.J.S.A. 58:4-1, et. seq.
- Office of Emergency Management: www.state.nj.us/njoem - Emergency Management laws: N.J.S.A. App. A:9-33, et. seq.

Burlington County Flood Impact Dams Funding Sources							
Storm Status	File #	Dam Name	Class	Municipality	NJ Loan App. *	FEMA **	SBA Loan ***
Failed	31-210	Kenilworth #2 Dam	S	Evesham Township			
Failed	31-067	Stokes-Lower Dam	S	Medford Township		X	
Failed	31-091	Lake Stockwell Dam	S	Medford Township	X		X
Failed	31-096	Birchwood Lake Dam	S	Medford Township	X		
Failed	31-056	Papoose Lake Dam	S	Medford Lakes Boro	X		
Failed	31-055	Upper Aetna Dam	S	Medford Lakes Boro	X	X	
Failed	31-052	Lower Aetna Dam	S	Medford Lakes Boro	X		
Failed	32-055	Camp Inawendiwin Lower Dam	S	Tabernacle Township	X		
Failed	32-065	Reeves Dam B	L	Woodland Township		X	
Failed	32-040	Lower Reeves Bog Dam	L	Woodland Township		X	
Failed	32-054	Camp Inawendiwin Upper Dam	L	Tabernacle Township			X
Failed	32-196	Crane Lake Dam	L	Evesham Township			X
Failed	32-219	Lost Lake Dam	L	Evesham Township			
Failed	21-225	Hinchman Dam	L	Medford Township		X	
Failed	32-63	Third Street Dam	L	Southampton Township			
Failed	31-016	Blue Lake Dam	L	Medford Township	X		
Failed	31-223	Squaw Lake Dam	L	Medford Township	X		X
Damage	31-081	Kenilwoth Lake Dam	S	Evesham Township			
Damage	31-173	Kettle Run Road Dam	S	Evesham Township			
Damage	32-031	Lebanon Forest #1 Dam	S	Pemberton Township	X	X	
Damage	31-102	Marlton Lakes Upper Dam	S	Evesham Township			X
Damage	32-011	Batsto Lake Dam	S	Washington Township		X	
Damage	31-224	Union Mill Lake Dam	S	Evesham Township		X	
Damage	31-182	Saipe Lake Dam	S	Medford Township		X	
Damage	31-226	Fostertown Road Dam	S	Medford Township		X	
Damage	31-068	Upper Stokes Dam	S	Medford Township			
Damage	31-141	Golf Course Dam	L	Evesham Township			
Damage	31-120	Mill Dam	L	Mount Holly Township	X	X	
Damage	31-194	Cranberry Lakes Dam #6	L	Medford Township			
Damage	31-012	Kirbys Mill Dam	L	Medford Township		X	
Damage	31-088	Burnt Bod Dam	L	Medford Township			
Damage	21-100	Oliphants Mill Lake Dam	L	Medford Township			
Damage	32-037	Old Forge Lake Dam	L	Southampton Township			
Damage	32-37	Bayberry Street Dam	L	Pemberton Township		X	
Damage	31-216	Upper Mimosa Dam	L	Medford Township			
Damage	31-211	Kenilworth #3 Dam	L	Evesham Township			
Damage	31-212	Mimosa Lake Dam	L	Medford Township			
Damage	32-062	Fisher Pond Dam	L	Southampton Township			
Damage	31-221	Quoque Dam	L	Medford Lakes Boro	X	X	
Damage	31-222	JCC Dam	L	Medford Township	X		
Damage	31-218	Van Dal Lake Dam	L	Evesham Township			
Damage	32-064	Sooy Dam	L	Woodland Township			
Damage	32-036	New Jersey No Name #8 Dam	L	Southampton Township			
Damage	31-089	Timber Lake Dam	H	Medford Township	X	X	
Damage	32-004	Vincentown Mill Dam	H	Southampton Township		X	

* Application deadline for NJ State Loan Program was September 30, 2004
** FEMA continuing to work on estimates
*** SBA continuing the review each loan application

1,000-YEAR STORM

Finding 10

Reprint of Sunday, August 22, 2004Article courtesy of the Courier Post, NJ

By Lawrence Hajna and Carol Comegno

Restrained, water is a beautiful thing.

Unleashed, it can become a terrifying force, able to devastate lives in a matter of minutes.

On July 12-13, water became the enemy when a tenacious rainstorm, now immortalized as the "1,000-year storm" deluged Burlington County with up to 13 inches of rain, causing at least $50 million in property damage.

What appeared to be a typical day of heavy summer rain became something unusual that evening, a perfect alchemy of meteorology and geography that led to the worst series of dam breaks in New Jersey since 1940. In all, 18 dams burst; many more came perilously close to failing.

The frenetic morning of July 13, officials heaved a sigh of relief: No one was killed or injured. Still, hundreds of homes were damaged or lost. Lives were shattered.

Many insist they never got alerts that might have helped them save valuables. Other praised the work of police and fire crews.

Communications did break down. Weather reports failed to pinpoint exactly where the heaviest rain would fall. Victims learned of the flood the hard way – when waters shot through their doors or rose around their homes, reflecting an odd shimmer of streetlights in the dark.

The *Courier-Post* interviewed dozens of victims and officials and reviewed scores of 9-1-1 tapes to recreate what happened the night of the storm.

- - -

July 12 was shaping up to be a hectic day for Al Cope, a senior meteorologist for the National Weather service station in Westhampton.

The office had already been monitoring a storm to the southwest when Cope started work at 9 a.m. Five hours earlier, the office had put out a flood watch for much of South Jersey, southeastern Pennsylvania and parts of Maryland and Delaware.

"We knew it was going to be busy," Cope said. "I anticipated it was going to be a day when I was out on the floor a lot."

What the storm had going for it was water: Lots of it.

Throughout the day, the weather service posted 17 flood and tornado warnings for the region, but most of the attention had focused on Maryland and Delaware. By dinner, concern shifted to South Jersey.

Cope decided to stay past the end of his shift, taking the role of storm coordinator. At 5:45 p.m., he issued a flash flood warning to virtually every South Jersey county.

"It's kind of unusual to issue a flash flood warning for that big an area all at once," Cope said. "We don't know at that point exactly who's going to get the really heavy rain."

While many parts of the region were pounded, by 8 p.m. radar showed that the heart of the system had stalled over a 50-square-mile area from Medford and Medford Lakes east to Southampton and Tabernacle. Heavy storms kept forming and re-forming over the same spot.

At 9:23 p.m., Cope put out a statement saying radar indicated very heavy rain, 8 inches or more, had fallen over central Burlington County.

Cope went home a half an hour latter, after being on duty for 13 hours. As he left, a flood warning was issued for the Rancocas Creek, which Cope said, was expected to rise "a little bit above flood stage, but nothing really severe."

At 12:40 a.m., nearly three hours after the first report of a dam break, the weather service, at the request of the state Office of Emergency Management, issued a special flash flood warning telling residents along the South Branch of the Rancocas Creek and its tributaries to evacuate.

There was no mention of dams having broken.

Critical Depression

Camp Inawendiwin is an idyllic Girl Scout camp in the Pine Barrens of Tabernacle.

A forest of oaks, white cedars and scrub pines rises ever so slightly – and ever so critically – over the depressions of the Lower and Upper Inawendiwin lakes and a little swampy area, a former reservoir, that sits above both lakes.

These areas would act as large bowls, collecting incalculable runoff resulting from some of the worst of the rainfall.

H.L. Ransom, the camp's 39-year-old on-site administrator, was at ground zero, though he wouldn't realize it until morning. Around 5:30 p.m., after the camp had shut down, the rain intensified even more, a "heavy teeming rain," Ransom recalled.

Likes sheets, runoff spilled down sandy slopes into the lakes and swamp. The camp had drained the lower lake to a sluggish stream two years earlier in anticipation of replacing its aging dam. By 8:30 p.m., the lake brimmed again.

Even with the wipers on his Ford pickup flicking furiously, he could barely see the woods around him.

"It was just coming down really hard," Ransom said. "I've lived in New Jersey all my life; I've never seen anything like that, as hard as it was coming down.

Around 11 p.m., Ransom inspected the upper lake dam. Unlike the lower dam, which was equipped with a rudimentary wooden spill box, the upper dam was relatively modern. It had a metal spillway gate that led to a big concrete discharge pipe.

Through the rain, Ransom's headlights illuminated a disquieting scene. The metal catwalk used to access the wheel that controls the spillway gate was completely submerged; water rushed through blueberry thickets along the entire length of the dam's earthen crest.

"I couldn't get any closer because the water was strafing over the top of this whole embankment,' he recalled.

Ransom went to bed at his house near the lower dam around midnight. He suspected the lower dam might give since it was due to be replaced anyway. It never occurred to him that the upper dam could break.

He didn't notify anyone.

Shortly thereafter, the dams would break, sending a powerful torrent of floodwaters down tree-choked Friendship Creek, toward Route 70 and Vincentown.

A Loud Gushing Sound

Barbara Bell owns a large rancher about 100 feet from the downstream side of the Upper Aetna Lake Dam, which separates two of the largest lakes in Medford Lakes. Hundreds of houses, many built in the 1920s and 1930sw to resemble log cabins surround the usually placid lakes.

When her husband, Matt, got home from work after 9 p.m., the rain was falling as hard as she had ever seen it. Matt desperately tried digging a little trench, hoping to divert water away from the house and protect their basement. The lake rose over Adirondack chairs in the back yard, directly over the lake.

About 10:20 p.m., rescue workers came to the door, telling the family to leave because Upper Aetna Lake was filling fast, Bell recalled. As the couple tried to gather some clothes and their sons, police came back, frantic. They said the dam was ready to break.

"They came in the house and ran down the hallway and started screaming for us to get out," Barbara said.

Barefoot and in their pajamas, she grabbed their youngest son, 7-year-old Noah. Water poured through the doors.

The dam broke as they fled to their cars. It not something they saw, but something they heard, like the loud thumping of helicopter rotors.

"It was unbelievable, loud," Bell said. "I've never heard anything like it before, a gushing, sucking sound. I just figured the house was gone. I was glad we had the kids: we threw them in the car and drove away."

They dropped the children off at a neighbor's and walked back to see what was left of their home. A light rain was falling.

In that time, maybe 10 or 15 minutes, the water had already receded: the Lower Aetna Dam downstream had broken.

The house was still standing but all was eerily quiet. Sand, muck, even little fish and snails were strewn inside the house.

Throughout the night, people milled about, bell recalled, "almost in a daze. It almost felt like after a nuclear war."

Confusion And Alarm

Greg Harlan lives on a little peninsula that juts into Medford Lakes' Lower Aetna Lake, just above the formidable Lower Aetna Dam.

The 44-year-old, food and beverage director for a Philadelphia hotel had the day off. He didn't give much thought to the daylong rain.

Around 6 p.m., though the lake reached the top of a wooden bulkhead he uses to launch canoes. Two hours later, it had risen over his dock and spilled onto his narrow back yard.

Water was starting to cut across the peninsular, barely large enough to contain a small cul-de-sac and several homes. Harlan and his wife, Nancy, watched storm radar on their home computer.

"We were seeing that it had basically stalled right above us, because Wilmington and Philadelphia had cleared out and we kept thinking it would clear out here," he said. : But that cell remained almost directly above us.

What Harlan saw next confused and alarmed him. Around 10:30 p.m., the water rose faster than ever though the rain was stopping.

"During 12 hours of rain it had risen 3 feet, and then, all of a sudden, in 10 or 15 minutes it had risen 18 inches.

Harlan didn't realize it at the time, but he was seeing water released by the breaking of the Upper Aetna Dam upstream.

Firefighters suddenly waded into Harlan's neighborhood, ordering everyone to evacuate. Harlan quickly gathered up his wife, who had been unsuccessfully trying to sleep upstairs, and their 8-year-old son, Colin, who was sound asleep.

He also picked up two neighbors, women who were alone. The family dog, a golden retriever named Sally, swam to Harlan's Jeep Cherokee as they made their getaway.

It was about 11 p.m.,]; the water was just a hair short of spilling into the first floor of the two-story log cabin. Minutes, the lower dam broke too. The water quickly receded, sparing Harlan's house significant damage.

"We were lucky," he said.

Communications Mix-Up

Throughout the early evening, county emergency management officials expected to deal with some flooding; they had little indication of the actual scope of flooding they would face.

Calls started pouring in around 7 p.m., less than three hours before the dams started breaking. Callers reported flooded roads and swamped cars and some minor basement and yard flooding in Medford and Medford Lakes. "It was from sheer runoff," said Edwin Wood III, Medford's police chief.

The first sign of something really unusual was at 9:38 p.m., when Mike Dzwill, property director at YMCA Camp Ockanickon called Wood, telling him that its Davy Crocket Dam had failed.

"He told me he wanted to make immediate notification because he was concerned about those downstream from the camp," Wood said.

It would not be clear until later that three dams actually failed at Ockanickon.

Wood said he immediately contacted officials in Medford Lake And Lumberton. Wood, however, said Medford Lakes officials never told him that the Upper and Lower Aetna dams, just downstream of Ockanickon, had failed. "We soon figured it out," he said.

County officials, however, indicate Medford Lakes officials did call the county emergency management office just after the Lower Aetna failure. Wherever the line of communication broke, no one ever told Frank Jacobs to evacuate.

Jacobs lives in Medford, where main street dips down to the South Branch of the Rancocas. Around 11 p.m., he saw the rising creek as an odd reflection of streetlights through the windows of his house.

When he went out onto his front porch to investigate, Jacobs realized the creek had risen around his property

Unseen Surge

Partly obscured by trees and shrubs, Haynes Creek makes a sharp bend behind the Medford home of John and Melanie Bilbow. The couple's crawl space began flooding at 8 p.m. and Melanie couldn't get the sump pump started.

When the water rose perilously close to their aboveground pool, Melanie called her husband, who immediately left work in Lumberton to lend a hand. The creek was just 2 feet from the back door when John got home. He desperately tried to build a makeshift levee around the crawl space door using wood and cinder blocks. It wasn't working.

About 9:30 p.m., the couple decided to evacuate their four children to Melanie's parents' home nearby. The door wouldn't open because of the pressure of the water, so they crawled out a window.

John and Melanie then returned to their home with a neighbor to save whatever they could.

About 11 p.m., the water suddenly surged, though they didn't notice it a first. Somehow the doors and walls were keeping most of the water outside.

"We were so busy trying to save what we could we hadn't noticed that the water outside was bout 4 feet high," John said. "Suddenly there was light shining in the window. It was the fire company telling us we had to evacuate immediately.

Again, they got out by a window and clambered into a small boat. That's when the magnitude of the disaster hit him.

"I remember sitting in the boat as they took us away, knowing that there was nothing more we could do to save the house, that we were about to lose everything."

Unexpected Delivery

By 9:45 p.m., water had risen over the bulkhead outside the home of Andrew and Margie Meltzer. They live next to the Birchwood Lake Dame in Medford.

Margie, expecting their second child in about two weeks, had been calm hours earlier, even tidying the house as the lake rose. Now she was in a panic.

Andrew left for Home Depot in Moorestown to get a sump pump. The store had closed before he arrived, but employees let him in when he told them about his pregnant wife. He got the last pump.

When he returned, however, he saw rapids pouring through a gap torn along the top of the dam; the water had risen several feet around his house.

The sump pump stayed in his Land Rover. He rushed in to get his wife and 22-month-old daughter, Marlaina, waiting upstairs.

Water had punched through the tempered glass doors of a sunroom, "filling it up like a fishbowl," he recalled. It was spitting through electrical sockets.

To get to their cars now parked on higher ground, Andrew and Margie waded out into a strong current that was above their waists. Marlaina, trembling, rode atop her father's shoulders.

Margie went into labor on July 14. Their son, Ashton, was born early next morning.

"It wasn't like her water broke when the water came in," Andrew said. But it was casual, we know that. We were both under a lot of stress.

Lumberton Pounded

At 9:30 p.m., Kevin Tuno, the county's emergency management coordinator, left home and ordered the county's emergency management center opened to respond to increasing street and basement flooding.

The center, in Hainesport, would not become operational until between 11 p.m. and midnight, Tuno said, explaining it took time for personnel from utility companies, the Red Cross, and other agencies to work their way around flooded roads.

Tuno had his first indication that the Lower Aetna Dam in Medford Lakes was failing at 10:10 p.m.

The first hints of something catastrophic began to filter into the county and Medford 9-1-1 centers just before 11 p.m.

At 10:51 p.m., a caller from Medford told a 9-1-1 dispatcher that the Birchwood Lake Dam had "let go." A police officer downstream saw a sudden rise as the water flowed into Timber Lake several minutes earlier.

At 11:33 p.m., a woman who lives along Birchwood Lake made her second call in about 30 minutes. "My whole property is flooded," she said. "I'm on the lake, or I was. Now I'm in the lake.:\"

At 10:17 a.m., a resident of Race Street in Vincentown called: "They told us to evacuate, but the water is coming down the road so bad, the force is so bad, we can't evacuate.

Major flooding in Lumberton on the South Branch of the Rancocas Creek just downstream of the confluence of the two major stream courses where dams failed, started after midnight. It would get worse as water from broken dams converged on the quaint village.

Firefighters and volunteers had already begun sandbagging low-lying areas typically vulnerable to flooding. But a couple of hours later, it was apparent that the situation was not typical.

Most residents were asleep at 3 a.m. A barking dog awakened Kimara Himchak. She lives on Edwards Avenue next to the downtown bridge.

At first, firefighters told her the rising waters would soon recede. When that didn't happen, they told her not to go back to her house. She went house to house waking neighbors.

A 3:33 a.m., a man in Lumberton called 9-1-1. "We're flooded," he said. Our whole first floor is flooded. I'm talking about like up to our neck."

Shortly after that, John Jardine woke up to the yelling of someone warning the driver of a truck to stoop trying to go down a flooded street.

Jardine awoke to a strange shimmering outside his house. "I look out there and what I see is glossy," Jardine said.

It was rising around his house.

Jardine put on his pants and went to the corner of Main Street and Creek Road, just outside his house. A few minutes later, he saw a police officer, who told him a dam broke, in Medford. There was no indication that many dams had burst.

"I just took off and ran in the house," he said.

He shouted to his family: "Everybody get up, grab everything you value and get it off the first floor!"

Jardine is puzzled that it took so long for officials to realize that dams had been failing for several hours. "No one had to lose everything," he said.

It remains unclear when Lumberton officials knew the extent of the dam breaks upstream.

Councilman John Pagenkoph said he got a call from township emergency management coordinator Bill Warren around 12:30 a.m. Warren recommended sandbagging along the creek. "I don't think he knew anything about the dams breaking," Pagenkoph said.

A few hours later, Pagenkoph was linking arms with his father, brother and son in a human chain to cross chest-high water to escape his house on Church Street. But he realized his electricity was still on and went back to turn it off, this time tethered to a rope. Sandbagging was futile.

Mayor DeWill Pennypacker is convinced the response worked as good as possible. "The amount of time it took for the main event to occur, you couldn't have done anything," Pennypacker said.

An Eerie Silence

John Richey, a state dam safety engineer, arrived in Vincentown at 2 a.m., fearing the dam on Race Street could give at any minute. Undergoing reconstruction, failure of this dam could threaten lives if it failed.

The dam was practically submerged. Richey met up with John Kale, the emergency coordinator from his office whose call got him out of bed less than two hours earlier.

Houses downstream had been evacuated. "Once we realized there was nothing we could possibly do, we walked to the center of town," Richey said.

A few homeowners, however, watched the floode3d downtown from the second-floor porches of old homes.

Ritchey and Kale drove to Medford Lakes to look into a call about a dam failure there. They arrived at the site of the Lower Aetna Dam just after 3 a.m. The dam was gone; a small group of teenagers played in the floodwaters near Tabernacle Road.

"It was very quiet, not a lot of people around," Ritchey said. "In fact, the kids were all the people we saw."

The soon determined that the dam at Upper Aetna Lake and another dam at Camp Ockanickon were gone too. "As we made our way to Ockanickon," Richey said, "it kind of hit me, the scale of the matter we had in front of us."

As dawn lightened the sky, Ritchey and Kale began to form teams of engineers to assess damaged dams throughout the region, to determine which ones could fail and threaten lives.

The 1,000-year storm was over. The recovery was just beginning.

Staff writers Tom Lounsberry and Mat Katz contributed to this report.

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New Jersey Dams

Finding 11

New Jersey Dams by County and Hazard Classification

County	Total	High	Significant	Low	Zero
Atlantic	43	3	9	26	5
Bergen	73	7	10	54	14
Burlington	157	10	41	92	7
Camden	74	1	17	49	3
Cape May	15	0	8	4	6
Cumberland	38	4	14	14	3
Essex	28	7	3	15	5
Gloucester	65	4	20	36	2
Hudson	3	0	0	1	8
Hunterdon	103	9	13	73	5
Mercer	87	6	8	68	6
Middlesex	43	3	11	23	9
Monmouth	111	9	12	81	13
Morris	239	31	54	141	7
Ocean	91	6	18	60	8
Passaic	144	49	26	61	4
Salem	47	1	23	19	8
Somerset	94	5	13	68	20
Sussex	252	22	53	157	2
Warren	31	3	7	19	11
Union	98	16	12	59	2
Total	1836	196	372	1120	148

Dam – Any artificial dike, levee or other barrier, together with appurtenant works, which is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five (5) feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or in the absence of an emergency spillway, the top-of-dam.

Hazard Classification – Classification of potential hazard a dam failure would cause downstream of the dam.

- **High Hazard Potential (Class I)** – Those dams the failure of which may cause the probable loss of life or extensive property damage.
- **Significant Hazard Potential (Class II)** – Those dams the failure of which may cause significant damage to property and project operation, but loss of life is not envisioned.
- **Low Hazard Potential (Class III)** – Those dams the failure of which may cause damage to the dam, but loss of property and project operation is not envisioned.
- **Zero Hazard Potential (Class IIII)** – Those dams the failure of which may cause damage to the dam itself.

Burlington County Dams

Stream ++	Name of Dam	Atlas ID #	Class	Status *	Municipality	**Ownership** **a)** Public **b)** Private Non Profit **c)** Private **d)** Public / Private	DEP Notice to Improve **Date Due**

Class I (High Hazard) and Class 2 (Significant Hazard) Dams that failed or were damaged

Haynes Creek Tr.	Timber Lake Dam	31-089	H	Damaged	Medford	■d) Birchwood Lake Colony Club and Medford Twp	4/04 EAP 8/04 Other
South Branch of Rancocas	Vincentown Mill Dam	32-004	H	Damaged	Southampton	■a) Southampton Township	
Batsto River	Batsto Lake Dam	32-011	S	Damagd	Washington	■a) NJ DEP Parks and Forestry	
Kettle Run	Marlton Lakes Upper Dam	31-102	S	Damage	Evesham	c) Marlton Lakes Civic Association	8/04 EAP 9/04 Other
Bighams Mill Creek	Lebanon Forest # 1 Dam	32-031	S	Damage	Pemberton	■a) Pemberton Township	8/04 EAP 10/02 S/P 9/04 Other
Haynes Creek Sharps Br.	Stokes Upper Dam	31-068	S	Damaged	Medford	c) Sam Mutch	9/04 Other
	Kenilworth Lake Dam	31-081	S	Damaged	Evesham	c) Pine Acres Associates	6/04 EAP 6/04 OAMP 4/04 Other
Kettle Creek	Kettle Run Road Dam	31-173	S	Damaged	Evesham	■b) YMCA of Camden County	9/04 Other
	Saipe Lake Dam	31-182	S	Damaged	Medford	■d) Medford Pines Homeowners Association Inc and Burlington Co.	8/04 CS 9/04 EAP 11/04 S/P 8/04 Other
Barton Run Tributary	Union Mill Lake Dam	31-224	S	Damaged	Evesham	c) Union Mill Lake Colony Club	9/04 Other
Southwest Branch of Rancocas	Fostertown Road Dam	31-226	S	Damaged	Medford	■a) Medford Township	9/04 Other
Haynes Creek Trib.	Lower Aetna Lake Dam	31-052	S	Failed	Medford Lakes	■c) Medford Lakes Colony Club	9/04 Other
Haynes Creek South Br.	Upper Aetna Lake Dam	31-055	S	Failed	Medford Lakes	■d) Medford Lakes Colony Club & Burlington Co.	6/04 EAP 9/04 Other
Haynes Creek	Papoose Lake Dam	31-056	S	Failed	Medford Lakes	■b) YMCA Camp Ockanickon, Inc.	10/03 EAP 9/04 Other
Haynes Creek	Stokes Lower Dam	31-067	S	Failed	Medford Lakes	■d) Sam Mutch and Burlington County	3/04 CS 9/04 Other
Haynes Creek South Br.	Lake Stockwell Dam	31-091	S	Failed	Medford Lakes	■b) YMCA – Camp Ockanickon, Inc.	0/03 EAP 10/04 S/P 9/04 Other
Haynes Creek Trib.	Birchwood Lake Dam	31-096	S	Failed	Medford	■c) Birchwood Lake Colony Club	10/04 EAP 10/04 OAMP
Barton Run Tributary	Kenilworth #2 Dam	31-210	S	Failed	Medford	c) Pine Acres Associates	9/04 Other
Friendship Creek	Camp Inawendiwin Lower Dam	32-055	S	Failed	Tabernacle	■b) Girl Scouts of Camden County	8/04 EAP 9/04 Other

Total of 19 dams

Class 3 (Low Hazard) Dams that failed or were damaged

	Upper Mimosa Dam	31-216	L	Damage	Medford	■d) Mimosa Lake Association and Medford Township	9/04 Other
South Branch of Rancocas	Old Forge Lake Dam	32-037	L	Damage	Southampton	■c) Leisure Technology	8/04 Other
Southwest Branch of Rancocas	Kirbys Mill Dam	31-012	L	Damaged	Medford	■a) Medford Township	
Cedar Run	Burnt Bog Dam	31-088	L	Damaged	Medford	c) Gardner Medford, Inc.	8/04 Other
Haynes Creek	Oliphants Mill Lake Dam	31-100	L	Damaged	Medford	■c) Oakwood Lakes Homeowners Association	9/04 Other
North Branch of Rancocas	Mill Dam	31-120	L	Damaged	Mount Holly	■a) Mount Holly	9/04 Other
North Br. of Blue Brook	Golf Course Dam	31-141	L	Damaged	Evesham	c) Links Golf Course, Kings Grant Management	8/04 Other
Birchwood Lake Trib.	Cranberry Lakes #6 Dam	31-194	L	Damaged	Medford	c) Pulte Home Corporation	
Barton Run Tributary	Kenilworth #3 Dam	31-211	L	Damaged	Medford	c) Pine Acres Associates	8/04 Other

	Mimosa Lake Dam	31-212	L	Damaged	Medford	■d) Mimosa Lake Association and Medford Twp	8/04 Other
Bethany Mole Run	Van Dal Lak Dam	31-218	L	Damaged	Evesham	c) Van Dale Partners	8/04 Other
	Quoque Dam	31-221	L	Damaged	Medford Lakes	■a) Medford Lakes Borough	9/04 Other
Edwards Branch Run	JCC Lake Dam	31-222	L	Damaged	Medford	b) JCC Camps	
South Branch of Rancocas	NJ No Name #8 Dam	32-036	L	Damaged	Southampton	■c) Rancocas Cranberry Co.	
Little Pine Creek	Bayberry Street Dam	32-061	L	Damaged	Pemberton	■a) Burlington County Pemberton Township	8/04 Other
Friendship Creek	Fisher Pond Creek	32-062	L	Damaged	Southampton	c) Daniel Fisher	8/04 Other
Burrs Mill Brook Trib.	Sooy Dam	32-064	L	Damaged	Woodland	c) Cranwood Associates	9/04 Other
Kettle Run South Br.	Blue Lake Dam	31-016	L	Failed	Medford	■c) Blue Lake Association	9/04 Other
Belhany Mole Run	Lost Lake Dam	31-219	L	Failed	Evesham	c) Van Istendal	9/04 Other
Haynes Creek	Squaw Lake Dam	31-223	L	Failed	Medford	■b) YMCA Camp Ockanickon, Inc.	9/04 Other
Haynes Creek Trib.	Hinchman Dam	31-225	L	Failed	Medford	a) Medford Board of Ed.	8/04 Other
Friendship Creek	Camp Inawendiwin Upper Dam	32-054	L	Failed	Tabernacle	■b) Girl Scouts of Camden County	9/04 Other
Burrs Mill Brook	Third Street Dam	32-063	L	Failed	Southampton	■c) Charles Thompson	8/04 Other
	Crane Lake Dam	31-196	L	Failed	Evesham	c) Marlton Lakes Civic Association	9/04 Other
Cooper Branch	Reeves Bog Lower Dam	32-040	L	Failed	Woodland	■a) NJ DEP Parks & Forestry	
	Reeves Dam A	NA	L	Failed	Woodland	■a) NJ DEP Parks & Forestry	
Cooper Branch	Reeves Dam B	32-065	L	Failed	Woodland	■a) NJ DEP Parks & Forestry	
	Reeves Dam C	NA	L	Damaged	Woodland	■a) NJ DEP Parks & Forestry	
	Reeves Dam D	NA	L	Damagerd	Woodland	■a) NJ DEP Parks & Forestry	
	Reeves Dam E	NA	L	Failed	Woodland	■a) NJ DEP Parks & Forestry	
	Reeves Dam F	NA	L	Failed	Woodland	■a) NJ DEP Parks & Forestry	
	Elmwood MUA	31-220	L	Failed	Evesham	a) Evesham Township MUA	

Total of 32 dams

All Dams that were not damaged or failed

	Pine Lake Dam	31-015	H	No Damage	Medford	■c) Lake Pine Colony Club	9/04 EAP
	Hanover Lake Dam	31-021	H	No Damage	Pemberton	a) US Dept of the Army	
	Ballinger Lake Dam	31-053	H	No Damage	Medford Lakes	■c) Medford Lakes Colony Club	
	Mishe-Mokwa Dam	31-054	H	No Damage	Medford Lakes	■a) Medford Lakes Borough	3/04 EAP 4/04 Other
	Cranberry Co. Dam	31-063	H	No Damage	Evesham	c) Marlton Lakes Civic Association	
	Braddocks Mill Dam	31-075	H	No Damage	Medford	■b) Braddocks Mill Conservation Association	10/03 CS
	Bethany Hole Dam	31-076	H	No Damage	Evesham	c) Little Mill Associates	12/03 CS
	Centennial Lake Dam	31-082	H	No Damage	Medford	c) Centennial Land and Development	
	Tomlinson Mill Dam	31-087	H	No Damage	Evesham	■a) Evesham Township	5/02 CS
	Lake James Dam	31-108	H	No Damage	Evesham	c) KGOSA	11/04 EAP 9/04 Other
	Big Look Trail Dam	31-175	H	No Damage	Medford	c) Medford Pines LLC	
	Wagush Levee Dam	31-191	H	No Damage	Medford Lakes	■c) Medford Lakes Colony Club	10/04 OAMP 10/04 S/P 10/04 Other
	Kettle Run Dam	31-203	H	No Damage	Evesham	■b) YMCA of Camden County	
	Atsion Lake Dam	32-001	H	No Damage	Shamong	■a) NJ DEP Parks and Forestry	6/03 Other
	Oswego Dam	32-015	H	No Damage	Washington	■a) NJ DEP Parks and Forestry	
	Country Lakes #1 Dam	32-023	H	No Damage	Pemberton	■a) Pemberton Township	9/04 Other
	Lebanon Lake Dam	32-026	H	No Damage	Woodland	■a) NJ DEP Parks and Forestry	8/04 EAP
	Country Lakes #3 Dam	32-027	H	No Damage	Pemberton	■a) Pemberton Township	9/04 Other
	Mirror Lake Dam	32-030	H	No Damage	Pemberton	■a) Pemberton Township	8/03 EAP 8/03 OAMP
	Bisphams Mill Dam	32-057	H	No Damage	Pemberton	a) NJ DOT	
	Sylvan Lake Dam	27-006	H	None reported	Burlington	■a) Burlington Township	11/03 CS 3/04 Other
	Smithville Dam	32-005	H	None reported	Eastampton	■a) Burlington County	4/02 OAMP
	Cub Lakes I Dam	31-152	L	No Damage	Medford	c) Lineliv LLC	
	Arrow Lake Dam	31-154	L	No Damage	Medford	c) Wilderness Run Homeowners Association	
	Cardinal Ridge Upper Dam	31-164	L	No Damage	Medford	■c) Cardinal Ridge Condo Assoc.	
	Cub Lakes II Dam	31-168	L	No Damage	Medford	c) Wilderness Run Homeowners Association	

	Cub Lakes III Dam	31-169	L	No Damage	Medford	c) Wilderness Run Homeowners Association	
	Woodlake Dam	31-171	L	No Damage	Medford	■c) Woodlake Homeowners Association	
	Cardinal Ridge #3 Dam	31-176	L	No Damage	Medford	■c) Cardinal Ridge Condo Assoc.	
	Coles Lake Dam	31-177	L	No Damage	Medford	c) Tucker's Notch Homeowners Association	
	Lake Siquitlse Dam	31-179	L	No Damage	Medford Lakes	■c) Medford Lakes Colony Club	
	Lakeaway Dam	31-180	L	No Damage	Medford Lakes	■a) Medford Lakes Borough	
	Laurelton II Dam	31-190	L	No Damage	Mt. Laurel	c) Tangent Builders	
	Cranberry Lakes #3 Dam	31-192	L	No Damage	Medford	c) Pulte Home Corporation	
	Cranberry Lakes #5 Dam	31-193	L	No Damage	Medford	c) Pulte Home Corporation	
	Croft Dam	31-209	L	No Damage	Medford	■c) John Croft	
	Pine Mill Lake Dam	32-022	L	No Damage	Pemberton	■a) Pemberton Township	
	Country Lakes #2 Dam	32-024	L	No Damage	Pemberton	■a) Pemberton Township	10/04 OAMP 10/04 S/P
	Cedar Run Dam	32-025	L	No Damage	Southampton	a) Southampton Township	
	Jade Run Dam	32-035	L	No Damage	Pemberton	c) Newton H. Ruch	
	Mt. Misery Dam	32-039	L	No Damage	Pemberton	■b) Commission on Camps, Conferences and Retreats	8/04 Other
	Lakeview Memorial Dam	27-019	L	None reported	Cinnaminson	c) Lakeview Memorial Park Association	
	Bitting's Lake Dam	27-020	L	None reported	Westampton	a) Westampton Township	
	Wetampton Detention Basin	27-040	L	None reported	Westampton	a) Westampton Township	
	Fire Lagoon Dam	27-042	L	None reported	Springfield	c) Interstate Sorage and Pipe Line Co	
	Dunn's Mill Dam	28-011	L	None reported	Bordontown	c) BT Motor Inn Co.	
	Camp Mahalala Dam	28-036	L	None reported	North Hanover	a) U. S. Government	
	Abstein & Brady Dam	28-039	L	None reported	Mansfield	c) Emidio & Victoria Puglia	
	Cookstown Mill Pond Dam	28-046	L	None reported	North Hanover	c) Harlin Bunn	
	Kuser Pond Dam	28-056	L	None reported	Chesterfield	c) Teresa Kuser	
	New Jersey No Name # 83 Dam	28-099	L	None reported	North Hanover	c) Alexander Luczaky	
	New Jersey No Name # 85 Dam	28-101	L	None reported	Chesterfield	c) John C. Probasco	
	New Jersey No Name # 86 Dam	28-102	L	None reported	North Hanover	c) J. Calvin and D. J. Reid	
	New Jersey No Name # 87 Dam	28-103	L	None reported	North Hanover	c) J. Calvin and D. J. Reid	
	New Jersey No Name # 88 Dam	28-104	L	None reported	North Hanover	c) Calvin Reid	
	New Jersey No Name # 89 Dam	28-105	L	None reported	North Hanover	c) John Gale	
	New Jersey No Name # 90 Dam	28-106	L	None reported	North Hanover	a) U. S. Army	
	New Jersey No Name # 92 Dam	28-108	L	None reported	North Hanover	a) U. S. Army	
	Thompson Dam	28-158	L	None reported	Chesterfield	■c) Bryce Thompson	
	Lippincott Pond Dam	31-011	L	None reported	Moorestown	a) Cinnaminson Township	
	Mill Street Dam	31-060	L	None reported	Mount Holly	■a) Mount Holly Township	
	Lower Hooten's Dam	31-070	L	None reported	Moorestown	a) Moorestown Township	12/06 OAMP
	Pachoango Dam	31-101	L	None reported	Evesham	c) Main Line Realty	
	Lake Dam	31-109	L	None reported	Evesham	c) KGOSA	
	Upper Lake Dam	31-110	L	None reported	Evesham	c) KGOSA	
	Larchmont Dam	31-143	L	None reported	Mt. Laurel	c) Orleans Builders	
	Emory Hill McConnell Dam	31-144	L	None reported	Westampton	c) Brandywine Realty Trust	
	Little Mill Lake Dam	31-153	L	None reported	Evesham	c) Country Club Lake Management	
	Upper Lake Dam	31-156	L	None reported	Mt. Holly	■a) Mt. Holly Township	
	Buttonwood Lake Dam	31-157	L	None reported	Mt. Holly	■a) Mt. Holly Township	
	Cardinal Ridge Lower Dam	31-163	L	None reported	Medford	■c) Cardinal Ridge Condominium Association	
	Shadow Lake Dam	31-165	L	None reported	Shamong	c) Shadow Lake Homeowners Association	
	Camp Moore Dam	31-174	L	None reported	Evesham	■b) YMCA of Camden County	
	Cranberry Lakes Dam # 6	31-194	L	None reported	Medford	c) Pulte Home Corporation	8/04 Other
	Eayrestown Dam	31-208	L	None reported	Medford	c) Medford Village East Associates	

	Pemberton Mill Dam	32-003	L	None reported	Pemberton Boro	■a) Pemberton Boro	=
	Pleasant Mills Dam	32-010	L	None reported	Washington	■a) State of New Jersey	
	Chatsworth Lake Dam	32-012	L	None reported	Woodland	c) A. R. DeMarco Enterprises	4/01 Other
	Lake Absegami Dam	32-018	L	None reported	Bass River	■a) Division of Parks and Forestry	
	New Jersey No Name # 17 Dam	32-038	L	None reported	Woodland	■c) Charles Thompson	6/01 Other
	Camp Inawendiwin Middle Dam	32-044	L	None reported	Tabernacle	■b) Camden County Girl Scouts	
	New Jersey No Name # 103 Dam	32-045	L	None reported	Woodland	c) Garfield DeMarco	
	New Jersey No Name # 104 Dam	32-046	L	None reported	Washington	c) Haines and Haines, Inc.	
	New Jersey No Name # 105 Dam	32-047	L	None reported	Bass River	) NA	
	New Jersey No Name # 106 Dam	32-048	L	None reported	Bass River	) NA	
	New Jersey No Name # 107 Dam	32-049	L	None reported	Bass River	c) Kupire Corporation	
	New Jersey No Name # 108 Dam	32-050	L	None reported	Bass River	a) U. S. Government	
	Indian Mills Brook Dam	32-059	L	None reported	Shamong	c) Saw Mill Associates	
	Breakneck Dam	31-018	S	No Damage	Medford	■c) Old Tauton Colony Club	2/04 CS 2/04 EAP
	Upper Sylvan Lake Dam	27-007	S	None reported	Burlington Boro	■a) Burlington Boro	2/02 OAMP
	Crystal Lake Dam	28-073	S	None reported	Brodontown City	a) NJ DOT	
	New Jersey No Name # 84 Dam	28-100	S	None reported	Chesterfield	■c) Walter Guzikowski	9/04 EAP 10/04 Other
	New Jersey No Name # 91 Dam	28-107	S	None reported	North Hanover	a) Department of the Army	9/04 EAP
	Woolman Lake Dam	31-047	S	None reported	Mount Hollyt	■a) Mount Holly Township	7/01 Other
	Hootens Creek Dam	31-061	S	None reported	Moorestown	a) Moorestown Township	1/05 EAP 6/06 OAMP
	Moorestown Dam	31-069	S	None reported	Moorestown	a) Moorestown Township	3/04 EAP 6/06 OAMP
	Indian Mills Dam	32-002	S	None reported	Shamong	a) Shamong Township	4/04 Other
	Harrisville Dam	32-014	S	None reported	Bass River	■a) Division of Parks and Forestry	
	Hanover Lake Dam	32-021	S	None reported	Pemberton	a) Department of the Army	
	Amphibious Lake Dam	32-033	S	None reported	Wrightstown	a) U. S. Army	

Total of 100 dams not damaged
Total of 151 dams in Burlington County

++ Information included when available.

* No inspection made on “None Reported” dams.

DEP Notices:

CS: Compliance Schedule
EAP: Emergency Action Plan
OAMP: Operation and Maintenance Plan
S/P: Study/Permit
Other: Usually refers to actions resulting from the July 2004 event.

■ Attended Dam Safety Workshop 9/23/2004 or 9/25/2004

Burlington County Failed/Damaged Dams
DR 1530 FEMA/NJOEM Inspections

Prepared by FEMA/NJOEM Public Assistance with information current as of 9/13/04

Atlas ID	**Dam Name** Municipality	Comments – FEMA aid on publicly owned dams and roadways only. Privately owned dams are not eligible for aid.	Estimated * FEMA Action
31-221	Quoque Medford Lakes	• DEP Dam Safety requires a safety inspection. Project Worksheet for dam is ineligible. • Not a dam prior to 7/12/04, road repairs by Medford Lakes Borough.	Repair
31-012	Kirbys Mill Dam Medford Township	• Project Worksheet prepared to conduct minor dam repairs and fencing replacement • Minor damage. Medford Township ownership based on NJ Dam Safety files.	Repair
31-120	Mill Pond Dam Mt. Holly	• Project Worksheet for Emergency repairs – Category B only. • Applicant says all damages were preexisting. Mt. Holly ownership by NJ Dam Safety files.	No action
32-061	Bayberry Street Dam Pemberton Township	• Eligible work. • Only road repairs done. No dam repairs. federal aid system highway, not eligible.	Repair
32-031	Lebanon Forest # 1 Pemberton Township	• Project Worksheet prepared for eligible roadway and dam repairs based on this flooding event only.	Repair
32-004	Vincentown Mill Dam Southampton Township	• Currently a NJ DOT project with federal funds for a portion. Additional storm related roadway damages captured only on submittal for this location from NJ DOT force account worksheets.	No action
32-021	Batsto Lake Dam Washington Township	• NJDEP roadwork only. No eligible dam damages.	No action
32-040	Reeves Dams/Lower Reeves Bog Dam	• NJDEP will conduct work by force account or contract. One large Project Worksheet to be prepared to include all 7 sites. Sites to list statement of work and damages to each site and eligible repair costs. • NJ DEP Parks and Forestry is providing ownership documentation	In question
NA	Elmwood Treatment Dam Evesham Township MUA	• Project Worksheet prepared to capture repair and/or replacement cost for eligible damages only. No DEP inspection file. Applicant may opt for alternate project or dam removal. • Probably remove dam. .	Repair or Removal
31-225	Hinchman Dam Medford Board of Education	• Project Worksheet prepared to capture repair cost for eligible damages only. No DEP inspection file. • Probably remove dam.	Repair or Removal
31-052	Lower Aetna Dam (private) Medford Lakes Colony Club	• Ownership claimed by Medford Lakes Borough by letter. Additional information i.e., land deed, Private-non-profit (PNP) application and club rules indicate that the dam is part of private association. Referred to SBA. • Not eligible may be PNP. Dam Safety records indicate that Colony Club has meet Dam Safety requirements for several years with inspections.	In question
31-055	Upper Aetna Dam Medford Lakes Borough	• Ownership claimed by Medford Lake Borough by letter. Project Worksheet prepared to capture eligible repair costs only. • Eligible for repair or replacement. Ownership established by Dam Safety – Completed inspection report and Maintenance Manual.	Replacement
31-224	Union Mill Dam (private) Evesham Township	• Evesham Township claims ownership of the roadway only, not the impoundment. A Project Worksheet will be prepared by PA to include only roadway repairs. Dam Structure is private. • Only NJ DOT road repairs done. No dam repair.	Repair by NJ DOT
31-089	Timber Lake Dam (private) Medford Township	• Medford Township claims ownership of the roadway only, not the impoundment. A Project Worksheet will be prepared by PA to include only roadway repairs. Dam Structure is private. • Only road repairs done. No dam repair.	Road Repairs
31-182	Saipe Lake Dam Medford Pines Association	• Federal aid system roadway. No eligible repairs. Dam Structure is private • Only road repairs done. No dam repair.	Road Repairs
31-226	Fostertown Road Dam Medford Township	• Repairs completed. Prepare Project Worksheet to reflect only eligible road repairs. Dam Structure is claimed by Township. • Safety files indicate Medford Township ownership.	Repair
31-067	Stokes Lower Dam Medford Lakes	• Federal aid system roadway. No eligible dam repairs. Dam Structure is private • Only road repairs done. No dam repair.	Road Repairs

LIABILITY AND RESPONSIBILITY OF DAM OWNERS

Finding 12

The following, which is from the website of the Commonwealth of Pennsylvania Department of Environmental Protection, contains information people may want to consider when working to improve dam safety in New Jersey.

Dam ownership carries with it significant legal responsibilities. The dam owner should be aware of the responsibilities and how to conscientiously deal with potential liabilities.

This fact sheet addresses general legal matters to help you minimize exposure to liability due to dam ownership and/or operation. This fact sheet does not answer specific legal issues. It is in the dam owner's/operator's best interest to obtain competent legal counsel when dealing with specific issues.

Problems for Dam Owners

A dam owner should first be familiar with the legal obligation to maintain a dam in a safe condition. The dam owner is responsible for flood damage incurred to upstream properties by the storage of flood waters and is responsible for the damage caused by the sudden release of stored water from a failure of the dam or intentional rapid draining of the impoundment. The general rule is that a dam owner is responsible for its safety. Liability may be imposed on a dam owner if he or she fails to maintain, repair, or operate the dam in a safe and proper manner. This liability may apply not only to the dam owner, but also to any company that possesses that dam, or any person who operates or maintains the dam. If an unsafe condition existed prior to ownership of the dam, the new dam owner may not be absolved of liability should the dam fail during his term of ownership. Thus, the owner must carefully inspect the structural integrity of any dam prior to purchase and then provide inspection, maintenance, and repair thereafter.

Since the dam owner is responsible for dam safety, it is important to note what is done to comply with that legal duty. The dam owner must do whatever is necessary to avoid injuring people or property. This usually applies to foreseeable circumstances and situations which can be anticipated with reasonable certainty. A dam owner would generally not be responsible for those circumstances that a reasonable person could not anticipate such as one key action is almost universally recognized: In order to assure owners meet their responsibility to maintain their dam in a reasonable and safe condition, the department requires a dam owner to conduct regular inspec-tions of the dam and correct deficient items. Also, regular inspections by qualified professionals are mandated so a dam owner may identify all problems and correct them.

Potential Personal Injury Liability

Dams and impoundments are popular places, even if located in remote areas. A dam may be visited by employees, contractors, invited visitors, or trespassers. The presence of these people is a potential liability to the dam owner. Liability or worker's compensation insurance should cover employees, contractors, or invited guests. However, the trespasser presents a unique problem.

The majority of trespassers at a dam site are probably members of the public who wish to use the site for fishing, boating, or swimming. While they mean no harm, their unauthorized use of the site is a serious liability problem for the dam owner.

The dam owner is responsible for making and keeping the premises safe. The general rule is that a dam owner must avoid conduct or conditions which could injure any person, even one who trespasses. If the dam owner knows that an unsafe condition exists, he is responsible to correct it and/or post warnings. Typical dangers at a dam site include fast moving water, open spillway (pipes), and thin ice. A particularly dangerous area is the portion of the weir immediately below the spillway. Boaters and swimmers have been trapped in the violent currents and eddies at the base of spillways of dams in Pennsylvania rivers and streams commonly frequented by canoeists, fishermen, and swimmers.

Owners of dams are charged with greater responsibility when the trespassers are children. By reasons of children's inability to understand the danger which a condition may pose, a dam owner is expected to protect children from the dangers of a dam site. In effect, this rule requires you to anticipate what parts of the facility would be particularly attractive to children. Since signs may not adequately warn children, security fencing may be necessary. Dam sites located near state or county roads, campgrounds, picnic areas, or near populated areas will attract many more people. These popular dam sites require frequent inspections by the dam owner to inspect and assure safety.

Potential Liability due to Operation of a Dam

In addition to liability problems arising out of dam ownership, operation of the dam is also a significant legal issue. First and foremost is the simple right to operate a dam and impound water. State law requires apermit to construct, operate, and/or maintain a dam. DEP`s Division of

Dam Safety should be consulted for particular matters regarding this issue. In addition, a dam on a navigable stream may involve federal government regulations which may govern operation.

Beyond the basic permitting question, all dam owners must also consider the effect of dam operation on the rights of other water users, whether they are upstream or downstream of the facility. For both upstream and downstream users, this responsibility includes a duty to avoid negligent flooding of their property.

In times of high runoff, the dam owner must assess the effects of operation which alter prevailing conditions. Increasing discharge may create flooding downstream while decreasing discharge may protect downstream property but cause flooding or other damage upstream. The dam owner must always consider the maximum discharge capacity of the structure relative to prevailing hydrologic conditions and weather forecasts. Overtopping of a dam due to insufficient or untimely operations must be avoided.

In situations where there is no specific duty to protect downstream land owners from flooding, the dam owner must still operate the dam conscientiously. As the dam owner, you must be in a position to clearly show that your dam did not increase flooding.

Upstream users may also have the right to be protected from damaged caused by operation of the dam. Therefore, the dam owner is advised to assess the legal as well as physical impact of any change in the level of impoundment, including dam removal.

A Final Word About Liability

This fact sheet is only a general introduction to the many issues regarding dam owner liability. The discussion is intended only to provide a basis for you to consider liability potentials and to encourage you, the dam owner, to seek competent legal counsel and/or technical experts to help resolve your problems. Where the ownership and operation of dams and impoundments are concerned, the old saying," an ounce of prevention..." is appropriate. Following it will truly save you the "pound of cure."

For further information on this program, contact:

Department of Environmental Protection
Bureau of Waterways Engineering
P.O. Box 8460
Harrisburg, PA 17105-8460
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Mitigation

Finding 13

A key feature of this New Jersey Burlington and Camden County disaster declaration is that the affected areas had not been impacted so severely by flooding in the past. The mitigation strategy for this event focused on the vulnerability of dams that give character to this region of the state.

Early mitigation implementation provides opportunities to identify objectives quickly. Federal mitigation funds are made available to the State of New Jersey to prevent the loss of life and reduce future property losses and disruption of community services. A portion of all the Federal funds spent in this disaster is set aside for mitigation purposes.

Specific mitigation opportunities include:

- Encourage dam owners, permit agencies and dam regulators to strengthen dams and other water control facilities to better withstand flood surges as a primary goal of the rebuilding process.
- Continue dialogues between Local Floodplain Administrator's Workshops, Building Officials/Code Officials, and representatives from insurance agents and lenders through regularly scheduled workshops
- Encourage greater development of all-hazards pre-disaster mitigation planning for local jurisdictions in Burlington and Camden Counties
- Develop comprehensive public education and awareness initiatives at the county and municipal levels to address dam safety, liability, maintenance and emergency actions.
- Provide relief to property owners through elevation or acquisition of repetitive loss structures in the floodplain
- Develop additional structural control and or protection projects that result in protection from flood hazards such as those that occurred
- Retrofit eligible public facilities that are likely to incur future damages
- Reevaluate floodplain mapping in coordination with the USGS and revise Flood Insurance Rate Maps as needed.

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In times of disaster, there exits an uncommon desire to help our neighbors. The floods that occurred on July 12, 2004 in Burlington and Camden Counties brought out a tremendous response from many organization and private citizens. In addition to the many paid volunteer members of police, fire and emergency medical services and emergency management that logged many hours and worked tirelessly throughout the event, the Interagency Waterway Infrastructure Improvement Task Force would like to acknowledge the groups and individuals that so unselfishly gave their time to help the victims of FEMA Disaster DR-1530-NJ.

Introduction

Storm Intensity, Heavy Rains and Flooding

Record setting rainfalls from July 12 to July 15, 2004 battered two south central counties of New Jersey with severe weather, heavy rain, area flooding and dam failures. Burlington and Camden Counties were inundated with as much as 13 inches of rainfall in 24 hours as recorded in local gaging stations. The incident was unusual because of several dam failures in a very localized area. The heavy weather experience in the epicenter municipalities in Burlington and Camden Counties was not felt as strongly only ten miles away.

Governor James E. McGreevey declared a State of Emergency in the two county area and submitted a request to the President of the United States for a major disaster declaration. An initial estimate of total damages incurred by this event was over $16.9 million. The incident was declared a major disaster on July 17, 2004; identified as FEMA 1530-DR-NJ.

In brief:

- Approximately 500 individuals were sheltered in six locations; 950 residents were evacuated; and over 400 families were displaced from their homes.
- The American Red Cross served over 18,000 meals.
- Thirty-three county roads were closed due to washouts, flooding, or collapse. One State Highway, one US highway and many municipal roads were closed.
- Twenty-one dams failed and another thirty were damaged including
  - 2 Class 1 – High Hazard Dams were damaged
  - 8 Class 2 – Significant Hazard Dams failed and
  - 9 Class 2 – Significant Hazard Dams were damaged
  - 32 Class 3 – Low Hazard Dams failed or were damaged
- Community Relations teams visited 1,586 residences, 318 businesses, 27 religious institutions and two senior citizen communities.
- Over 25 tons of hazardous waste and 3,631 tons of household waste were disposed and over 30,000 gallons of wastewater/oil mixture were disposed.

Purpose of Report

On August 5, 2004 The Federal Emergency Management Agency (FEMA) and the New Jersey Office of Emergency Management (NJOEM) established an Interagency Waterway Infrastructure Improvement Task Force to develop strategies for repairing and restoring dams impacted by the 1,000-year storm. In accordance with applicable federal and state laws and regulations.

The findings of this joint Federal-State – Interagency Waterway Infrastructure Improvement Task Force report provides guidance for the State of New Jersey and its counties and municipalities. The findings will also be of use to dam owners and local residents in their repair and restoration activities. It contains information that should result in reduced damages from future flooding events.

FEMA and NJOEM partnered with the NJ Department of Environmental Protection, NJ Pinelands Commission, Small Business Administration, NJ Office of the Attorney General, Burlington County Freeholders, Burlington County Office of Emergency Management, US Army Corps of Engineers, USGS, US Department of Agriculture, NJ Board of Public Utilities and NJ Department of Agriculture in the development and compilation of materials for this report.

Scope of Report

The report includes:

- The reprint of the Courier Post Sunday, August 22, 2004 article has been included as Appendix A to provide personal accounts of the event. (Finding 10)
- A description of the waterways in Burlington and Camden counties and an overview of observed debris following on on-site helicopter survey is included in Finding 1.
- A brief outline of the permitting and regulatory process and its impact on the repair of damaged dams in the area. (Finding 2).
- Dam Safety enforcement efforts of the New Jersey Department of Environmental Protection (Finding 3). Current introduced legislation is included in this Finding. Also included is a stream flow illustration showing the condition of the dam following the July storm event.
- Finding 4 and Finding 5 covers a discussion of stream gages
- Soils and their impact on flooding is discussed in Finding 6)
- Options for financing dam maintenance and compensating loss caused by dam failure (Finding 7)

- The National Dam Safety Program, a FEMA program, provides financial assistance to states for strengthening dam safety programs (Finding 8).
- Frequently asked questions about New Jersey dams are answered in Finding 9.
- A complete listing of Dams is included in Finding 11.
- Liability and responsibility of dam owners is discussed in Finding 12.

More accurate flood risk information is being developed. FEMA has commissioned the URS Corporation and Dewberry and Davis Corporation to study 8 rivers, streams and creeks in Burlington and Camden Counties. Engineers will collect stream elevations data using aerial photography and ground crews will survey the stream banks. Stream flow information and any resulting changes to the floodplain maps and flood insurance rates will be finished by the Spring, 2005. Also, FEMA funds for dam repair and restoration will be based on the design standards resulting from these studies.

* * *

On March 1, 2003, FEMA became part of the U.S. Department of Homeland Security. FEMA's continuing mission within the new department is to lead the effort to prepare the nation for all hazards and effectively manage federal response and recovery efforts following any national incident. FEMA also initiates proactive mitigation activities, trains first responders and manages the National Flood Insurance Program and the U.S. Fire Administration.

NJOEM, a Section of the New Jersey State Police, is responsible for planning, directing and coordinating emergency operations within the State that are beyond local control.

Federal Coordinating Officer – Peter J. Martinasco
State Coordinating Officer – Captain Karl Kleeberg
Federal Task Force Co-Chair – Harold Spedding
State Task Force Co-Chair – Sergeant Thomas Scardino

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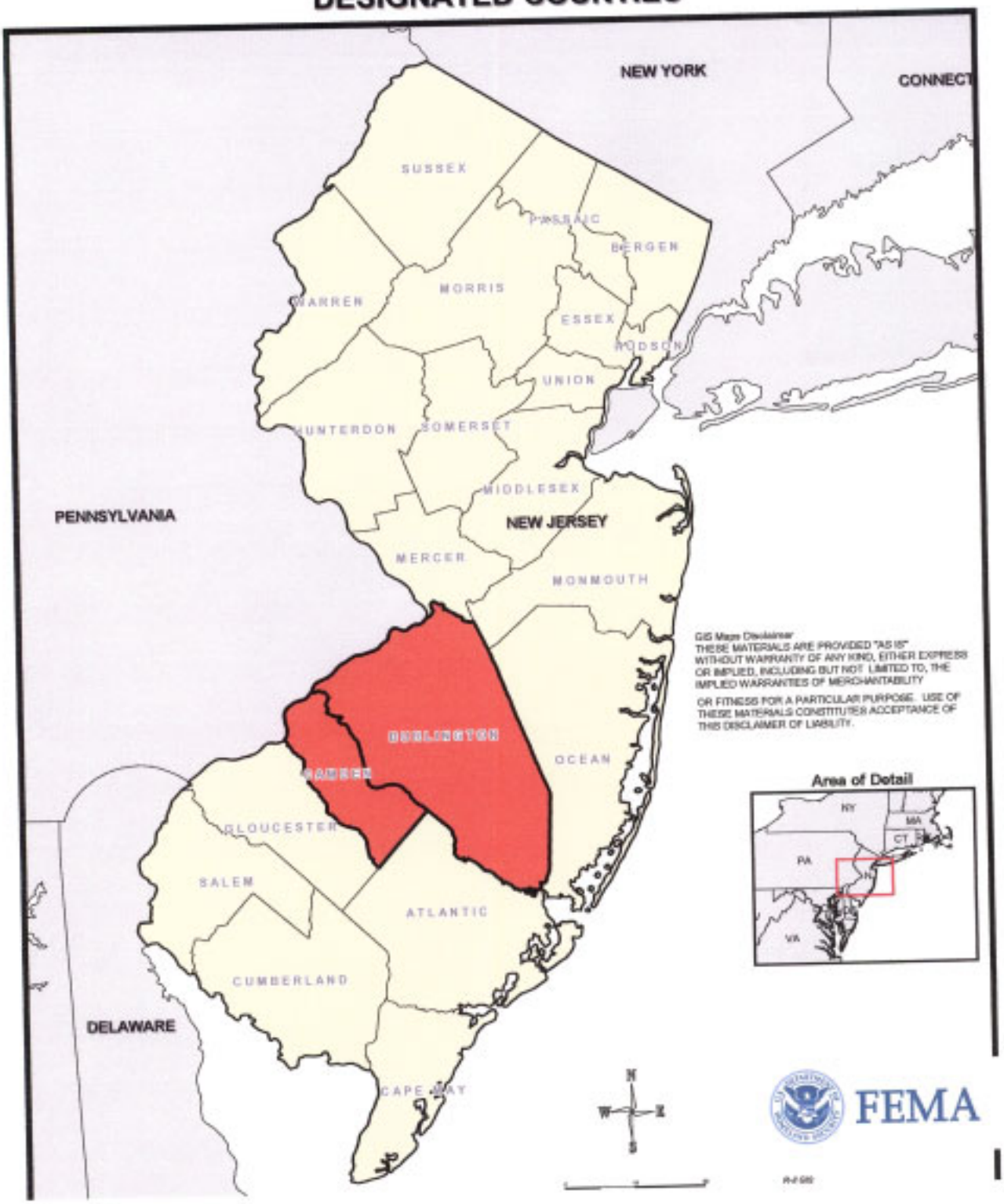
Photographs: Local emergency workers took NJOEM and FEMA field inspectors during the pre-disaster declaration assessment all photographs. They show conditions that existed immediately after the flooding in Lumberton, Southampton, Medford Townships and Medford Lakes Borough, Burlington County.

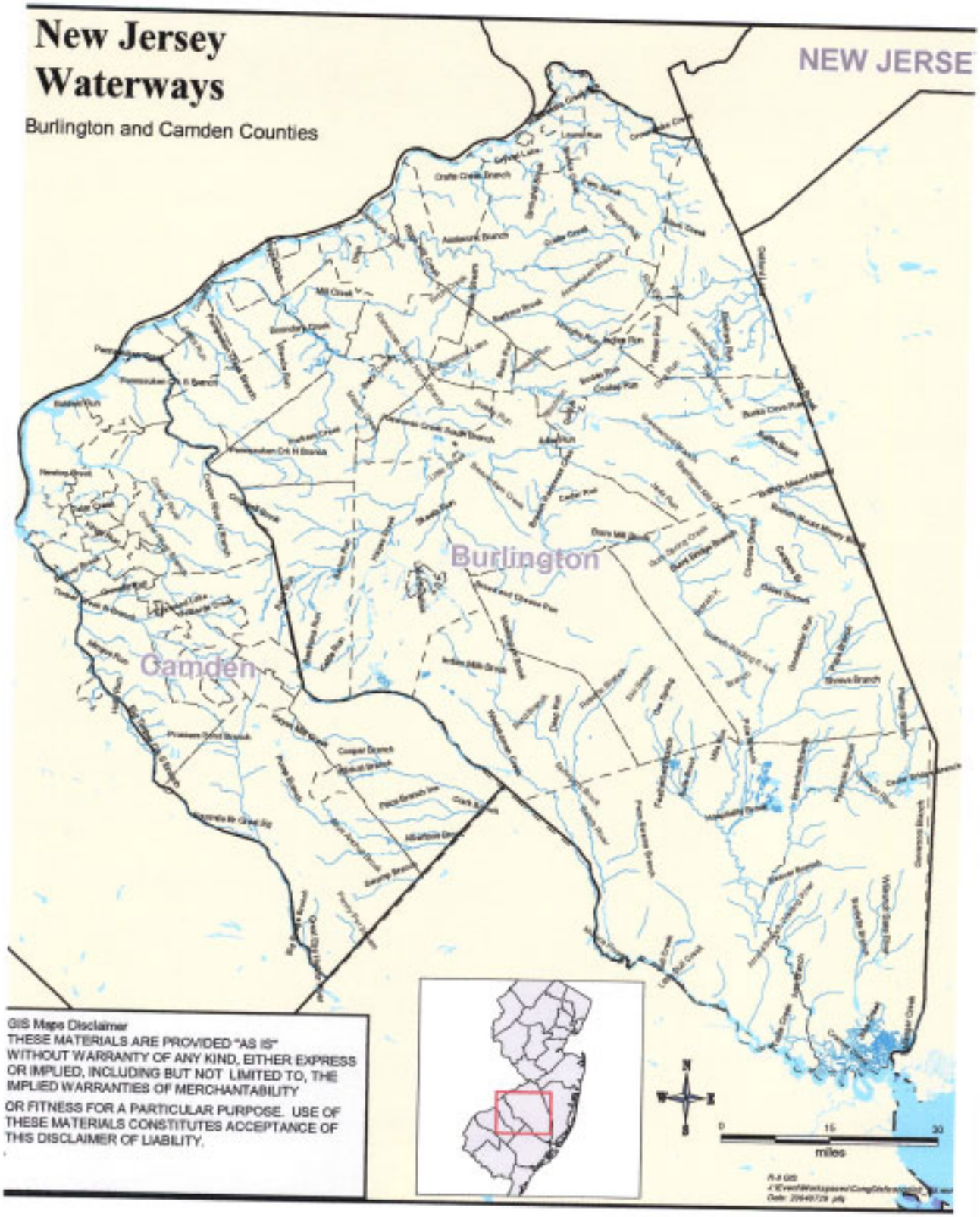
Findings of the Interagency Waterway Infrastructure Improvement Task Force

FEMA-1530 DR NJ

October 2004

FEMA - 1530 - DR - NJ
DESIGNATED COUNTIES




New Jersey
Waterways
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NEW JERSE
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Water, taken in moderation, cannot hurt anybody.

Mark Twain *US humorist, novelist, short story author, & wit (1835 - 1910)*