US Army Corps
of Engineers
New York District

MILLSTONE RIVER BASIN, NEW JERSEY

Reconnaissance Study For Flood Control & Ecosystem Restoration

Section 905(b) (WRDA 86) Preliminary Analysis

September 2000

RECONNAISSANCE STUDY

Section 905(b) (WRDA 86) Preliminary Analysis

Millstone River Basin, New Jersey
Flood Control and Ecosystem Restoration Study

1. STUDY AUTHORITY

The Millstone River Basin (New Jersey) Flood Control and Ecosystem Restoration Study is being conducted under the U.S. Army Corps of Engineers (Corps) General Investigations Program. The study was authorized by the U.S. House of Representatives Resolution dated 05 August 1999:

> *Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers titled Basinwide Water Resources Development Report on the Raritan River Basin, New Jersey, published as House Document 53, 71st Congress, 2nd Session, Section 729 of the Water Resources Development Act 1986 and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time in the interest of water resources development, including flood control, environmental restoration and protection and other allied purposes on the Millstone River, New Jersey.*

2. STUDY PURPOSE

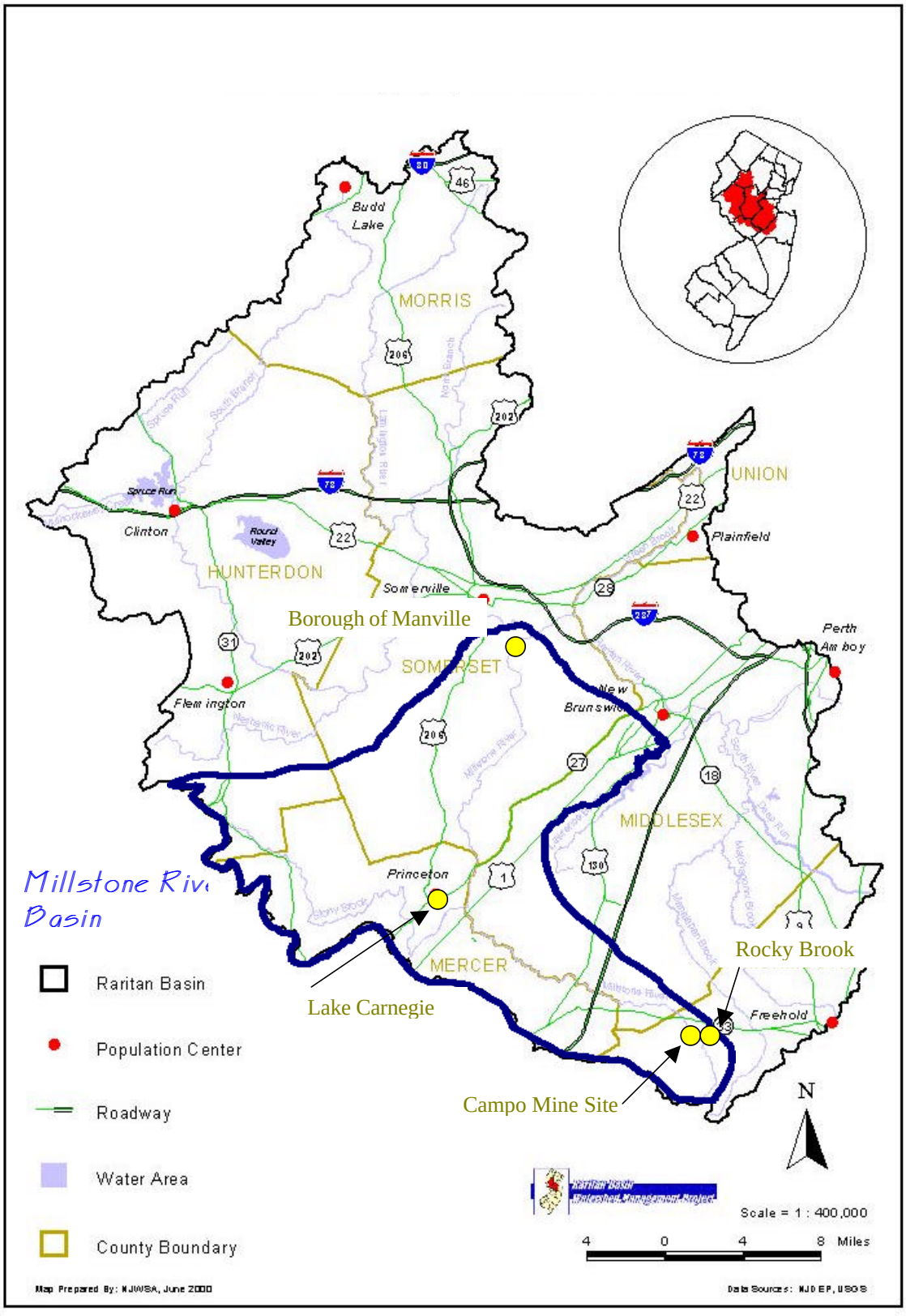
The purpose of this Section 905(b) (WRDA 86) analysis is to evaluate the Federal interest in flood damage reduction and ecosystem restoration within the Millstone River Basin in New Jersey. If Federal interest is demonstrated, this study will result in the development of a Project Management Plan for the next phase of study (i.e., the feasibility phase) and in the negotiation of a Feasibility Cost Sharing Agreement (FCSA) with a non-Federal partner.

3. LOCATION OF PROJECT/CONGRESSIONAL DISTRICT

The study area is the Millstone River Basin. The Basin is located in north-central New Jersey, halfway between Philadelphia and New York City. The Basin includes the Millstone River and its major tributaries located in the New Jersey counties of Mercer, Middlesex, Monmouth, Hunterdon, and Somerset. The 238-square mile Basin is a major tributary of the Raritan River. Stony Brook, which is the largest tributary to the Millstone River, is located near Princeton Township, New Jersey. This subbasin has a drainage area of 56 square miles. Figure 1 depicts the location of the Millstone River Basin within the Raritan River Basin.

The study area is located in New Jersey's 7th Congressional District (Congressman– Bob Franks R) and the 12th Congressional District (Congressman - Russ Holts D).

FIGURE 1
STUDY AREA



4. PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS

There are no existing Corps water resources development projects in the Millstone River Basin.

4.1 Prior Studies and Reports

Numerous Corps reports and studies by others were reviewed as part of this investigation. The Corps reports that were reviewed and used in this 905(b) analysis include the following:

- U.S. Army Corps of Engineers, The Floods of August and September 1971 (Hurricane Doria) (1975),
- U.S. Army Corps of Engineers, Survey Report for Flood Control, Raritan River Basin, New Jersey (August 1982),
- U.S Army Corps of Engineers, Survey Report For Flood Control Raritan River Basin, New Jersey (March 1985),
- U.S Army Corps of Engineers, Final Tropical Storm Floyd September 16, 1999 Post-Flood Report, New Jersey (July 2000).

Studies by others include:

- U.S. Department of Agriculture Soil and Water Conservation Plan for Stony Brook Watershed (July 1951),
- U.S. Department of Agriculture Soil and Water Conservation Plan for Stony Brook Watershed (July 1956),
- State of New Jersey Department of Environmental Protection Delineation of Flood Hazard Areas, Raritan Basin Millstone River, Rock Brook (February 1973),
- New Jersey Water Supply Authority, Water Budget in the Raritan River Basin, A technical Report for the Raritan Basin Watershed Management Project (March 2000).
- New Jersey Water Supply Authority, Setting of the Raritan River Basin, A technical Report for the Raritan Basin Watershed Management Project (July 2000).

Relevant information from studies by others, as well as from previous Corps studies, has been incorporated into the discussions that follow regarding existing conditions and problem identification.

5. PLAN FORMULATION

As part of this investigation, the New York District has coordinated with interested Federal, State, and local entities, as well as citizen groups, to identify problems and opportunities for flood damage reduction and ecosystem restoration in the Millstone River Basin. In addition, a literature search and review was conducted to identify available information regarding water resources issues in the Basin. Field reconnaissance was conducted to: (1) identify opportunities for flood damage reduction and ecosystem restoration, and (2) evaluate potential restoration opportunities identified by local stakeholders.

Plan formulation was conducted using a five-part process in coordination with Federal, state and local resource agencies and local stakeholders. First, a profile of existing conditions was developed, including identification of problems related to flooding and ecosystem degradation. Second, planning objectives and constraints were specified. Third, opportunities to address flooding and ecosystem degradation problems were identified. Fourth, selected sites were evaluated for potential Federal interest. Finally, discussions were held with potential non-Federal sponsors to determine their interest in participating in feasibility phase investigations.

5.1 Identified Problems

5.1.1 Existing Conditions - Flooding

Flooding in the Millstone River Basin results from complex interactions of physical and human influences. From its headwaters near Millstone Township in Monmouth County, the Millstone River flows northward to its confluence with the Raritan River at the Borough of Manville. The 238-square mile watershed falls within the Piedmont Plateau and Coastal Plain physiographic provinces. The Millstone River above Plainsboro is in the Coastal Plain. The remaining portion of the Millstone River is in the Piedmont Plateau. The Basin receives about 47 inches of precipitation annually, which is fairly evenly distributed throughout the year.

Flooding in the Millstone River Basin occurs as the result of intense thunderstorms, northeasters, and hurricanes. The greatest floods in the Basin have occurred as the direct result of hurricanes (Doria in 1971 and Floyd in 1999). These storms can deposit large amounts of precipitation in the watershed, producing significant runoff and headwater flooding of the low-lying and relatively flat floodplain. Coincident and backwater flooding also occurs in association with the Raritan River. The Borough of Manville located at the confluence of the Millstone and the Raritan Rivers is flooded by headwater and backwater events.

Rapid development in the watershed is increasing runoff potential and flood hazards. Many areas that previously were not subject to flooding are now reporting damages during severe events, such as Hurricane Floyd.

Municipalities in the study area were contacted during this investigation to determine the severity of their flooding problems associated with the Millstone River and its tributaries. Municipal engineers, public works officials, and construction superintendents were interviewed. For most of the Millstone River communities, structural protection from flooding is not economically feasible, since flood-prone structures are widely distributed. Non-structural measures may be viable means to reduce flood damages in these areas.

Based on interviews with State, county, and local officials, the most significant flooding problems in the Millstone River Basin are in the Borough of Manville. More than 1,200 homes were affected by flooding during Hurricane Floyd. Local officials estimated that 75 homes suffered major structural damage. The Lost Valley District was one of the hardest hit areas with over 500 homes damaged. Total damages in the Borough of Manville from Hurricane Floyd were estimated to be more than $15.9 million.

The recorded flood history for the Millstone River Basin began in 1921. Several significant flood events have been recorded since that time including:

July 23, 1938
September 21, 1983
June 3, 1946
December 31, 1948
March 7, 1967
August 28, 1971 (Doria)
August 2, 1973
September 16, 1999 (Floyd)

5.1.2 Existing Conditions – Ecosystem Degradation

Land use patterns and practices in the Basin have degraded the structure and function of natural systems in the Basin and have greatly reduced the river's ability to perform critical local and regional ecological functions. The following discussions describe the significance of natural resources of the Basin and identify factors contributing to ecosystem degradation in the Basin.

The Millstone River has environmental significance at the national, regional, and local scales. At the national scale, the river is an important tributary to the Raritan River and Raritan Bay. Raritan Bay is located within the nationally significant Hudson River Estuary, which is part of the National Estuary Program. The Millstone River Basin has direct biological and hydrological connections with this estuary of national significance. At the regional scale, the Millstone River is the critical component of aquatic ecosystems in the 238-square mile watershed. The mainstem, in-line ponds and lakes, and the river's tributaries support a myriad of important habitats for aquatic organisms, fishes and terrestrial and avian species. At the local scale, the river provides a broad variety of freshwater habitats and micro–habitats in rural, agricultural, and urbanized areas.

With its mixed rural, suburban and urban character, the Millstone River Basin is rich in ecological features and natural resources. Major habitat types include freshwater ponds, lakes, marshes, woody swamps, successional meadows and fields, as well as upland and riparian forests. The Millstone River is also an important aesthetic and recreational resource in a highly developed region.

The significance of the ecological resources in the Millstone River Basin is illustrated in a new initiative by New Jersey Department of Environmental Protection (NJDEP) to support watershed planning in the Basin. NJDEP is helping organize public and private stakeholders to better manage Basin environmental resources. This effort is currently focusing on: (1) identifying critical resources in the Basin, (2) formulating watershed management goals, and (3) developing a process to coordinate State, county, and local resource management.

The U.S. Fish and Wildlife Service (USFWS) documented the ecological significance of the Millstone River Basin in its 17 July 2000 letter to the New York District (see Attachment 1). In that letter, the USFWS noted the importance of Basin resources to wintering waterfowl; wading birds, migrant and resident landbirds; resident, and anadromous fish; and a variety of reptiles and amphibians. Since many of the waters are relatively shallow, the area serves as an important nursery area for many freshwater fish species and helps support recreational fishing in the Basin.

Two State-listed threatened species have been documented in the Millstone River Basin. The barred owl (*Strix varia*) is known to breed at several locations in the Basin. Also, the wood turtle (*Clemmys inscuplta*) can be found in several locations within the Basin. The Bog Turtle *(Clemmys muhlenbergii)* and the swamp pink *(Helonias bullbata)* are Federally-listed threatened species with known occurrences with the Millstone River Basin. Many migratory passerine birds breeding in Northeastern America use migration corridors which pass through, over, or adjacent to the Millstone River Basin both during the spring and the fall migrations.

The New Jersey Natural Heritage program lists floodplain forests in its rare species and Natural Communities database as an ecosystem of state concern in need of protection and expansion.

The Millstone River Basin has been subjected to a variety of disturbances that have degraded its ecosystem including:

- Residential, commercial and municipal development has increased the percentage of impervious surface in the watershed, increasing the total volume of runoff delivered to stream systems during storms. This, in turn, has affected the frequency and duration of bankfull events leading to severe stream disequilibrium and channel instability.

- Increased imperviousness of the watershed has reduced infiltration, depleted baseflows, and led to streams drying out during droughts.

- Poor sediment control practices in the watershed increase sediment discharges to waterways, ponds, and lakes. As a result, there is increased turbidity, reduced light penetration for subaquatic vegetation, increased covering and suffocation of benthic communities, and reduction of water depths.

- Point and non-point urban, suburban, and agricultural water pollution degrades water quality in the rivers and creeks. In particular, non-point nutrient inputs to Basin waterways have significant adverse effects on the aquatic ecology of the Basin.

- Agriculture activity, stream-channel modifications, water impoundments, mining, and urbanization have destroyed riparian ecosystems throughout the Millstone River Basin. Riparian areas provide crucial ecological functions and also enhance the quality, function and value of adjoining aquatic (streams) and terrestrial ecosystems and wildlife.

Other ecological damages occur along the rivers and creeks, including:

- Loss of wetlands along the rivers and creeks in the Basin degrades the quality of aquatic ecosystems. Wetlands protect water quality by filtering pollutants and provide important fish and wildlife habitat.

- Aggradation, infilling and eutrophication of ponds and lakes is depleting fish breeding and rearing habitat. Also, potential wood turtle habitat in lakes and ponds is being degraded.

5.1.3 Expected Future Conditions

Under without-project future conditions, many areas along the Millstone River Basin will continue to be subject to flooding. In particular, the Borough of Manville is particularly vulnerable. Damage potential may be reduced by nonstructural measures, particularly the acquisition of flood-prone structures. However, continued development in the Basin could exacerbate the flooding in Manville and other floodprone areas.

Degradation of the structure and function of the Millstone River Basin's ecosystem will continue without focused restoration efforts. The Basin's ecosystem will continue to function significantly below its ecological potential. Chronic stresses will continue to reduce species diversity and abundance. The creation of a watershed management program and process will help offset adverse influences on the ecology of the Basin. However, these efforts are limited in terms of their technical resources and financial ability to implement restoration of degraded Basin ecosystems.

5.1.4 Planning Objectives and Constraints

Planning objectives and constraints provide a framework for plan formulation. As planning objectives for this investigation, it is in the Federal interest to:

- Contribute to National Economic Development (NED) through the reduction of urban flood hazards, and
- Contribute to National Ecosystem Restoration (NER) through restoration of degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition.

The following planning constraints were used to formulate alternative plans:

- Improvements for flood control purposes shall have benefits in excess of estimated costs;
- Anticipated ecological benefits of restoration plans must be reasonable when compared to project costs;
- There must be a reasonable probability that identified ecosystem restoration projects would contribute significantly to improvement in the Basin ecosystem;

- The projects must be technologically feasible and cost effective, using proven technology; and
- Identified alternatives are within the authority of the Corps of Engineers and the non-Federal sponsor to implement; and,
- There is a reasonable assurance that a public entity (i.e., state or local unit of government) is capable and willing to participate as a non-Federal partner in a cost-shared feasibility study.

5.1.5 Summary of Problems and Opportunities

Evaluation of flooding problems in the Millstone River Basin has identified the Borough of Manville as the most significant problem area in the Basin. Manville was selected for detailed consideration in this investigation, serving as a test case for Federal interest in flood protection in the Millstone River Basin. During feasibility study additional investigations of flooding problems in other communities in the Basin may be warranted, since the flood-prone structures are not concentrated in specific areas, non-structural measures will be investigated as a viable solution to the isolated flooding problems.

Officials from the Borough of Manville report that the recurrent flooding problems are prevalent throughout the Borough in areas proximate to the Raritan River and the Millstone River. In the Borough of Manville, the Lost Valley District is one of the most significant impact areas. As a result, plan formulation focused on flooding problems and opportunities in this area.

Significant degradation of the ecology of the Millstone River Basin has occurred as a result of development activity. Additional degradation will continue without focused ecosystem restoration efforts. There is strong support among local public and private stakeholders for ecosystem restoration in the Basin. Ecosystem restoration potential in the Basin was evaluated using: (1) information provided by local stakeholders, (2) previous studies, (3) GIS output, (4) aerial photographs, and (5) field reconnaissance. Many opportunities for ecosystem restoration exist in the 238-square mile watershed. Plan formulation will focus on several types of restoration opportunities that represent a subset of the potential projects in the Basin. Additional opportunities for ecosystem restoration may be identified and investigated during the feasibility phase. The types of ecosystem restoration to be formulated include:

- Lake Restoration and Watershed Management (Carnegie Lake),
- Comprehensive Riparian System Restoration (Rocky Brook),
- Disturbed Land Restoration (Campo Mine), and
- Ecological Enhancement in association with a Flood Control Project (Manville).

As described below, these restoration activities would result in significant site and systemic benefits to the ecology of the Millstone River Basin.

5.2 Alternative Plans

5.2.1 Alternative Flood Damage Reduction Plans – Lost Valley District

Flooding problems in the Borough of Manville are exacerbated by land use changes in the Basin and consequent hydrologic modification of the Millstone River, increasing runoff and headwater flows. Backwater flooding from the Raritan River is also increased by the land use changes from elevated flows in conjunction with a reduction in channel capacity and the lowering of the hydraulic gradient of the river due to sedimentation. Almost all areas of the Borough of Manville adjacent to streams and rivers have some of flooding problems. The Lost Valley District is one of the most densely populated portions of the floodplain. Figure 2 is an aerial view of the Lost Valley District. During Hurricane Floyd over 500 residential structures sustained flood damage in the Lost Valley District.

Structural and nonstructural plans were considered as alternative solutions to flooding problems in this area. Some houses in the Lost Valley District have already been elevated. Non-structural (acquisitions, floodproofing) and structural measures were evaluated to alleviate flooding at this location.

Non-structural Plan
The non-structural alternative provides flood damage reduction up to the 100-year design level. This plan evaluates and provides flood protection on a building-by-building basis. In some cases, providing flood protection to individual flood prone buildings is more cost effective than providing flood protection for entire reaches of the river. The method used for a particular structure is dependent on a number of factors such as the depth of flooding; the type of building; the presence of a basement or a crawl space; soil conditions; and the layout of a property. Flood protection measures range from very radical foundation changes and elevating the structure to measures that require minimal physical changes, such as impermeable sheeting and waterproof closures. Potential non-structural measures include the following:

- Aquisitions – purchase, evacuation and removal of buildings in the floodplain;
- Raising - elevating the structures lowest floor above the 100-year floodplain;
- Ringwalls – surrounding a property with a structural barrier to stop floodwater from entering;
- Floodproofing - dry floodproofing applies measures to keep floodwater out of the structure by wrapping a structure with impermeable material or other measures, and/or wet floodproofing where flood waters are allowed to enter the structure but major utilities and contents are elevated to reduce damages.

FIGURE 2
Borough of Manville
Lost Valley Residential District

Based on the public acceptability various nonstructural techniques, non-structural acquisitions and floodproofing plans were formulated for the Borough of Manville.

Acquisition Plan. An acquisition plan for the 241 structures located in the 100-year floodplain was analyzed. The acquisition plan would entail the permanent evacuation of existing floodprone structures through land and structure acquisition. Structures would be demolished or relocated out of the 100-year floodplain. If contiguous parcels with adequate physical properties to support ecosystem enhancements were identified, the purchased properties may be enhanced to restore the 100-year floodplain to a less degraded more natural condition.

Floodproofing Plan. A plan was analyzed for floodproofing assuming that 241 structures located at or below the 100-year flood elevation were appropriate for various types of floodproofing.

Structural Plan

Structural alternatives providing flood damage reduction up to the 100-year design level were evaluated. Alternative structural plans include earthen levees and inverted T-type concrete floodwalls to reduce flood damages. A pumping station was assumed to be necessary to control interior drainage behind levees. Roadway closure structures were included where the line of protection crossed an existing roadway.

Two plans with alternative levels of protection were considered: a protection plan with a top of levee/floodwall elevation of 43 feet National Geodetic Vertical Datum of 1929 (NGVD) and a protection plan with a top of levee/floodwall elevation of 41 feet NGVD. Level of protection elevations were selected based on 50-year and 100-year flood levels of 39.5 feet and 41.6 feet NGVD.

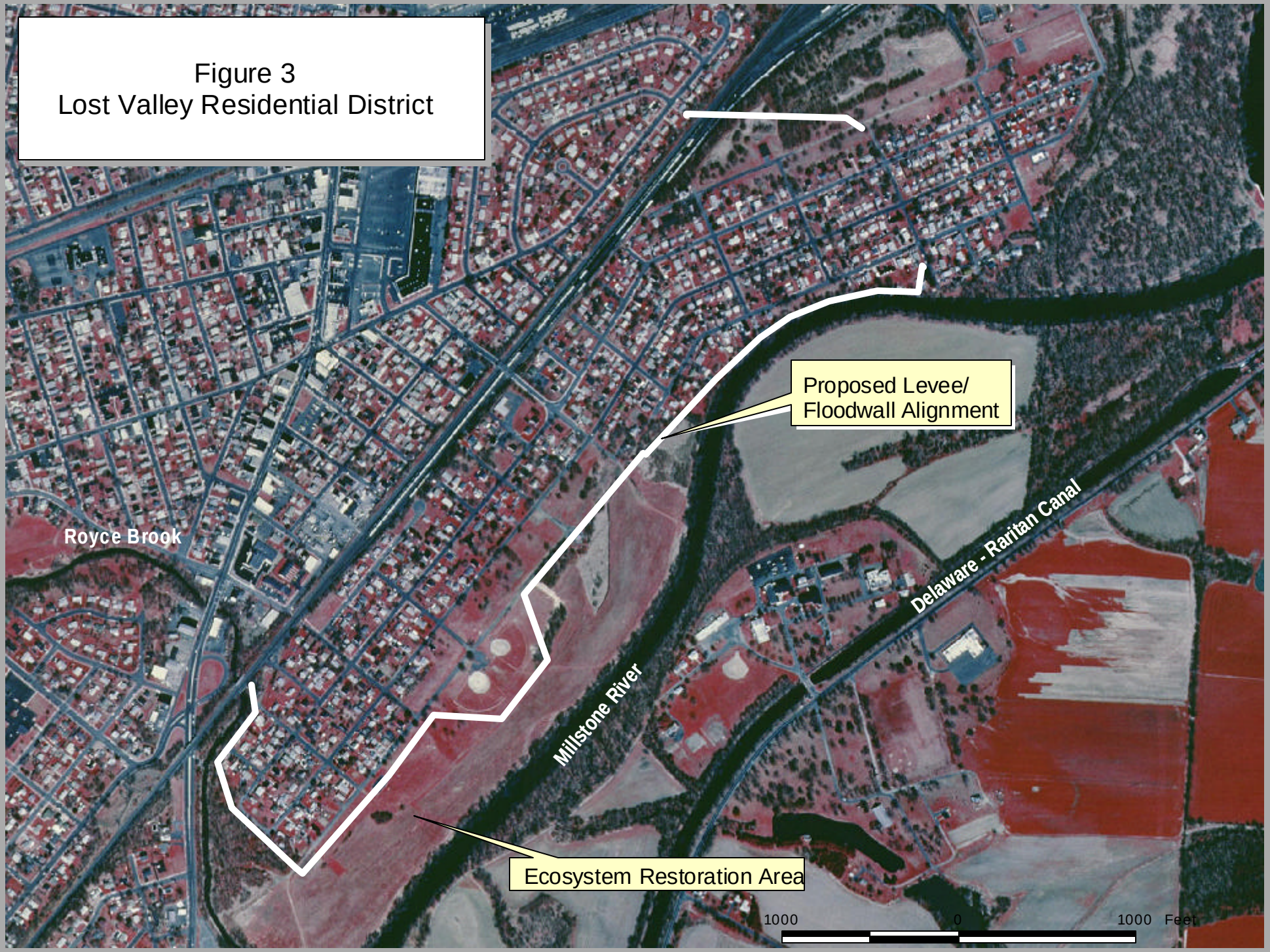
Structural Plan 1 – 100-year Level of Protection (43 feet NGVD) Levee and Floodwall

Approximately 7,900 feet of levee and floodwall with an average height of 15 feet would be necessary to protect the Lost Valley District up to the 100-year flood event. Levee/floodwall alignments would consist of two parts: one, along the Millstone River, and a second, shorter levee segment to prevent inundation from the Raritan River. The Structural Plan 1 levee and floodwall layout is shown in Figure 3. The shorter levee segment would cross the railroad tracks and require a two-foot raising and re-leveling of the tracks. This plan also requires a road closure gate at Kyle Street or filling the Kyle Street under pass to prevent potential flooding from Royce Brook. A stormwater pump station is included with this plan to ensure drainage of the areas behind the line levee and floodwall.

Structural Plan 2 – 50-year Level of Protection (41 feet NGVD) Levee and Floodwall

Approximately 7,100 feet of levee and floodwall with an average height of 13 feet would be necessary to protect the Lost Valley District up to the 50-year event. The levee and floodwall alignments would consist of two parts: one, along the Millstone River, and a second, shorter levee segment to prevent inundation from the Raritan River. However, at the design elevation,

Figure 3
Lost Valley Residential District



the shorter levee segment would tie into the railroad tracks, eliminating the need to raise the tracks. The Structural Plan 2 levee and floodwall layout is shown in Figure 3. This plan would also require a road closure gate at Kyle Street or filling the Kyle Street under pass to prevent potential flooding from Royce Brook. A stormwater pump station is included with this plan to ensure drainage of the areas behind the line levee and floodwall.

Both structural plans would include enhancement of the riparian corridor between the levee and floodwall and the rivers. Based on the preliminary layouts approximately 28 acres could be ecologically enhanced. Wetlands and riparian buffer areas could be established. The details of the ecological improvements are discussed in the next section.

5.2.2 Alternative Ecosystem Restoration Plans

Through initial field reconnaissance, literature reviews, and discussions with local stakeholders, four types of potential ecosystem restoration were identified in the Millstone River Basin. Each of these restoration actions would result in significant systemic improvements in the Millstone River Basin ecosystem, as well providing significant on-site ecological and aquatic ecosystem improvements. The four types of ecosystem restoration identified through this investigation represent the diversity of ecosystems in the Millstone River Basin. A profile of each restoration type is provided below, including the location, site description, and ecosystem problems and opportunities.

Carnegie Lake Restoration and Watershed Management Plan. Carnegie Lake is a narrow 3-mile long lake located adjacent to Princeton University east of Princeton Borough. Figure 4 shows an aerial view of a portion of Carnegie Lake. The lake was created in 1907 by constructing a dam across the Millstone River. A primary use of the lake was rowing. Three islands are present in the lake, which is crossed by three bridges. The lake encompasses 237 acres and has a 47.8 square mile watershed. Land use within the watershed is 30-percent agricultural, 11-percent forested, and 12-percent other. The Stony Brook and the Upper Millstone River comprise the majority of the drainage to Carnegie Lake. In 1997, water depths within Carnegie Lake ranged from 4 to 9 feet with active aggradation occurring.

The lake was first dredged in 1927 to remove 5,000 cubic yards of silt deposits. Intermittent dredging occurred between 1937 and 1938. During this period an estimated 160,000 cubic yards of material were removed. In 1972, the lake was dredged again, removing 1 million cubic yards of silt and gravel. The accelerating erosion, transport, and deposition of sediments into Carnegie Lake remain the primary water resource problem for the lake.

In an effort to limit the transport of sediment to Carnegie Lake, 12 sediment retention facilities were constructed in the Stony Brook watershed in 1954. These basins capture a portion of the sediment load but continue to require maintenance. Previous studies have identified the Stony Brook Basin as the primary contributor of sediment to Carnegie Lake. The soft shale soils of the Stony Brook watershed are easily eroded and transported into the stream system. Sediment input from stream banks, agricultural practices and residential development also contribute significant sources of sediment.

FIGURE 4
Carnegie Lake

Nutrient runoff and input to the lake is also high. Nutrient inputs appear to be greater from the upper Millstone River, Harry's Brook, and Stony Brook. Agricultural (row crops, dairy farms) and non-agricultural (septic systems, lawns, impervious areas) activities contribute to elevated phosphate and nitrate levels within the lake.

Fish habitat within Carnegie Lake is diminished by reduced water quality and continual sedimentation. Sediment inputs increase turbidity, reduce primary production, and smother spawning beds and benthic habitat. Open water mud flats and shallow areas created by sediment aggradation elevate summer temperatures and reduce dissolved oxygen levels. These shallow areas are populated with mono-typic stands of invasive r-selected weed species.

A comprehensive Lake Restoration and Management Plan would significantly increase the ecological value and help restore the aquatic ecosystem to a less degraded, more natural condition. The potential plan features could include:

- An assessment of the watershed to identify the major sediment sources, the effectiveness of the existing basins. This would support development of a holistic approach to first, limit erosion and second, control the transport and deposition of excess bedload to Carnegie Lake.
- An ecological inventory to identify the high quality habitat areas presently functioning in and adjacent to the lake.
- A comprehensive plan identifying ecologically impaired areas for improvement within the 3-mile long lake.
- The development of an environmental dredging plan to support the existing primary functions and uses of the lake in conjunction with the deepening of areas to benefit the aquatic ecosystem, including fisheries. The identification of placement areas proximate to dredging is critical to control dredging costs. Placement areas would be selected and configured to support environmental enhancements. The potential enhancements include the creation of open freshwater areas for the establishment of submerged aquatic vegetation, the creation of shallow fresh marshes and emergent wetland areas, the creation of competent transition channels from tributaries to the lake and the placement of structures to increase spawning and rearing habitat in the lake. Conversion of existing emergent wetland areas to forested wetland through plantings would also be evaluated.
- An integrated vegetation management plan employing native species would be developed to guide planting of restored habitat and to control the spread of nuisance species. A nuisance species eradication plan would also be developed as part of this plan.
- Development of in-lake forebays and the identification of areas for sediment capture and periodic maintenance dredging. Potential sediment capture areas could include in-lake subaqueous weirs, stilling basins, and floodplain wetlands.
- A community education program to facilitate stewardship and improve water quality through better homeowner practices.

Rocky Brook Comprehensive Riparian System Restoration. The headwater channel of Rocky Brook in Millstone Township has aggraded two feet due to a catastrophic sediment input during Hurricane Floyd. Prior to Hurricane Floyd historical, development activities altered the Rocky Brook watershed's rainfall – runoff relationship and significantly changed the stream's hydrologic regime. These changes initiated channel instability. A series of channel adjustments, first downcutting and then channel widening has occurred in the upper 2,000 linear feet of the stream. The massive input of sediment during Hurricane Floyd has rejuvenated the channel instability, covered and smothered benthic habitat and annihilated the baseflow channel. Figure 5 is an aerial view of the headwater portion of Rocky Brook.

The downstream portion of Rocky Brook has been protected from the excess bedload by an in-line pond. This pond captured the majority of the sediment transported by the stream during Hurricane Floyd and continues to trap excess bedload. Sediment capture degraded the pond ecosystem. Sediment-laden streamflow has raised the turbidity in the pond, in-filled creating shallow areas and increased the ambient summer water temperature. As a result, the amphibian, reptile, and fish habitat of the pond is severely degraded.

The riparian corridor of Rocky Brook and the pond have also been impacted by development and agricultural activities. Landscaped lawns and pasture line the unforested portion of the stream valley. In some areas, the remaining forest riparian buffer is narrow (i.e., less than 25 feet wide).

Millstone Township has plans for a regional detention structure to help restore Rocky Brook's hydrologic regime. A comprehensive riparian corridor restoration, including stream channel and pond restoration in conjunction with regional detention would significantly restore the headwater aquatic ecosystem to a less-degraded, more-natural condition. First, the in-line pond could be enlarged and retrofitted to enhance sediment retention. This improvement would ensure the continued protection of downstream aquatic resources during implementation of upstream restoration measures. Next, a more natural stream pattern and channel geometry could be reestablished to facilitate a dynamic stream equilibrium.

Environmental dredging and reconfiguring of the in-line pond could then be implemented to maximize the ponds ecological potential. Potential measures include construction of a forebay for primary sediment capture and maintenance, grading and planting of shallow water and shoreline, areas to enhance existing wetlands, and creating new wetlands. A 100-foot wide riparian corridor would be established adjacent to the in-line pond and Rocky Brook. This corridor then could be planted with native shrub and tree species connecting the upstream and downstream habitat fragments into a contiguous corridor.

Riparian corridors provide substantial benefits to aquatic resources and wildlife of a basin. They function as transition zones that improve water quality and provide habitat migration corridors for wildlife. As part of the comprehensive riparian system restoration, a riparian corridor restoration plan would be prepared for the Millstone River and its tributaries in Princeton Township. The plan would identify denuded riparian areas, infringed upon narrow riparian areas, and riparian areas that could be improved through better management practices such as tree planting. Modifications such as minor regrading and hydrologic connections to the river would also be identified. A ranking system would be developed based on a priority matrix to guide implementation of riparian restoration projects. Additional ecosystem restoration projects would likely be identified in conjunction with this plan.

FIGURE 5
Rocky Brook Subbasin

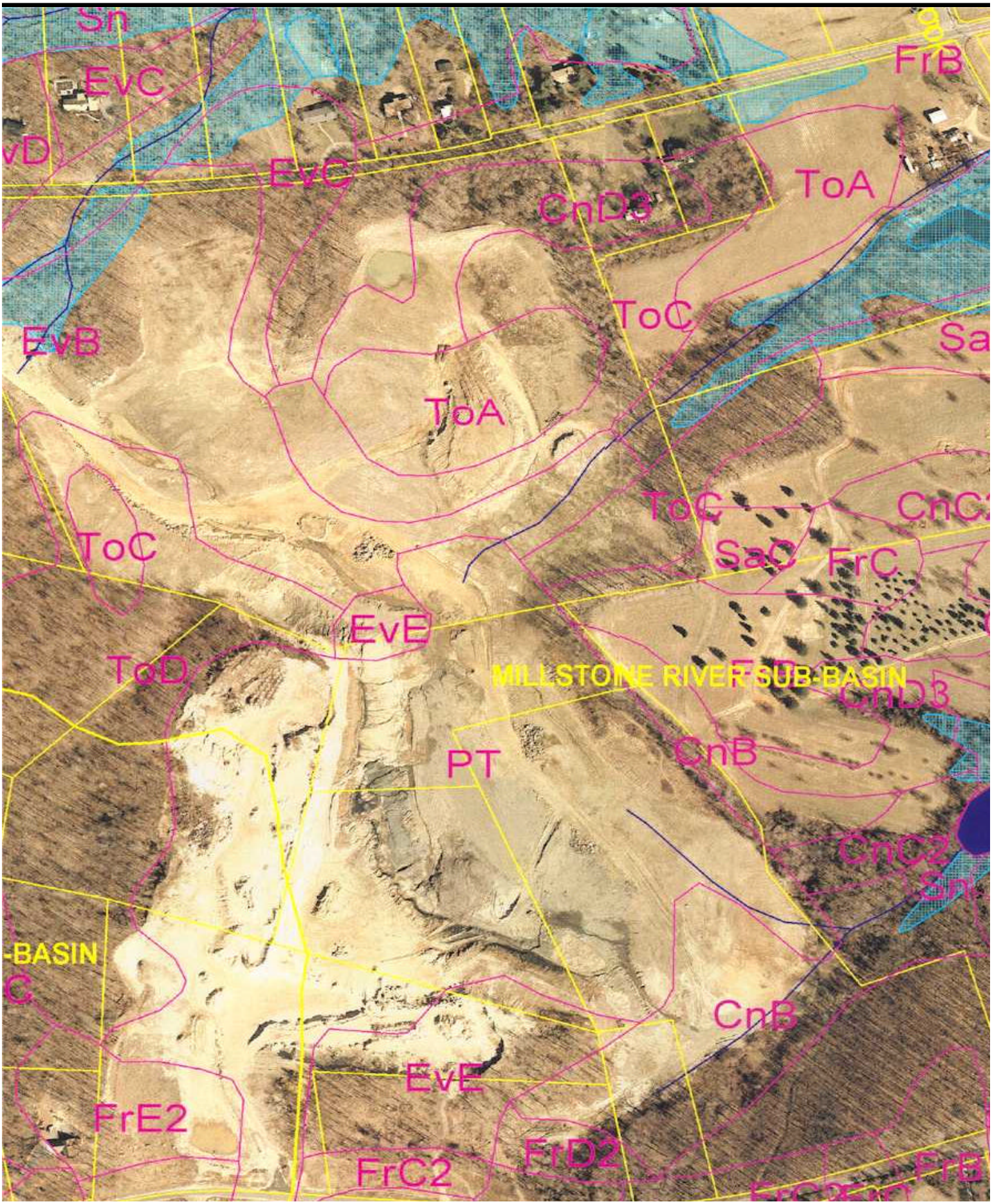
Campo Mine Site - Disturbed Land Restoration: The Campo Mine site is a 90-acre inactive sand mine adjacent to the Millstone River in Millstone Township. Figure 6 is an aerial depiction of the Campo Mine Site. The site is almost devoid of vegetation with 20 to 30 foot highwalls and sand piles. Several first order streams were destroyed during mining. Unconsolidated sandy soil is actively eroding and transported into the remaining three tributaries that drain the site. This sediment is overloading the transport capacity of these streams and causing aggradation. Within the exposed sand layers are deposits of marl - low permeability clay. Wetland creation at this site would be possible by diverting up gradient drainage to target wetland creation areas lined with the marl.

Millstone Township is reliant on groundwater for water supply. With development, more areas of the township are converted to impervious surfaces, and the recharge of the aquifer is reduced. The natural recharge potential of the highly pervious sand mine could be exploited by routing outflow from created wetland areas into recharge structures. This series of restoration components will increase the aquatic habitat at the site, help maintain the aquifer, and support baseflow maintenance in the Millstone River.

The entire 90 acres would be restored. Restoration would create as much as 10 percent emergent wetland areas, 10 percent infiltration / recharge structures, 30 percent riparian corridor with the remainder of the site in transition areas and forest. Exposed highwalls would be backfilled and regraded with of the site restored to a more natural landscape characteristic, i.e. riparian wetlands, bottomland forest outcrop, and dry ridge highlands. Passive recreation and public education opportunities via trails and interpretive stations would also be included, based on the interest of the local sponsor.

Manville Ecological Enhancement in Association with a Flood Damage Reduction Project: Floodplain restoration has been evaluated in conjunction with the above-described structural flood control plans for the Borough of Manville. Twenty-eight acres are available in the floodplain situated between the proposed levee and floodwall alignments and the Raritan and Millstone Rivers (see Figure 3). Historical agricultural landuse and urbanization have resulted in the reduction in the function and value of the existing habitat for wildlife and aquatic resource value. The site is presently owned by the Somerset County Park Commission and is open space with most of the site in early successional meadow. Small portions of the site presently support wetlands. The overall vegetative diversity of the site is low. There is significant opportunity at this site to increase vegetative diversity and overall ecological value of the site is high. Components of the restoration plan include 10 acres of wetland restoration and creation, revegetation of the riparian corridor and the hydrologic reconnection and restoration of up to 20 acres of the floodplain riparian system. Wetlands and the riparian corridor would be planted with desirable native species.

FIGURE 6
Campo Mine



Other Restoration Opportunities: During the feasibility phase, other restoration opportunities may be identified through the development of the Carnegie Lake watershed plan and the riparian corridor restoration plan. In particular, three ecosystem restoration opportunities should be considered in the feasibility phase. First, in its letter of support for this investigation, USFWS indicated the presence of multiple low-head dams along Millstone River tributaries (see Attachment 1). The removal of these dams would allow passage of fish species. There may be potential for sediment retention structures, floodplain wetland creation and natural channel restoration in the Carnegie Lake watershed. Reestablishment of fully functioning contiguous riparian corridors would provide opportunities for wetland creation, restoration and enhancement as well as forest stand restoration.

5.3 Preliminary Evaluation of Alternatives

5.3.1 Evaluation of Alternative Flood Damage Reduction Plans

The benefits and costs of the alternative flood damage reduction plans are discussed below. Benefits are based on avoided flood damages for the structures (primarily residential) in Lost Valley District. During Hurricane Floyd over 500 residential structures sustained flood damage in the Lost Valley District.

Nonstructural Plans

Acquisition Plan: The estimated cost to acquire 241 structures and property in the 100-year floodplain within the Lost Valley District of Manville is $44.7 million. The cost of this plan, which includes resident relocation and structure demolition, significantly exceeds potential benefits and is not recommended as a stand-alone plan. Limited acquisitions may be an effective component of other plans that are determined to be in the Federal interest.

Flood Proofing Plan: Structures were not evaluated on an individual basis to determine floodproofing measures applicable for each one. Rather, an average cost for floodproofing structures using costs from the "Green Brook Flood Control Project" was used to estimate the total cost of the floodproofing plan. This plan would provide protection for 241 structures in the 100-year floodplain at a cost of approximately $18 million. This plan provides protection for residential structures and their contents. Damages to automobiles, garages, out-buildings and their contents, landscaping, public infrastructure, and roads that would be reduced with a structural plan would continue to occur. The cost of this plan exceeds the potential benefits and is not recommended as a stand-alone plan. Limited flood proofing may be an effective component of other plans that are determined to be in the Federal interest.

Structural Plans

Costs for the two structural plans are based on construction cost estimates for similar projects by the New York District. In addition to sharing in the cost of constructing the project, the local sponsor would be responsible for all operation and maintenance (O&M) costs.

Structural Plan 1 (100-year protection): The estimated cost of structural plan 1 is $18.6 million with an annualized cost of approximately $1.3 million. It is expected that the annual benefits of the structural alternatives would likely equal or exceed the estimated annual costs.

Structural Plan 2 (50 year protection): The estimated cost of structural plan 2 was $10.3 million dollars with an annualized cost of approximately $1 million. It is anticipated that the annual benefits of the structural alternatives would likely equal or exceed the estimated annual costs.

The benefits of flood damage reduction in the Borough of Manville are expected to exceed the costs. Evaluation of flooding problems and potential solutions in the Lost Valley District illustrates Federal interest in flood damage reduction in the Millstone River Basin. During feasibility studies, flood damage reduction at other locations in Manville and in the Basin may be identified.

5.3.2 Evaluation of Alternative Ecosystem Restoration Plans

To determine Federal interest in ecosystem restoration in the Millstone River Basin, costs and benefits of the alternative plans are estimated below. The four restoration projects previously identified would produce the following ecological outputs:

- Carnegie Lake Restoration and Watershed Management Plan: approximately three feet of material would be dredged from an average 200-foot wide section of 2.5 miles of the lake, 10 pools would be dredged to create deeper water habitat, up to 10 forebays would be constructed to provide areas for sediment deposition and cost effective maintenance, 9,500 feet of shoreline would be stabilized using a combination of dredged material and bioengineering techniques, 9,500 feet of shoreline would be planted with woody material to reestablish the riparian corridor and 44 acres of emergent, scrub shrub and wooded wetlands would be created through the placement of dredged material.

- Rocky Brook Comprehensive Riparian System Restoration: approximately 2,000 linear feet of stream channel would be restored, the existing 4.4 acres of pond would be dredged and expanded by 1.5 acres to restore and enhance aquatic habitat and upgrade with a forebay for sediment capture and maintenance, 10 acres of forested riparian corridor would be reestablished connecting existing large forested habitat fragments, and 2 acres of mixed emergent wetland and turtle habitat would be created.

- Campo Mine Site - Disturbed Land (Mine land) Restoration: approximately 10 acres of palustrine emergent wetlands, 10 acres of recharge basin, 27 acres of forested riparian buffer and 43 acres of revegetated terrestrial habitat would be created.

- Manville Ecological Enhancement in Association with a Flood Damage Reduction Project: approximately 15 to 20 acres of riparian buffer including wetlands would be restored.

Table 1 contains estimates of construction and O&M costs for the four restoration projects described above.

TABLE 1
COSTS OF ECOSYSTEM RESTORATION PROJECTS

Site	Construction Costs	Operation & Maintenance
Carnegie Lake Restoration and Watershed Management Plan	$6,000,000	$30,000
Rocky Brook Comprehensive Riparian System Restoration	$800,000	$5,000
Campo Mine Site – Disturbed Land (Mine land) Restoration	$1,980,000	$20,000
Manville Ecological Enhancement in Association with a Flood Damage Reduction Project	$300,000	$5,000

Ecosystem restoration is a high priority mission for the Corps and a major goal of the Administration. The restoration opportunities described above represent a holistic approach to restoration of degraded aquatic, wetland, and riparian habitat within the Millstone River Basin. These actions would result in significant benefits to ecosystems of local, regional, and national significance.

The restoration projects would help offset degradation and loss of critical habitat in the Millstone River Basin. They would improve vegetation, fish, and wildlife biodiversity. These restoration projects would also provide fish and wildlife habitat on-site and produce systemic improvements to the Basin ecosystem.

5.3.3 Watershed Management Planning

The effectiveness of the restoration efforts proposed for Carnegie Lake would be increased if they were planned and implemented as a part of a comprehensive basin-wide watershed management plan. The basin-wide watershed management plan would give structure to the restoration effort, act as a coordinating tool for these activities, and provide the necessary management guidelines that would enhance the success of these and other restoration efforts. The basin-wide watershed management plan would also include non-structural components for environmental restoration, such as identifying regulatory actions that may be implemented on a municipal level to enhance restoration activities at specific sites.

As described above, a watershed management planning process has been initiated by NJDEP. The Corps could support this effort through: (1) data gathering to inventory the characteristics of the watershed and (2) development of hydrologic, hydraulic, and water quality models. Once the characteristics and conditions of the watershed are identified and modeled, existing management strategies can be evaluated and new management strategies could be developed in support of future restoration actions.

The combination of data gathering, modeling, and management strategy development would support identification and effective implementation of structural and non-structural opportunities for watershed management. Structural opportunities include restoration projects such as those identified in this report. Non-structural opportunities may include revision or enforcement of

zoning ordinances, easements, or building permit requirements that would be implemented by state or local authorities. The basin-wide watershed management approach incorporates the dynamic relationships between ecosystem functions and communities. In the framework of a basin-wide watershed management approach, ecosystem restoration planning would consider the roles of plant and animal species populations and their habitats in the larger context of community and ecosystem relationships.

6. FEDERAL INTEREST

There is clearly a Federal interest in flood damage reduction and ecosystem restoration in the Millstone River Basin. Feasibility studies of flooding problems in the Borough of Manville are warranted. This is illustrated by the demonstrated feasibility of the 100-year flood protection for the Lost Valley District. Existing floodplain ordinances are in force and will serve to control new development in the regulated floodplain.

The ecosystem restoration projects identified in this investigation are also of Federal interest. Ecosystem restoration is one of the primary missions of the Corps of Engineers Civil Works Program. The Corps objective in ecosystem restoration planning is to contribute to NER by increasing the net quantity and/or quality of desired ecosystem resources (ER 1105-2-100, 22 Apr 2000). With the Civil Works program, priority is given to restoration projects that restore degraded ecosystem structures and functions, including the ecosystem's hydrology and plant and animal communities, to a less degraded, more natural condition (ER 1105-2-501, 30 Sep 1999).

No adverse environmental impacts are anticipated from any of the proposed actions. The preliminary analysis conducted during the reconnaissance phase indicates that the ecological and economic benefits of proposed efforts will exceed project costs, that the proposed measures are technologically feasible, and that they can be accomplished in a cost effective and efficient manner.

7. PRELIMINARY FINANCIAL ANALYSIS

The New Jersey Department of Environmental Protection (NJDEP) and the Borough of Manville have expressed interest in serving as non-Federal partners for a joint flood control and ecosystem restoration feasibility study of the Borough of Manville. The Millstone Township and the Stony Brook - Millstone Watershed Association have expressed interest in serving as non-Federal partners in conjunction with NJDEP for an ecosystem restoration feasibility study of the Rocky Brook, Millstone River riparian corridor and Carnegie Lake Watershed. Letters of intent from NJDEP and other partners are anticipated to be received in the near future by the New York District Corps of Engineers. All partners have indicated that they understand the feasibility and construction cost sharing responsibilities. For flood damage protection features, the non-Federal partner is aware that they will be responsible for all lands, easements, rights-of-way, relocations, and disposal areas for the project (LERRD), plus a cash contribution of a minimum of 5 percent of total project costs (only for the flood damage reduction portion of the project). In the event that LERRD costs plus 5 percent total project costs does not equal at least 35 percent of total project costs, the non-Federal partner is aware that it must contribute additional cash to equal 35 percent

For ecosystem restoration features, the non-Federal partner is aware that they will be responsible for all lands, easements, rights-of-way, relocations, and disposal areas for the project (LERRD). In the event that LERRD costs do not equal at least 35 percent of total project costs, the non-Federal partner is aware that it must contribute additional cash to equal 35 percent.

The non-Federal partner is also aware that they will be responsible for operating and maintaining the project at 100 percent non-Federal expense upon completion of construction.

8. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS

1. A number of assumptions have been used to guide development of the Project Management Plan (PMP) and schedule for the feasibility study. These assumptions are listed below.

2. A single feasibility study for flood control and ecosystem restoration in the Millstone River Basin will be executed.

3. The decision document will be an integrated Feasibility Report and a National Environmental Policy Act (NEPA) document prepared by the New York District.

4. Based on the non-Federal partners' fiscal year and budgets the exact amount of funds available for reprogramming cannot be determined at this time. The feasibility study schedule shown in Section 9 may be extended during development of the Project Management Plan.

5. An MCACES cost estimate will be performed on the structural and non-structural features that comprise the selected plan. The cost of preliminary alternative structural and non-structural measures will be developed at a lesser level of detail with comparative cost estimating techniques.

6. There will be no AFB Decision Conference, since the decision to have an AFB conference has already been made. The AFB technical memorandum will be provided to HQ one month prior to the AFB. The AFB technical memorandum will document the results of plan formulation, identification of the NED/NER plan, and selection of the recommended plan. However, final design and MCACES cost estimates for the selected plan will be prepared after the AFB, in time to be included in the Draft Integrated Feasibility Report and NEPA document.

7. A cost effectiveness and incremental analysis (CE/ICA) will be prepared for ecosystem restoration features. Plan features which have both ecological as well as traditional economic benefits (such as streambank stabilization using bioengineering techniques) will be evaluated with both CE/ICA and traditional benefit-cost evaluation techniques and integrated in order to evaluate and select the recommended plan.

8. Benefit-cost analysis will be prepared for flood control features, in accordance with the requirements of ER 1105-2-100 (22 April 2000).

9. FEASIBILITY PHASE MILESTONES

A three-year schedule has been developed for the feasibility study. However, the schedule may need to be extended to four years, due to first year non-Federal funding constraints. Because the exact amount of funds available is not known at this time, the feasibility study schedule shown in Table 2 may be extended during development of the Project Management Plan.

TABLE 2
FEASIBILITY PHASE MILESTONES

Milestones	Date
Notice of Intent/ Notice of Initiation of Feasibility Study	Jan-01
Joint EIS/EIR Scoping Meeting – Public Workshop	Jan-01
Field Investigations Complete	Jan-02
Alternative Designs Complete	Oct-02
Alternative Formulation and Evaluation Complete	Feb-03
Alternative Formulation Report Complete	Mar-03
Alternative Formulation Briefing	Apr-03
DFR and DEIS review/comment/revision	May-03
Prepare Draft Feasibility Report (DFR) and Draft EA/EIS	Jul-03
Transmit DFR and DEA/DEIS to Division and HQ and mail to public	Jul-03
Comment and Response Period	Sep-03
Prepare Final Feasibility Report (FFR) and Final EA/EIS	Nov-03
Transmit FFR and FEA/FEIS to Division and HQ	Nov-03
Division Commander's public notice	Jan-04

10. FEASIBILITY PHASE COST ESTIMATE

Table 3 contains an initial estimate of the cost to complete the feasibility study. This estimate will be finalized upon completion of the Project Management Plan.

TABLE 3
FEASIBILITY PHASE COST ESTIMATE

Study Tasks	Federal Cost	Non-Federal In-Kind	Total Task Cost
Public Involvement	$62,500	$62,500	$125,000
Environmental Studies	$350,000	$350,000	$700,000
Cultural Studies	$90,000	$90,000	$180,000
Economic Studies	$217,500	$217,500	$435,000
Project Management	$140,000	$140,000	$280,000
Plan Formulation & Reports	$309,402	$309,402	$618,803
Engineering			
Survey and Mapping	$562,500	$562,500	$1,125,000
Modeling (H&H)	$390,000	$390,000	$780,000
Analysis and Design	$487,500	$487,500	$975,000
Real Estate Studies	$124,000	$124,000	$248,000
Review Contingency	$150,000	$150,000	$300,000
Total Costs	$2,733,402	$2,733,402	$5,466,803
Percentage of Total	50%	50%	100%

11. RECOMMENDATIONS

This investigation has clearly demonstrated Federal interest in flood damage reduction and ecosystem restoration in the Millstone River Basin. Examples of potential flood damage reduction measures and ecosystem restoration measures have been provided. It is anticipated that benefits of flood damage reduction measures and ecosystem restoration measures would exceed project costs, resulting in positive contributions to the NED and NER accounts. There is significant local support for flood damage reduction and ecosystem restoration, and it is expected that a non-Federal project partner will be willing and able to cost share feasibility studies and project implementation.

It is recommended that this 905(b) Preliminary Analysis report be approved as a basis for developing the Project Management Plans for a Millstone River Basin feasibility study, finalizing the Feasibility Cost Sharing Agreements with the non-Federal partners, and proceeding to the feasibility phase of the study under the authority of the General Investigations program.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority for authorization and/or implementation funding.

12. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE

The partners have indicated their willingness and capability to fulfill their commitments under the potential agreement. Discussions with the partners indicate no issues that would preclude their signing a Feasibility Cost Sharing Agreement. Discussions are currently underway with the partners to determine the most advantageous approach for budgeting and scheduling purposes.

13. VIEWS OF OTHER RESOURCE AGENCIES

Other resource agencies have expressed interest and support for flood control and ecosystem restoration projects in the Millstone River Basin. The Natural Resource Conservation Service is undertaking a complimentary watershed study of the Millstone River. The Department of Housing and Urban Development is providing a $50 million grant to foster business development in areas damaged by Hurricane Floyd. The U.S. Fish and Wildlife Service provided preliminary input to the study and state their support of restoration efforts in the basin. These agencies have been active participants in this 905 (b) analysis and anticipate coordinating and sharing resources during the feasibility study.

14. PROJECT AREA MAP

The following project area maps are included in the text.

Figure 1 - Study Area
Figure 2 – Borough of Manville Lost Valley Residential District
Figure 3 – Lost Valley Residential District
Figure 4 – Carnegie Lake
Figure 5 – Rocky Brook Subbasin
Figure 6 – Campo Mine

William H. Pearce
Colonel, Corps of Engineers
District Engineer

ATTACHMENT 1
LETTER FROM U.S. FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
927 North Main Street (Bldg. D1)
Pleasantville, New Jersey 08232

Tel: 609-646-9310
FAX: 609-646-0352

IN REPLY REFER TO:
FP-00/23

July 17, 2000

John O'Conner, P.E.
Project Planner
Planning Division
New York District
U.S. Army Corps of Engineers
26 Federal Plaza
New York, New York 10278-0090

Dear Mr. O' Conner:

The U.S. Fish and Wildlife Service (Service) has received the Public Notice (PN) of April 2000, "Millstone River Basin, New Jersey, Reconnaissance Phase Study." This PN announces the initiation of a federally funded reconnaissance level study for the initial examination of flood control and ecosystem restoration potential for the Millstone River Basin, including upstream Stony Brook, New Jersey, as authorized by U.S. House of Representatives Resolution, Docket 2611 dated August 5, 1999. Your PN requested pertinent information about the project area from any federal, State, or local agency, and the private sector.

AUTHORITY

The following comments on the proposed activity are provided as technical assistance and are consistent with the intent of the Service's Mitigation Policy (Federal Register, Vol. 46, No. 15, Jan. 23, 1981). The Service has also reviewed the proposed project pursuant to Section 7 of the Endangered Species Act (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) to ensure the protection of federally listed and proposed endangered and threatened species. These comments do not preclude separate review and comments by the Service as afforded by the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), nor do they preclude comments on any forthcoming environmental documents pursuant to the National Environmental Policy Act (83 Stat. 852; 42 U.S.C. 4321 *et seq.*).

IMPORTANCE OF THE PROJECT AREA TO FISH AND WILDLIFE

The Millstone River Basin provides important habitat for numerous fish and wildlife resources including wintering waterfowl, wading birds, migrant and resident landbirds, resident,

anadromous, and catadromous fish, and a variety of reptiles and amphibians. Since many of the waters are relatively shallow, the area serves as an important nursery area for many freshwater fish species and helps support recreational fishing in the basin.

The Millstone River system is frequented in winter by Wood Duck (*Aix sponsa*), American Black Duck (*Anas rubripes*), Mallard (*Anas platyrhynchos*), Green-winged Teal (*Anas crecca*), Common Goldeneye (*Bucephala clangula*), Bufflehead (*Bucephala albeola*), Ring-necked Duck (*Aythya collaris*), Hooded Merganser (*Lophodytes cucullatus*), and several other waterfowl species. Plainsboro Pond (Plainsboro Township) is an example of an important wildlife lake in the Basin. River otters (*Lutra canadensis*) occur here, indicative of high water quality and plentiful forage fish. The Rogers Refuge (private wildlife refuge) adjacent to Institute Woods has breeding Sora *(Porzana carolina*) and Virginia Rail (*Rallus limicola*) and is another example of a significant wetland in the Millstone River Basin. The historical loss of wetlands in this system has likely had an adverse affect on the foraging habitat and abundance of both fish and wintering waterfowl.

Many migrant passerine birds breeding in Northeastern North America use migration corridors passing through, over, or adjacent to the Millstone River Basin during both spring and fall migrations. Migratory passerines include more than 30 species of warblers, 5 species of vireos, both cuckoo species, 10 species of flycatchers, and 8 species of thrushes, the majority of these being neotropical migrants. The state-listed Barred Owl (*Strix varia*) breeds at several locales in this watershed (e.g., Princeton University's Institute Woods). Additionally, the wood turtle (*Clemmys insculpta*), a State-listed reptile, is known from several locales within the basin. The Service would favor efforts at restoring vegetated riparian corridors, joining previously fragmented habitats to create larger habitat patches, removing riprap and restoring natural banks, restoring a natural stream pattern to previously channelized areas, and restoring fringing wetlands to increase migratory cover for these species.

Many areas along the Millstone River and its tributaries have been cleared of trees and shrubs and planted to lawn for both commercial and residential developments. The cumulative impact of hundreds of lawns has led to increased runoff following precipitation events. This increased runoff has no doubt contributed to "spikes" in the flow pattern, which aggravate flooding conditions. The Corps should consider working with riverbank property owners in establishing a riparian buffer, which would restore both the shrub and forest layers. Some limited clearing and snagging in the smaller tributaries might increase flow rates with a resultant increase in water quality for the river system, especially during periods of low flow. Caution must be taken to assure that wildlife habitat is not compromised.

The headwater tributaries of the Millstone River are relatively short in length, but many of the tributaries that flow into the main stem have small man-made dams that preclude the existence of significant anadromous and catadromous fisheries. Many of these dams appear old and obsolete and may not be serving the purposes for which they were originally designed. The Corps should seriously consider removal of these dams or construction of fish ladders to allow fish access to

these impounded waters. In evaluating whether a dam should be removed, the Corps should conduct a thorough field survey of any wetland that has formed upstream of the dam. Should a high-quality wetland exist, dam removal might be the less attractive option to providing a fish ladder.

The Service strongly advocates non-structural alternatives as potential solutions to flood-control problems. Solutions that may initially appear expensive, such as buyouts and restoration of the natural flood plain may actually be less expensive as a long-term answer to basin flooding and offer positive benefits to natural resources.

ENDANGERED AND THREATENED SPECIES

Bog Turtle

Potentially suitable habitat for the bog turtle (*Clemmys muhlenbergii*) (federally listed as threatened) occurs on or in the vicinity of the proposed project area. In New Jersey, bog turtles inhabit open, wet meadows and bogs with standing or slow-moving shallow water over a mucky substrate, emergent and scrub/shrub wetlands, spring-fed fens, and forested wetlands that contain emergent or scrub/shrub wetlands. There are historical reports of bog turtles from Franklin Township in Somerset County and Lawrence Township in Mercer County and recent records from Millstone Township in Monmouth County.

To assist you in determining potential impacts of the proposed project on the bog turtle, additional detailed information regarding the species and its habitat is enclosed. If any wetlands will be disturbed, or if materials will be discharged into or upstream of such wetlands, a habitat survey of the project area(s) must be conducted by a qualified herpetologist (see attached list of recognized qualified bog turtle surveyors) to determine presence or absence of bog turtle habitat. If the survey documents the presence of bog turtles, or habitat, within the project area(s), an assessment of potential project impacts must also be completed. Project construction or implementation must not commence until the survey results and assessment of impacts have been forwarded to this office to determine if further consultation under Section 7 of the ESA is required.

Swamp Pink

The project area is located within the geographic range of the federally listed (threatened) plant, swamp pink (*Helonias bullata*). There are known occurrences of swamp pink within the project study site. Swamp pink typically occurs in forested wetlands, although occurrence in scrub / shrub wetlands is known. Threats to swamp pink include direct loss of its wetland habitat due to filling or draining, and indirect degradation of its habitat due to sedimentation, erosion, disruption of groundwater hydrology, and adverse impacts to water quality. There are historical records of swamp pink from West Windsor Township in Mercer County and recent records from Millstone Township in Monmouth County.

Swamp pink is an obligate wetland species that occurs in a variety of palustrine forested wetlands in New Jersey, including forested wetlands bordering meandering streamlets, headwater wetlands, sphagnous Atlantic white-cedar (*Chamaecyparis thyoides*) swamps, and spring seepage areas. Specific hydrologic requirements of swamp pink limit its occurrence within these wetlands to areas with lateral ground-water movement that are perennially saturated, but not inundated by floodwaters. Threats to swamp pink include: loss of habitat due to wetland filling, clearing and draining; degradation of habitat due to sedimentation from off-site construction activities; flooding and erosion due to increased runoff from upstream sites; and, subtle changes in groundwater and surface water hydrology due to adjacent developments. Additionally, stormwater outfalls discharging into wetlands that support swamp pink can increase the frequency, duration, and volume of flooding in these wetlands and adversely affect swamp pink.

Many areas of New Jersey, including the project area, have not been thoroughly surveyed for endangered and threatened plant and animal species. Therefore, occurrences of bog turtle and swamp pink could be located in other wetlands within the project boundaries than currently documented.

In accordance with Section 7(a)(2) of the Endangered Species Act, an assessment of potential direct, indirect, and cumulative impacts is required for all federal actions that may affect listed species. Therefore, further consultation pursuant to Section 7 will be necessary on this project if swamp pink and/or the bog turtle are found to occur within the vicinity of the project site.

Should the Corps proceed further with the feasibility phase for this project, the Service would be willing to discuss the development of a scope-of-work pursuant to an interagency agreement for a Planning Aid Report or a FWCA Section 2(b) report. These technical reports would describe the natural resources of the project area in substantial detail and provide recommendations regarding project alternatives.

The Service looks forward to continuing to work with your staff on this project. Should you have any questions regarding these comments, please contact Robert P. Russell or John Staples of my staff at (609)646-9310, extensions 47 and 18 respectively.

Sincerely,

Clifford G. Day
Supervisor

Enclosures