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RECONNAISSANCE PHASE MAIN REPORT AND SUPPORTING DOCUMENTATION FISH AND WILDLIFE RESTORATION NAB LITTLE CREEK VA
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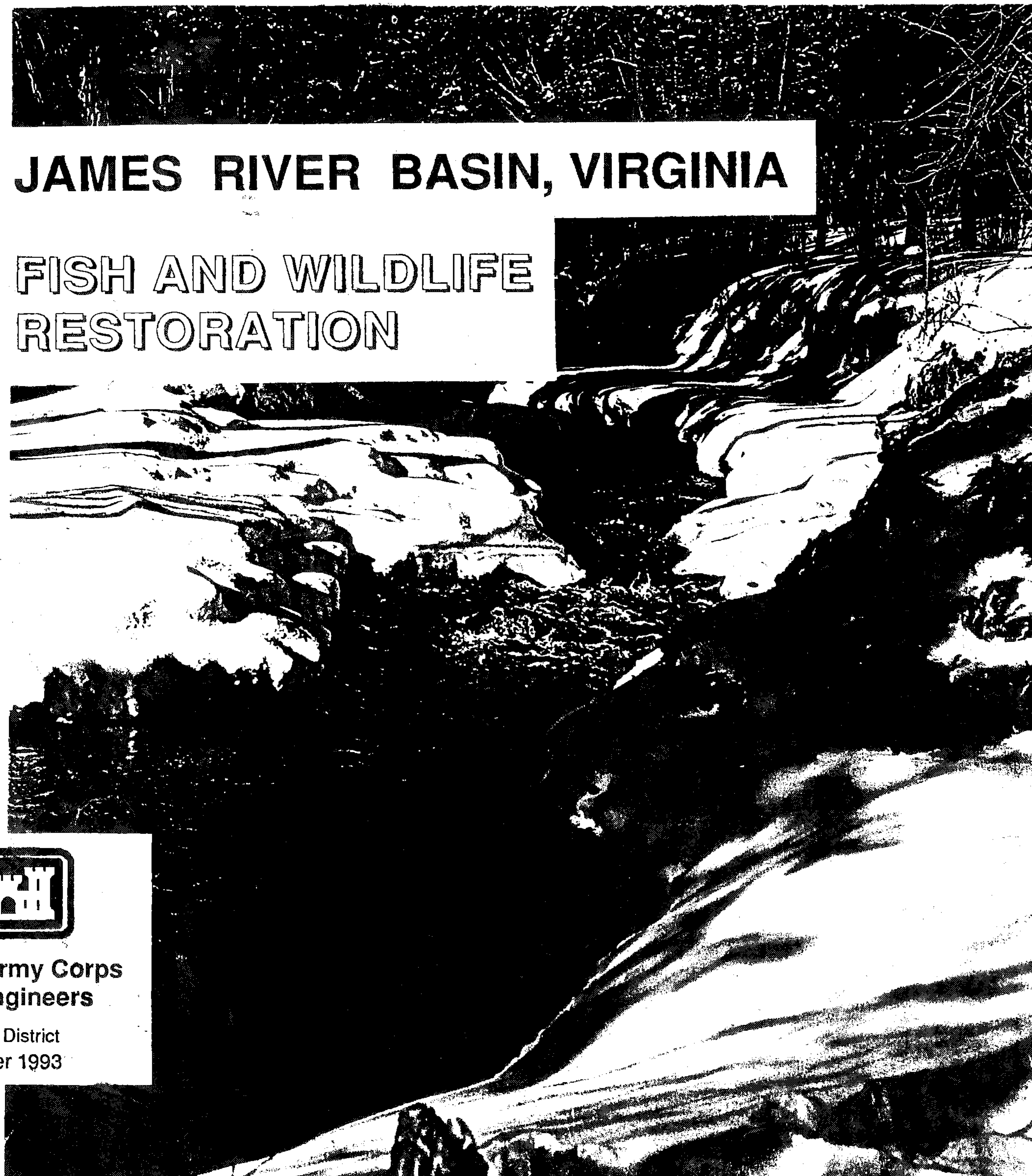
U S ARMY CORPS OF ENGINEERS

Reconnaissance Phase

MAIN REPORT AND SUPPORTING DOCUMENTATION

JAMES RIVER BASIN, VIRGINIA

FISH AND WILDLIFE RESTORATION



US Army Corps
Of Engineers
Norfolk District
October 1993

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

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INTRODUCTION

STUDY AUTHORITY

This study was authorized by a resolution adopted June 17, 1987 by the Committee on Environment and Public Works of the U.S. Senate, which stated:

> "The Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on James River, Virginia and tributaries published in House Document 207, 80th Congress, First Session, and other pertinent studies, with a view to determining whether any modification of the recommendations contained therein are advisable at the present time in the interests of flood control and related purposes."

The Norfolk District also received a letter, dated January 1992, from Senator John Warner, the sponsor of the resolution, which states that the study can be done under this authority and encourages the Norfolk District ". . . to identify environmental engineering and fish and wildlife restoration opportunities . . . valuable to the basin's long term management." "Related purposes," in the context of this study, therefore, is defined to mean fish and wildlife restoration opportunities in the James River Basin.

STUDY PURPOSE

The Corps of Engineers, Norfolk District, initiated a reconnaissance study during fiscal year 1993 to identify environmental restoration opportunities in the James River Basin, Virginia. Some examples of these restoration opportunities include fish and wildlife population reestablishment; habitat evaluation, improvement, and restoration; removal of fish migration barriers; and food source supplementation.

The natural resources in the major river basins in eastern Virginia have been heavily exploited since the earliest European settlements. Massive population growth, development, and changes in land use in this century have further stressed the renewal and survival process. In particular, the Corps Gathright Dam-Lake Moomaw project blocked the Jackson River to anadromous fish and inundated 2,532 acres of wooded upland, wetland, riparian, and aquatic habitat, portions of which were in the Tom Gathright Wildlife Management Area and George Washington National Forest. A wide-ranging variety of environmental restoration opportunities associated with these changing conditions appear to be available in the James River Basin. Studies were undertaken to identify measures that would attempt to restore to historic levels the environmental values of the James River Basin. The purpose of the James River Basin Fish and Wildlife Restoration reconnaissance study is to evaluate fish and wildlife related problems in the basin, define potential solutions, determine if there is a Federal interest in the implementation of solutions, and identify a non-Federal cost-sharing partner to participate in the feasibility study phase of planning. The feasibility study could lead to a recommendation to Congress to implement the recommended solution. This report presents the findings of the reconnaissance study and outlines the process and procedures utilized to support the conclusions of the report. It provides an interim response to the Congressional authority for investigation in the James River Basin. Study for initiation funds were appropriated in the first quarter of Federal fiscal year (FY) 1993 and the study was initiated in October 1992.

This reconnaissance report documents the findings of the first phase, reconnaissance phase, of the feasibility study which will be a partial response to the resolution previously cited. The objective of the reconnaissance phase of this fish and wildlife restoration study is to make a determination whether the planning process should proceed further based on this preliminary appraisal of the Federal interest and if potential solutions to restoring habitat are in concert with current polices and budgetary priorities.

STUDY PROCESS

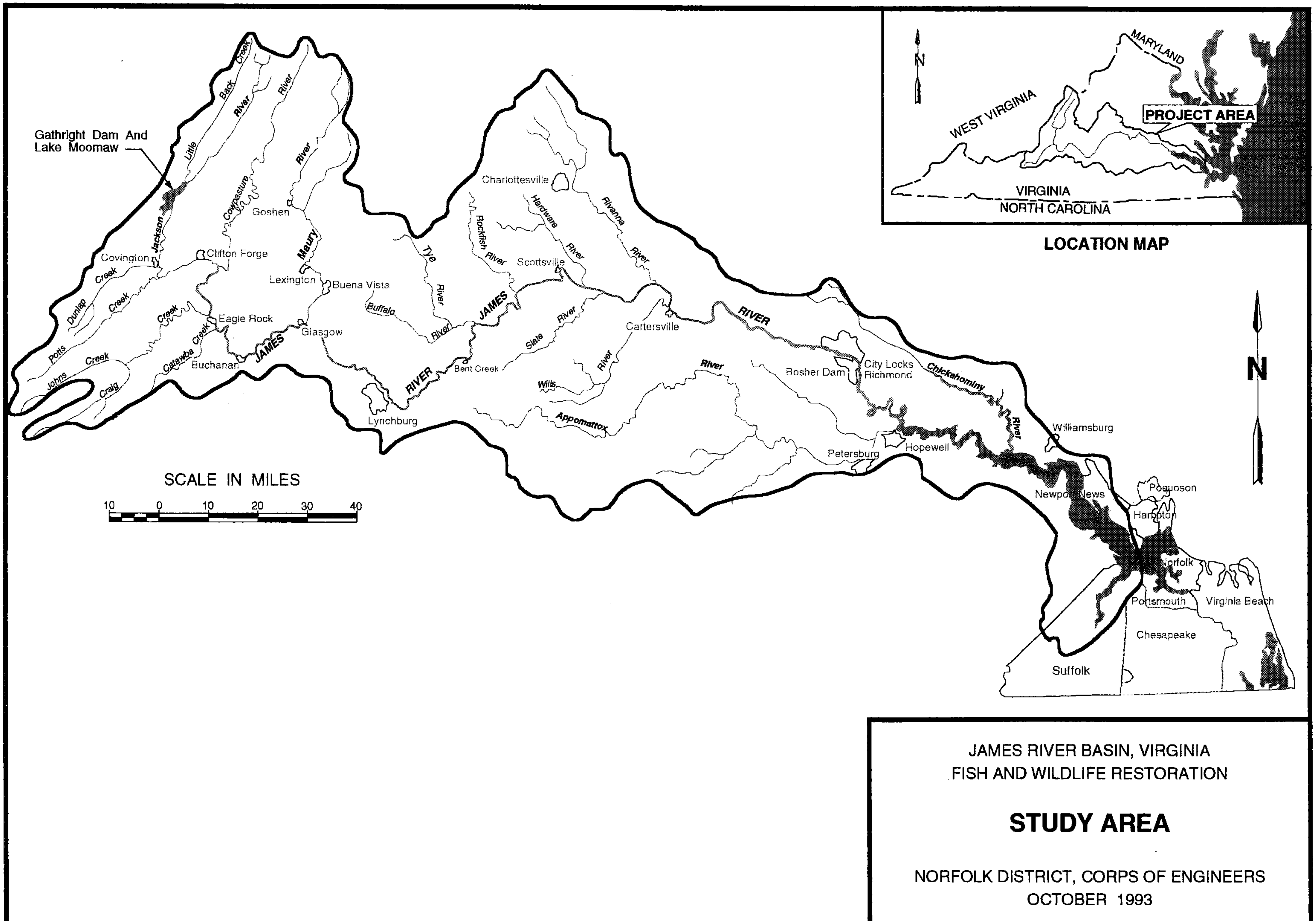
All feasibility studies undertaken by the Corps of Engineers are conducted in two phases--a reconnaissance phase and a feasibility phase. The purposes of the reconnaissance phase are to define the nature and magnitude of a particular problem, to determine a Federal interest in solving that problem, and to determine a range of acceptable solutions. Solutions are evaluated based on their potential from environmental, economic, and engineering perspectives. If Federal and non-Federal participants agree that there are potentially acceptable solutions, then the purposes of the feasibility phase are to conduct detailed engineering and environmental analyses and to recommend projects or measures for implementation, if warranted. The two-phase study procedure is designed to encourage non-Federal participation throughout the feasibility study and to increase the certainty that projects which are planned will be implemented.

The reconnaissance study was initiated in October 1992 and is conducted entirely at Federal expense. Following the reconnaissance phase, a feasibility study may be undertaken to conduct detailed investigations of potential solutions. This study is cost-shared equally between the Federal Government and a non-Federal sponsor. The anticipated product of the feasibility phase is a report containing recommendations for implementation of those projects that are judged to be economically and environmentally acceptable and have the required non-Federal support. This report will be submitted to higher authority within the Department of Defense and ultimately will be used as the authorization document for submission to the U.S. Congress. Recommendations will be made only where a Federal interest has been established and an economically feasible, environmentally acceptable plan has been endorsed by a non-Federal sponsor.

The Commonwealth of Virginia, Department of Environmental Quality, is the local sponsor of this reconnaissance study.

STUDY AREA

The James River Basin is the largest river system in Virginia, encompassing over 10,200 square miles of drainage area, or just over 25 percent of the state's area (figure 1). The James has more tributaries than any other Virginia river. The major tributaries include the Jackson, Cowpasture, Maury, Rivanna, Appomattox, and Chickahominy Rivers. The James is tidal from its mouth to the fall line, a distance of about 90 miles. The James River bisects four major physiographic regions--from west to east, the James flows across the Valley and Ridge, the Blue Ridge, the Piedmont, and the Coastal Plain physiographic provinces.



JAMES RIVER BASIN, VIRGINIA
FISH AND WILDLIFE RESTORATION

STUDY AREA

NORFOLK DISTRICT, CORPS OF ENGINEERS
OCTOBER 1993

Figure 1

The entire river basin is the study area for this reconnaissance study. While the entire basin will be evaluated for fish and wildlife restoration opportunities, special emphasis will be focused on the non-tidal fresh waters of the James above the fall line at Richmond. The need for an intensive look at restoration opportunities in the upper basin was emphasized early in the coordination meetings and discussions with state and local government agencies. The emphasis is also consistent with recent directives of the 1993 Chesapeake Bay Program initiatives to expand restoration programs from the bay proper into the tributaries that enter the estuary.

PRIOR STUDIES AND REPORTS

Responsibilities of the Corps of Engineers in the James River Basin can be divided into six areas.

1. Navigation - maintenance of authorized navigational depths when supported by commercial navigation to include debris removal.

2. Flood Control - investigation and implementation of structural and/or nonstructural means to reduce flood damages and inspection of Federal flood control projects.

3. Permitting of modifications (i.e., pipeline crossings) to existing authorized Federal projects.

4. Permitting related to Section 10 of the Rivers and Harbors Act of 1899 (alteration or obstruction of navigable water).

5. Permitting related to the discharge of dredged or fill material into the waters of the United States (Section 404, Clean Water Act).

6. Water resources development.

As a result of these responsibilities, the Corps of Engineers has a long history of involvement in the basin and will continue to make a significant contribution to the water resources needs and restoration efforts of the basin.

Several reports and studies of varying scope and detail have been prepared prior to the initiation of this study which concern flooding and other water resource problems in the James River Basin. The following table summarizes these documents.

Table 1. PRIOR REPORTS

Description	Date
Survey Report on James River, Virginia (Corps of Engineers)	1882
Survey Report on James River, Virginia (Corps of Engineers)	1929
Report on James River, Virginia, HD 192/73/2 (Norfolk District, Corps of Engineers)	1934
Survey Report Recommending Authorization of Gathright - Falling Spring Project	1945
Survey Report on James River, Virginia, HD 207/80/1 (Norfolk District, Corps of Engineers)	1947
Design Memorandum 1-19, Gathright Lake, Virginia (Norfolk District, Corps of Engineers)	1953-1974
Review Report on James River, Virginia (Norfolk District, Corps of Engineers)	1962
Report for Development for Water Resources in Appalachia (Office of Appalachian Studies, Corps of Engineers)	1969
Parrish Court, Covington, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1971
The August 1969 Storm and Flood in the Virginias Associated with Hurricane Camille (Norfolk District, Corps of Engineers)	1971
James River, Buena Vista, Virginia, Local Flood Protection, Feasibility Report (Norfolk District, Corps of Engineers)	1972
Final Environmental Impact Statement, Gathright Lake, Virginia	1973

Table 1. PRIOR REPORTS
(Cont'd)

Description	Date
Agnes in Virginia, June 1972 (Norfolk District, Corps of Engineers)	1974
James River Basin Water Resources Study (Norfolk District, Corps of Engineers)	1975
Hampton Roads, Virginia, Water Supply Study (Norfolk District, Corps of Engineers)	1984
South River, Vesuvius, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1985
Jackson River, Lower Jackson Street, Covington, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
Harmons Run at Industrial Park, Covington, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
Calfpasture River and Mill Creek, Goshen, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
Maury and James Rivers, Glasgow, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
Ramseys Draft, Augusta County, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
Little Calfpasture River, Augusta Springs, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
St. Marys River, Augusta County, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1986
Gathright Dam and Lake Moomaw, Virginia, Hydropower and Water Supply Study (Norfolk District, Corps of Engineers)	1987
Covington, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1987

Table 1. PRIOR REPORTS
(Cont'd)

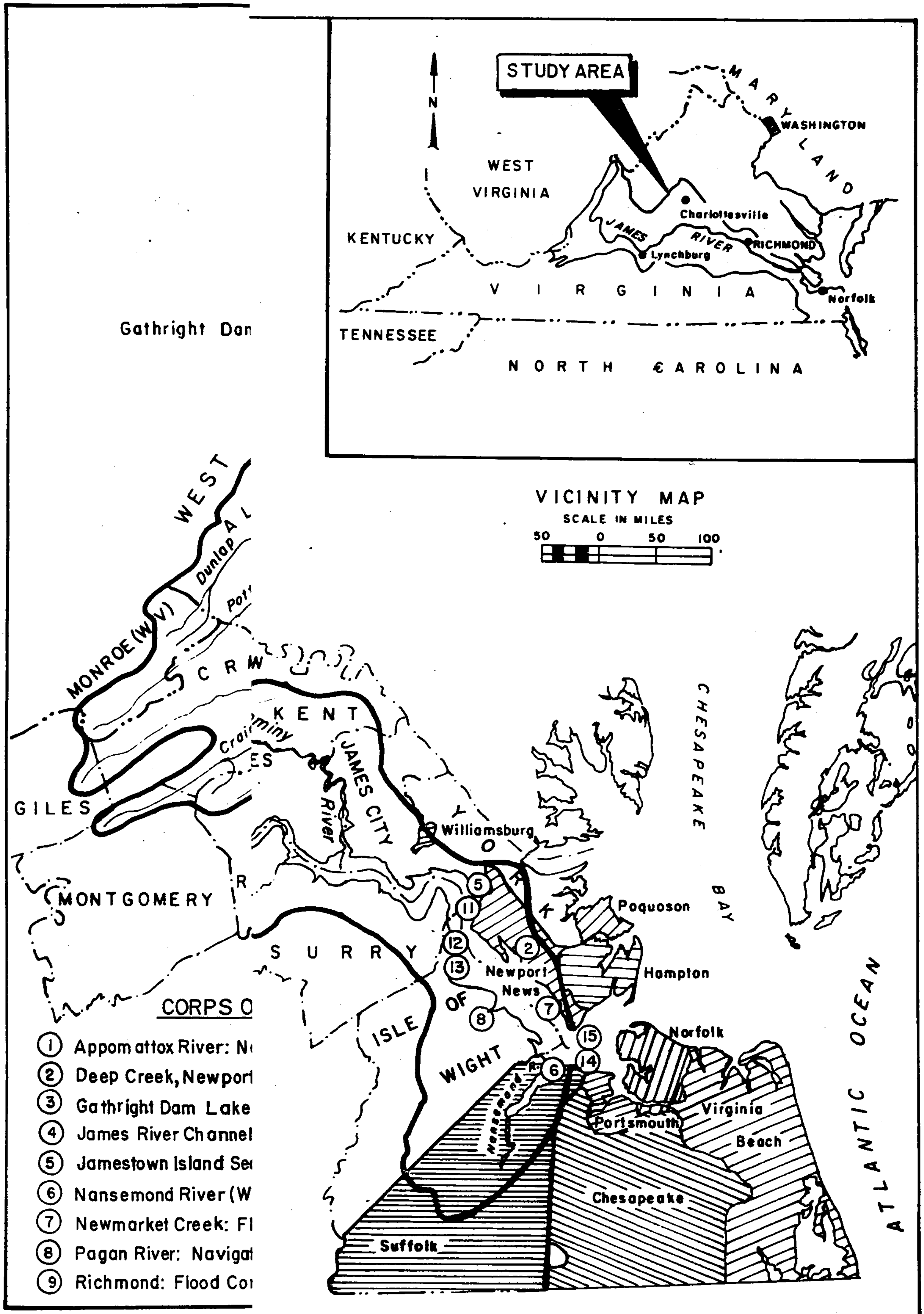
Description	Date
James River, Buchanan, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1988
James River, Eagle Rock, Virginia, Flood Control Study (Norfolk District, Corps of Engineers)	1989
James River, Buena Vista, Virginia, Local Flood Protection (Norfolk District, Corps of Engineers)	1990
James River, Study of Modifications to Existing Navigation Channel (Norfolk District, Corps of Engineers)	1990
Upper James River Basin, Flood Control Study	1992

ACTIVE/COMPLETED CORPS OF ENGINEERS PROJECTS

Figure 2 shows the location of active/completed Corps of Engineers projects.

Navigation

Appomattox River. This river, a large, navigable tributary, enters the James River at Hopewell. The navigable section, extending from Petersburg downstream 11.5 miles to Hopewell, has been under improvement for approximately 100 years. A channel 80 feet wide and 10 feet deep from the mouth to Petersburg was completed in 1931. Commerce consists of sand, gravel, and crushed rock; fertilizers; fuel oil; sulfuric acid; and shellfish.



STUDY AREA
N
WEST VIRGINIA
MARYLAND
WASHINGTON
Charlottesville
JAMES RIVER
RICHMOND
Lynchburg
KENTUCKY
VIRGINIA
Norfolk
TENNESSEE
NORTH CAROLINA
VICINITY MAP
SCALE IN MILES
50 0 50 100
Gathright Dan
WEST
Dunlap
MONROE (W. V.)
CRAW
GILES
MONTGOMERY
KENT
JAMES CITY
James River
Williamsburg
YORK
Poquoson
Hampton
Newport News
SURRY
ISLE OF WIGHT
Norfolk
Portsmouth
Virginia Beach
Chesapeake
Suffolk
Nansemond
CHESAPEAKE BAY
ATLANTIC OCEAN
CORPS O
1 Appomattox River: N
2 Deep Creek, Newport
3 Gathright Dam Lake
4 James River Channel
5 Jamestown Island Se
6 Nansemond River (W
7 Newmarket Creek: Fl
8 Pagan River: Navigat
9 Richmond: Flood Co

Figure 2

Deep Creek, Newport News. This project, located in Newport News on the north side of the James River and 10.5 miles upstream from its mouth, was modified by the River and Harbor Act of June 30, 1948. The project consists of an approach channel 8 feet deep and 100 feet wide, extending from that depth in the James River to a point where the natural creek entrance to Deep Creek is constructed, a distance of 9,040 feet; 8 feet deep and 60 feet wide through the constricted entrance, a distance of 700 feet. Modifications involved the enlargement of the harbor in Deep Creek opposite Menchville, extending upstream to a point near Parker's Landing and to the foot of Maxwell's Lane, from 6.4 acres to about 20 acres with a depth of 8 feet, 400-740 feet wide, and 1,940 feet long. The improvement is used principally for receiving seafood and as a harbor of refuge and overnight anchorage for oyster boats operating in the James River. A modification of the project was authorized under Section 107 of the 1960 River and Harbor Act during 1979 to provide for widening the channel within Deep Creek. This has never been constructed.

James River Channel. The project provides for a channel 25 feet deep and 300 feet wide from the mouth to Hopewell, 25 feet deep and 200 feet wide following the cutoff route to Richmond Deepwater Terminal and 18 feet deep to Richmond Lock. The total length in channel included in the project is 90.8 miles. The above work was completed in 1947.

Modification of this project was authorized by Congress in 1962 to provide for a channel 35 feet deep and 300 feet wide from deep water in Hampton Roads to the Richmond Deepwater Terminal with easing of bends to a minimum radius of 3,000 feet, supplemented by benching at Jones Neck to improve the sight distance; a mooring basin 35 feet deep, 180-200 feet wide, and 2,100 feet long alongside the channel opposite the waterfront at Hopewell; and enlargement of the turning basin at Richmond Deepwater Terminal to a width of 825 feet and a length of 2,770 feet at a depth of 35 feet. An economic analysis was conducted in 1972 and it was concluded that these modifications were not justified. A favorable reconnaissance report was submitted in September 1990 indicating that a 27-foot-deep by 300-foot-wide channel from the mouth of the James River to Richmond is a potentially feasible plan. The local sponsor, the city of Richmond, is reviewing courses of action available for further investigation, so the district is currently holding the study in abeyance until a decision is reached. Commerce consists chiefly of fertilizers, gasoline, and asphalt.

Nansemond River. This estuary, located in the city of Suffolk, enters the southwest portion of Hampton Roads. The project provides a channel 12 feet deep and 100 feet wide from the mouth upstream to a point 0.5 mile above the highway bridge at Suffolk, Virginia, a total distance of 18.7 miles. It has a turning basin 200 feet square at Suffolk and a channel in the western branch 10 feet deep and 80 feet wide upstream to Reids Ferry, Virginia. The improvement is used for moving petroleum products, sand, gravel, and fertilizer to Suffolk.

Pagan River. This tributary enters the south side of the James River in Isle of Wight County. The existing project provides for a channel 10 feet deep and 80 feet wide from that depth in the James River to Smithfield, a distance of about 6.7 miles. Commerce consists of fresh seafood. The project was completed in 1923.

Tylers Beach Channel. This project is located on the south shore of the James River in Isle of Wight County in a deep indentation known as Burwells Bay about 13 miles upstream from the mouth of the James. The project provides for a harbor of refuge 6 feet deep, 150 feet wide, and 300 feet long in the marsh area south of Tylers Beach, and a channel 6 feet deep, 50 feet wide and about 2,350 feet long from that depth in Burwells Bay to the harbor of refuge. The project was completed in 1968 under provisions of Section 107 of the 1960 River and Harbor Act, in the interest of the seafood fleet that operates in that area.

Tylers Beach Revetment. A detailed project report was completed in 1981 under authority of Section 107 of the River and Harbor Act of 1960, as amended. A two-fold problem existed at Tylers Beach, (a) rapid shoaling of the entrance channel, and (b) recession of the shoreline and bank along both sides and within the throat of the inlet. Construction of two 370-foot placed stone revetment/jetty structures along the banks of the inlet throat leading to the harbor at Tylers Beach was completed in 1982.

Flood Control

Gathright Dam and Lake Moomaw. This development was authorized by the Flood Control Act of 1946 as a multipurpose project with power which included the Falling Spring Regulation Dam. A restudy of the project which was completed in 1964 indicated that conventional power, as originally planned, was not economically feasible. The modified project includes low water regulation for water quality control, flood control, and recreation. The Falling Spring Dam is not needed at this time, since hydroelectric power has been excluded from the initial development.

The Gathright Dam site is located about 43.4 miles above the mouth of the Jackson River, 19 miles upstream from Covington in western Virginia. It is about 47 miles north of Roanoke and 57 miles north of Lynchburg. The dam and a portion of the lake is in Allegheny County, with most of the lake being in Bath County. The project controls the runoff from a drainage area of 345 square miles. The beneficial effects of flood control have been realized along the Jackson and James Rivers from Covington to Lynchburg and downstream. Release of water from the conservation storage pool for improvement of water quality in the stream below Covington increases low river flow along about 275 miles of the Jackson and James Rivers from the dam downstream to Richmond. This increased flow, in combination with adequate treatment or control of wastes at their source, improves water quality.

The lake created by the construction of the dam, with an area of 2,539 acres at the maximum conservation pool elevation (1,582 feet), also provides recreational benefits. The lake at this level has a length of about 12 miles and a shoreline of about 43.5 miles. With the selective withdrawal of water from the lake, a trout habitat is maintained downstream from the dam.

The project became operational for flood control in December 1979, with filling operations completed in 1982.

Newmarket Creek. Newmarket Creek local protection project is located in Newport News and Hampton, Virginia, a portion of which forms the boundary between the two cities. The project provides for improvement of the channel of Newmarket Creek from the vicinity of Dresden Drive in Newport News to U.S.

Highway 258 and improvement of the entire length of Government Ditch. A dam across Newmarket Creek diverts flood water from the creek into Government Ditch and into the James River. The project was approved by the Chief of Engineers in 1965 under authority of Section 205 of the Flood Control Act of 1948, as amended. Construction of the project was initiated in August 1967 and completed in December 1969.

Richmond. The city of Richmond experienced severe flooding in 1969, 1972, and 1985, with damages totalling $39 million, $112 million, and $53 million, respectively. To alleviate this problem, a floodwall and levee is being constructed to protect the city's historical center on the north side and the commercial/industrial complex on the south side of the James River. The project was authorized by the Water Resources Development Act of 1986.

The north side alignment consists of 4,470 linear feet of concrete T-wall, including nine street and rail closures and a 75,000 GPM pump station and related interior drainage. The southside alignment consists of 10,000 linear feet of levee and 2,000 feet of concrete wall, with six street and rail closures, including two pump stations (29,000 and 4500 GPM), accompanying ponding areas and related interior drainage. Construction is scheduled to be completed in 1993.

Richmond Filtration Plant. The Richmond Water Filtration Plant is in the western portion of the city on the left bank of the James River. The project is authorized to provide for protection of the municipal water supply treatment plant for the city of Richmond. The basic plan provides for raising concrete walls on three sides of the plant and tying into high ground. The walls will have an average height of about 9 feet above existing ground, with a top elevation of 117.0 feet mean sea level.

The project was authorized in 1976. Preconstruction planning was completed in FY 1981 and plans and specifications for construction were completed in FY 1982. The project is currently undergoing final design.

Scottsville. The town of Scottsville is located on the north bank of the James River, 185 miles above its mouth and 25 miles south of Charlottesville, Virginia. Severe flooding has plagued the town for many years. Authorized under Section 205 of the 1948 Flood Control Act, as amended, this flood control project includes an earthen levee partially riprapped, a concrete floodwall, two closures, a gated structure in a box culvert, and a pumping station. The levee is 3,635 feet long, with a height varying from 1 to 21 feet, a top width of 10 feet, a bottom width varying from 1 to 100 feet. It extends from the Albemarle-Fluvanna County line westward paralleling the James River and CSX Railroad tracks to a point just upstream of the old Scottsville Elementary School. The project was completed in December 1989.

Buena Vista. Buena Vista is located in the western part of the state near Rockbridge County. It is situated along a bend of the Maury River about 11 miles upstream of the confluence of the Maury and James Rivers.

A flood control project for Buena Vista was authorized by Congress in the Water Resources Development Act of 1990. The project includes a combination of levees, floodwall, and minor stream channelization which will provide protection to much of the city's industrial and commercial area to a flood of record. Construction start is scheduled in 1993.

Emergency Rehabilitation

Jamestown Island Seawall. A study of emergency rehabilitation for the Jamestown Island Seawall was conducted under the authority of Public Law 84-99 in 1982. Rehabilitative work, completed in 1985, consisted of the construction of a new timber bulkhead with continuous sheet piling. The new bulkhead was placed 1 foot riverward of the existing bulkhead. A concrete cap was placed over both the new and existing bulkheads and extends over the bottom two rows of block. Concrete blocks at the major failure areas and the small isolated failure location and along the bottom rows of the wall were removed and the sand and bedding stone underlayers were replaced; the concrete blocks were then relaid.

EXISTING AND FUTURE CONDITIONS

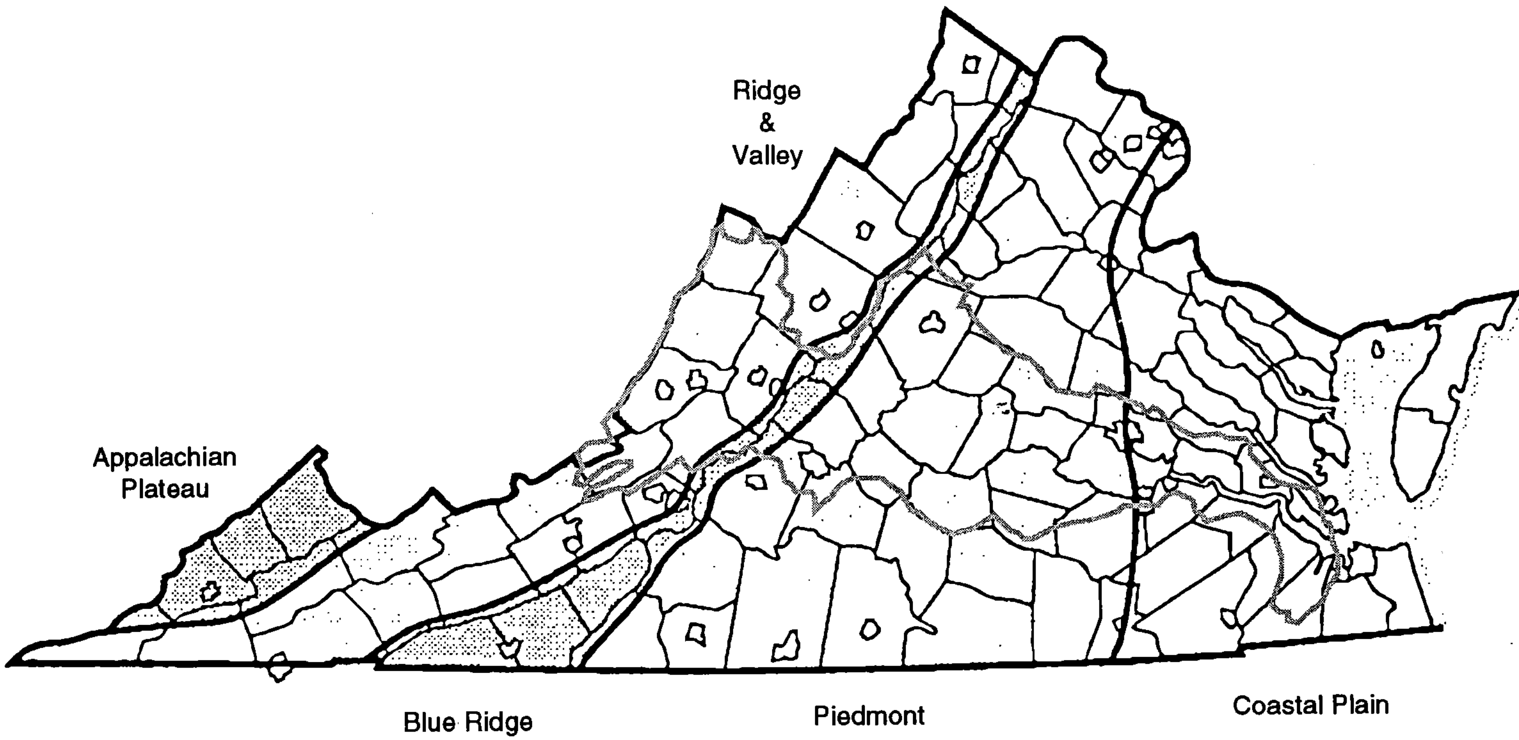
DESCRIPTION OF STUDY AREA

The James River Basin is the largest river system in Virginia, encompassing over 10,206 square miles (26,440 km ^{2}) of drainage area (just over 25 percent of the state's area). Originating at the confluence of the Jackson and Cowpasture rivers near Clifton Forge, Virginia, the James flows in a southeasterly direction through the central portion of the state, descending a total vertical distance of 988 feet (301 m) to sea level at the fall line at Richmond, Virginia. The mainstream extends 339 miles (545 km) from its origin to its mouth, where it empties in the southern portion of the Chesapeake Bay at Hampton Roads. The James has more tributaries than any other Virginia river--major tributaries include the Maury, Rivanna, Appomattox, and Chickahominy Rivers. The James is tidal from its mouth to the fall line, a distance of about 90 miles (145 km). The mean range of tide is 2.6 feet (0.8 m) at Newport News, and 3.2 feet (1 m) at Richmond. The mean annual discharge is approximately 7,500 cubic feet per second (c.f.s.; 1 cubic foot of water equals about 2.8 liters), with extremes as low as 320 c.f.s. and as high as 400,000 c.f.s.

Physiography

The James River bisects four major physiographic regions: From west to east, the James flows across the Valley and Ridge, the Blue Ridge, the Piedmont, and the Coastal Plain physiographic provinces (figure 3). The upper portion of the basin includes the former two provinces, and is characterized by rocky (gravel to bedrock) substrata, a meandering path, and a moderate gradient, ranging from 6.3 to 12 ft/mi (1.2-2.3 m/km). The middle and lower portion of the basin include the Piedmont and Coastal Plain provinces; the river here is alkaline, hard-bottomed, and has a moderately low gradient, averaging 2.6 ft/mi (0.5 m/km).

Figure 3



JAMES RIVER BASIN, VIRGINIA
FISH AND WILDLIFE RESTORATION

PHYSIOGRAPHIC PROVINCES

NORFOLK DISTRICT, CORPS OF ENGINEERS
OCTOBER 1993

<u>SOURCE:</u>
Virginia Statistical Abstract
1992 - 1993, Center for Public
Service, University of Virginia

The Valley and Ridge province consists of numerous parallel valleys and ridges, trending northeast to southwest. The current topography was produced primarily by the weathering processes that followed the intense folding of the sedimentary rock formations present in the area. These processes dissolved or eroded, and then carried away the relatively soft and/or unstable rocks (mostly carbonates and shales), creating the valleys; the ridges are composed of the remaining, more resistant, sandstones and quartzites. Elevations in this province range from about 400-4,000 feet (120-1200 m) (Div. of Water Resources, 1965). Streams in the Valley and Ridge province have developed a pattern roughly conforming to the depositional pattern of the rocks. A few of the primary streams (including the Jackson River, which constitutes the uppermost portion of the James River), have cut deep gaps through the ridges, but most streams flow either within the main valleys, or down the valley sites, nearly perpendicular to the valley trends. This gives an overall rectilinear drainage pattern, often referred to as trellis drainage (Dietrich, 1970 and 1990).

The Blue Ridge province is a long, narrow area consisting of the Blue Ridge Mountains. These mountain chains range from a single ridge less than 2 miles (3 km) wide to complex groups of closely packed ridges with an overall width of 10-14 miles (16-22 km). The area is relatively rugged, with many rock exposures, slopes covered with rubble or talus, and supporting a sporadic growth of scrub fir and other trees and brush. Although generally appearing irregular, neighboring summits are commonly of about the same elevation. Summit elevations range from about 1,200- 4,100 feet (365-1250 m) (Dietrich, 1970 and 1990). Streams of the Blue Ridge have beds with very steep gradients within narrow, V-shaped valleys, except in the lower foothills where flood plains have developed. These streams are said to be young in geologic age, with their greatest work being vertical, or downcutting (Division of Water Resources, 1965).

The western boundary of the Blue Ridge province consists of relatively steep ridges, which are commonly covered with rubble and talus deposits. Directly west of these is a broad area of low relief, part of which is veneered by alluvial gravels deposited where stream gradients changed abruptly from high to low. The base of the steep ridges is generally considered to mark the boundary between the Blue Ridge and the Valley and Ridge provinces.

The Piedmont province is a plateau that lies between eastern foot of the Blue Ridge Mountains and the fall line at Richmond. The land surface slopes generally toward the east from an elevation of 1,350-1,000 feet to the fall line, at about 300 feet. Topography is subdued, well-rounded, and of mild to moderate relief. Streams in this province flow in entrenched, sinuous beds, with occasional riffles and moderate gradients. As the Piedmont approaches the Blue Ridge Mountains, it generally becomes more hilly although there are some areas where the main, old-age surface of the plateau extends without interruption to the base of the Blue Ridge.

The fall zone constitutes an 11 mile stretch of the James at Richmond and is the transitional zone between the middle and lower portions of the basin. This region is characterized by a much steeper local stream gradient (averaging 8.5 ft/mi), exposed bedrock, and frequent falls and rapids. Here, the substratum is primarily composed of older, weathering-resistant crystalline rocks of the Piedmont, covered with a thin layer of the soft sediments typical of the Coastal Plain. The Falls of the James (proper) extend from Bosher Dam to the head-of-tide at Mayo's Island in central Richmond.

The Coastal Plain province includes all lands east of the fall line to the Chesapeake Bay. These are characterized by deposits typical of deltaic alluvial plains; substrata vary widely from one location to another, depending upon the recent depositional environment of the area. Sediments may be sandy, silty, clayey, or loamy (or a combination), with a great deal of variation within a relatively small area. The bedrock of the Coastal Plain is situated at a depth of about 13,000 feet beneath these sediments. Soils on the Coastal Plain are generally fertile, and wetlands, both tidally influenced and fresh water, are relatively abundant in this province.

The James River Basin includes the watersheds of the Jackson and Cowpasture Rivers above their confluence, since their waters drain into and form the James River. The Jackson watershed lies along the eastern foothills of the Allegheny Mountains principally in Highland, Bath, and Allegheny Counties. From its source in north-central Highland County, the Jackson River flows for a distance of 90 miles to its junction with the Cowpasture River. The Jackson watershed lies within the Valley and Ridges province. Lands here are generally forested, except for the cities and small towns.

Lake Moomaw, the reservoir created by Gathright Dam, lies in an area of varying topography, ranging from rolling agricultural lands to rugged, undeveloped mountains. In the immediate project vicinity, about 90 percent of the surrounding land is woodland or forest; 10 percent is cropland and pasture. The Gathright project lies within a portion of the George Washington National Forest and is partially surrounded by the T.M. Gathright Wildlife Management Area. This area was a private wildlife preserve for many years, and was purchased in 1958 by the State of Virginia to provide public hunting and habitat for wild turkey production.

Geology

The upper James River Basin is underlain by sedimentary rocks and is characterized by alternating linear ridges and valleys trending northeast to southwest. The ridges and valleys of the region are formed by a series of alternating anticlines and synclines, formed from intense folding and faulting of the original flat-lying sedimentary rocks. Erosion has exposed Ordovician (and Silurian) formations along the axes of the anticlines, and Devonian shales and sandstones along the synclinal axes. These rocks are highly fractured but have low porosity and permeability. Unconsolidated deposits of the Cenozoic age occur throughout the area in the form of talus on the steep ridges, broad, apron-like deposits of sand and gravel on the lower slopes and in the valleys, and terraces and flood plain deposits along major streams.

Bedrock of the Blue Ridge differs markedly from place to place. Along the western margin, there are relatively resistant late Precambrian and Cambrian clastic sedimentary rocks. East of these late Precambrian formations, volcanics occur in some places, with several diverse Precambrian and Paleozoic metamorphic and intrusive igneous rocks in other places (Dietrich, 1970 and 1990).

Overlying the unweathered bedrock of the Valley and Ridge province is an average of 50 feet of weathered rock, known as saprolite. The saprolite consists of soil cover, a highly weathered zone, and a moderately weathered zone. In isolated areas, there are Triassic sedimentary and igneous rocks. The Triassic sedimentary rocks are generally fine- to coarse-grained continental clastic material, which is, in some areas, interbedded with basalt flows, pyroclastic rocks, coal, and limestone, or intruded by diabase dikes and sills.

The Piedmont is underlain chiefly by Precambrian and Paleozoic metamorphic and igneous rocks, but it also has relatively large areas underlain by Triassic sedimentary rocks, along with sporadic basaltic sills and dikes (Dietrich, 1979 and 1990).

In the fall zone, the stream bottom is characterized by granite outcropping and rock slabs, and is strewn with large- and medium-sized boulders. Sandy substrata are also common throughout the fall zone, especially where the water reaches greater depths. There are many small and some large islands in this zone, and the river channel is broad, varying from 500 to 2,500 feet (about 150-600 m).

Climate

Temperatures below 0° F (-18°C) occur annually in the portion of the James River Basin west of the Blue Ridge Mountains and occasionally over the entire basin. East of this mountain barrier, warm air from the Atlantic Gulf Stream moderates the climate. The average annual temperature is about 56° F (20° C), with extremes below 0° F and above 100° F. These extremes are more pronounced in the west where the moderating effects of the Chesapeake Bay and Atlantic Ocean are more removed. Hot, humid weather is frequent in the summer, but hot, dry weather may cause an occasional drought. The average annual rainfall is approximately 42 inches and is fairly constant over the entire basin, varying no more than 5 to 6 inches from the mean in any one area of the basin, although the western portion is slightly drier, on the average, than the east. The mean annual snowfall ranges from over 30 inches in the mountains to less than 10 inches along the coast.

Water temperatures in the James River tend to increase slightly from upstream to downstream; temperatures in the upper river rarely exceed 88° F (31°C), while they may reach up to 92° F (33° C) nearer the Chesapeake Bay. Somewhat cooler water, with maximum temperatures around 82° F (28° C) prevail in the tributaries of the upper basin. The James is not typically subject to ice cover.

Water Resources

Water areas comprise about 179,900 acres (72,830 hectares), or 2.7 percent of the James River Basin. About two-thirds of these waters are in the estuary and tidal tributaries of the James River. The physical and hydrologic features of Virginia's estuaries is depicted in table 2. Water quality in the upper James River Basin is generally good, with the exception of the mainstem James River and the Jackson River downstream of Covington where dioxins are entering the river (at about 180 parts per quadrillion) in effluent water from the Westvaco paper mill. Another exception is the metallic contamination of waters in Lake Moomaw. In the summer when thermal stratification occurs, the hypolimnion of Lake Moomaw becomes depleted in dissolved oxygen (DO), causing iron and manganese to become more soluble and dissolve in the lake waters. By fall, relatively high concentrations of these elements may be present in the hypolimnion, where they can have potentially toxic effects.

Table 2. PHYSICAL AND HYDROLOGIC FEATURES OF VIRGINIA'S ESTUARIES

Estuary name	EDA(1)	FDA	Total	Water surface area	Average daily freshwater input
		(100 square miles)		(sq. mi.)	(100 c.f.s.)
Chesapeake Bay	**220**	**473**	**693**	**3,830**	**858**
Patuxent River	9	0	9	47	9
Potomac River	31	115	146	494	159
Rappahannock River	12	15	27	145	29
York River	26	0	26	74	25
James River	**44**	**58**	**102**	**236**	**125**
Chester River	5	0	5	57	5
Choptank River	9	0	9	110	10
Tangier/Pocomoke Sounds	26	0	26	459	29

Source: *Agricultural Pesticide Use in Coastal Areas: A National Summary*, US Dept. of Commerce, 1992.

(1) Abbreviations: EDA = Estuarine drainage area; FDA = Fluvial drainage area

The Gathright project is operated to improve water quality in the Jackson and James Rivers by making releases from storage during periods of low natural streamflows. The rate of release is governed by natural flows at Covington above Dunlap Creek. Flows required at Covington for water quality control, as determined by the U.S. Public Health Service assuming pre-project stream temperatures, are presented in table 3.

Table 3. FLOW REQUIRED AT COVINGTON FOR FLOW AUGMENTATION (c.f.s.)

Month	Flow (a)	Month	Flow
Jan	158	Jul.	283
Feb	168	Aug.	278
Mar	171	Sept.	245
Apr	194	Oct.	188
May	231	Nov.	161
Jun	269	Dec.	158

(a) At Dunlap Creek.

Once the James passes Lynchburg, about 100 river miles upstream from Richmond, there are no major point-source discharges. However, some urban runoff does enter the river at Lynchburg, and low DO levels in the river in the immediate vicinity of Lynchburg occur in the summer. For the most part, water quality between Lynchburg and Richmond is primarily determined by various natural processes as they influence flow, temperature, suspended solids and DO.

There have been no significant water quality problems immediately upstream from Richmond. In the upper portion of the fall zone, any adverse water quality impacts are likely to occur only under extreme low-flow conditions, when DO concentrations are limited by high ambient water temperatures in the summer.

Approximately halfway through the Falls of the James at Richmond, water quality is potentially affected by a number of combined sewer overflows (CSOs) that may also have significant impacts on water quality in the upper James River estuary. (A CSO occurs when heavy rainfall causes the combination storm-municipal-waste sewage system to overflow into the river, rather than following its normal route to sewage treatment.) Downstream of the Falls, the primary causes of any adverse impacts on water quality are: (1) Richmond CSOs, (2) urban runoff, and (3) wastewater treatment plant discharges to the upper estuary.

Kepone, a highly chlorinated hydrocarbon pesticide, was discharged into the environment around Hopewell, Virginia from 1966 to 1975 from two manufacturing operations. The Allied Chemical Corporation's Semi-Works Plant produced Kepone intermittently from 1966 to 1974. Life Sciences Products Company initiated Kepone production under contract to Allied Chemical in 1974 and continued production until closure of the plant in September 1975. Fish and sediment samples indicated that Kepone contamination existed in the James River as early as 1967. The finding of high levels of Kepone contamination in James River fish brought about a ban on fishing for a wide range of species. Estimates indicated that there were 20,000 to 38,000 pounds of Kepone in the top 1 foot of James River sediments (EPA, 1978). Bed sediments were contaminated from the source at Hopewell to Hampton Roads, a distance of 55 miles.

Downstream of Hopewell (65 miles or 100 km from the Chesapeake Bay), Kepone levels have now declined in the water column (probably due to covering of contaminated sediments) and water quality has improved sufficiently for a 13-year fishing ban to be lifted from the lower James River and its estuary.

The salinity in the lower James is too high for the water to be potable for humans, ranging from one part per thousand (ppt) near Richmond to 15-25 ppt at the mouth of the river. Variations in the estuarine salinity structure are caused primarily by the volume of fresh water flowing into the system, and by changes in the Chesapeake Bay salinity regime. The James is nearly homogeneous from the surface to the bottom and, as a result, salinity values show very little variation with depth. Even less variation in salinity is observed in the winter months, when stratification of the Bay waters is minimized.

BASELINE BIOLOGICAL RESOURCES

Aquatic Habitats

The term aquatic habitat is used here to denote only those habitats that occur in water (i.e., instream and riverbeds). Pools are areas of low velocity and deep water in relation to that of the main current. In the James true pools are infrequent and limited in area, with a maximum depth rarely exceeding 12 feet. Pool substrata are dominated by sand of varying texture and bedrock.

Shoals are areas where the stream gradient is steeper than surrounding reaches because of an outcropping of bedrock present in the stream. Here, water depth is typically shallower and water velocity is faster than adjacent habitat types. Shoals give rise to various habitat subtypes, and hence, diversity tends to be high in shoals. Shoals dominate the upper and middle James River, with the subtype known as a run (where water velocity is relatively high, but surface turbulence is low) dominating throughout the middle James, and alternating riffles and pools dominating the upper portion of the river.

The lower James is generally wider, deeper, and has a lower gradient than most of the rest of the basin. Habitat diversity here is somewhat lower than in reaches farther upstream.

Fish and Fisheries

A total of 100 fish species representing 20 families are reportedly distributed among the lacustrine, lowland, upland, montane, big river, stream, and creek habitats of the James River. The list of expected species is composed of 67 native, 20 introduced, and 13 marine/euryhaline fishes. Since expected species encompass all of the James River Basin, fish species richness within a particular segment of the James River is expected to be less than 100.

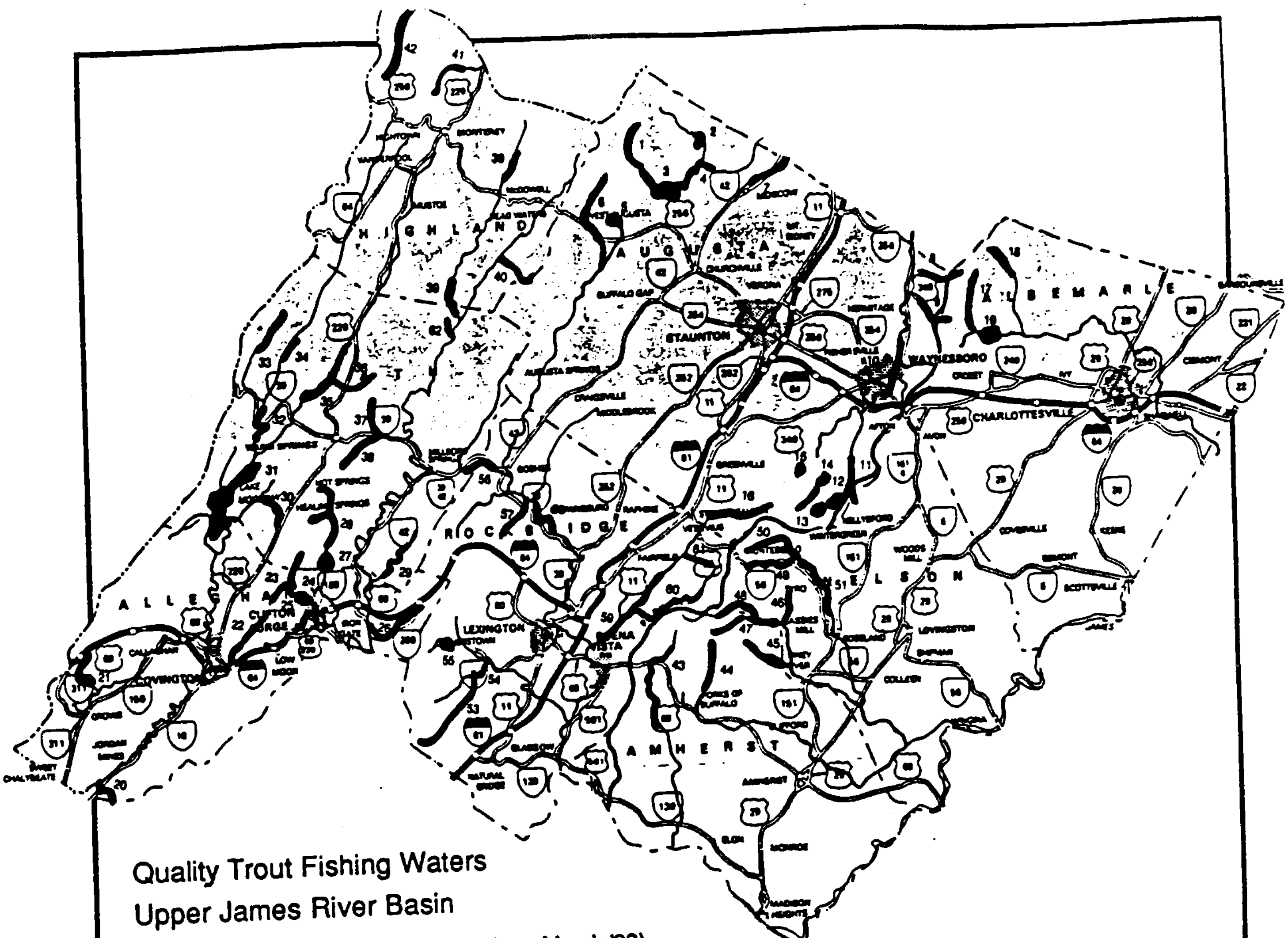
Fresh water ponds, reservoirs, and streams east of the Blue Ridge account for 29 percent of the fishing waters; about 4 percent of the fish habitat is in the Valley and Ridge province. Of the total annual harvest of all fish taken from the James River Basin, approximately 97 percent are taken from the lower James and its tributaries, 2.5 percent from the fresh waters east of the Blue Ridge, and only 0.5 percent from the Valley and Ridge province.

Resident Fishes

The Jackson River above Covington supports a high-quality stream fishery which features such indigenous sport fish as smallmouth bass, sunfish, pickerel, fallfish, and sucker. The portion of the river within the publicly accessible Gathright Wildlife Management Area is a stocked trout stream, as are more than 50 stream segments in western Virginia. This stocking program is conducted by the Virginia Department of Game and Inland Fisheries (VDGIF), which annually stocks the area with rainbow and brook trout to maintain a high-quality fishery. Between Covington and the Lake Moomaw reservoir, the Jackson River remains a high-quality trout fishery except that nearly all streaming lands are in private ownership, thus limiting public access. Other quality trout fishing waters in the upper James are shown in figure 4.

About 460 miles (1,500 km) of marginal and extremely marginal trout waters are found in the Blue Ridge and Valley and Ridge provinces (upper basin). Short reaches of the Cowpasture and Jackson Rivers support native trout, but almost no other streams provide the critical conditions throughout the year which are necessary for natural reproduction. Low flows and warm temperatures also limit the season for the stocking of hatchery trout from late spring to early summer in most streams. Predominant fresh water species include bass, catfish, and various sunfish. Several publicly owned lakes are also stocked and managed by state agencies.

Several previous James River fish community studies focused on the possible effects of the operation of the Bremo Power Station, a reach located about 55 miles upstream from the fall zone. Fifty species were reported in the Bremo vicinity, which represents a large portion of the species known to occur in the James River above Richmond. Thermal pollution has not significantly affected fish abundance and species composition, but hydropower dams have limited migration of anadromous fish.



Quality Trout Fishing Waters
Upper James River Basin
Source: VDGIF (Va. Wildlife Magazine - March '93)

Augusta County
(1) North River
(2) Hearthstone Lake
(3) Elkhorn Lake
(4) North River
(5) Braley Pond
(6) Ramseys Draft
(7) Mossy Creek
(8) Meadow Run (SNP)
(9) Paine Run (SNP)
(10) South River
(11) Back Creek
(12) Lower Sherando Lake
(13) Upper Sherando Lake
(14) Mills Creek Reservoir
(15) Coles Run Reservoir
(16) St. Marys River

Albemarle County
(17) N. Fk. Moormans River (SNP)
(18) Doyles River (SNP)
(19) Sugar Hollow Reservoir

Allegheny County
(20) Shawvers Run
(21) Jerrys Run
(22) Pounding Mill Creek
(23) Smith Creek
(24) Clifton Forge Reservoir
(25) Smith Creek
(26) Simpson Creek

Bath County
(27) Douthat Lake
(28) Wilson Creek
(29) Pads Creek
(30) Cascades Creek
(31) Lake Moomaw
(32) Back Creek
(33) Little Back Creek
(34) Back Creek
(35) Jackson River
(36) Muddy Run
(37) Jordan Run
(38) Mares Run
(62) Spring Run

Highland County
(39) Bullpasture River
(40) Benson Run
(41) S. Fk. Potomac River
(42) Laurel Fork

Amherst County
(43) Pedlar River
(44) N. Fk. Buffalo River
(45) Little Piney River
(47) S. Fk. Piney River
(48) N. Fk. Piney River

Nelson County
(46) Shoe Creek
(49) S. Fk. Tye River
(50) N. Fk. Tye River
(51) Tye River

Rockbridge County
(53) S. Fk. Buffalo Creek
(54) Buffalo Creek
(55) Lexington Reservoir
(56) Mill Creek
(57) Guys Run
(58) Maury River
(59) South River
(60) Irish Creek
(61) Big Marys Creek

Figure 4. Quality Trout Fishing Waters in James River Basin

The fall zone, as previously described, represents a unique area of transition between the Piedmont and Coastal Zone reaches of the James River. The physical attributes of this physiographical transition zone provide unique habitat (i.e., a large river with steep gradients like a mountain stream) for fishes as well as the means for a fish assemblage gradient between Piedmont and Coastal Plain species.

Based on fish collection experience and collection records, Garman (1990) has identified the presence of 50 fish species representing 13 families from the greater Richmond vicinity. This complement of expected/potential species represents half of all species reported for the entire James River Basin. Some of these species have been reported in very small numbers and/or on very few occasions near Richmond--flathead catfish, rock bass, and redear sunfish, for example, are not common in the area and appear to represent range extensions within the drainage basin.

Resident species in the lower James River and in the James River estuary include Atlantic silversides, Atlantic croaker, striped anchovy, spot, weakfish, hogchoker, bluefish, naked goby, oyster toadfish, skilletfish, blackcheek tonguefish, summer flounder, and black seabass. Bluefish, flounder, and seabass are all considered to be commercially important species, and spot and croaker are also popular game fish. Temperature appears to be the major factor affecting distribution of resident fishes in the lower James in winter, while food availability is the major factor in summer. Principal finfish uses of the lower James and its estuary are (1) nursery and spawning grounds for both resident and anadromous fish, (2) adult feeding grounds, and (3) spawning grounds for important forage species, such as the bay anchovy and Atlantic silverside. Spawning and nursery sites for various James River fishes are shown in table 4.

Table 4. SPAWNING AND NURSERY SITES FOR VARIOUS JAMES RIVER FISHES

SPECIES	SPAWNING TIME	SPAWNING AREA	LARVAE & POSTLARVAE	JUVENILES	COMMENTS
FRESHWATER					
Channel Catfish	Late May - Early July	Freshwater	Freshwater	Freshwater - Oligohaline	Salinity tolerance to 15 ppt
White Catfish	Late May - Early July	Freshwater	Freshwater	Freshwater - Oligohaline	Salinity tolerance to 14 ppt
White Perch	March - June (Apr - May)	Oligohaline (fresh)	Oligohaline (fresh)	Oligohaline (fresh)	
ESTUARINE					
Naked Goby	May - Sept (June, July)	Poly, meso, oligo	Poly, meso, oligo, fresh	Poly, meso, oligo	
Hogchoker	May -Sept (August)	Meso, poly	(Meso), poly	Fresh, (oligo), meso	
Oyster Toadfish	April - Oct	Meso	Meso	Meso	
Other Cyprinids	Early April - Late August	Freshwater	Freshwater schooling	Freshwater to oligohaline	
Crappie	May - August	Freshwater	Freshwater schooling	Freshwater schooling	
Bass	May - August	Freshwater	Freshwater schooling	Freshwater to oligohaline	
Yellow Perch	April - May	Freshwater	Freshwater	Freshwater to oligohaline	

Table 4. SPAWNING AND NURSERY SITES FOR VARIOUS JAMES RIVER FISHES
(Cont'd)

SPECIES	SPAWNING TIME	SPAWNING AREA	LARVAE & POSTLARVAE	JUVENILES	COMMENTS
ESTUARINE & FRESHWATER					
Mosquitofish	May - Sept	Freshwater (oligo)	Freshwater (oligo)	Freshwater (oligo)	
Carp	Late May - July	Freshwater to mesohaline	Freshwater to mesohaline	Freshwater to mesohaline	Salinity tolerance to 17 ppt
ANADROMOUS					
Blueback Herring	April - late June	Freshwater	Freshwater	Freshwater until early fall, then migrate downriver and into Chesapeake Bay by December	
Alewife	March - early June	Freshwater (usually trib.)	Freshwater (strongly schooling)	Same as above	
Striped Bass	April - June	Freshwater	Oligohaline	Mesohaline (oligohaline)	
Gizzard Shad	May - June	Freshwater	Freshwater	Freshwater - Oligohaline	Salinity tolerance to 7.6 ppt
Threadfin Shad	May - July	Freshwater	Freshwater	Freshwater - Oligohaline	Abundant in James between miles 60-75
American Shad	March - Late May	Freshwater	Freshwater	Freshwater - Oligohaline	

Table 4. SPAWNING AND NURSERY SITES FOR VARIOUS JAMES RIVER FISHES
(Cont'd)

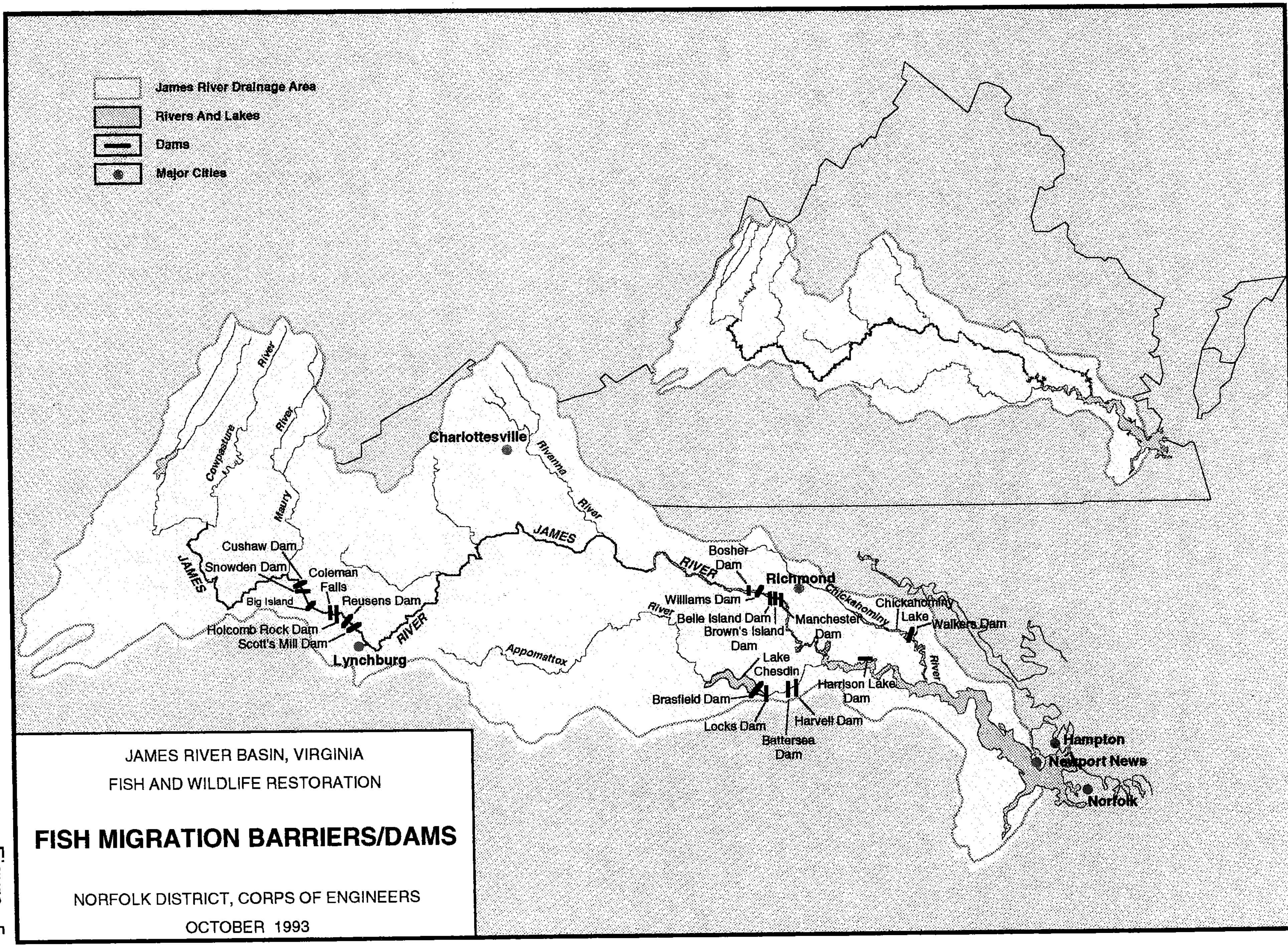
SPECIES	SPAWNING TIME	SPAWNING AREA	LARVAE & POSTLARVAE	JUVENILES	COMMENTS
MARINE					
Spotted Seatrout	May - Aug	Poly (coastal)	Poly, meso, oligo	Poly, meso	
Spot	Nov - June	Poly (coastal)	Meso, poly	Oligo, meso	
Atlantic Croaker	Aug - Dec	Poly (coastal)	Meso, poly	Oligo, meso	
Atlantic Menhaden	Sept - March	Poly (coastal)	Fresh, oligo	Oligo, meso	

	River Mile	Salinity (ppt)
Poly haline	0-13	16.5 - 30
Mesohaline	13-28	3.0 - 16.5
Oligohaline	28-38	0.5 - 3.0
Freshwater	38-up	less than 0.5

Anadromous Species

Historically, the James River was an important spawning river for several species of anadromous fish. Runs of American shad (*Alosa sapidissima*), hickory shad (*A. mediocris*), alewife (*A. pseudoharengus*), blueback herring (*A. aestivalis*), and striped bass (*Morone saxatilis*) may have extended up to and beyond Lynchburg, Virginia, with at least one species, American shad, reaching the headwaters of the James, near Clifton Forge. The populations of these important commercial and recreational anadromous species are in a serious state of decline, partly due to the loss of suitable spawning habitat as a result of dam construction, which blocks upstream migration. Dams in the James River Basin are illustrated in figure 5.

Recently, Garman and Mitchell (1989) and Garman and Eareckson (1990) conducted studies within the fall zone to assess the efficiency of the Richmond dam breaches and gathered information to assist in design and placement decisions regarding proposed fishway structures. Study objectives were to collect and provide data regarding the temporal and spatial utilization of the James by anadromous fishes. Represented in the collections were each of the four species of anadromous clupeids known to occur within the region (hickory and American shad, and alewife and blueback herring, known collectively as river herring) as well as anadromous striped bass. The authors reported that 14 percent and 54 percent of their 1989 and 1990 catch, respectively, belong to the anadromous taxa. The authors further noted that 99 percent of the anadromous fish catch was from the lowermost sampling location, below Manchester Dam. Garman and Eareckson (1990) found that all American shad collected during 1990 passed through the Manchester/Brown's Island and Belle Island breaches. Striped bass were also taken from above the breaches. In contrast, river herring were not. Overall results of these studies indicate that, despite blockage of fish passage that has prevailed over the last 100 years, viable populations of some anadromous clupeids persist within the drainage, albeit in low numbers.



JAMES RIVER BASIN, VIRGINIA

FISH AND WILDLIFE RESTORATION

FISH MIGRATION BARRIERS/DAMS

NORFOLK DISTRICT, CORPS OF ENGINEERS

OCTOBER 1993

Figure 5

The lower James River and the James River estuary support the same anadromous species as those found in the upper portions of the river, but the individuals present occur at different life stages from those in the upper river. In general, anadromous fish larvae and juveniles move downstream (toward increasingly saline waters) as they mature, so that pre-adult and adult members of the species tend to be found in the lower reaches of the James. Adult members found in the upper portion of the river are there for procreation, and do not survive in the fresh water long after spawning. River herring in general seem to be better adapted to spawning in more saline waters, and so the lower James serves as a nursery ground for these, as well as American shad and striped bass.

Shellfish

Blue crabs are a commercially important estuarine species of the lower James and are harvested as both hard-shell and soft-shell crabs for the local seafood market, as well as exported from the Chesapeake Bay area. The lower James also contains some of the best oyster beds in the world, totalling about 25,000 acres. Oyster abundance in Chesapeake Bay, however, is at its lowest level in history. This situation is described in detail in the problems and needs section of this report.

Oyster beds in the James are not only important for the mature oyster harvest, but also for the seed oysters, which are transplanted to other rivers in order to ensure populations for future harvest. In the past 50 years, approximately 75 percent of the seed planted in Virginia came from the James River. Beginning in the 1986-87 season, emphasis in the James shifted from harvest of seed to harvest of market oysters, with the advent of the "clean cull" law. That year the James fishery accounted for 42 percent of the state total of market oysters; now 90 percent comes from the James (public beds) (Barber and Mann, 1991). Oyster production is generally limited to the portion of the lower James between the mouth and the northern end of Rocklanding Shoal Channel (figure 6).

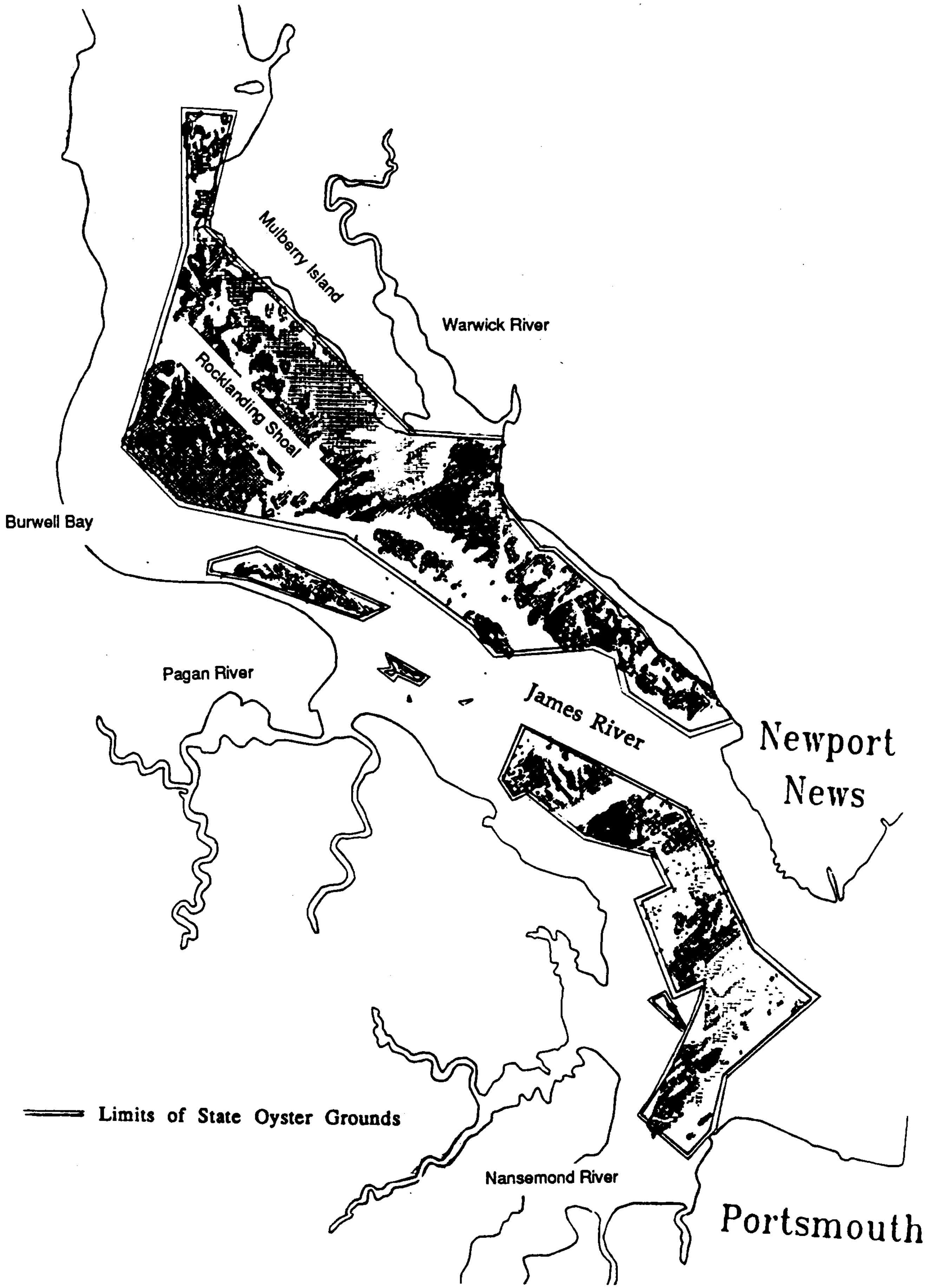


Figure 6. Oyster Grounds in the James River

Wetlands

Wetlands constitute a transition between aquatic and fully terrestrial habitats, and overall characteristics of wetlands in the James River Basin are dependent upon the degree and frequency of inundation, the substratum, and the salinity of inundating waters. Wetlands are among the most productive ecosystems in the biosphere and it has been estimated that 95 percent of the fish in the Chesapeake Bay are dependent in some way upon tidal wetlands for survival. Wetlands supply food to the aquatic system via runoff of detritus and other organic materials, and also act as water filters that remove impurities from rain water, and can be used for tertiary sewage treatment. Wetlands also provide protection from floods due to storms because of high absorptivity of peat and other organic matter which form their substrate.

Table 5. WETLAND ACREAGE IN VIRGINIA

Wetland type	Estimated current acreage	Loss(+) or gain(-) from 1950-70/80	% Loss/gain from previous total acreage
Estuarine emergent	135,450	-5,109	-3.6
Tidal flat	100,670	-1,223	-1.2
Palustrine (1)	752,742	-57,038	-7.0
Ponds	55,281	+34,853	+107.6
SAV	30,470	-55,000	-64.1

Source: *Virginia Outdoor Plan, Commonwealth of Virginia, 1989.*
(1) Refers to fresh water tidal and nontidal waters.

Wetland types include riverine, lacustrine/palustrine, and tidal, all of which are present in the James River Basin. Estimated acreage of various wetland types in Virginia is shown in table 5. The tidal wetlands, especially salt marshes, are the most productive in terms of biomass produced annually, while the fresh water wetlands have a higher diversity of plant and animal life, providing habitat for birds, reptiles, fish, amphibians, and mammals.

Currently Virginia has slightly more than 1 million acres of wetlands, with tidal wetlands representing about 25 percent of these, and the majority being fresh water wetlands. Most of Virginia's wetlands are found on the coastal plain, where 64 percent of the state's fresh water wetlands (and all of the tidal wetlands) are located. The Piedmont Plateau has 22 percent of the state's total wetlands, which constitute 28 percent of the fresh water wetlands in Virginia. The remaining 5 percent of Virginia's total wetlands is scattered about the state, occurring in specialized landscapes in higher elevations. Various wetland areas within the James River Basin have been recommended for protection in the Virginia Outdoors Plan (1989). These wetlands are presented in table 6.

Table 6. COUNTY BY COUNTY INVENTORY OF WETLAND IN THE JAMES RIVER BASIN RECOMMENDED FOR PROTECTION BY THE VIRGINIA OUTDOORS PLAN

County	Wetland
Albemarle	Fernbrook Natural Area
Allegheny	Potts Pond
Amelia	Appomattox River Wetland
Augusta	Back Creek Mt. Torrey Furnace Campbells Pond Cold Spring Bridge Green Pond Grove Farm Pond St. Mary's River South River Wet Meadow Maple Flat Sinkhole Pond Wakena-Gleason Marsh Warehouse Marsh Peterson Pond Lebanon Church Fault Ramseys Draft Natural Chimneys Magnolia Swamp Kennedy Mountain Meadow Shenandoah Mountain Sink Holes
Bath	Bolar Mountain Pond Shenandoah Mountain Sink Holes
Botetourt	James River Terrace near Warminster
Buckingham	Slate River James River Arborvitae Bluff
Charles City	Herring Creek Marsh Weyanoke Point Parsons Island/Sunken Neck/Old Marsh Morris Creek Marsh Chickahominy River Marshes Chickahominy Swamp Lower Kittewan Marsh Salem Run Bog Chickahominy WMA
Chesterfield	Dutch Gap Fault Appomattox River Marshes Appomattox River Wetlands Presquile NWR
Cumberland	Willis River Wetlands

Table 6. COUNTY BY COUNTY INVENTORY OF WETLAND IN THE JAMES RIVER BASIN RECOMMENDED FOR PROTECTION BY THE VIRGINIA OUTDOORS PLAN (cont'd)

County	Wetland
Hanover	Chickahominy Swamp North Anna River Wetlands Curles Neck
Henrico	Chickahominy Swamp Chickahominy River Preserve
Highland	Shenandoah Mountain Sink Holes
Isle of Wight	Lawnes Neck Creek Marsh Pagan River Marsh Ragged Island WMA Ballard Marsh Blackwater River Swamp Horse Swamp Zuni Pine Barrens
James City	Big Marsh Point Yarmouth, Simpson, and Wright Creeks Ware Creek and Terrapin Point Taskinas Creek Passmore Creek College Creek Marsh Chisel Run Bog Chickahominy River Marshes
Nelson	Love Swamp Tye River Hemlock-Beech Slope Helena's Island Preserve
New Kent	Lilly Point Marsh Complex West Island Cousiac Marsh Hill Marsh Ware Creek and Terrapin Point Chickahominy River Marshes Chickahominy Swamp Lanexa Marsh Cumberland Thoroughfare Matton Creek Whites Landing Holts Creek North Anna River Wetlands Big Creek
Nottoway	Nottoway River Swamp Nottoway Falls

Table 6. COUNTY BY COUNTY INVENTORY OF WETLAND IN THE JAMES RIVER BASIN RECOMMENDED FOR PROTECTION BY THE VIRGINIA OUTDOORS PLAN (cont'd)

County	Wetland
Powhatan	Appomattox River Wetlands
Prince Edward	Allen's Mill
Prince George	Powell Creek Marsh Kennon Marsh Ward's Creek Dutch Gap Fault Upper Chippokes Creek Appomattox River Wetlands Appomattox River Marshes
Rockbridge	Goshen Pass Natural Area Short Hills
Suffolk	Nansemond River/Bennett Creek Marshes Hoffler Creek Marsh South Quay Pine Barrens Blackwater River Great Dismal Swamp NWR
Surry	Upper Chippokes Creek Sunken Meadow Pond Crouch Creek and Timber Neck Creek Lower Chippokes Creek Marsh Hog Island Lawnes Neck Creek Marsh Blackwater River Swamp Surry Site Swann's Point Mt. Pleasant

Source: *Virginia Outdoors Plan, Commonwealth of VA, 1989.*

Nontidal Wetlands. A variety of nontidal wetland types are found across the different regions of James River Basin in Virginia. Variations in wetland types are due to factors such as underlying geology, soil type, climate, and water movement.

The water sources for all types of nontidal wetlands usually include both surface waters and ground water. Wetlands found along the upper edges of rivers are generally seasonally flooded, as water tables rise in the spring. Flood plain wetlands, such as bottomland hardwoods, are usually temporarily flooded. The type vegetation found in a given riverine wetland will vary, usually depending on the hydroperiod and the soil type. Wet meadows are often found on flood plains, although they may result from the natural filling in of a small lake or pond. The nontidal wetlands of the Piedmont region are mostly riverine flood plains.

Lacustrine and palustrine wetlands are characterized by the presence of a body of water that generally lacks unidirectional flow, and may or may not be fed water by a stream (i.e., lakes and ponds). The main criterion used to distinguish between lacustrine and palustrine systems is the depth of the water, although total area of the water body is also a factor. Lacustrine wetlands are those with both the greater depth and, when it applies, surface area. The amount and type of vegetation associated with these wetland types will vary greatly, depending upon the soils present, and the local topography.

Many of Virginia's nontidal wetlands are shallow areas that are mostly vegetated. Nontidal wetlands in the Blue Ridge and Valley and Ridge provinces of the state include excavated basins, with sparse vegetation. Ground water seeps are also found in this region. Clay deposits and flat topography in the Coastal Plain have contributed to the formation of substantial areas of nontidal wetlands, which extend high up into the watershed of rivers and streams.

Non-Tidal Wetland Functions. The ecological functions and importance of Virginia's non-tidal wetlands are discussed in detail in appendix A.

Virginia's Tidal Wetlands. Submerged aquatic vegetation (SAV) communities are those in which the plant life present requires complete submersion all or most of the time. In areas where the vegetation is not completely submersed at all times, only the tops of plants are exposed at periods of low tides, or when weather conditions cause the temporary removal of water from the water body in which they occur. The predominant form of SAV in the more saline portions of the James River is eelgrass (Zostera marina), which grows in dense patches on the benthos in the depth zone where light penetration is good (the phototrophic zone). The entire James River had less than 3 hectares of SAV in 1991. This moderately dense bed is located at the mouth of Hampton Creek near the north end of the Hampton Roads Bridge-Tunnel.

Mud flats are thick layers of fine-grained sediments that occur along the margins of relatively calm, highly saline waters. They are typically non-vegetated, with a rich concentration of phytoplankton and other microscopic and submicroscopic life forms, as well as a large assortment of invertebrates. Mud flats are usually at least partially flooded on a daily basis.

Salt marshes are often found directly landward of mud flats, and also occur in low-lying areas that are close enough to saline water bodies to be flooded on a regular basis. Vegetation in James River salt marshes consists primarily of various species of cordgrass, saltgrass, and salt bushes. Irregularly flooded salt marshes tend to be dominated by needlegrass. Salt marshes are populated by a large variety of invertebrates, mammals, waterfowl and other birds.

Tidal fresh water wetlands occur landward (upstream) of estuaries where the water is of extremely low salinity and tidal cycles cause daily flooding of the area. Fresh water marsh vegetation includes cattails, reeds, arrow arum, big cordgrass, wild rice, three-square, tearthumb, and pickerel weed. Like the salt marshes, a large variety of invertebrates, birds and wildlife populate tidal fresh water wetlands.

Acreage of tidal wetlands within the counties of the James River Basin is presented in the following table.

Table 7. ACREAGE OF TIDAL WETLANDS IN JAMES RIVER BASIN COUNTIES

County	Total acreage
Charles City	4,037
Chesterfield and city of Richmond	872
Henrico	192
Isle of Wight	5,378
James City	7,028
New Kent	5,467
Prince George	1,466
Suffolk	5,535
Surry	1,988

Source: *VIMS Tidal Wetland Inventories*

Tidal Wetland Functions. The ecological functions of Virginia's tidal wetlands are discussed in appendix A.

Terrestrial Habitats

The upper James River Basin is about 80 percent forested, with the majority of this area in the Jefferson and George Washington National Forests. Forests of the region are predominantly oak-pine. A variety of oaks dominate the north-facing slopes, while pine (especially Virginia pine and pitch pine) are generally more abundant on the slopes facing south and in flat areas. Stream bottoms support a more diverse plant community, of which sycamore, white pine, maple, hemlock, basswood, cedar, black locust, and chestnut, white, and red oaks are conspicuous members. Some of the common understory species are mountain laurel, greenbriar, blueberry, dogwood, and persimmon.

An estimated 2 million acres in the basin are managed in varying degrees and intensities for wildlife and hunting. About 40 percent of these lands are in the Jefferson and George Washington National Forests. The state of Virginia has purchased nine public hunting areas totalling 78,346 acres and manages wildlife resources on another 30,000 acres in state forests, parks, and recreational areas. Numerous wood-using industries have opened large tracts of land to public hunting either through cooperative agreements or through annual permits to individuals. Wildlife food-planting projects are carried out on innumerable individual farms.

Wildlife

The Valley and Ridge province supports a major portion of the deer, bear, and turkey harvest. This mountainous wooded area supports a low percentage of the small game, except for squirrels.

In general, the Piedmont-Blue Ridge area sustains a moderate portion of the deer, bear, and turkey, but, as a whole, the area is generally better adapted to small game such as quail, doves, and rabbits. The more mountainous, wooded areas produce a major portion of the state's large game species and a lower percentage of small game than the valley areas.

The Coastal Plain still supports moderate harvests of deer, despite intensive urban and industrial development. The large expanses of wooded flatlands also provide habitat for squirrel and other small game. Wetlands are numerous here, although development is rapidly destroying or fractionating thousands of acres each year. The lower James is also important to numerous North American species of migratory birds, as it is part of the North-South Flyway, a major migratory path utilized by most migratory species that occur east of the Mississippi River. As many as 350 different species of Federally protected birds may use part of the James River Basin annually.

The T.M. Gathright Wildlife Management Area (18,392 acres located in the upper James River Basin) is regarded by state wildlife officials as probably one of the best wildlife management areas in Virginia. Gathright's high productivity is essentially the result of a diversity of habitat together with good management. Valley floors support a mixture of hardwoods and cropland.

Hillsides are characterized by upland hardwoods scattered with pines. Some ridges, such as Bolar Ridge, carry mature, mast-producing hardwoods mixed with shrubs and vines. Shale slopes and ridges, characterized by steep grades and low soil fertility, are more sparsely covered with a mix of hardwood and pine.

Approximately 1,240 acres of Gathright Wildlife Management Area are classified as agricultural land. Most of this is on the bottomlands along the Jackson River. The cropping potential, 300 acres, is realized by leasing lands for farming, some of which is left for wildlife. Other land management practices which favor wildlife are the planting of cover strips, small grains, and stands of pine in the larger open fields. Some open areas are kept mowed to favor small game by controlling invading brush.

Small and upland game within the Gathright area include cottontail rabbit, gray squirrel, raccoon, mourning dove, and ruffed grouse. Big game are represented by whitetail deer, wild turkey, and black bear. Furbearers include beaver, mink, muskrat, and skunk. Gray fox, opossum, woodchuck, and bobcat are also prevalent.

In the lower James River Basin, lands adjoining the river are composed of fertile agricultural tracts. Marshes, forested bottomland, and swamps affording high-value habitat for migratory waterfowl and other birds, and game and fur-bearing animals are prevalent. The Virginia Department of Game and Inland Fisheries (VDGIF) maintains a 2,100-acre waterfowl refuge in Hog Island and the U.S. Fish and Wildlife Service (USFWS) maintains Presquile National Wildlife Refuge, a 1,329-acre refuge on Turkey Island below Hopewell.

The James River Basin supports a variety of wildlife, defined in this context as terrestrial forms, excluding domesticated animals. A list of the fauna expected to be found within the study area is found in appendix A.

Endangered and Threatened Species

A list of the endangered and threatened species expected to be found in the study area is found in appendix A. The list of species includes not only those living within the James River Basin that are protected by law (endangered and threatened species), but also those whose populations could suffer serious effects if mismanaged. In the context of this study, fish and wildlife habitat restoration would give priority consideration to the protection and restoration of the habitat of these species.

Historically, the Federally listed endangered James spinymussel (*Pleurobema collina*) was widespread in the James River drainage area (USFWS 1990). Table 8 lists the historic and present locations of the species. Clarke and Neves (1984) surveyed 73 potential locations for the species, but were able to find the spinymussel at only six of the historic sites: two in Johns Creek, three in Craig Creek, and one in Potts Creek. Based on this survey, and other more recent survey data (Hove 1990 and Neves comm. with USFWS), the species is now known to inhabit sites in 10 streams.

Primary factors thought responsible for the James spinymussel decline include point source water pollution, siltation/agricultural runoff, competition from the Asian clam, and impoundment of free-flowing streams and rivers (USFWS, 1990). Considering primary land uses in the upper James, siltation and agricultural runoff probably constitute the biggest threat to existing spinymussel populations.

Table 8. THE JAMES SPINYMUSSEL IN THE JAMES RIVER BASIN

Historic Occurrences	
James River Mainstem	
James River near Natural Bridge	Rockbridge County, VA
James River at Buchanan	Botetourt County, VA
James River at Columbia	Fluvanna County, VA
James River at New Canton	Buckingham County, VA
James River opposite Maidens	Goochland County, VA
James River at Maidens	Goochland County, VA
James River at Rock Castle	Goochland County, VA
James River at Pemberton & Cartersville	Goochland & Cumberland Counties, VA
Rivanna River Basin	
Rivanna River near Columbia	Fluvanna County, VA
Rivanna River near Palmyra	Fluvanna County, VA
Rivanna at Crofton	Fluvanna County, VA
Maury River Basin	
Calfpasture River	Rockbridge County, VA
North (= Maury) River, Lexington	Rockbridge County, VA
Mill Creek near Millboro	Bath County, VA
Present Occurrences	
Rivanna River Basin	
Mechums River	Albemarle County, VA
Rocky Run (Moormans River)	Albemarle County, VA
Moormans River	Albemarle County, VA
Craig Creek Basin	
Craig Creek near New Castle	Craig County, VA
Craig Creek near Silent Dell	Botetourt County, VA
Craig Creek near Eagle Rock	Botetourt County, VA
Johns Creek near Maggie	Craig County, VA
Johns Creek along Sevenmile Mountain	Craig County, VA
Dicks Creek	Craig County, VA
Patterson Creek	Botetourt County, VA
Jackson River Basin	
South Fork Potts Creek	Monroe County, WV
Potts Creek	Craig and Alleghany Counties, VA
Other Basins	
Catawba Creek	Botetourt County, VA
Pedlar River	Amherst County, VA

CULTURAL RESOURCES

The entire study area has many known archaeological and historical sites and many areas which have a high potential for containing undiscovered sites. Areas along rivers and streams, particularly the flood plains with a slight to moderate slope, frequently are high probability areas for undiscovered sites.

A literature search for an earlier study of the upper James River Basin revealed that of over 4,000 archaeological and historical sites identified previously, at least 52 sites have been indicated as needing further study. As many as 320 of the 4,000 have been identified as Native American sites, of which 35 have stratified remains, and therefore, require future study. A total of 218 known sites were disturbed or lost by the Gathright Dam/Lake Moomaw project in the upper Jackson River. Historical sites consist primarily of farms and farmhouses of varying age, but also include several sites containing remains of the James River-Kanawha Canal system that at one time connected several communities in the upper basin.

While all of the counties and municipalities in the upper James River Basin contain sites, none has been subjected to systematic surveys designed to inventory sites of all periods located within a sizable geographic area, with the exception of the survey conducted for the Gathright/Lake Moomaw project and the Lake Verona project. Most of the sites discovered during these surveys no longer exist. Furthermore, few of the recorded sites have been field-checked; this will be an important component of any additional work in the upper portion of the basin which would affect previously undisturbed land.

The work done for Gathright resulted in identification, evaluation, and data recovery for numerous sites from the Paleo-Indian through Late Woodland periods. The research indicated that the human occupation and use of the area may have been infrequent and consisting of rather small-scale settlements. From that time, through the period associated with the Early and Middle Archaic, settlement remained infrequent and transitory and focused on the activities of small groups of seasonal migrants. The Late Archaic marked the first period of extensive human settlement; sites were typically campsites and occasional base camps. Again these routines appeared to be both seasonally migratory and associated with the actions of small groups of people. There was little perceived change in the settlement or demographic patterns from the Late Archaic to the Late Woodlands. Overall, the research gave some insight into the progression of events associated with the Late Woodland period; however, it contributed little to the archaeological delineation of those societies occupying the area.

East of Lynchburg, there are numerous sites listed on the National Register of Historic Places throughout the region. Of particular note are the University of Virginia Historic District, Monticello, and Ash Lawn, all located in the Charlottesville vicinity. Sites located in the counties between Lynchburg and Richmond include various county courthouse historical districts, plantations, churches, homes, and taverns. Richmond itself has numerous sites of historical importance located throughout the city, some of which are associated with its role as capital of the state and the Confederacy during the Civil War.

The James River and Kanawha Canal Historic District is of special interest since the old canal system is adjacent to the river itself as it flows through Richmond and part of Henrico County. The head of commercial navigation on the James River is at the old lock at Richmond, which marks the eastern terminus of the abandoned James River-Kanawha Canal. This canal system, constructed in the 1850's, connected the city of Richmond with the city of Lexington on the Maury River and other points along the James. The Civil War, the floods of 1870 and 1877, and the railroads all led to the demise of the canal system by 1881.

The lower James River and the surrounding land areas have many known historical and archaeological resources also. Jamestown Island, restored in 1957 and located approximately 30 miles upstream of the mouth of the river, is the site of the first permanent English settlement in North America. Nearby Williamsburg, presently restored to its pre-Revolutionary style, served as the colonial capital of Virginia and as an important center during the Revolutionary War. Other sites along the river contain evidence of early colonial settlements and major plantations. Petersburg and the surrounding area experienced major action during the Civil War, with several sites preserved as part of the Richmond-Petersburg National Battlefield Park. The river itself was the site of several battles, the remnants of which lie on the bottom of the river at various locations.

SOCIO-ECONOMIC RESOURCES

Population

The population in the counties and cities which encompass the James River Basin, which was 1,975,832 in 1990 according to the U.S. Census, constitutes about 32 percent of the state's total population. This region increased in population 12.1 percent between 1980 and 1990, while the state's population as a whole grew by 15.7 percent. Projections by the Virginia Employment Commission through the year 2030 show a similar pattern with the study area's population increasing at a slightly slower rate than that of the state. These projections show the area with 2.9 million residents and the state with 9.4 million people.

Within the study area, there is considerable variation in growth rates. The western portion of the study area is one of the slower growing areas of the state, with 7 out of the 13 political jurisdictions losing population between 1980 and 1990, while the Richmond and Hampton Roads areas are among the faster growing areas in the state. In the central portion of the study area, the counties of Albemarle, Fluvanna, Greene, and Goochland have a high growth rate while the remainder of the area is growing at a much slower rate. Overall, the largest rates of population increase between 1980 and 1990 occurred in James City County (56 percent) and Chesterfield County (48 percent). The largest declines took place in Covington (-23 percent) and Bath County (-18 percent). The decline in Bath County's population can be attributed to the completion of a massive construction project which had brought in many workers in the 1980's. Projections show the county's population increasing steadily into the next century.

In the western portion of the study area, the areas of growth tend to be adjacent to the larger cities, such as Bedford County, which is next to both Roanoke and Lynchburg. The smaller cities and nearby counties have either stable or declining populations. The population decreases in the cities are typical of older, industrial cities across the state, many of which have been decreasing in size in recent years.

Growth in the central portion of the study area is greatest in the counties near Charlottesville although Charlottesville's population itself remained virtually static between 1980 and 1990. The other counties in the area are more rural in nature and are experiencing little or no growth.

The eastern portion of the study area consists of both rural and urban areas. The counties near the larger cities of Hampton Roads and Richmond showed significant growth in the past decade, while the more rural counties such as Surry, Charles City, and Dinwiddie had population declines between 1980 and 1990. Richmond and Petersburg have been decreasing for several decades, a common occurrence for older, industrial cities.

Housing

In general, housing in the study area is dominated by owner-occupied units with values below those of the state as a whole. Only 7 cities and counties out of 48 had median values for owner-occupied housing higher than the state median, which was $91,000, according to the 1990 U.S. Census. The three highest values were found in York and James City Counties and the city of Williamsburg, which are adjacent to each other and are in the eastern portion of the study area. Other areas of higher values are Albemarle, Goochland, and Hanover Counties and the city of Suffolk. The places with the lowest values were the cities of Clifton Forge ($35,200) and Covington ($38,700) with Buena Vista and Nottoway County next. Other areas where housing values tend to be significantly lower are the older industrial cities and the rural counties.

As of 1990, there are only five localities in the study area where rental housing predominates. Three of these localities are the larger cities of Richmond, Petersburg, and Newport News, and the other two cities, Charlottesville and Williamsburg, are dominated by the presence of colleges. Williamsburg's housing is 68 percent rental, the highest proportion in study area with Charlottesville next at 60 percent. Four of the five localities with lowest percentage of rental housing are in the eastern portion of the study area--they are New Kent, Hanover, Powhatan, and Charles City Counties. These counties, along with Botetourt, all have rental housing rates of 20 percent or less of total housing units.

Land Use

Within the study area can be found all types of land uses in various concentrations. In the upper reaches of the James River, the area is predominantly rural with one major city, Lynchburg, and four smaller ones. Although the city of Roanoke is not included within the study area, parts of the study area close to the city are affected by its presence and connected economically with it. Most of the industrial and commercial land in the region can be found in its cities and towns. The majority of the upper basin lands are undeveloped, with much of the undeveloped portions lying within the George Washington and Jefferson National Forests. A significant part of the undeveloped land in all the counties is used for agriculture, particularly in Augusta and Bedford Counties.

The middle portion of the study area, from east of Lynchburg through the Richmond area, contains large sections of undeveloped and agricultural land with development concentrated around the cities of Charlottesville and Richmond. In the rural counties such as Buckingham and Cumberland, agricultural land use is significant with minor commercial use in the small towns and communities throughout the counties. The largest amounts of industrial land are located in the Richmond-Petersburg area with smaller amounts in Charlottesville and some of the counties in the region. Commercial and residential development are also concentrated in the Richmond-Petersburg and Charlottesville metropolitan areas. As the state capital, Richmond has significant parcels of land falling into the public use category.

The lower portion of the study area is a combination of rural, suburban, and urban land uses. Charles City, Surry, and portions of Isle of Wight and New Kent Counties are predominantly rural, while James City and York Counties are rapidly developing suburban counties adjacent to the cities of Newport News and Hampton. Industrial land use is significant in Isle of Wight County, Surry County, Newport News, and Suffolk. Commercial and residential development are most prevalent in the cities and the suburban areas of the region.

Employment

Employment in the study area is fairly well distributed over the major categories. In the western part of the study area, manufacturing is a significant source of employment in Covington-Alleghany County, Buena Vista-Rockbridge County, Lynchburg-Campbell County areas with factories that manufacture paper products, fabric, carpet, electrical equipment and other products. Agricultural employment is significant in Highland, Augusta, and Craig Counties, although it is projected to decline through the year 2035 according to the U. S. Department of Commerce, Bureau of Economic Analysis (BEA). The services sector, which is the largest sector of the economy for many counties, provides about half the employment for residents of Bath County and the city of Lexington and between 20 and 35 percent for the other localities (U.S. Census). The wholesale and retail trade, public administration, and construction industries provide additional jobs for residents.

In the middle portion of the study area, manufacturing is important for residents of Appomattox County and the Richmond-Petersburg area, while agriculture employs a larger than average proportion of people in the rural counties in the area. Hopewell is the site of several major chemical manufacturing plants, while Petersburg has factories which produce tobacco products and durable goods. The services industry tends to be somewhat smaller in the non-urban localities in the area than the more developed areas such as Richmond and Petersburg. Forty-three percent of the residents of Albemarle County, which has significant employment related to the presence of the University of Virginia, are employed in services, the highest percentage for this section of the study area.

Richmond's location in the central part of the state has played an important role in the area's growth in manufacturing, wholesale trade, transportation, and warehouse activities. Richmond and its surrounding counties are also a center of financial and insurance services as well as a source of governmental employment, primarily at the state level.

The economy of the lower portion of the study area is based on a strong manufacturing sector; significant government employment at the the Federal, state, and local levels; retail trade; and services. Manufacturing is particularly important in Newport News, where the state's largest employer, Newport News Shipbuiding and Drydock, is located. Meat packing plants and a paper mill are major industrial employers in Isle of Wight County, and a nuclear power plant is an important industry in Surry County. The services and trade sectors are more prominent in the cities and suburban areas, while agriculture is still important in Charles City, Surry, and Isle of Wight Counties.

Employment projections by BEA indicate a trend of slightly declining proportions of manufacturing jobs, actual declines in agriculture and Federal Government, and small increases in the percentage of service and trade jobs. Employment for the whole study area is projected to grow at an annual rate of 0.3 percent.

Unemployment rates vary throughout the study area from 2.2 to 12.5 percent for 1990, according to the Bureau of Labor Statistics. The lowest rates occurred in the Charlottesville-Albemarle County area, the counties near Richmond, and Roanoke County. The highest rates were found in the Covington-Alleghany County area and in Prince Edward County.

Income

In general, the higher income localities tend to be the higher growth counties near major urban areas and the lower incomes in the rural areas and small cities. Chesterfield County, with a 1979 median family income of $48,064 (U.S. Census), had the highest figure, and Nottoway County with $25,966, had the lowest figure. Per capita income varied from $9,031 for Prince Edward County to $18,312 for Goochland County with $15,713 for the state. Projections by BEA show per capita income for the whole study area at 97 percent of the national average and staying at approximately this level through the year 2035.

Port Facilities

The primary ports operating on the James River are those at Hopewell and Richmond.

The Port of Hopewell is the site of several industries and a branch railroad terminus located at and near City Point. A pier owned by Allied Chemical Company is used for receipt of petroleum products and liquid chemicals and the shipment of aluminum sulfate. Immediately southward of the chemical pier is a pier owned by the Continental Can Company. This pier provides berthing area for petroleum barges. A barge wharf and an oil terminal T-head pier are located southeast of the Continental Can Company pier.

River commerce at Richmond is handled by two city-owned terminals, city wharfs, Richmond dock, and several privately owned wharfs within or in the immediate vicinity of Richmond Harbor. The two city-owned terminals are the Richmond Deepwater Terminal and the Richmond Upper Marine Terminal, both of which are fronted by turning basins, and are served by trunk railway and major highways.

Transportation and Utilities

In general, the James River Basin has an adequate-to-good transportation system: the interstate system includes I-64, which runs east-west, and I-81 and I-95, which go north and south through the study area. Other major routes which traverse the basin include US 460, 360, and 220. CSX and Norfolk Southern Corporations are the major rail lines in the area, providing access to markets in Washington, D.C., Baltimore, Richmond, Norfolk, and Charlotte. Significant air transportation is generally limited to the larger metropolitan areas, as are the mass-transit bus systems. Waterborne transportation is somewhat limited, with the majority of the port area and facilities located along the James River.

Throughout the James River Basin, water service is supplied primarily by the various municipalities of the region. In most of the rural areas, residents get their water from individual wells. Individual political subdivisions generally control the sewage removal and treatment facilities. The major producer and distributor of electrical power is the Virginia Power Company, which supplies power either directly to the consumers, or else to other systems which provide it to the residents of some of the rural areas.

Much of the electricity produced in the James River Basin is a product of hydroelectric dam operation, especially in the middle and upper portions of the basin. There are 12 low-head hydropower dams on the James proper; 5 of them, Manchester, Brown's Island, Belle Island, Williams, and Bosher Dams are located in the greater Richmond area. The previous three are no longer actively used, and both Manchester and Brown's Island Dams have been breached for anadromous fish passage to spawning grounds. The other seven low-head dams are found upstream of Lynchburg. These are (from downstream to upstream) Scott's Mill, Reusens, Holcomb Rock, Coleman Falls, Big Island, Snowden, and Cushaw Dams. Five other low-head hydropower dams exist on James River tributaries, including (again, from downstream to upstream) Harvell, Battersea, Locks, and Brasfield Dams on the Appomattox River, and Walker's Dam on the Chickahominy River. As well as producing hydroelectric power, many of these dams, especially in the Richmond area, serve to divert water from the James for various purposes.

Electrical power is also generated by the Surry Nuclear Power Plant, named for Surry, Virginia, located in the lower reaches of the James River Basin. This power plant, as well as the Chesterfield and Bremo hydroelectric plants (found respectively in the middle and upper portion of the basin) discharge their cooling waters into the mainstream of the James.

Recreation

Within the study area there are numerous recreational resources, although the demand for certain types of facilities and opportunities exceeds the supply in some localities, according to the 1989 Virginia Outdoors Plan. In the western portion of the study area, recreational opportunities are heavily associated with the mountains, streams, and lakes found there. Parts of the George Washington and Jefferson National Forests, which provide opportunities for hiking, camping, hunting, and fishing, are located in this region. The national forest land makes up half of all the public outdoor recreation land in the state. Shenandoah National Park, the Blue Ridge Parkway, and several state parks provide significant recreational resources for both local residents and visitors from all over the nation.

Also found in the upper basin (overlapping the two national forests) is the Gathright Wildlife Management Area (WMA), which sustains 20,000 man-days of hunting annually. The area is open to both big and small game, although deer hunting is the primary attraction. Only spring gobbler hunts are permitted in the Gathright WMA since, in the fall, turkeys are trapped for release in other areas. Several private hunt clubs exist in the Gathright project area. From their bases of operation, club members avail themselves of hunting on club lands, the Gathright Wildlife Management Area, and the national forests.

Public access points and facilities in the Gathright WMA are operated by the National Forest Service and consist of one public recreation area with swimming, picnicking, and camping facilities; three other picnic areas; two other camping areas; eight boat-launching ramps at two independent locations; and two scenic overlooks. Future plans call for additional swimming, picnicking, camping, and boat-launching facilities. A log cabin complex, a stable, and several boat docks are planned, assuming private concession interest.

Recreational opportunities in the middle portion of the state are concentrated in the state parks, state forests, wildlife management areas, and local facilities. State forest acreage is concentrated between Richmond and Lynchburg and contains several state parks such as Bear Creek Lake State Park in the Cumberland State Forest. Military facilities such as Fort Pickett have acreage periodically available for hunting and small lakes and ponds for fishing. There are numerous streams flowing through this region which provide fishing and other water recreation opportunities although access is limited in many places.

In the lower portion of the study area, water resources dominate the recreational facilities. As with the middle section of the area, access is limited, particularly for boaters. A state park and two wildlife management areas are located along the southern side of the James River, and there are several local parks providing recreational facilities of various types. There are also several commercial theme parks which are used by visitors to the region as well as local residents.

The Commonwealth of Virginia has formally designated portions of the James as components of the Virginia Scenic River System. The Virginia Scenic River Program began in 1970 with the approval of the Virginia Scenic Rivers Act. The intent of the Scenic Rivers Program is to identify, recognize and provide a level of protection to those rivers whose scenic beauty, history, recreational significance, and natural characteristic make them resources of particular importance.

Three sections of the James totaling 47 miles received official designation. The James was the first to receive official recognition in 1972, when the city of Richmond secured designation of a portion of the James within the city as a historic river. Later, in 1984, the designation was extended through downtown Richmond to its current terminus at Almond Street. At this time, the James was formally declared a State Scenic River. The Historic Falls of the James Scenic River, as it is named, is 8 miles in length.

In 1985, a 14-mile section of the James River in Buchanan County was designated as a scenic river followed by a 25-mile segment between Trees Point and Lawnes Creek in James City and Surry Counties in 1988.

Expected Future Conditions

The James River Basin area will continue to grow in population in the coming decades. This growth will be stimulated in part by continued commercial and industrial development in the region. Housing needs and associated residential development would also be expected to increase. While the efforts of state and local interests will play a significant role in decreasing the further adverse impacts of increased development, the environmental values in the basin are expected to remain significantly below historic benchmarks. National and regional environmental incentives, such as those contained in the 1987 Chesapeake Bay Agreement, will contribute significantly to improving the basin environment, but these programs alone cannot completely restore fish and wildlife habitat lost as a result of the construction of Federal projects. It is also likely that efforts to restore fish passage and stocking, particularly at the state, local, and private levels, will continue to make progress in the restoration of anadromous fishes and their historical habitat. However, depleted stocks and/or decline of upstream habitat of anadromous fishes may prevent the complete restoration to historic population levels.

Water quality is expected to improve in the Chesapeake Bay and its tributaries in the future. Nutrient reduction has been identified as a key bay restoration effort, with the goal of 40 percent reduction of nutrients entering the bay by the year 2000 set in the 1987 Bay Agreement, and reinforced in the 1992 Nutrient Re-evaluation. In August 1992, the Chesapeake Executive Council (the top policy-making body for the Bay cleanup effort) spelled out specific amounts of nutrient reductions for specific regions and individual tributaries, including the James River. The implementation of these tributary-specific strategies began in August 1993. A reduction in nutrients is expected to alleviate low oxygen conditions in the tributaries and the bay in the future.

The populations and habitat of some threatened, or endangered plant and animal species may continue to decline. The rate of this inevitable decay, however, may depend upon the success or failure of Federal regulations protecting them, or on developmental pressures on their habitat.

Changes will continue to take place within the basin. Biological components will continue to diminish, especially in developing areas where adequate water supplies facilitate development, and fluctuating in rural areas depending on local agricultural practices. In some rural areas, forest land will be cleared and converted to crop or pasturelands. Forests will diminish in developing areas. Water quality of some rivers and streams should be better than at present if water quality management plans and water quality regulations are successfully implemented by state and local governments. New treatment facilities should improve water quality in sections where inadequately treated waste waters are causing problems. However, the overall quality in some streams could be lowered slightly as discharges to them are increased.

NATIONAL AND REGIONAL INCENTIVES

Numerous national and regional incentives for fish and wildlife preservation and restoration have been promulgated in the last decade. These include the Environmental Provisions of the Water Resources Development Act of 1986 (WRDA 86, P.L. 99-662); the 1987 Chesapeake Bay Agreement (including the 1992 amendments which expand the focus of the bay cleanup effort to include the estuary's tributaries); the 1988 Chesapeake Bay Preservation Act; the North American Waterfowl Management Plan (1986); and the North American Wetlands Conservation Act of 1989, to mention a few. The provisions of these acts and agreements are expanded on in appendix A.

Wetlands restoration assistance is available in Virginia through the Virginia Department of Game and Inland Fisheries (VDGIF), the Virginia Department of Forestry, the Natural Heritage Program, Virginia Department of Conservation and Recreation (DCR), and the U.S. Department of Interior, Fish and Wildlife Service (FWS).

PROBLEMS, NEEDS, AND OPPORTUNITIES (PROBLEM IDENTIFICATION)

WETLAND LOSS, DEVELOPMENT, AND MANAGEMENT

Because of the general disregard for the value of wetlands as areas of productivity, flood control, and water purification, they have been abused for many centuries. In rural areas many wetlands were drained and/or filled, and cleared for crop production, while in urban areas, they have been cleared for housing, industrial facilities, other buildings, and sanitary landfills.

The most recent information on the status and trends regarding wetlands in the Mid-Atlantic states comes from a joint U.S. Fish and Wildlife Service-U.S. Environmental Protection Agency study, which employed a statistical sampling design to assess changes in wetlands from the mid-1950's to the late 1970's. Current acreage and trends were estimated from this information.

In Virginia, The U.S. Fish and Wildlife Service (1983) estimated that approximately 1,849,000 acres of wetlands existed in the 1780's (approximately 7.1 percent of the total land area). Later estimates by Tiner and Finn (1986) and the Commonwealth of Virginia (1988) estimate remaining wetland acreages at approximately 1,074,613 acres (about 4 percent of the total Virginia land area). This represents a 42 percent decline in the wetland acreage within the Commonwealth of Virginia over that time period. About 72 percent of all wetlands in Virginia are located in the Coastal Plain, 22 percent in the Piedmont area, and 6 percent in the Appalachian Highlands. Within the Chesapeake Bay watershed, approximately 46 percent of the existing wetlands are located in Virginia (Tiner, 1987). Annual average wetland losses in Virginia between 1956 and 1977 were approximately 3,000 acres.

Between 1956 and 1977, over 63,000 acres of Virginia's coastal wetlands and inland vegetated wetlands have been lost, constituting a loss of 6 percent of the total wetlands present in the state in 1956. Historical annual losses for Virginia in the past have averaged about 3,000 acres/year. Inland forested wetlands have suffered the greatest losses of about 9 percent in the last 21 years, while inland vegetated wetlands of the Coastal Plain have experienced losses of about 14 percent in the same time period. Historically, wetland destruction on the Coastal Plain has accounted for 80 percent of the state's inland vegetated wetland losses. Using wetland distribution as a key, wetland losses for the upper James River Basin are estimated at about 77 acres annually.

Direct conversion of wetlands to croplands has been the primary cause of wetland loss historically, while other types of development, especially channelization projects and reservoir construction, constitute most of the remaining losses.

The following sections are excerpts from a report prepared for the Virginia Council on the Environment (currently: Virginia Department of Environmental Quality, Intergovernmental Affairs) entitled "The Assessment of State and Federal Programs that affect Virginia's Nontidal Wetlands (Senate Document No. 9, 1993):

> *"Due to their physical characteristics and their locations in watersheds, nontidal wetlands provide substantial benefits to downstream lands and waters. The most valuable functions performed by nontidal wetlands are their capacity to enhance water quality, their ability to reduce flooding, and the food and habitat they provide for fish, waterfowl, and rare, threatened, and endangered species.*
>
> *"Understanding the types of nontidal wetlands present in a region and the functions they perform is important in balancing wetlands protection with other uses and in targeting management efforts."*

A more complete synopsis of the state's recommendations regarding nontidal wetlands which came out of this report is presented in appendix A.

The U.S. Fish and Wildlife Service estimates that Virginia lost 57,000 acres, or 14 percent of its 800,000 acres, of nontidal vegetated wetlands between 1956 and 1977. Agricultural drainage, mostly in the Coastal Plain, was the largest contributor to the conversion of nontidal wetlands over this period.

FISH AND WILDLIFE HABITAT LOSS

Anadromous Fishery in Virginia

The Chesapeake Bay and its tributaries were once known for their annual runs of migratory fish which traveled inland great distances from the Atlantic Ocean. Early European colonists reported seeing shad and river herring as far up the James River as Covington in Alleghany County. These ecologically important anadromous fish require miles of clean, fresh water to spawn and thrive in. The abundant fish populations had historically supported extensive recreational and commercial fisheries. However, recently, from 1976 to 1985, commercial harvests of these species from the Chesapeake Bay have declined by 82 percent (VDGIF Memo). The commercial harvest of shad, for example, has declined from 11 million pounds per year a century ago to a 1990 commercial harvest of 396,276 pounds in Virginia which was the lowest recorded landing dating back to World War II. The 1991 and 1992 (preliminary) landings are slightly higher. Unfortunately, over-fishing, contamination of nursery grounds, loss of hundreds of miles of historical spawning habitat, and inconsistencies in management actions have all contributed to the downward spiral of migratory fish populations.

A new VMRC regulation in 1991 established a season from 4 February to 30 April 1991 for American shad fisheries, and prohibited the use of more than 3,000 yards of gill net by any single vessel. The 1992 season continued under the same regulations. In December 1992, VMRC reduced Virginia's 1993 American shad season in the Chesapeake Bay and its tributaries to 30 days, March 15 to April 15. The ocean fishery remains unregulated except for the 3,000 yard gill net restriction. A total moratorium on Virginia's American shad fisheries within Chesapeake Bay and its tributaries will go into effect on January 1, 1994.

In the past, several rivers in Virginia provided good spawning habitat for migratory fish as they made their annual runs from the Atlantic Ocean in the spring. Of these rivers, the James River is the longest and largest river in Virginia and historically supported huge migrations of anadromous fish. As shown in table 9, the construction and operation of dams within the mainstem of the James River prior to this century has resulted in the loss of 227 miles or nearly 13,000 acres of historic fish habitat (VA Wildlife). This estimate does not include tributaries and represents lost habitat that would support, based on average river flows, runs of about 1.2 million American shad and 13 million river herring.

Realizing the importance of re-establishing the number of anadromous fish to historic levels, the Virginia General Assembly directed state and local agencies to conduct a feasibility study of fish passage in the Richmond area of the James River through House Joint Resolution 233. As a result, representatives from the VDGIF, the Virginia Institute of Marine Science (VIMS), the Virginia Marine Resources Commission (VMRC), FWS, and the National Marine Fisheries Service (NMFS) formed the James River Fish Passage Facilities Committee. The committee's 1983 report recommended fish passage facilities for the dams in the Richmond area and also stimulated the interest of several legislators and the public for such facilities.

Table 9. FISH MIGRATION BARRIERS IN JAMES RIVER BASIN

River	Dam	Miles from mouth of James River	Federal	Non-federal
James at Richmond	Bosher	113		X
	Williams Island	109		X
James at Lynchburg	Scott's Mill	252		X
	Reusens	256		X
	Holcomb	264		X
	Coleman Falls	266		X
	Big Island	270		X
	Snowden	274		X
	Cushaw	275		X
Appomattox	Harvell	84		X
Rivanna	Woolen Mills	198		
Jackson	Gathright	383	X	

Following the recommendations of the James River Fish Passage Committee, the Tennessee Valley Authority (TVA) was contracted in 1984 to assist in the development of a breach system that would allow fish movement through the two most downstream dams on the James River, Manchester and Brown's Island Dams in Richmond, Virginia (VDGIF Memo). The TVA prepared computer models of several breach configurations and submitted a report in

1986 which provided detailed information on different breaching options. Both dams were initially breached in January of 1989 at a cost of $179,000. Manchester Dam had a 124-foot-wide opening created and Brown's Island Dam had three spillway sections constructed (Va Wildlife). The fish passage modifications opened 6 miles of previously obstructed migratory fish habitat. The next upstream dam, Williams Island Dam, is scheduled to receive a 30-foot notch during the summer or fall of 1993.

Although the breaches are currently being utilized by several anadromous fish species, not all fish species (e.g., alewife and river herring) have been observed upstream of the dams (Garman 1993). This problem was evaluated during the spring of 1993 by Dr. Greg Garman of Virginia Commonwealth University in a field study and report submitted to the Norfolk District, Army Corps of Engineers. Dr. Garman, using radio telemetry, was able to obtain 92 positional fixes on 27 blueback herring over a 3-day period in late April and early May. Several fixes were recognized within 100 meters of Manchester Dam which indicate substantial upstream movement by individual blueback herring. Using statistical and biological data, Dr. Garman has concluded that there are three possible explanations for the lack of river herring beyond the two dams.

First, it is believed that the fish may currently be constrained below Manchester and Brown's Island Dams by intrinsic biological factors. For example, the upstream migration of anadromous fish to specific locations is thought to involve both genetic and behavioral factors. If the dams remained intact and prevented spawning by blueback herring upstream for a substantial period of time, a gradual elimination of fish that historically spawned above the barriers could occur. Consequently, even though the dams were breached in 1989, the river herring may have lost the motivation to swim further upstream. If this is the case, pre-productive herring should be trapped and transported above the existing obstacles in an attempt to revive the desire to swim farther upstream to spawn.

The second hypothesis is related to the physical characteristics of the river herring and their relationship to other anadromous fish which utilized the existing breaches. It has been documented that three larger species of migratory fish, which include American shad, striped bass and sea lamprey, have been collected consistently above Manchester Dam since the breaches were installed. Because these fish are less abundant in the Richmond area than the blueback herring and since American shad are thought to be better physically adapted for structure passage, questions have been raised pertaining to the physical ability of the blueback herring and other smaller migratory fish to successfully take advantage of the existing breaches. Given that the burst speeds attainable by fish are directly proportional to their length, Dr. Garman has concluded that only the larger, hence faster, migrants are able to take advantage of the breaches during the spring flows. Therefore, it is suggested that breach water velocities be reduced to 0.31 to 0.61 meters per second, (maximum acceptable breach velocities for blueback herring) in order to facilitate passage for the species.

Finally, the third possible explanation involves the theory of distributional "straying" by a portion of the blueback herring population. The term straying is used to describe a small segment of the fish population which consists of individuals that do not home to an imprinted location for one reason or another. If straying is a possibility, the intensive sampling performed by Virginia Commonwealth University and Virginia Department of Game and Inland Fisheries above Manchester and Brown's Island Dams since 1989 should have encountered at least some of these strayers. Since biological sampling above the breaches has collected no river herring, Dr. Garman has suggested that the fish are unable to swim farther upstream than Manchester Dam and that further breach modification would be required to correct the problem.

Dr. Garman's recommendations:

> *"Results of the present study showed that the overall degree of upstream migration by 27 anadromous blueback herring within the James River at Richmond was not significant, but did indicate movements by some individuals to a region immediately below the breaches. Whether or not these, or other, blueback herring were prevented by Manchester dam from further movement upstream cannot be determined with certainty, based on the available information. A conclusion concerning breach modification that considers only the telemetry findings would recommend against structural changes, in favor of re-*

establishment tactics such as trap-and-transport of migrating adult river herring.

"However, a judgement based on a wider range of available and pertinent information, some of which was presented above, would support modifications to the present breaches that reduce current velocities to less than approximately 0.6 m/s during the spawning run (March-May). There is a reasonable probability that such modifications would immediately allow passage of some river herring, and a high probability that the changes would, in several years, enhance the passage of blueback herring and/or alewife that result from alternate restoration tactics. In addition, the proposed modifications the Manchester and Brown's Island structures would probably result in greater numbers of American shad at the proposed fish passage facility at Bosher's dam on the James River."

Once the anadromous fish have successfully negotiated the breaches at Manchester/Brown's Island, Hollywood/Belle Island and Williams Island Dams, the fifth and last dam in the Richmond area is Bosher Dam. VDGIF has begun conceptual work on providing fish passage. A matching grant from the U.S. Fish and Wildlife Foundation has spearheaded efforts to fund the facility at Bosher Dam and negotiations continue between VDGIF, the city of Richmond, and other interested parties to make the passage facilities at Williams Island and Bosher Dam a reality. A fish trap is also proposed at Bosher Dam to be used to catch migrating fish and use them for artificial propagation in the state's fish hatcheries.

Scott's Mill Dam, in the city of Lynchburg, is the next upstream impediment to fish passage on the mainstem James River. By constructing a vertical slot fishway or Denil-style fishway at Scott's Mill Dam, the remaining six dams (Reusens, Holcomb Rock, Coleman Falls, Big Island, Snowden and Cushaw) in the Lynchburg area would be required to provide fish passage by FERC licensing requirements. Opening Scotts Mill Dam would, in turn, effectively open the entire mainstem of the James River (450 miles from its origin in West Virginia to the Chesapeake Bay) to the anadromous fishery's historical spawning habitat.

In an effort to help strengthen and/or restore the naturally occurring spawning populations in targeted streams and rivers of Virginia, a fish hatchery in the James River basin has been proposed. Hatchery-reared shad have been used successfully in the past to restock Virginia waters, including the James River. In a recent restocking effort, enough American shad eggs were collected at two different locations in Virginia to produce 150,000 fry. The eggs were transported out of state and raised to fry-size in a Pennsylvania fish hatchery before being brought back to Virginia for release (Richmond Times). State biologists believe that the chances for fry survival in Virginia water would be greatly increased if they were able to utilize a hatchery within the James River Basin. First, they hope to raise some fish to a larger, fingerling size which may help the fry better survive encounters with predators. Second, they would be able to experiment with natural reproduction between selected males and females. Finally, biologists would be able to collect more eggs by improving their collecting techniques, gain experience and plan future restoration needs (Richmond Times).

Construction began in 1992 on a modern, state-of-the-art American shad rearing facility at the VDGIF hatchery in King and Queen County at Stevensville. When completed in the spring of 1994, this facility will begin the hatching and rearing of James River shad eggs destined for restocking in the middle and upper James River. Another possibility to deal with the need for a hatchery would be to retrofit the Harrison Lake Federal hatchery to become a shad hatchery. Compared to constructing a completely new facility, retrofitting could be done relatively inexpensively. Grow-out ponds could be constructed at the facility and shad could be released into the adjacent Herring Creek, which is a tributary of the James River. The fry may also be transported to selected areas above fish passages and return to these same areas to spawn after they reach sexual maturity in 3 to 4 years.

Fish hatchery and fish-passage projects in the basin will promote the restoration of a rapidly declining fishery that is an extremely important commercial industry in the Commonwealth of Virginia. Estimates of potential revenue generated by recreational and commercial shad fishermen alone range from $5 million to $7 million per year (Richmond Times).

Shellfish Decline

Oyster Decline in the Chesapeake Bay

Oyster abundance in Chesapeake Bay is at its lowest level in history. Scientists estimate populations are no more than 1% of historic levels (Barber and Mann, 1991; Meyer, 1991). As shown in table 10, approximately 46,500 market bushels of oysters were harvested in Virginia waters between October 1, 1992 and February 28, 1993. Almost all of these have been taken from the James River. That is almost 50% less than the previous season's harvest and only a fraction of the 4 million bushels taken by watermen in the 1950's (figure 7). This has threatened a way of life for both oystermen and for the bay itself. The continuing decline of the bay's oyster population is a complex problem. Outbreaks of disease epidemics, commercial overharvesting and environmental degradation all have played their roles.

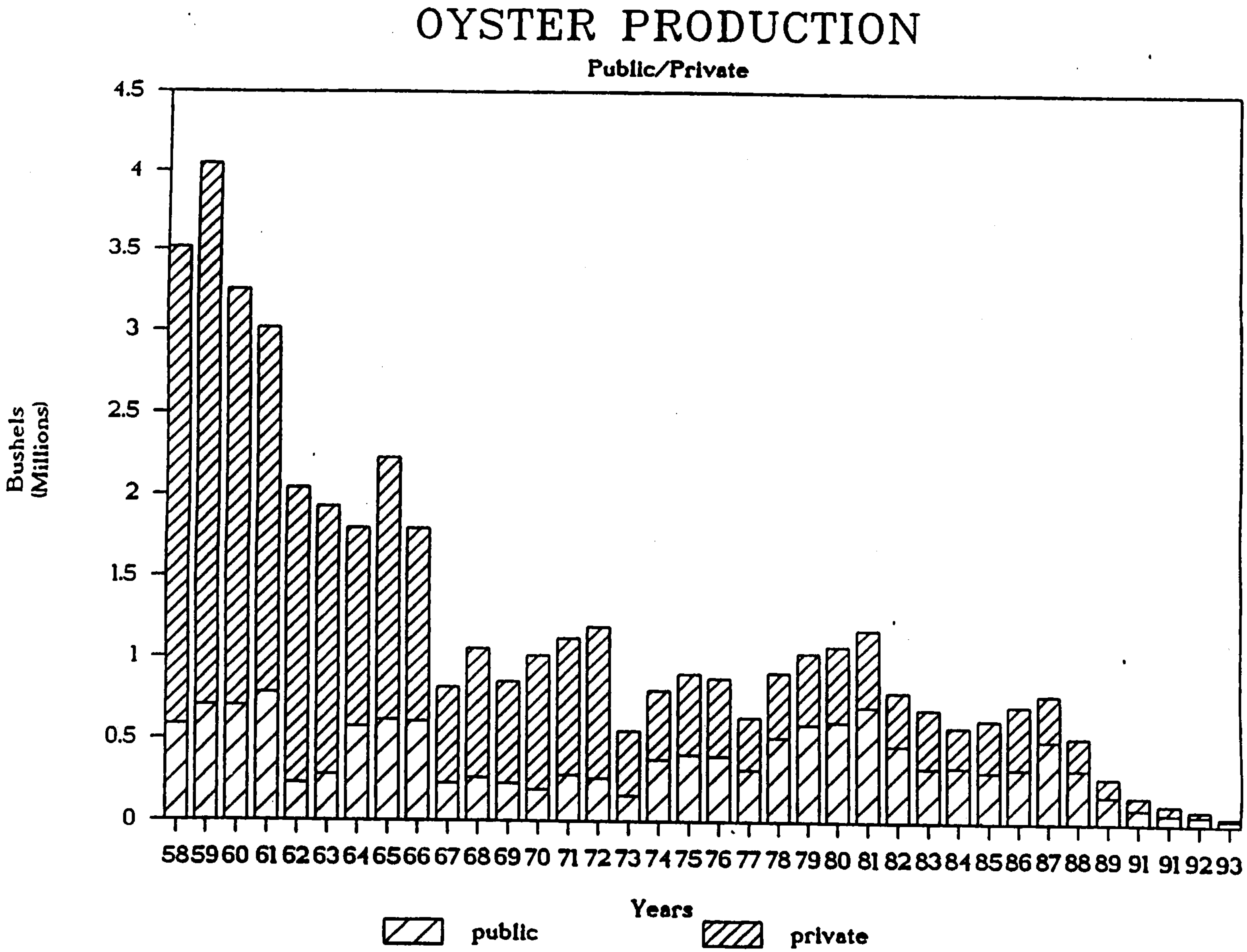
The deadly microorganisms responsible for oyster diseases were first encountered in the bay in the late 1950's; however, scientists, to date, have been unsuccessful in developing a mechanism for immunity or prevention. These organisms are the endoparasite *Haplosporidium nelsoni* responsible for the disease MSX (multinucleated sphere X) and *Perkinsus marinus* or dermo. The loss of oyster populations due to these parasites has been most severe in regions with salinities over 12 parts per thousand (ppt). Only small areas, mostly near the upstream limits of oyster habitat in tributaries such as the James River, now have parasite-free oyster stocks. While MSX cannot survive in salinities below 10 ppt, dermo is more tolerant of lower salinities.

The progressive eutrophication of the bay as a result of point and nonpoint sources of pollution may have detrimentally affected the oyster's ability to fight these diseases. The few disease-free oyster beds in the upper James River are believed currently to be the source of all of Virginia's seed (Hargis, pers. comm.).

Table 10. VIRGINIA'S MARKET OYSTER HARVESTS FROM PUBLIC AND PRIVATE BEDS
(in thousands of bushels)

Year	Public	Private
1960-61	781.8	2,237.7
1965-66	606.0	1,188.6
1970-71	281.0	836.0
1975-76	397.2	475.2
1980-81	704.8	472.5
1985-86	328.3	386.7
1990-91	59.9	52.1
1991-92	53.3	29.1
1992-93 (1)	30.2	16.3

Source: Virginia Marine Resources Commission
(1) Oct - Feb, incomplete figures.



Source: Virginia Marine Resources Commission

Figure 7. Virginia Market-Oyster La[illegible]s for the Harvest Years 1958 through 1993

The decline of oyster populations has significant consequences to both the economic and ecological health of the Chesapeake Bay. Not only have oysters historically been an important commercial resource, but they also play an important role in the bay's natural ability to cleanse itself, or its "resilience." Oysters feed by filtering organic matter out of the water. Historic populations could filter the volume of the bay every 4 days. Now it takes the current population over 1 year to filter that same volume. It is through this process that oysters help in filtering suspended particles out of the water increasing light penetration. Clearer water enhances submerged aquatic vegetation growth as well as other important primary producers in the water column.

The extensive reef systems in existence prior to this century likely had a profound influence on the ecology of the entire Chesapeake Bay (Newell, 1989). The decimation of these traditional "cleaners" has only made the attempt to restore the bay a more difficult task.

Because of this decline, on September 29, 1993, the VMRC voted to restrict harvesting of oysters from October 1 through December 31 for 1993. The season normally continues through March. The total harvest is limited to 6,000 bushels of market oysters in the James River. The restrictions apply to 243,000 acres of public oyster beds in Virginia rivers and the Chesapeake Bay. Beds on the seaside of the Eastern Shore and those that are privately owned are exempted. The commission will review the decision in January 1994.

River and Stream Habitat

Historical Information. The streams and rivers of Virginia are vast, complex ecosystems located throughout the Commonwealth. The majority of the state's streams originate as springs or seepage in higher elevations. In turn, they feed the rivers as the water makes its way to the Chesapeake Bay. Since the first loggers began making their way through the mountains of Virginia in the early 1900's, the stream and river systems have been forced to adjust to changes in their surrounding habitat. Presently, many stream systems in the state have been overburdened beyond their ability to process and react to outside stresses. Many have received excessive amounts of pollutants and have been subjected to considerable amounts of bank and channel erosion.

These stresses are destroying the complex systems by overtaxing aquatic organisms and forcing them to leave their historic habitat.

Stream Characteristics. The characteristics of individual streams may vary tremendously and are largely dependent upon the velocity at which the water travels, temperature of the water, nature of the bottom, and the amount of oxygen and nutrient levels present (Niering, 1989). Cool water streams are typically associated with hilly or mountainous regions, which aerate the waters as they pass over rapids and riffles. However, as these streams adjust to changes in the surrounding topography, they may begin to widen and slow, the waters warm, and their oxygen-holding capacities decrease (Niering, 1989). Similarly, the plant and animal life associated with the stream must also adjust.

Surrounding Habitat. The important relationship between the stream and its surrounding habitat is crucial to the survival of aquatic dependent organisms. For instance, if the vegetation along a cool water stream was removed naturally, or by man, the resulting ecological changes represent dramatic physical and biotic alterations. The lack of plant life will inevitably create a stressful environment for the existing stream inhabitants and force them to make adjustments to their changing surroundings. Bank vegetation provides shade and cover, absorbs minerals in the soil, slows and filters runoff, and prevents bank and channel erosion. Erosion causes the stream to widen, thereby decreasing water depth and water velocity. The loss of deeper pools and reduction of current speeds results in the increase of water temperature which adversely affects cold water fish species such as trout. Furthermore, increased sedimentation rates caused by the eroding shoreline and channel will impact riffle areas in the stream, which are the primary source areas for base food web organisms. Ultimately, the lack of vegetation will cause the stream pH to decrease, while the nutrient and nitrate content in the water may surpass levels which are suitable for human consumption (Niering 1989).

Fish Habitat. Typically, along the course of a mountain stream in Virginia, the water temperature, water acidity, and fish community will change considerably within a short distance (Niering, 1989). As stream conditions change along this gradient, cool and warm water fish species will retreat upstream or downstream to areas which will meet their survival standards. For example, in the head waters of a well-oxygenated stream, a number of brook trout may be found inhabiting the cool waters (less than 65° F). As the water temperature increases slightly from exposure to the sun's rays, a short distance downstream rainbow trout may gradually replace the brook trout. Farther downstream, as the water temperature and acidity continues to increase, the rainbow trout may be joined and/or replaced by a number of fish species which are adapted to warmer waters (above 70° F) such as brown trout, central stoneroller, common shiner, longnose dace, and common sucker (Niering, 1989). This type of fish species variation in a stream occurs along a type of "environmental gradient" and is tremendously dependent on the conditions of the aquatic environment. The fish will remain in a given area as long as the water quality is satisfactory and the stream can provide the minimum standard conditions for the balanced life cycle of each inhabitant (PA Fish Comm.).

Present Conditions. Approximately 460 miles (1500 km) of marginal and extremely marginal trout waters are found in the upper portion of the James River Basin (Lynchburg to headwaters). Short reaches of the Cowpasture and Jackson Rivers support native trout, but practically no other stream in the area is capable of providing the critical conditions throughout the year which are necessary to maintain a naturally healthy trout fishery. Between the city of Covington and the Lake Moomaw reservoir, the Jackson River remains a high-quality trout fishery but agricultural activities and other practices on private lands adjacent to the river are a constant threat to native trout habitat. Stream stocking programs are currently being implemented in an effort to maintain trout populations, but they must be supplemented with attempts to improve the aquatic environment of the fish species living there and the organisms upon which these fish depend for food.

One of the largest contributors to the decline in water quality and trout habitat in the Upper James River system is non-point pollution (Bourgeois Memo, 4/93). Excessive siltation, nutrient loading, and herbicide/pesticide runoff from intensive land development and poor agricultural practices are the primary culprits. Acidic precipitation is also slowly causing the demise in biotic integrity in several streams. Only if the pollutant input has been reduced or sufficiently diluted will the original inhabitants return and the stream is healthy once more (Niering, 1989). Therefore, the restoration of riparian zones along selected upper watersheds will be enormously beneficial to reducing nonpoint pollution into headwaters and streams which can disrupt or reverse downstream recovery efforts within the James River or Chesapeake Bay.

WATER QUALITY

Upper James Basin

Stream Acidification. Burning coal and other fossil fuels releases sulfur dioxide and nitrogen oxide into the atmosphere. Acidic gasses and particulates from smokestacks and tailpipes come back as acidic compounds that eat away at statues and buildings, depress the productivity of croplands and forests, and disrupt the ecology of mountain watersheds. Although unpolluted rainfall is slightly acidic, the acidity of Virginia's precipitation has increased to harmful levels in recent decades, due primarily to increased sulfur and nitrogen emissions from the burning of fossil fuels. Rainfall in Virginia now has an average pH of 4.27, ten times more acidic than normal. Whereas unpolluted environments receive 2-3 pounds of sulfate per acre per year in rainfall, Virginia's Blue Ridge and western highlands currently receive about 25 pounds of sulfate per acre each year, a higher rate of deposition than in the northeastern United States.

VDGIF funded a study to look at the effects of manmade acidic precipitation on Virginia's wild trout streams. The first phase of this Virginia Trout Stream Sensitivity Study (VTSS) was a far-reaching stream sampling effort conducted in the spring of 1987. The study called for taking an initial "snapshot" of the chemistry of Virginia's native trout streams. The study found that 93 percent of the streams monitored were sensitive to acidification; that 49 percent of the streams were extremely sensitive; and that 10 percent of the streams were acidic. These results indicate that most of Virginia's wild trout habitat is vulnerable to acidification.

During 1990, VDGIF biologists also looked into acidification of the St. Mary's River, located in the upper reaches of the James River Basin in Augusta County. The St. Mary's, with wild populations of brook, brown, and rainbow trout, is known as one of Virginia's best trout streams. The VTSS determined that the St. Mary's was a poorly buffered, extremely sensitive stream, one which would undoubtedly suffer severely from acidification. This has indeed been the case. The most significant signs of acidification have been a decline in the population of rainbow trout, the most acid-sensitive trout species, and the near disappearance of blacknose dace in the upper reaches of the river, where stream pH is lowest. Furthermore, the biological diversity of the river is in sharp decline. Acid-sensitive species of mayflies and stoneflies are fast disappearing while acid-resistant species of aquatic insects are thriving. The facts emerging from Virginia's trout streams indicate that acid deposition will, over the next few decades, reduce Virginia's wild trout habitat and threaten the survival of Virginia's remnant wild trout populations.

Pesticides. Although upper James River water quality is considered to be generally good by established Department of Environmental Quality-Water Division (DEQ-WD) parameters, no data has previously been collected in regard to organic and metallic toxins on a regular basis. Although special circumstances have warranted testing for specific toxins in the past, pesticides and other organic toxins were not established as a standard test parameter for DEQ-WD by the EPA until 1991, and no meaningful data in this regard will be available from DEQ-WD until 1995 or 1996 (Fults, 1993).

Sensitivity to a variety of insecticides, including 2,4-D, trichlophon, toxaphene, chlordane, simerizine, and propamocarb, as well as the products of their degradation have been established for the early life stages of both fresh water mussels and a variety of fish species (throughout their life cycles) in the James River Basin. Since the fish vector required to complete the early life stage is not known for most of the fresh water mussels in the basin, (Terwilliger, 1991; Williams, 1993), pesticide effects that decimate fish populations can also indirectly damage the mussel population as well.

In the James River Basin, four species of threatened fresh water mussels (2 of which are endemics) continue to decline, despite the relatively high quality of the water. These declines have historically been associated with habitat losses due to modifications in and near the rivers and streams previously inhabited by these species. Now, however, it is generally agreed that pollutants, including pesticides, play the major role in fresh water mussel declines in the James River Basin (Terwilliger, 1992; Williams, 1993). Agricultural pesticide use in Virginia is shown in table 11.

Table 11. AGRICULTURAL CHARACTERISTICS OF VIRGINIA'S ESTUARIES

Estuary name	Agricultural area	Herbicides	Insecticides	Fungicides	Total
	(%)	(1,000 lbs. per year)			
Chesapeake Bay	**33**	**4,050**	**745**	**46**	**4,841**
Patuxent River	20	116	26	2	144
Potomac River	24	255	61	2	318
Rappahannock River	29	192	42	1	235
York River	25	315	71	1	387
James River	**24**	**371**	**127**	**2**	**500**
Chester River	40	468	53	1	522
Choptank River	52	262	35	3	300
Tangier/Pocomoke Sounds	26	736	106	11	853

Source: *Agricultural Pesticide Use in Coastal Areas: A National Summary*, U.S. Dept. of Commerce, 1992.

Dissolved Metals in Lake Moomaw. When thermal stratification occurs in Lake Moomaw during the summer months, circulation of the water within the water column becomes extremely limited and the hypolimnion becomes depleted in DO. When this occurs, iron and manganese are brought into solution as their oxides in the sediments give up oxygen to the DO-deficient water. By fall, relatively high concentrations of these dissolved metals (DMs) may have built up in the hypolimnion.

Dioxins. A VWCB study (1992) of dioxin contamination in James River fish was initiated following a 1984 EPA study that showed that effluent water from the Westvaco paper mill, Covington, Virginia, contained 180 parts per quadrillion dioxins, placing the Westvaco mill among the top 10 mills in the nationwide 104-mill study. Dioxins were found to be present in the tissues of both sportfish and bottom feeders. Further results of this study are found in appendix A.

Lower James River Basin

From central Richmond downstream to the Hampton Roads Harbor, the primary cause of adverse impacts on water quality are: (1) Richmond combined sewer overflows (CSOs), (2) urban runoff, and (3) wastewater treatment plant discharges to the upper estuary.

CSO and Wastewater. The old (1880's) sewer system which is found in the central area of Richmond results in combined sewer overflows into the James. During dry weather, the combined sewer/stormwater system carries all sewage to the Water Treatment plants (WTPs). However, when runoff due to rainfall events exceeds the capacity of the system, excess runoff and raw sewage are discharged directly into the James River. As of September 1991, their were 36 CSO outfalls along the river downstream from approximately Powhite Parkway Bridge. CSO discharges are located on both sides of the river, and extending as far downstream as Almond Creek, which is in the vicinity of the Richmond wastewater discharge into the tidal portion of the James River. Portions of the James River and estuary that are affected by CSOs have been the subject of intensive study.

A number of CSO-related water quality and modeling studies of the tidal estuary and lower James in Richmond have been sponsored or conducted by the VWCB, the Virginia Institute of Marine Science (VIMS), and the city of Richmond. These studies have culminated in the development of a strategy for the city of Richmond to address its combined sewer overflow problem (city of Richmond, 1986, 1988, 1989, undated).

To some extent the CSO modeling analyses are based on the results of intensive water quality surveys of the James River below Richmond that were sponsored by the VWCB in July 1976 and September 1978. The survey data from these studies indicated regions of dissolved oxygen (DO) depression below Richmond and below Hopewell, and led to the conclusion that DO concentrations in the upper reaches of the James River estuary are predominantly governed by ammonia-N loadings in the Richmond WTP discharge, and to a lesser extent by CSO-related loadings of organic matter that increase biological oxygen demand (BOD).

In the 1982 VWCB wasteload allocation plan for the upper James River (VWCB, 1982a), it was pointed out that (1) the Richmond WTP outfall was located in a very critical point along the James River estuary and the WTP would require upgrading even if the other immediate discharges below the Richmond outfall were eliminated, (2) the effect of low-flow augmentation of the James River flow-by releases approximately 800 c.f.s. (simulated increase from 700-1,500 c.f.s.) from Lake Moomaw would not appreciably change the summer DO profile in the upper James River estuary, and (3) the effect of these flow releases from Lake Moomaw would be negligible in terms of a permitted reduction in the degree of treatment needed for WTP discharges in the Richmond area.

The 1982 Richmond-Crater Interim Water Quality Management Plan (VWCB, 1982b) was based on a water quality modeling study of various management options, including low-flow augmentation due to increased flow releases from Lake Moomaw. These water quality modeling studies showed that a simulated increase in flow from 680 c.f.s. to 1,500 c.f.s. would not appreciably affect water quality (as indicated by DO levels) in the upper James River estuary. This suggests that the relatively small change in James River streamflows due to the Henrico County water supply withdrawal (approximately 53 c.f.s. average daily withdrawal) may not result in a measurable change in water quality (DO levels) within the upper James River estuary.

In the June 1984 VIMS report on benthic oxygen and nutrient fluxes in the upper James River estuary (Cerco, 1984), it is indicated that the predominant source of ammonia-N loadings is the release from channel bottom sediments. Sediment release rates were observed at seven of eight stations, and the largest releases occurred between river miles 100 to 110, immediately downstream of Richmond.

The city of Richmond CSO study addressed both water quality and public health concerns. Water quality evaluations, which built upon the above previous studies, were used to develop the city's CSO management plan. In regard to water quality, the study makes the point that CSO discharges to the upper James River estuary are relatively short-term, intermittent, and variable, and their effects on the DO budget of the James are transient.

In regard to public health, the city study points out that the principle risk is associated with body contact from recreation in the James during and after storm events that cause CSO discharges. This would be of particular concern in the vicinity of the Reedy Creek portion of James River Park, on the south side of the river where CSOs discharge to side channels of the James. Under summer low-flow conditions when these side channels sometimes become isolated and dewatered, there may not be sufficient flow in the river to flush CSO discharges into the mainstem and out of the system. In these cases, CSO discharges with their large loads of carbonaceous material may create a significant aesthetic and public health problem. Under such conditions, it is also possible that in limited areas of the lower James River, these water quality episodes could be detrimental to aquatic biota.

The city of Richmond has formulated a plan to deal with its CSO problems (City of Richmond 1992). The details of this plan are presented in appendix A.

Kepone. From 1966 through 1975, Allied Chemical Company and its subsidiary Life Sciences Products, Inc., produced a persistent chlorinated hydrocarbon insecticide called Kepone. During production, the company discharged Kepone into the James River estuary at Hopewell, Virginia. They released an estimated 200,000 pounds (90,720 kg) of Kepone to the environment through atmospheric emissions, wastewater discharge and disposal of off-specification batches. Kepone contaminated the river from Hopewell to Newport News; scientists found fish adulterated with the substance as far upriver as Richmond (figure 8).

State and Federal agencies initiated environmental monitoring to determine the extent and degree of the Kepone problem and found widespread contamination of the water, sediment, fish, and shellfish. As an extension of the initial study, the Virginia State Water Control Board designed and implemented a long-term monitoring program to evaluate and track the Kepone problem.

With the discovery of widespread Kepone contamination in 1975, the state closed the James River to all finfish and shellfish harvesting. After a thorough review of the initial data, the state permitted catches of shad, herring catfish and female blue crabs. The fishing ban was further modified over the years as scientists gathered additional information. In 1980, the sportfishing ban was lifted. By 1981, commercial fishing resumed for shellfish and all finfish except striped bass. As the information base expanded, the state again placed restrictions on certain fish species. By 1984, it opened the river to most fishing and the restrictions were allowed to expire in 1988 when Kepone levels in all fish remained consistently below the FDA action level.

Kepone levels in the James River sediments have generally decreased since the onset of the monitoring program as a result of the burial and dilution of Kepone-containing sediments by less contaminated sediments. However, the water, sediment, and finfish of the James River are still contaminated with Kepone and scientists do not predict complete cleansing of the river. Fortunately, levels in all areas have decreased and should slowly continue to drop over the years.

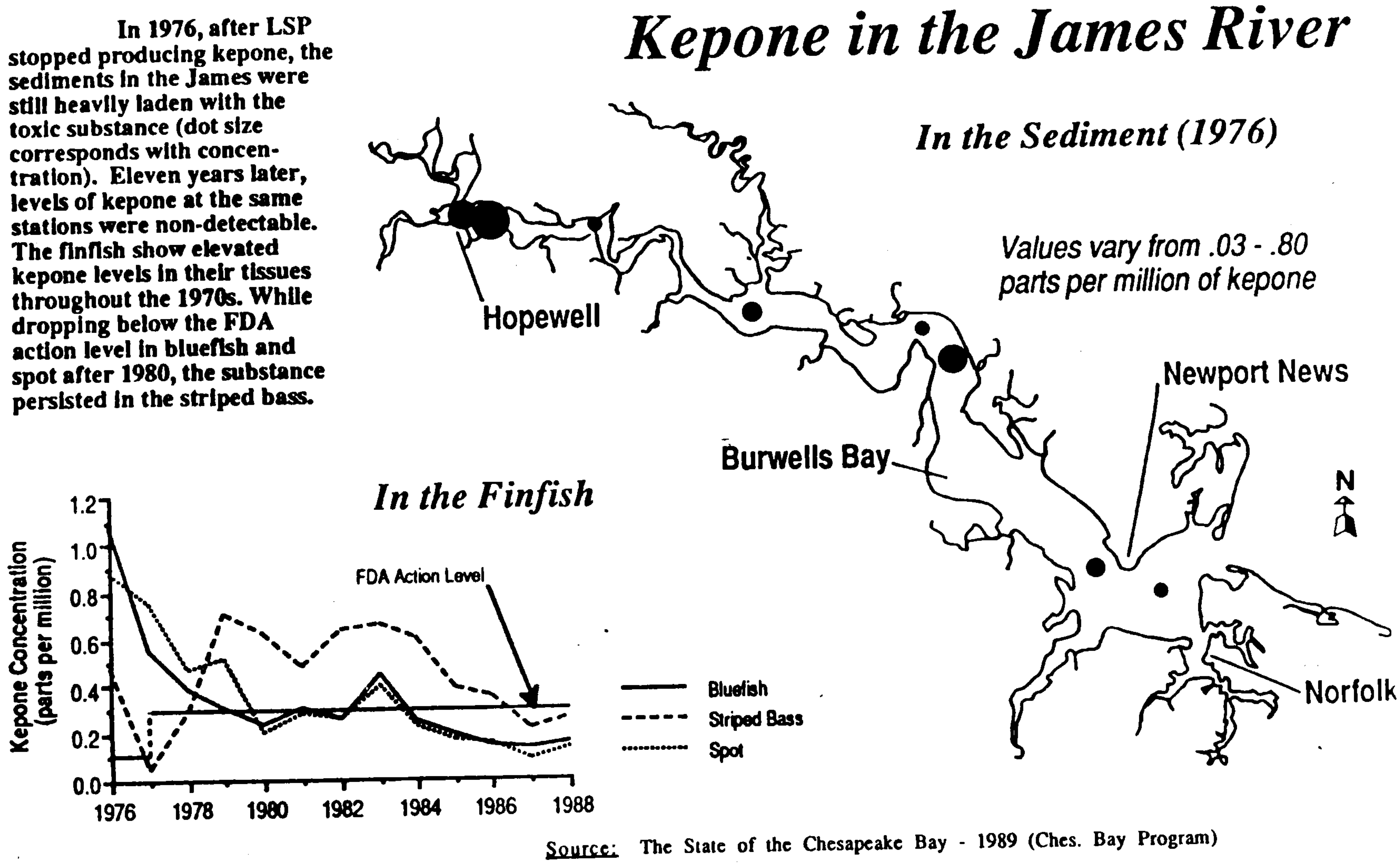


Figure 8. Kepone in the James River

CORPS INDUCED FISH & WILDLIFE HABITAT LOSSES IN THE BASIN

Gathright Dam and Lake Moomaw

The Gathright Dam/Lake Moomaw project is located on the Jackson River, Virginia, which joins the Cowpasture River near Lick Run to form the James River. The dam site is 43.4 miles above the mouth of the Jackson River, and 19 miles above the city of Covington, and is approximately 215 miles southwest of Washington D.C. The reservoir impounds water in both Alleghany and Bath Counties.

The Gathright Dam project was authorized for construction under the flood Control Act of 1946. Construction of the dam was completed in 1979 and the initial filling of Lake Moomaw was completed in 1982. Lake Moomaw, the reservoir created by Gathright Dam, lies in an area of varying topography, ranging from rolling agricultural lands to rugged, undeveloped mountains. In the immediate project vicinity, about 90 percent of the surrounding land is woodland or forest; 10 percent is cropland and pasture. The Gathright project lies within a portion of the George Washington National Forest and is partially surrounded by the T.M. Gathright Wildlife Management Area. This area was a private wildlife preserve for many years, and was purchased in 1958 by the State of Virginia to provide public hunting and habitat for wild turkey production. The multi-purpose project was designed to control floods from 344 square miles of the upper Jackson River drainage area, increase low flows for improvement of the quality of the downstream rivers, and provide opportunity for water-based recreation in and around Lake Moomaw.

The project also produced substantial environmental impacts. Approximately 2,530 acres of wetlands and wildlife habitat were permanently inundated, most of which is part of the Gathright Wildlife Management Area, and up to 630 acres are flooded as necessary to control floods. Furthermore, 12 miles of free-flowing stream habitat were permanently lost as well as 2,000 acres of wildlife habitat lost to the construction of recreational facilities. Therefore, in the case of Gathright Dam/Lake Moomaw, a variety of fish and wildlife restoration opportunities are available which may be directly associated with losses incurred by the Corps project.

Other Corps Projects

A number of other Corps projects have been constructed in the James River Basin. These projects have provided navigation improvement, flood control, shoreline protection and dredged material management areas. The fish and wildlife habitat losses associated with these projects is summarized below.

Summary of Corps Induced Losses:

1. Appomattox River- Navigation

1) River bottom disturbed by dredging: 70 acres

2) Approximately 80 acres of wetlands destroyed to build diversion channel and levee.

References:
- Water Resources Development in Virginia 1991, North Atlantic Division.
- Appomattox River, Virginia Master Plan for Diversion Channel, Norfolk District, Aug. 1958.

2. Deep Creek, Newport News- Navigation

1) River bottom disturbed by dredging: 42 acres

2) Acreage affected by dredged material placement:

- Marsh - 87 acres
- Upland - 23 acres
- River bottom and tidal flats - 30 acres

References:
- Reconnaissance Report on Disposal Area Study, Norfolk District, May 1979.
- Deep Creek, Newport News, Virginia, Disposal Site Study, USF&WS Planning Aid Report, Gloucester Point Office, Feb 1979.
- Environmental Assessment, Deep Creek, Newport News, Virginia, Proposed Small Navigation Project, Norfolk District, Oct 1978.
- Draft Environmental Impact Statement, Maintenance Dredging at Deep Creek, Norfolk District, approx. 1974

3. Gathright Dam and Lake Moomaw- Flood Control

1) Loss of 2,530 acres of wetlands and wildlife habitat to permanent inundation.

2) Loss of 12 miles of free-flowing stream habitat.

3) Loss of 2,000 acres of wildlife habitat used for recreational facilities.

References:
- Final Environmental Impact Statement, Gathright Lake, Virginia, Jan 1973.
- Supplement to Final Environmental Impact Statement, Gathright Lake, Virginia, May 1973.

4. James River Channel- Navigation

1) River bottom disturbed by dredging: 950 acres

2) Temporary and permanent loss of wetlands from dredged material placement: 1,200 acres

3) Open water areas affected by overboard placement of dredged material: 7,900 acres

4) Mechanical damage to 65 acres of oyster beds during dredging in the lower reaches of the James.

References:
- Improvement of Navigation Channel, Design Memorandum No. 1, Project Economics and Formulation, Norfolk District, Apr 72.
- Final Report on Results of Operation James River, VIMS report, Hargis, Dec 66.
- Waterways Experiment Station (WES) report, Sep 66.
- Public Notice 72, Maintenance Dredging-Harbor, Deepwater Terminal and Two Shoals between Deepwater Terminal and Hopewell, 3 Jul 80.
- Final Environmental Impact Statement, James River, Virginia, Maintenance Dredging, 20 February 1974.
- F&WS Report, "A Preliminary Report on the Considered Navigation Channel Improvements, James River, Virginia, in Relation to Fish and Wildlife Resources," Region 4, Atlanta, 1958.

5. Jamestown Island Seawall- Emergency Rehabilitation

Loss of less than one acre of benthic habitat in shallow water intertidal zone due to fill to repair seawall.

References:
- Jamestown Island, Emergency Seawall Failure, Investigation Report, Norfolk District, Aug 82.

6. Nansemond River (Western Branch) - Navigation

1) River bottom disturbed by dredging: 250 acres

2) Areas of dredged material placement in wetlands: 14 acres

References:
- Nansemond River, Environmental Assessment, Maintenance Dredging, Norfolk District, Mar 76.

7. Newmarket Creek- Flood Control

Due to previously existing improvements to Newmarket Creek and construction of Government Ditch by local interests, the project did not adversely impact fish and wildlife habitat to any significant degree.

References:
- Detailed Project Report (revised), Newmarket Creek, Newport News and Hampton, Virginia, Norfolk District, 24 Mar 65.

8. Pagan River- Navigation

River bottom disturbed by dredging: 65 acres

References:
- Water Resources Development in Virginia 1991, North Atlantic Division.

9. Richmond- Flood Control

Loss of slightly over 1 acre of aquatic, river bottom habitat under the south side wall

References:
- Final Environmental Impact Statement, Flood Protection Measures at Richmond, Virginia, Office of the Chief of Engineers, Nov 75.

10. Scottsville- Flood Control

Because the ground was already disturbed by non-Corps activity, there were no permanent habitat losses from construction. Both the borrow site and disturbed areas around the project site were replanted.

References:
- Scottsville Flood Control, Expanded Reconnaissance Report, Norfolk District, May 84.

11. Skiffes Creek, Fort Eustis, Virginia- Navigation

1) River bottom disturbed by dredging: 70 acres

2) Temporary or permanent loss of up to 25 acres of tidal and non-tidal wetlands for dredged material placement.

References:
- Final Environmental Impact Statement, James River, Virginia, Maintenance Dredging, Norfolk District, 20 February 1974.
- Environmental Assessment, Maintenance Dredging, Skiffes Creek, Fort Eustis, Virginia, Norfolk District, Aug 88.

12. Tylers Beach, Isle of Wight County, VA- Navigation (jetties)

1) Loss of approximately 1/2 acre of benthic habitat, offset by gain of different habitat on vertical structure of the jetties.

References:
- Detailed Project Study and Environmental Assessment, Tyler's Beach, Norfolk District, Dec 89.
- Detailed Project Study and Environmental Assessment on Navigational Difficulties at Tyler's Beach, Isle of Wight County, Virginia, Norfolk District, Mar 81.
- Water Quality Monitoring Program for the Tyler's Beach Federal Navigation Channel, Isle of Wight County, Virginia, Norfolk District, August 1982.

13. Tylers Beach, Isle of Wight County, VA- Navigation (channel)

1) River bottom disturbed by dredging: 4 acres

2) Placement of dredged material destroyed approximately 1 acre of wetlands and removed the connection of a further 36 acres of wetlands to the James River. The project also impacted intertidal flats, but the amount was not quantified.

3) Overboard placement in Burwell's Bay may have impacted the adjacent oyster beds and anadromous fish migration through siltation and resuspension of Kepone. Anticipated effects were relatively small, since the plume stayed within the 21-foot depth contour and Kepone levels in the sediments have been decreasing.

References:
- Detailed Project Study and Environmental Assessment, Tyler's Beach, Norfolk District, Dec 89.

- Water Quality Monitoring Program for the Tyler's Beach Federal Navigation Channel, Isle of Wight County, Virginia, Norfolk District, August 1982.
- Tyler's Beach, Virginia, An Inventory of Environmental Quality and Resources, Hayes, Seay, Mattern and Mattern, no date (approx. 1979).

14. Craney Island Dredged Material Management Area

Loss of approximately 2,500 acres of wetland, benthic, and shallow water habitat. In the mid-1950's the Corps constructed the 2,500-acre Craney Island Disposal Area to contain dredged material from the Federal channels within Hamptons Roads and the Elizabeth River, as well as material from private dredging projects. Craney Island was created from shallow estuarine habitat in Hampton Roads and includes an open water rehandling basin immediately to the east of the site.

References:
-Norfolk Harbor & Channels, Virginia, Long-Term Dredged Material Management (Inner Harbor) Information Report, Appendix E, 1990.
- General Design Memorandum on Craney Island Disposal Area, Norfolk Harbor, Virginia, 1953.

15. Craney Island Dredged Material Management Area Perimeter Dike Stabilization

Disturbance of approx. 675 acres of subaqueous bottom with approx. 42 acres of subaqueous bottom changed to terrestrial habitat (i.e., above m.h.w.) and 26 acres of subaqueous bottom changed to intertidal habitat.

References:
- Environmental Assessment, Craney Island Disposal Area Perimeter Dike Stabilization, 1987.
- Meeting Notes: 12 March 1987, F&WS Coordination Act Meeting between Corps, F&WS, and NMFS.

Table 12 summarizes these losses.

Table 12. SUMMARY OF CORPS-INDUCED FISH AND WILDLIFE HABITAT LOSSES IN THE JAMES RIVER BASIN

Type of loss	Corps project(s)	Area impacted
River Bottom (dredging)	Appomattox River, Deep Creek, James River, Nansemond River, Pagan River, Skiffes Creek, Tyler's Beach	1,450 acres
Overboard Placement	James River	7,900 acres
Wetlands	Appomattox River, Deep Creek, James River, Nansemond River, Skiffes Creek, Tylers Beach, Gathright Dam/Lake Moomaw	1,500 acres
Trout Stream	Gathright Dam/Lake Moomaw	12 miles
Wildlife Habitat (Developed)	Gathright Dam/Lake Moomaw	2,000 acres
Mechanical Damage to Oyster Beds	James River	65 acres
Shallow Water	Craney Island Dredged Material Mgmt. Area	2,570 acres
Wildlife Habitat (Inundated)	Gathright Dam/Lake Moomaw	2,460 acres

PLAN FORMULATION

The purpose of this section is to provide both the background on the criteria used in the formulation process and a logical presentation of the procedures followed from the identification of the study objectives to the designation of the final array of plans. The formulation process involved the evaluation of alternative measures for resolving the problems and fulfilling the fish and wildlife restoration needs that have been identified in the study area. These alternatives were screened to arrive at an array of plans that best responds to the problems and needs of the area. Plans were formulated with due regard for all pertinent benefits and costs, both tangible and intangible.

FEDERAL OBJECTIVE

The traditional Federal objective of water and related land resources project planning is to contribute to national economic development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. This objective was established by the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies published on March 10, 1983.

The Federal objective of environmental restoration, however, as defined by Corps of Engineers regulations, is the production of environmental quality outputs. Unlike traditional civil works water resources projects mentioned above, environmental restoration projects are not measured by the contribution to NED. A comparison of environmental quality outputs and the cost of project alternatives through the use of incremental analysis techniques provides a means to evaluate project benefits.

Restoration is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance. In restoration, ecological damage to the resource is repaired.

Fish and wildlife restoration consists of measures undertaken to return fish and wildlife habitat resources to a modern historic condition. The goal of fish and wildlife restoration is to reverse the adverse impacts of human activity and restore habitats to previous levels of productivity but not a higher level than would have existed under natural conditions in the absence of human activity or disturbance.

Fish and wildlife restoration activities may be recommended as Corps projects only if justified and (1) if a Civil Works project has contributed to the degradation (the degradation was caused at least in part by a Corps project) or (2) restoration can be most cost effectively accomplished through modification of an existing Civil Works project (modification of an existing Corps project is an essential element of the restoration). Fish and wildlife restoration measures at new projects must address degradation caused at least in part by an existing Corps project. Under current guidance, this means that if there is not an existing Corps project adversely impacting the study area, there is no opportunity for Corps participation in fish and wildlife restoration.

Restoration activities can be undertaken at an existing Corps project site to remediate its impact, or alternative measures can be identified elsewhere if they result in greater environmental output or efficiency. Conversely, the Federal objective would also be satisfied if a Corps project did not contribute to an environmental loss, but modifications of an existing Corps project would result in greater environmental output or efficiency.

Restoration measures must address significant resources and be justified through a determination that the combined monetary and non-monetary value of the last increment of benefits or losses prevented or replaced exceeds the combined monetary and non-monetary cost of the last added increment of the fish and wildlife restoration measure. The least cost alternative does not of itself provide justification and may not maximize the net environmental benefits.

Fish and wildlife restoration measures may be studied as part of a cost shared (50-50) feasibility study undertaken to identify a water resource project and such measures may be recommended for authorization.

The following policy guidelines (Memorandum, CECW-PA, 7 March 1991, subject: Policy Guidance Letter No. 24, Restoration of Fish and Wildlife Habitat Resources) should be followed when recommending a fish and wildlife restoration proposal for authorization.

(1) Fish and wildlife restoration measures at an existing project could address adverse fish and wildlife impacts of that project. However, any fish and

wildlife restoration measures found to be justified at existing projects must be cost shared as fish and wildlife restoration not mitigation.

(2) An existing project could be modified to add fish and wildlife restoration measures where degradation was not contributed to by the Corps project as long as the resource is not restored beyond modern historic conditions.

(3) Proposals for fish and wildlife restoration (non 1135 (b) proposals) at existing projects may include land acquisition. In those cases, the authorizing document will provide that lands, easements, rights-of-way, relocations, and disposal (LERRD) for fish and wildlife restoration will be provided by the non-Federal sponsor with the value of the LERRD credited against the non-Federal 25% share. Where the value of LERRD exceeds the non-Federal sponsor's 25% share, the sponsor will be reimbursed for the value of LERRD exceeding the 25% non-Federal share.

(4) Operations, maintenance, repair, rehabilitation and replacement (OMRRR) for fish and wildlife restoration measures at existing projects should be accomplished by the non-Federal sponsor at 100% non-Federal cost.

PLANNING OBJECTIVES

The Federal objective of water and related land resources planning is to contribute to NED consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.

In a statement dated June 25, 1990, the Assistant Secretary of the Army for Civil Works directed the Corps of Engineers to utilize new approaches to implement the President's goal of maintaining and restoring the health of the environment. One of the suggested ways to achieve this objective is to use

Federal funds to restore environmental values to modern historic levels where a Federal project has contributed to their degradation.

Environmental quality (EQ) outputs are produced by the restoration of fisheries and fisheries habitat, riparian habitat, wetlands, water quality, and upland wildlife. Systematic planning to provide these outputs can best be achieved if the outputs are precisely defined. However, it is recognized that often many of these types of output are not readily quantifiable in monetary terms and measurement will have to be based on need, least cost, and qualitative analysis. The proposed projects will also produce NED benefits which will be quantified.

APPROACH

To the extent practical, environmental quality (EQ) outputs will be expressed in quantitative units preferably in terms of habitat. Outputs will be defined with reference to specific species which are representative of a specific habitat type and quality. Project output measurements and justification will be based on the significance and scarcity of the resources produced and/or protected. Significance will be determined based on legal and/or institutional recognition, scientific importance, and public recognition. The analysis will be based, as much as possible, on existing information available from past reports, aerial photographs, USGS quadrangle maps, published and unpublished literature, and various other data sources.

The NED outputs of the proposed EQ projects will also be evaluated where applicable. Habitat restoration benefits can also be quantified to some extent. For example, wetlands restoration contributes to NED outputs such as water quality improvements, retention of floodwaters and stormwaters, and erosion control. The cost of wetlands restoration to accomplish the same purpose may be used as a measure of wetlands benefits. Removal of fish migration barriers in the James River Basin will open hundreds of miles of historic spawning grounds to anadromous fisheries. It is anticipated that this would, in turn, revitalize the recreational and commercial fishery for these species, producing NED benefits which can be quantified.

The specific objective of this report is to determine the feasibility of restoring fish and wildlife habitat destroyed or degraded as a result of the construction or operation of any COE projects within the James River Basin.

PLANNING CONSTRAINTS

Planning constraints are any consideration that has the capacity to restrict or otherwise impact the planning process. Typical constraints include existing laws, policies, regulations, and the authorizing document; state-of-the-art technology; money; and time.

More specific constraints include the following:

a. This is the first or reconnaissance phase of a feasibility study. A total of 12 months was allowed from study initiation to submission of the final reconnaissance report to higher headquarters for review. This limits the extent of investigation possible. Therefore, analyses will be based largely on existing data with only limited field work possible.

b. As also dictated by Corps regulations, the purpose of the reconnaissance study is to determine if there is at least one potential solution likely to have Federal interest and local support. Therefore, while a broad range of fish and wildlife restoration measures may be considered, some obviously infeasible measures may be screened out in the early stages of the study, based on limited analysis. This leaves more time to concentrate on the more promising measures. This is especially the case in this study given the size of the study area and the complex variety of restoration opportunities available. A more detailed analysis is conducted in the next phase of study, the feasibility phase, wherein a plan is developed which maximizes the benefits in economics, engineering, and the environment as defined by Corps criteria.

c. In addition, if at least one potential solution is found in the reconnaissance phase, the Corps and the local sponsor execute a Feasibility Cost-Sharing Agreement (FCSA) for the feasibility phase of study. At this time, the local sponsor is informed of funding responsibilities for the detailed planning phase and has a preliminary estimate of its share of the construction cost. Under Public Law 99-662, the feasibility phase of study would be cost shared on a 50/50 basis between the Federal Government and the local sponsor. The local sponsor would be responsible for a minimum of 25 percent of the total project construction costs. The local sponsor's maximum funding commitment would depend on land, easement, right-of-way, and relocation costs, which are totally a non-Federal responsibility.

d. Several studies have already been done in the study area as discussed in the "Introduction" section. The findings of those studies may influence the conduct of this investigation.

e. Some of the measures considered span more than one jurisdiction and/or affect areas outside the immediate project location. Any impacts resulting from feasible plans developed in this study must be identified and thoroughly coordinated with those areas affected.

f. Document the historical plan and purpose of previous modifications to the James River Basin.

g. Determine impact of previous Corps of Engineers and other actions in view of present understanding of terrestrial and aquatic ecology, and propose measures to restore environmental values while maintaining original project purposes. The study considers only those fish and wildlife restoration activities for which: (1) a Civil Works project has contributed to the degradation or (2) restoration can be most cost effectively accomplished through modification of an existing Civil Works project.

h. Appropriate measures must be taken to ensure that any resulting project is consistent with local, regional, and state land use plans, and that the necessary environmental permits/certificates and approvals are obtained.

i. Any project resulting from this study must comply with the policies of Federal and state agencies having regulatory jurisdiction.

FORMULATION AND EVALUATION CRITERIA

The formulation and evaluation of a final array of plans, including the screening of alternatives, must be within the context of an appropriate set of formulation and evaluation criteria. Such criteria--technical, economic, environmental, social, cultural, institutional, and intangible considerations--permit the development and selection of a final array of plans which best respond to the problems and needs of the study area and are justifiable.

Technical Criteria

The criteria specified in all applicable Corps guidance related to environmental restoration were used to evaluate project features. For example, EM 1110-2-5026 (June 1987), "Beneficial Uses of Dredged Material" provides guidance for planning, designing, developing, and managing dredged material for beneficial uses, including fish and wildlife habitat enhancement and restoration.

Economic Criteria

Unlike traditional civil works resources projects, environmental restoration projects are not measured by the contribution to NED. A comparison of environmental quality outputs and the cost of project alternatives through the use of incremental cost analysis techniques provides a means to evaluate project benefits.

Restoration of fish and wildlife habitat may be undertaken once it has been established that an existing Corps project has caused or contributed to the decline of environmental resources. Restoration actions can be undertaken at an existing Corps project site to remediate its impact, or alternative measures can be identified elsewhere if they result in greater environmental output or efficiency. Conversely, the Federal objective would also be satisfied if a Corps project did not contribute to an environmental loss, but modifications of an existing Corps project would result in greater environmental output or efficiency.

Environmental Criteria

The following criteria within the foregoing framework were selected to assist in the formulation and evaluation of plans relative to their contributions to environmental quality.

a. Plans are formulated in a manner to maximize the beneficial and minimize the adverse effects of the project on:

(1) Manmade resources

(2) Natural resources

(3) Air

(4) Water

(5) Land

b. Plans avoid detrimental environmental effects to the extent feasible.

c. Unavoidable adverse environmental impacts are fully noted, quantified when possible, and qualified in any case to facilitate a knowledgeable decision-making process.

Social and Cultural Criteria

With regard to social and cultural effects, the following criteria were considered in the formulation and evaluation process.

a. Plans minimize and, if possible, avoid destruction or disruption of community cohesion, injurious displacement of people, and disruption of desirable community growth.

b. Plans do not significantly increase noise pollution during construction or create conditions that will tend to raise the overall noise level of the area over the project life.

c. Consideration is given to protection of historical, archaeological, and other public interest areas.

Institutional Criteria

Institutional feasibility involves the ability and willingness of existing political and social institutions to fulfill the necessary requirements to transform the various plans into realities. Local assurances must be obtainable, and so must the necessary permits, approvals, and endorsements.

EVALUATION OF ALTERNATIVE SOLUTIONS

As outlined in the previous paragraphs, there are a variety of fish and wildlife habitat-related problems and needs in the James River Basin. These include wetlands and riparian habitat loss/degradation; anadromous fishery decline; river and stream habitat alteration/degradation; and degraded water quality from point and non-point discharges. Adverse impacts from Corps projects within the basin have contributed to this decline.

The purpose of this portion of the report is to describe specific fish and wildlife restoration measures which were identified as possible solutions to the problems and needs of the study area. Also, as discussed in the previous section under problems and needs of the basin, restoration measures are categorized by habitat type - wetland, fisheries, stream, and terrestrial habitat restoration recommendations. Because of the different types of fish and wildlife habitat restoration projects available in the Gathright Dam and Lake Moomaw project area, a separate category was identified for habitat restoration projects within this area.

SCREENING OF ALTERNATIVES

Coordination with various environmental resource agencies such as the U.S. Fish and Wildlife Service, U.S. Forest Service, Virginia Department of Game and Inland Fisheries, Virginia Marine Resources Commission, and a variety of other state agencies was undertaken in order to identify potential restoration projects in the basin (see "Coordination with Others" section of this report). The results of these efforts are shown in table 13 (Fish and Wildlife Restoration Identification Matrix). Potential restoration projects were screened to determine which plans were in the Federal interest and could provide benefits of priority to the non-Federal sponsor.

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
1. Gathright Dam/Lake Moomaw Fisheries/Habitat Restoration	Construction of Gathright Dam and Lake Moomaw inundated shallow water aquatic habitat used by fish species for shelter, spawning and for providing food for waterfowl, otters, minks and bald eagles.	Losses are directly linked to the Corps Civil Works project at Gathright Dam/Lake Moomaw. Project would introduce aquatic structures and wetlands in Lake Moomaw to enhance fish habitat.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $62,500
2. Gathright Dam/Lake Moomaw Waterfowl Habitat Restoration	Inundation of wetlands by the construction of Gathright Dam and Lake Moomaw destroyed waterfowl habitat.	Losses are directly linked to the Corps Civil Works project at Gathright Dam/Lake Moomaw. Project would enhance existing nesting islands and create new islands; create a shallow water wetland impoundment; and establish grazing meadows.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $85,000
3. Gathright Dam/Lake Moomaw Endangered Species	Numerous caves along the Jackson River, inhabited by the Federally listed endangered Indiana Bat and other bat species, were inundated following construction of Gathright Dam/Lake Moomaw. Remaining caves are subject to human disturbances.	Losses are directly linked to the Corps Civil Works project at Gathright Dam/Lake Moomaw. Project would construct gates to reduce human access to the remaining bat caves.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $15,000

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX (cont'd)

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
4. Gathright Dam/Lake Moomaw Bank/Soil Stabilization	The shoreline along Lake Moomaw is susceptible to erosion due to annual drawdown. This erosion causes increased sedimentation in the lake and reduces habitat quality for wildlife and fish species.	Losses are directly linked to the Corps Civil Works project at Gathright Dam/Lake Moomaw. Project would establish emergent vegetation on suitable areas and place riprap on steep slopes.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $500,000
5. Gathright Dam/Lake Moomaw Herbaceous Habitat Restoration and Preservation	Construction of Gathright Dam and Lake Moomaw inundated or otherwise impacted ~4,500 acres of wildlife habitat.	Losses are directly linked to the Corps Civil Works project at Gathright Dam/Lake Moomaw. Project would restore existing herbaceous wildlife habitat by creating wildlife openings and acquiring land to restore and preserve as herbaceous habitat.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $125,000
6. George Washington National Forest - Wetland Creation and Restoration	Wetland losses in the James River Basin, due to intensive land development and poor agricultural practices. Wetland habitat for waterfowl is now limited in western Virginia.	Various Corps dredging projects along the James River and its tributaries have destroyed wetlands, particularly from dredged material placement. Project would construct shallow water impoundments and may include seeding/planting of emergent vegetation.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $312,500

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX (cont'd)

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
7. Amelia WMA Wetland Creation and Restoration	Wetland losses in the James River Basin, due to intensive land development and poor agricultural practices.	Various Corps dredging projects along the James River and its tributaries have destroyed wetlands, particularly from dredged material placement. Project would construct shallow water impoundments to restore wetland habitat in the state owned/managed WMA.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $31,300
8. James River WMA Wetland Creation and Restoration	Wetland losses in the James River Basin, due to intensive land development and poor agricultural practices.	Various Corps dredging projects along the James River and its tributaries have destroyed wetlands, particularly from dredged material placement. Project would construct shallow water impoundments to restore two wetland areas in the state owned/managed WMA.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $62,500
9. Hardware River WMA Wetland Creation and Restoration	Wetland losses in the James River Basin, due to intensive land development and poor agricultural practices.	Various Corps dredging projects along the James River and its tributaries have destroyed wetlands, particularly from dredged material placement. Project would construct shallow water impoundments to restore a wetland area in the state owned/managed WMA.	WRDA Section 1135 project will be developed, subject to available funding. Estimated project cost: $37,500

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX (cont'd)

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
10. Terrestrial Habitat Woodcock Habitat Restoration (George Washington National Forest and Gathright, Highland, Goshen, and Little North Mountain WMAs).	Decline of American Woodcocks due to loss of early successional habitat, particularly wooded upland and wooded riparian areas.	Losses can be linked to Corps Gathright Dam project. Project would create/maintain upland herbaceous habitat, with trees/shrubs planted near edges to establish cover. Riparian areas would be fenced from cattle and planted to enhance woodcock habitat.	Project may possibly be funded under Section 1135 or by other Corps/Federal authorities. Estimated project cost: $250,000
11. Endangered Mussel Species Stream Habitat Restoration (Rivanna River)	Populations of fresh water mussels have decreased in the James River Basin, including endangered James River Spiny mussel. This decrease is due to reduced water quality caused by human activities.	Losses cannot be linked to any Corps civil works project. Project would replant riparian vegetation, develop a storm water filtering system, fence streams from livestock, and develop alternative water sources for livestock.	Project cannot be funded under Section 1135 but may be funded by other Corps/Federal authorities. Estimated project cost: $80,000
12. Anadromous Fish Dam Breach Modifications	Dams along the James River have obstructed fish passage for anadromous fish species. The Manchester and Browns Island Dams were breached to allow fish passage, but not all fish species can use these breaches, because of the high water velocities.	Anadromous fish habitat losses w Corps Gathright Dam project. Project would include enlarging both breaches in order to reduce breach water velocities.	Project may possibly be funded under Section 1135 or by other Corps/Federal authorities. Estimated project cost: $150,000

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX (cont'd)

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
13. Bosher Dam Anadromous Fish Fish Trap	Dams along the James River have obstructed fish passage for anadromous fish species. Bosher Dam blocks 140 miles of former upstream spawning habitat between Richmond and Lynchburg.	Anadromous fish habitat losses w Corps Gathright Dam project. Project would include construction of a vertical slot fishway at Bosher Dam. A fish trap would be constructed at the inlet or outlet of the fishway.	Project may possibly be funded under Section 1135 or by other Corps/Federal authorities. Estimated project cost: $50,000
14. Scott's Mill Dam Anadromous Fish Fish Passage	Dams along the James River have obstructed fish passage for anadromous fish species. Scott's Mill Dam blocks 4 miles of upstream habitat in the Lynchburg area. If fish passage is provided at Scott's Mill, then other upstream dams in the Lynchburg area will be required to provide passage.	Anadromous fish habitat losses w Corps Gathright Dam project. Project would include construction of a vertical slot fishway or Denil-style fishway at Scott's Mill Dam.	Project may possibly be funded under Section 1135 or by other Corps/Federal authorities. Estimated project cost: $200,000
15. Harrison Lake Anadromous Fish Shad Hatchery	Populations of anadromous fish species have rapidly declined in the James River Basin. Some species, such as the American shad, are rarely found in their historical range. These species were once the basis of an important commercial fishery.	Anadromous fish habitat losses w Corps Gathright Dam project. Project would include retrofitting an existing hatchery to handle shad for restocking the James River basin.	Project may possibly be funded under Section 1135 or by other Corps/Federal authorities. Estimated project cost: $200,000

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX (cont'd)

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
16. Bank/Soil Stabilization Stream Habitat Restoration	Increased rates of sedimentation and siltation have reduced water quality and degraded aquatic habitat in the James River Basin. This adversely affects habitat for some threatened and endangered mussel species. Livestock, especially cattle, cause severe bank erosion and increased stream turbidity.	Losses cannot be linked to any Corps civil works project. Project would include fencing of streams to reduce livestock access, replanting of riparian vegetation, placement of low water bridges, and placement of riprap along stream corridors.	Project cannot be funded under Section 1135 but may be funded by other Federal programs. Estimated project cost: $1,000,000
17. Acid Rain Mitigation Stream Habitat Restoration Saint Mary's River	Increasing acidification of the St. Mary's River, from the input of acid rain, has extirpated the rainbow and brown trout species and stressed the native brook trout in the river.	Losses cannot be linked to any Corps civil works project. Project would increase pH (lower acidification) by placing limestone sand in the river.	Project cannot be funded under Section 1135 but may be funded by other Federal programs. Estimated project cost: $100,000
18. Trout Stream Structures Stream Habitat Restoration	Construction of Gathright Dam and Lake Moomaw resulted in the loss of 12 miles of trout stream habitat.	Losses are directly linked to the Corps Civil Works project at Gathright Dam/Lake Moomaw. Project would include placement of natural or natural-appearing structures such as deflectors in streams in various locations in the upper James River basin to improve and restore trout habitat.	Proposal for Section 1135 project will be developed, subject to available funding. Estimated project cost: $200,000

TABLE 13. FISH AND WILDLIFE RESTORATION IDENTIFICATION MATRIX (cont'd)

Fish and Wildlife Restoration Initiative	Problem Identification	Comments	Conclusions
19. Trout Hatchery Pond Renovation - Coursey Springs (Cowpasture River)	Populations of trout species have declined drastically in the James River Basin due to reduced water quality and degraded habitat, primarily caused by nonpoint source pollution. Construction of Gathright Dam and Lake Moomaw resulted in the loss of 12 miles of trout stream habitat.	Losses may be linked to Corps Gathright Dam project. Project would support VDGIFs existing trout stocking program by repairing the Coursey Springs trout hatchery. Repairs include bank stabilization for the water system and conversion of earthen ponds to concrete ponds.	Project may possibly be funded under Section 1135 or by other Corps/Federal authorities. Estimated project cost: $500,000
20. Oyster Ground Restoration	Oyster populations have decreased dramatically in the last decade, even in the lower James River, which is a primary source of seed oysters to other tributaries of Chesapeake Bay.	Various Corps dredging projects for the James River channel have impacted oyster beds. Project would include construction of intertidal/subtidal reefs on several 5 to10-acre sites in the lower James River, using dredged material and shell.	Proposal for Section 1135 project will be developed, subject to available funding. Estimated project cost: $344,000

Virginia's Secretary of Natural Resources was personally visited and apprised of this study and she enthusiastically endorsed it to all Virginia resource agencies. Numerous meetings with local, state and Federal agencies were conducted to identify problems, needs and issues related to restoration in the basin.

As part of the plan formulation and screening process, coordination and discussion was instrumental in identifying potential restoration alternatives. Once these alternatives were identified, the local sponsor (Commonwealth of Virginia) was then requested to prioritize the projects based upon their own restoration plans, goals, and incentives. The projects were also screened to determine which plans were in the Federal interest (i.e., provided environmental restoration benefits and an assurance that the environmental degradation was caused, at least in part, by a Corps civil works project).

The following projects culminated from this evaluation and screening process.

FISHERIES RESTORATION OPPORTUNITIES

Anadromous Fisheries Restoration

Breach Modifications - Dams at Richmond. Following the recommendations of the James River Fish Passage Committee, the Tennessee Valley Authority (TVA) was contracted in 1984 to assist in the development of a breach system that would allow fish movement through the two most downstream dams on the James River, Manchester and Brown's Island Dams in Richmond, Virginia (figure 9). Both dams were initially breached in January of 1989 at a cost of $179,000. Manchester Dam had a 124-foot-wide opening created and Brown's Island Dam had three spillway sections constructed. The fish passage modifications opened 6 miles of previously obstructed migratory fish habitat.

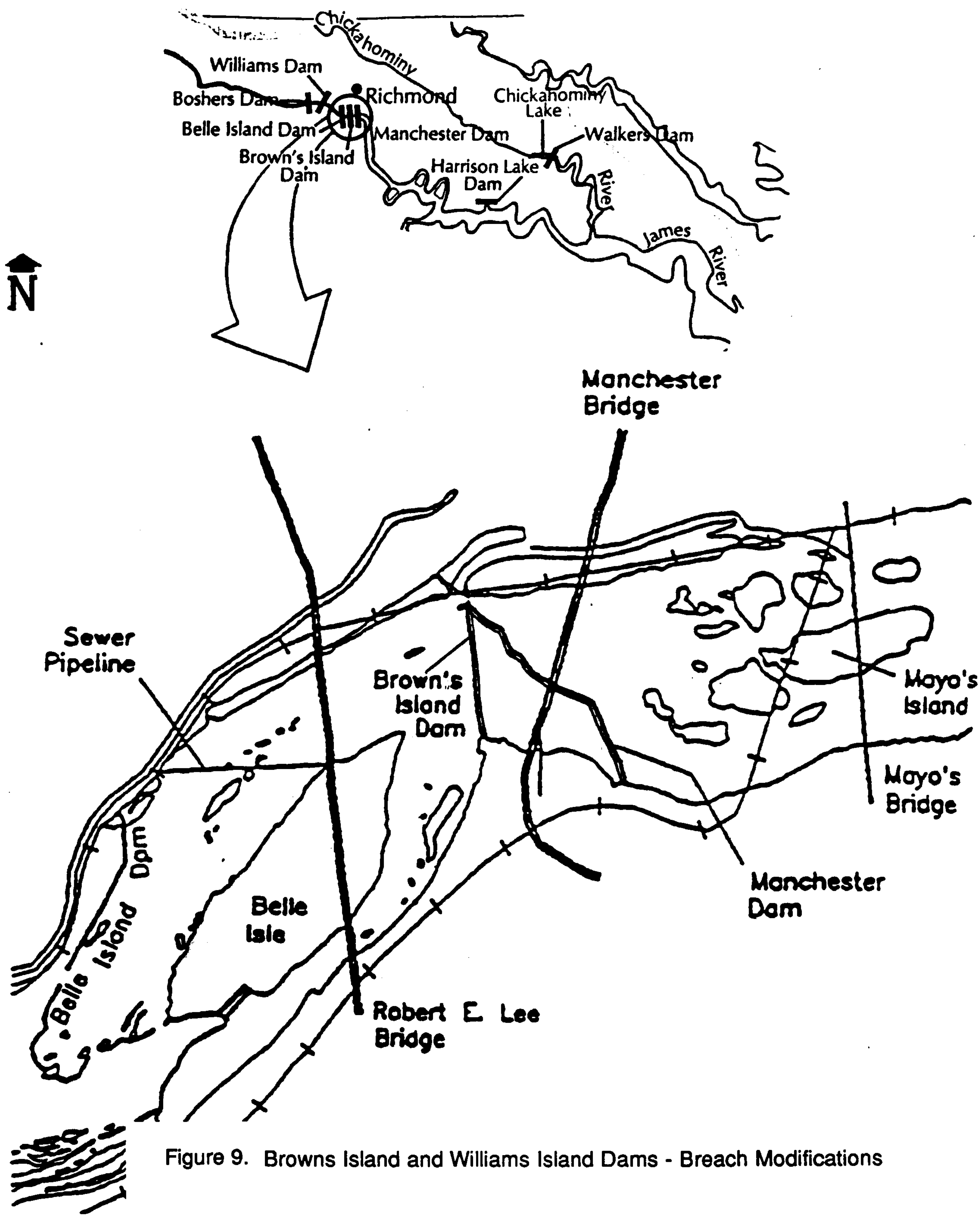


Figure 9. Browns Island and Williams Island Dams - Breach Modifications

Although the breaches are being utilized by several anadromous fish species, not all fish species (i.e., most noticeably alewife and river herring) have been observed upstream of the dams (Garman 1993). This problem was evaluated during the spring of 1993 by Dr. Greg Garman of Virginia Commonwealth University in a field study and subsequent report submitted to the Norfolk District Corps of Engineers (Appendix D). Dr. Garman, using radio telemetry, monitored the movement of blueback herring in relation to the Manchester/Brown's Island breaches. He was able to obtain 92 positional fixes on 27 blueback herring over a 3-day period in late April and early May 1993.

Dr. Garman concluded from these investigations that only the larger, hence faster, migrants are able to take advantage of the breaches during the spring flows. Therefore, Dr. Garman recommended that breach water velocities be reduced to less than 0.6 m/s (meters per second) during the spring spawning run (March-May) to allow passage of smaller fish. There is a reasonable probability that such modifications would immediately allow passage of some river herring, and a high probability that the changes would, in several years, enhance the passage of blueback herring and/or alewife. In addition, the proposed breach modifications would probably result in greater numbers of American shad at the proposed upstream fish passage facility at Bosher dam.

VDGIF estimates the cost to enlarge both breaches would be approximately $150,000.

<u>Fish Passage/Trapping at Bosher Dam</u>. Once the anadromous fish have successfully negotiated the breaches at Manchester/Brown's Island, Hollywood/Belle Island, and Williams Island Dams, the next major migratory obstacle is Bosher Dam (figure 5). This dam is 10 feet high and blocks 140 miles of former upstream spawning habitat between Richmond and Lynchburg. The VDGIF is proposing construction of a vertical slot fishway at Bosher to allow passage of anadromous species. It is proposed that a special fish trap be constructed at either the inlet or outlet of the fishway. A trap would enable wildlife agencies to collect migrating fish for brood purposes, truck and transport, population dynamics, genetics, and fish health studies. Based upon

fish traps constructed elsewhere, it is anticipated that the cost of a fish trap structure would be approximately $50,000 (VDGIF estimate).

Scott's Mill Dam (Lynchburg) Fish Passage. Upstream of Bosher Dam, Scott's Mill Dam, in the city of Lynchburg, is the next impediment to fish passage on the mainstem James River (figure 5). The dam is approximately 925 feet long and is a 15-foot-high masonry structure. By constructing a vertical slot fishway or Denil-style fishway at Scott's Mill Dam, the remaining six dams (Reusens, Holcomb Rock, Coleman Falls, Big Island, Snowden and Cushaw) in the Lynchburg area would be required to provide fish passage by FERC licensing requirements. When completed, modifications to Scott's Mill and the restoration of approximately 4 river miles (72 acres) of habitat (to the next upstream impediment) should provide sufficient habitat for 3,000 to 4,000 shad and 30,000 to 40,000 river herring annually. Conservative estimates for providing passage at Scott's Mill would be $250,000 annually. Benefits will be much greater upon completion of passage at the six remaining dams within the Lynchburg area.

Costs were calculated for a Denil fishway at Scott's Mill using a per vertical foot cost of $15,000 (quote provided by Dick Quinn, USFWS). Construction costs, including design, and plans and specifications, would be approximately $200,000 based on these estimates.

Harrison Lake Shad Hatchery. In an effort to help strengthen and/or restore the naturally occurring anadromous populations in Virginia, a fish hatchery in the James River Basin has been proposed. Hatchery-reared shad have been used successfully in the past to restock such Virginia waters as the Susquehanna River and the upper Chesapeake Bay. In a recent restocking effort, enough American shad eggs were collected at two different locations in Virginia to produce 150,000 fry. The eggs were transported out of state and raised to fry-size in a Pennsylvania fish hatchery before being brought back to Virginia for release (Richmond Times). State biologists believe that the chances for fry survival in Virginia water would be greatly increased if they were able to utilize a hatchery within the James River Basin. First, they hope to raise some fish to a larger, fingerling size which may help the fry better survive encounters with predators. Second, they would be able to experiment with natural reproduction between selected males and females. Finally, biologists would be able to collect more eggs by improving their collecting techniques, gain experience and plan future restoration needs (Richmond Times).

To provide American shad juveniles and fry for stocking the James River, a large hatchery system is necessary. The Harrison Lake Fish Hatchery, a Federal facility in the James River Basin (figure 10), can be retrofitted to become a shad hatchery relatively inexpensively. Grow-out ponds can be constructed at the facility and fish can be released into the adjacent Herring Creek, which is a tributary to the James River. The fry may also be transported to selected areas above present or future fish passages and will likely return to these same areas to spawn after they reach sexual maturity in 3 to 4 years.

The estimated construction cost of retrofitting the existing hatchery at Harrison Lake for shad, as described above, would be approximately $200,000 (conversation with Alan Blair, hatchery manager).

The fish hatchery and other fish-passage projects will promote the restoration of a rapidly declining fishery that is (was) an extremely important commercial industry in the Commonwealth of Virginia. Estimates of potential revenue generated by recreational and commercial shad fishermen alone range from $5 million to $7 million per year (Richmond Times).

Oyster Restoration in the James River

Much work is being done in an attempt to replenish oyster stocks in Virginia. Up until 1991, approximately $1 million per year was spent by the Commonwealth on the oyster repletion program. Restoration and enhancement of natural oyster habitat has been endorsed by the Chesapeake Bay Program and continues to be one of its primary goals. Most of the oyster repletion in the James River involves "cultivation" of the beds, rather than actually placing shell on the beds. Cultivation is the physical turning of the shell bottom to clean the shell and expose clean surface for oyster larvae attachment. Scientists are now proposing the rebuilding of oyster beds or reefs, providing a more suitable habitat for the establishment and settling of oyster spat. The use of dredged material to recreate oyster reefs may have some merits in this respect.

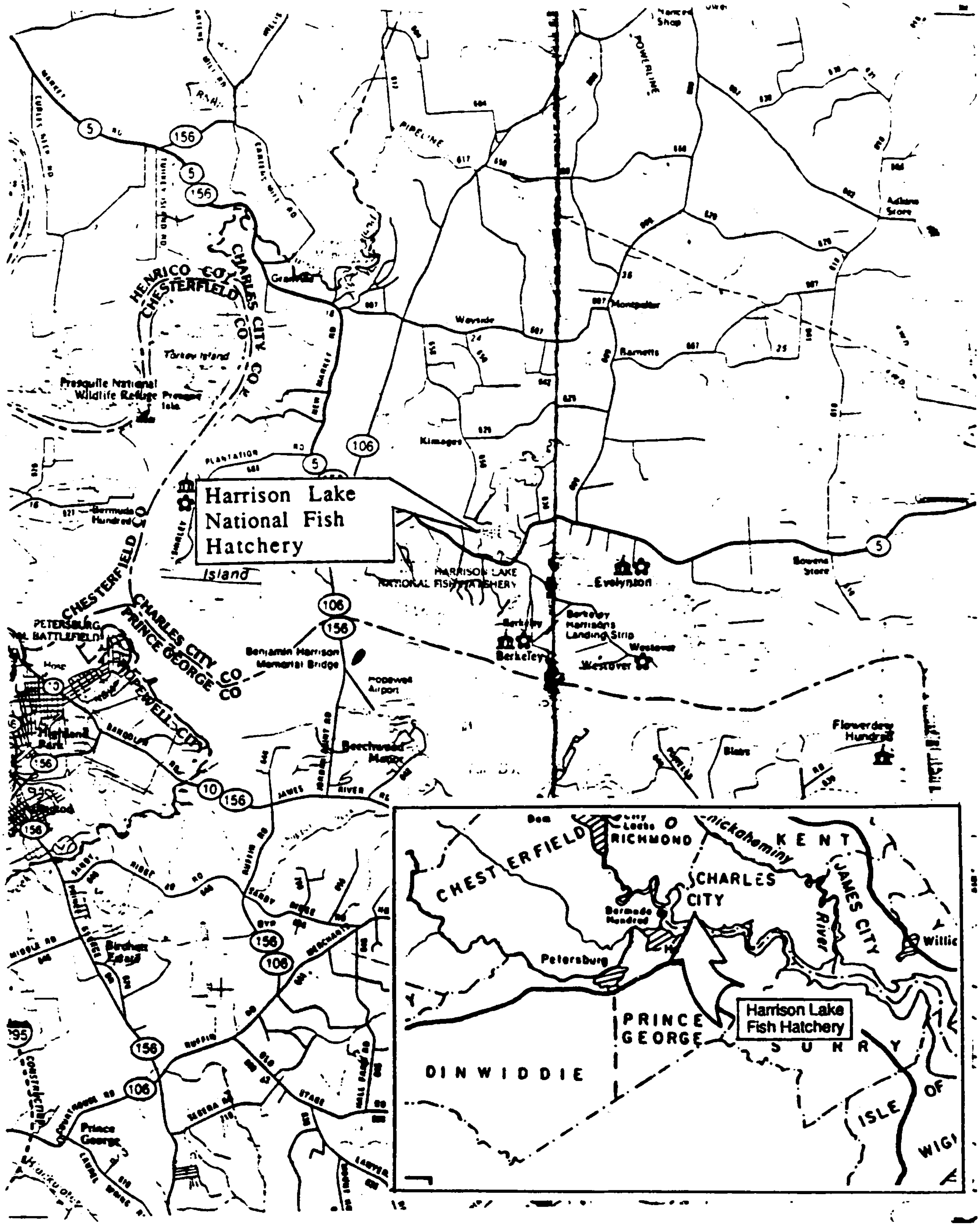


Figure 10. Harrison Lake National Fish Hatchery - Shad Hatchery Proposal

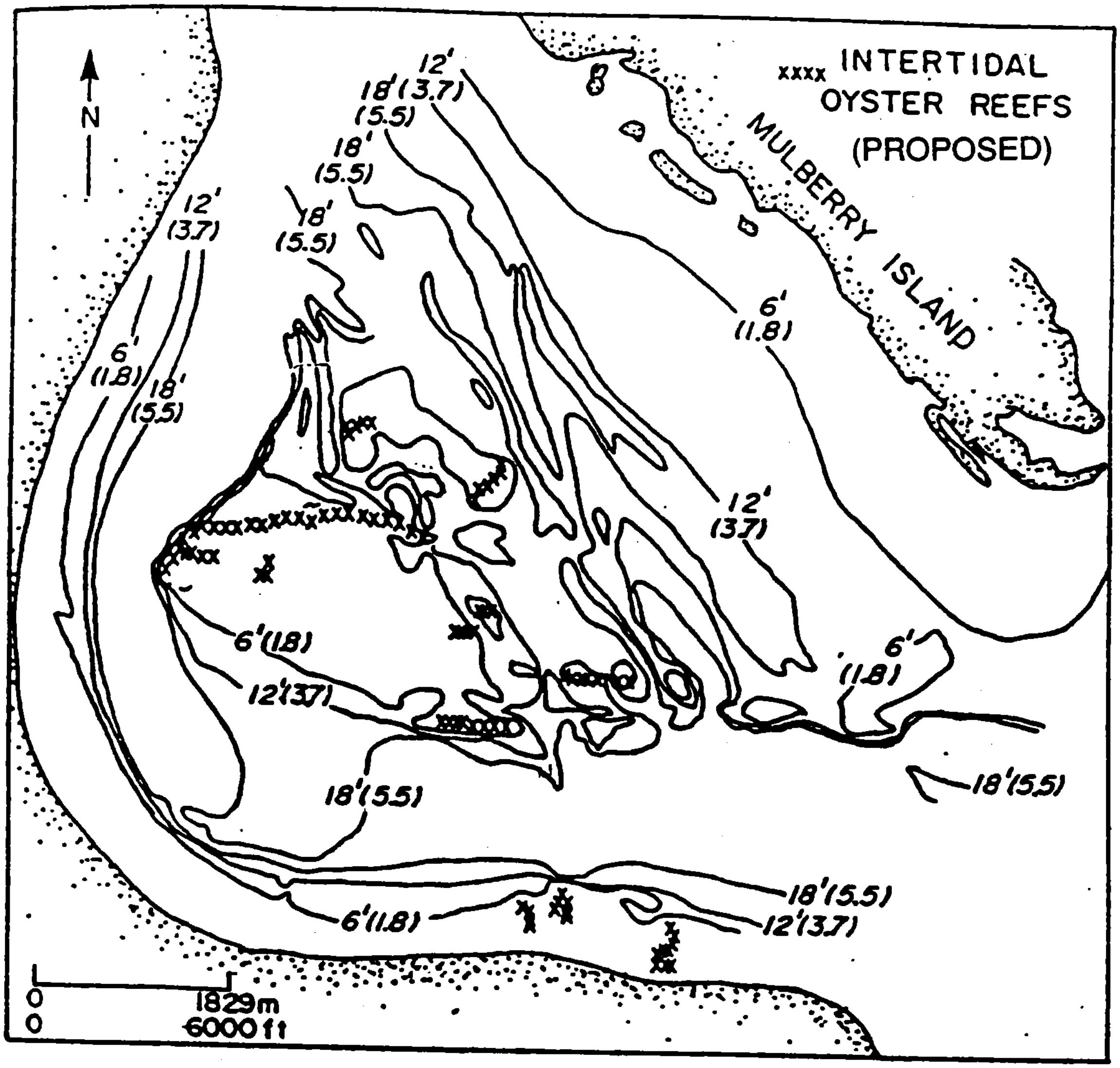
There are at least two methods available to attempt to restore oyster habitat using dredged material. One is to create new oyster bars in areas that are known to have viable oyster stocks (i.e., are parasite-free). In 1987, the Corps of Engineers, Baltimore District, in cooperation with the National Marine Fisheries Service evaluated the potential for oyster reef development using dredged material in the upper Chesapeake Bay (Slaughter Creek). Approximately 14,000 cubic yards of dredged material (60 percent fine sand and 40 percent silt) were placed in conjunction with 2,256 cubic yards of contractor-placed oyster shell cultch to create 2.1 acres of oyster reef adjacent to a State-charted, productive oyster bar.

The Maryland Department of Natural Resources survey conducted after 5 months indicated that the rehabilitated oyster bar yielded approximately 62 spat per bushel relative to 39-341 spat per bushel at adjacent natural bars. Numerous studies have established a wide degree of natural variation in spat counts ranging from 0.35 to 500 spat per bushel of shell, with a "typical" count estimated at 60 spat per bushel (Krantz and Meritt, 1977). Survival beyond the sublegal stage did not differ significantly between the experimental and natural bars. Mortality due to factors such as MSX or dermo disease infections, water quality conditions, or substrate characteristics appeared to effect oyster populations equally at all three sites (experimental and two natural). Based on a 3-year study of this experimental oyster reef in Maryland, the use of dredged material as a substrate for oyster reef habitat is encouraging.

The other opportunity for oyster habitat restoration is to create oyster bars that are intertidal rather than subtidal. Placing newly-set oysters intertidally may not only serve to minimize the effects of predation and competition, but may also serve to increase the oyster's resistance to disease through exposure to air. The Virginia Marine Resources Commission (VMRC) has endorsed a plan to construct oyster shell reefs with higher elevations in the James, Piankatank and Wicomico Rivers and along the Eastern Shore oceanfront using disease-free cultch material. These will be experimental reefs to test the survival of the oysters, the success or failure of which will not be able to be determined for another 3 to 5 years. The reefs will be monitored by researchers at VIMS who will keep the beds clean and, hopefully, parasite and disease free.

The project specifics include the creation of 25,000 feet of reefs, 5 feet high in the James River below Fort Eustis off Newport News; a 1,000-foot-long, 100-foot reef created at the mouth of the Piankatank; the removal of disease-infected shells from oyster beds in the Piankatank and Wicomico River and replenishment of about 25 acres with cleaned oyster shells; and the restoration of old oyster beds along the Eastern Shore oceanfront using a machine to blow sand off old beds in preparation for new seeding. Work on the projects began in mid-May 1993.

This reconnaissance study proposes oyster restoration sites in the James River presented in a December 1992 report to the Governor and General Assembly of Virginia by the VIMS. The project sites would complement the test sites and would be relatively small (5 to 10 acres), located in the lower James River (figure 11). This area is both historically and currently successful with oyster populations, and may provide an additional source of oyster seed for potential beds downstream and in the bay. The success of the state's endeavors and this project could indicate promise for future and more widespread application of this type of restorative measure. The benefits of restoration and creation of oyster reefs include water quality improvement as a result of increasing the bay's filtering capacity, habitat diversity for benthic organisms and nektonic fishes, and the reestablishment of a valuable commercial resource.



Source: *Beneficial Uses of Dredged Material, VIMS Report to Governor and General Assembly of Virginia, December, 1992*

Figure 11. Oyster Reef Restoration Sites

A letter to Norfolk District from VMRC dated September 22, 1993, enthusiastically supports the Norfolk District's proposal ". . . to restore subtidal and intertidal oyster grounds on the James River . . ." in concert with VMRC's ongoing management strategies (appendix C).

Gathright Dam/Lake Moomaw

The Gathright Dam/Lake Moomaw project is located on the Jackson River, Virginia, which joins the Cowpasture River near Lick Run to form the James River. The dam site is 43.4 miles above the mouth of the Jackson River and 19 miles above the city of Covington, Virginia and is approximately 215 miles southwest of Washington D.C. The reservoir impounds water in both Alleghany and Bath Counties.

The Gathright Dam project was authorized for construction under the flood Control Act of 1946. Construction of the dam was completed in 1979 and initial filling of Lake Moomaw was completed in 1982.

As a result of construction, approximately 2,530 acres of wetlands and wildlife habitat were permanently inundated, most of which is part of the Gathright Wildlife Management Area, and up to 630 acres are flooded as necessary to control floods. Furthermore, 12 miles of free-flowing stream habitat was permanently lost as well as an additional 2,000 acres of wildlife habitat lost to the construction of recreational facilities.

A variety of fish and wildlife restoration opportunities are available at Gathright Dam/Lake Moomaw which may be directly associated with the Army Corps of Engineers project (figure 12).

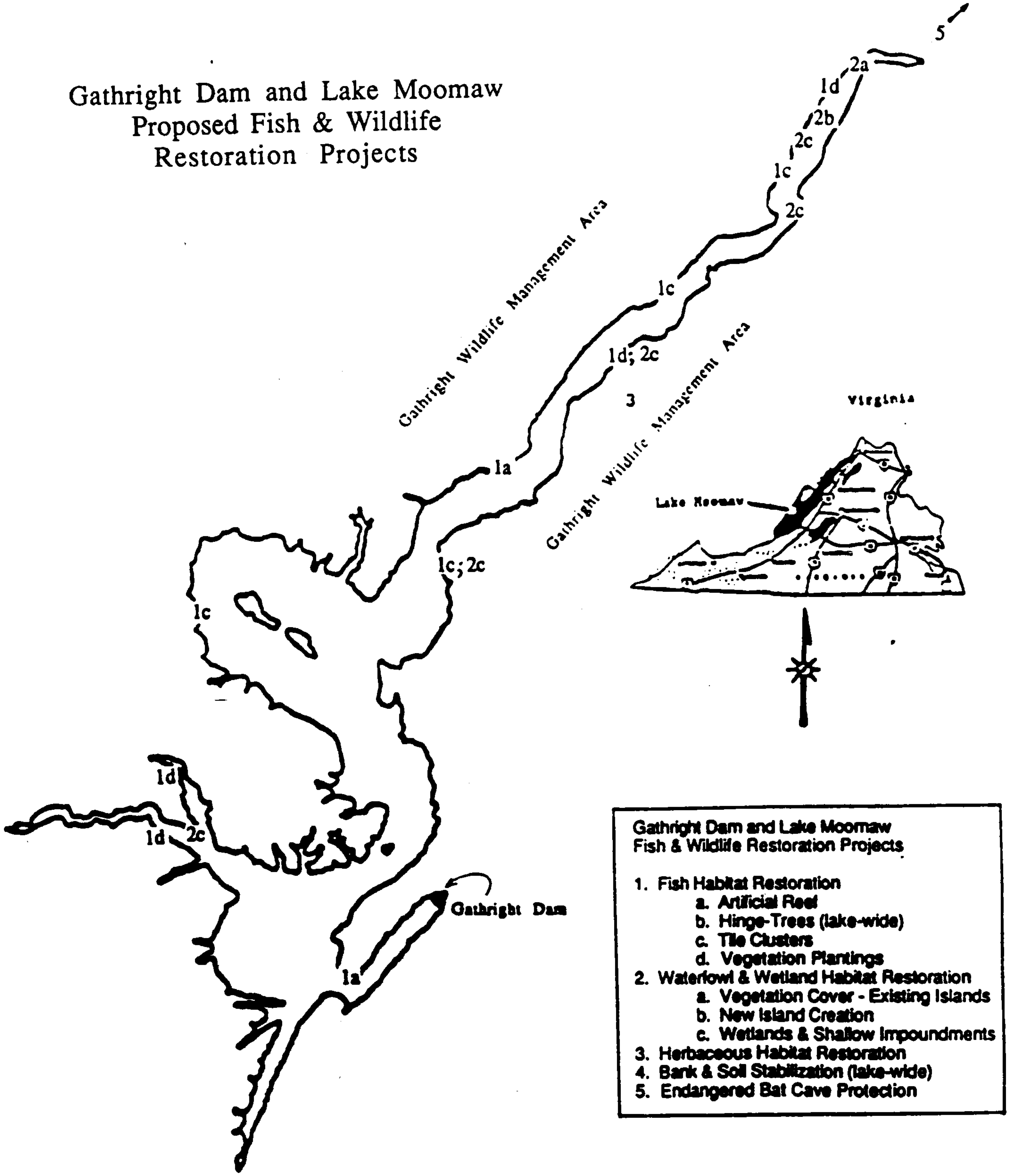


Figure 12. Gathright Dam and Lake Moomaw - Proposed Restoration Projects

Waterfowl/Wetland Habitat Restoration. Wetland habitats are limited in the mountains of western Virginia yet they provide critical habitat for wood ducks, black ducks, mallards, Canada geese and other waterfowl and shorebirds. When Lake Moomaw was created in the early 1980's, hundreds of acres of beaver ponds and nontidal wetlands were lost to rising reservoir waters. These wetland areas provided critical year-round and migratory habitat and were not subject to the water level fluctuations that exist on Lake Moomaw presently (average annual drawdown of the lake is 14 vertical feet). Currently, important shallow portions of the lake are dry during the fall which prevents waterfowl from utilizing the aquatic resources within the reservoir.

The proposed projects address these habitat losses by creating and restoring habitat within Lake Moomaw and the Gathright Wildlife Management Area (GWMA). One method includes establishing grass cover on several existing nesting islands by bringing in topsoil and spreading it and seeding to a grass mixture. A second method includes creating four to five additional nesting islands by using a large dozer to dredge or push up material from the lake bottom (figure 13). By dredging material between the shore and the islands, the old river channel will be deepened and allow the nesting habitat to be surrounded by water for an extended period of time which offers greater protection from predators. The islands will be riprapped on the sides with river jack or commercial stone and topsoil placed on the tops before seeding to grass. A third method includes establishing several grazing meadows for Canada geese on the existing larger islands. This will involve clearing the existing shrub cover, preparing a seedbed and seeding to a mixture of grasses/legumes preferred by geese. Water level fluctuations in Lake Moomaw prevent the establishment of fringing wetlands. Partially pervious dikes can be used to maintain elevation desired for wetland establishment. Sites where tributaries flow into the lake are selected in order to provide a continuous source of water during drawdown. Suitable substrate is provided behind the structure, and wetland vegetation is planted or allowed to colonize naturally. An emergent and scrub/shrub wetland community that would imitate a beaver pond complex would be created. National Forest (NFS) Staff at George Washington National Forest have selected four potential sites around Lake Moomaw (figure 14). NFS staff describe the sites as follows:

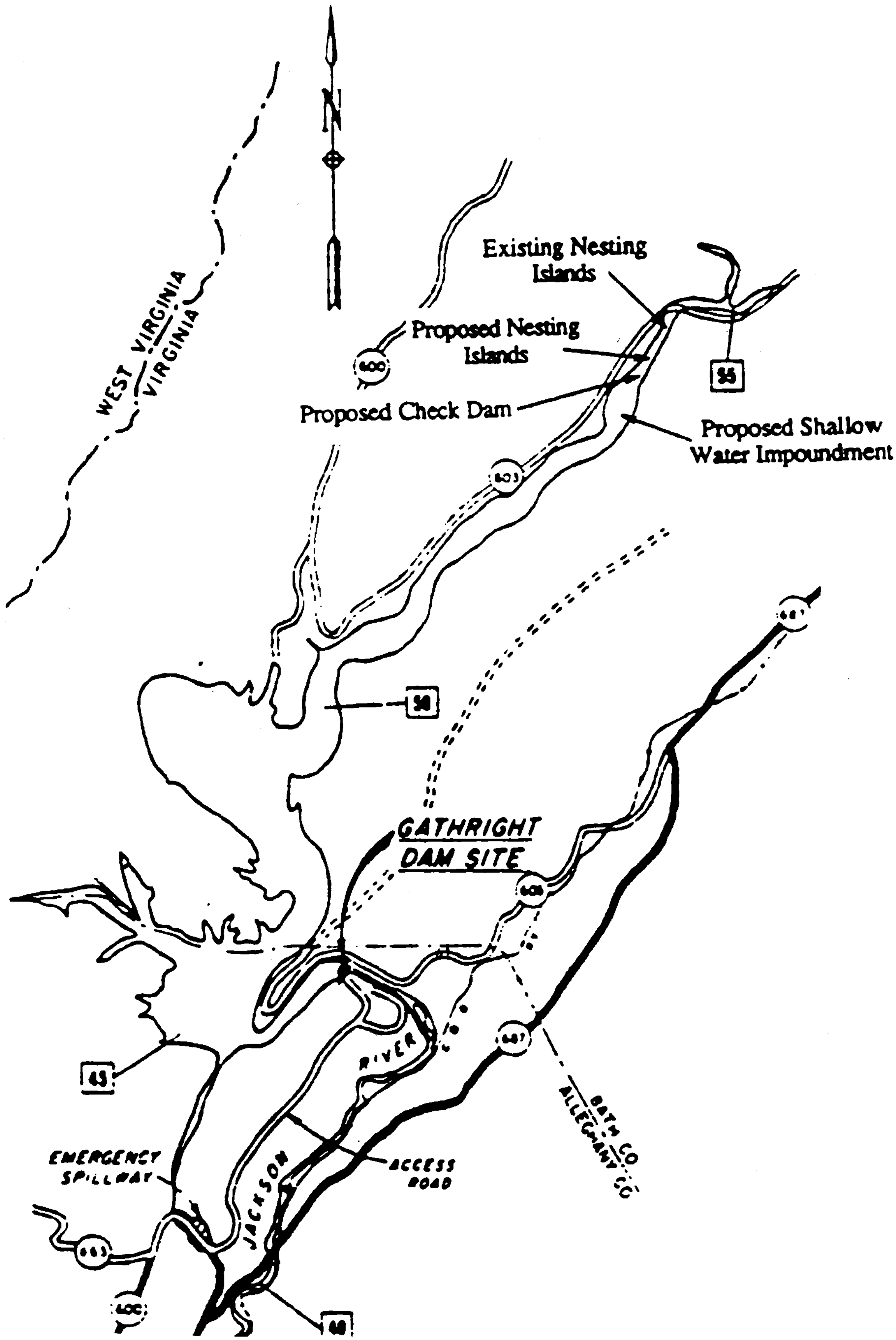


Figure 13. Gathright Dam and Lake Moomaw - Waterfowl Habitat/Islands

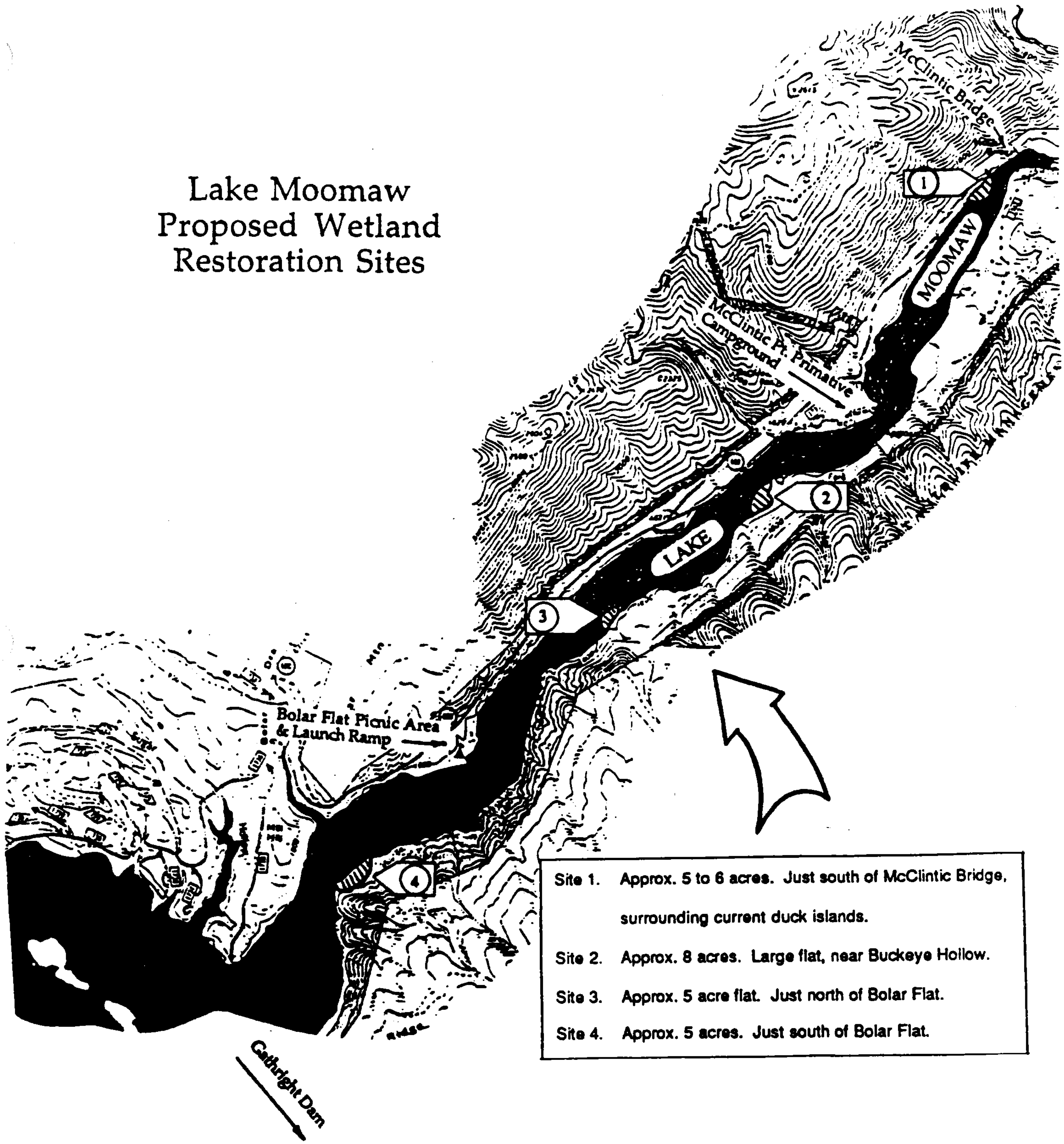


Figure 14. Gathright Dam and Lake Moomaw - Wetland Impoundment Sites

Site 1. Surrounding the current duck islands, it is approximately 5 to 6 acres. Water during low flow would have to be siphoned off the nearby main river. Access with heavy equipment would not be a problem.

Site 2. Large flat, approximately 8 acres. Water during low flow may be a problem unless the tributary at Buckeye Hollow could be incorporated, or water obtained from the main channel. Access with heavy equipment would be a problem.

Site 3. A less than 5-acre flat, with some vegetation already established. A small tributary could supply water during low flow. Access with heavy equipment would be a problem.

Site 4. Approximately 5 acres. Water during low flow, as well as access with heavy equipment may be a problem.

The nesting islands, shallow water impoundment and goose grazing areas will enhance the waterfowl habitat from fair to moderately good by increasing the available wetland habitat in this area. Currently, 125-150 Canada geese utilize the Lake Moomaw reservoir, but VDGIF estimates that goose usage could double or triple if the project is implemented. The impoundment will also result in a significant increase in species populations that utilize wetlands for part of their life cycle.

Based upon Soil Conservation Service (SCS) estimates for a similar impoundment project (see appendix B), the estimated costs for wetlands restoration at Lake Moomaw would be approximately $14,700 per acre. The total cost of waterfowl/wetland habitat restoration is estimated to be $85,000.

Lake Moomaw Fish Habitat Restoration. Certain indigenous fish species thrived in the Jackson River before the Gathright Dam was completed in 1979. Some of these game fish and nongame fish species adjusted to their newly impounded environment while others did not. In an effort to restore fish populations, biologists from VDGIF determined that the Moomaw reservoir was favorable to accommodate additional warm-water and cold-water fishes. Thus, a stocking plan was conceived in the early stages of lake development that would complement existing species and enhance the fishery to its greatest potential. However, fish are not only dependent on certain water temperatures and dissolved oxygen levels, but also on the physical environment of structural surroundings. Naturally occurring aquatic structures like boulders, rootwads, and vegetation provide shelter, spawning habitat, and a surface for promoting the growth of filamentous algae, mosses, periphyton, and benthic macro-invertebrates (the base of the aquatic food web). Typically, these types of structures are lacking in fresh water manmade environments, particularly reservoirs similar to Lake Moomaw, for several reasons: (1) standing timber is clear-cut in potential shallow areas before impoundment in order to avoid navigational hazards; (2) standing timber that was not initially clear-cut has decayed; (3) silt may have covered much of the firm substrata in shallow areas, resulting in unstable mud (muck) bottoms; and (4) fluctuating water levels prevent growth of aquatic vegetation (average annual drawdown of the lake is 14 vertical feet).

The proposed project consists of the introduction of aquatic structures and wetlands in Lake Moomaw that will enhance fish habitat in Lake Moomaw (figure 15). Fish restoration/enhancement features include:

(1) The development of two artificial reefs composed of brush shelters (clusters of evergreen and hardwood trees anchored with cinder blocks), wood cribs (stacked logs weighted with rocks), pallet triangles (wooden pallets weighted with cinder blocks), and stake beds (wooden stakes embedded in the sediment or attached to a weighted wooden grid). Each reef will contain 30 of these structures and will be located near underwater ledges.

(2) The construction of 50 cabled hinge-trees along the shoreline (shoreline trees cut and allowed to fall into the water perpendicular to the shore and cabled to the stump with stainless steel cable).

(3) The construction of 20 drain tile clusters (stacked clay pipe or black plastic culvert pipe, weighted with cement).

(4) The planting of 75-100 acres of emergent vegetation and shrubs in coves and large flats.

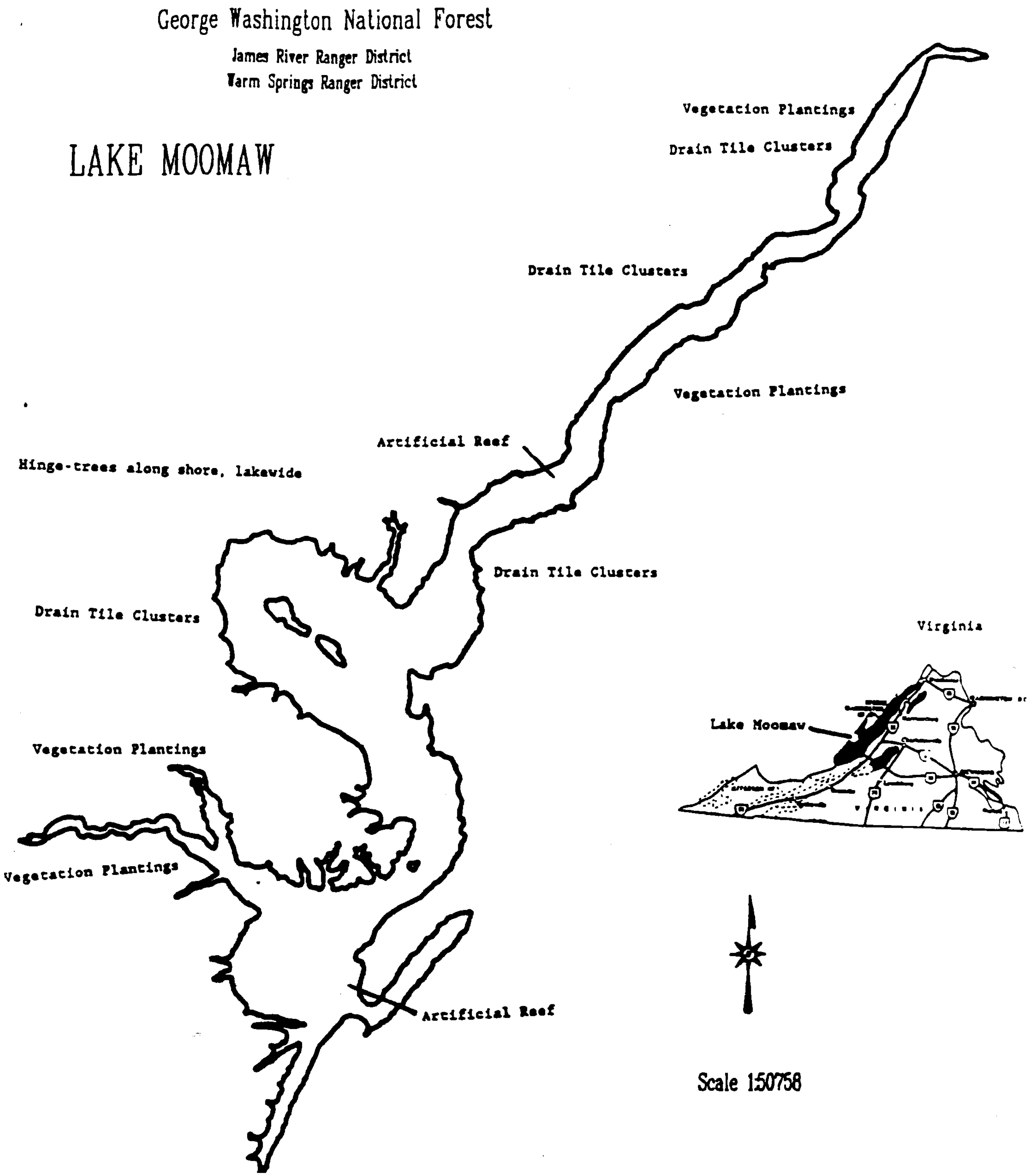


Figure 15. Gathright Dam and Lake Moomaw - Fish Habitat Restoration

The lake-wide restoration features will enhance the aquatic habitat from poor to moderately good. Twenty-six different indigenous and introduced fish species such as bass, sunfish, shad, catfish and trout will benefit greatly from the project. Although the project is designed around benefiting various fish species, other aquatic-dependent species will also benefit from the increase of food organisms associated with the structures.

Total project cost is estimated to be $62,500 (VDGIF and NFS estimate). Currently, VDGIF estimates that Lake Moomaw maintains a fish population which is below its optimum holding capacity. However, if implemented, the project will increase the fish population in the area by providing shelter, spawning habitat and a surface for the attachment of fish food organisms. In addition to fish habitat, the creation of the 75-100 acres of emergent wetlands will provide critical habitat for a variety of game and nongame wildlife species such as waterfowl and songbirds that are dependent on wetlands for part of their life cycle.

Herbaceous Habitat Restoration and Preservation. When Lake Moomaw was created by Gathright Dam in the early 1980's, over 1,000 acres of prime upland habitat was permanently inundated. A large portion of these uplands were herbaceous habitats which were inhabited by a variety of game and nongame wildlife species. In addition to lost wildlife habitat, vehicle access to points on the west slope of Coles Mountain was eliminated which restricted habitat management and public access activities on this side of Gathright Wildlife Management Area (GWMA).

The proposed project addresses these losses and consists of replacing the lost wildlife openings by creating and acquiring herbaceous wildlife habitat in and around GWMA. The first phase of the proposed project consists of herbaceous habitat creation. Twenty (20) acres of permanent linear herbaceous wildlife habitat would be developed on government-owned uplands surrounding Gathright Dam and the Lake Moomaw reservoir. This will involve clearing and/or bulldozing openings in forested areas (the trees will most probably have been cut during a timber sale), preparing a seedbed, and seeding the opening areas and borders. Typically, the open areas are seeded with a mixture consisting of orchardgrass and ladino clover, while field borders are seeded with warm season native grasses and wildlife-benefiting shrubs such as VA 70 lespedeza, silky dogwood, indigobush and American plum.

The second phase of the project would consist of conservation of existing herbaceous habitat. One hundred to 150 acres of privately owned upland field habitat along Rt. 600 and adjacent to the GWMA would be acquired to preserve and protect remaining herbaceous habitat. Land acquisition will involve working with local real estate companies to purchase suitable herbaceous lands from property owners that are willing to sell.

The creation and acquisition of the upland herbaceous openings would enhance the wildlife habitat from poor to moderately good by providing critical nesting cover, shelter from predators and summer brood range (insect foraging areas) for wild turkey, ruffed grouse, as well as year round cover/shelter and feeding/grazing area for quail, squirrel, rabbit, white-tailed deer, black bear, and various other nongame wildlife species. In addition to wildlife habitat, some of the open areas will furnish fire lines for prescribed burning and provide public and administrative personnel access to portions of GWMA that are not presently accessible.

The total project cost is estimated to be $125,000 (VDGIF estimate). The cost to push stumps, work the soil up and seed, lime, and fertilize the forest openings is approximately $1,500 per acre and the cost to purchase old farmland along Rt. 600 is between $450 and $700 per acre. The primary benefits from the project are associated with the significant restoration and improvements to game and nongame wildlife resources in and around the GWMA and George Washington National Forest.

Bank/Soil Stabilization. The shoreline along Lake Moomaw is highly susceptible to erosion due to the annual average drawdown of lake which is 14 vertical feet. The fluctuating water levels cause the shoreline to steepen and introduce excessive amounts of sediments into the lake and, in turn, causes a reduction in the habitat quality of both wildlife and fish species. In order to decrease shoreline erosion, emergent vegetation may be established on suitable areas and riprap may be placed along steep slopes. By reducing the shoreline erosion rates along Lake Moomaw at an estimated cost of $500,000, the water quality will increase and habitat for a variety wildlife surrounding the lake and habitat for numerous fish species within the lake will be improved.

Endangered Species Protection. Numerous caves along the Jackson River were inundated following the construction of Gathright Dam and the creation of Lake Moomaw in the early 1980's. These caves were inhabited by a variety of bat species including the Federally endangered Indiana Bat (*Myotis sodalis*). Other caves remaining in the area serve as habitat for the bat species; however, human-related disturbances within these caves have been shown to greatly reduce the number of bats in the hibernacula. Disturbances increase bat mortality in nursery caves and also increase the chances that hibernation will be interrupted, causing the bats to lose valuable energy during the critical over-wintering period. For these reasons, controlling human access to the caves would significantly increase survivability of the bat species.

The proposed project addresses the preservation of current cave habitat within the region and consists of the construction of gates that would be installed at the entrances of one particularly important endangered bat cave (figure 16). The manmade structures prohibit disruptive human entrance to the cave while permitting ingress and egress of the Federally endangered bat species *Myotis sodalis*s as well as other native cave-dwelling bat species. The gates will be welded on site to fit the specific dimensions of the cave entrance. The gates would be constructed with pipe and rebar, designed and installed in a naturally appearing manner, and anchored to either the bedrock or poured cement.

The project will protect the declining habitat conditions and should substantially enhance the growth of the bat population by providing an undisturbed roost. Furthermore, cave invertebrates would benefit from improved water quality by reducing disturbance to aquatic portions of the cave. The cave is located on U.S. Forest Service land.

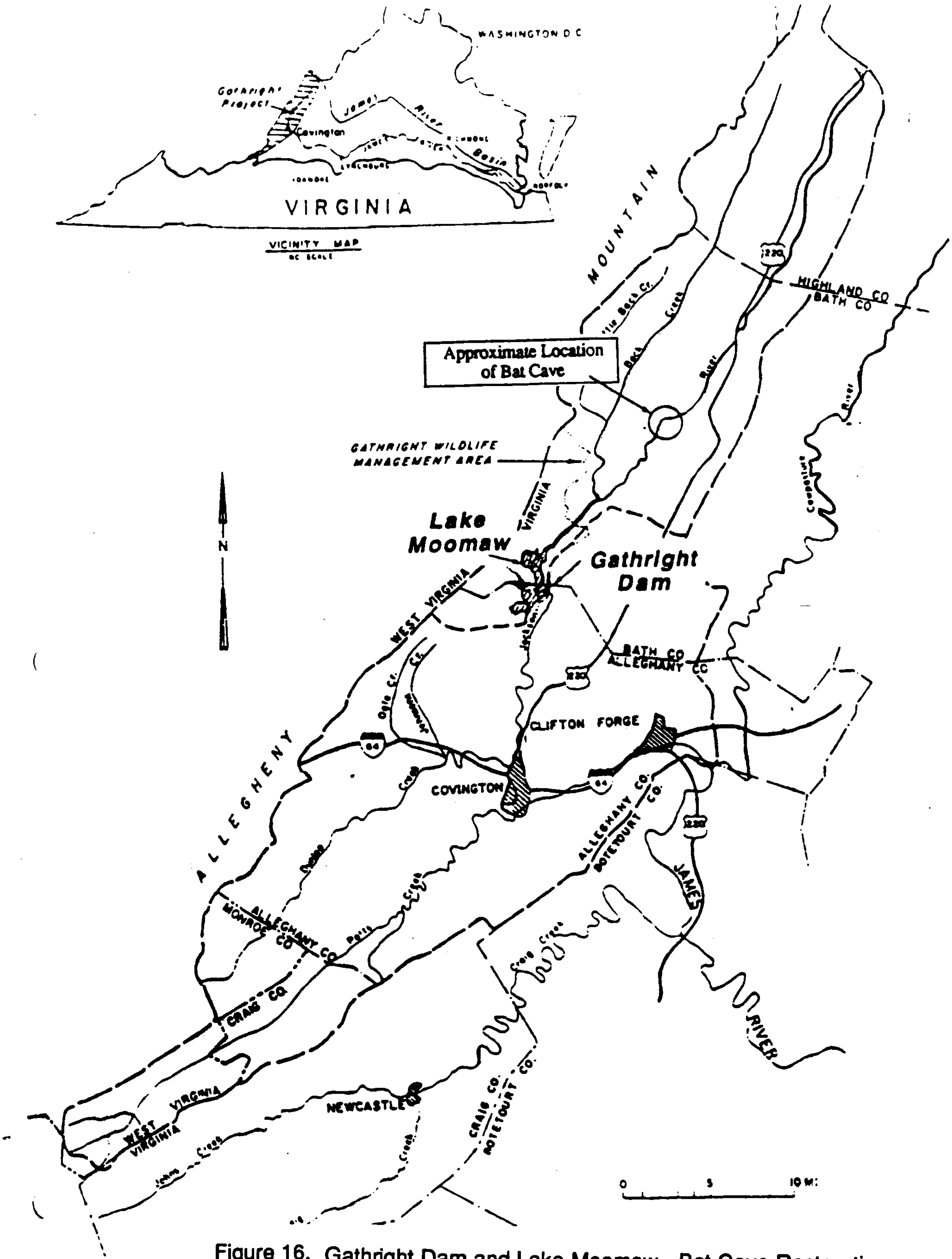


Figure 16. Gathright Dam and Lake Moomaw - Bat Cave Restoration

The total project cost is estimated to be $15,000 (VDGIF estimate). The benefits associated with the project are providing protection to a local population of Federally endangered bat species or possibly saving the species from extinction. The project would support the Endangered Species Act of 1973, as amended, by providing a program for the conservation of endangered bat species.

Stream Habitat Restoration

Bank/Soil Stabilization. Reducing the sedimentation and siltation rates in streams would improve water quality and result in improved habitat for a variety of aquatic plants and animals including some threatened and endangered species such as the James Spinymussel and Notched Rainbow Mussel. Excessive sediments in the water settle on gravel beds and decrease the vitality of the filter-feeding mussels which prefer a silt-free substrate.

Free-roaming cattle, grazing on riparian lands and wading in stream beds, contribute to increased turbidity and sedimentation by disturbing bottom sediments and accelerating bank erosion. They consume and trample stream-side vegetation with their hooves causing the stream to become turbid, warm, shallow, and too congested with fine sediment to support native fish and their food base. The elimination of riparian vegetation leads to gradual channel widening, aggradation, lowering of the water table, and the general decline in water quality downstream.

Fencing, replanting of riparian vegetation, placement of low water bridges, and introduction of riprap along stream corridors would prevent livestock from further access to unprotected areas. These features can be constructed in a manner which would allow cattle to continue to utilize the resources provided by the stream while protecting it from the environmental impacts created by the cattle. A recent study conducted in the Sheep Creek, Colorado (Stuber, 1985) found that, compared to unfenced streams, biomass of trout was 96% to 127% greater in regions where the streambank was fenced. The estimated cost of the proposed projects is $1,000,000.

Acid Rain Mitigation. The Saint Mary's River, a tributary of the South River, was once known as the best trout river in Virginia (figure 17). The river contained an abundant population of reproducing rainbow, brown and native brook trout. Recently however, the rainbow and brown trout have been extirpated due to acidic water conditions and only the brook trout remain. The acidification in the river has been well documented and believed to be caused by the release of sulfur dioxide and/or nitrous oxide into the atmosphere which form acidic rain, hail, and snow. As the acidic precipitation is deposited and travels through the surrounding watershed, the lack of buffering capacity within the drainage basin cannot protect the river against the increasing amounts of acidic water. The acidic conditions kill fish and threaten the health and reproductive success of many aquatic animals. Given the current situation of the Saint Mary's River, it is unknown how much longer the brook trout can survive the ongoing acidic increase which has affected their food chain and resulted in the continual degradation of the water quality.

Trout require pH levels above 6.0 and substantial amounts of acidic rainfall within the western portions of Virginia has lowered pH levels in many rivers and streams. Recent experiments have involved the introduction of limestone sand into acidic streams in an effort to modify pH levels. The limestone sand can be incorporated into the stream system by truck, tractor, or by aircraft in some of the less accessible areas. Liming, as it is known, neutralizes acid waters and soils and buffers them from rapid fluctuations in pH. Liming can reduce the effects of acidification and can restore the diversity of acid-damaged fish populations and other forms of aquatic life (Weigman, et. al., 1993). Other benefits of liming include: increased pH, increased alkalinity, increased calcium, increased biodiversity, and decreased toxic metals. It is important to note, however, that the intention of the pH modification project is not to reintroduce non-native trout species such as rainbows and browns, but an attempt to protect and preserve the existing native brook trout populations.

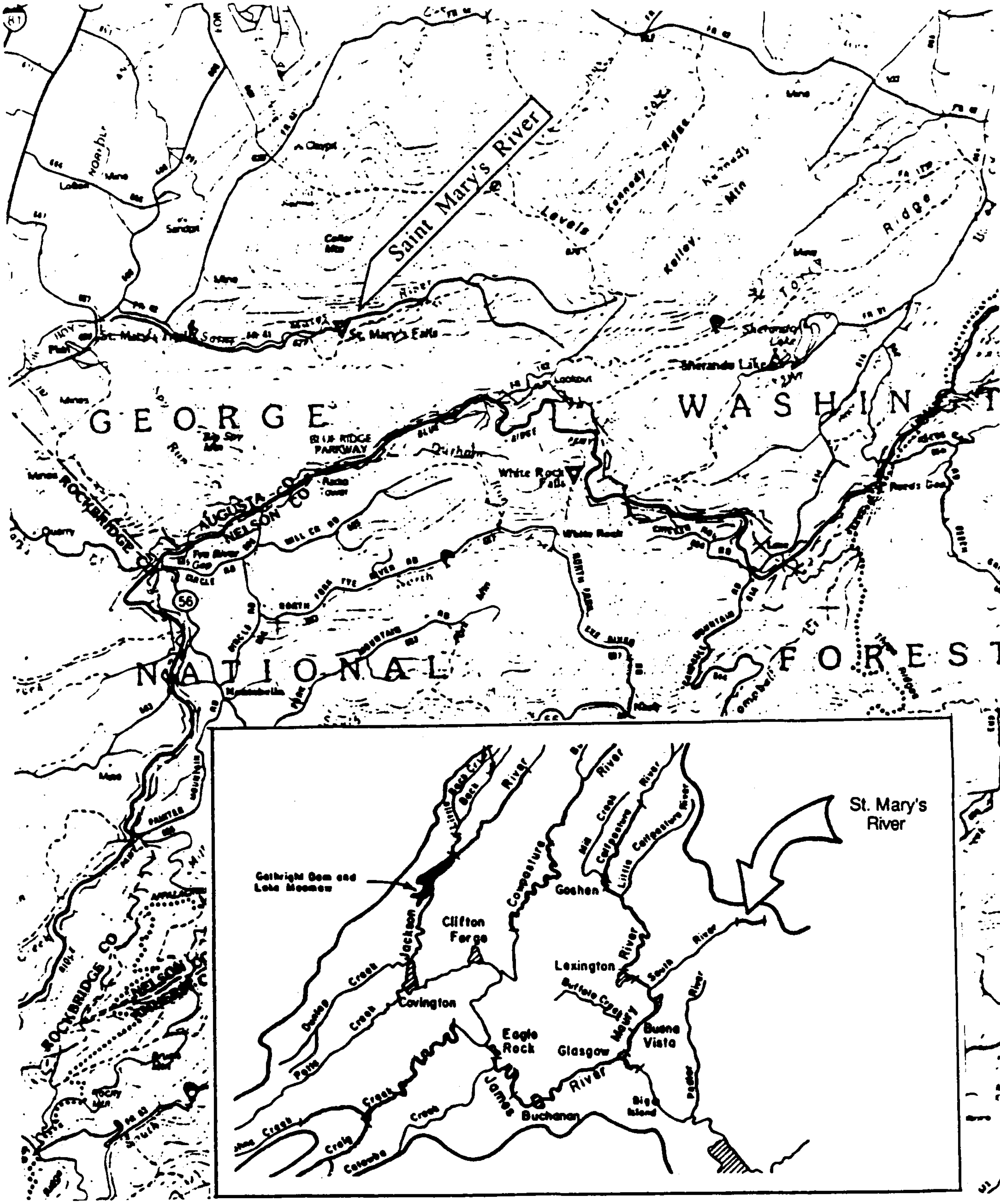


Figure 17. St. Mary's River Restoration

Costs for stream liming vary considerably, depending on accessibility, the method of application selected, and equipment needed. The Saint Mary's River is not readily accessible for direct streambed application and would probably require helicopter or fixed-wing aircraft for limestone application. The estimated cost of the proposed project is $100,000.

Trout Stream Habitat Restoration. In order to restore and/or maintain a healthy and productive trout fishery, the prospective stream must satisfactorily meet the five basic needs of the various trout species.

Water: The stream's water must be present 365 days a year in sufficient quantity and quality to support the fish and the chain of aquatic organisms which are a vital food source.

Shelter and Cover: There should be an adequate amount of hiding places in the stream where the trout may find protection from high water velocities and predators (animals higher on the food chain, including man). Typically, shelter areas along a stream may include a deep pool, an undercut bank, overhanging vegetation, a large rock or log, or any other object which has fallen into the stream.

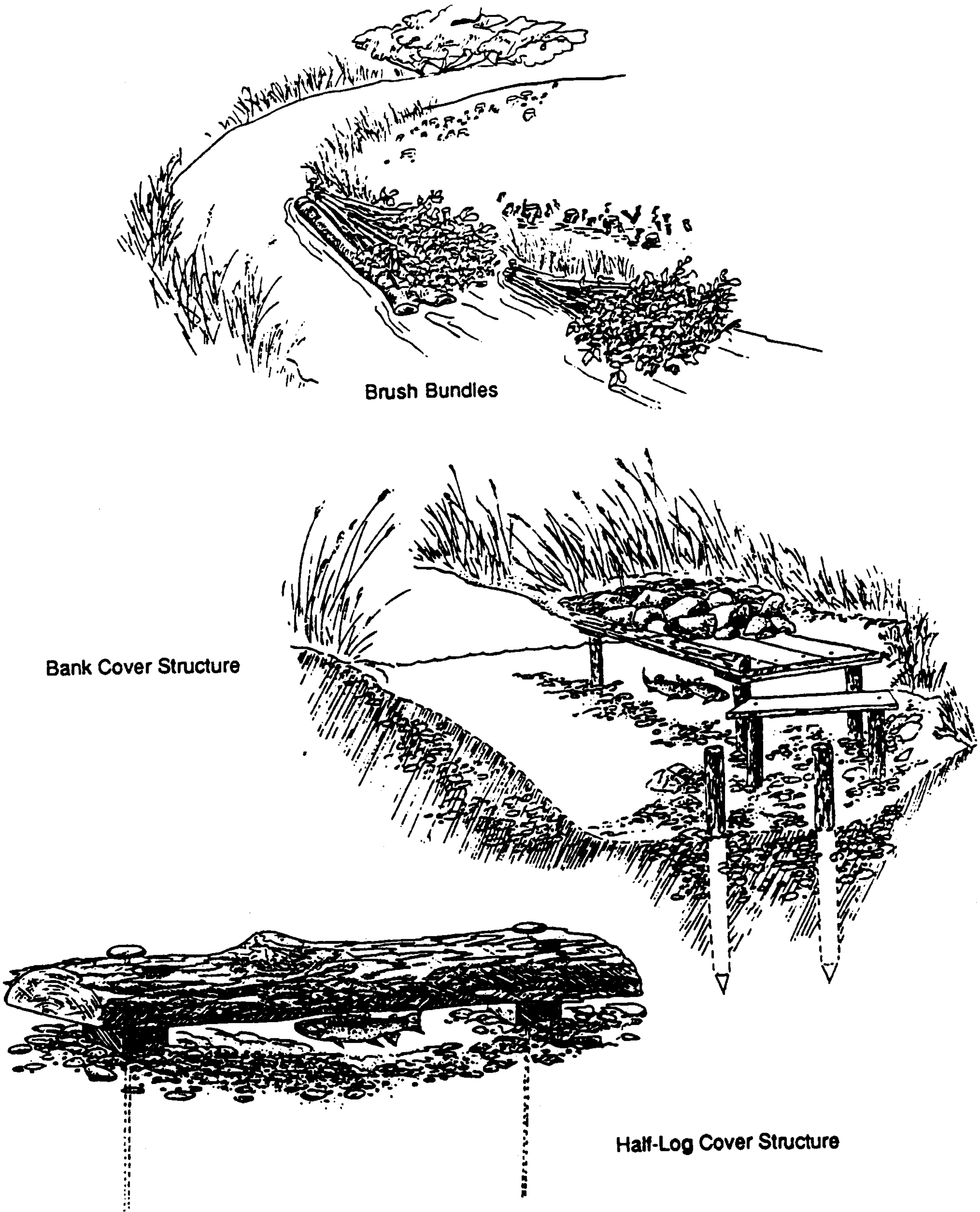
Cool Water Temperatures: These structures would not only provide the trout with shelter, but would also help regulate and maintain lower water temperatures by shading the stream from the direct rays of the sun. This is important because trout are cold water fish and prefer water temperatures that do not exceed 65° F. The following represents the minimum and maximum lethal temperatures of native and non-native trout species of Virginia (Weigmann et. al., 1993):

Common Name	Scientific Name	Water Temperature Requirements
Brown Trout	*Salmo trutta*	Tolerant from 0° C - 27° C (32° F - 80° F)
Brook Trout	*Salvelinus fontinalis*	Tolerant from 0° C - 24° C (32° F - 75° F)
Rainbow Trout	*Oncorhynchus mykiss*	Tolerant from 0° C - 27° C (32° F - 80° F)

Food: Trout are continually seeking food that is attached to objects anchored in the stream or floating freely in the current. They are near the top of the stream food chain and will eat a variety of foods. The preferred food is aquatic insects or insect larvae such as blackflies, mayflies and stoneflies (Niering, 89). These aquatic insects prefer the shallow, well-aerated and silt-free environment provided in the riffle regions of the stream. When insects are in short supply, trout may also eat minnows, crustaceans, amphibians, and even smaller terrestrial animals that may fall into the stream such as mice and birds.

Reproduction: Fish must be capable of reproducing and maintaining their own numbers in order to complete their life cycle. Trout must lay their eggs in well-aerated gravel areas of the stream which are free of silt. The well-aerated water must continually pass over and through the egg nest and remove waste products produced by the eggs and fry as well as supply the nest with much-needed oxygen.

Restoration Structures. A number of natural or naturally appearing structures may be utilized to improve or restore a trout stream when one or more of the basic habitat needs are not met. The relatively inexpensive structures are built with rocks, logs, rootwads, boards, wire baskets and other similar materials (figure 18). They are designed and positioned within the stream to distribute the available water in a more efficient manner and create cover which will benefit the targeted fish species. Devices such as deflectors are used to control the direction of water flow while dams are utilized to form a drop where water falling over the dam will dig and maintain a hole below it creating deep pools. The overall goal of these devices is to reduce the amount of flat water in a stream and create the optimum trout environment which consists of 50% pool, 45% riffle and 5% flat water. Other devices such as randomly placed half-logs and boulders can improve the carrying capacity of a trout stream by providing additional cover and velocity shelter.



Source: Glossary of Wisconsin Trout Habitat Development Techniques, Dept. of Natural Resources, Madison, Wisconsin - 1987

Figure 18. Typical Trout Stream Structures

Several stream enhancement structures may be grouped together in a section of a stream or they may be used alone depending on the desired habitat improvement. The following is an example of one structure which may be used in the various streams of Virginia. A tip deflector is one of many such structures which may be constructed relatively easily and serve a variety of purposes if it is positioned properly in a stream which is too shallow to support a trout fishery. Tip deflectors consist of 12-inch diameter logs which are stacked three high in the form of a 30° -60° -90° triangle. The logs are buried in the streambank and secured to each other and the streambed with metal rods. The long side of the triangle is positioned against the shoreline with the 30° pointed upstream and the short side of the triangle facing downstream. A 2-inch-thick timber deck is constructed at the instream tip of the deflector (60°) which will be suspended above the stream bottom and provide cover for fish. The remaining portion of the frame is then filled with stone sloping upwards to meet the bank. The design of the tip deflector enables it to provide a number of features which will benefit the trout and other inhabitants of the stream. The most evident features include:

(1) Redirect the water into a single channel reducing the risk of stream evaporation during periods of low flow.

(2) Prevent channel and shoreline erosion and create a narrower, deeper channel which will expose less surface area to the sun, thereby maintaining the cooler waters required by trout and reducing the chances of any large temperature fluctuations that will cause tremendous stress.

(3) Reduce the amount of sedimentation by increasing the water velocity which is beneficial to trout reproduction (improved trout nesting habitat) and trout food sources (improved aquatic insects habitat).

(4) Provide shelter and cover for trout as the current scours out a deep hole beneath the deflector overhang.

There are several streams and creeks within the James River Basin which have the potential to benefit greatly from assorted stream restoration structures. The following represents a list of potential locations which have been recommended by the VDGIF. For a vicinity map showing general locations of these rivers, see figure 1.

Pedlar River - headwaters to confluence with the James River

• Enchanted Creek
• Browns Creek
• Little Irish Creek
• Brown Mountain Creek
• Lovelady Creek
• Davis Mill Creek
• Stations Creek
• Ladyslipper Run
• Nicholson Run

South River - Headwaters to confluence with Maury River

• Big Marys Creek
• Irish Creek

Headwaters of Tye River, Piney River, and Buffalo River

• Georges Creek
• Greasy Springs Branch
• South Fork Piney River
• Crabtree Creek
• Meadow Creek

James River

• Otter Creek

Trout Hatchery Restoration. VDGIF is presently conducting a trout stocking program in an effort to strengthen and restore several trout species to their historic levels. Portions of the Gathright Wildlife Management Area, as well as more than 50 other stream segments in western Virginia, are stocked with rainbow and brook trout on an annual basis. Hatchery-reared fish have also been used successfully in the past to restock such Virginia waters as the Susquehanna River and the upper Chesapeake Bay (VA Wildlife). In an effort to improve and expand the trout stocking program in Virginia, three cold water fish hatcheries in the upper James River Basin could be renovated and/or upgraded. The existing Virginia hatcheries include the Montebello (Tye River), Paint Bank (Potts Creek to the James River), and Coursey Springs (Cowpasture River). All three facilities were constructed 30 to 50 years ago and are in various stages of decline.

Plant improvements would allow hatchery personnel to more adequately research trout strains, study salmonid diseases, improve feeding/grading techniques, and meet future needs for management of salmonids in Virginia.

A priority location identified by the state for accomplishing these repairs is at the Coursey Springs (Cowpasture River) trout hatchery (figure 19). The water system (spring containment) requires bank stabilization. The estimated cost for this repair is $150,000. In addition, several earthen ponds need to be restored/upgraded to concrete ponds. The estimated cost for the pond restorations is $500,000.

Endangered Mussel Species Restoration/Protection. Fresh water mussels are very important to the aquatic ecosystem in the rivers and lakes of Virginia. Younger mussels are eaten by waterfowl and game fish while mature mussels serve as a major food source for valuable wildlife species such as muskrat, raccoon, otter and mink. They also serve as biological filters which help cleanse turbid and polluted waters by filtering particulate matter out of the water column (Zale & Neves, 1983). Unfortunately, populations of mussels are dramatically decreasing in Virginia and throughout North America.

According to Virginia's Division of Natural Heritage (DNH), the James River Spinymussel is one of seven endangered mussel species that was once found throughout the James River Basin. The decrease in population is primarily due to poor water quality associated with man's alteration of the aquatic environment. Typical, poor agricultural, forestry and mining practices have increased siltation rates which may suffocate the bivalves.

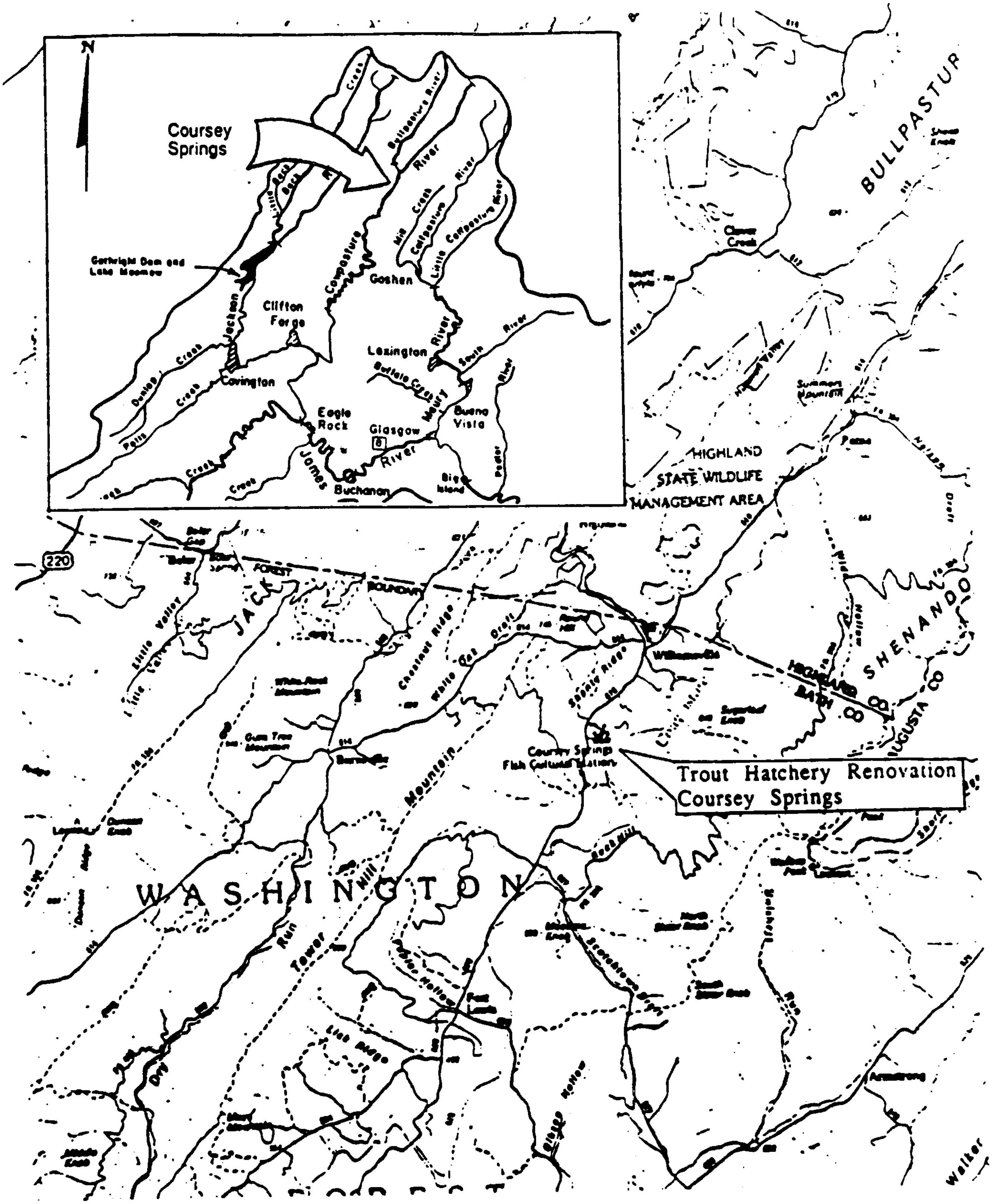


Figure 19. Coursey Springs Trout Hatchery Restoration

Until water quality in the James River Basin can be fully assessed, it will be difficult to determine exactly which pollutants are having the most powerful impacts on fresh water mussels in the region. This does not mean, however, that these species cannot be protected from pesticide contaminants in the interim. Where fresh water mussel habitats are known to exist, upstream wetlands and improved riparian zones can be established as buffers that will slow both organic and inorganic pollutant entry into these sensitive streams. Such measures should be at least somewhat effective regardless of the type of pesticide being used nearby, since wetlands have been shown to detain a wide variety of contaminants, both organic and inorganic (Brady, 1990; EPA, 1982; VOP, 1989). Also, some wetlands flora are known to metabolize and detoxify certain pesticides. Establishment of upstream wetland/riparian buffer zones can also have the added benefit of partially reducing downstream turbidity usually caused by storm runoff (Brady, 1990; Rule, 1992; VOP, 1989), therefore improving the habitat conditions of the fresh water mussels and juvenile fish there.

Table 14 summarizes the areas that require immediate consideration for protection from agricultural contaminants via establishment of wetlands/riparian buffers.

Table 14. JAMES RIVER FRESH WATER MUSSELS AND THEIR HABITAT LOCATIONS

Species	River/stream	Counties
Atlantic pigtoe (*Fusconaia masoni*)	Minor James tributaries	Albemarle, Henrico
	Craig Creek and tributaries	Craig, Alleghany, Botetourt
	Appomattox River	Prince Edward
Green Floater (*Lasmigona subdiridis*)	Appomattox River (near headwater)	Appomattox
	Pedlar River	Amherst
	Minor Rivanna tributaries	Albemarle
James spinymussel (1) (*Pleurobema collina*)	Pedlar River	Amherst
	Potts Creek	Alleghany
	Craig Creek	Craig, Botetourt
	Johns Creek	Craig, Botetourt
	Dicks Creek	Craig, Botetourt
	Patterson Creek	Craig, Botetourt
	Catawba Creek	Craig, Botetourt
	Mechums River	Albemarle
	Moormans River	Albemarle
	Rocky Run	Albemarle
Virginia pigtoe (1) (*Lexingtonia subplana*)	Craig Creek	Craig, Botetourt

Source: *Virginia's Endangered Species*, Terwilliger, 1991
(1) James River Basin endemic species.

More specifically, restoration and protection for the endangered James River Spinymussel may be available on the south fork of the Rivanna River, a tributary to the James River (figures 1 and 20). Structural restoration measures that would help improve water quality include replanting of riparian vegetation, development of storm water filtering system (such as artificial wetlands), fencing of streams to reduce access to livestock, and development of alternative livestock water sources. Costs associated with such restoration features have been estimated to be as little as $80,000. DNH is developing a more specific proposal for work to be accomplished.

Terrestrial Habitat Restoration Opportunities

Woodcock Habitat Restoration. American woodcock populations have been declining nationwide due to loss of early successional habitats, of particular importance are wooded upland and wooded riparian sites. These habitats are critical as breeding sites and summer roosting fields, plus edges of these openings are used by resident and migrant woodcock as daytime cover.

Creating and/or maintaining upland herbaceous habitats may be done on designated areas on the George Washington National Forest (Hidden Valley, Poor Farm, Wallace Tract, Marshall Tract, Walton Tract, and Evans Tract) and suitable ares on the Gathright, Highland, Goshen and Little North Mountain Wildlife Management Areas. Edges and drainage areas within herbaceous openings would be planted to trees/shrubs which will establish cover for woodcock (hawthorn, crabapple, dogwood, willow, alder, aspen, etc.). Riparian areas, which are fenced from cattle could be planted to wetland trees and shrubs to provide habitat for resident and migrant woodcock, may also be developed. Suitable riparian sites on USFWS, VDGIF, and private lands could be enhanced for woodcock. The total project cost is estimated to be $250,000. The primary benefits from the project are associated with the significant restoration and improvements to wildlife resources in the Wildlife Management Areas and George Washington National Forest. These habitat improvements will significantly increase woodcock access to herbaceous forage and shelter sites and thus increase productivity, body weight and overall animal health and address a critical need for this species (see North American Woodcock Plan).

Rivanna River

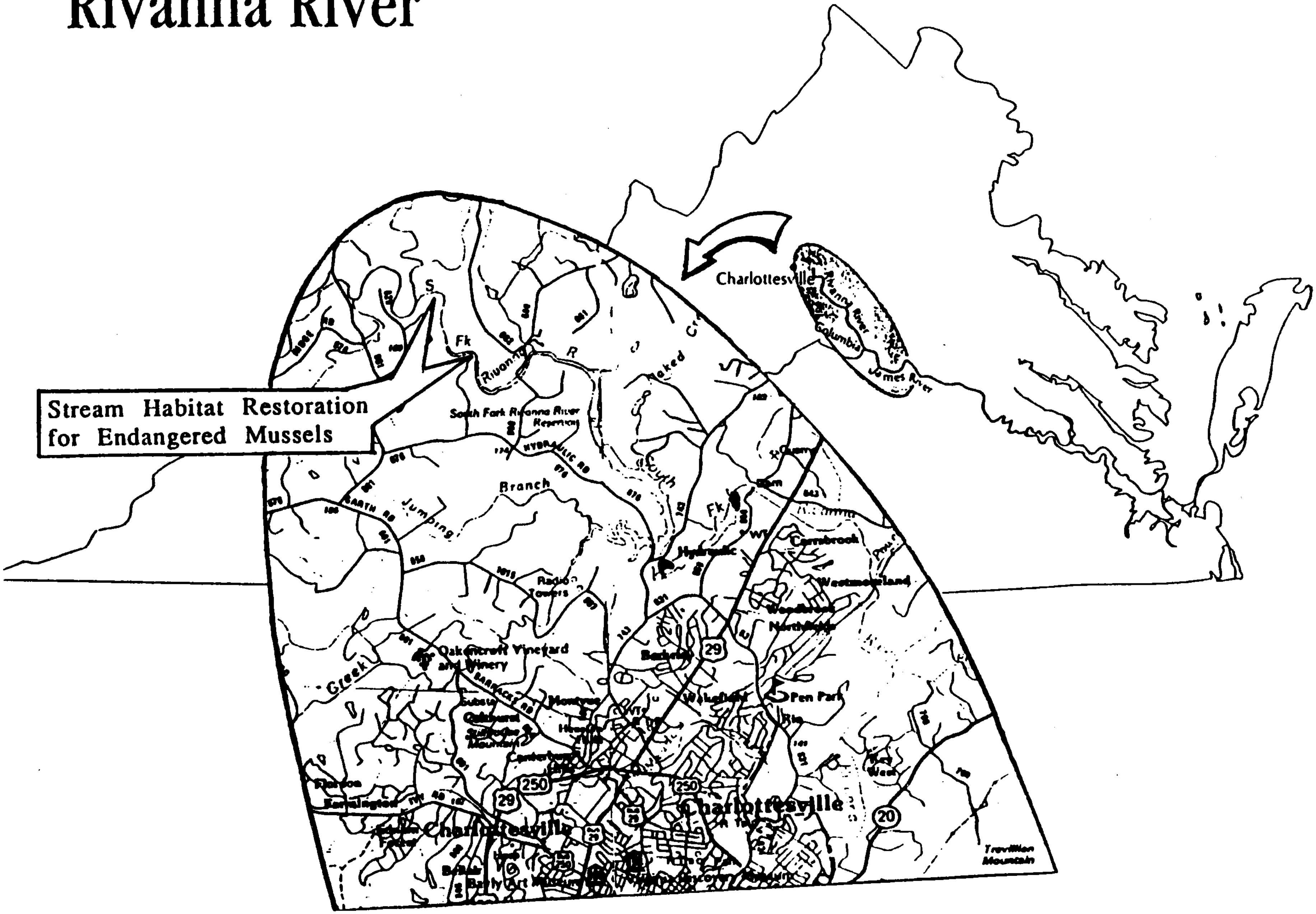


Figure 20. Rivanna River Mussel Habitat Restoration

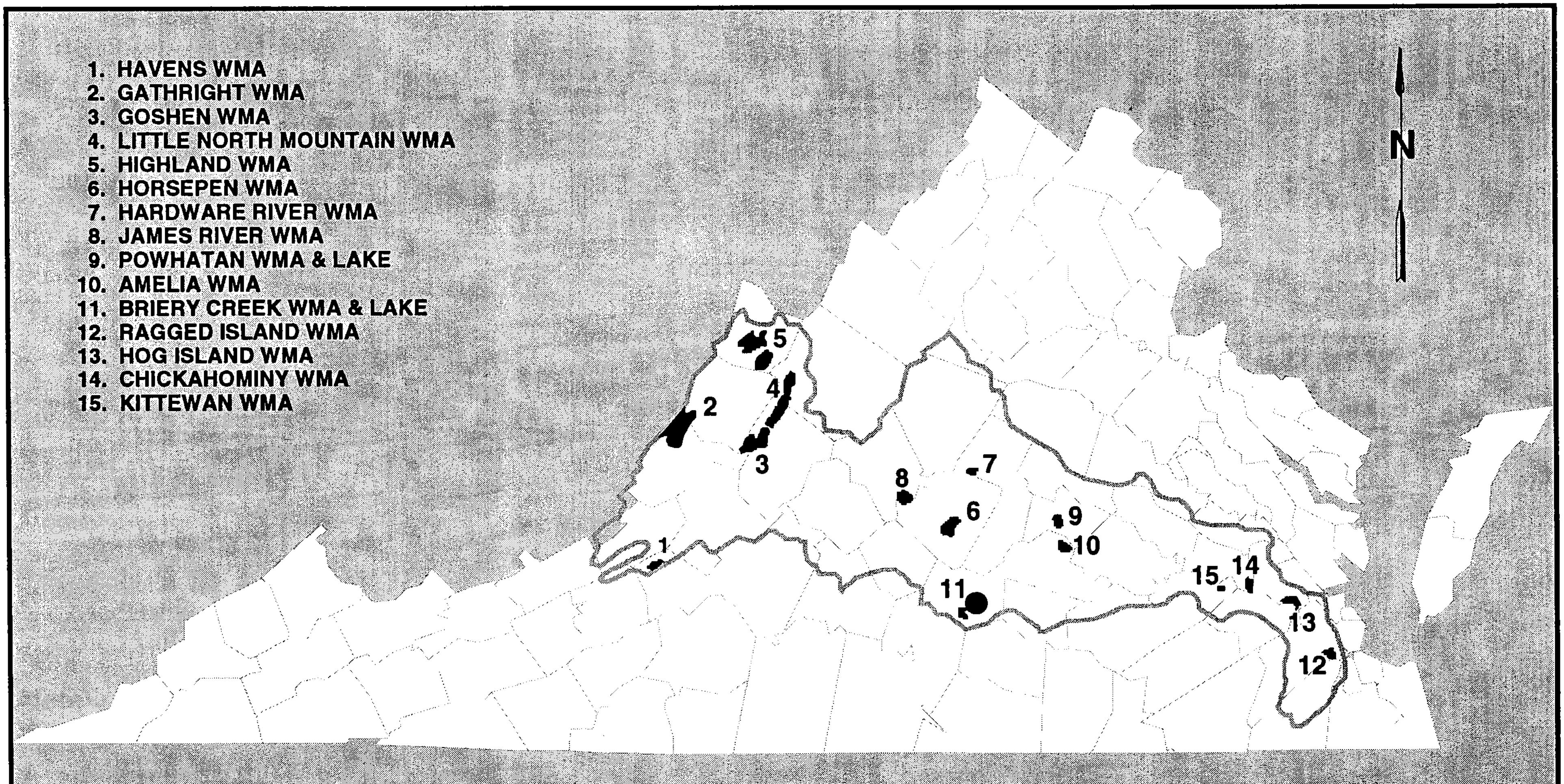
Floodplain Restoration with Warm Season Grasses. Warm season grasses (WSG) are a group of native grasses including, but not limited to: big and little bluestem (Andropogon spp.), indian grass (Sorghastrum spp.), switchgrass (Panicum spp.), side-oats grama (Bouteloua spp.), and eastern gamagrass (Tripsacum spp.) Unlike tall fescue, WSG benefit wildlife because of the bunchgrass growth form. Overhead cover for protection, sites for nesting, with bare ground between bunches for movement and food searching are provided to species such as quail, rabbit, and other ground nesting species such as meadow lark and turkey. Once established, WSG require virtually no additional maintenance, are more productive than cool season grasses, and provide quality summer forage to livestock. Historically, where openings existed due to fire or other disturbances which prevented trees or shrubs, the James River flood plain supported the WSG habitat type.

Converting James River flood plain dominated by fescue to WSG is an inexpensive means of providing habitat where little now exists. There is an additional water quality benefit in that WSG require little if any application of fertilizer, thereby reducing nutrient loading into the James. The VDGIF has produced two publications on establishing WSG fields and wildlife habitat.

Several projects have been conducted by VDGIF on private lands (farms) to successfully demonstrate the benefits of WSG. While no specific sites for application of this type of project are identified in this report, VDGIF indicates that they ". . . feel certain that we could locate and gain concurrence from several landowners . . ." to use their lands as demonstration farms (VDGIF letter to Norfolk District dated April 9, 1993).

Wetland Restoration Projects. Historically, the entire James River flood plain was dotted with extensive wetlands, beaver ponds, overflow channels and similar wetlands. As recent settlement and "modification" of the river basin occurred (Gathright Dam for example), thousands of acres of wetland habitat have been adversely affected or permanently lost. These wetlands constitute a transition area between aquatic and fully terrestrial habitats and supply food to the aquatic system via runoff of detritus and other organic materials, act as giant water filters that remove impurities fresh water run-off, and may also be used for tertiary sewage treatment. Furthermore, wetlands provide protection from rising flood waters due to the high holding capacity from the large amounts of peat and/or other organic matter buildup. The tidal wetlands within the James River are the most productive in terms of biomass produced annually, but the fresh water wetlands have the higher diversity of plant and animal life which provide habitat for birds, reptiles, mammals, fish and amphibians.

Virginia has slated to protect or restore approximately 60,000 acres of wetlands by the year 2000 and, by restoring wetland habitats, the following projects offer a constructive step toward achieving these wetland restoration goals. Furthermore, several of these Wildlife Management Areas (WMA's) lie within the Virginia portion of the Atlantic Coast Joint Venture land which is Federally recognized to be in need of special conservation/restoration efforts due to its significance to wintering or migrating waterfowl (figure 21). The development of a more dependable and extensive wetland habitat will result in an increase of Canada geese and large counts of ducks. It is further anticipated that the current low level usage by wintering bald eagles will increase significantly due to the establishment of a more reliable food supply.



JAMES RIVER BASIN, VIRGINIA
FISH AND WILDLIFE RESTORATION

STATE WILDLIFE MANAGEMENT AREAS

NORFOLK DISTRICT, CORPS OF ENGINEERS
OCTOBER 1993

Figure 21

Proposed Wetland Restoration Projects.

James River Wildlife Management Area. The proposed project involves the restoration of two wetland areas in the state-owned and managed James River Wildlife Management Area (JRWMA - figure 22). The wetlands can be restored, at an estimated cost of $62,500, using VDGIF and F&WS techniques previously implemented at this site and determined to be successful. One wetland parcel can be created on newly acquired land which was a wetland many years ago (prior to use for agriculture). It can be restored to its previous wetland functions through the development of low-level dikes and installation of water control structures to regulate water flow. Risers equipped with flashboards will control water levels. The impoundment would inundate approximately 4-5 acres. The second wetland, which can be created just south of a previously constructed wetland restoration project, will be restored to its past wetland functions through the development of low-level dikes and installation of water control structures. Risers equipped with flashboards will control water levels. This impoundment would inundate approximately 4-5 acres. The dike will be created with earthen materials. A buffer area around both wetland parcels would be planted with native herbaceous cover to increase functional restoration of the wetland. Both wetlands would also be designed to compliment the existing wetland.

The addition of two wetlands to the existing wetland at JRWMA will increase wetland-related functions from fair to moderately good and provide increased flexibility in managing the area. Occasionally a wetland will be drawn down or needed to hold waters deeper than normal for a significant period, resulting in a loss of habitat for wetland-oriented species. With two other wetlands in the area adjacent to the existing one, all wetland-related species would be able to relocate easily to another marsh. Under current conditions, the VDGIF is reluctant to use extremes of water manipulation because of the potential to displace the wildlife utilizing the restored wetland, even when such management is in the best interest in the long run.

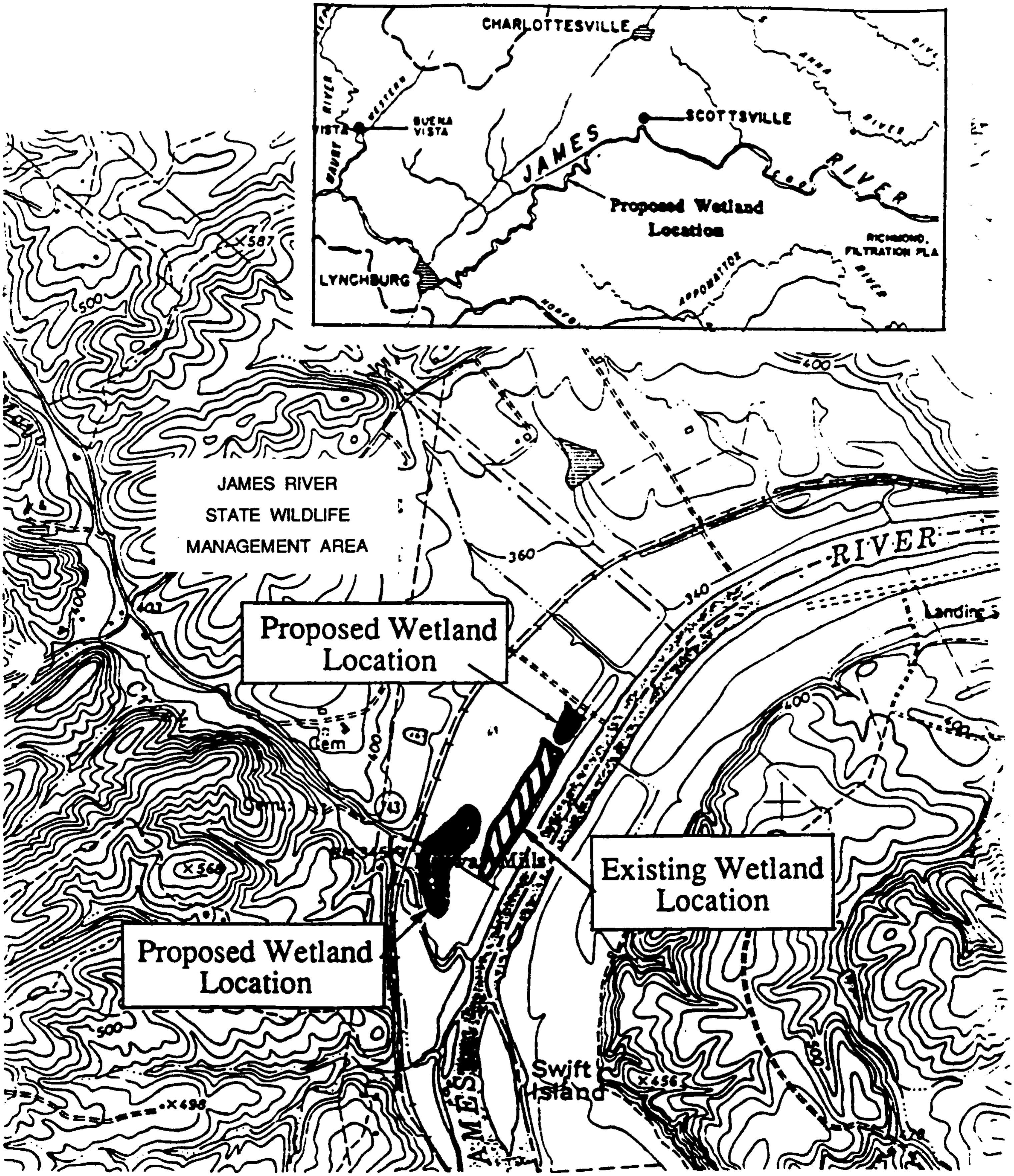


Figure 22. James River Wildlife Management Area Wetland Restoration

Hardware River Wildlife Management Area. This wetland project involves the restoration of wetland habitat in the Hardware River Wildlife Management Area (HRWMA - figure 23). The wetland will be restored, at a cost estimated to be $37,500, using techniques previously demonstrated and proven at HRWMA to restore wetlands. The wetland will be restored to its past wetland functions through the development of low-level dikes and installation of water control structures to regulate water flow. Risers equipped with flashboards will control water levels. Impoundments will inundate 4-5 acres of former farmland. The dike will be created with earthen materials. A buffer area around the wetland will be planted with native herbaceous cover to increase functional restoration of the wetland.

Amelia Wildlife Management Area. Wetlands at the Amelia Wildlife Management Area (AWMA) will be restored using techniques of VDGIF and USFWS proven to successfully restore wetlands at AWMA (figure 24). The wetland is intended to be constructed at the lower end of an open field and to the west into a sweetgum and brush area, not the adjacent lowland birchstand which is an existing wetland. Like the JRWMA wetland restoration project, the addition of wetland habitat to existing marshlands will increase wetland-related functions and provide increased flexibility in managing the area. Wetland-related species would be able to relocate more easily to another marsh when management techniques stress the habitat. The wetland will be restored to its past wetland functions at a cost of $31,300 and will increase the available acres of wetlands through the development of low-level dikes and installation of water control structures. Risers equipped with flashboards will control water levels. The impoundment will inundate 4-5 acres of former farmland. The dike will be created with earthen materials. A buffer area around the wetland will be planted with native herbaceous cover to increase functional restoration of the wetland.

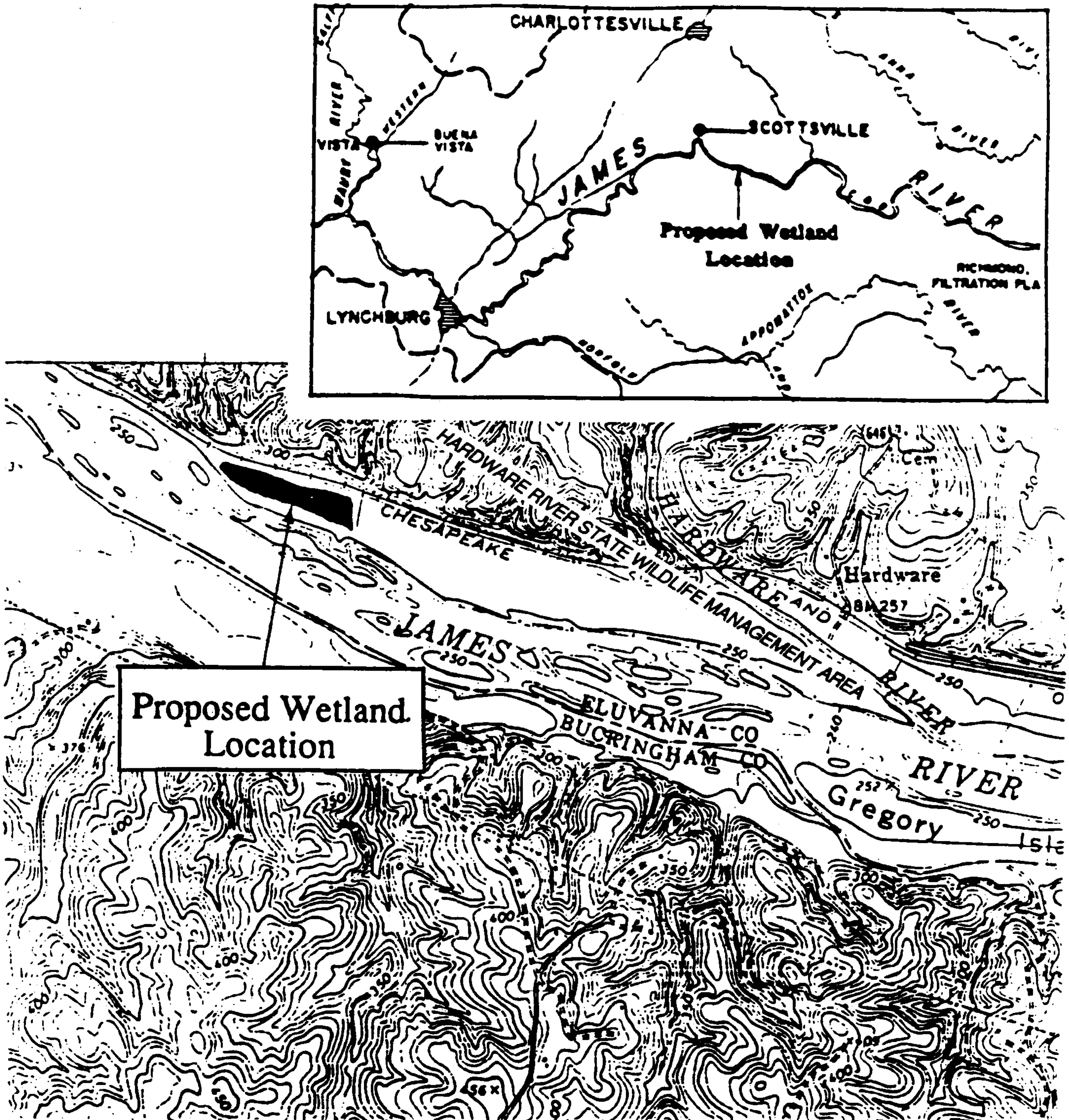


Figure 23. Hardware River Wildlife Management Area Wetland Restoration

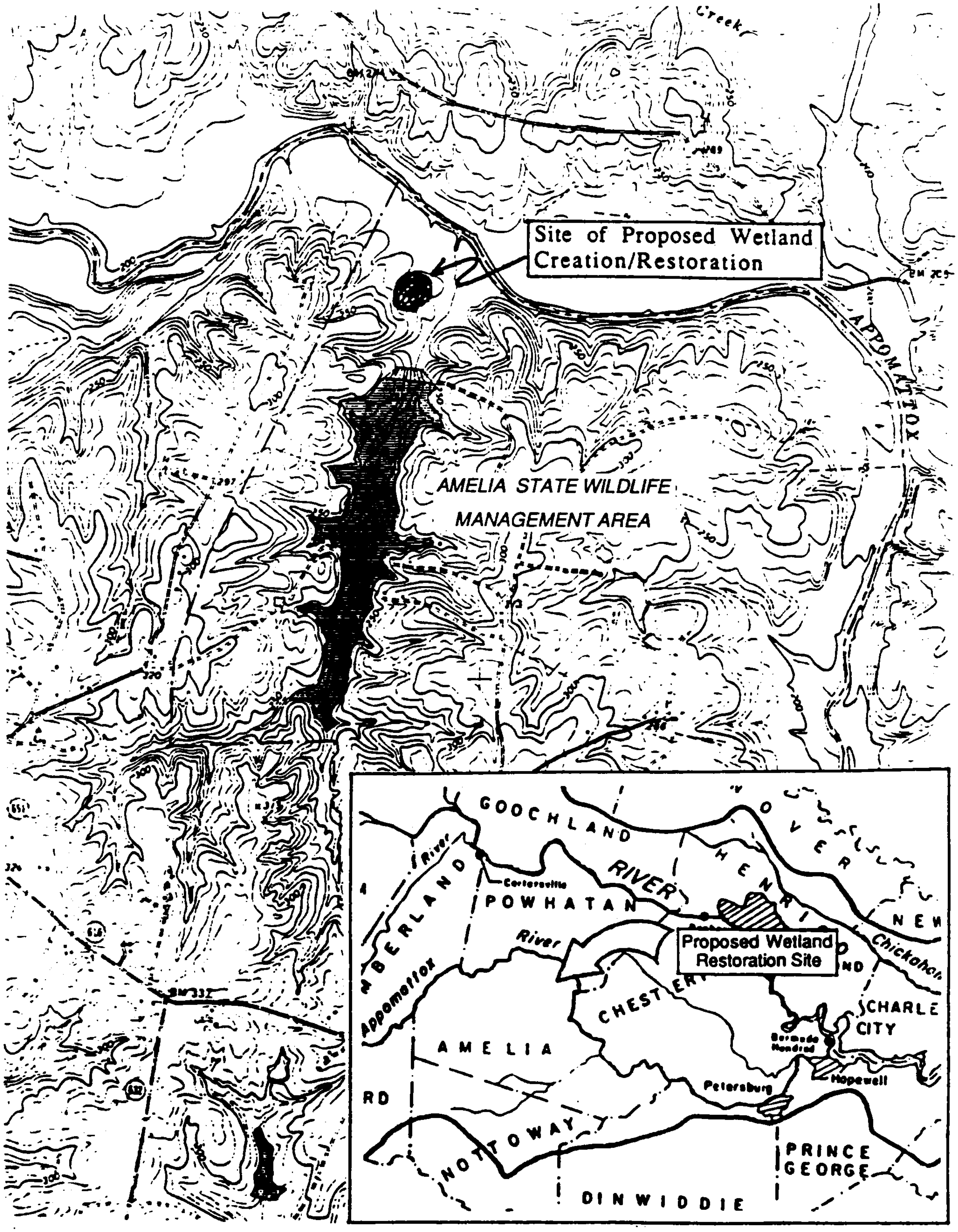
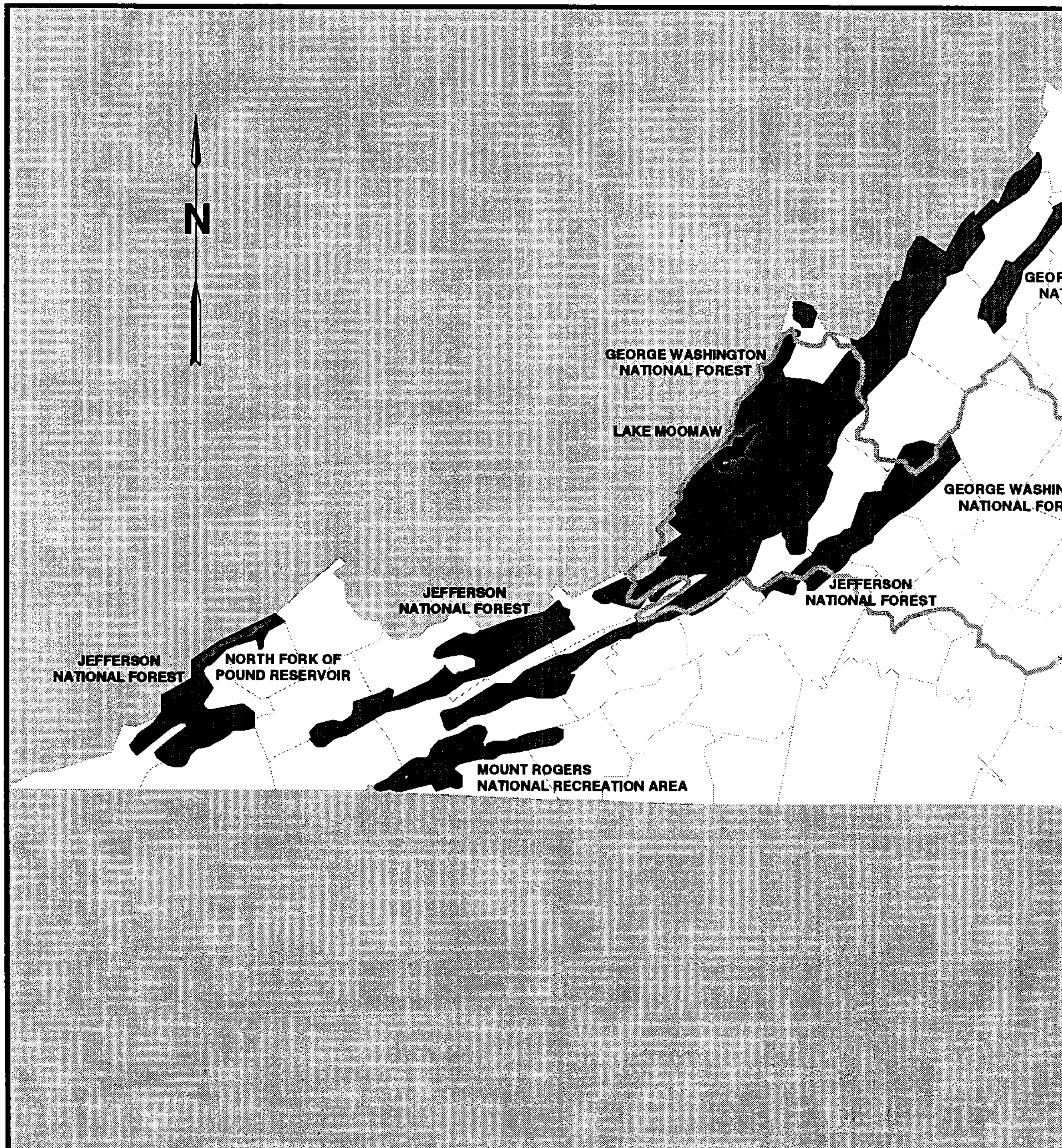


Figure 24. Amelia Wildlife Management Area Wetland Restoration

The proposed JRWMA, HRWMA, and the AWMA restoration projects will increase the wetland area responsible for retaining flood waters and trapping silt and nutrients, as well as restoring and enhancing habitat that supports extensive waterfowl and other wildlife populations. Species that depend on wetlands for part of their life cycle that will benefit greatly from wetland restoration include both game and nongame fish, waterfowl and mammals, and various amphibians, reptiles, and insects. Wetland sites are located on lands owned by VDGIF that were once wetlands but were converted for agricultural purposes.

George Washington National Forest - Wetland/Waterfowl Habitat. In an effort to restore, protect, and enhance waterfowl populations and their habitats in the George Washington National Forest (figure 25), several waterfowl habitat projects have been recommended by the VDGIF and the U.S. Forest Service. The proposed waterfowl habitat restoration projects involve construction of shallow impoundments and devices for regulating water level and will encourage native aquatic plant growth and/or will involve seeding of aquatic emergent vegetation. The proposed project areas include a 5-acre marsh in Hidden Valley, 2 acres in Evans, 8 acres in Wallace, 3 acres in Walton, and 3 acres in Marshall. The projects will enhance waterfowl habitat by increasing available wetlands in these areas at an estimated cost of $312,500. While the wetlands will be designed primarily to benefit waterfowl, a significant increase in other species populations that use wetlands for part of their life cycle is anticipated. These species include game and nongame mammals, and a variety of fish, amphibians, and reptiles. The entire project modification will be implemented on existing lands within the George Washington National Forest.



JAMES RIVER BASIN, VIRGINIA
FISH AND WILDLIFE RESTORATION

NATIONAL FORESTS AND WILDLIFE REFUGES

NORFOLK DISTRICT, CORPS OF ENGINEERS
OCTOBER 1993

Figure 25

Hazardous, Toxic and Radioactive Waste (HTRW) Evaluation of Alternative Plans

In accordance with ER-1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance, a reconnaissance-level assessment of HTRW was conducted during this study to determine the existence and potential for HTRW in the proposed project areas, and to determine the relative level of effort to be undertaken in the subsequent studies in regard to HTRW considerations for the alternative project plans. The investigation requested information from EPA, Region III, regarding known, alleged or potentially hazardous, toxic, and radioactive waste sites in the basin. This information is available as a computer listing known as the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). The information obtained from CERCLIS is presented in appendix E. Land uses that indicate the potential for HTRW contamination in and near the proposed project areas were evaluated from USGS maps. A listing of sites in Virginia on EPA's National Priorities List of Hazardous Waste Sites ("Superfund") is shown in Table 15. Sites found in the James River Basin are in italics.

Table 15. NATIONAL PRIORITIES LIST OF HAZARDOUS WASTE SITES IN VIRGINIA: 1991

Site name	Location	Date first proposed
Abex Corporation	Portsmouth	1988
Arrowhead Assoc./Scovill Corp.	Montross	1988
Atlantic Wood Industries, Inc.	Portsmouth	1986
Avtex Fibers, Inc.	Front Royal	1984
Buckingham County Landfill	Buckingham	1985
C&R Battery Co., Inc.	Chesterfield	1987
Chisman Creek	York	1981
Culpeper Wood Preservers, Inc.	Culpeper	1984
Defense General Supply Center	Chesterfield	1987
Dixie Caverns County Landfill	Salem	1987
First Piedmont Corporation Rock Quarry	Pittsylvania	1985
Greenwood Chemical Co.	Newtown	1987
H & H Inc., Burn Pit	Farrington	1987
L.A. Clarke & Son	Spotsylvania	1984
Rentokil, Inc.	Richmond	1987
Rhinehart Tire Fire Dump	Frederick	1984
Saltville Waste Disposal Ponds	Saltville	1982
Saunders Supply Co.	Chuckatuck	1987
Suffolk City Landfill	Suffolk	1988
U.S. Titanium	Piney River	1982

Source: United States Environmental Protection Agency, Office of Emergency and Remedial Response. National Priorities List, Supplementary Lists and Supporting Materials, February 1991. U.S. Government Printing Office, Wash., D.C., 1991.

Land uses near project areas located upstream of Covington, Virginia and in other more rural areas did not indicate a significant potential for HTRW. Land uses indicate that there is greater potential for the presence of HTRW below Covington and in the vicinity of major urban areas such as Richmond, Hopewell, and Newport News.

Based upon this preliminary investigation, no known HTRW sites were identified that would potentially jeopardize the implementation of the proposed project alternatives. All site alternatives would have to be evaluated more thoroughly for HTRW during subsequent phases of investigation, with assumption that the urban sites will require more detailed evaluations.

STUDY COORDINATION

The Commonwealth of Virginia, Council on the Environment, is the local sponsor of the James River Basin Fish and Wildlife Restoration reconnaissance study. On October 2, 1992, an overview meeting was arranged by the Corps to coordinate the study with the Commonwealth.

It was explained that the Corps desire was to develop an interagency work group with other state and Federal agencies who would have an interest in this study. A "brainstorming" session where different areas of interest in the basin could be identified and prioritized was desired. To this end, an interagency meeting was conducted on November 18, 1992. Agencies represented were the Army Corps of Engineers (ACOE), Virginia Council on the Environment (Council), U.S. Fish & Wildlife Service (FWS), State Water Control Board (SWCB), Virginia Department of Game and Inland Fisheries (VDGIF), Chesapeake Bay Local Assistance Department (CBLAD), Virginia Marine Resources Commission (VMRC), Virginia Department of Conservation and Recreation (DCR), Virginia Department of Forestry (VDOF), Virginia Commonwealth University (VCU), and Virginia Polytechnic Institute and State University (VPI).

A group discussion of fish and wildlife restoration opportunities in the James River Basin was conducted. Many ideas were suggested and discussed under the general headings of fisheries, wetlands, water quality, riparian habitat, and endangered species. Much of the discussion concentrated on nontidal areas of the James River above the fall line.

The group discussed the suggestions and made a preliminary attempt to determine priorities. There was general consensus that the projects most likely to win Federal and local sponsor approval were those that involved practical or active restoration efforts, rather than just studies.

Another meeting was held on December 9, 1992. The focus of this meeting was to look, more specifically, at potential fish and wildlife restoration projects in the James River Basin that have a strong local interest (i.e., are supported by the Commonwealth) and that also could be endorsed by the Federal Government within the parameters of this study. The previously assembled study team was reconvened to accomplish these objectives.

The state followed up this meeting by prioritizing, in writing, the various areas proposed for restoration and presented specific locations for evaluation to the Corps (see appendix C).

A meeting was conducted in Covington, Virginia, on March 3, 1993 to specifically focus on the fish and wildlife restoration needs and opportunities in the vicinity of the Corps Gathright Dam and Lake Moomaw project in western Virginia. Representatives of the U.S. Forest Service, George Washington National Forest (Warm Springs, Pedlar, and James River Ranger Districts), Virginia Department of Game and Inland Fisheries, U. S. Fish and Wildlife Service, Virginia Council on the Environment, and the Corps of Engineers (Norfolk District) were present.

After a discussion of potential fish and wildlife restoration projects, it was agreed that the Forest Service and VDGIF would coordinate and submit a list of specific projects.

The meeting was followed by a field visit to prospective fish and wildlife restoration sites in the Gathright Wildlife Management Area and Lake Moomaw vicinity overseen by the U.S. Forest Service.

Another meeting of the interagency work group was held on April 15, 1993. The meeting objectives were to: (1) present an overview of the projects which will be addressed in the reconnaissance study and re-confirm the local sponsor's interest in these projects; and (2) discuss general procedures and possible options related to local sponsor funding sources for meeting 50/50 match requirements for the next study phase (feasibility phase).

Projects were reviewed and, where there were concerns/changes related to specific projects, they were discussed. The reconnaissance study schedule was reviewed with participants and the possible initiation of the feasibility study phase in May 1994 was discussed. Numerous informal meetings and telephone conversations were used to exchange information and solicit support for the study.

More recently, the local sponsors were apprised that the study would not recommend continuing into a full feasibility study under the General Investigations program. As conveyed, further consideration will be given to evaluating fish and wildlife habitat restoration projects under Section 1135 of the WRDA 1986, as amended. A letter was received from VDGIF dated August 25, 1993, fully supporting this approach, endorsing and prioritizing the various projects discussed in this report.

SUMMARY AND CONCLUSIONS

The primary water resources-related problems in the James River Basin are the result of the effects of industrialization, urbanization and previous construction of Federal projects to meet water resources needs including flood control, navigation, and dredged material placement/containment. As a result of these developmental pressures, fish and wildlife habitat has been degraded and the overall environmental quality of the James River Basin has been diminished. The reconnaissance study process identified measures that could be undertaken in concert with the ongoing efforts of Federal, state, local and regional governments and private industry to restore the environmental values of the basin approaching historic levels. Emphasis was placed on those measures that could restore anadromous fish habitat, wetlands, endangered and threatened species habitat, and riparian and upland wildlife habitat.

The Corps of Engineers has constructed seven navigation projects, one reservoir project, six flood protection projects, one permanent and sizable dredged material management area, and one emergency seawall rehabilitation project within the James River Basin. Miles of suitable habitat upstream of Gathright Dam is currently inaccessible to anadromous fish species.

Development of a basinwide plan to restore fish and wildlife habitat throughout its historic range was beyond the scope of this reconnaissance study. During this study, no restoration plans were identified that were of a scope large enough to warrant a full followup feasibility study under the General Investigations program. Instead, a number of individual smaller projects were identified which will be considered under separate authority such as Section 1135 of the Water Resources Development Act of 1986, as amended. While the proposed projects are relatively small, they offer the potential to make significant contributions to fish and wildlife habitat restoration in the basin. The proposed projects, if implemented, would (1) restore anadromous fisheries spawning range in the basin; (2) provide for a hatchery to augment anadromous populations; (3) restore riparian and instream habitat in selected areas; (4) protect and restore endangered species habitat; (5) restore wetlands habitat in the state's wildlife management areas; and (6) restore waterfowl habitat.

The proposed restoration projects have been discussed with state and local interests and non-Federal sponsors have indicated a willingness to cost share in followup studies. The VDGIF has been identified as the local sponsor for the proposals presented in this report. VDGIF has provided a letter of endorsement to the Corps which also prioritizes their funding of the projects identified in this study.

RECOMMENDATIONS

Based on the findings of this reconnaissance phase study as presented in this report, further study to determine the feasibility of constructing fish and wildlife restoration projects in the James River Basin is not appropriate under the General Investigations program. However, it is recommended that further consideration be given to evaluating fish and wildlife habitat restoration projects under Section 1135 of the WRDA 1986, as amended.

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ENVIRONMENTAL RESOURCES

APPENDIX A

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HABITAT FUNCTIONS WITHIN THE JAMES RIVER BASIN

NONTIDAL WETLANDS

1. Current scientific research indicates that the most prominent types of nontidal wetland in Virginia are associated with high levels of water quality enhancement and are important contributors to aquatic food chains. Virginia's nontidal wetlands also perform a variety of other important environmental functions which are discussed in the following paragraphs.

Ground Water Discharge and Recharge

2. Both ground water discharge and recharge result from the retention of water in a nontidal wetland. Recharge refers to the channeling of surface flow into aquifers, replenishing water supplies. Discharge conveys water to the surface, augmenting the base streamflow.

Wildlife Habitat

3. Wetlands support over 50 percent of rare, threatened or endangered plant species in Virginia. For example, bottomland hardwoods support a high density of amphibian, waterfowl [and other avian], and mammalian species. Game species use nontidal wetlands because of a high density of invertebrate food sources and cover.

Flood Storage and Peak Reduction

4. Wetlands slow discharges and reduce flood peaks by intercepting and temporarily storing storm runoff. Numerous wetlands within a watershed may store peak flows, releasing the waters gradually. Both functions serve to contain flows within downstream channels. Reduction of flood peaks may reduce flood damage and reduce the need for flood control measures.

Shoreline Anchoring and Dissipation of Wave Energy

5. Riparian nontidal wetlands help stabilize shoreline soil and buffer the shore from erosive forces with their roots and vegetation. Abatement of erosion

conserves fertile soil, prevents sediment deposition in navigable channels and impoundments, and preserves shoreline property.

Water Quality Maintenance

6. Wetlands serve as natural filters by retaining suspended sediments and associated nutrients, pesticides, heavy metals, and other toxins derived from land runoff. Removal processes involve sedimentation of organic matter, adsorption onto soil particles, metabolism of organics, and microbial conversion of gases. Nutrients are taken up by the vegetative and microbial components of nontidal wetlands, which may be later released in different form. Such processes preserve water quality by reducing turbidity and by removing toxic compounds and inorganic nutrients.

Food Chain Support

7. Wetlands are effective aquatic food chain support due to their high degree of primary productivity and dispersal of nutrients in forms that are usable to higher trophic levels. Seasonally flooded and riparian wetlands have been reported to contribute substantially to food chains. Organic carbon and nitrogenous compounds, bound in exported leaf matter, may benefit animals inhabiting downstream aquatic environments, including commercially valuable shellfish and sportfish.

Recreation and Open Space Value

8. Wetlands possess numerous recreational values. Game species such as inland waterfowl and sportfish depend upon nontidal wetlands. Wetlands provide native ecological systems important to education, and wetlands are important in maintaining water quality in areas of water-based recreation. In addition, nontidal wetlands provide scenic, open space, natural, and scientific values.

9. The predominant functions of the prominent wetland types vary among regions. Nontidal wetlands such as bogs, ponds and meadows in the western portion of Virginia, as well as headwater wetlands throughout the state, buffer and detain flood waters for the protection of downstream areas. These areas may also serve as sites for ground water recharge.

10. Wetlands located along rivers and streams in the Piedmont and Mountain regions perform nutrient retention, sediment filtering, and other water quality functions similar to those provided by tidal fringe marshes of the Coastal Plain. These wetlands also serve as conduits for ground water discharge, helping to maintain the flow levels of streams and rivers.

11. Bottomland hardwood swamps of the Coastal Plain are important sources of food production for aquatic animals. These wetlands provide habitat for numerous species and are important for water quality protection, erosion control, and hunting and other recreational activities.

TIDAL WETLANDS

Wildlife Habitat

12. Virginia's tidal marshes are an important component of the Atlantic Coastal Flyway, a major north-south migratory route for birds of eastern North America. Most of the waterfowl reared between the western shore of Hudson Bay and Greenland spend some time in the marshes and on the waters of the Chesapeake Bay during their migrations. The tidal wetlands of the Chesapeake Bay, including those in the James River estuary, provide some of the most heavily used wintering habitat for waterfowl along the Atlantic Flyway.

13. Deer and a variety of small mammals, as well as some of their natural predators, also inhabit the tidal marshes of the James River. Some of these support local hunting.

Fish and Aquatic Habitat

14. Tidal wetlands are important feeding, breeding, and nursery grounds to a wide variety of fish, crabs, and other estuarine and marine organisms. The wetlands provide cover and food in the form of plant matter.

Food Chain Support

15. Tidal wetlands are among the most productive ecosystem types in the world. The large amounts of organic matter produced by tidal wetland plants and phytoplankton serve as the primary food source for all manner of invertebrates, which serve as food sources for consumers at higher trophic

levels. It has been estimated that 85-90 percent of the commercially important finfish and shellfish species in the Chesapeake Bay and its estuarine tributaries are supported by tidal wetlands, either directly or indirectly.

Water Quality Maintenance

16. Tidal wetlands act as particulate filters, trapping sediments and slowing the rate of siltation on shellfish beds and navigation channels. Tidal wetlands can act as pollutant detention sinks, where nitrogenous, phosphoric, and organic pollution can be at least partially assimilated by the wetland biota before re-release in the aquatic system.

Erosion and Turbidity Control

17. Tidal marshes can buffer wave action and slow the rate of runoff from coastal rainfall, thereby reducing the erosive effects of both of these agents. Marshes planted along shorelines have proven to be relatively inexpensive deterrents to erosion. Wetlands are especially important to this function in the estuarine portions of the James River since they stabilize the relatively fine-grained sediments of the intertidal zone. Prolonged turbidity can interfere with the normal life functions of filter-feeding organisms, and the movements of organisms dependent upon visual clarity of the water for feeding and/or migration.

FOREST LANDS

18. Wooded lands occupy about 64 percent of the Commonwealth of Virginia as a whole, and approximately 13 percent of the forest land in Virginia is owned and managed by the state and Federal Governments. Of the remainder, 12 percent is owned by the forest industry and 75 percent is in the hands of private owners.

19. The management of forest land for timber is one of the largest industries in Virginia. In addition to wood production, forests serve as ground water recharge areas, protect water quality by reducing erosion, provide wildlife habitat, offer recreational opportunities, and provide aesthetic benefits.

20. Forest lands reduce erosion by increasing water infiltration into the soil, retaining soil through extensive root systems, and providing windbreaks. The

proper use of Best Management Practices (BMPs) in forestry operations to minimize erosion protects water quality. Examples of BMPs are: filter strips of vegetation along streambanks, proper site preparation, rapid revegetation, and proper pesticide control.

21. Forested lands provide diverse habitats, food supplies, and breeding areas to a variety of wildlife communities. For the landowner who plants wooded land, the attraction of wildlife such as pheasant, quail, deer, songbirds, and other species is an important benefit. Trees also contribute to microclimate conditions, by moderating air temperatures, increasing humidity, and reducing wind speed and noise. Many landowners are managing their lands for timber production and are employing conservation techniques at the same time.

22. In addition to financial value, forest lands have significant recreational and aesthetic benefits. The Virginia Outdoors Plan, published by the Department of Conservation and Historic Resources, identifies many prime forest lands which should be protected as natural areas.

RIPARIAN AREAS

23. Width of riparian woodland also determines the degree to which impacts of adjacent land use on water quality are buffered before reaching the stream. Optimum width for a riparian buffer zone varies with stream type, type of impact, sensitivity of the resource, and water quality standards. Buffer strips reduce erosion (and pollution), preserve the stream channel's stability, retard runoff, trap sediments and nutrients, and maintain suitable water temperatures for aquatic life.

24. The following is a qualitative list of values of riparian ecosystems adapted from Lugo and Brinson (1978).

<u>Hydrologic Values</u>

- Store flood waters and ameliorate downstream flooding
- Serve as areas of aquifer recharge or discharge
- Provide year-round source of water in arid climates

Organic Productivity Values

- Have higher primary productivity than surrounding uplands
- High secondary productivity supports fisheries, trapping, and hunting
- Export organic matter to downstream ecosystems such as lakes and estuaries
- Produce high yields of timber and quality lumber

Biotic Values

- Serve as required habitat for endangered plant and animal species, as refuge for upland species, and as corridors for animal movement
- Provide spawning areas for some anadromous and other fish species
- Produce organic matter from riparian vegetation for aquatic food chains in small streams

Biogeochemical Values

- Have high capacity to recycle nutrients; usually accumulate nitrogen and phosphorus
- Sequester heavy metals and some poisonous chemicals in anaerobic soil zones and/or clays
- Provide buffer zones for maintaining water quality
- Accumulate organic matter and thus provide sink for atmospheric CO_2

Geomorphic Values

- Contribute to landscape diversity
- Provide areas of sedimentation for building soils
- Have topographic relief that is maintained by stream meandering

FAUNA AND FLORA IN THE JAMES RIVER BASIN

25. The James River Basin supports a variety of wildlife, defined in this context as terrestrial forms, excluding domesticated animals. The fauna mentioned are reported on a regional basis, in that the range of these animals can be expected to be found within the study area. The following lists, which contain the dominant forms of wildlife species, are intended to illustrate the diversity found within the river basin, and do not presume to name all species that will occur.

BIRDS

Pied-billed Grebe*, *Podilymbus podiceps*
Double-crested Cormorant*, *Phalacrocorax auritus*
Canada Goose, *Branta canadensis*
American Black Duck [d], *Anas rupripes*
Gadwall*, *A. streptera*
Mallard, *Anas platyrhychos,*
Wood Duck, *Aix sponsa*
Blue-winged Teal*, *A. crecca*
Green-winged Teal*, *A. discors*
Canvasback, *Aythya valisineria*
Bufflehead*, *Bucephala albeola*
Ruddy Duck*, *Oxyura jamaicensis*
Common Merganser, *Mergus merganser*
Hooded Merganser, *Lophodytes cucullatus*
American Coot, *Fulica americana*
Ring-billed Gull*, *Larus delawarensis*
Herring Gull*, *L. argenatus*
Greater Black-backed Gull*, *L. maritimus*
Laughing Gull*, *L. atricilla*
Caspian Tern*, *Sterna caspia*
Royal Tern*, *S. maxima*
Least Tern*, *S. albifrons*
Great Blue Heron, *Ardea herodias*
Little Blue Heron, *Florida caerulea*
Great Egret, *Casmerodias albus*
Black-crowned Night Heron*, *Nycticorax nycticorax*
Yellow-crowned Night Heron*, *Nyctianassa violacea*
Green Heron, *Butorides striatus*
Virginia Rail*, *Rallus limicola*
King Rail*, *R. clegans*
Killdeer, *Charadrius vociferus*
American Woodcock, *Philohela minor*
Common Snipe, *Capella gallinago*
Spotted Sandpiper, *Actitus macularia*
Least Sandpiper*, *Calidris minutilla*
Wild Turkey, *Meleagris gallopavo*
Ruffed Grouse, *Bonasa umbellus*
Common Bobwhite, *Colinus virginianus*
Sharp-shinned Hawk, *Accipiter striatus*
Northern Harrier (Marsh Hawk)[d], *Circus cyanus*
Red-tailed Hawk, *Buteo jamaicensus*
Red-shouldered Hawk, *Buteo lineatus*
Osprey*, *Pandion halieaetus*
Turkey Vulture, *Cathartes aura*
Black Vulture, *Coragyps atratus*
American Kestrel, *Falco sparverius*
Common Screech Owl, *Otus asio*

Great Horned Owl, *Bubo virginianus*
Barred Owl, *Strix varia*
Barn Owl, *Tyto alba*
Mourning Dove, *Zenaida macroura*
Yellow-billed Cuckoo, *Coccyus americanus*
Whip-poor-will, *Caprimulgus vociferous*
Chuck-will's-widow, *Caprimulgus carolinensis*
Ruby-throated Hummingbird, *Archilochus colubris*
Belted Kingfisher, *Megaceryle alcyon*
Red-headed Woodpecker, *Melanerpes erythrocephalus*
Pileated Woodpecker, *Drycopus pileatus*
Northern Flicker, *Colaptes auritus*
Red-bellied Woodpecker, *Melanerpes carolinus*
Yellow-bellied Sapsucker, *Sphyrapicus varius*
Downey Woodpecker, *Picoides pubescens*
Hairy Woodpecker, *P. villosus*
Eastern Kingbird, *Tyrannus tyrannus*
Great Crested Flycatcher, *Myiarchus crinitus*
Eastern Phoebe, *Sayornis phoebe*
Acadian Flycatcher, *Empidonax virescens*
Purple Martin, *Progne subis*
Barn Swallow, *Hirundo rustica*
Tree Swallow, *Iridoprocne bicolor*
Chimney Swift, *Chaetura pelagica*
Fish Crow, *Corvus ossifragus*
American Crow, *C. brachyrhynchos*
Blue Jay, *Cynocitta cristata*
Carolina Chickadee, *Parus carolinensis*
Tufted Titmouse, *P. bicolor*
White-breasted Nuthatch, *Sitta carolinensis*
Red-breasted Nuthatch, *S. canadensis*
Brown-headed Nuthatch, *S. pusilla*
House Wren, *Troglodytes aedon*
Winter Wren, *T. troglodytes*
Carolina Wren, *Cistothorus palustris*
Ruby-crowned Kinglet, *Regulus calendula*
Golden-crowned Kinglet, *R. satrapa*
Blue-gray Gnatcatcher, *Polioptila caerula*
Brown Thrasher, *Toxostoma rufum*
Gray Catbird, *Dumetella carolinensis*
Northern Mockingbird, *Mimus polyglottis*
Eastern Bluebird, *Sialia sialis*
Northern Water Thrush, *Seiurus motacilla*
Hermit Thrush, *Chatarus guttatus*
Cedar Waxwing, *Bombycilla cedroron*
Red-eyed Vireo, *Vireo olivaceus*
Warblers (15+ species), family *Parulidae*
Red-winged Blackbird, *Agelaius phoeniceus*
Brown-headed Cowbird, *Molothus ater ater*

Common Grackle, *Quiscalus quiscula*
Eastern Meadowlark, *Sturnella magra*
Orchard Oriole, *Icterus spurius*
Dark-eyed Junco, *Junco hyemalis*
Northern Cardinal, *Cardinal cardinalis*
House Finch, *Carpodacus mexicana*
American Goldfinch, *Carduelis tristis*
Blue Grosbeak, *Guiraca caerula*
Indigo Bunting, *Passerina cyanea*
Sparrow (10+ species), family *Fringillidae*

* Species found in tidally influenced areas only.
[d] Species is declining.

MAMMALS

Virginia Opossum, *Didelphis virginiana*
Least Shrew[d] *Cryptois parva*
Eastern Mole, *Scalopus aquaticus*
Eastern cottontail (rabbit)[d], *Sylvilagus floridanus*
Woodchuck, *Marmota monax*
Gray squirrel, *Sciurus carolinensus*
Beaver, *Castor canadensis*
Muskrat, *Ondatra zibethicus*
Red fox, *Vulpes vulpes*
Gray fox, *Urocyon cinereoargenteus*
Black bear[d], *Ursus americanus*
Raccoon, *Procyon lotor*
Mink, *Mustela vison*
River otter, *Lutra canadensis*
Nutria,
Bobcat[d] *Felis rufus*
White-tailed deer, *Odocoileus virginianus*
Skunk, *Mephitus mephitus*

REPTILES

Snapping turtle, *Chelydra serpentina*
River cooter, *Chrysemys concinna*
Eastern box turtle, *Terrapene carolina*
Eastern musk turtle, *Sternothaerus odoratus*
Northern water snake, *Nerodia sipedon*
Eastern ribbon snake, *Thamnophis sauritus*
Eastern kingsnake, *Lampropeltis gentulus*
Rat snake, *Elaphe obsoleta*
Eastern garter snake, *Thamnophis sirtalis*
Rough green snake, *Opheodrys aestivus*
Eastern hognose snake, *Heterodon platyrhinos*
Copperhead, *Agkstrodon contorttrix*

ENDANGERED AND THREATENED SPECIES

Amphibians:
Barking tree frog, *Hyla gratiosa*
Eastern tiger salamander
White spotted salamander

Birds:
Bald Eagle, *Haliaeetus luecocephalus*
Loggerhead Shrike, *Lanius ludovicianis*
Bewick's Wren, *Thyromanes bewickii*

Fish:
Atlantic shortnose sturgeon, *Acipenser oxyhynchus oxyhynchus*
Roughhead shiner, *Notropis semperasper*
Orangefin madtom, *Noturus gilberti*

Invertebrates:
Atlantic pigtoe mussel, *Fusconaia masoni*
James spinymussel, *Pleurobema collina*

Mammals:
Eastern woodrat, *Neotoma floridana*
Indiana bat, *Myotis sodalis*
Northern flying squirrel, *Glaucomys sabrinus fuscus*
Northern water shrew, *Sorex palustris*
Social myotis, *Myotis sodalis*
Virginia big-eared bat, *Placotus townsendii virginianus*
Water shrew, *Sorex palustris punctulatus*

Vascular Plants:
Northern joint-vetch, *Aeschynomene virginica*
Shale barren rockcress, *Arabis serotina*
Tropical water-hyssop, *Bacopa innominata*
Piratebush, *Buckleya distichophylla*
Variable sedge, *Carex polymorpha*
Swamp pink, *Helonias bullata*
Small whorled pogonia, *Isotria medeoloides*
Prairie white-fringed orchid, *Habenaria leucophaea*
Northeastern bulrush, *Scirpus ancistrochaetus*

FISH AND WILDLIFE RESTORATION PROGRAMS

NATIONAL AND REGIONAL PROGRAMS/INCENTIVES

Environmental Provisions of Water Resources Development Act (WRDA) 86

26. WRDA 86, P.L. 99-662, in addition to setting forth cost-sharing provisions for non-Federal sponsors of water resource projects, enacted a variety of measures directed at evaluation, restoration, and protection or enhancement of the natural environment. Individual measures contained in the act include (but are not limited to) the creation of an Office of Environmental Policy in the Civil Works Directorate of the Office of the Chief of Engineers (Sec. 924), provision for modification of projects constructed prior to passage of the act to improve environmental quality (Sec. 1135), authorization of an Environmental Protection and Mitigation Fund (Sec. 908), the requirement that mitigation plans be submitted along with a proposed project, and for the mitigation to be done before or concurrent with project construction (Sec. 906), and authorization of a number of studies and/or projects that either directly (Study of Corps Capability to Conserve Fish and Wildlife, Sec. 704) or indirectly address environmental concerns.

27. Section 1135 of WRDA allows the Corps of Engineers to modify the maintenance or operation of existing projects in an effort to enhance the environment. The general continuing authority contained within Section 1135 of WRDA 1986 (P.L. 99-662), states in part that:

> "(a) The Secretary (of the Army) is authorized to review the operation of water resources projects constructed by the Secretary to determine the need for modifications in the structures and operations of such projects for the purpose of improving the quality of the environment in the public interest.
>
> "(b) The Secretary is authorized to carry out a program for the purpose of making such modifications in the structures and operations of water resources projects constructed by the Secretary which the Secretary determines (1) are feasible and consistent with the authorized project purposes, and (2) will improve the quality of the environment in the public interest. The non-Federal

share of the cost of any modifications carried out under this section shall be 25 percent. No modification shall be carried out under this section without specific authorization by Congress if the estimated cost exceeds $5,000,000.

"(c) The Secretary shall coordinate any actions taken pursuant to this section with appropriate Federal, state, and local agencies.

"(d) Beginning in 1992 and every 2 years thereafter, the Secretary shall transmit to Congress a report on the results of reviews conducted under subsection (a) and on the program conducted under subsection (b).

"(e) There is authorized to be appropriated not to exceed $25,000,000 annually to carry out this section."

28. The 1135 process is attractive to the Corps and the non-Federal sponsor because:

a. It reduces the amount of time to construct smaller restoration projects;

b. The local sponsor is not required to pay any up-front costs for the feasibility study. Funding contributions of the non-Federal sponsor for feasibility studies are only required if the project is authorized for construction.

29. A panel consisting of representatives of Planning, Operations, Engineering, and Program Management at Headquarters, U.S. Army Corps of Engineers meet at regular intervals to review proposals submitted by the Corps division offices. The criteria used for evaluation of 1135 proposals are:

a. The proposed work must be structural or operational modifications that will restore fish and wildlife resources at completed Corps projects.

b. The modifications must be consistent with and not unacceptably impact the authorized project purposes.

c. The modifications must have tangible and intangible benefits (monetary and non-monetary) judged to exceed the tangible and intangible costs.

d. Any economic benefits from the modifications must be associated primarily with improvements to fish and wildlife resources.

e. The modifications should be accomplished within 2 years of initial funding for implementation of construction.

f. Non-Federal sponsors will provide at least 25 percent of the implementation costs.

g. The modifications should have a justifiable end point to Federal involvement.

The 1987 Chesapeake Bay Agreement

30. The Chesapeake Bay Agreement was signed by the states of Maryland, Pennsylvania and Virginia, and the District of Columbia with the Environmental Protection Agency as the representative of the Federal Government. The goals of the agreement are:

a. Reduce point and nonpoint sources of nutrient loadings to attain nutrient and dissolved oxygen concentrations necessary to support the living resources of the bay.

b. Reduce point and nonpoint sources of toxic materials to attain or maintain levels of toxicants not harmful to humans or living resources, their habitats, and ecological relationships.

c. Provide for the restoration and protection of the living resources, their habitats, and ecological relationships.

d. Develop and manage related environmental programs with a concern for their impact on the bay.

e. Support and enhance a cooperative approach toward bay management at all levels of government.

31. The 1987 Chesapeake Bay Agreement contains goals and priority commitments for living resources; water quality; population growth and development; public information; education and participation; public access; and governance.

Living Resources

32. Goal: Provide for the restoration and protection of the living resources, their habitats, and ecological relationships.

33. Commitments:

- To develop and adopt, by January 1988, criteria for protection of water quality and habitat and use criteria as guidance in implementation of water quality and habitat protection programs.

- To develop and adopt a bay-wide plan for assessment of commercially, recreationally and ecologically valuable species by July 1988.

- To adopt, by January 1989, a schedule for the development of bay-wide fishery management plans for commercially, recreationally and ecologically valuable species.

- To protect and restore tidal and nontidal wetlands.

Water Quality

34. Goal: Reduce and control point and nonpoint sources of pollution to attain the water quality condition necessary to support the living resources of the bay.

35. Commitments:

- To develop, adopt and begin implementation by July 1988, a basin-wide plan to achieve a 40 percent reduction, by the year 2000, of nutrients entering the Chesapeake Bay system. To reevaluate the 40 percent reduction target by December 1991, based on the results of modeling, research monitoring and progress to date.

• To develop and adopt, by December 1988, a basin-wide implementation plan for the reduction and control of toxic materials entering the bay system.

• To develop and adopt, by July 1988, a basin-wide implementation plan for the management and control of conventional pollutants entering the bay system from point and nonpoint sources.

• EPA will develop and adopt, by July 1988, a plan for the control and reduction of point and nonpoint sources of nutrient, toxic, and conventional pollution from all Federal agencies and installations.

Population Growth and Development

36. Goal: Plan for and manage the adverse environmental effects of human population growth and land development in the Chesapeake Bay watershed.

37. Commitments:

• To adopt, by July 1988, development guidelines designed to reduce adverse impacts on the water quality and living resources of the bay, and to cooperatively assist local governments in evaluating land use and development decisions.

• To evaluate state and Federal development projects in light of their potential impacts on the water quality and living resources of the bay, and design and carry out each state and Federal development project so as to serve as a model for the private sector in terms of land use practices.

• Provide incentives, technical assistance and guidance to local governments to actively encourage them to incorporate protection of tidal and nontidal wetlands in their land-use planning and other growth-related management processes.

• Commission a panel of experts to report, by July 1988, on anticipated population growth and land development patterns in the bay region through the year 2020.

Public Information, Education and Participation

38. Goal: Promote greater understanding among citizens about the Chesapeake Bay system, the problems facing it, and the policies and programs designed to help it, and foster individual responsibility and stewardship of the bay's resources.

39. Commitments:

• To conduct education and information programs to inform the general public, local governments, industry and others of their roles, responsibilities, and opportunities in the restoration and protection effort, and to promote public involvement in the management and decision-making process.

• To provide for public review and comment on all implementation plans developed pursuant to this agreement.

• To meet with and report annually to the public on progress made in fulfilling the commitments of this agreement.

• To develop, by January 1988, individual communication plans for public information, education, and participation, and by March 1988, to develop a unified, bay-wide communication plan.

• To promote Chesapeake Bay restoration efforts by establishing an annual bay-wide, Governor's Cup Fishing Tournament.

Public Access

40. Goal: Promote increased opportunities for public appreciation and enjoyment of the bay and its tributaries.

41. Commitments:

• Improve and maintain access to the bay by expanding and improving public access opportunities through Federal, state, and local governments.

Governance

42. Goal: Support and enhance the present comprehensive, cooperative, and coordinated approach toward management of the Chesapeake Bay system.

43. Commitments:

• To continue to support bay-wide environmental monitoring and research to provide the technical and scientific information necessary to support management decisions.

• To continue to support the Chesapeake Executive Council and associated advisory and support bodies.

Chesapeake Bay Agreement - 1992 Amendments

44. The 1992 amendments to the Chesapeake Bay Agreement expand the focus of the bay cleanup effort to include the estuary's tributaries. In August 1992, the Chesapeake Executive Council signed amendments pledging development of cleanup strategies for the tributaries similar to efforts begun for the bay itself by the original 1987 agreement. Those strategies include a 40 percent reduction of nutrients entering the tributaries and restoring water quality conditions necessary for the living resources of the streams. Excess nutrients, nitrogen and phosphorus, are recognized by researchers as the bay's major water quality problem. The 1987 agreement called for a 40 percent reduction by the year 2000, and bay-area states regulations to begin achieving that goal. This has resulted in a 19 percent reduction in phosphorus loading to the bay; however, loading of nitrogen, primarily a nonpoint source pollutant, has not declined. Larry Minnock of the Virginia Council on the Environment said a bay computer model, operated by the U.S. Army Corps of Engineers, found that the original reduction goal, focusing only on the bay, has brought about less improvement than expected. Bay researchers concluded that nutrient reduction efforts need to be extended to the tributaries, which includes the James River.

The Virginia tributaries, however, do not carry significant loads of nutrients to the bay. However, nutrient reduction strategies will be devised for these rivers as well as the others because all are part of a system of living resources vital to the bay.

Chesapeake Bay Preservation Act

45. The 1988 Virginia General Assembly passed a law entitled the Chesapeake Bay Preservation Act. The purpose of the law is to regulate development on lands considered to be important to the protection of water quality in the Chesapeake Bay and its tributaries. Those lands are called Chesapeake Bay Preservation Areas. The law requires local governments to implement the state-mandated rules and regulations affecting land-use development. Local governments are to use their zoning ordinances, subdivision ordinances, and other development control ordinances to achieve compliance with the law.

North American Waterfowl Management Plan

46. Draining and filling wetlands important for nesting cover and migratory/wintering habitat is the major cause of a long-term downward trend in several waterfowl populations. Recognizing the need to reverse or modify this trend, the U.S. Secretary of the Interior and the Canadian Minister of the Environment signed the North American Waterfowl Management Plan (NAWMP) on May 14, 1986. The plan provides a blueprint for restoring waterfowl populations on the North American continent.

47. On January 23, 1989 the Corps of Engineers and the Fish and Wildlife Service entered into a cooperative agreement regarding the North American Waterfowl Management Plan. The management plan was based on the recognition by the two countries that waterfowl, the most economically important group of migratory birds in North America, have undergone drastic population declines primarily due to losses of nesting, migratory, and wintering habitat. The Cooperative Agreement between the Corps and the Fish and Wildlife Service states that the two agencies will use their authorities to further the goals of the NAWMP.

48. One of the overall goals of the NAWMP is to maintain the current distribution of waterfowl populations and to "maintain the habitat value of designated areas of international significance to waterfowl." As part of the specific goals and recommendations for waterfowl habitat included in the plan is the recommendation that "Public works projects planning should include the prevention or mitigation of destruction or degradation of waterfowl habitats." The entire Chesapeake Bay basin east of the fall line has been included in Area 20 (Middle-Upper Atlantic Coast) of waterfowl habitat areas of major international importance.

49. Concerning habitats along the Atlantic Coast of the United States, one priority is currently the black duck population and the need for habitat for migration, nesting, and overwintering.

North American Wetlands Conservation Act of 1989, P.L. 101-233

WETLANDS RESTORATION ASSISTANCE IN VIRGINIA

Virginia Department of Game and Inland Fisheries (VDGIF)
50. Technical expertise and planning assistance is available for wildlife habitat management, particularly for farm property, wetlands, timberland, nongame and backyard habitat. VDGIF also provides advice for management of individual species, including threatened and endangered species and a variety of information and education programs. Wetland restoration and creation assistance including site evaluation, design and assistance in the permitting process, coordination with FWS funding and management recommendations for completed projects is also available. VDGIF acquires habitat and accepts land donations.

Virginia Department of Forestry (VDOF)
51. As part of their Forest Stewardship Program, VDOF provides forest management advice and technical assistance with forest management plans for wildlife, reforestation, insect and disease control, and maintenance of water quality. Cost-sharing funds are also available for wildlife habitat development, including development of shallow-water marshes and certain other activities.

Natural Heritage Program, Virginia Department of Conservation and Recreation (DCR)

52. DCR's Division of Natural Heritage serves as a centralized repository of data to identify the Commonwealth's most significant natural areas through an intensive statewide inventory. The division maintains site-specific information on documented occurrences of rare plant and animal species, unique or exemplary natural communities, and conservation sites that support natural heritage resources of the Commonwealth.

53. A variety of conservation tools including conservation easements, management agreements, leases, registry, open-space designation, and natural area dedication are used by Heritage to protect public and privately owned areas identified through the inventory process. Their stewardship staff provides technical assistance to landowners on issues relating to rare species and natural community management, monitoring and recovery.

U.S. Department of Interior, Fish and Wildlife Service (FWS)

54. The FWS has funds available to private landowners to restore degraded wetlands and riparian habitats under the Partners for Wildlife program. Biologists will also provide information on the functions and values of wetlands and technical assistance for conservation of wetlands and protection of water quality.

ACTIVITIES THAT AFFECT VIRGINIA'S WETLANDS

55. For most of Virginia's history, wetlands have been considered wastelands, of little value to society and economy. This perception has led to the destruction of wetlands through agricultural drainage; channelization for flood control; dredging and/or filling for housing, marinas, highways, industry and landfills; reservoir construction; timber harvest; ground water extraction; and water pollution and waste disposal. These activities vary in the degree to which they destroy the functions of a wetland, and the degree to which the impacts are reversible.

56. *Filling wetlands* is typically the most destructive and irreversible type of impact. Wetlands fill eliminates the basic character of the wetland and is usually followed by some form of permanent development or construction activity.

57. *Wetlands dredging and excavation* also destroys wetlands systems. However, the open water habitat that is created may replace some of the lost wetland values. Dredged or excavated wetlands that are converted to open water may revert to wetlands over time.

58. *Draining and other forms of hydrologic modifications* have variable effects on wetlands. These activities typically destroy the wetland over a number of years, but this is reversible where subsequent development has not taken place.

59. *Clearing wetlands for silviculture* has definite short-term impacts on wetlands systems. However, the long-term effects of these activities may be ameliorated where proper forestry Best Management Programs (BMPs) are employed.

60. Changing economic factors over the past 15 years and establishing conservation programs over the past 7 years have decreased the rate of agricultural conversion. During this period, land development and other activities associated with population growth have become a significant cause of wetland loss in Virginia. Other activities associated with population growth include road construction, mining for sand and gravel, pond or lake construction, water supply impoundment, and the degradation of water quality from urban runoff.

61. The following recommendations were made regarding nontidal wetlands in a 1993 report to the state entitled "The Assessment of State and Federal Programs that Affect Virginia's Nontidal Wetlands":

> <u>*State Management of Nontidal Wetlands*</u>
>
> ***"1. Virginia should pursue a nontidal wetlands program that improves the protection of nontidal wetlands, provides the***

necessary leadership for consistent regulation, establishes specific guidelines for federal and state programs and builds upon the existing program structure in state and federal agencies.

"2. The State Water Control Board should examine its authority, particularly the Water Protection Permit Section of the State Water Control Law, to support a program for conserving nontidal wetlands, based on their functional values, using state authority and the authority of Section 401 of the Clean Water Act.

"3. As the State Water Control Board evaluates its current authority, it should pay particular attention to the need for expanding the definition of Beneficial Uses of Waters of the Commonwealth under the Water Protection Permit Section to include all values of nontidal wetlands, such as flood storage capacity.

"4. The foundation of a Section 401 program for nontidal wetlands should be water quality standards for regulating proposed uses in these wetlands and design standards for Best Management Practices and wetlands creation/mitigation projects.

"5. The Water Control Board, in conjunction with the Virginia Institute of Marine Science, the Department of Conservation and Recreation, the Department of Game and Inland Fisheries, and other appropriate agencies should develop a classification and ranking system that is based on all important values of nontidal wetlands. Efforts should be made to map the location of these nontidal wetlands in Virginia. The agencies should also identify the resources necessary to pursue the program.

"6. The implementation of a Section 401 program should include a monitoring system to assess the capability of the program to meet the goal of no net loss of nontidal wetlands values.

"7. As funds become more available, staff levels dedicated to nontidal wetlands regulation at the Water Control Board should be enhanced.

"8. The State Water Control Board (WCB) and other agencies and institutions involved in managing wetlands should give consideration to the results of the study being conducted by the Council on the Environment in order to ensure consistent expertise in wetlands identification and delineation among regulators and the regulated development community.

Chesapeake Bay Area Program

"As Virginia proceeds in developing specific water quality standards for wetlands, the Chesapeake Bay Local Assistance Department and the Water Control Board should pursue consistency between the standards and management practices of the two programs.

Agricultural Programs

"1. Water Quality Specialists in Soil and Water Conservation Districts should emphasize wetlands protection in choosing among alternative agricultural Best Management Practices for development of Soil and Water Quality Conservation Plans.

"2. Development and approval of Soil and Water Quality Conservation Plans by Water Quality Specialists should be contingent upon compliance with Section 404 and 401 programs and the prohibitions against drainage and clearing of nontidal wetlands. Where Water Quality Specialists observe agricultural drainage of nontidal wetlands, landowners should be informed that final plan approval depends upon compliance with requirements of the Section 404 and 401 programs.

"3. As funds become available, additional Water Quality Specialists should be added to appropriate Soil and Water Conservation Districts in order to increase their ability to work with individual farmers and to ensure consistency in their application of Virginia's programs for conserving water quality and nontidal wetlands.

"4. Virginia should continue to work toward an effective resolution of the wetlands delineation in order to facilitate nontidal wetlands protection under the Federal Swampbuster Program.

"5. Virginia should continue, and enhance, efforts to educate farmers on program opportunities under the Wetlands Reserve Program.

"6. After the first year of implementing the Wetlands Reservation easement program, the program's success in Virginia should be assessed.

Silvicultural Programs

"1. The Department of Forestry should enhance training of District Foresters to include site assessment for the application of wetlands BMPs. The Department of Forestry should identify the resources necessary to enhance the application of wetlands BMPs.

"2. In its work with forestry activities and logging operators, the Department of Forestry should actively recommend BMPs for logging sites and operations. These recommendations should emphasize pre-season planning to avoid harvesting in wetlands during the wet season.

"3. The BMP assessment should be enhanced to include specific evaluations of private forestry compliance with wetlands BMPs.

"4. This assessment should be used to guide further forester training and program development in areas where wetlands BMP implementation is found to be insufficient.

Transportation and Road Construction:

"1. Transportation and Natural Resource Agencies should work together under the Governor's transportation initiative to find ways to address the secondary impacts of growth and land development on areas of dense nontidal wetlands. This process should be coordinated with the comprehensive planning of affected local governments.

"2. Wetlands creation and mitigation banking by the Department of Transportation should continue and should be coordinated with further research on the site-specific values of nontidal wetlands.

"3. The Department [of Transportation] should ensure that on-site wetlands creation is maintaining the functions of wetlands and that off-site mitigation banking practices are maintaining water quality and flood control needs of individual watersheds. All nontidal wetlands lost as a result of road construction should be compensated through wetlands mitigation and mitigation banking.

Mining:

"Where permits are granted for sand and gravel mining or borrow pits under a Section 401 program, permit conditions should address the maintenance and restoration of nontidal wetlands values.

Nonpoint Source Pollution Control:

"1. The WCB, in cooperation with the DCR, the Chesapeake Bay Local Assistance Department (CBLA) and affected local governments, should develop guidelines for coordinating the protection of nontidal wetlands and the management of nonpoint-source pollution. These guidelines should be designed to assist localities in the development of watershed management plans that will be agreed upon by state and federal permitting agencies involved in wetlands protection and nonpoint-source pollution control.

"2. The WBC, the DCR, and the CBLA should coordinate and agree on an approach for achieving the objectives of their respective programs related to nonpoint-source pollution control and nontidal wetlands.

"3. In the classification and ranking of nontidal wetlands, Virginia should designate locations and classes of high-value wetlands which will be protected from nonpoint-source pollution control facilities and related impoundments and excavations.

Local Land-use Programs:

"Local governments should be encouraged to administer land-use programs which increase allowed land-use intensities on the upland portions of parcels which are substantially affected by nontidal wetlands and floodplain regulation.

Floodplain Management:

"1. The DCR , as lead floodplain management agency, and other agencies including the USGS, should research and evaluate the various types of nontidal wetlands in Virginia for their flood storage capacities.

"2. Information on the flood storage functions of nontidal wetlands should be incorporated into nontidal wetlands management decisions and provided to local governments for the purpose of planning, regulation and acquisition under the Community Rating System.

"3. As Virginia localities develop Community Rating System programs, the DCR should evaluate the effect of these programs on the natural and beneficial values of nontidal wetlands and floodplains.

Acquisition and Easements

"1. The DCR should include nontidal wetlands as an important and sensitive natural resource in its evolving Land Classification System and should consider the water quality protection, flood buffering, and habitat values of nontidal wetlands in determining the importance of individual wetlands. Virginia should continue to place a high priority on purchasing valuable nontidal wetland and natural heritage areas.

"2. As staff and resources permit, the Natural Heritage Program should assist other agencies in developing or maintaining current inventories and management plans for protecting nontidal wetlands on state-owned lands, as appropriate, using the DCR's Land Classification System.

"3. Lands acquisition for the protection of nontidal wetlands and related resources should be exempted from Department of General Services (DGS) requirements prohibiting the purchase of floodplains. The requirement of the DGS Directive #1, Section IV.1:F should be amended to address only acquisition projects where capital improvement is proposed.

"4. Natural Heritage Resource Inventories of state-owned lands should be expanded to include the review of all lands proposed for surplus for the purpose of protecting valuable natural resources including nontidal wetlands.

"5. As local non-profit conservation organizations are established and pursue conservation holdings and easements under the authority of the Virginia Conservation Easement Act, the DCR, as staff and resources permit, should assist these groups in the identification of valuable nontidal wetlands and other natural resources.

Research, Classification, and Mapping

"1. Appropriate agencies and institutions should be supported through available funds to continue research into the functions performed by Virginia's nontidal wetlands. This research should

address: groundwater discharge and recharge; habitat for wildlife, including rare and endangered species; flood storage capacity; shoreline anchoring and dissipation of water energy; maintenance of water quality; and aquatic food-chain support.

"2. The WCB, in cooperation with other appropriate agencies and institutions, should develop site-specific techniques for assessing the functions performed by nontidal wetlands. Funding for such a project may be made available through the Council on the Environment from federal grant funds under Section 309 of the Coastal Zone Management Act.

"3. Appropriate agencies within the Secretariat of Natural Resources should investigate the feasibility of providing local governments with unified maps of nontidal wetlands, the 100-year floodplain and (in Tidewater) Chesapeake Bay Preservation Areas."

WATER QUALITY IN THE JAMES RIVER BASIN

CSOs IN THE JAMES RIVER AT RICHMOND

62. The old (1880's) sewer system which is found in the central area of Richmond results in combined sewer overflows (CSO) into the James. During dry weather, the combined sewer/stormwater system carries all sewage to the water treatment plants (WTPs). However, when runoff due to rainfall events exceeds the capacity of the system, excess runoff and raw sewage are discharged directly into the James River. As of September 1991, their were 36 CSO outfalls along the river downstream from approximately Powhite Parkway Bridge. CSO discharges are located on both sides of the river, and extend as far downstream as Almond Creek, which is in the vicinity of the Richmond wastewater discharge into the tidal portion of the James River. Portions of the James River and estuary that are affected by CSOs have been the subject of intensive study.

63. A number of CSO-related water quality and modeling studies of the tidal estuary and lower James in Richmond have been sponsored or conducted by the Department of Environmental Quality-Water Division (DEQ-WD), the Virginia Institute of Marine Science (VIMS), and the city of Richmond. These studies have culminated in the development of a strategy for the city of Richmond to address its combined sewer overflow problem (city of Richmond, 1986, 1988, 1989, undated).

64. To some extent, the CSO modeling analyses are based on the results of intensive water quality surveys of the James River below Richmond that were sponsored by the Department of Environmental Quality-Water Division (DEQ-WD) in July 1976 and September 1978. The survey data from these studies indicated regions of dissolved oxygen (DO) depression below Richmond and below Hopewell, and led to the conclusion that DO concentrations in the upper reaches of the James River estuary are predominantly governed by ammonia-N loadings in the Richmond WTP discharge, and to a lesser extent, by CSO-related loadings of organic matter that increase biological oxygen demand (BOD).

65. In the 1982 Department of Environmental Quality-Water Division (DEQ-WD) wasteload allocation plan for the upper James River (VWCB, 1982a), it was pointed out that (1) the Richmond WTP outfall was located in a very critical point along the James River estuary and the WTP would require upgrading even if the other immediate discharges below the Richmond outfall were eliminated, (2) the effect of low-flow augmentation of the James River flow-by releases on the order of 800 c.f.s. (simulated increase from 700-1500 c.f.s.) from Lake Moomaw would not appreciably change the summer DO profile in the upper James River estuary, and (3) the effect of these flow releases from Lake Moomaw would be negligible in terms of a permitted reduction in the degree of treatment needed for WTP discharges in the Richmond area.

66. The 1982 Richmond-Crater Interim Water Quality Management Plan (VWCB, 1982b) was based on a water quality modeling study of various management options, including low-flow augmentation due to increased flow releases from Lake Moomaw. These water quality modeling studies showed that a simulated increase in flow from 680 c.f.s. to 1,500 c.f.s. would not appreciably affect water quality (as indicated by DO levels) in the upper James River estuary. This suggests that the relatively small change in James River streamflows due to the Henrico County water supply withdrawal (approximately 53 c.f.s. average daily withdrawal) may not result in a measurable change in water quality (DO levels) within the upper James River estuary.

67. In the June 1984 VIMS report on benthic oxygen and nutrient fluxes in the upper James River estuary (Cerco, 1984), it is indicated that the predominant

source of ammonia-N loadings is the release from channel bottom sediments. Sediment release rates were observed at seven of eight stations, and the largest releases occurred between the river miles 100 to 110, immediately downstream of Richmond.

68. The city of Richmond CSO study (city of Richmond, 1986, 1988, 1989, undated) addressed both water quality and public health concerns. Water quality evaluations, which built upon the above previous studies, were used to develop the city's CSO management plan. In regard to water quality, the study makes the point that CSO discharges to the upper James River estuary are relatively short-term, intermittent, and variable, and their effects on the DO budget of the James are transient.

69. In regard to the public health, the city study points out that the principal risk is associated with body contact from recreation in the James during and after storm events that cause CSO discharges. This would be of particular concern in the vicinity of the Reedy Creek portion of James River Park, on the south side of the river where CSOs discharge to side channels of the James. Under summer low-flow conditions when these side channels sometimes become isolated and dewatered, there may not be sufficient flow in the river to flush CSO discharges into the mainstem and out of the system. In these cases, CSO discharges with their large loads of carbonaceous material may create a significant aesthetic and public health problem. Under such conditions, it is also possible that in limited areas of the lower James River, these water quality episodes could be detrimental to aquatic biota.

70. The city of Richmond has formulated a specific plan to deal with its CSO problems (City of Richmond, 1992).

71. One benefit of Richmond's combined sewer system is that it serves to reduce pollutants associated with urban runoff into the James River by directing runoff into the WTP. Therefore, many of the pollutants that collect on city streets are removed before the water is released into the James. These include petroleum-based pollutants from automobile traffic and also particulate "fallout" from local industries that place such pollutants in the air locally.

72. In view of this fact, one measure that may increase the efficiency of the new improvements to the Richmond combined sewer system is to replace current paving materials with more porous road materials that are now available whenever Richmond streets are in need of new pavement. This measure would provide two important benefits: (1) A more porous pavement can hold more water and delay its runoff into the storm sewers, giving the system more time to deal with large inputs of precipitation; (2) The delay of runoff from city streets allows the rainwater to soak off some of the less soluble pollutants, which otherwise might not be released until a large amount of rain has passed over them, at a time when the combined sewer system is more likely to be at or near capacity, and more likely to overflow. A study using the porous pavement in Rochester, New York, showed a peak runoff reduction as great as 83 percent (EPA, 1990).

73. Porous pavements are, in general, somewhat more expensive to construct than traditional pavements when repaving roads, but in relation to new construction, the cost is about equal to traditional pavements because fewer stormwater inlets and less subsurface piping is required to handle the runoff from porous pavements (EPA, 1990).

DIOXINS

74. Water quality in the upper James River Basin is generally good, with the exception of the Jackson River downstream of Covington where dioxins are entering the river (at about 180 parts per quadrillion) in effluent water from the Westvaco paper mill.

75. A DEQ-WD study (1992) of dioxin contamination in James River fish was initiated following a 1984 EPA study that showed that effluent water from the Westvaco paper mill, Covington, Virginia, contained 180 parts per quadrillion dioxins, placing the Westvaco mill among the top 10 mills in the nationwide 104-mill study. Dioxins were found to be present in the tissues of both sportfish and bottom feeders.

76. The following trends were observed in the DEQ-WD study: (1) Concentration of dioxin was consistently higher in bottom-feeders than in

sunfish; (2) Tissue dioxin levels decreased with increasing distance downstream from the Westvaco mill.

77. The decrease in tissue dioxin levels downstream from the source is considered to be a result of the increasing dilution factor of the river as it progresses downstream. Lipid content of the various fish tested was fairly consistent (and in any event did not decrease downstream), and so was ruled out as a factor in this trend.

78. The fact that bottom feeders have higher levels of dioxins concentrated in their tissues supports the findings of other studies that indicate that dioxin concentration is generally higher in the sediments than in the water column. The implication of this is that sediments are the major vehicle of dioxin pollution; as the sediments are washed progressively downstream, the dioxin pollution is moved with them.

79. In response to the 1992 tissue contamination study the DEQ-WD recommended the following actions:

> "1. The results of the study should be reviewed by the public health authority for assessment of possible health hazards.
>
> "2. Another study should be conducted to assess how far downstream the contamination extends, since dioxin contamination was present at all of the test sites in the 1992 study (i.e., no end point of the pollution was found).
>
> "3. A study should be conducted to determine the level of sediment contamination throughout the affected area."

TURBIDITY IN THE JAMES RIVER

80. There are two major causes of incidental turbidity in the lower portions of the James and in the upper James River estuary. They are: (1) dredging, which creates a highly localized, frequently thick plume of turbidity at and downstream of the dredge site, and (2) storm events, which create more turbidity over a larger area than dredging. The second of these two causes is

virtually impossible to control, although some effects can be reduced by erosion-control measures along banks that are typically hard-hit by storms. The former of the two causes is much easier to control, and dredging, therefore, is managed in such a way so as to have a minimal effect on aquatic and benthic organisms.

81. The primary effects of the increased turbidity due to dredging are (1) a decrease in submerged aquatic vegetation (SAV) due to decreased light levels caused by the turbid water, (2) a decrease in the vitality of filter-feeding organisms (especially common on the benthos) due to choking from the excess sediment in the water, and (3) interference with visual cue used by fish for navigation, which can result in interference with the prespawning migration of anadromous fish, as well as the return downstream of their offspring.

82. The James River estuary has three shoals that are in need of regular dredging. The National Marine Fisheries Service (NMFS), in cooperation with the Corps has developed a sequential schedule to minimize the effects of the dredging operations on the anadromous fish species important in the James River, which include striped bass (*Morone saxitilis*), American and hickory shad (*Alosa sapidissima* and *A. mediocris*, respectively), and the river herring, alewife and blueback herring (*A. pseudoharengus*, and *A. aestevalis*, respectively). The shoal furthest downstream, near Dancing Point, is dredged first in the spring--the rationale being that here the relative width of the river allows the adults that are migrating upstream to spawn to navigate around it. The next dredge site is the shoal furthest upstream, near Dutch Gap above Hopewell; this area is a spawning ground for the above-mentioned species, and the effects of dredging are minimized by the timing of the dredging operation, since by this time, the eggs and larvae resulting from the spawning event have washed downstream into the nursery areas. The third dredging site is situated between the first two, near Windmill Point, just downstream of Hopewell, which supports some spawning, but is primarily a nursery ground for larvae spawned further upstream. This shoal is dredged last (in the fall) because most of the larvae will have already passed through the area, and any juveniles remaining are presumed to have had an opportunity to reach a size that will allow them to navigate around the turbidity plume.

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FISH AND WILDLIFE SERVICE PLANNING AID REPORT

JAMES RIVER BASIN, VIRGINIA
FISH AND WILDLIFE RESTORATION
RECONNAISSANCE STUDY

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Norfolk District, Corps of Engineers
Planning Division
Environmental Analysis Branch

September 1993

Abstract

James River Basin, Virginia
Fish and Wildlife Restoration
Reconnaissance Study

Baseline Biological Conditions,
Opportunities for Fish and Wildlife Improvement Projects,
and Preliminary Study Requirements

John W. Gill
September 1993

This report provides planning aid information to assist the Norfolk District, U.S. Army Corps of Engineers, in a reconnaissance level study of environmental resource problems and opportunities in the James River Basin, Virginia. The report describes baseline biological conditions, discusses opportunities to implement fish and wildlife improvements, and suggests further studies where information is lacking. Information contained herein is derived from existing data sources, and communication with natural resource professionals having expertise in the areas of concern. The best opportunities for environmental improvement involve wetland restoration, water quality improvement, habitat enhancement, riparian restoration, removal of barriers to migratory fish, and fish and wildlife population reestablishment.

Key Words: watershed, habitat restoration and improvement, anadromous fish, endangered species, wetlands

INTRODUCTION

The Norfolk District, U.S. Army Corps of Engineers (Corps), is conducting a reconnaissance level study of the James River Basin, in Virginia. The study objective is to identify environmental restoration and mitigation opportunities along the river and tributaries. Potential restoration opportunities include habitat restoration/enhancement, water quality improvements, removal of barriers to migratory fish, and fish and wildlife population reestablishment. One area of mitigation interest is the Corps Gathright Dam and Lake Moomaw. The project blocked the Jackson River to upstream fish movement, and inundated 2,532 acres of wooded upland, wetland, riparian, and aquatic habitat, portions of which were in the Tom Gathright Wildlife Management Area and the George Washington National Forest.

The study area includes the entire James River Basin. However, in keeping with recent Chesapeake Bay Program directives to expand restoration programs into the miles of rivers and streams which flush into the estuary, the study focuses on non-tidal waters of the James and its tributaries above and including the fall line at Richmond.

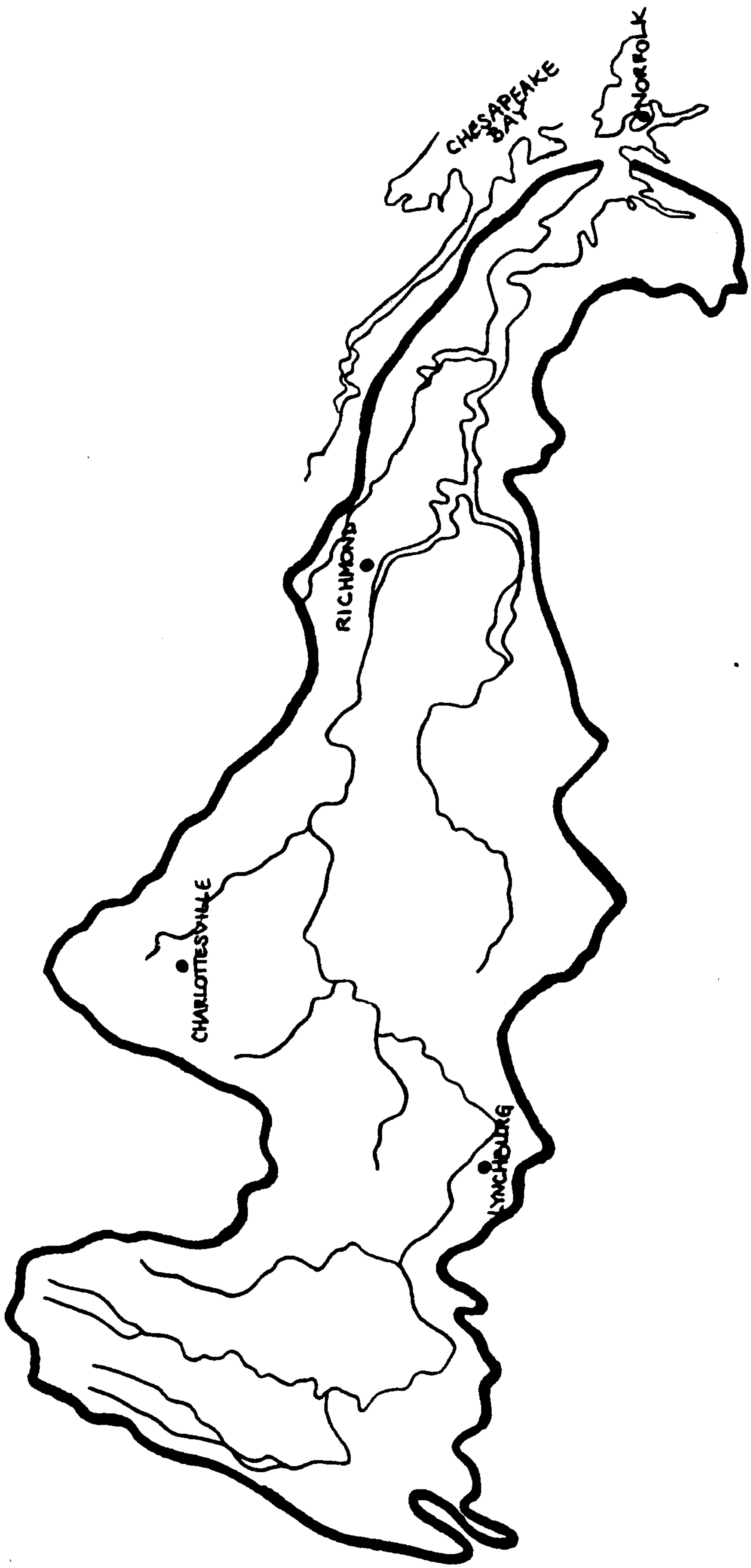
This Planning Aid Report provides information to assist the Norfolk District in a study of environmental resource problems and opportunities in the James River Basin. The report describes baseline biological conditions, discusses opportunities to implement fish and wildlife improvements, and suggests further studies where information is lacking. It is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. et seq.).

DESCRIPTION OF THE AREA

Compromising over 25 percent of the total area of Virginia, the James River Basin is the largest river system in the state (Leonard et al. 1986). Except for a few small tributaries in Monroe County, West Virginia, the James River lies entirely within Virginia (Figure 1). From the headwaters in central - western Virginia, the James flows 450 miles to Chesapeake Bay (VWCB 1990). Four major physiographic provinces are bisected along the river course. Approximately one third of the state's population resides within and uses water resources of the basin (VWCB 1990).

The major tributaries to the James include the Jackson, Cowpasture, Maury, Tye, Rivanna, Appomattox, Chickahominy, Nansemond, and Elizabeth Rivers (Virginia Water Control Board (VWCB) 1989). Below the fall line at the City of Richmond, down stream of Manchester Dam, the river is tidal. Daily average inflow into the estuary from the James River near Richmond is 7,200 cubic feet per second (VWCB 1990).

Figure 1. James River Drainage Basin



Land uses in the upper basin are primarily forest and agriculture, with the majority of the area forested. Jefferson and George Washington National Forests account for substantial acreage. Elevations in the upper basin range from 810 feet at Buchanan in Botetourt County, to over 4,300 feet in Giles and Highland Counties (Raleigh et. al. 1974).

The Army Corps of Engineer constructed the only large dam in the upper basin, Gathright Dam on the Jackson River. Some urban-industrial development exists, primarily in areas around the cities of Covington, Lexington, and Buena Vista, Virginia. Below Covington the river receives urban and industrial waste. With the exception of these areas, little development or environmental degradation has occurred in areas above Covington (USFWS 1991).

Downstream from the Valley and Ridge and the Blue Ridge physiographic provinces, the river traverses a more rolling topography. Approximately 25 to 33 percent of the land is devoted to agriculture, with the rest primarily forested (VWCB 1990). Lynchburg and Charlottesville are the major urban and industrial centers.

The lower limit of the study area encompasses the eight mile river reach through Richmond known as the Falls of Richmond. Richmond is located at the fall line. The steep gradient drops 100 feet over this stretch, from Bosher Dam downstream to Manchester Dam (USFWS 1987). Five low head dams exist along this section. At Richmond the river width varies from 500 to 2500 feet, and contains areas of riffles, pools, islands, exposed bedrock, and many large boulders (USFWS 1987).

The Virginia legislature has designated the Falls of the James as a State Historic and Scenic River. The area included is from the western section of Williams Island Dam downstream to the tidal section of the river just above the Richmond Wastewater Treatment Plant (USFWS 1987). The designation prohibits the construction of structures that would impede the natural flow of the river unless exempted by the General Assembly.

Twelve industrial point source discharges into the James occur between Henrico County and Richmond. Within the study area, this section of River is the most developed and industrialized. Six publicly owned sewage treatment plants serving the expanding human population discharge into the James and tributaries (National Wildlife Federation 1981). However, with the exception of Kepone contamination in the tidal James, there have been no severe water quality problems in the vicinity of Richmond (USFWS 1987).

BASELINE BIOLOGICAL CONDITIONS

Streams and rivers in the upper basin Ridge and Valley province are physically diverse (Raleigh et. al. 1974), and are characterized by trellis drainage patterns (USFWS 1991). Small high gradient streams are often intermittent, while larger streams exhibit high base flows due to abundant groundwater discharge (Leonard et. al. 1986). Pool/riffle ratios generally vary from 30:70 in the high mountain streams to 70:30 in the larger rivers (USFWS 1991). Substrates are dominated by gravel and rubble (USFWS 1991).

While water quality in the upper basin is generally considered good, pollution originating from the Covington area has degraded the fishery resource and eliminated nearly all freshwater mussels in the lower section of the Jackson River, and in the James River Mainstem between Iron Gate and Eagle Rock, in Botetourt County (USFWS 1991).

The Upper James River Basin supports a healthy sportfish assemblage. Many of the headwater areas support trout fisheries. Popular warm water species in the larger creeks and rivers include smallmouth bass, rock bass, redbreast sunfish, and muskellunge. The Cowpasture River is particularly known for its outstanding sportfish value.

Leonard et al. sampled fish at 13 sites in the James River Basin (Table 1). Raleigh et al. (1974) documented fish composition for rivers and creeks in the Upper James which were under consideration to be impounded as part of a Corps Regional Flood Control Project. Data from five tributaries is presented in Table 2.

Comprising 80 percent of the upper drainage basin, forests are predominately oak-pine, with pines tending to occur on dryer, south-facing slopes. Stream bottoms are characterized by sycamore, white pine, maple, hemlock, basswood, cedar, black locust, and chestnut, white, and red oaks. Understory is typified by mountain laurel, blueberry, greenbriar, and dogwood. Wildlife resources in the upper basin consist of species associated with forests, active farms, and early succession, fallow areas. Common game species are listed in Table 3.

The Lower James, in the vicinity of the Falls of the James, supports a productive warm water fishery. Table 4 provides a list of species that have been collected in the vicinity of Richmond. Popular sportfish include smallmouth bass, catfish, sunfish, bluegill, crappie, and yellow perch.

The James River is also an important spawning river for anadromous species of fish including striped bass, American shad, hickory shad, alewife, blueback herring, Atlantic sturgeon, and, historically, the endangered shortnose sturgeon (USFWS 1987). The river herrings spawn in the smaller tributary streams, while shad, striped bass, and sturgeon spawn in the James and major tributaries. The spawning season begins in March, continuing through June. The James is also an important nursery area for juvenile anadromous fish.

Table 1

FREQUENCY OF OCCURRENCE, AND PERCENT OF ALL FISH COLLECTED FOR FISH SPECIES AT 13 SITES IN THE JAMES RIVER BASIN (FROM LEONARD ET AL. 1986)

Scientific Name	Common Name	Frequency of occurrence	Percent of fish in samples from 13 site
Carpiodes cyprinus	Quillback	1	<1
Catostomus commersoni	White sucker	9	2
Erimyzon oblongus	Creek chubsucker	3	<1
Hypentelium nigricans	Northern hog sucker	7	1
Moxostoma cervinum	Black jumprock	8	2
Moxostoma erythrurum	Golden redhorse	2	<1
Moxostoma rhothoecum	Torrent sucker	6	2
Ambloplites rupestris	Rock bass	12	8
Lepomis auritus	Redbreast sunfish	12	10
Lepomis gibbosus	Pumpkinseed	4	1
Lepomis macrochirus	Bluegill	5	
Micropterus dolomieui	Smallmouth bass	12	2
Cottus bairdi	Mottled sculpin	8	
Cottus girardi	Potomac sculpin	2	<1
Phoxinus oreas	Mountain redbelly dace	2	1
Clinostomus funduloides	Rosyside dace	2	<1
Cyprinus carpio	Carp	3	1
Exoglossum maxillingua	Cutlips minnow	9	3
Nocomis leptocephalus	Bluehead chub	12	16
Nocomis micropogon	River chub	3	<1
Nocomis raneyi	Bull chub	8	4
Notropis analostanus	Satinfin shiner	5	1

Table 1 continued

Scientific Name	Common Name	Frequency of occurrence	Percent of fish in samples from 13 site
Notropis ardens	Rosefin shiner	12	5
Notropis cornutus	Common shiner	12	6
Notropis hudsonius	Spottail shiner	6	2
Notropis procne	Swallowtail shiner	3	2
Notropis rubellus	Rosyface shiner	4	1
Notropis semperasper	Roughhead shiner	8	1
Notropis volucellus	Mimic shiner	2	<1
Pimephales notatus	Bluntnose minnow	8	3
Rhinichthys atratulus	Blacknose dace	4	<1
Rhinichthys cataractae	Longnose dace	2	2
Semotilus corporalis	Fallfish	7	2
Esox americanus americanus	Redfin pickerel	1	<1
Esox niger	Chain pickerel	3	<1
Ictalurus natalis	Yellow bullhead	5	<1
Ictalurus nebulosus	Brown bullhead	2	<1
Ictalurus punctatus	Channel catfish	1	<1
Noturus insignis	Margined madtom	10	2
Etheostoma flabellare	Fantail darter	9	2
Etheostoma longimanum	Longfin darter	6	1
Etheostoma nigrum	Johnny darter	1	<1
Percina roanoka	Roanoke darter	5	2
Percina notogramma	Stripeback darter	4	<1
Percina peltata	Shield darter	6	<1

Table 2
Fish Fauna In Five Tributaries of the Upper James River
Number of Individuals Captured at Sample~~s~~ Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
Catostomidae (suckers)											
(Quillback) Carpiodes cyprinus											
(White sucker) Catostomus commersoni	16	21	1		1			2	2	2	36
(Creek chubsucker) Erimyzon oblongus	1		1								1
(Northern hogsucker) Hypentelium nigricans	6	12	1		2	1	3	8	3		4
(Black jumprock) Moxostoma cervinum			8		15	2	4				
(Golden redhorse) M. erythrurum	2		1								
(Torrent sucker) M. rhothoecum	15	144			22			30	17	9	31
Centrarchidae (sunfishes)											
(Rock bass) Ambloplites rupestris	28	16	5	3	19	14	55	6	34	52	68

Table 2 continued
Fish Fauna In Five Tributaries of the Upper James River
Number of Individuals Captured at Samples Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
(Redbreast sunfish) Lepomis auritus	101	15	26	17	18	15	9	10		30	8
(Pumpkinseed) Lepomis gibbosus	4										
(Bluegill) Lepomis macrochirus	7				1		1				
(Smallmouth bass) Micropterus dolomieui	2		1	1		15	9		4	6	2
Cottidae (sculpins)											
(Mottled sculpin) Cottus bairdi			3		64		19	76	44	9	42
(Form of Mottled scuplin) Cottus girardi							13				
Cyprinidae (minnows)											
(Stoneroller) Campostoma anomalum	5	12			42		4	120	10	4	
(Mountain redbelly dace) Phoxinus oreas		28						36	1		

Table 2 continued
Fish Fauna In Five Tributaries of the Upper James River
Number of Indiv iduals Captured at Samples Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
(Rosyside dace) Clinostomus funduloides		17					3	28			1
(Carp) Cyprinus carpio											
(Cutlips minnow) Exoglossum maxillinqua	19	10	5	6	7			60	31	17	75
(Bluehead chub) Nocomis leptocephalus	242	161	10	9	40	11	40	93	89		
(Hybrid chub) N. leptocephalus											
X N. micropogon											
(River chub) N. micropogon										6	
(Bull chub) N. raneyi			9	15	17	7	16				
(Satinfin shiner) Notropis analostanus	9			1			3				

Table 2 continued
Fish Fauna In Five Tributaries of the Upper James River
Number of Individuals Captured at Samples Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
(Rosefin shiner) N. ardens	7		2	2	8	3	87	22	1	14	5
(Common shiner) N. cornutus	13	34	8	20	51		16	65	7	1	8
(Spottail shiner) N. hudsonius			21	2				24			15
(Swallowtail shiner) N. procne			1		1			5			
(Rosyface shiner) N. rubellus	8		1				27	13	1	4	
(Roughhead shiner) N. semperasper			4	7	5		1	4			40
(Mimic shiner) N. volucellus			12	3							
(Bluntnose minnow) Pimephales notatus	25		30	3	2		15	2	1		
(Blacknose dace) Rhinichthys atratulus		31			1			2			2

Table 2 continued
Fish Fauna In Five Tributaries of the Upper James River
Number of Individuals Captured at Samples Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
(Longnose dace) R. cataractae	5	21		1	7	6	6	25	4	2	8
(Creek chub) Semotilus atromaculatus											
(Fallfish) S. corporalis					3	4	2	15			2
Esocidae (pikes)											
(Redfin pickerel) Esox americanus											
(Muskellunge) E. masquinongy											
(Chain pickerel) E. niger			1								
Ictaluridae (catfishes)											
(Yellow bullhead) Ictalurus natalis	1		1				1				

Table 2 continued
Fish Fauna In Five Tributaries of the Upper James River
Number of Individuals Captured at Samples Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
(Brown bullhead) I. nebulosus					2						
(Channel catfish) I. punctatus											
(Margined madtom) Noturus insignis											
Percidae (perches)											
(Fantail darter) Etheostoma flabellare	7	31	3		13	1	26	10	1	3	4
(Longfin darter) E. Longimanum	11	30			5		1	17	5	4	6
(Johnny darter) E. nigrum					2			4			
(Piedmont darter) Percina crassa roanoka			8	2	30						
(Stripeback darter) P. notogramma	4		1		3				4		

Table 2 continued
Fish and Fauna In Five Tributaries of the Upper James River
Number of Individuals Captured at Samples Sites Near Proposed Reservoirs
(From Raleigh et al. 1974)

SPECIES	CATAWBA CREEK		CRAIG CREEK			COWPASTURE RIVER		POTTS CREEK		DUNLAP CREEK	
Sample No:	41	42	43	44	45	49	50	61	62	63	64
(Shield darter) P. peltata				2	3		1	7			
Salmonidae (trouts)											
(Rainbow trout) Salmo gairdneri											
(Brown trout) S. trutta									1		
(Brook trout) Salvelinus fontinalis									1		
TOTAL (FISH)	582	545	165	95	389	79	362	686	271	170	359
TOTAL (SPECIES)	24	16	26	17	28	11	24	26	21	16	20

Table 3. Wildlife species commonly found within the Project Area

Common Name	Scientific Name
White-tailed deer	Odocoileus virginianus
Eastern wild turkey	Meleagris gallopavo
Black bear	Ursus americanus
Bobwhite quail	Colinus virginianus
Eastern mourning dove	Zenaida macroura
Cottontail rabbit	Sylvilagus floridanus
Gray squirrel	Sciurus carolinensis
Fox squirrel	Sciurus niger
Ruffed grouse	Bonasa umbellus
American woodcock	Scolopax minor
Raccoon	Procyon lotor
Mink	Mustela vison
Muskrat	Ondatra zibethicus
Gray fox	Urocyon cinereoargenteus
Red fox	Vulpes fulva
Bobcat	Lynx rufus

Table 4. Freshwater Fish Species in the James River in the Vicinity of Richmond (U.S. Fish and Wildlife Service, 1983).

Longnose gar	*Lepidosteus osseus*
American eel	*Anguilla rostrata*
Gizzard shad	*Dorosoma cepedianum*
Carp	*Cyprinus carpio*
Eastern silvery minnow	*Hybognathus regius*
River chub	*Nocomis micropogon*
Bull chub	*Nocomis raneyi*
Comely shiner	*Notropis amoenus*
Satinfin shiner	*Notropis analostanus*
Rosefin shiner	*Notropis ardens*
Common shiner	*Notropis cornutus*
Spottail shiner	*Notropis hudsonius*
Swallowtail shiner	*Notropis procne*
Rosyface shiner	*Notropis rubellus*
Fallfish	*Semotilus corporalis*
Quillback	*Carpoides cyprinus*
White sucker	*Catostomus commersoni*
Creek chubsucker	*Erimyzon oblongus*
Northern hogsucker	*Hypentelium nigricans*
Shorthead redhorse	*Moxostoma macrolepidotum*
White catfish	*Ictalurus catus*
Yellow bullhead	*Ictalurus natalis*
Brown bullhead	*Ictalurus nebulosus*
Channel catfish	*Icatlurus punctatus*
Margined madtom	*Noturus insignis*
Pirate-perch	*Aphredoderus sayanus*
Bluespotted sunfish	*Enneacanthus gloriosus*
Redbrest sunfish	*Lepomis auritus*
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Smallmouth bass	*Micropterus dolomieui*
Largemouth bass	*Micropterus salmoides*
Black crappie	*Pomoxis nigromaculatus*
Fantail darter	*Etheostoma flabellare*
Johnny darter	*Etheostoma nigrum*
Yellow perch	*Perca flavescens*
Stripeback darter	*Percina notogramma*
Shield darter	*Percina peltata*

THREATENED AND ENDANGERED SPECIES

Occurrences of Federal and state-listed threatened and endangered species, as well as other rare species on the Virginia Division of Natural Heritage (DNH) list, are provided on the following Map and Image Processing System (MIPS) maps developed by the DNH (Figures 2 and 3). The maps provide information for the upper basin, and are color coded to distinguish between the following groups: invertebrate animal, vertebrate animal, vascular plant, nonvascular plant, significant cave, and natural community.

Federally-listed or proposed endangered or threatened species that may be present in the upper James River Basin include:

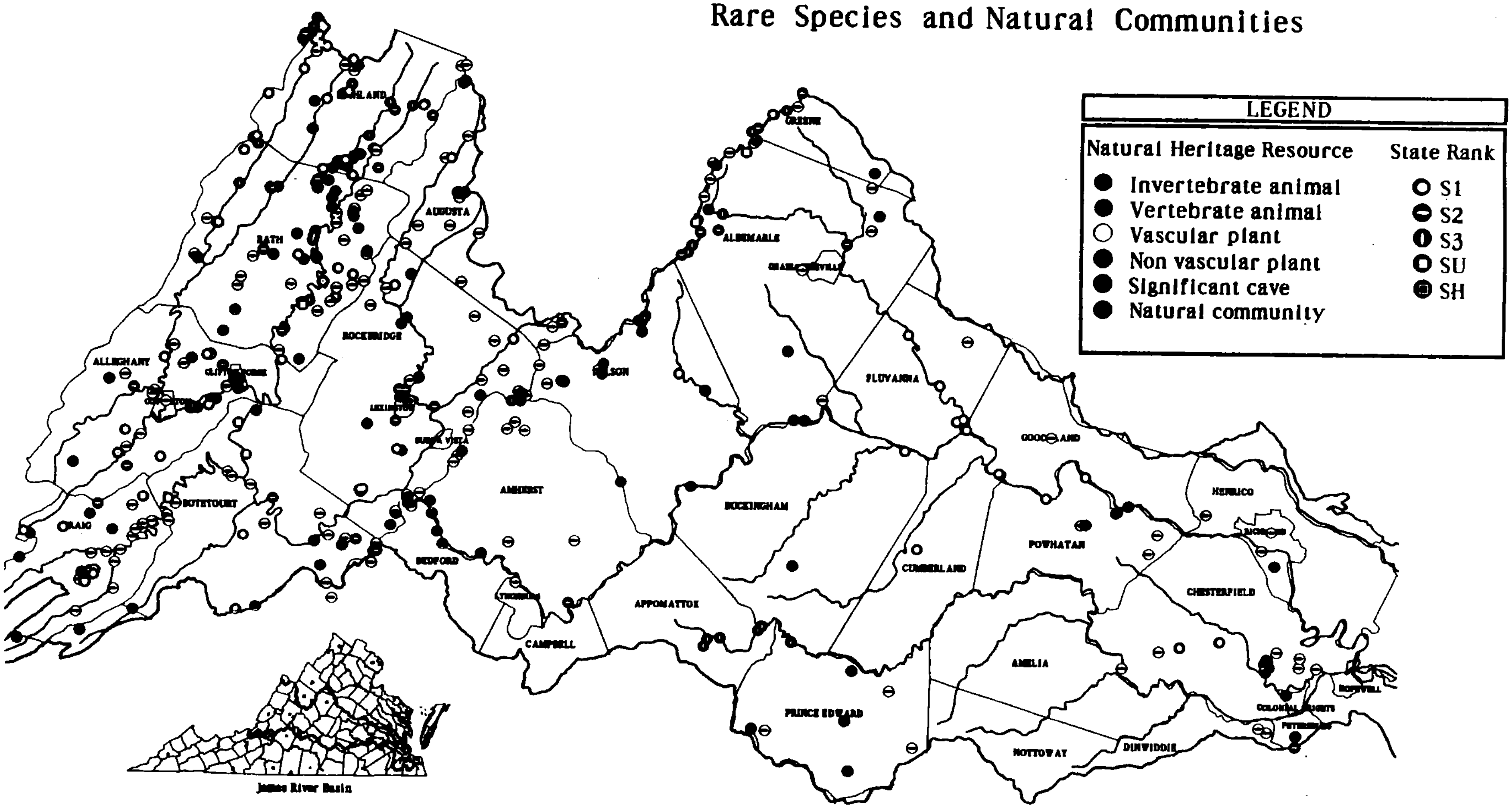
Indiana bat	*Myotis sodalis*
Virginia big-eared bat	*Plecotus townsedii virginianus*
VA N. flying squirrel	*Glaucomys sabrinus fuscus*
James spiny mussel	*Pleurobema collina*
Smooth rockcress	*Arabis serotina*
Northeastern bulrush	*Scirpus ancistrochaetus*

Occasional transients are not included in this list.

In addition to these listed species, the following "candidate" species (those placed under review in the Federal Register to determine suitability for listing) may be present in the upper basin.

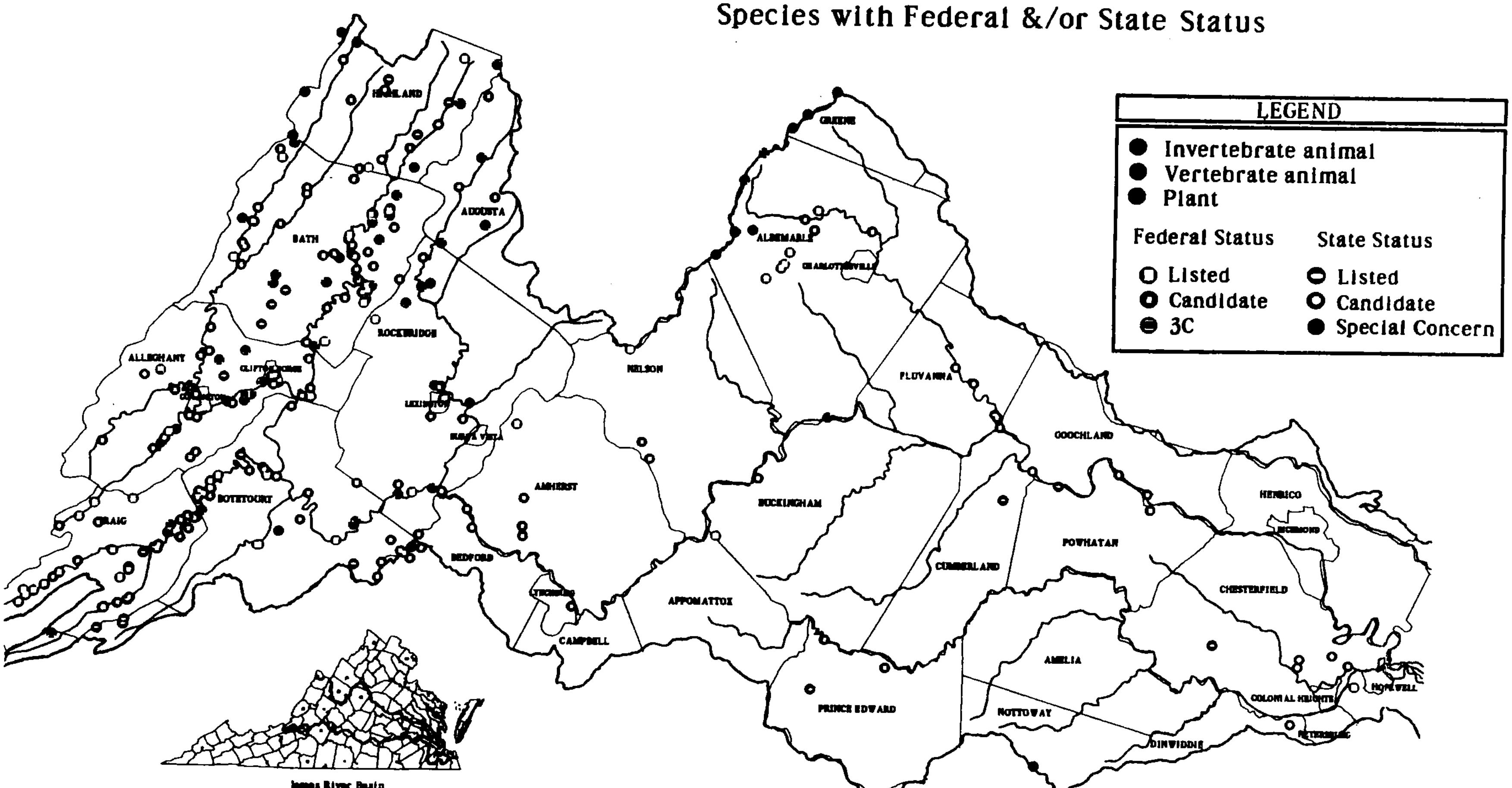
Eastern woodrat	*Neotoma floridana magister*
Southern pygmy shrew	*Microsorex hoyi winnemana*
Rock shrew	*Sorex dispar*
Northern water shrew	*Sorex palustris punctulatus*
White-spotted salamander	*Plethodon punctatus*
Roughhead shiner	*Notropis semperasper*
Atlantic pigtoe mussel	*Fusconaia masoni*
Yellow lance mussel	*Elliptio lanceolata*
Orangefin madtom	*Noturus gilberti*
Bath County cave amphipod	*Stygobromus mundus*
Burnsville Cove cave amphipod	*Stygobromus conradi*
Morrison's cave amphipod	*Stygobromus morrisoni*
Variable sedge	*Carex polymorpha*
Yellow nailwort	*Paronychia virginica*
Kankakee globemallow	*Iliamna remota*
Virginia sneezeweed	*Helenium virginicum*
Quillwort	*Isoetes virginica*
Gray's lily	*Lilium grayi*
Virginia least trillium	*Trillium pusiullum* var. *monticulum*
Millboro leatherflower	*Clematis viticaulis*
Wolf's milk spurge	*Euphorbia purpurea*
Purple coneflower	*Echinacea laevigata*
Cliff green	*Paxistima canbyi*
Piratebush	*Buckleya distichophylla*

FIGURE 2: NATURAL HERITAGE RESOURCES of the UPPER JAMES RIVER BASIN
Rare Species and Natural Communities



Map by: VA Dept. of Conservation & Recreation, Division of Natural Heritage - - Data Current to 8/93

FIGURE 3: NATURAL HERITAGE RESOURCES of the UPPER JAMES RIVER BASIN
Species with Federal &/or State Status



Map by: VA Dept. of Conservation & Recreation, Division of Natural Heritage - - Data Current to 8/93

ENVIRONMENTAL RESTORATION OPPORTUNITIES

Opportunity exists for the Corps to restore some of the environmental values of the James River Basin which have been lost to human population growth, development, and changes in land use. Specifically, the Service recommends the following projects be considered for further analysis:

* * o Wetland restoration and waterfowl habitat enhancement at Lake Moomaw.
* o Streamside fencing and riparian restoration to provide water quality benefits in areas supporting Federally-listed endangered mussels.
* * o Removal or mitigation of barriers to migratory fish in areas not already being funded through other programs.
* o Assess desirability of using Harrison Lake National Fish Hatchery for hatching and rearing shad.
* o Restore floodplain areas dominated by fescue to native riparian communities.
* o Reintroduce river otter to historic James River range.
* * o Restore wetlands on State Wildlife Management Areas (WMA).
* o Restore wetlands on George Washington National Forest (GWNF).
* * o Construct human exclusion gates at bat nursery caves.
* o Control purple loosestrife (*Lythrum salicaria*).

Recommended projects anticipated to be cost shared by the Virginia Department of Game and Inland Fisheries (VDGIF) with in the next 1-2 years are highlighted by asterisk * (R. Fernald, VDGIF, pers. comm.). Other cost share partners would be required for the additional projects listed. Virginia Department of Conservation and Recreation (VDCR) would be a potential funding source for projects benefitting endangered species and biological diversity. Service recommended projects are covered in more detail in the proceeding section.

In addition to Service enumerated opportunities, the VDGIF recommends the following projects be considered (R. Fernald, pers. comm.):

* o Coursey Springs Trout Hatchery spring containment restoration.
* o Coursey Springs Trout Hatchery pond renovation.
* o Lake Moomaw/Gathright WMA herbaceous wildlife habitat development.

The VDCR, in accordance with the Natural Area Preserves Act, maintains a comprehensive inventory of the state's natural heritage resources. The data bank is used to establish a conservation agenda in order to protect Virginia's biological diversity. VDCR has identified the following inventory, assessment, and planning needs for the James River Basin:

- Inventory and assessment of critically rare species and natural communities.
  - Riparian Grasslands
  - Kankakee Mallow, a Federal candidate
  - Freshwater Mussels (17 species occur in the basin, 6 of which are of Federal concern)
  - Purple Loosestrife (determine extent of infestation and potential for control)

- Protection and restoration planning for significant natural areas.
  - Conservation Planning
  - Landowner Contact and Education

RECOMMENDED PROJECTS

(Projects are not listed in priority order)

1. Wetland Restoration/Habitat Enhancement at Lake Moomaw

When Gathright Dam flooded what was to become Lake Moomaw, many acres of beaver ponds and riparian wetland types were lost. Prior to impoundment, these wetlands provided year round or migratory habitat to waterfowl, shorebirds, waterbirds, and aquatic furbearers. Species such as American woodcock, passerines, amphibians, wild turkey, and bald eagle used the wetland and riparian habitats for part of their life cycle. Extreme water level fluctuations associated with present water releases at Gathright Dam have prevented reestablishment of these wetland types around the reservoir shoreline. Wetland habitat is presently limited in the mountains of western Virginia.

Waterbird and wetland oriented wildlife habitat restoration could include several small projects in and around Lake Moomaw. At the upper, shallow water end of the reservoir 4 to 5 additional waterfowl/waterbird nesting islands could be created. Islands would be created when the lake is drawn down, through the use of dozers pushing up mounds to an elevation above full pool level. The islands should be protected from erosion with riprap, and topsoil placed on top before planting with native grass and shrub species. A shrub canopy will minimize depredation on nests from avian predators. Habitat value of the existing islands can also be enhanced by providing topsoil and revegetating. Benefits would include increased waterfowl and waterbird recruitment. Wood duck boxes should be placed where suitable water levels and brood habitat exist to further enhance production of this cavity nesting species. The VDGIF estimates cost to create islands, provide erosion protection, spread topsoil, and vegetate at approximately $20,000. The cost to spread topsoil and revegetate existing islands is estimated at $2,500. Redcedar-plank wood duck box units (two boxes mounted back to back on a 4" X 4" pressure treated post with conical metal predator guard) are approximately $90 each (N. Gerber, Chesapeake Wildlife Heritage, pers. comm.).

The VDGIF recommends wetlands be developed in the lower fields below the manager's residence. The recommended impounding of the location should be predicated on the site not already being a wetland. Using moist soil management techniques, a 1 to 2 acre impoundment could be constructed to provide a 50:50 ratio of emergent wetland and shallow water. The habitat development would require construction of a clay core trench and dike, installation of a water control structure and spillway, and seeding of exposed soil. Plantings of native upland plants beneficial to wildlife around the impoundment, selecting growth forms that provide vertical and horizontal structural heterogeneity, would diversify the habitat values provided. Game and nongame wildlife would benefit, including species of amphibians, rails, puddle ducks, fish-eating birds, wetland and floodplain associated passerines, and shorebirds. Unlike the drawdown schedule of the lake, the waterbird impoundment drawdown schedule can be timed for migratory users. The VDGIF anticipates cost for the work at approximately $10,000.

As mitigation for wetlands lost to a flood control and water supply reservoir on Cedar Run, near Warrenton, Virginia, the Soil Conservation Service (SCS) constructed 17 acres of wetlands using partially pervious stone dikes to maintain requisite water levels. The technique could be a solution to the water level fluctuations at Lake Moomaw preventing fringing wetland establishment. Dikes are constructed to be impervious up to an elevation desired for wetland establishment. During drawdown the dikes maintain water within the impervious elevation. During higher water levels water flows through the upper pervious portion of the dike, or completely over the top. Spillways are not required as the entire dike can perform this function. Sites where tributaries flow into the lake should be selected in order to provide a continuous source of water during drawdown. Suitable substrate is provided behind the structures, and wetland vegetation is planted or allowed to colonize naturally. An emergent and scrub/shrub wetland community that would imitate a beaver pond complex would be appropriate as mitigation for habitat lost to the creation of Lake Moomaw. National Forest Service (NFS) staff at George Washington National Forest have selected 4 potential sites around Lake Moomaw (Figure 3). NFS staff describe the sites as follows (D. Kirk, NFS, pers. comm.):

Site 1. Surrounding the current duck islands, it is approximately 5 to 6 acres. Water during low flow would have to be siphoned off the nearby main river. Access with heavy equipment would not be a problem.

Site 2. Large flat, approximately 8 acres. Water during low flow may be a problem unless the tributary at Buckeye Hollow could be incorporated, or water obtained from the main channel. Access with heavy equipment would be a problem.

Figure 4. Potential Wetland Restoration Sites Around Lake Moomaw

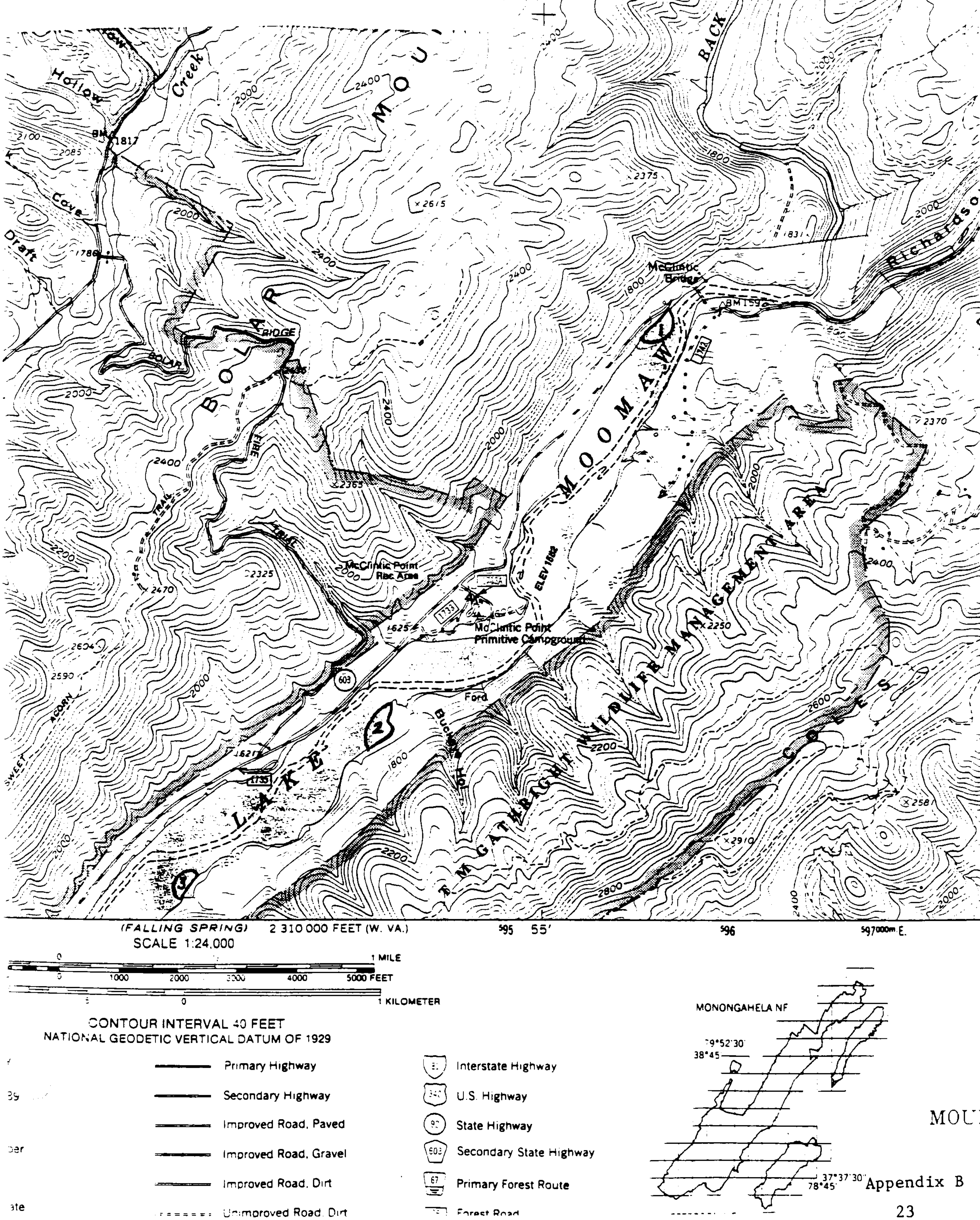
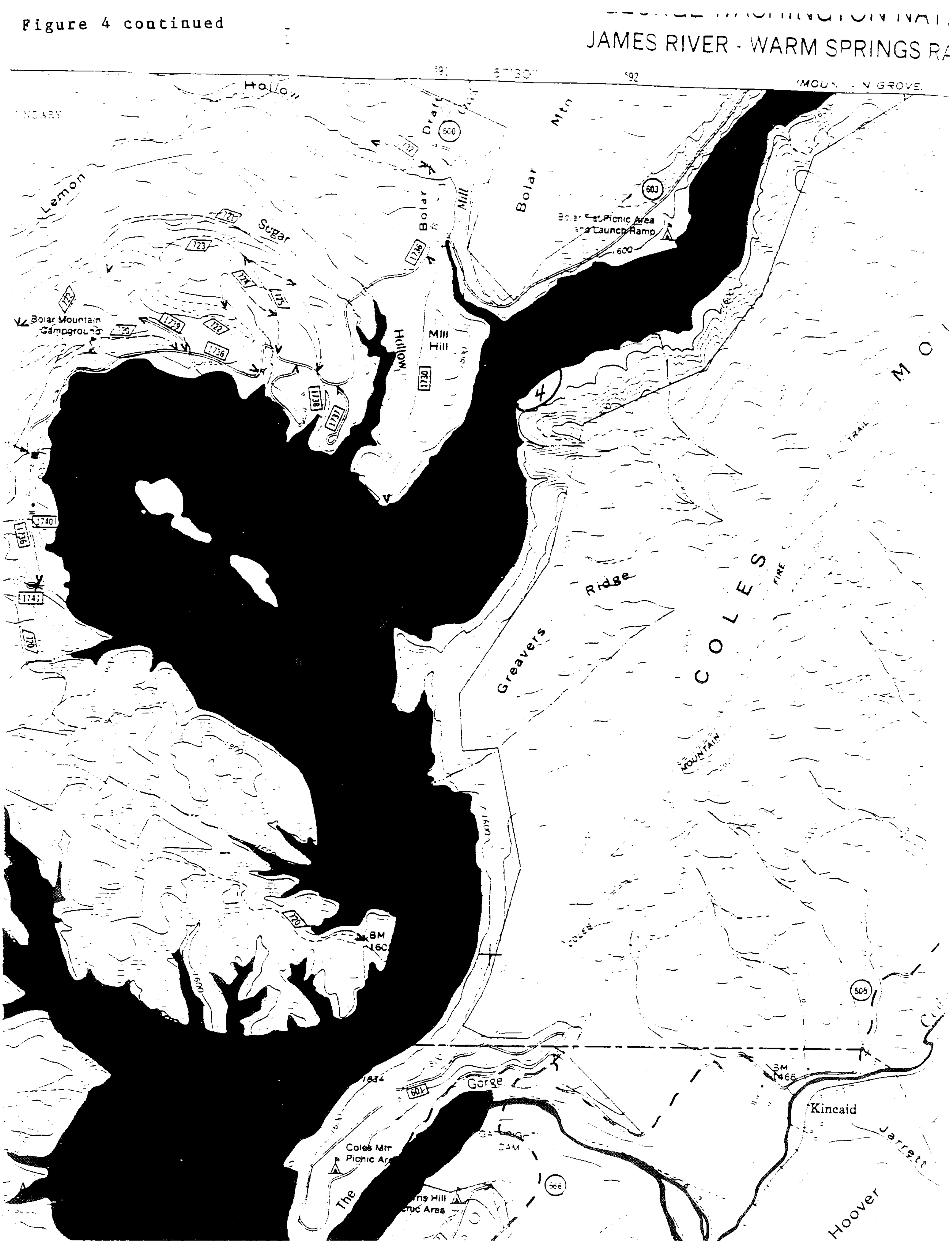


Figure 4 continued



Site 3. A less than 5 acre flat, with some vegetation already established. A small tributary could supply water during low flow. Access with heavy equipment would be a problem.

Site 4. Approximately 5 acres. Water during low flow, as well as access with heavy equipment may be a problem.

The SCS spent $249,771 to create 17 acres of wetlands at Cedar Run (J. Blodgett, SCS, pers. comm.). Assuming similar material and logistic costs at Lake Moomaw, wetlands could be restored at a cost of approximately $14,700 per acre. Benefits would include partially restored habitat values lost to creation of the reservoir, partial rectification of habitat values lost to the reservoir's fluctuating water level, and improved water quality for waters entering the reservoir.

2. Streamside Fencing and Riparian Restoration Benefiting Endangered Mussels

Historically, the Federally-listed endangered James spinymussel was widespread in the James River drainage (USFWS 1990). Table 5 lists the historic and present location of the species. Clarke and Neves (1984) surveyed 73 potential locations for the species, but were able to find the spinymussel at only six of the historic sites: two in Johns Creek, three in Craig Creek, and one in Potts Creek. Based on this survey, and other more recent survey data (Hove 1990 and Neves pers. comm.), the species is now known to inhabit sites in ten streams (USFWS 1990):

<u>Craig Creek drainage - Craig and Botetourt Counties, Virginia</u>

1. Craig Creek
2. Johns Creek
3. Dicks Creek
4. Patterson Creek

<u>Other drainages</u>

5. Potts Creek - Monroe Co., WV and Craig and Alleghany Co., VA
6. Pedlar River - Amherst Co., VA
7. Mechums River - Albemarle Co., VA
8. Moormans River - Albemarle Co., VA
9. Rocky Run (Moormans River) - Albemarle Co., VA
10. Catawba Creek - Botetourt Co., VA

In addition to those listed above, Stevenson (1992) located one site on Wards Creek, Albemarle County, Virginia. General locations of the extant populations are shown in Figure . With the exception of the Craig and Johns Creek populations, all extant populations appear to be small and very restricted in distribution (USFWS 1990).

Table 5: Historic (H) and present (P) occurrences of the James spinymussel. Data taken from Clarke and Neves 1984; Neves, in litt., 1989.

	James River Mainstem	
(H)	James River near Natural Bridge	Rockbridge County, VA
(H)	James River at Buchanan	Botetourt County, VA
(H)	James River at Columbia	Fluvana County, VA
(H)	James River at New Canton	Buckingham County, VA
(H)	James River opposite Maidens	Goochland County, VA
(H)	James River at Maidens	Goochland County, VA
(H)	James River at Rock Castle	Goochland County, VA
(H)	James River at Pemberton and Cartersville	Goochland and Cumberland Counties, VA
	Rivanna River Drainage	
(H)	Rivana River near Columbia	Fluvanna County, VA
(H)	Rivanna River near Palmyra	Fluvanna County, VA
(H)	Rivanna River at Crofton	Fluvanna County, VA
(P)	Mechums River	Albemarle County, VA
(P)	Rocky Run (Moormans River)	Albemarle County, VA
(P)	Moormans River	Albemarle County, VA
	Maury River Drainage	
(H)	Calfpasture River	Rockbridge County, VA
(H)	North (= Maury) River, Lexington	Rockbridge County, VA
(H)	Mill Creek near Millboro	Bath County, VA
	Craig Creek Drainage	
(P)	Craig Creek near New Castle	Craig County, VA
(P)	Craig Creek near Silent Dell	Botetourt County, VA
(P)	Craig Creek near Eagle Rock	Botetourt County, VA
(P)	Johns Creek near Maggie	Craig County, VA
(P)	Johns Creek along Sevenmile Mountain	Craig County, VA
(P)	Dicks Creek	Craig County, VA
(P)	Patterson Creek	Botetourt County, VA
	Jackson River Drainage	
(P)	South Fork Potts Creek	Monroe County, WVa
(P)	Potts Creek	Craig and Alleghany Counties, VA
	Other Drainages	
(P)	Catawba Creek	Botetourt County, VA
(P)	Pedlar River	Amherst County, VA

Primary factors thought responsible for the James spinymussel decline include point source water pollution, siltation/agricultural runoff, competition from the Asian clam (*Corbicula fluminea*), and impoundment of free-flowing streams and rivers (USFWS 1990). Considering primary land uses in the upper James, siltation and agricultural runoff probably constitute the biggest threat to existing spinymussel populations. Fencing along stream banks upstream and adjacent to mussel beds to prevent livestock access, reduce erosion, and reduce nonpoint source runoff is an effective mechanism to protect and enhance mussel habitat.

Streamside improvement projects generally consist of fencing to exclude cattle, and some or all of the following: cattle/vehicle stream crossings, native tree plantings, and alternative water supply. The overall goal is improved water quality. In addition, private landowners should be encouraged to implement nutrient management and grazing rotation systems. These types of "Best Management Practices" (BMP's) are designed by state and Federal soil and water conservation agencies. Both fencing and BMP's can be cost shared by the soil and water conservation agencies. Additionally, the USFWS Partners for Wildlife program can pay 65% - 100%. Benefits include assuring the continued existence of an endangered species, and improved water quality in the local watersheds.

Costs

Fence	3 - 5 strand high-tensile electric at an average 95 cents/foot.
Stream Crossings	Approximately $2,500 each.
Alternative Water (well, pipe, trough)	Approximately $3,500 for well, and $1,500 for the rest.
Trees	Can be donated by VA Forestry Dept., or standard large volume nursery prices.

3. Removal of Barriers to Migratory Fish

As part of Virginia's and the multiagency Chesapeake Bay Program's effort to restore declining stocks of anadromous fish, breaches were constructed during 1989 in Manchester and Brown's Island dams. These dams are the two lowermost barriers to migratory fish on the James River. Monitoring conducted by Virginia Commonwealth University (VCU) from 1989 to 1992 documented utilization of the breaches by American shad and striped bass (Garman and Eareckson 1990). However, no blueback herring or alewife have been collected above the breaches since monitoring began. Large numbers of these species are known to occur below the breaches (Garman 1993).

Using radio telemetry, Garman (1993) tested whether the observed distribution of blueback herring and alewife in the vicinity of Richmond was the result of intrinsic biological factors (e.g. a lack of imprinting to locations above existing breaches), or whether the breaches continue to act as barriers to the species. He found that the overall degree of upstream migration by 27 anadromous blueback herring within the James River at Richmond was not significant, but did indicate movements by some individuals to a region immediately below the breaches. Garman concluded that considering only the telemetry findings, structural modifications to the breaches to improve passage are not merited. However, he states "a judgement based on a wider range of available and pertinent information, some of which was presented above, would support modifications to the present breaches that reduce current velocities to less than approximately 0.6 meter/second during the spawning run (March - May)".

Studies of fish movements using radio telemetry may be limited by specific problems, including relatively small sample sizes and the likelihood of abnormal behavior by recently tagged individuals (Garman 1993). Garman also suggests that there is circumstantial evidence suggesting that wider and/or deeper breaches at the two locations could reduce velocities to allow for smaller alosid migrants to continue upstream. The three larger anadromous species can navigate the existing breaches, including American shad, striped bass, and sea lamprey. The USFWS agrees with this rational, and supports modification of the breaches at Manchester and Brown's Dams (R. Kelsey, USFWS, pers. comm.). Mr. Dick Quinn of the USFWS should be contacted regarding structural needs and engineering techniques for breach modifications. He may be contacted at the USFWS Region 5 Office at (413) 253-8200.

Regarding fish passage at Bosher's Dam, there is an ongoing multiagency and private effort to raise money to construct a vertical slot fishway. Construction is expected to take place within the next several years. At this time, the Corps James River Restoration effort should be directed towards complimenting the Bosher's dam project by pursuing other projects or blockages in the watershed. As an alternative, the VDGIF has suggested constructing a fish trap at the inlet or outlet of the future fishway. The trap would benefit collection, monitoring, and tagging of migrating fish populations. This information will be vital for future management of the resource. The VDGIF estimates the cost at approximately $50,000.

Scott's Mill Dam is the next impediment to fish passage on the James River. With the successful completion of fishways on Williams Island and Bosher's Dams in several years, Scott's Mill Dam will require fish passage. The six dams above Scott's Mill Dam will be required to provide fish passage through the Federal Energy Regulatory Commission (FERC) licensing program (Table 6).

Scotts Mill Dam, located within the city limits of Lynchburg, is approximately 925 feet long, and is a 15 foot high masonry structure. At this time little is known regarding structural, cost, acquisition, and engineering needs in order to provide fish passage. Habitat for American shad and river herring above Scotts Mill Dam to the most upstream dam which is not already breached, Cushaw Dam, is poor (R.Kelsey, USFWS, pers. comm.). However, once beyond Cushaw Dam, suitable spawning habitat exists. The VDGIF estimates annual benefits for restoration of anadromous fish to the middle and upper James River range from $5.5 to $6.8 million, based on the restoration of habitat to support 600,000 American shad and 6 million river herring.

TABLE 6. FERC License Requirements on
JAMES RIVER DAMS - LYNCHBURG AREA

Dam/Owner	River Mile	FERC License Type[1] and Number	Fish Passage Requirements[2]
Scotts Mill / Appalachian Power Co.	252.1	NONE	NONE
Reusens / Appalachian Power Co.	255.6	MAJOR #2376	Articles 15 & 16
Holcomb Rock / Nekoosa Packaging Corp.	264.0	MAJOR #2901	Articles 15 & 16
Coleman Falls / Nekoosa Packaging Corp.	266.2	EXEMPTION #5456	Mandatory Terms and conditions as prescribed by USFWS
Big Island / Nekoosa Packaging Corp.	270.5	MINOR #2902	Articles 11 & 12
Snowden / City of Bedford	273.7	MAJOR #5596	Articles 15 & 16
Cushaw / Virginia Power Co.	274.9	MAJOR #906	Articles 15 & 16
Balcony Falls / ?	?	NONE	BREACHED

1 FERC LICENSE TYPE:
MAJOR = >5 MW
MINOR = <5 MW
EXEMPTION = <5 MW and exempted from all or part of Part I of the Federal Power Act (pursuant to 18 CFR Part 4 SUBPART K (1980) implementing in part Section 408 of the Energy Security Act of 1980).

2 FISH PASSAGE REQUIREMENTS: SEE ATTACHMENTS

Table 6 continued:

STANDARD LICENSE ARTICLE 11 (MINOR PROJECT) AND 15 (MAJOR PROJECT)

The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain, and operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable modifications of the project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the project or a part thereof is located, after notice and opportunity for hearing.

STANDARD LICENSE ARTICLE 12 (MINOR PROJECT) AND 16 (MAJOR PROJECT)

Whenever the United States shall desire, in connection with the project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities as its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost, such of the Licensee's lands and interests in lands, reservoirs, waterways and projects works as may be reasonably required to complete such facilities or such improvements thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the project operation as may be reasonably prescribed by the Commission in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under this license.

The preference for providing fish passage at Scotts Mill Dam would be to 1) breach or remove the dam, 2) construct a fish ladder, or 3) construct a fish lift. The desirability of implementing a truck and transport operation should also be assessed. At this time, Corps efforts would be best directed at funding a feasibility study to analyze the various options. An additional consideration is the expected year migratory fish populations would be great enough to push fish upstream to this location.

4. Shad Rearing using Harrison Lake National Fish Hatchery

As a stop-gap measure to maintain American shad in the James River, it has been suggested that Harrison Lake National Fish Hatchery be refitted for shad production. Shad would be cultured to augment the dwindling natural population, not to support a "put and take" fishery. The feasibility and desirability of such an approach would need to be assessed by the USFWS, the Virginia Marine Resources Commission (VMRC), and the VDGIF before consideration by the Norfolk District, Corps. If it were determined that a shad rearing facility was needed to support shad restoration efforts, it would be necessary to extend and modify the existing Cooperative Agreement between USFWS and VDGIF. Such a determination must also consider the Virginia shad production effort at King and Queen Fish Cultural Station in Stevensville, on the York River, (vs. the need for another facility on the James River). To date, no interagency coordination between the USFWS, the VDGIF, or the VMRC has occurred. Specific needs and costs associated with refitting Harrison Lake are not known.

5. Restore floodplain areas Dominated by Fescue to Native Warm Season Grasses

Warm Season Grasses (WSG) are a group of native grasses including, but not limited to: big and little bluestem (*Andropogon spp.*), indian grass (*Sorghastrum spp.*), switchgrass (*Panicum spp.*), side-oats grama (*Bouteloua spp.*), and eastern gamagrass (*Tripsacum spp.*). Unlike tall fescue, WSG benefit wildlife because of the bunchgrass growth form. Overhead cover for protection, sites for nesting, with bare ground between bunches for movement and food searching are provided to species such as quail, rabbit, and other ground nesting species such as meadow lark and turkey. Once established, WSG require virtually no additional economic inputs (e.g. no fertilizer), are more productive and palatable than cool season grasses, and provide quality summer forage to farmers. Recent problems with tall fescue pasture infection by endophyte fungus, and production failure during drought has focused attention on WSG as an alternative to traditional pasture management. Historically, where openings existed due to fire or other disturbances which prevent trees or shrubs, the James River floodplain supported the WSG habitat type.

Converting James River floodplain dominated by fescue to WSG is an inexpensive means of providing habitat where little exists. There is an additional water quality benefit in that WSG require little if any applications of fertilizer, thereby reducing nutrient loading into the James. Economic and forage benefits to the farmer can promote projects on private as well as public lands. WSG establishment can also be done in conjunction with other recommended projects (e.g. in areas around Lake Moomaw).

The VDGIF has produced two publications on establishing WSG fields and wildlife habitat. These documents should be referred to for specific information on benefits, planting methods, planting rates, weed control, grazing, haying, burning, and managing to optimize wildlife use.

6. Reintroduce River Otter

During the last century, river otter populations have exhibited dramatic declines. Although agricultural pollution and land development have damaged some habitat, over-exploitation has probably been the most detrimental factor. The augmentation of low wildlife populations, and the reintroduction of species extirpated from portions of their historic range, is a proven management technique to reestablish species abundance where suitable habitat exists. River otter reintroductions have been successful in other states.

Virginia initiated an otter relocation project in 1988 on the Cowpasture River (A. Bourgeois, VDGIF, pers. comm.). The project ended the following year due to lack of funds. Corps restoration funds could be used to reiniate the otter relocation work. Wild otters would be trapped from areas supporting large populations, and relocated into major tributaries of the James where numbers are low. A monitoring component would be required to determine fate of the animals and overall reintroduction success.

The river otter is a species of special concern in the western counties of Virginia. The project would directly benefit a visible and publicly popular species. In so doing, an important higher order element in the food chain can be restored to its former range. The VDGIF estimates $20,000 as a minimum amount to initiate the work.

7. Restore Wetlands on State Wildlife Management Areas

The entire James River Basin flood plain once supported extensive areas of beaver ponds, overflow channels, and other wetland types. As the area was settled and farmed, vast areas were modified and a large percentage of the wetlands lost. Previously-converted (p-c) wetlands can be restored using techniques such as those used by The USFWS and the VDGIF in the Partners for Wildlife Program on private lands.

There are two locations at the James River WMA where p-c wetlands are presently farmed. One is located near Midway Mill, and the other next to an existing wetland restoration project. Another p-c is located at the Hardware River WMA. Restoration would be accomplished by constructing berms, installing water control devices, seeding exposed areas, and establishing buffers of native vegetation. Water levels are manipulated in order to maintain desired wetland communities. The VDGIF has supplied the Corps with detailed information on each proposal (R. Fernald, VDGIF, pers. comm.). The VDGIF estimates cost for the two James River WMA projects at $50,000, and $30,000 for the Hardware River WMA project. Projects will support the goals of the North American Waterfowl Management Plan by providing wetland habitat for game and non-game species.

8. Restore Wetlands on the George Washington National Forest

Additional wetland restoration opportunity exists on the GWNF. Restoration would be accomplished as proposed on the state WMA's, using p-c sites which are presently farmed or in pasture. Project costs would be comparable on a per acre basis to the WMA proposals. Resource benefits would be the same.

Five sites have been recommended for wetland restoration. They include: Hidden Valley (5 acres), Evans (2 acres), Wallace (8 acres), Walton (3 acres), and Marshall (3 acres). Specific site plans for the locations have not been developed.

9. Gate Bat Nursery Cave

Human disturbances to bat caves have been shown to reduce the number of bats in a roost. Disturbance can also increase the chance hibernation will be broken, causing energy to be lost during the critical over-wintering period of bats. Gating caves is an effective means of increasing survival for resident bats. The approach has been used to reduce human disturbance to hibernacula, while permitting free ingress and egress for bat populations.

Approximately 5-6 miles northwest of Warm Springs, Virginia, on the GWNF is a hibernacula supporting the Federally-listed endangered Indiana bat (*Myotis sodalis*). The VDGIf recommends constructing gates at this cave to exclude human activity. Several gates are needed as the cave has multiple entrances. Gates are welded on site to fit the unique dimensions of a particular entrance, using pipe and rebar, anchored in the bedrock or poured cement.

The VDGIF estimates the project cost at $12,000. The action will provide protection to a Federally-listed endangered species, potentially allow the population to grow, and equally benefit other bat species using the cave.

10. Purple Loosestrife Control

Purple loosestrife is an exotic emergent wetland species with an aggressive growth pattern. Once established, purple loosestrife can completely take over a marsh, eliminating other species and forming monotypic stands. Wetland and habitat diversity is lost, resulting in fewer wildlife species able to utilize the wetland. Purple loosestrife is of particular concern for wetland complexes supporting endangered species of plants. At present, this species occurs but is not prevalent in Virginia. Judicious use of herbicide could be used to control, and where possible eradicate, the species before it becomes a major problem.

Working through VDCR, surveys would be conducted to determine where purple loosestrife infestations occur in the watershed. Wetland complexes supporting endangered plants would be of highest priority. At selected sites the herbicide Rodeo (Monsanto Co., St. Louis , MO., active ingredient: isopropylamine salt of glyphosate, N - (phosphonomethyl) glycine) would be applied at manufacturers recommended rates. If similar to common reed (*Phragmites communis*) control rates, it would be applied as a foliage spray at 4 pints per acre for broadcast spraying, or a 1 1/2 percent solution for hand held spray equipment (S. Ailstock, Anne Arundel Community College, pers. comm.). Aerial application can be performed for approximately $50 - $60 per acre (S. Ailstock, pers. comm.).

Herbicide control of purple loosestrife should occur before inflorescence. Although translocated herbicide will kill plants and root stock, seeds will remain viable. In Massachusetts, spraying of loosestrife is no later than the second week in August (E. Moses, USFWS, pers. comm.). Where large colonies of loosestrife occur, burning of dead vegetation is desirable to allow for sunlight penetration, and recolonization by native species. Following treatment, all sites should be evaluated for loosestrife recruitment, and need for subsequent treatments. It is likely that at least two treatments (covering two years) would be required.

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STUDY COORDINATION CORRESPONDENCE

APPENDIX C

COMMONWEALTH of VIRGINIA

Council on the Environment

KEITH J. BUTTLEMAN
ADMINISTRATOR

202 NORTH NINTH STREET
SUITE 900
RICHMOND 23219
804-786-4500
TDD 804-371-7604

August 7, 1991

Colonel R. C. Johns
District Engineer
Norfolk District, Army Corps of Engineers
803 Front Street (Fort Norfolk)
Norfolk, Virginia 23510

Dear Colonel Johns:

I am writing to express the interest of the Council on the Environment in sponsoring a Corps environmental engineering restoration initiative for the James River basin. This would begin with a reconnaissance-level study by the Corps to determine whether more detailed feasibility studies are warranted for environmental improvements in the James River basin.

We understand that the Commonwealth is under no obligation with regard to the reconnaissance-level studies, and that obligations for cost-sharing would arise only if we assist with detailed feasibility studies or project implementation, on the basis of the reconnaissance study. The range of federal cost-sharing responsibility would be 50% to 75%, leaving 25% to 50% of the cost for feasibility studies or implementation to the state or other non-federal sponsor. We understand further that the time frame for the reconnaissance-level study is federal fiscal year 1993 (beginning in October 1992).

The Corps will, through these studies, examine ways to provide environmental improvements to the river basin, such as habitat improvement, re-establishing historic species of fish or wildlife, removal of barriers to migratory fish, supplementation of food sources, and other measures, depending on river basin needs, opportunities, and funding as identified, with our help, in the reconnaissance study. These aims are important to the Commonwealth, and we welcome an opportunity to initiate reconnaissance-level studies.

We ask that the Corps, prior to beginning the reconnaissance study, consult with other federal agencies with activities and responsibilities in the James River Basin in order to avoid possible duplication of effort. In addition, we ask that the Corps solicit the views of appropriate state agencies concerning the topics that should be addressed at the reconnaissance level. The Council staff can provide suggestions regarding this consultation or coordinate the effort, depending on our mutual needs and on the scope of the inquiry. Additional coordination will take place as we review the reconnaissance-level study and decide upon future actions and involvement.

We believe that reconnaissance-level studies would be helpful to us in deciding on future actions with respect to river basin restoration and enhancement. If this request is approved, we will work with you to define the scope of the reconnaissance study.

Sincerely,

Keith J. Buttleman

cc: The Honorable Elizabeth H. Haskell
Bud Bristow, DGIF
William A. Pruitt, MRC
Richard N. Burton, SWCB
Jerald F. Moore, DCR
R. Keith Bull, CBLAD
P. Scott Eubanks, DED

JOHN WARNER
VIRGINIA

COMMITTEES:
ARMED SERVICES
SELECT COMMITTEE ON INTELLIGENCE
ENVIRONMENT AND PUBLIC WORKS
RULES AND ADMINISTRATION

United States Senate

225 RUSSELL SENATE OFFICE BUILDING
WASHINGTON, DC 20510-4601
(202) 224-2023

CONSTITUENT SERVICE OFFICES

4900 WORLD TRADE CENTER
NORFOLK, VA 23510-1624
(804) 441-3079

MAIN STREET CENTRE
600 MAIN STREET
RICHMOND, VA [illegible]

235 FEDERAL BUILDING
180 WEST MAIN STREET
ABINGDON, VA 24210-0887
(703) 628-8158

DOMINION BANK BUILDING
213 S. JEFFERSON ST. SUITE [illegible]
ROANOKE, VA 24011-[illegible]
(703) 982-4676

January 9, 1992

Colonel Richard C. Johns
District Engineer
Norfolk District, Corps of Engineers
803 Front Street
Norfolk, Virginia 23510

Dear Colonel Johns:

As you may know, I have long supported the Corps of Engineers work to analyze the James River Basin in an effort to improve flood control and the environmental integrity of the basin.

I continue to believe the Corps ongoing efforts to examine the James River Basin in sufficient detail to identify environmental engineering and fish and wildlife restoration opportunities are valuable to the basin's long-term management.

As the major river basins of eastern Virginia continue to be stressed by the many demands for recreation, fish and shellfish productivity, water supply and other uses, I trust the Corps will continue its commitment to preventing further degradations and preserving our environment for future generations.

The Committee Resolution of June 17, 1987 which I sponsored in the Committee on Environment and Public Works offers the Corps full authority to examine the James River watershed. I hope the Corps to continue its excellent analysis and management of the basin and urge you to allocate necessary resources to fulfill this mission.

With kind regards, I am

Sincerely,

John Warner

John Warner

JW:al

TOTAL P.02

1st Session

United States Senate

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

COMMITTEE RESOLUTION

RESOLVED BY THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on James River, Virginia and tributaries published in House Document 207, 80th Congress, First Session, and other pertinent studies, with a view to determining whether any modification of the recommendations contained therein are advisable at the present time in the interests of flood control and related purposes.

Quentin Burdick, CHAIRMAN

Robert T. Stafford, RANKING MINORITY MEMBER

Adopted: June 17, 1987

ENVIRONMENTAL ENGINEERING
FISH AND WILDLIFE RESTORATION STUDY
JAMES RIVER BASIN, VIRGINIA (GI)

EXECUTIVE SUMMARY

* AUTHORITY: U.S. SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS RESOLUTION ADOPTED ON 17 JUN 87 WHICH DIRECTS CORPS " ... TO REVIEW REPORT OF CHIEF ... ON JAMES RIVER, VA AND TRIBUTARIES ... IN HOUSE DOCUMENT 207, 80TH CONGRESS, FIRST SESSION AND OTHER PERTINENT STUDIES, ... TO DETERMINE WHETHER ANY MODIFICATIONS ... ARE ADVISABLE ... IN THE INTEREST OF FLOOD CONTROL AND RELATED PURPOSES."

* THE NATURAL RESOURCES IN THE MAJOR RIVER BASINS IN EASTERN VIRGINIA HAVE BEEN HEAVILY EXPLOITED SINCE THE EARLIEST EUROPEAN SETTLEMENTS. MASSIVE POPULATION GROWTH, DEVELOPMENT AND CHANGES IN LAND USE IN THIS CENTURY HAVE FURTHER STRESSED THE RENEWAL AND SURVIVAL PROCESS. THE CORPS GATHRIGHT DAM-LAKE MOOMAW PROJECT BLOCKED THE JACKSON RIVER TO ANADROMOUS FISH AND INUNDATED 2,532 ACRES OF WOODED UPLAND, WOODED WETLAND, RIPARIAN, AND AQUATIC HABITAT, PORTIONS OF WHICH WERE IN THE TOM GATHRIGHT WILDLIFE MANAGEMENT AREA AND GEORGE WASHINGTON NATIONAL FOREST.

* THIS STUDY WILL EXAMINE THE JAMES RIVER BASIN IN SUFFICIENT DETAIL TO IDENTIFY ENVIRONMENTAL ENGINEERING RESTORATION OPPORTUNITIES TO INCLUDE FISH AND WILDLIFE POPULATION REESTABLISHMENT, HABITAT EVALUATION, IMPROVEMENT, AND RESTORATION, REMOVAL OF MIGRATION BARRIERS, FOOD SOURCE SUPPLEMENTATION, ETC.

* THE COMMONWEALTH OF VIRGINIA HAS ALREADY PROVIDED FISH PASSAGE THROUGH SEVERAL DAMS IN THE RICHMOND AREA AND IS QUITE INTERESTED IN THIS STUDY.

* THE RECON PHASE OF THE JAMES RIVER BASIN ENVIRONMENTAL RESTORATION STUDY IS SCHEDULED TO BE COMPLETED IN SEPT 93. THE RECON STUDY IS EXPECTED TO RECOMMEND SEVERAL FEASIBILITY STUDIES WHICH WILL FOLLOW. THE COMMONWEALTH OF VIRGINIA, COUNCIL ON THE ENVIRONMENT IS THE LOCAL SPONSOR AND IS AWARE OF THE COST-SHARING REQUIREMENTS.

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

October 13, 1992

Environmental Analysis Branch

Mr. Keith J. Buttleman
Administrator
Council on the Environment
Commonwealth of Virginia
202 N. Ninth Street, Suite 900
Richmond, Virginia 23219

Dear Mr. Buttleman:

This letter is in regard to the James River Basin, Virginia, fish and wildlife restoration study currently being initiated by the Corps of Engineers.

As discussed in a meeting at your office on October 2, 1992, with John Marling, Larry Minnock, Ellie Irons, and Adam Frisch of your staff, we would like to have a meeting with other state and Federal agencies who would have an interest in this study. This was recommended in your letter of support to the Corps dated August 7, 1991. We want to use this meeting as a "brainstorming" session where different areas of interest in the basin could be indentified and prioritized. This would then help set the direction of the reconnaissance study to be conducted over the next year.

John Marling requested that we assemble a package of background information for these agencies. This package is enclosed and includes a description of the study and study process, a map of the study area, the U.S. Senate Committee Resolution, Senator John Warner letter, a tentative study schedule, and the Council on the Environment letter of support. We would appreciate your review of the package for completeness. In addition, please provide a list of state agencies which you feel should be invited to this meeting. As discussed, our target date for this meeting is the first or second week of November to be held in Richmond with your office coordinating the details of the meeting location. When we get your mailing list, we will handle mailing of the meeting announcement and information package.

If you have questions, or if we can provide additional information, please contact Mr. Craig Seltzer, project manager, at (804) 441-7767.

Sincerely,

Robert V. Ogle

Robert V. Ogle, P.E.
Chief, Planning Division

Enclosure

JAMES RIVER BASIN, VIRGINIA
Fish and Wildlife Restoration Study

The Corps of Engineers, Norfolk District, is initiating a reconnaissance study to be conducted during Fiscal Year 1993 to identify environmental restoration opportunities in the James River Basin. These restoration opportunities will include fish and wildlife population reestablishment; habitat evaluation, improvement, and restoration; removal of fish migration barriers; and food source supplementation, to mention a few.

The natural resources in the major river basins in eastern Virginia have been heavily exploited since the earliest European settlements. Massive population growth, development, and changes in land use in this century have further stressed the renewal and survival process. In particular, the Corps Gathright Dam-Lake Moomaw project blocked the Jackson River to anadromous fish and inundated 2,532 acres of wooded upland, wetland, riparian, and aquatic habitat, portions of which were in the Tom Gathright Wildlife Management Area and George Washington National Forest. A wide-ranging variety of environmental restoration opportunities associated with these changing conditions appears to be available in the James River Basin.

Studies will be undertaken to identify measures that would attempt to restore to historic levels the environmental values of the James River Basin. As shown on the enclosed map, the study area includes the entire James River Basin. Special emphasis in this study, however, will be focused on the non-tidal fresh waters of the James and its tributaries above the fall line at Richmond. This emphasis is in keeping with recent directives of the Chesapeake Bay Program to expand restoration programs out of the bay and into the miles of rivers and streams that flush into the estuary.

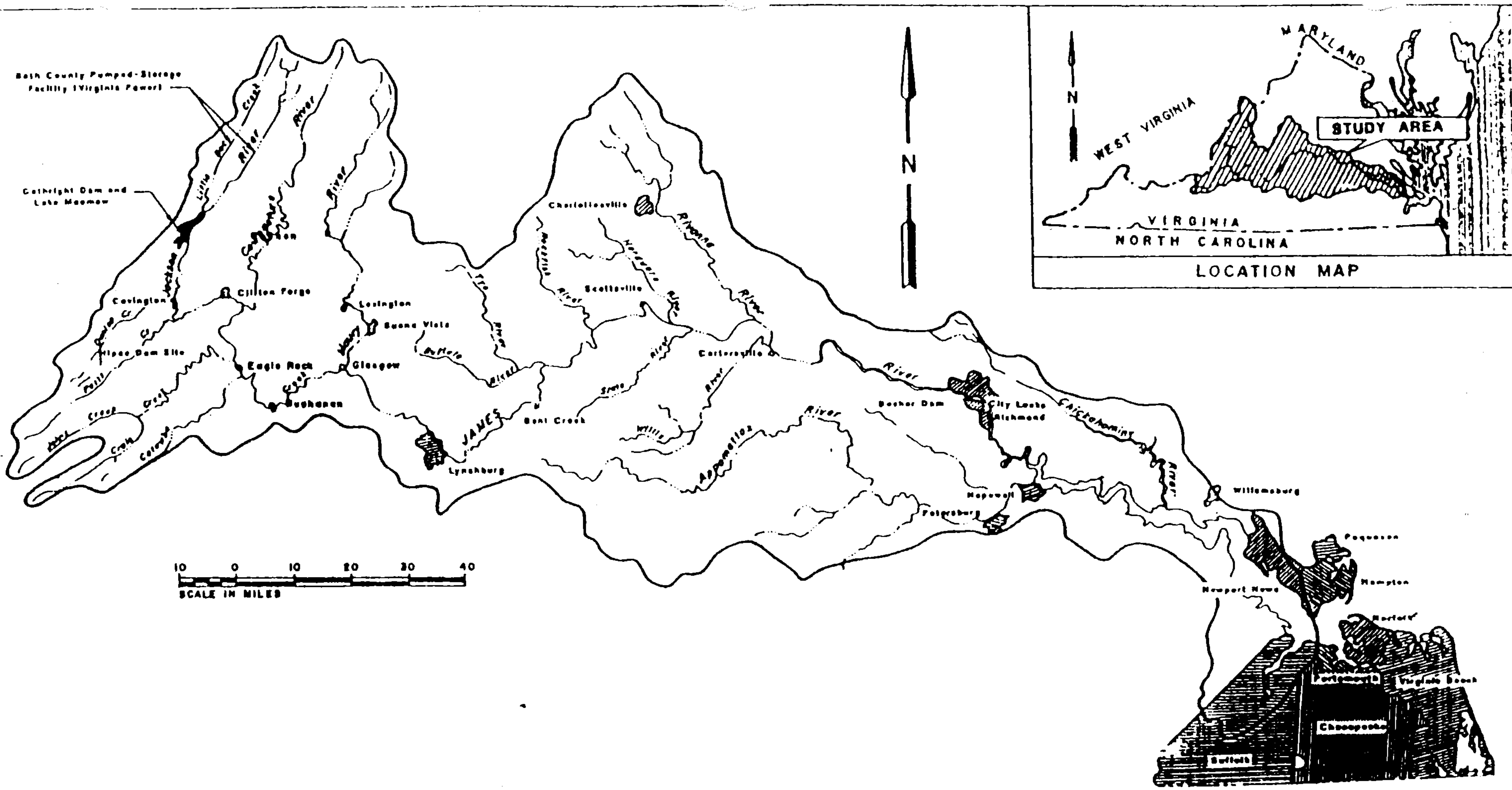
The authority to conduct this study is a U.S. Senate Committee on the Environment and Public Works Resolution adopted June 17, 1987. This resolution directs the Corps "...to review the report of the Chief of Engineers on James River, Virginia and tributaries...with a view to determining whether any modifications...are advisable...in the interest of flood control and related purposes." The Norfolk District also received a letter dated January 1992 from Senator John Warner, the sponsor of the resolution, encouraging the District to pursue this study and stating that the study can be done under this authority.

enclosure

All feasibility studies undertaken by the Corps of Engineers are conducted in two phases - a reconnaissance phase and a feasibility phase. The purposes of the reconnaissance phase are to define the nature and magnitude of a particular problem, to determine a Federal interest in solving that problem, and to determine a range of acceptable solutions. Potential solutions would be evaluated based upon their potential from environmental, economic, and engineering perspectives. In other words, is the proposal engineeringly feasible, do the benefits exceed the cost, and does the proposal make significant contributions to environmental restoration? If Federal and non-Federal participants agree that there are potentially acceptable solutions, then the purposes of the feasibility phase are to conduct detailed engineering and environmental analyses and to recommend projects or measures for implementation, if warranted. The two-phase study procedure is designed to encourage non-Federal participation throughout the feasibility study and to increase the certainty that projects which are planned will be implemented.

The Reconnaissance Study will be initiated in October 1992 and will be conducted entirely at Federal expense. Following the reconnaissance phase, a feasibility study may be undertaken to conduct detailed investigations of potential solutions. This study is cost-shared (50/50 split) between the Federal government and a non-Federal sponsor. The anticipated product of the feasibility phase is a report containing recommendations for implementation of those projects that are judged to be economically and environmentally acceptable and have the required non-Federal support. This report will be submitted to higher authority within the Department of Defense and ultimately will be used as the authorization document for submission to the U.S. Congress. Recommendations will be made only where a Federal interest has been established and an economically feasible, environmentally acceptable plan has been endorsed by a non-Federal sponsor. The reconnaissance report, currently scheduled to be completed in October 1993, is expected to recommend several feasibility studies which will follow this preliminary one year investigation.

The Commonwealth of Virginia, through its various state agencies, is currently involved in pursuing restoration opportunities in the James River Basin and has expressed interest in participating with the Corps in evaluating additional alternatives in this study. The Commonwealth of Virginia, Council on the Environment, is the local sponsor of the study.



JAMES RIVER BASIN, VIRGINIA

FISH AND WILDLIFE

RESTORATION STUDY

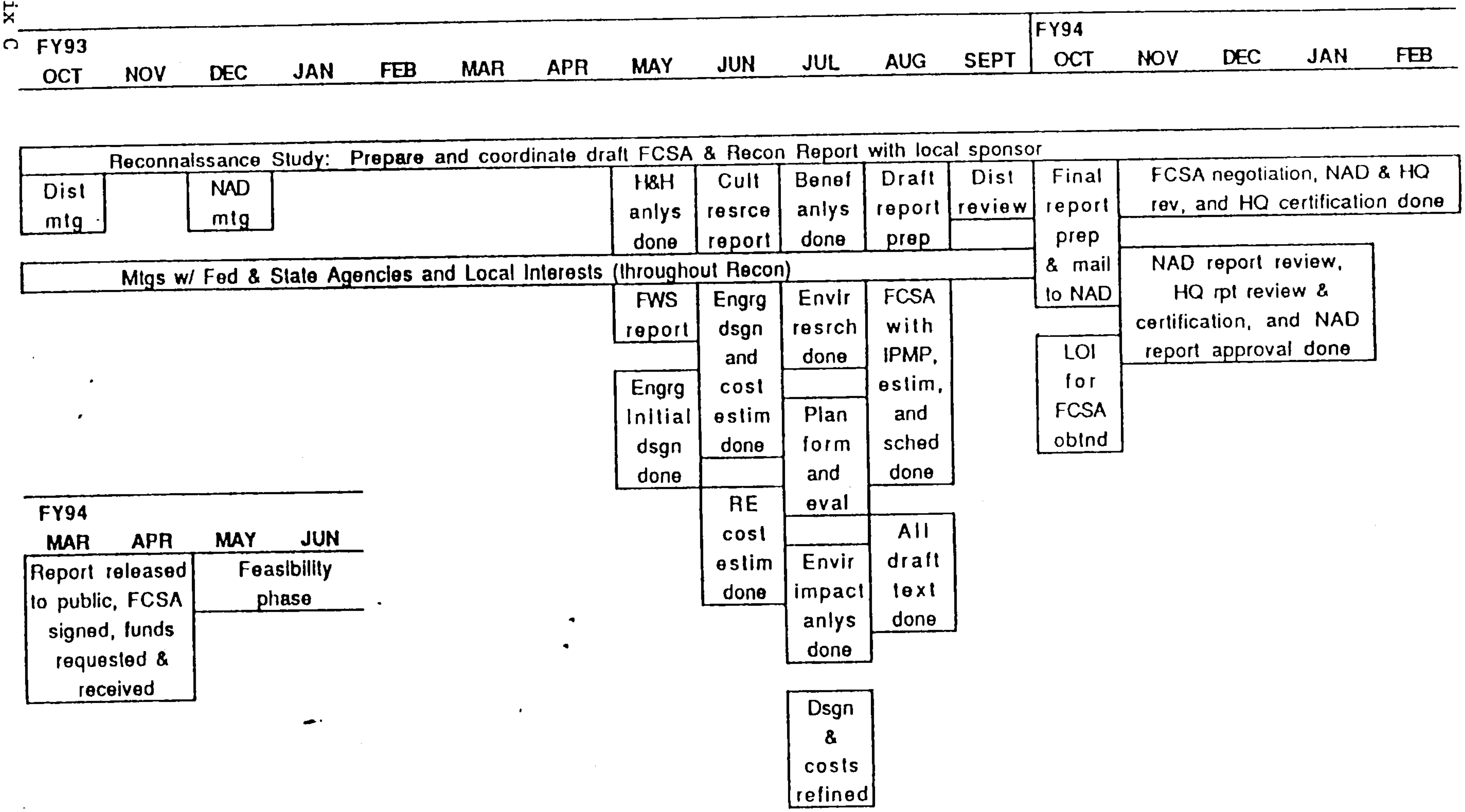
DIVISION:NORTH ATLANTIC

DISTRICT:NORFOLK

OCTOBER 1992

US Army Corps
Of Engineers
Norfolk District

JAMES RIVER BASIN, VA - FISH AND WILDLIFE RESTORATION - STUDY SCHEDULE



NAD - Corps No. Atlantic Div HDQS
FCSA - Feasibility Cost Sharing Agreement
IPMP - Initial Project Mgmt. Plan
LOI - Letter of Intent
FWS - US Fish & Wildlife Service

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT CORPS OF ENGINEERS
FORT NORFOLK 803 FRONT STREET
NORFOLK VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

October 14, 1992

Environmental Analysis Branch

Mr. John P. Wolflin, Supervisor
Annapolis Field Office
U.S. Fish and Wildlife Service
Division of Ecological Services
1825 Virginia Street
Annapolis, Maryland 21401

Dear Mr. Wolflin:

The Corps of Engineers, Norfolk District, is initiating a reconnaissance study to be conducted during Fiscal Year 1993 to identify environmental restoration opportunities in the James River Basin. These restoration opportunities will include fish and wildlife population reestablishment, habitat evaluation, improvement, and restoration, removal of fish migration barriers, and food source supplementation, to mention a few.

The authority to conduct this study is a U.S. Senate Committee on the Environment and Public Works Resolution adopted June 17, 1987. This resolution directs the Corps "...to review the report of the Chief of Engineers on James River, Virginia and tributaries...with a view to determining whether any modifications...are advisable...in the interest of flood control and related purposes." The Norfolk District also received a letter dated January 1992 from Senator John Warner, the sponsor of the resolution, encouraging the District to pursue this study and stating that the study can be done under this authority.

Enclosed you will find a package of information pertinent to this study. The package includes a description of the study and study process, a map of the study area, the U.S. Senate Committee Resolution, Senator John Warner letter, a tentative study schedule, and the Council on the Environment letter of support.

As you will observe on the study schedule, the reconnaissance study is scheduled to be completed in October 1993, and is expected to recommend several feasibility studies which will follow this preliminary one year investigation. The Commonwealth of Virginia, Council on the Environment, is the local sponsor of the study.

As discussed recently with Mr. John Gill of your staff, the involvement of the U.S. Fish and Wildlife Service is considered extremely important and we will be contacting your office to discuss how you can participate with us in these investigations. If you have any questions or comments, please contact Mr. Craig Seltzer, project manager, at (804) 441-7767.

Sincerely,

Larry E Holland

for Robert V. Ogle, P.E.
Chief, Planning Division

Enclosure

COMMONWEALTH of VIRGINIA

Council on the Environment

KEITH J. BUTTLEMAN
ADMINISTRATOR

202 NORTH NINTH STREET
SUITE 900
RICHMOND 23219
804-786-4500
TDD 804-371-7604

October 29, 1992

MEMORANDUM

TO: Bud Bristow, DGIF
Richard Burton, VWCB
Keith Bull, CBLAD
William Pruitt, VMRC
Robert Hicks, DCR
James Garner, DOF

FROM: Keith Buttleman, COE Ann DeWitt Brooks

SUBJECT: Army Corps of Engineers - James River Restoration Project

I would like to bring to your attention a project being undertaken by the Norfolk District of the Army Corps of Engineers. The purpose of this project is to identify, and ultimately implement, environmental restoration activities within the James River basin, mostly within the nontidal reaches. This project may offer important fish and wildlife restoration opportunities for Virginia, and I am asking that you send one or more representatives to an upcoming kick-off meeting scheduled for November 18, 1992 (10:00 am). The meeting will be held at the office of the Council on the Environment, which will serve as the state sponsor of the project.

The project will begin with a reconnaissance study to identify possible opportunities for environmental restoration in the James River. This phase of the project is 100% federally funded ($400,000) and will take place during federal fiscal year 1993, which began October 1, 1992. If circumstances are appropriate, this study will be followed by feasibility studies of the more beneficial projects, and then by project implementation. Any feasibility studies and subsequent projects will require a 50% state match. At no time will Virginia's involvement in any phase of this project commit the state to further involvement or dedication of funds.

The types of activities that may be undertaken through this project include fish and wildlife population reestablishment (such as development or support of hatchery operations); habitat evaluation, improvement and restoration (such as wetland creation); removal of fish migration barriers; and food source supplementation.

I have included with this letter a briefing package that has been provided by the Corps of Engineers, Norfolk District. The deadline for the reconnaissance study is eleven months away, and Norfolk District personnel have indicated that they would like this first meeting to be a brainstorming session.

Please call me, or Collin Powers of my staff, if you have any questions or concerns.

Virginia Commonwealth University

October 29, 1992

Mr. Craig Seltzer
U. S. Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, VA 23510

Dear Craig:

Enclosed is a copy of the executive summary for the James River Mainstem Investigation, recently completed for VDGIF. The summary is organized into sections describing major findings and management recommendations for each of five jobs. Several of these discuss sub-optimal habitat for fish and macroinvertebrates in some river sections (e.g. impoundments above Lynchburg, substrate composition in Richmond, etc.). Of course, no details are provided in this document, but these could be made available, in addition to reports of VCU's anadromous fish monitoring efforts since 1989.

I would encourage you to also consider aspects of anadromous fish passage and restoration, specifically: the apparent "failure" of existing Richmond breaches to pass anadromous river herring species, the need for a "notch" in William's Dam, and of course the Bosher's facility itself. All of these are needs that have been recognized by VDGIF and COE for some time and have developed a lot of public interest. Finally, I have to make the point that biological and ecological studies would support, enhance, or even be fundamental to, any proposed fishery/habitat restoration project for the James River. I'd certainly like to see VCU play a role here, if possible.

If you have any questions, please don't hesitate to give me a call at 804 367-1562. Thanks for your interest.

Sincerely,

Greg C. Garman, PhD
Associate Professor

encl.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

Virginia Commonwealth University

November 10, 1992

Mr. Craig Seltzer
Dept. of the Army
U. S. Army Corps of Engineers
803 Front Street
Norfolk, VA 23510-1096

Dear Craig:

Thank you for faxing the information on the James River Restoration Study. I hope you have also received materials that describe some of VCU's fisheries research within the James river system. Collin Powers (COE) has invited me to attend a meeting on November 18th at 10 am, and I'm looking forward to meeting you at that time.

Attached are some thoughts (unsolicited) relating to your project goals, as outlined in Keith Buttleman's letter of 7 August, and based on our (VCU Aquatics Lab) research experience. My comments are also based on the premise that the major structural modification to the nontidal James river has been the construction of no less than twelve dams on the mainstem and tributaries. In addition, I would argue that the major ecological modification to the system has been the introduction of a large number of exotic fish species, and these taxa have significantly altered (positively and negatively) the James River as an aquatic resource. These changes are interactive and both have occurred over a time-course of at least a century. The challenge, then, is to restore structural and ecological components to some approximation of historical conditions. In many cases, however, our understanding of these historical conditions is less than complete.

Hopefully, you will find these comments to be of some use. One last item: Harold Marshall of ODU recently contacted me in relation to this project and requested information. I sent him most of what I sent you, as well as original copies of the James River Mainstem Investigation reports.

Sincerely,

Greg

Greg C. Garman, PhD
Associate Professor

encl.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

POSSIBLE RESTORATION PROJECTS

NON-TIDAL JAMES RIVER

I. Barriers to anadromous fish passage

A. Manchester/Brown's Island/Belle Island Dams - Biological monitoring has shown that existing breaches at these structures are totally ineffective at passing some anadromous species (blueback herring and alewife), although other species (American shad and striped bass) are able to utilize the breaches. In contrast, most studies of other river systems have found that breaches used by the larger shad species will also be used by the smaller river herrings. Two hypotheses have been proposed to explain the observation: either existing breaches require further modification in order to be useful, or the river herring populations in question have lost the genetic "motivation" to move above Richmond and spawn. Results of a preliminary fish transport and telemetry study conducted this year to test these hypotheses were equivocal, and require follow-up investigations to determine appropriate remedial action.

B. William's Dam - Although monitoring in 1991 and 1992 found that some American shad are able to pass this barrier during Spring floods (> 25,000 cfs), a 2x20 foot notch in the dam is required to insure passage during normal Spring discharges. Preliminary hydrologic studies for the notch have begun, and the City of Richmond has approved the project.

C. Bosher's Dam - Passage over Bosher's Dam, the only major James river barrier between Richmond and Lynchburg, would restore large areas of historical American shad spawning and nursery habitat. In 1991 and 1992, a small remnant (1,000-2,000 individuals) of the original upper-river shad population spawned in the sub-optimal habitat below Bosher's Dam; the status of this population and the success of recent spawning events is generally unknown. Passage at Bosher's Dam would also restore an undetermined amount of riverine habitat to other economically valuable anadromous clupeids (hickory shad, blueback herring and alewife) and to striped bass.

In addition to planning and construction of the passage structure, biological studies are needed to determine spawning run timing, habitat preference, and status of the remnant population (e.g., abundance, reproductive condition, genetic structure, etc.).

II. Exotic fish species

A. Interactions with anadromous fishes - American shad that are successfully passed to the upper James river will encounter no less than 18 non-native fish species, whose introductions followed the initial construction of barriers to shad migrations in the mid-

1800s. Several of these exotic species, such as smallmouth bass, spotted bass, common carp, and threadfin shad, may prey on, or compete with, young American shad during riverine residence. Ecological studies involving experimental stockings of young shad to the upper river would allow the development of strategies to mitigate the possible impacts of these novel, non-native predators or competitors.

B. Dams above Lynchburg - Biotic integrity of the James river fish community, although relatively high overall, is reduced substantially at specific locations by degraded riverine habitat, and in particular by impoundment. In addition, the dominance of several "undesirable" exotic fishes in the non-tidal river is strongly and positively correlated with impounded conditions. A section of the James river above Lynchburg, representing approximately 12 percent of the non-tidal mainstem, is affected by a series of low-head impoundments. It may be possible to modify river habitat within this section (e.g. current velocity, substrate composition, macrophyte standing stock) in such a way that restores some characteristics of the unimpounded river and improves biotic integrity, but does not require removal of dams.

G. Garman
Nov. 10, 1992

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

November 16, 1992

Planning Division

Ms. Elizabeth Haskell
Secretary of Natural Resources
Office of the Governor
525 Ninth Street Office Building
Richmond, Virginia 23219

Dear Ms. Haskell:

Let me say once again how much I enjoyed our meeting on November 5, 1992. I felt it was very informative and productive.

I have enclosed additional information on two of the studies we discussed: The James River Basin Drought Preparedness Study and the James River Basin Fish and Wildlife Restoration Study. Our primary points of contact are Erlinda Patron of the State Water Control Board and Collin Powers of the Council on the Environment, respectively. We have also dealt with Jack Frye on other projects in the past. The next meeting involving Mr. Powers is scheduled for Wednesday, November 18, at his office. On Thursday, November 19, Ms. Patron will be assisting in a workshop to be held in Lynchburg.

I was encouraged by our meeting and the coordination that has taken place between our two agencies. However, it also appears that there is a need to make a more proactive effort to ensure full coordination between our various staff levels. To that end, I have appointed Roland Culpepper as the single point of contact for the District. He stands ready to meet with a representative of yours to fully explore all the opportunities available to the Commonwealth through the programs offered by the Corps. Mr. Culpepper can be contacted on (804) 441-7110.

Thank you once again for your cooperation.

Sincerely,

R. C. Johns

R. C. Johns
Colonel, Corps of Engineers
District Engineer

Enclosures

November 16, 1992

Mr. Greene A. Jones, Director
Environmental Services Division
U.S. Environmental Protection Agency
Region III
841 Chestnut Building
Philadelphia, PA 19107

RE: Meeting in Richmond, Virginia on the James River Restoration Project being undertaken by the Norfolk District of the Army Corps of Engineers.

Dear Mr. Jones:

Please pardon the lateness of this invitation. I am writing to request your attendance at a meeting that will be held later this week (November 18) in Richmond, Virginia for the purpose of initiating the reconnaissance phase of the James River Basin fish and wildlife restoration project of the Army Corps of Engineers. The meeting will be held at 10:00 am at the office of the Council on the Environment, 202 Ninth St., Suite 900 (ninth floor of Ninth Street Office Building, corner of Ninth and Grace Streets, across from the Capitol).

The Council on the Environment has been designated as the local (state) sponsor for this project. The meeting will include interested state and federal agencies.

It is anticipated that the meeting will last into the early afternoon. I hope that you or your representative are able to attend. Please call me at (804) 786-4500 if you have any questions.

Sincerely,

Collin Powers
Environmental Planner

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
Agenda
November 18, 1992

1. Introduction and Background
    a. Study Area
    b. Study Authority
    c. Local Sponsor: Virginia Council on the Environment
    d. Study Objectives
    e. Restoration Opportunities
    f. Funding and Study Schedule

2. Group Discussion of Fish and Wildlife Restoration Opportunities
    a. Fisheries
    b. Wetlands
    c. Water Quality
    d. Riparian Habitat
    e. Endangered Species
    f. Upland Habitat
    g. Other Restoration Opportunities

3. Prioritization of Restoration Opportunities
    a. Chesapeake Bay Agreement Initiatives
    b. Anadromous Fisheries Restoration Initiatives
    c. Other Federal/State Restoration Initiatives

4. Conclusion and Adjourn

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
Meeting Notes
November 18, 1992

1. Present: See attached list of attendees. Agencies represented were the Army Corps of Engineers (ACOE), Virginia Council on the Environment (Council), U.S. Fish & Wildlife Service (FWS), State Water Control Board (SWCB), Department of Game and Inland Fisheries (DGIF), Chesapeake Bay Local Assistance Department (CBLAD), Virginia Marine Resources Commission (VMRC), Department of Conservation and Recreation (DCR), Virginia Department of Forestry (VDOF), Virginia Commonwealth University (VCU), and Virginia Polytechnic Institute and State University (VPI).

2. Craig Seltzer (ACOE) initiated the meeting with an overview of the study and ACOE interests in environmental restoration. The overview material was furnished as an information package to participants prior to the meeting.

3. Various questions were addressed on local participation, including cost-sharing in the feasibility phase and obtaining credit for study work already completed. In response to a question from Collin Powers (Council), Craig discussed the schedule for the Reconnaissance Study, stressing the short time frame and the need for local support to ensure selection of feasible projects. There was general agreement that the Corps would work with individual agencies, with coordination assistance from the Council. Collin stressed the need to keep the Secretary of Natural Resources informed throughout the reconnaissance study. Most money in the Reconnaissance study will be spent in-house by the Corps, but the Corps will accept proposals from state agencies (coordinated through the Council) to receive funding for work on some parts of the study.

4. Greg Garman, from VCU, gave a short presentation on fish migration barriers on the James River. They are investigating whether the existing breeches in the Manchester Island, Brown's Island, and Belle Island Dams are helping fish migration to any significant degree. Williams and Bosher Dams remain to be breached. Preliminary work shows that while shad use the breeches, alewife and blueback herring do not appear to use them successfully. Stocking of shad in the upper James River has begun also, using hatchery stock obtained from Pennsylvania. Greg provided copies of a pamphlet summarizing the results of their mainstem study of the James. The findings show a fairly robust fishery in the James, with minimal water quality effects, except in some local areas, which is an improvement from past conditions. Most current fisheries problems are related to barriers and impoundments along the river and its tributaries.

5. Larry Minock, from CBLAD, talked about the Chesapeake Bay Initiatives and recent amendments to the agreement, which have implications for the Bay tributaries. He said that though the James, York, and Rappahannock Rivers have a relatively small effect on overall nutrient loading to the Bay, the Commonwealth is committed to the 40 percent reduction in nutrient loading in these tributaries. His organization is looking for funding to expand 3-D numerical modeling efforts in the James.

6. Craig Seltzer initiated a group discussion of fish and wildlife restoration opportunities in the James River. Various ideas were suggested and discussed, under the general headings of fisheries, wetlands, water quality, riparian habitat, and endangered species. The

discussion concentrated on non-tidal areas of the James River, above the fall line. Suggestions included:

a. Migration barriers - Remove or otherwise provide passage at barriers along the James at Richmond and upstream. Resolve hydrodynamic and biological questions about newly created breeches in existing barriers at Richmond. Assess need and means of getting striped bass above Richmond for spawning. Evaluate William's/Bosher's Dam passages. Evaluate barriers on the Chickahominy and Appomattox Rivers.

b. Shad restoration - Build fish hatchery facility. Rebuild populations with stocking programs. Assess habitat quality.

c. Study Jackson River access and trout habitat improvement in the reservoir, particularly with regards to aeration.

d. Evaluate impact of sand mining on habitat and endangered species, especially in the Rivanna River.

e. Investigate regulatory biocriteria.

f. Evaluate and reduce impacts of erosion on riparian habitat and endangered species (mollusks in particular).

g. Evaluate and reduce adverse impacts from erosion, pollution, impoundments, etc. on endangered species, both plant and animal, in the upper James River basin.

h. Water quality impacts on habitat and fisheries: Evaluate and reduce impact on fisheries below Covington and Lynchburg. Evaluate impact of acid deposition in the tributaries to the James. Investigate instream flows. Evaluate impact of flood control modifications, both in terms of fluvial effects as well as bank-cutting, erosion, etc. Evaluate impacts of nutrients on migratory fish. Investigate higher level trophic manipulation to reduce eutrophication.

i. Water quality: Determine nutrient (non-point source) and sediment loads in the James and its tributaries. [Some opinions were expressed that this is not a significant problem in the upstream portion of the river.] Evaluate impact of sewage treatment plants and point sources (Richmond, Covington, Lynchburg, Buena Vista, Charlottesville, Rivanna). Address combined sewer overflow problems in Richmond. Evaluate and find means to reduce the impacts of agricultural runoff. Use streamside fencing. Work with existing agricultural programs to educate farmers and implement measures to reduce erosion and nutrient input along streams. Evaluate adverse impact on primary contact recreation east of Lynchburg.

j. Wetlands: Create wetlands for habitat and flood control, and secondarily for stormwater management and sewage treatment. Restore historical wetlands in the floodplain. Identify critical wetlands that need restoration. Construct a demonstration project to benefit endangered species. Evaluate land use patterns and trends to assess need for wetlands acquisition and protection. Identify and control purple loosestrife infestations. Work within existing programs to the greatest extent possible; avoid "political" issues associated with wetlands restoration.

k. Restore/repair riparian forested areas, particularly along the Tye River.

7. Caren Caljouw from the Division of Natural Heritage provided a list of suggestions for projects concerning endangered species in the James River and its tributaries (see enclosed).

8. The group discussed the suggestions and made a preliminary attempt at determining priorities. There was general consensus that the projects most likely to win Federal and local sponsor approval were those that involved concrete or active restoration efforts, rather than just studies. Fish migration barriers emerged as one priority for action. The timing for this proposal could be tricky since the state is ready to pursue dam breaching in Richmond while upstream dams have not received much study. Another suggested priority was to find an area with multiple environmental problems (involving anadromous fisheries,

endangered species, erosion, etc.) and do a demonstration project, perhaps involving wetlands creation. Construction of a shad fish hatchery also received broad support.

9. There was a brief discussion about other agencies that should be contacted with particular mention of the Virginia Department of Agriculture and Consumer Services and the Soil Conservation Service. Programs already in existence which would be related to the Reconnaissance Study include Partners for Wildlife and the Wetlands Reserve Program (authorized in 1990 amendments to the Farm Bill).

10. It was agreed that the setting of firm priorities would continue in separate meetings between ACOE and various agencies, to be arranged in the near future. Collin suggested that the Council could help to facilitate meetings with local officials to obtain additional information needed for the Reconnaissance Report. In addition, there was a suggestion that this group should reconvene mid-way and upon completion of the reconnaissance study.

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
November 18, 1992

Attendees

Name	Agency
Ray Fernald	Va. Department of Game and Inland Fisheries
Jack Raybourne	Va. Department of Game and Inland Fisheries
David Whitehurst	Va. Department of Game and Inland Fisheries
Kris Holdereid	Corps of Engineers
Rob Kelsey	U.S. Fish and Wildlife Service
John Gill	U.S. Fish and Wildlife Service
David Knowles	Va. Marine Resources Commission
Doug Plasencia	Va. Department of Conservation and Recreation
Collin Powers	Va. Council of the Environment
Ann DeWitt Brooks	Va. Council of the Environment
Robert B. Atkinson	V. P.I. Center for Envionmental Studies
Sam Austin	Va. Department of Forestry
Alfredo C. Frauenfelder	Va. Council of the Environment
Theresa Duffey	Va. Department of Conservation and Recreation
Bob Munson	Va. Department of Conservation and Recreation
Caren Caljouw	Va. Department of Conservation and Recreation (Division of Natural Heritage)
Chester Bigelow, III	Va. State Water Control Board
Jean Gregory	Va. State Water Control Board
Greg Garmon	Virginia Commonwealth University
Helene Haluska	Corps of Engineers
Craig Seltzer	Corps of Engineers
R. Gibbons	Va. Department of Conservation and Recreation

Virginia Commonwealth University

MEMORANDUM

TO: Craig Seltzer

FROM: Greg Garman Greg

DATE: November 18, 1992

SUBJECT: Restoration Study

It was good to finally meet you today, and to have the opportunity to talk about some issues related to fish passage. Immediately after your meeting, David Whitehurst and I met again, specifically to discuss fish passage. We both feel that one of the needs at present relates to possible modifications of the existing breaches at Manchester/Brown's Island, so that anadromous herring and alewife might also utilize these structures and move up to Bosher's Dam. I would suggest that limited biological monitoring and telemetry studies this spring would be critical in determining the need for such modifications, and would be an appropriate component of the reconnaissance phase.

I realize that you would rather use existing information, and not support extensive research during 1993. However, a relatively modest effort in this case would directly support any future feasibility projects relating to the fish passage issue. Perhaps you might consider this until our next meeting.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

CENAO-PL-R 24 November 1992

MEMORANDUM FOR: Collin Powers, Va. Council on the Environment

SUBJECT: James River Basin, VA, Fish and Wildlife Restoration Study

1. Our meeting with the state and Federal agencies in Richmond on the 18th seemed to indicate that the following fish and wildlife restoration opportunities have both a state and Federal interest at this point :

a. removal/modification of fish migration barriers

b. anadromous fisheries restoration

c. construction of a fish hatchery

d. bank stabilization along eroding river banks

e. riparian habitat restoration/improvement

f. improvement/restoration of historic wetlands

g. endangered species habitat protection/restoration

2. We need to identify a manageable number of specific alternatives that we can begin looking at immediately. As we discussed previously, we would like to have a follow-up meeting with the state agencies to accomplish that purpose. This is the break-down that I envision for our next meeting:

a. <u>Present at each meeting:</u> Corps of Engineers, Virginia Council on the Environment (Council), U.S. Fish & Wildlife Service (FWS)

b. <u>Present at morning (am) meeting:</u> Department of Game and Inland Fisheries (DGIF), Virginia Commonwealth University (VCU)

c. <u>Present at afternoon (pm) meeting:</u> Department of Conservation and Recreation (DCR), Virginia Department of Forestry (VDOF), Virginia Polytechnic Institute and State University (VPI), Virginia Department of Agriculture and Consumer Services (VDOA) and the (state representative of the)Soil Conservation Service (SCS).

I see the discussions of items a-c in paragraph one taking place in the morning session; the discussion of items d-g taking place in the afternoon session.

3. The agencies should come prepared to discuss specific projects at specific sites. I would recommend that they attend the meeting with maps, reports, etc. documenting and showing where they feel projects could be accomplished to restore fish and wildlife habitat.

4. At the afternoon session I would also like to explore programs already in existence which would be related to the Reconnaissance Study including Partners for Wildlife and the Wetlands Reserve Program.

5. I would like to target Thursday, December 10 as the date that these meetings take place and would be relying on you to request participation of the state agencies. I think it would be important to convey to the agencies that we are looking for more specific input at these meetings. I am, of course, open to any and all suggestions you may have regarding these meetings.

Sincerely,

Craig

Craig Seltzer

COMMONWEALTH of VIRGINIA

Department of Game and Inland Fisheries

DRAFT

M E M O R A N D U M

TO: The Honorable Elizabeth H. Haskell

FROM: Bud Bristow

DATE: December 2, 1992

SUBJECT: Historical Overview of Efforts to Provide Fish Passage on the James River

The decline of migratory fish populations, especially a number of important anadromous (fish that swim from the ocean into rivers and streams to spawn) species, along the East Coast of the United States has been recognized for a number of years. These populations had historically supported extensive recreational and commercial fisheries prior to the mid-1970's. However, in the 10-year period from 1976 to 1985, commercial harvests of these species from the Chesapeake Bay have declined by 82%. The commercial harvest of shad has declined from 11 million pounds per year a century ago to approximately 500,000 pounds per year currently. In 1981, the Atlantic States Marine Fisheries Commission attributed the decline in the stocks of these species to "overfishing, loss of habitat (resulting from construction and operation of dams and from pollution), inconsistencies in management actions, and the lack of adequate data".

4010 WEST BROAD STREET, P.O. BOX 11104, RICHMOND, VA 23230-1104
(804) 367-1000 (V/TDD) *Equal Opportunity Employment Programs & Facilities* FAX (804) 367-9147

DRAFT

The Virginia General Assembly recognized the need to re-establish anadromous fish to their historical spawning and rearing areas in 1981 and directed the appropriate state agencies and local political subdivisions to conduct a feasibility study of fish passage in the James River in the Richmond area through House Joint Resolution Number 233. Consequently, the James River Fish Passage Facilities Committee was formed by representatives of the Virginia Department (Commission at that time) of Game and Inland Fisheries, the Virginia Institute of Marine Science, the Virginia Marine Resources Commission, the U.S. Fish and Wildlife Service, and the U.S. National Marine Fisheries Service. That committee's 1983 report recommended fish passage facilities for the dams in the Richmond area and also stimulated interest for several legislators and the public for such facilities.

Following the feasibility study, the Department contracted with the Tennessee Valley Authority (TVA) in 1984 to assist in the development of a breach system that would permit fish movement through the two most downstream dams, the Manchester and Browns Island Dams. TVA prepared a functional hydraulic evaluation (computer model) of several breach configurations and submitted a report in 1986 which provided detailed information on different breaching options. Simple 100-foot breaches in both dams along the north shore of the river were chosen as the best approach for providing fish passage at these sites. The Department also initiated actions to secure necessary environmental approvals in 1984, suspended such actions for the duration of the TVA study, and completed environmental assessments after the study was finalized.

The Department and the City of Richmond maintained dialogue on the need and impacts of fish passage in the James River from the early 1980's and possibly before then. The City expressed its concerns about breaches in the two dams (Manchester and Browns Island) in a meeting with Department officials on August 24, 1984, and subsequently restated them in a letter dated October 8, 1984. Their apprehensions focused on the size of the breaches, the possibility of de-watering the river around the eastern end of Belle Isle, possible destruction of several rapids for canoeists, the potential removal of a pedestrian bridge on Browns Island Dam, and the possible elimination of flows into the Haxall Canal.

The City continued to express concern about possible reductions in water levels caused by the breaches during low flow periods and of perceived impacts to the historic, recreational, developmental, and aesthetic values of the river. The Department did not think that the breaches would cause significant reductions in water levels but understood the City's reasons for

DRAFT

concern. By 1986, the City expressed a willingness to support fish passage at Manchester and Browns Island Dams, provided that assurances and funding would be forthcoming for adding gates to the breaches. Discussions continued during 1986 about developing a "total package" fish passage project (gates and breaches) for the two dams to present to the 1987 Session of the General Assembly.

During the 1987 Session of the General Assembly, Delegate Hatcher Crenshaw submitted a budget amendment to the House Appropriations Committee for $800,000 for construction of the fish passage projects. The City had appropriated $300,000 in its 1987 budget for this purpose, and the Department had $200,000; however, the amendment failed. This funding scenario would have provided funding for both the breaches and the gates. Furthermore, the General Assembly established a sunset clause of January 1, 1989 on the exemption for dams in the City of Richmond and Henrico County in the fish passage law (29.1-532) during that session. Later that year, the Department initiated preplanning studies for submission of a fish passage project proposal for the 1988-90 biennial budget. This project was included in the Governor's 1988-90 budget.

The 1988 Session of the General Assembly allocated $900,000 for the breaching of the Manchester and Browns Island Dams to be matched with $300,000 of local funds. Additionally, the Department obligated $140,000 for this project for a total allocation of $1,340,000 for the breaches and the construction and installation of gates on Browns Island Dam. The City of Richmond, the Council on the Environment, and the Department continued to work on project-related details and also developed an agreement concerning the construction, operation, and maintenance of the fishways.

The City assumed the lead role in the final planning, design, and construction of the project, including the solicitation of bids and contract awards. The two dams were breached on January 15, 1989 for a cost of $178,829.82 which was reimbursed by the Department ($140,000) and the Council ($38,829.82). The City awarded a contract for $418,000 for the manufacture of the bascule gates and solicited bids for gate installation. The City's consultant had estimated that $600,000 would cover the installation costs; however, the low bid for performing this work was $1,079,000. This bid exceeded the total project allocation by $336,000 and delayed further progress on construction and installation of the gates. The Council was billed for $76,609.43 for design and initial construction work on the gates and also for City personnel services. The City prepared a revised budget

DRAFT

with their design consultant's input, but a copy of that budget is not in our files.

Our files contain very little information concerning actions between August 1989 and September 1990 so the following account is based largely on our understanding of the happenings. By this time, the summer "low flow" period had arrived, and no noticeable reductions in water levels behind Browns Island Dam had occurred nor had problems been reported on water-based recreational activities in this area. After observing water levels during the dry season, I believe that the City developed a "wait-and-see" attitude concerning the need for gates.

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
Meeting Notes
December 9, 1992

1. Present: See attached list of attendees. Agencies represented were the Army Corps of Engineers (ACOE), Virginia Council on the Environment (Council), U.S. Fish & Wildlife Service (FWS), Department of Game and Inland Fisheries (DGIF), and Virginia Commonwealth University (VCU).

2. The meeting was a follow-up to the interagency meeting held on November 18, 1992. The focus of this meeting was to look, more specifically, at potential fisheries restoration projects in the James River Basin that have a strong local interest (i.e., are supported by the Commonwealth) and that also could be endorsed by the Federal government within the parameters of this study. The purpose of the Reconnaissance (Recon) Study was reiterated. The problems and opportunities must be documented; estimation of benefits and costs of solutions must be calculated; and the interest of the Federal government and the local sponsor must be established. The Corps and the non-federal sponsor must agree, at the end of the recon, to share equally in the cost of the feasibility phase. With the help of the resource agencies, the Corps will use existing information in the recon to the greatest extent possible to achieve these objectives.

3. David Whitehurst (VDGIF) and Greg Garman (VCU) discussed fish migration barriers on the James River. In Richmond, they have been investigating whether the breaches created in the Manchester and Brown's Island dams in 1989 have allowed fish passage up to the Williams Island dam. Williams Island and Bosher dams are the two remaining barriers to fish passage through Richmond. Passage is to be provided at Williams Island during the summer of 1993, and at Bosher during the spring of 1995. Three years of investigation have shown that shad use the breaches, but that alewife and blueback herring and most striped bass do not appear to use them successfully. Stocking of shad in the nontidal reaches of the James River has begun also, using James River stock which was reared with the help of the state of Pennsylvania (which has a fully developed hatchery). Concerns were expressed that the small numbers of shad found in the James River, especially of hickory shad, indicate that the species may need protection under the Endangered Species Act.

5. With regard to fish hatcheries and stocking, there are many questions that still need to be addressed. Some of these questions are:

- How many fish need to be stocked? Where should they be stocked?
- Logistical questions such as "where should hatchery be located?"
- Use fingerlings or post-larvae?
- Need for rearing facilities at hatchery?
- What is survival/long-term fate of fish stocked?
- What has been and can be learned from Pennsylvania stocking programs?
- Are there enough James River shad to maintain stocking program initially?

6. With regard to the anadromous fishery in the James River Basin, Craig Seltzer (ACOE) suggested that the Recon Report could, with existing information, establish the following:

• That the fishery is depleted and that there is a state and Federal interest in restoration

• The success of other efforts to restore anadromous fisheries (including fish hatcheries) in Pennsylvania and other areas of the northeast U.S.

• Preliminary results/findings from shad stocking programs in Virginia

• Current (and potential) economic value of the anadromous commercial and recreational fishery in Virginia

7. VDGIF received an appropriation from the General Assembly of $150 K for shad restoration program last fiscal year. This is being used to build a very simple hatchery facility. VDGIF will also receive $63K this year for shad restoration program. Greg stressed the importance of determining why herring are not using the breaches at Manchester and Brown's Island. He discussed the type of study that needs to be done to determine this, the results of which would be important in determining if additional structural modifications are needed at existing breaches.

8. In order to better determine how fish are moving through the existing breaches at the dams at Richmond we discussed the possibility of Greg Garman conducting a fish tagging study this spring. The cost of such an effort would be between $10,000 and $15,000 and could provide valuable information for the recon study. The Corps will pursue this further with Greg and will attempt to identify the funds that could be used to accomplish this work.

9. The discussions on the anadromous fishery concerns in the James River Basin led to a consensus of opinion that a "Long-Term Management Plan" was needed to better define what needed to be done to restore the fishery and over what time period. The management plan could in itself be one project addressed in the Recon, in addition to several other specific projects identified as current restoration priorities for fisheries. These include:

• Provision of fish passage at dams on James River mainstem including possible additional modifications at passages on dams already breached
• Stocking strategies/programs
• Possible alteration/modification of existing breaches
• Construction of fish hatchery

10. With regard to other fisheries-related concerns in the basin, David, Greg and Price Smith (VDGIF) mentioned several:

• Water management and in-stream-flow
• Jackson River trout fishery
• Reservoir management at Gathright Dam/Lake Moomaw
• Sand mining in the Rivanna River
• Acid deposition and potential for a liming demonstration project

In addition to the anadromous fisheries, one or more of these issues may be addressed in the recon study.

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
December 9, 1992

Attendees

Name	Agency
David Whitehurst	Va. Department of Game and Inland Fisheries
Price Smith	Va. Department of Game and Inland Fisheries
John Gill	U.S. Fish and Wildlife Service
Collin Powers	Va. Council of the Environment
Greg Garman	Virginia Commonwealth University
Helene Haluska	Corps of Engineers
Craig Seltzer	Corps of Engineers
Kris Holderied	Corps of Engineers

Proposal For Anadromous Fish Studies

Submitted to
U. S. Army Corps of Engineers

Dr. Greg C. Garman
Department of Biology
Virginia Commonwealth University
Richmond, Virginia

December 11, 1992

4

PROPOSAL

<u>OBJECTIVE:</u> As one component of the ongoing anadromous fish restoration effort on the James River Mainstem, we propose to assess efficacy of existing James River dam breaches for passage of anadromous game fishes. Specifically, the study will test the hypothesis that the Manchester and Brown's Island Dams, although breached in 1989, continue to act as physical barriers to upstream migration by some anadromous species.

<u>BACKGROUND:</u> Through a cooperative effort involving the State of Virginia and the City of Richmond, Manchester and Brown's Island dams (James River) were breached in 1989 for the purpose of re-establishing passage for migrating anadromous fishes. However, recent studies at this location (Garman and Eareckson 1990; Garman et al. 1991) suggest that, although American shad (<u>Alosa sapidissima</u>) successfully negotiate the Manchester breaches and swim upstream to the next significant barrier (Bosher's Dam), alewives (<u>A</u>. <u>psuedoharengus</u>) and blueback herring (<u>A</u>. <u>aestivalis</u>), collectively termed river herring, do not utilize the breaches. In addition, striped bass (<u>Morone saxatilis</u>) are abundant below Brown's Island, but only a few individuals have been collected farther upstream.

These findings contrast with those of other studies which show that passage structures employed by American shad are generally acceptable to related species and to striped bass. Furthermore, the historical (i.e., pre-dam) range of spawning blueback herring and alewife (and possibly striped bass) extended above the Manchester breaches. As a result, the usefulness of proposed fish passage facilities at William's and Bosher's Dams, which are designed to pass river herrings and striped bass, will be substantially limited by the apparently ineffective breaches downstream.

<u>HYPOTHESES</u>: Failure of river herring to use the existing breaches may simply be the result of biology -- in other words, the fish are not imprinted to upstream waters or are not genetically "motivated" to swim farther. Hence, the occurrence of fish at the breaches, but not above them, is possibly a matter of coincidence. If true, however, some straying of fish through

the breaches would be expected, as homing in clupeid fishes (shads and herrings) is not precise, but straying by even a few individuals has not been observed.

Alternatively, the existing breaches may be flawed in their location or construction, creating conditions that do not allow upstream passage by some fishes. For example, maximum (burst) swimming speed is directly a function of fish length, and the largest anadromous species (American shad) is also the only taxon to effectively use the Manchester Breaches. In contrast, the much smaller river herring species do not move upstream, and only a small number of intermediate-size, juvenile striped bass have been collected at Bosher's Dam. Hence, the breaches may generate a current velocity greater than can be negotiated by all but the largest (fastest) fish. Such a problem could be corrected by structural modifications to the breaches.

SCOPE OF WORK: During the peak of the alosid spawning run (mid April, 1993), alewife and/or blueback herring (n=20) will be collected from below the Manchester breaches by boat electrofishing (pulsed D.C., low output). Fish will be fitted with a small (approximate dimensions 8 mm x 20 mm), intra-gastric radio transmitter. Tagged fish will be held in cages at the collection site for 24 h and monitored for evidence of handling stress. Transmitters will be recovered from any fish exhibiting symptoms of stress or injury. Fish showing no signs of handling stress (n=15) will be transported above the Manchester/Brown's breaches, monitored again for stress, and released in the vicinity of Belle Island. At the same time, a control group of alewife and/or blueback herring will be fin-clipped, implanted with "dummy" transmitters and held in-situ for several days in order to assess post-tagging mortality. Fish for the telemetry study will be collected, handled and transported using techniques developed during previous studies at the location (Garman and Mitchell 1989, Garman and Eareckson 1990).

Direction and rate of movement of tagged fish will be monitored immediately after release using a multiple channel directional receiver. Locations of individual fish will be determined at 12 to 24 h intervals for five days, the approximate longevity of transmitter batteries; limited battery life is a consequence of the small size of transmitters. A replicate of the study, using an additional 15 fish will be conducted during late April, 1993, providing a total sample size of approximately 30 individuals.

ANTICIPATED RESULTS: The transport of tagged herring to a point above the breaches, and confirmation of resumed upstream migration, based on telemetry studies, would support the hypothesis that characteristics of the Manchester breaches (e.g., location, configuration, etc.) currently limit passage by anadromous fishes other than American shad. Such a finding would also strongly suggest that modifications to the breaches would be effective in restoring anadromous fish passage through that section of the James River. Hence, by identifying a specific, correctable problem, the telemetry study would directly support the Reconnaissance Phase of the Habitat Restoration Initiative. The details of modifications would depend on further studies (Feasibility Phase).

Alternatively, if transported fish fail to move significantly upstream, the above hypothesis could be rejected, and modifications to the breaches would probably be unwarranted. Other solutions to the problem, such as trap and transport of pre-spawn river herring could be investigated during subsequent years. Results of a preliminary telemetry study (1992) were equivocal, due to sample size constraints.

JOB DURATION: February 01, 1993 - May 30, 1993.

JOB SCHEDULE: Between February 1 and March 15, 1992, equipment will be fabricated and tested, and personnel trained. Fish telemetry studies will begin on or about April 1, 1992 and will continue, as hydrological conditions permit, through April 30, 1992. The month of May, 1993 will be used for data analysis and report preparation. A final report will be provided to the Corps on or before June 01, 1993.

PERSONNEL: Dr. Greg C. Garman, Associate Professor and Principal Investigator, VCU
Mr. Mark King, Research Associate, VCU
Mr. Scott Stranko, Graduate Assistant, VCU

COST: Project costs will result primarily from personnel needs and the construction of 30 intra-gastric radio transmitters. In addition, some funds will be required for supplies and operation of an electrofishing boat and four-wheel drive vehicle. In order to minimize costs, the Principal Investigator (GCG) will provide his time on a *gratis* basis. In addition, Virginia Commonwealth University will contribute (waive) overhead (indirect cost) expenses normally charged to sponsors. A breakdown of estimated project costs is provided below:

Literature Cited

Garman, G. and D. Mitchell. 1989. Temporal and spatial distribution of anadromous fishes in relation to barriers of the James River, Virginia. Final report, Virginia Council on the Environment.

Garman, G. and M. Eareckson. 1990. Utilization of fish passage structures by migratory fishes of the James River, Virginia. Final report, Virginia Council on the Environment.

Garman, G., M. King, J. Snyder and M. Eareckson. 1991. James River Mainstem Investigation, Job 1- Fish Community Studies. Federal Aid in Fish Restoration project F-74-R.

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
Meeting Notes
December 14, 1992

1. Present: See attached list of attendees. Agencies represented were the Army Corps of Engineers (ACOE), Virginia Council on the Environment (Council), U.S. Fish & Wildlife Service (FWS), Department of Game and Inland Fisheries (DGIF), Department of Conservation and Recreation (DCR), Department of Agriculture and Consumer Services (DACS), and Virginia Polytechnic and State University (VPI).

2. The meeting was a follow-up to the interagency meeting held on November 18, 1992. The focus of this meeting was to look, more specifically, at wetland restoration, endangered species habitat protection/restoration, and riparian habitat restoration/improvement projects in the James River Basin that have a strong local interest (i.e., are supported by the Commonwealth) and that also could be endorsed by the Federal government within the parameters of this study. Craig Seltzer (ACOE) briefly discussed the planning process with emphasis on the reconnaissance and feasibility phases.

3. Steve Capel (DGIF) discussed the Joint Venture Board and the North American Waterfowl Management Plan. Waterfowl habitat creation is the focus of these programs with efforts being concentrated east of the Fall Line for Virginia. He then discussed habitat creation activities of the DGIF upstream of the Fall Line on the James. These involve the restoration and creation of wetlands and developing filter strips along the river and its tributaries. Areas which have potential for additional wetlands development include the James River, Amelia (on Appomattox River), Powhatan, and Hardware River Wildlife Management Areas (WMA). DGIF has already carried out two restoration projects at Amelia and has another one in the planning stages. Waterfowl nesting islands were created at Gathright, but the potential for wetlands creation at this WMA is much more limited. In addition to these areas, there are also Forest Service lands which might benefit from either habitat creation or filter strip improvement. Steve also discussed the access problems to the James that exist downstream of Gathright and the demand for the trout fishery.

4. The group discussed the feasibility of restoring wetlands on various areas on the James and its tributaries. General consensus was that projects on state- or federally-owned land would be the most feasible and least controversial. Steve Capel and Collin Powers (Council) discussed wetlands restoration projects that have been done in conjunction with FWS as part of the Partners For Wildlife Program. The majority of these projects have been done in the lower James River basin, below the fall line.

5. Rob Atkinson (VPI) presented the idea of using wetland creation to reduce nutrient flow to the James River from sewage treatment plants. The wetlands would not be used for treatment, per se, since the outflow would already meet water discharge standards. Collin noted that State Water Control Board input and support would be needed for this idea since localities are not likely to be interested.

6. Caren Caljouw (DCR) discussed mussel restoration. She said that most of the endangered species habitat in the James River watershed is private lands. However, there is some land within the George Washington National Forest which is adjacent to or part of endangered species habitat. DCR is participating in the implementation of the new management plan for the George Washington National Forest. The draft is presently being

reviewed in Atlanta. John Gill (FWS) will make contact with forestry people to see how this plan may be compatible with this recon study.

7. Doug Plasencia (DCR) said the study should focus on a particular tributary or reach of the river, not the whole river and that such a study should take more of a holistic approach to the problems of that portion of the river, including a detailed resource analysis. After extensive discussion, Collin said that this approach would probably be more appropriate for the state agencies to do themselves. Corps representatives stressed that time constraints and the purpose of the study would make Doug's approach very difficult to implement. Collin also mentioned the need to collect existing natural resource information or the James in a GIS-type format, to facilitate easy access to the data.

8. The group attempted to identify specific areas as priorities for fish and wildlife habitat restoration. Steve suggested reaches below Gathright Dam, from Lynchburg to Scottsville, and on the Appomattox as potential areas for wetlands restoration, and the St. Mary's River as a site needing work on acid deposition problems. Caren mentioned areas on the Jackson, Craig and Cow Pasture Rivers as critical endangered species habitats, particularly for freshwater mussels. The Jackson and Craig River sites were cited as the most important and Caren mentioned that there are also candidate rare plants in these areas, as well as problems with invasive species like purple loosestrife. The Hardware River and James River WMAs were considered high priorities for wetlands restoration, and further investigation of the use of wetlands for reducing nutrient loading from sewage treatment plants was also recommended. The Rivanna River, downstream from Charlottesville, was cited as a good area for a demonstration restoration project, due to the combination of environmental issues present (sand mining, sewage treatment, dam, endangered species, and recreation).

9. Rob Atkinson requested that a educational component be included for whatever plans were recommended. He stressed the need to involve students in the study in a way to increase environmental awareness.

10. It was decided that the state needs to prioritize the various areas proposed for restoration and present specific locations for study to the Corps. DGIF will also provide the Corps with a rough idea of the types of restoration projects they would be interested in doing. In order to allow adequate time for proposals to be evaluated within the framework of this reconnaissance study, the Corps needs this information as soon as possible (late January or early February at the latest). The Corps will continue to work with the Council to identify potential projects.

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
December 14, 1992

Attendees

Name	Agency
Steve Capel	Va. Department of Game and Inland Fisheries
Ray Fernald	Va. Department of Game and Inland Fisheries
John Gill	U.S. Fish and Wildlife Service
Collin Powers	Va. Council of the Environment
Doug Plasencia	Va. Department of Conservation and Recreation
Caren Caljouw	Va. Department of Conservation and Recreation (Division of Natural Heritage)
Robert Atkinson	V.P.I. Center for Environmental Studies
John Tate	Va. Department of Agriculture and Consumer Services
Helene Haluska	Corps of Engineers
Craig Seltzer	Corps of Engineers
Kris Holderied	Corps of Engineers
Betty Waring	Corps of Engineers

COMMONWEALTH *of* VIRGINIA

Department of Game and Inland Fisheries

December 18, 1992

Mr. Craig Seltzer
Planning Division
Army Corps of Engineers
803 Front Street
Norfolk, VA 23510-1093

Dear Mr. Seltzer:

I was recently notified by Dr. Greg Garman that he has submitted a proposal to you outlining a radio telemetry study on the James River. The scope of the study would involve tracking migratory patterns of thirty (30) spawning-run river herring in the vicinity of the man-made breaches at Manchester and Brown's Island Dams. Greg feels that such a study would directly support the Reconnaissance Phase of your Habitat Restoration Initiative and would help determine the scope of the Feasibility Phase.

I would like to strongly support Greg's initiative. When the fish passage modifications were made at Manchester and Brown's Island, expert advice and state-of-the-art modeling were utilized to determine the best placement and design. However, as was summarized at the December 9 meeting, the river herring are not using the breaches as expected. Reasons for this apparent lack of use are totally speculative. Telemetry, utilizing radio tagged fish, is an accepted, proven method to help determine migratory patterns for fish and is the best means to ascertain the effectiveness of the breaches for river herring (*Alosa pseudoharengus* and *A. aestivalis*). This preliminary study during the Reconnaissance Phase would determine the scope of, and provide the basic framework for, much of the Feasibility Phase that follows.

4010 WEST BROAD STREET, P.O. BOX 11104, RICHMOND, VA 23230-1104
(804) 367-1000 (V/TDD) *Equal Opportunity Employment Programs & Facilities* FAX (804) 367-9147

I have the highest regard for Greg and the work that he has accomplished as an Associate Professor at Virginia Commonwealth University. Under contract with our Department, he was Project Leader for an extensive fish population survey on the James River and continues (as funding allows) his close association with our Department by conducting anadromous fish monitoring work for us. He has helped design and lead those studies from conception to completion with all goals and deadlines met. I firmly support this telemetry study at the breaches and recommend Greg as the Principal Investigator.

I look forward to receiving confirmation that this study has been approved for this spring (1993). Please feel free to contact me if you need or desire further information.

Sincerely,

David K. Whitehurst
Chief, Fisheries Division

DKW/PPS/fha

cc: Dr. Greg Garman
Mr. Larry Hart
Mr. Collin Powers

COMMONWEALTH of VIRGINIA

Council on the Environment

KEITH J. BUTTLEMAN
ADMINISTRATOR

202 NORTH NINTH STREET
SUITE 900
RICHMOND 2321?
804-786-4500
TDD 804-371-760?

January 4, 1993

Mr. Craig Seltzer
Planning Division
Army Corps of Engineers
803 Front Street
Norfolk, District 23510-1093

Dear Mr. Seltzer:

I would like to thank you and the Norfolk District office for the efforts you have undertaken through the James River Restoration Study. Restoring the ecological integrity and value of the James River is a valuable opportunity for Virginia. I would like to reaffirm our support for any projects that further this important goal.

I understand that your office is faced with a rigorous timetable for the reconnaissance phase of the Study and that our efforts during this period must focus on specific projects. Nonetheless, I urge you to recognize the long-term commitment that is required for true ecological restoration and protection. I also urge you to consider long-term management opportunities and to incorporate ongoing basin-wide investigation and planning into the Study as it moves forward.

Consequently, as local sponsor of the Study, I recommend for your consideration a proposal for funding that has been developed by Dr. Greg Garman of the Virginia Commonwealth University Biology Department. The proposed project is designed to address one of the major fish passage issues currently facing the Commonwealth: understanding why river herring do not move upstream through the breaches at the Manchester and Browns Island dams.

Ensuring that all anadromous fish are restored to their historical spawning grounds is a goal of Virginia's fish passage program. This is important not only for full ecological restoration, but also in providing the economic rationale for continued efforts at fish passage upstream.

I wish you success on this important project.

Sincerely,

Keith J. Buttleman

enclosure

cc: Colonel Andrew M. Perkins, Jr., Army Corps of Engineers
Dr. Greg Garman, VCU Biology Dept.
David Whitehurst, Dept. of Game and Inland Fisheries

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

January 12, 1993

Environmental Analysis Branch

Mr. Keith J. Buttleman
Administrator
Council on the Environment
Commonwealth of Virginia
202 N. Ninth Street
Suite 900
Richmond, Virginia 23219

Dear Mr. Buttleman:

This letter is in regard to the James River Basin, Virginia, fish and wildlife restoration reconnaissance study currently being conducted by the Corps of Engineers with the Council on the Environment supporting the Corps as local sponsor.

In reference to your letter of January 4, 1993, and specifically your recommendation of Dr. Greg Garman's proposal, we are in the process of developing a scope of work and funding arrangements with Dr. Garman. After talking to Mr. Collin Powers, Mr. David Whitehurst, Dr. Garman and others, we are convinced that we need a better understanding about river herring and why they do not move upstream through the existing breaches at the Manchester and Browns Island dams.

At a meeting with state fisheries experts coordinated by your office on December 9, 1992, discussions on the anadromous fishery concerns in the James River Basin led to a group consensus that a "Long-Term Management Plan" was needed to better define what needed to be done to restore the fishery and over what time period these strategic steps could be taken. The management plan and all its individual components could in itself be one project addressed and supported in the Reconnaissance Study. As envisioned, components of the management plan would include, at a minimum:

- Strategy for provision of fish passage at dams on James River mainstem and its tributaries
- Stocking strategies/programs to augment existing populations
- Possible alteration/modification of existing dam breaches
- Construction of fish hatchery
- Regulatory requirements

Dr. Garman's investigations would be important for answering questions related to fish passage and would allow us to make more well-informed decisions regarding viable strategies for restoration which will be addressed in the reconnaissance report.

Your continued support and exchange of ideas is appreciated and encouraged. If you have questions, or if we can provide additional information, please contact Mr. Craig Seltzer, project manager, at (804) 441-7767.

Sincerely,

J. Mell

for Robert V. Ogle, P.E.
Chief, Planning Division

RECEIVED JAN 26 1993

DEPARTMENT OF GAME AND INLAND FISHERIES

WILDLIFE DIVISION

MEMORANDUM

Fax mem 22 Jan 1993

TO: Ray Fernald

FROM: Steve Capel

DATE: JANUARY 21, 1993

SUBJECT: James River Basin Restoration Study, COE

This is a preliminary summary of potential projects that are of interest to the Wildlife Division for inclusion in the Corps of Engineers' James River Basin Fish & Wildlife Restoration Study. Since we were not in on the original meetings, we have been rushed to pull this information together. There will probably be a few added items in the next few weeks, but thought you had better have this material to work from for the present.

Amelia WMA Wetland Restoration: $6,000 for restoration of wetland adjacent the Appomattox River. Ducks Unlimited cooperative venture. This is an existing proposal that has been placed on hold pending DU freeing adequate funds for construction.

James River WMA Wetland Restoration: Both on the newly acquired parcel and the existing acreage of James River WMA there are prior-converted wetlands that can be restored to useful wetland function with the installation of appropriate water control structures and birm construction. No engineering has been completed at these sites as yet. The projects would be: a) silt removal from existing impoundment and b) wetland renovation of a 10 acre site in PC wetlands. A rough estimate is that $35,000 would complete both projects.

Non-Game Education: Provide bird feeders, ID booklets and "backyard habitat" plant materials to 60 grade schools in upper James River. Would include 3 feeders and starter seed. Schools would be encouraged to provide subsequent seed by turning recycling proceeds into $ for bird seed. Est. cost: $6,600

Gate Bat Caves: There are several caves in the upper James region that are habitat for several endangered and threatened bats. Nursery caves often suffer disruption and mortality from caving activity. Gates that permit ingress/egress by bats but prohibit human entrance have been successfully installed on other Virginia caves. This would provide three cave gates. Est. Cost $15,000

Gathright WMA Clearing Development: Develop permanent upland herbaceous clearings to compensate for loss of this habitat type when Lake Moomaw was created. Would develop 15 acres of forest openings and plant to grass/legume mixtures. Est. Cost $10,000

Demonstration Farms: $20,000 to add 20 habitat demonstration farms in 22 James River Drainage counties to existing demonstration farm program. This would entail providing plant material and habitat improvement implementation labor on these farms. They are then used in subsequent years for habitat management techniques stops on bus tours, workshops and similar activities.

Purple Loosestrife Control: $10,000 in a cooperative program with Division of Natural Heritage and Virginia Department of Agriculture and Consumer Affairs for control of purple loosestrife infestations. This is the greatest single threat to existing freshwater wetlands in Virginia. Invasion from northern states is a threat that can still be held in check with prompt control action. Currently 12 of the 25 known infestations in Virginia lie within the James River Basin. Almost all are less than an acre in size. If treated soon, minimal chemical use would be involved.

Fescue Replacement with Warm Season Grasses: $20,000 for use on Amelia, Powhatan, Hardware River & James River WMAs that have over 300 acres of infestations of fescue that will be converted over to native Warm Season Grasses like switchgrass, bluestems, indiangrass and coastal panicgrass. This will include site preparation and reseeding costs.

Use of Warm Season Grasses For Livestock Forage: There are vast acreages in the upper James River drainage that are planted to fescue for livestock forage. Warm Season Grasses (WSG) offer vastly greater wildlife benefits, are higher quality forage and are more productive, yet their acceptance by farmers has been hindered by slower establishment and lack of detailed management knowledge under these soil/climate conditions. Larger, grazable stands of WSG need to be established in key areas, and stocking rates, grazing dates and similar management refinements evaluated. Partnerships for this practice need to be explored. Cost estimate for this work is in the range of $30,000, depending on manpower availability (note: includes cost of WSG drill, which could also be used to establish WSG on DGIF, GWNF and private timberlands—log landings, roads, etc).

Replace Swinging Bridge in Bullpasture Gorge, Highland WMA: Bridge is a major access to Highland WMA, and is in need of major repair, currently in marginal condition. Receives traffic from hikers, fishermen, cavers, tubers, hunters, etc. Est. cost $30,000

Replace Stream Fords, Goshen WMA: Two major stream crossings on Goshen WMA need attention. Replace with 96" culverts and fill. Would improve trout habitat considerably. Est. Cost: $20,000

Impact of Pesticides on Farm Wildlife: Farm wildlife like quail and rabbits live in circumstances of routine exposure to acreages that are being treated with pesticides. A major study to evaluate sublethal implications of this exposure to nesting, brood survival and recruitment is being proposed. Several aspects of this study would be appropriately funded, especially as they will involve recommendations for minimizing exposure of wildlife to these pesticide applications, such as discontinuing spraying of headlands. Implications to James River drainage water quality are additional benefits that could derive from this study. Phases of the study that might legitimately be funded under this effort might be in the neighborhood of $30,000.

Dioxin Levels in Jackson River Wildlife: There is considerable question and debate surrounding the degree of contamination of the Jackson River with dioxins.

Health warnings have been issued in the past, but no measurements have ever been made of dioxin levels in such animals as wood ducks, mink and other wildlife inhabiting the lower Jackson River and very upper James River. The main issue that has continually stopped further examination of this problem is cost of running dioxin analyses. A proposal is pending with the US Fish & Wildlife Service that would develop a screening tool to detect dioxin indirectly through liver microsomal biochemistry at a far cheaper cost per analysis. This study might fund the actual dioxin analyses of wood ducks and mink, estimated at $35,000.

Wetland Restoration, George Washington N. F.: Several projects have been completed to date. At least five sites remain that offer similar wetland restoration opportunity—Hidden Valley (5 ac), Evans (2 ac), Wallace (8 ac), Walton (3 ac), and Marshall (3 ac). Rough cost estimate is $52,000.

Establish Emergent Aquatic Vegetation, Lake Moomaw: Plant or seed emergent aquatic vegetation in the shallow areas and nesting islands in the upper reaches of Lake Moomaw. COE/DGIF/GWNF cost share $6,500

This has been prepared with minimal response time from our field personnel. I am sure that as they see this list, they will have the benefit of stimulation of ideas from others, and we will see additional projects come forth. Please bear with us in this process.

cc. Sims, Ellis, Bowman, Keyser, Jeffreys, Busch, Bourgeois, Spiers, Fies, Stinson, Moore

COOPERATIVE AGREEMENT
BETWEEN U.S. FISH AND WILDLIFE SERVICE
AND
VIRGINIA COMMONWEALTH UNIVERSITY

I. TITLE

"Fate and Significance of Post-Spawn Clupeid Fish Carcasses in a Large Mid-Atlantic River."

II. BACKGROUND, AUTHORITY AND PURPOSE

Two offices of the U.S. Fish and Wildlife Service that are cooperating toward restoration of anadromous fish in Virginia waters are the Northeast Anadromous Fish Research Laboratory (NAFRL), Turners Falls, MA and the Virginia Fisheries Coordinator, Arlington, VA. As a component of the National Fisheries Center, Leetown, WV, the NAFRL has the responsibility for developing and implementing research efforts involving all anadromous fish resources in the Northeastern United States from the Chesapeake Bay to the coastal rivers of Maine. Areas of research include identification of factors affecting mortality, investigation of techniques that contribute to substantial mortality reductions, fish behavior during upstream and downstream passage, physiology, genetics and stock assessment.

The Virginia Fisheries Coordinator works with State and other Federal agencies toward restoration of anadromous fishes to Virginia waters, with special emphasis on striped bass, shad and river herring. One major function is to see that the resources of the several agencies are coordinated toward necessary restoration activities. Restoration and research needs for striped bass, shad and river herring have been identified in conjunction with the Atlantic States Marine Fisheries Committee, the Virginia Anadromous Fish Restoration Committee and several groups pursuant to the Chesapeake Bay Agreement. One of these needs is to evaluate the effects of anadromous fish restoration efforts on target species and other organisms in the biological community.

By the late 1870's, the construction of several dams on the James River in the vicinity of Richmond, Virginia prevented clupeid migration above the Fall Line. Since that time, at least six species of non-native fishes (of particular interest is smallmouth bass) were introduced and have become established. Hence, the biological community in which anadromous clupeids originally played a role has been significantly altered.

Major efforts are underway throughout the Chesapeake Bay area to remove impediments to migrating fishes. Two dams in the Richmond area of the James River were breached in January, 1989. Passage beyond the remaining Richmond dams is scheduled for the early 1990's. Once passage is provided, more than 100 miles of the James River, as well as associated tributaries, will be open to clupeid spawning runs for the first time in over a hundred years. This presents an opportunity to investigate the ecological effects of clupeid restoration on the existing biological community.

Several investigators have traced significant, episodic inputs of nutrients (e.g. phosphorus) into high gradient watersheds of the Pacific Northwest to decaying salmon carcasses. The extent to which post-spawning clupeid carcasses will be utilized as a source of allochthonous energy in the moderate gradient James River, and the processing mechanisms involved, are open to speculation. At this time, there is a need to gather preliminary data on potential effects of clupeid restoration to provide a focus for future investigations once passage is provided.

The objectives of this study are:

1. to estimate retention time of carcasses within the James River, and evaluate possible retention mechanisms;

2. to assess the role of biological processes (e.g. scavenging) on carcass processing;

3. to assess the role of physical processes (e.g. abrasion) on carcass processing; and,

4. develop energy equivalents for carcasses.

This Cooperative Agreement between the U.S. Department of the Interior, U.S. Fish and Wildlife Service, hereinafter referred to as "FWS," and Virginia Commonwealth University, hereinafter referred to as "VCU," is entered into under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e) as amended, and the Fish and Wildlife Act of 1956 (16 U.S.C. 742 (a) -754), as amended. This Agreement will facilitate the cooperation of the two parties in the conduct of studies to determine the effects of anadromous fish restoration efforts on existing biological communities.

III. <u>SCOPE OF WORK</u>

For a period as hereinafter set forth, FWS and VCU shall furnish the necessary personnel, equipment, and facilities and otherwise perform all things necessary for or incident to the performance of work as set forth in the attached proposal.

A. Specifically, FWS will:

(1) Provide funding in the amounts not-to-exceed $9,625 as itemized in the project budget, which is made a part hereof.

(2) Provide personnel assistance, on an as available basis, necessary to support collection of specimens.

(3) Provide technical assistance and cooperate with University personnel on aspects of the project that may be viewed as part of the cooperative effort.

B. Specifically, VCU will:

(1) Conduct the study in accordance with the attached proposal. Any deviations from these procedures specified in this proposal shall be presented to and approved by the FWS Contracting Officer before being implemented.

(2) Meet monthly with FWS Project Officer to discuss progress and exchange information to assure coordination and development and application of methods in the research effort.

(3) Provide the FWS Project Officer with the following required reports:

(a) <u>Progress Reports</u> - reports to detail the progress to date and to specify problems encountered or recommended on subsequent research will be submitted quarterly.

(b) <u>Final Report</u> - a comprehensive report or manuscript(s) that documents experimental procedures, results, and recommendations based on effort conducted by VCU shall be submitted within 30 days of the completion of this agreement.

IV. <u>PERIOD OF PERFORMANCE</u>

The period of performance of this Cooperative Agreement is one year from the effective date of signature by the FWS Contracting Officer. However, an extension of an additional 1 or 2 years may be necessary to assure replication of the results.

V. FINANCIAL ADMINISTRATION

A. The total not-to-exceed amount of funding to be provided by FWS under this agreement is $9,625. The Cooperator shall not incur costs to be charged to the FWS, nor shall FWS be obligated to reimburse VCU in excess of the funding obligated under this Agreement.

B. Pre-Agreement Costs: Allowable costs to be reimbursed to VCU under this Agreement shall include such direct and indirect costs incurred during the period from January 1, 1989, to the effective date of signature by the FWS contracting officer; provided however, that such costs shall not in the aggregate, exceed $2,000.00, which is included in the not-to-exceed amount provided under this agreement.

C. Travel Costs: Travel expenses incurred by VCU exclusively in direct performance of this agreement shall be in accordance with standard GSA and VCU policy with the following rate authorized for reimbursement. (Any proposed change in VCU policy will require further authorization):

1. Cost of travel by privately owned vehicle or by VCU vehicle at the rate of $0.225 in lieu of actual cost of rental vehicle.

D. Submission of Vouchers:

1. An original and two copies of all cost reimbursement vouchers, including the final voucher, shall be submitted to the designated FWS Project Officer for approval; and transmittal to the paying office. All vouchers shall include a reference to FWS Cooperative Agreement No. XX-XX-XXXX-89-XXX. Payment approval shall be subject to satisfactory progress and to the receipt and acceptance of the progress and final reports by the FWS Project Officer.

2. VCU shall furnish the following minimum information on VCU letterhead in support of all costs vouchered:

(a) The period of performance for the cost claimed;

(b) Current and cumulative amounts of the following items of cost: direct labor; overhead and burden; material costs; equipment costs; consultant's costs; subcontractor costs; travel costs itemized including origin and destination; and any other supporting data for unusual expenditures.

VI. PROJECT OFFICERS

The following officials are responsible for performance of the work described in the scope of work and coordinating this project:

A. U.S. Fish and Wildlife Service

Mr. Robert J. Batky
Virginia Fisheries Coordinator
1000 N. Glebe Road - 5th Floor
Arlington, VA 22201

B. Virginia Commonwealth University

Dr. Greg C. Garman
Virginia Commonwealth University
Department of Biology, Box 2012
816 Park Avenue
Richmond, VA 23284

VII. SPECIAL PROVISIONS

A. The U.S. Fish and Wildlife Service General Provisions for Grants and Cooperative Agreements, dated August 1, 1985, are hereby attached and shall be applicable to this Agreement.

B. Government Property

Upon acquisition of the property authorized under this Agreement, VCU shall forward to the Contracting Officer the make, model, serial number, and cost of the acquired property. Title of the property shall vest in the Government. The property shall be maintained in accordance with Clause 15 of the General Provisions.

C. Publication of any reports or parts thereof by Cooperator personnel are subject to FWS review. Authorship will not incur any privileges of copyright or restriction on distribution. Appropriate credits to the U.S. Department of the Interior, Fish and Wildlife Service shall be in any formally published article providing the Service does not otherwise feel it appropriate to issue a disclaimer.

D. FWS Project Officer Authorities

1. The Project Officer is responsible for administering the performance of work under this Cooperative Agreement. In no event, however, will any understanding, agreement, modification, change order, or other matter deviating from the terms of this Agreement be effective or binding upon the Government unless formalized by proper documentation executed by the FWS Contracting Officer prior to completion of the Agreement.

2. The Contracting Officer shall be informed of any actions or inactions by either party of this Agreement which will change the required delivery or completion times stated in the Agreement, and the Agreement will be modified accordingly.

3. On all matters that pertain to the Cooperative Agreement terms, the cooperator shall communicate with the Contracting Officer. Whenever, in the opinion of the Cooperator, the Project Officer requests effort outside the scope of the Agreement, the Cooperator shall so advise the Project Officer. If the Project Officer persists and there still exists a disagreement as to proper agreement coverage, the Contracting Officer shall be notified immediately by the Cooperator, in writing. Proceeding with work without proper coverage in the Agreement could result in nonpayment or necessitate the submittal of a claim.

VIII. MODIFICATION

Modifications to this Agreement may be proposed at any time during the period of performance by either party and shall become effective upon approval by both parties. This Cooperative Agreement, unless otherwise modified, is scheduled for completion one year from the effective date of signature by the FWS Contracting Officer.

IX. TERMINATION

Termination of this Cooperative Agreement may be made by either party by providing written notice to the other party thirty (30) days in advance of the proposed termination date.

IN WITNESS THEREOF, the parties hereto have caused this Cooperative Agreement to be executed as of the date therein written.

U.S. Fish and Wildlife Service

Name:____________________

Title:____________________

Date:____________________

Virginia Commonwealth University

Name:____________________

Title:____________________

Date:____________________

B:AMSVCU.1
BBatky: 3/22/89

COMMONWEALTH of VIRGINIA

Department of Game and Inland Fisheries

February 8, 1993

Mr. Craig Seltzer
Norfolk District , Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

Re: Project recommendations for the James River Basin Fish and Wildlife Restoration Reconnaissance Study
ESSLOG #4977

Dear Mr. Seltzer:

As we discussed earlier today on the telephone, attached please find our recommendations of projects to be considered for the James River Basin Fish and Wildlife Restoration reconnaissance study. These project summaries have been compiled by our Fisheries and Wildlife divisions, respectively. The projects are not prioritized at this time, and only the Wildlife project proposals have monetary cost estimates. We gladly will meet with you to discuss these proposals, and we look forward to augmenting the project descriptions, priorities, costs, etc. as appropriate. Please call me at (804) 367-8999 when you have reviewed these outlines, if we may assist in further development of these proposals and prioritization of topics for the reconnaissance study, or if we may be of further assistance.

Sincerely,

Raymond T. Fernald, Manager
Environmental Services Section

RTF/mbm

4010 WEST BROAD STREET, P.O. BOX 11104, RICHMOND, VA 23230-1104
(804) 367-1000 (V/TDD) *Equal Opportunity Employment Programs & Facilities* FAX (804) 367-9147

COMMONWEALTH of VIRGINIA

Department of Game and Inland Fisheries

February 10, 1993

Mr. Phil Stevenson
Department of Conservation and Recreation
Division of Natural Heritage (DNH)
1500 E. Main Street, Suite 312
Richmond, Virginia 23219

Dear Phil:

Thank you for making the trip to Blacksburg for our meeting on Monday (Feb.3th) to discuss and coordinate our conservation efforts for rare and endangered mussels and fish species throughout Virginia. I am particularly interested in your proposal to the Army Corps of Engineers (Corps) to identify and correct sedimentation problems in the Rivanna River and its watershed. In the recovery plan for the federally endangered James spinymussel, *Pleurobema collina*, siltation is identified as a significant factor contributing to this species' decline. The work that DNH currently is conducting in the Rivanna River (*P. collina* inventory), and the project that you are proposing to the Corps, are both Priority 1 Recovery Tasks for this endangered freshwater mollusk species (see excerpt from plan, enclosed).

The likelihood of success of this proposed project seems great. An existing database and a willing, experienced individual (University of Virginia graduate student) are at your fingertips to analyze sedimentation problems within the watershed. With relatively little effort, areas of high soil loss can be overlayed with your inventory information to identify areas to target for restoration to help prevent further declines of the James spinymussel within the James River Basin. Secondly, involvement of local government is crucial to the recovery of endangered species, and Albemarle County obviously has been and remains committed to protecting the upper James River watershed. For numerous years now, the county has maintained a full-time water resources manager. David Hirschman, the newly hired manager, has expressed great interest in becoming an active player in the project if approved by the Corps. I am familiar with David's work; he has a strong land ethic and is deeply committed to the protection of water quality for multiple uses (human consumption, recreation, fisheries and wildlife resources). We couldn't ask for a better individual to help ensure that this project is well-rounded and properly implemented.

4010 WEST BROAD STREET, P.O. BOX 11104, RICHMOND, VA 23230-1104
... Employment Programs & Facilities FAX (804) 367-9147

As the state regulatory agency responsible for managing and protecting Virginia's wildlife resources, the Department of Game and Inland Fisheries fully supports your proposal, and hopes that funding becomes available to proceed. Additionally, we appreciate and I personally accept your invitation to participate in this exciting project, and look forward to working with you, Albemarle County, and the Corps of Engineers in the near future.

Sincerely,

Sue

Sue A. Bruenderman
Aquatic Biologist
Virginia's Nongame and Endangered Species Program

Enclosure

cc: David Whitehurst, Chief, Fisheries Division, VDGIF, Richmond
John Kaufmann, Regional Fisheries Manager, VDGIF, Charlottesville
Andy Moser, Endangered Species Biologist, U.S.F.W.S., Annapolis
David Hirschman, Water Resources Manager, County of Albemarle, Department of Engineering, Charlottesville

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

February 11, 1993

Environmental Analysis Branch

Mr. David K. Whitehurst
Chief, Fisheries Division
Department of Game and Inland Fisheries
P.O. Box 11104
4010 W. Broad Street
Richmond, Virginia 23230-1104

Dear Mr. Whitehurst:

This letter is in regard to the James River Basin, Virginia, fish and wildlife restoration study currently being conducted by the Corps of Engineers with the Commonwealth of Virginia cooperating as local sponsor.

As discussed in a meeting at your office on February 9, 1993, with Gary Martel, Price Smith, and Tom Gunter of your staff, we are very interested in addressing the anadromous fishery concerns in the James River Basin as a part of this study. As we have discussed with you in previous meetings, during this reconnaissance phase we are attempting to establish opportunities and needs related to, and Federal and local sponsor interest in, fish and wildlife restoration projects in the basin.

Based upon our conversations, we understand that VDGIF has the following priorities related to the anadromous fishery in the James River Basin:

1. Provide fish passage at dams in Richmond.

2. Strengthen fish populations through stocking and truck and transport initiatives.

3. Evaluate the use of breaches at Brown's Island and Manchester Dams by river herring and shad. Determine the need for modifications to the breaches and the extent and scope of changes.

4. Build a shad hatchery on the James to help restore American and Hickory shad populations to historical levels.

5. Provide fish passage at dams upstream of Richmond.

6. Work with the State Water Control Board to improve water quality at Lynchburg and Covington.

We discussed at length how the present Corps study could address these priorities and arrive at recommendations and solutions related to the needs of the anadromous fishery.

It was determined that the present study could have valuable input to the following areas and that in order for the Corps to proceed with their evaluation some follow-up input from your department would be needed.

1. Shad/Anadromous Fish Hatchery on the James River - We will need an approximate location or locations (e.g., a mile reach of the river) from you as to where an anadromous fish hatchery and ponds should be sited on the James River. Also, we will need information on the approximate size and type of facility that would be envisioned. It does not appear that there will be any additional anadromous fisheries facilities needed at the King and Queen State Fish Hatchery at Stevensville at this time. However, hatchery improvements related to the anadromous fishery at King and Queen, if warranted, could be addressed within the scope of this study.

2. Dams - Williams Island will be breached this summer and there is no need for Corps involvement. The vertical slot fishway at Boshers Dam should be constructed sometime in the near future, although the complete details on timing and funding are not certain at this time. The Corps could include the first Boshers fishway in this reconnaissance study, at your discretion and recommendation. If not; a second fishway at Boshers, which apparently will eventually be needed, could be included as part of this study. We would need information from your office that would clearly support the need for a second fishway. Also, any design or cost information related to the fishway would be helpful. Regarding the Scotts Mill Dam at Lynchburg, as part of this study we will do very preliminary work to investigate the possibility of acquiring the dam and breaching, removing, or constructing a fishway at this impediment to fish migration.

The Corps is presently working with Dr. Greg Garman to develop a scope of work to evaluate the use of breaches at Brown's Island and Manchester Dams by river herring and shad. The work will be accomplished this spring.

If the information that we are requesting cannot be provided immediately, we would appreciate receiving an approximate time-frame for acquisition. The reconnaissance study report must be completed by October 1993, so in order for these ideas to be evaluated we would need the requested information at least 4-5 months in advance of that date. Your continued support and dialogue with us on these important topics is appreciated and encouraged. If you have questions, or if we can provide additional information, please contact Mr. Craig Seltzer, project manager, at (804) 441-7767.

Sincerely,

J. Ogle

for Robert V. Ogle, P.E.
Chief, Planning Division

CF: Collin Powers, Council on the Env

James River Basin, Fish and Wildlife Restoration Study
Anadromous Fisheries Management Plan

Migration Barriers
1. What are the costs associated with providing passage at dams on the James River? Who should bear these costs?
2. Has any design work been done on fish passage at Williams Island and Boshers Dams?
3. On what dates do FERC licenses have to be renewed at different dams on James R. mainstem? Is it true that, as part of this license renewal, passage for fish must be provided by dam owners?
4. What is the effectiveness of existing breaches? Are they or are they not completely effective? Why?
5. Who are the owners of the dams? What is the best way to deal with dams in private ownership?
6. What is (should be?) the long term strategy for provision of fish passage at dams in the James River Basin?
7. What is the present arrangement with the City of Richmond to provide passage at remaining dams at Richmond?
8. What is the time schedule for providing passage at remaining dams at Richmond?

Habitat
1. If passage can be provided to historical spawning and rearing areas, are these areas still capable of providing the habitat needs (e.g., feeding, spawning, rearing, etc.) for anadromous fish? What are these habitat needs?
2. What needs to be done, specifically, to improve degraded upstream habitat to make it more acceptable for fisheries spawning and rearing? Where, specifically, should these improvements be made?
3. Are there studies that need to be accomplished to better answer these questions (no.'s 1 & 2 above)?

Restocking
1. Purpose is to strengthen the naturally occurring spawning populations in targeted rivers and streams. Where, specifically, should restocking take place? How is this determined?
2. What are the most effective methods of restocking? What studies have been conducted to determine effectiveness? What future studies are needed?
3. What is cost of restocking?
Greg 4. What are the preliminary findings from restocking efforts that took place in 1991/92?

Hatchery
1. What is the need for a hatchery to provide juvenile fish for restocking efforts?
2. What have been the results of the pilot hatchery program initiated in 1992?
3. Is there a reliable source for James River shad eggs?
4. Where is the best place for a hatchery to be located? What is the optimal size and what would be the approximate construction costs?

Water Quality

1. With only two exceptions, water quality in the James River above the city of Richmond is considered to be in good to excellent condition. Pollution problems still persist in the Lynchburg area (high bacterial counts in the summer), and below the Westvaco plant in Covington low dissolved oxygen problems occasionally occur during the summer. What can be done to improve water quality in these areas? Is the Commonwealth doing anything?

Management

1. How should fishing pressure on the anadromous fishery be regulated? Is it currently being regulated? How?
2. What is the role of the Atlantic States Marine Fisheries Commission (ASMFC) and the Virginia Marine Resources Commission (VMRC)?
3. The highest priority for management should be the conservation of sufficient adult stocks to bring about the recovery of all depleted populations. Which populations should receive attention first? How are regulations enacted?

Meeting Notes

On February 12, 1993 Craig Seltzer and Helene Haluska met with Phil Stevenson of Division of Natural Heritage, his supervisor, and a representative of the Thomas Jefferson Planning District Commission.

Research on the presence of the James spinymussel on the Rivanna River is spotty. Most of the surveys have been done at bridge crossings where access is not a problem. The stretches of river between the crossings have not been surveyed much at all. Natural Heritage is especially interested in the Rivanna because this area is east of the Blue Ridge Mountains and there are fewer locations of mussels on the eastern side compared to the western side.

The PDC is interested in the study from the perspective of their regional carrying capacity study. Specific issues which would be influenced by mussel research are: water supply, threats from urbanization and acidification, and presence of trout in the river. The PDC is interested in the impact of growth on the mussel, with the decline of mussel being an indicator of other environmental problems.

The PDC has a GIS system which has information on soils, slope, elevation, historical resources, roads, land use(Albemarle and Louisa Counties), and third order watershed boundaries. The PDC is currently developing priorities for the various basins. It is also concerned about stormwater management and reduction of non-point sources of pollution and siltation.

Areas where potential projects might be located include two streams which are tributaries of the Rivanna, Moorman's (sloping terrain) and Meachim's (level terrain), Buck Mountain Reservoir, and the Shenandoah National Park. The Virginia Department of Soil and Water Conservation, which ranks watersheds as vulnerable to degradation, has given the Rivanna a high priority ranking because of the potential for development in the watershed.

Local interests in any project in this area include the Albemarle County Board of Supervisors, Charlottesville City Council, and the League of Women Voters. Cost sharing with these entities is problematic because of the stresses on local funding. They could probably contribute "in-kind "services.

The next step would be for Phil to prepare a detailed scope of work with costs for any work requiring immediate Corps funding, i.e., grad student at UVA working on correlating erosion and locations of mussels. The time schedule for the remaining work may be a problem because of our short study time.

ADMINISTRATION
NATURAL HERITAGE
PLANNING AND RECREATION RESOURCES
SOIL AND WATER CONSERVATION
STATE PARKS

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

DIVISION OF NATURAL HERITAGE

Main Street Station, 1500 East Main Street   Suite 312
TDD (804) 786-2121   Richmond, Virginia 23219   (804) 786-7951   FAX (804) 371-2674

M E M O R A N D U M

DATE: February 12, 1993

TO: Collin Powers, COE; Craig Seltzer, USACE; Tom Smith, DCR-DNH; Michael Collins, Thom. Jefferson Planning District Commission

FROM: Philip H. Stevenson

SUBJECT: Proposed Reconnaissance Project for Rivanna Watershed

In accordance with the goals of the ongoing Army Corps of Engineers reconnaissance survey of the James Basin for fish and wildlife habitat restoration opportunities, an initial proposal has been developed for consideration. The proposal deals with habitat restoration related to the James spinymussel, Pleurobema collina, a federally and state listed endangered species. The area considered for this project is within the Rivanna River watershed in Albemarle County. An outline of the project follows.

Objective Identify areas in the South Fork Rivanna River watershed in which riparian restoration/protection is significant for restoration/protection of aquatic habitat of the James spinymussel. The identification of the significant habitat protection areas may lead to a feasibility phase study which uses the habitat restoration/protection needs and rates alternatives for meeting such needs. Secondary benefits of the project will be general identification of protection needs for aquatic life and water quality of the South Fork Rivanna Reservoir, the principal water supply for Albemarle County and the City of Charlottesville.

Method The project will accomplish its objective by relating information regarding soil loss, soil erodibility, and James spinymussel distribution within the watershed. Soil information currently exists to accomplish the evaluation of soil erosion. Ongoing inventory of James spinymussel in the Rivanna watershed can provide majority of data needed to resolve spinymussel status.

Products Products of this reconnaissance study are to be:

1) map of the distribution of the James spinymussel and the areas of significance for habitat restoration/protection

2) report providing interpretation of the map product.

Cooperators The potential list of cooperating entities for the performance of the study are:

Albemarle County
Thomas Jefferson Planning District Commission (TJPDC)
Dept. of Conservation and Recreation- Div. of Natural Heritage (DCR-DNH)
Department of Game and Inland Fisheries (DGIF)
University of Virginia (UVa)

This list does not include the Army Corps as the funding source or the Council on the Environment as the coordinator of overall state participation. The list is limited to those entities which may be directly responsible for producing study results to be provided to USACE and COE.

Tasks Potential allocation of work among the cooperators is as follows:

1) Soil information analysis and support- TJPDC, UVa
2) Map production - TJPDC, UVa
3) Survey of James spinymussel - DCR-DNH
4) Analysis mussel survey data - DCR-DNH, DGIF
5) Reconnaissance Report - DCR-DNH, Albemarle Co.

The above distribution of work should be considered as a general exploration of potential performers. The work and the individuals who have committed to specific tasks are:

Task 3: Phil Stevenson, DCR-DNH
Task 4: Sue Bruenderman, DGIF
Phil Stevenson, DCR-DNH

The participation of UVa. may be limited to that of one graduate student providing time to do the soil information analysis. The student may be supported via UVa or TJPDC in performing Task 1 and 2, depending on availability and cost of resources. Task 5 requires involvement of both an aquatic biologist and a watershed protection analyst/engineer. This task in the reconnaissance phase requires both inputs as the biological evaluation is near completion and the detail design for the feasibility phase, primarily a responsibility for a watershed protection analyst, must follow from the reconnaissance report.

Costs

Task 1 Cindy Donohue, a graduate student in the University of Virginia Dept. of Environmental Planning, has committed to do soil erosion analysis as an academic credit research project. An expansion of the project to include buffer designs may be worthwhile. TJPDC can provide technical support of her work. Also, she has potential availability of resources at UVa. Costs her are for any reimbursement to Cindy Donohue and any billable costs of computer resources.

Task 2 Production of final map products can be performed at UVa or TJPDC. It would be more desirable to have the product produced by whoever is most likely to cooperate in the feasibility phase, so availability/archival of the map/data is expeditious to performance of feasibilty phase. The costs here are those related to production of a final map product.

Task 3 This task is largely being performed under a previously funded study. The inventory effort needed for completeness of the mussel distribution survey for this study requires 4 man days of field work and the associated data processing and overhead. Est. cost $1500.

Task 4 No direct costs are associated with this item.

Task 5 Estimated writing time is approximately 5 days. Until a distribution of work effort and project coordination is complete, the only estimate is maximum cost. Estimated cost $1,000.

M E M O R A N D U M

DATE: February 17, 1993

TO: Thomas Smith
Collin Powers
Craig Seltzer
Michael Collins

FROM: Phil Stevenson

SUBJECT: Minutes of Meeting on James Basin Reconnaissance Study - Rivanna Proposal

Attendees:
Craig Seltzer, Army Corps of Engineers, Norfolk District
Helene Haluska, Army Corps of Engineers, Norfolk District
Michael Collins, Thomas Jefferson Planning District Commission(TJPDC)
Steven Roble, Dept. of Conservation and Recreation- Division of Natural Heritage(DCR-DNH)
Philip Stevenson, DCR-DNH

A memo outlining some possible scenarios for a reconnaissance study in the South Fork Rivanna Watershed was distributed. The following major points were established during the course of the meeting:

No field studies should be included in any reconnaissance proposal. The existing information resources of DCR-DNH and TJPDC seem adequate to meet reconnaissance study demands. The reconnaissance study does not require a definitive relationship between the habitat parameters and the mussel distributions. Such a relationship appropriately should be proved during the feasibility analysis. Feasibility would be when field studies are performed.

The products of the study can be provided in at least two sections. The description of the initial relationship between soil erosion parameters and mussel distribution along with estimates of the structural measures needed should be prepared by June 30, 1993. The structural measures estimate is to not include cost; but, is to estimate the land area requiring specific forms of measure. Structural measures would include replanting of riparian vegetation, development of storm water filtering systems(such as artificial wetlands), fencing of streams to reduce access to livestock, and development of alternative livestock water sources. This early provision of the data/maps is to provide sufficient time for Army Corps staff to develop benefit/cost analysis of the overall project. The second major portion of the reconnaissance study is to develop an initial feasibility study and budget. This would be due with the completed reconnaissance study by September 30, 1993.

Several expected roles in the performance of the reconnaissance study were outlined. Phil Stevenson of DCR-DNH would provide mussel information and other aquatic habitat data. Mike Collins of TJPDC could provide the technical support for the soil data analysis and map production. Cindy Donohue, a U. Va. graduate study, could provide the soil data analysis and interpretation, possibly including providing restoration and protection measures. It was noted that for the feasibility phase of the study to be possible, the County of Albemarle must be involved directly. David Hirschman, Watershed Protection Manager in the Engineering Dept. of Albemarle County, would be the recommended candidate to represent the county and possibly provide overall coordination of feasibility phase work. Phil Stevenson will provide initial coordination of the reconnaissance phase and may continue that role for the reconnaissance phase only.

FEB 1

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

MEETING WITH FEDERAL & STATE AGENCIES GATHRIGHT DAM AND LAKE MOOMAW PROJECT AREA
Agenda
March 3, 1993

1. Introduction and Background
    a. Study Area
    b. Study Authority
    c. Local Sponsor: Virginia Council on the Environment
    d. Study Objectives
    e. Restoration Opportunities
    f. Reconnaissance Study Funding and Schedule

2. Group Discussion of Fish and Wildlife Restoration Opportunities in the Gathright Dam and Lake Moomaw Project Area
    a. Fisheries
    b. Wetlands
    c. Water Quality
    d. Riparian Habitat
    e. Upland Habitat
    f. Endangered Species
    g. Waterfowl
    h. Other Restoration Opportunities

3. Prioritization of Restoration Opportunities
    a. Federal/State Restoration Initiatives
    b. Long-Term Management Plans/Master Plans
    c. Funding

4. Other Discussion

5. Conclusion and Adjourn

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING IN
COVINGTON, VIRGINIA
March 3, 1993

MEETING NOTES

1. Representatives of the U.S. Forest Service, George Washington National Forest (Warm Springs, Pedlar, and James River Ranger Districts), Virginia Department of Game and Inland Fisheries, U. S. Fish and Wildlife Service, Virginia Council on the Environment, and the Corps of Engineers (Norfolk District) met in Covington on March 3, 1993 to discuss fish and wildlife restoration opportunities in the upper James River watershed. A list of attendees is attached.

2. Craig Seltzer gave a short presentation on the history of the study, its authority, the objectives, the funding, and the study schedule. There were several questions about cost sharing, particularly as it relates to another Federal agency. Craig said that the cost sharing partner for this study could not be another Federal agency; it would have to be the state, a state agency, or some local agency. If a mechanism is already set up for private organizations to participate with local, state or Federal government, their involvement can be considered.

3. Various ideas were suggested as possibilities for consideration. Among these were the following:

• Creating ponds for waterfowl and changing the vegetation to support more wildlife at the Hidden Valley Recreation Area (this would support the Watchable Wildlife Program)

• Liming of streams which are acidic (St. Mary's, for example)

• Clear areas in the Gathright area (i.e., create herbaceous openings) which would support wild turkey, grouse, etc.

• Acquire land to provide better access to the bottomland portions of the Gathright WMA (access to several large parcels of land was lost when Lake Moomaw was filled)

• Reintroducing otter in the streams in the area

4. It was mentioned that the Alleghany Highlands Tourism Council, which has representaives from Bath, Alleghany, and Highland Counties, would be highly supportive of any projects which would encourage tourism. Also, if State legislators can see any of these proposals as benefitting their constituency, they would likely sponsor a bill to cost-share in study and construction funding.

5. It was then recommended that projects be grouped by watershed and submitted that way. The watersheds suggested are:

• Jackson River
  a) Upper
  b) Lake Moomaw
  c) Lower
• Cowpasture River

a) South River (Incl. St. Mary's)
b) Calfpasture
c) Lower Calfpasture

- Pedlar
- Tye headwaters
- Buffalo River

6. We then concentrated on options for Lake Moomaw. These included:

- Island creation for waterfowl and wetlands
- Planting of emergents
- Changes in water releases
- Wildlife enhancement through:
  - Creating bald eagle nesting sites
  - Controlling beavers
  - Habitat development through increased public access, creation of linear strips, and creation of brood strips
- Reducing erosion along the shoreline of the lake
- Enhancing the fishery through creation of aritificial reefs (structures) using natural materials

7. After some discusssion, it was agreed that the Forest Service and VDGIF would submit a list with specific projects they would be interested in to the Corps by early April. They would also supply whatever cost information they could obtain with their list.

8. The meeting was followed by a field visit to prospective fish and wildlife restoration sites in the Gathright Wildlife Management Area and Lake Moomaw vicinity overseen by the U.S. Forest Service.

List of Attendees

John Bellmore	U.S. Forest Service
Al Bourgeois	Va. Dept. of Game & Inland Fisheries
John Gill	U.S. Fish & Wildlife Service
Helene Haluska	Corps of Engineers
Ed Haverlack	U.S. Forest Service
Dawn Kirk	U.S. Forest Service
Scott Klinger	U.S. Forest Service
Sharon Mahney	U.S. Forest Service
Collin Powers	Virginia Council on the Environment
Craig Seltzer	Corps of Engineers
Kenny Sexton	Va. Dept. of Game & Inland Fisheries
Cindy Snow	U.S. Forest Service

James River Basin Fish and Wildlife Restoration Study
Potential Projects

1. Anadromous Fish Passage @ Bosher's Dam - The state expects to construct a vertical slot fishway at Bosher's Dam sometime in the near future, although the complete details on timing and funding are not certain at this time. The Corps could include the first Bosher's fishway in this reconnaissance study, at the discretion and recommendation of the VDGIF. If not, a second fishway at Bosher's, which VDGIF says will eventually be needed, could be included as part of this study. We have requested and are waiting for information from VDGIF that would clearly support the need for a second fishway. Also, we are looking for any design or cost information related to the fishway that we can get from VDGIF.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

2. Fish Passage Modifications - Brown's Island and Manchester Dams have recently been breached but are not being used by some anadromous fish species (river herring). This will be evaluated this spring by Virginia Commonwealth University (G. Garman). Depending on results of these investigations, modifications to the breaches may be required to accomodate passage for river herring.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

3. Scott's Mill Dam - Investigate the possibility of acquiring privately-owned Scott's Mill Dam (Lynchburg) and breaching, removing or constructing a fishway at this impediment to fish migration.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

4. Hatchery - A shad hatchery is needed on the James River to help restore American and Hickory shad populations in Virginia. We have requested from VDGIF approximate location or locations (e.g., a mile reach of the river) where an anadromous fish hatchery and ponds should be sited. Also, we have requested information on the approximate size and type of facility that would be envisioned. From our discussions with VDGIF, it does not appear that there will be any additional anadromous fisheries facilities needed at the King and Queen State Fish Hatchery at Stevensville at this time. However, hatchery improvements related to the anadromous fishery at King and Queen, if recommended by VDGIF, could be addressed within the scope of this study.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

5. Endangered Species Restoration - According to Virginia's Division of Natural Heritage (DNH), the James River spinymussel is declining throughout the basin primarily due to water quality concerns. Restoration/protection for the spinymussel may be available on the south fork of the Rivanna River, a tributary to the James. Structural restoration measures that would help improve water quality include replanting of riparian vegetation, development of storm water filtering system (such as artificial wetlands), fencing of streams to reduce access to livestock, and development of alternative livestock water sources. DNH is

developing a proposal for work to be accomplished during the reconnaissance study that would help identify problems and needs.
Contact: Phil Stevenson (DNH)

6. Amelia WMA Restoration - Restoration of wetland adjacent to the Appomattox River, a tributary to the James. This is a proposal that has been under discussion with Ducks Unlimited, however the proposal has been placed on hold pending DU funding.
Contact: Steve Capel (VDGIF)

7. James River WMA Restoration - Both on the newly acquired parcel and the existing acreage of this WMA there are prior-converted wetlands that can be restored to useful wetland function with the installation of appropriate water control structures and berm construction. Projects would include: a) silt removal from existing impoundment, and, b) wetland renovation of a 10 acre site in PC wetlands.
Contact: Steve Capel (VDGIF)

8. Gathright WMA Clearing Development - Develop permanent upland herbaceous clearings to compensate for loss of this habitat type when Lake Moomaw was created. Would develop 15 acres of forest openings and plant grass/legume mixtures.
Contact: Steve Capel (VDGIF)

9. George Washington National Forest - Several projects have already been completed. At least five sites remain that offer similar wetland restoration opportunity - - Hidden Valley (5 ac), Evans (2 ac), Wallace (8 ac), Walton (3 ac), and Marshall (3 ac).
Contact: Steve Capel (VDGIF)

10. Lake Moomaw - Establish emergent vegetation. Plant or seed emergent aquatic vegetation in the shallow areas and nesting islands in the upper reaches of the lake.
Contact: Steve Capel (VDGIF)

James River Basin Study Meeting
March 3, 1993

New Mission for Corp's - "Environmental" --Fish and Wildlife Restoration Projects

This study is targeting the area above the fall line on James River

Senator Warner initiated study
The local cost-share sponsor for the State of Virginia will be the Council on the Environment (represented by Mr. Colin Powers)

3 Stages

1 yr.	1. Reconnaissance study - Corps expense ($375.000 available this year)
3-4 yr.	2. Feasibility study - (begins May of 1994) share expense with others
1-20 yr.	3. Implementation - (May of 1997 or later) millions of dollars available

James River Basin studies objective is to identify environmental restoration opportunities

Restoration Opportunities Include:

1. fish and wildlife re-establishment
2. habitat evaluation, improvement and restoration
3. remove fish migration barriers
4. food source supplementation

*Corps is open to almost any projects

Criteria for projects ties to Corp's incurred losses!

Federal Government will pick up 75% of cost and local sponsor 25% of cost on restoration projects

Can't match federal dollar with federal dollar (need to check on this)

***build a case for the environmental quality benefits of a project

land acquisition can be part but must be tied to an environmental quality project (restoration)

Discussion of some Potential Projects - need specific locations and areas.

1. acid problems on trout streams
2. obstructions to trout streams
3. Hidden Valley Ecosystem Restoration (WC habitat, WSG's, etc.)
4. Lake Moomaw habitat restoration -
   - fish shelters and emergent vegetation
   - wood duck box management
   - black duck habitat enhancement
   - waterfowl nesting islands
5. waterfowl habitat development and watchable wildlife
6. otter re-introduction
7. peregrine falcon restoration - habitat development

It's best to package several projects under one larger study
(decision made to develop studies on an ecosystem basis)

Proposed Ecosystem Projects

A. Jackson River
   - Upper Jackson
   - Lake Moomaw
   - Lower Jackson

B. Cowpasture River (includes Bullpasture River)

C. Maury River
   - South River
     - St. Mary's
   - Calfpasture
   - Little Calfpasture

D. Pedlar River

E. Tye River Headwaters

Example: Lake Moomaw Ecosystem

Wetlands

-nesting islands
-establish emergent aquatic vegetation/upper end and coves
fish cover
waterfowl food
-water release considerations (ie. holding water for fall migrations)

Wildlife
-Otter reintroduction
-waterfowl habitat development
-beaver control
-bald eagle nesting sites or perches
-upland habitat development (Gathright WMA)
-improve public access to Gathright WMA
-woodcock habitat enhancement
-T & E species

Watershed

-fence cattle out of streams/riparian areas (above Lake Moomaw)
-address erosion problems upstream
-shoreline erosion Lake Moomaw

Fisheries

-structures
-aquatic emergents + shrub plantings

Need to get specific on each of these items and give locations - (include any cost information if available)

"Think Big" - MILLIONS of DOLLARS are available !!!!!!!

(JRBasin.ab)

FEB 1 ...

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

MEETING WITH
FEDERAL & STATE AGENCIES
GATHRIGHT DAM AND LAKE MOOMAW
PROJECT AREA
Agenda
March 3, 1993

1. Introduction and Background
    a. Study Area
    b. Study Authority
    c. Local Sponsor: Virginia Council on the Environment
    d. Study Objectives
    e. Restoration Opportunities
    f. Reconnaissance Study Funding and Schedule

2. Group Discussion of Fish and Wildlife Restoration Opportunities in the Gathright Dam and Lake Moomaw Project Area
    a. Fisheries
    b. Wetlands
    c. Water Quality
    d. Riparian Habitat
    e. Upland Habitat
    f. Endangered Species
    g. Waterfowl
    h. Other Restoration Opportunities

3. Prioritization of Restoration Opportunities
    a. Federal/State Restoration Initiatives
    b. Long-Term Management Plans/Master Plans
    c. Funding

4. Other Discussion

5. Conclusion and Adjourn

Appendix C

~ wezel

COMMONWEALTH OF VIRGINIA
VIRGINIA DEPARTMENT OF GAME & INLAND FISHERIES

MEMORANDUM

Staunton Field Office
Comm. of Game & Inl. Fish.
Route 6, Box 484-A
Staunton, VA 24401

TO: Distribution
FROM: Al Bourgeois
DATE: March 5, 1993
SUBJECT: Project Proposals - James River Basin Study

Attached please find information relating to a recent meeting some of us attended with the Army Corp's and USF&WS relating to the James River Basin Study. I've included some material passed out at the meeting and a copy of my notes for background information.

To briefly summarize the Army Corp's is looking to redirect their energies into environmental restoration and have targeted the James River drainage basin above the fall line as a project area. Almost any type of environmental restoration project can be considered and there are **MILLIONS of DOLLARS** available.

The work will be done primarily on governmental lands (ie. local municipalities, counties, state and federal lands). However, projects can include private land if the benefits warrant it!

We agreed that project proposals should include large areas which involve several smaller projects or developments. Therefore, we decided on an ecosystem/watershed approach as outlined in my notes.

The Army Corp's (Mr. Craig Seltzer) needs our input by early April. So I would like to invite you to a project coordination meeting on April 5, 1993 beginning at 9:00 am at the Deerfield Ranger District office in Staunton, Va.

Please get together with your respective Ranger District or agency personnel and develop proposals to bring to this meeting. Let me know if you have any questions. You can send written comments to me if you can't attend the meeting.

cc:				
	Bellemore	Spiers	Capel	Sims
	Klinger	Snow	Haverlack	Reynolds
	Fies	Rhodes	Mohn	Martin
	Kocka	Mohney	Kirk	Chandler
	Hudy	Norman	Gaines	Hunt

James River Basin Fish & Wildlife Restoration Study
Fish and Wildlife Service Scope of Work
(as developed at Annapolis, MD Field Office on 11 March 1993)

In addition to the previously submitted scope of work (attached), the following work will be accomplished in support of the reconnaissance study on the James River Basin Fish & Wildlife Restoration Study:

1) Update design and cost information presented in Feasibility Study of Fish Passage Facilities in the James River, Richmond, VA (December '83) for Bosher's dam fish passage. This will be coordinated with Dick Quinn of the F&WS regional office.

2) For the dams at Lynchburg, provide FERC license numbers and requirements for providing fish passage at each of the dams.

3) At Scott's Mill Dam (Lynchburg) evaluate what would be needed to provide fish passage (type of structure and approx. cost). Also, at Scott's Mill Dam investigate the approximate cost and benefit of providing trap and transport instead a fish ladder.

4) Depending on Dr. Greg Garman's study results at Brown's Island and Manchester dams - work with Dick Quinn to redesign breaches (concept design).

5) Shad Hatchery - Cost and size information on recently constructed hatcheries in the United States that would be typical for VDGIF shad hatchery on James River.

6) Harrison Lake - Coordinate with Albert Spells to see what is needed to retrofit existing hatchery for shad.

7) Follow through with the USFS (Dawn Kirk) on sill idea at upstream end of dam to provide wetland and permanently inundated area.

8) Follow through with the Lake Moomaw ideas which include:

- Island creation for waterfowl and wetlands
- Planting of emergents
- Changes in water releases
- Wildlife enhancement through:
  - Creating bald eagle nesting sites
  - Controlling beavers
  - Habitat development through increased public access, creation of linear strips, and creation of brood strips
- Reducing erosion along the shoreline of the lake
- Enhancing the fishery through creation of artificial reefs (structures) using natural materials

Get conceptual design and rough cost information for these proposals.

9) To the extent practicable (for a recon-level evaluation), do a "desk-top" HEP analysis to come up with quantifiable benefits.

Thomas Jefferson Planning District Commission
413 East Market Street, Suite 102
Charlottesville, Virginia 22902-5213
Telephone 804/972-1720

March 12, 1993

Mr. Phil Stevenson
Aquatic Zoology Research Assistant
Virginia Department of Conservation and Recreation
Division of Natural Heritage
1500 East Main Street, Suite 312
Richmond, Virginia 23219

Dear Mr. Stevenson:

The Thomas Jefferson Planning District wishes to support the proposed project "A Proposal for the Reconnaissance Phase of the James Spinymussel/Sediment Loading Study". In the proposal dated 3/3/93 to Mr. Craig Seltzer, Corps of Engineers, the costs for the Planning District's involvement is shown as $1525.00.

Mr. Michael Collins of our staff has brought to my attention cost limitations on the availability of funds for our portion of this project. It is my understanding that of the needed $1525, only $999.99 is available under this phase of the project.

Due to our commitment to environmental protection in this region, we can make a commitment to provide John Potter's GIS work for the $999.99 now available. However, this contract amount must be payable in advance without an ensuing requirement for documentation of expenses. If these terms are acceptable to the Corps of Engineers and the Division of Natural Heritage, Mr. Potter can commence work on the project with Cinde Donaghue.

I see this project as a seed for further evaluation of the Spinymussel Habitat in the Rivanna River basin in years to come and welcome the opportunity to engage in a partnership with the Corps of Engineers, the Virginia Division of Natural Heritage, and the University of Virginia.

Thank you for your interest in this federally endangered species, and if you have any questions, I can be reached at (804)-972-1720.

Sincerely,

Nancy K. O'Brien
Nancy K. O'Brien
Executive Director

cc: Mr. Craig Seltzer, COE
Ms. Cinde Donaghue, UVA
Mr. David Hirschman, Albemarle County
Mr. Michael Collins, TJPDC

Albemarle County, Charlottesville, Fluvanna County, Greene County, Louisa County, Nelson County

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COMMONWEALTH OF VIRGINIA

DEPARTMENT OF GAME AND INLAND FISHERIES

MEMORANDUM

TO: Ray Fernald

FROM: Price Smith PS

DATE: February 2, 1993

SUBJECT: James River Restoration Study

Those projects and studies that would be pertinent to the Fish Division for inclusion in the James River Basin Fish and Wildlife Restoration Study are listed below. I have not had time to receive such input from field staff, as was the case with Steve Capel, and thus there may be addendum(s) to this list within several weeks. However, I expect that this will set the basic groundwork for the Fish Division. I have not prioritized these projects, nor have I attempted to estimate monetary figures; that information can be better defined if, and when, the Corps expresses an interest or a willingness to do a particular project.

1. Migratory impediments: evaluate anadromous fish passage at barriers in the James River in the vicinity of Richmond and Lynchburg. Specifically:

a. Utilizing radio telemetry, evaluate the use of the breaches at Brown's Island and Manchester Dams by river herring and shad. Determine the need for modifications to the breaches and the extent and scope of those changes.

b. Determine the need for gates at the Brown's Island breaches to maintain the integrity of the riverine pool behind the dam.

c. Investigate the possibility of acquiring Scott's Mill Dam (Lynchburg) and breaching, removing, or constructing a fishway at this impediment to fish migration.

2. Shad hatchery design and construction to help restore American and Hickory shad populations in Virginia. The hatchery would be involved in collection, rearing, and stocking of shad from major rivers in Virginia in order to restore remnant populations to their historical levels.

3. Investigate instream flow needs for the entire James River watershed through modeling and field investigations to determine long term needs and the relationships between water uses, water quantity and quality, habitat creation/loss, and fish migration.

4. Evaluate the feasibility of creating urban fishing areas in highly urbanized areas such as Lynchburg and Richmond (modify and/or construct access sites to and along the James River Floodwall).

5. Study the feasibility of conducting watershed aerial liming or ground based non-mechanized liming studies on the St. Mary's River Watershed and, if deemed appropriate, proceed with the liming project and follow-up with a long term study of the changes in the watershed's flora and fauna.

6. Study and improve Jackson River access below Lake Moomaw, adding additional sites as deemed necessary, improving existing access, and initiating a public relations project to improve landowner/general public relations.

7. Study the effect of water releases at Lake Moomaw and the relationship of various release regimes on water quality and fisheries habitat in the Jackson River and Lake Moomaw as well as in the vicinity of the Town of Covington.

8. Evaluate the impact of river mining on riparian and river habitat, water quality, and species diversity in the Rivanna River.

9. Evaluate and correct (where applicable) the impacts of non-point pollution and erosion on riparian habitat.

10. Study the extent of the loss of riparian habitat throughout the James River drainage basin and work to restore that habitat, particularly in urban and agricultural settings, creating zones of protected riparian habitat (greenbelts) throughout the watershed.

11. Study the impact of the rapidly expanding range and population of flathead catfish in the James and its tributaries, particularly in the lower and upper James River, and its impact on the indigenous fauna of those river reaches.

12. Thoroughly delineate the range of the James River Spiny Mussel and map out a course of action that will protect its existing population and extend its range.

Thanks for the opportunity to comment on and make suggestions for such an important study as the James River Restoration Study. Call if you have questions about the suggestions above.

cc: John Kauffman

COUNTY OF ALBEMARLE
Department of Engineering
401 McIntire Road
Charlottesville, Virginia 22902-4596
(804) 296-5861

February 3, 1993

Phil Stevenson
Aquatic Zoology Research Assistant
Division of Natural Heritage
Department of Conservation and Recreation
1500 East Main Street, Suite 312
Richmond, Virginia 23219

Dear Mr. Stevenson:

I have reviewed the information you sent on the Army Corps of Engineers efforts in the James River Basin. A habitat restoration project concerning the James spinymussel in the Rivanna River Basin (specifically Mechums River) would be very compatible with water quality management efforts underway in Albemarle County. The county is very concerned about this section of the Rivanna Basin because it feeds directly into a major drinking water impoundment, the South Fork Rivanna Reservoir.

At present, the county has two local ordinances that pertain to this area: (1) the Runoff Control Ordinance that attempts to control the quantity and quality of runoff from development activities, and (2) the Water Resources Protection Areas Ordinance, based on local ordinances adopted by Chesapeake Bay localities, providing for vegetated buffer areas along all perennial streams and rivers. Also, as the Water Resources Manager for Albemarle County and the City of Charlottesville, I plan to work with the Thomas Jefferson Soil and Water Conservation District on encouraging the use of Best Management Practices for agriculture, forestry, and other land and resource use activities.

The project you are proposing would have multiple benefits: habitat protection and restoration, drinking water protection, and soil and water conservation. I would welcome the opportunity to work with you, other state agencies, and the Army Corps on the feasibility and project phases of the proposed work.

Sincerely,

David J. Hirschman

David J. Hirschman
Water Resources Manager

COMMONWEALTH of VIRGINIA

Council on the Environment

KEITH J BUTTLEMAN
ADMINISTRATOR

202 NORTH NINTH STREET
SUITE 900
RICHMOND 23219
804-786-4500
TDD 804-371-7604

March 25, 1993

MEMORANDUM

TO: See Distribution List

FROM: Collin Powers, Council on the Environment CHP

SUBJECT: Upcoming Meeting on James River Restoration Study

Craig Seltzer of the Army Corps of Engineers has asked me to convene a meeting to discuss the projects that have been identified, to date, under the reconnaissance phase of the James River Restoration Study (for your review, I have attached a copy of their current list of projects). We have scheduled a meeting for April 15, 1993, at 10:00 AM, in the conference room of the Department of Game and Inland Fisheries (4010 West Broad Street, Richmond).

Mr. Seltzer would also like to discuss general procedures and possible options related to state funding sources for meeting match requirements under the next phase of the project (the feasibility phase). If your agency is involved in a proposed project, please be ready to discuss ways of identifying or pursuing possible fund sources.

As we have noted before, the Corps of Engineers is proceeding on a demanding timetable for this Study and I believe that it would be too late to propose any further projects. However, if you have an exceptional idea for a project in the James River basin that is supported with strong state interest, please call me as soon as possible.

If your agency is adequately represented and you have no specific interest in learning more about the projects under consideration, you don't need to attend this meeting. If you would like to attend but are unable to make it on April 15, please call me.

Distribution:

Jack Raybourne, VDGIF
Steve Capel, VDGIF
David Whitehurst, VDGIF
Price Smith, VDGIF
Gary Martel, VDGIF

Appendix C

Ray Fernald, VDGIF
Theresa Duffey, VDCR
Richard Gibbons, VDCR
Bob Munson, VDCR
Doug Plasencia, VDCR
Caren Caljouw, VDCR
Rick Hill, VDCR
Phil Stevenson, working with VDCR
Sam Austin, VDOF
Greg Garman, VCU
Jean Gregory, VWCB
John Tate, VDACS
Robert Atkinson, VA Tech
David Knowles, VMRC
Rob Kelsey, USFWS
John Gill, USFWS
Craig Seltzer, USACOE
Cindy Snow/Ed Haverlack, USDA Forest Service
Dawn Kirk, USDA Forest Service
Michael Collins, Thomas Jefferson PDC

enclosure

COMMONWEALTH of VIRGINIA

Department of Game and Inland Fisheries

April 9, 1993

Mr. Craig Seltzer
Corps of Engineers
Norfolk District
803 Front St.
Norfolk, VA 23510-1096

Dear Craig,

This is in response to questions raised on our tour of several of the proposed projects for the James River Basin Fish and Wildlife Restoration program.

Although there are a variety of caves across Virginia that harbor hibernacula of Federally Threatened and Endangered bats, only one occurs within the James River Basin that is currently experiencing enough human pressure to warrant gating it. It is, however, a multiple entrance cave that will require more effort and expense than a single entrance cave. The estimated cost of this project is $12,000. The cave is located on a small tributary of the upper Jackson River just upstream from the Gathright Dam area, as indicated on the enclosed map. Due to the sensitive nature of disclosure of exact locations of T&E species, I have indicated the general location of the cave. The endangered species involved is the Federally Endangered Indiana bat, Myotis sodalis.

The gate usually involves installation of a concrete-rebar, welded gate across the entrance(s) that allows smooth movement in and out by bats but prevents unauthorized human access.

I have enclosed a better map of the existing and proposed marshes at the James River WMA.

Also enclosed is a booklet on Warm Season Grasses that will help explain the pros and cons of these grasses for both wildlife and for livestock. We do not have additional landowners "ready to enroll;" however, I feel certain that we could locate and gain concurrence from several such landowners in these counties, well before this project will be in a position to provide actual funding for demonstration farms.

Regarding the proposed marsh at Amelia WMA, I have enclosed SCS design for this marsh. Note that it is intended to be constructed at the lower end of the field and to the west into that sweetgum and brush area, not the lowland birch stand, which is an existing

75
VIRGINIA GAME DEPARTMENT

4010 WEST BROAD STREET, P.O. BOX 11104, RICHMOND, VA 23230-1104
(804) 367-1000 (V/TDD) *Equal Opportunity Employment Programs & Facilities* FAX (804) 367-9147

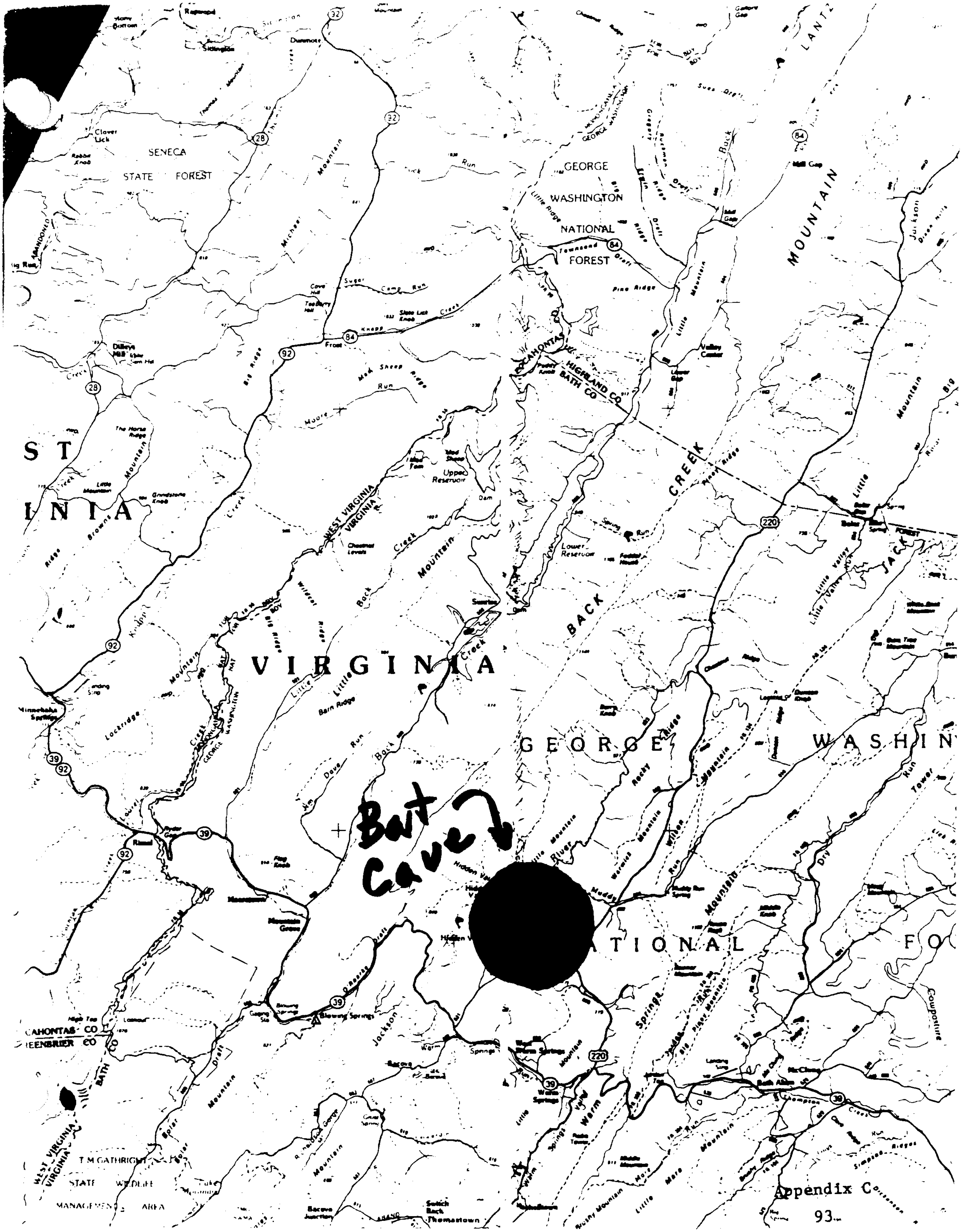
wetland. Although that latter area might prove more productive, it would entail a wetland "type conversion" which is frowned on in certain circles these days. Estimated cost of this project is in the neighborhood of $7,000.

Sincerely,

Stephen Capel

Stephen Capel
Farm/Wetland Supervisor

cc. John Gill, Ray Fernald, Jay Jeffreys, Pat Keyser, J. Sims, Karen Terwilliger, Rick Reynolds, Bob Ellis



SENECA
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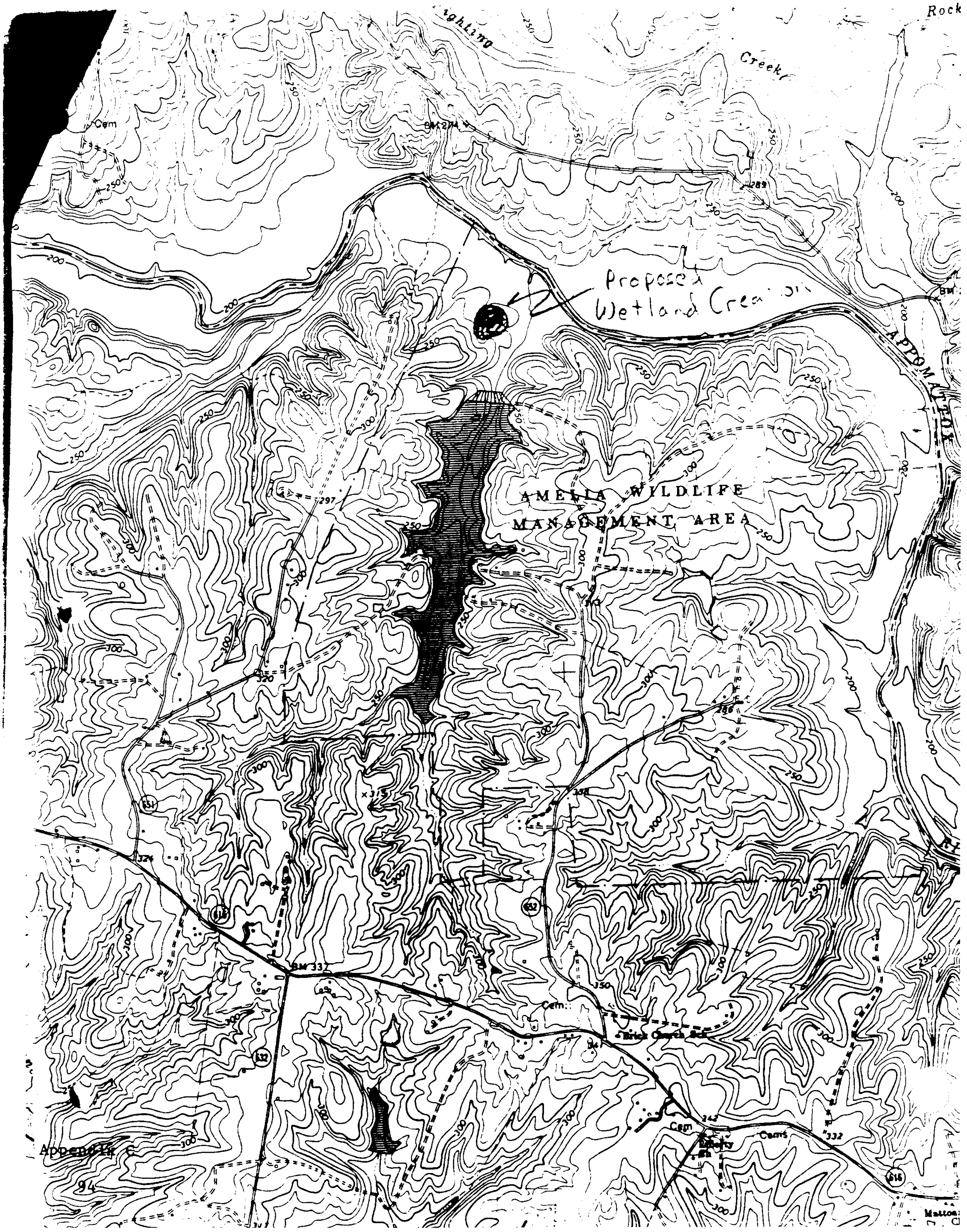
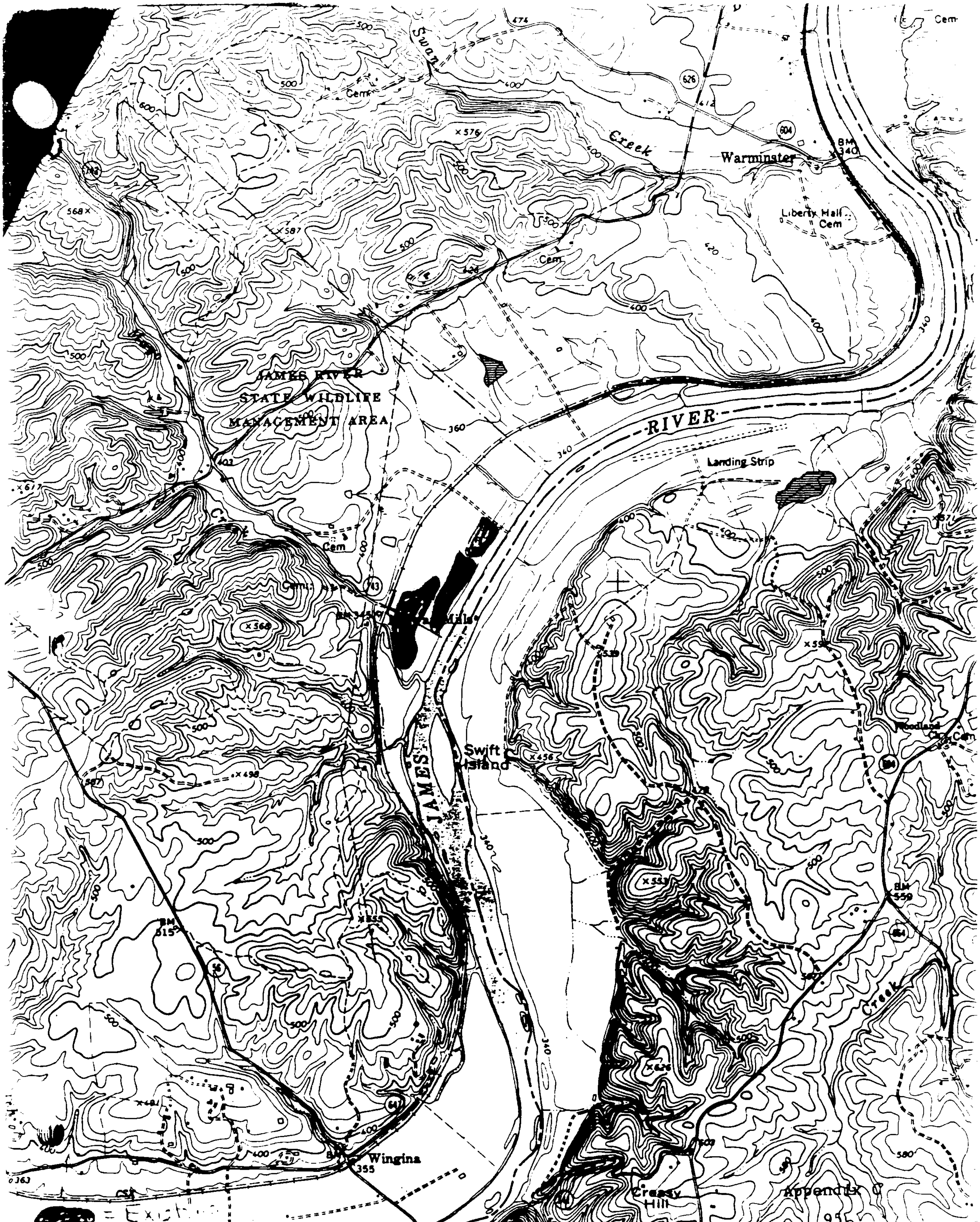
BATH CO
POCAHONTAS CO
GREENBRIER CO
WEST VIRGINIA
VIRGINIA
Upper Reservoir
Lower Reservoir
Minnehaha Springs
Blowing Springs
Warm Springs
Bath Alum
Bacova
Bacova Junction
Switch Back
Thomastown
T.M. GATHRIGHT
STATE WILDLIFE
MANAGEMENT AREA
Frost
Clover Lick
Dunmore
Mountain Grove
Bat Cave

Appendix C


Proposed Wetland Creation
AMELIA WILDLIFE MANAGEMENT AREA
APPOMATTOX
Creek
Rock
Cem
Brick Church Sch
Liberty Ch
Cems
Mattox

Appendix C



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Appendix C

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
Meeting Notes
April 15, 1993

1. Present: See attached list of attendees (attachment 1). Agencies represented were the Army Corps of Engineers (ACOE), Virginia Department of Environmental Quality (DEQ), Department of Game and Inland Fisheries (DGIF), Department of Conservation and Recreation (DCR), and Virginia Commonwealth University (VCU).

2. Craig Seltzer (ACOE) began by discussing the objectives of the meeting. Meeting objectives were: (1) present an overview of the projects which will be addressed in the Reconnaissance Study and re-confirm the local sponsor's interest in these projects; (2) discuss general procedures and possible options related to local sponsor funding sources for meeting 50/50 match requirements for the next study phase (Feasibility Phase). A hand-out was furnished to participants describing proposed projects (attachment 2).

3. Jim Melchor talked about how the Corps (Norfolk District) is investigating ways to approach the proposed projects in a non-traditional way. That is, instead of a lengthy (and costly) feasibility study phase, many of these projects would lend themselves to being addressed in an expanded recon study or an abbreviated feasibility study. The reason that many of these projects would lend themselves to this approach is that feasibility has already been established and much of the design work has already been completed by the sponsoring agency. Also, costs to construct most projects are under $500,000 and many are under $100,000. As far as the local sponsor is concerned, it would just be a matter of using the existing feasibility, design, and cost information to construct the project. It was emphasized that Corps higher authority will require documentation to establish Federal interest, and confirmation on design, cost, environmental effects, etc. However, it is conceivable that this could be largely established with existing information. The Norfolk District will approach our higher authority with this proposal, with no guarantee on how it will be received. It was pointed out that, if we get approval use this approach, we would be looking for local sponsor money to support additional effort beyond a typical recon-level effort.

4. Projects (attachment 2) were reviewed and where there were concerns/changes related to specific projects they were discussed as follows:

a. Bosher's Dam - VDGIF is not interested in the Corps pursuing the fishway at Bosher's dam as a traditional Feasibility Study. Since the feasibility and design work has been completed, the state sees no need for a full-blown study. They would only support this if it could be evaluated using an abbreviated approach (e.g., an expanded recon or reduced feasibility level effort). The state is still interested in the Corps addressing fish traps and a fish viewing window at Bosher's dam as part of the Recon report.

b. Hatchery - VDGIF is no longer interested in the Corps pursuing a <u>new</u> hatchery facility on the James River. Primary interest is in retrofitting or modernizing the Harrison Lake Federal hatchery for shad. This option would be more realistic, given the budgetary constraints the state is facing.

c. Gathright - Al Bourgeois stated that much wildlife habitat was lost to the state with the creation of Lake Moomaw. In addition to fish and wildlife restoration items 8-12 (attachment 2), approximately 100 acres of wildlife habitat has been identified that could be purchased to compensate for this loss. Jim Melchor stated that land purchase is typically a local sponsor cost. However, it may be feasible to cost share land purchase for wildlife restoration. Authorization to do this will be investigated.

d. Regarding item 12 (attachment 2), Craig Seltzer stated that he will discuss these proposals with Al Bourgeois in the next week to get more specific information.

e. Endangered Species - Phil Stevenson reported on the progress of the study being done regarding the James spiny mussel in Albemarle County. A potential project would be to develop a land buffering system to protect existing mussel stocks from siltation and streambank erosion. Albemarle County (a potential local sponsor) has shown interest in measures to protect various watersheds in the county. Fencing along streams to reduce erosion by livestock would be one option. Jim Melchor stated that we would need to clarify ownership and easement issues in this area.

f. Wetlands Creation/Filter Strips - Craig Seltzer briefly outlined options for wetlands creation/restoration at Amelia and James River WMA's. Steve Capel mentioned the possibility of getting landowners to volunteer to have filter strips of non-fescue grasses planted on their property adjacent to the James River or its tributaries as demonstration projects. Deborah Southard said that she could identify property owners willing to have demonstration projects conducted on their property.

5. Discussions regarding funding:

a. The reconnaissance study schedule was reviewed with participants (attachment 3). The recon study report will be submitted in October 1993. The Corps will be requesting signature to a Feasibility Cost Sharing Agreement approximately one year from today. This would initiate the Feasibility Study Phase in May 1994. The local sponsoring agencies need to begin now to budget for the feasibility studies to be initiated in one year. As stated previously, the Feasibility Phase is cost-shared on a 50/50 basis.

b. Ray Fernald and others stated that they need to know what the Feasibility studies will cost in order to budget for them. The Corps does not have this information yet as the study costs will largely depend on whether we can get approval from higher authority to go to an expanded recon or compressed feasibility study as mentioned in paragraph 3. As soon as we get this information, we will contact each potential local sponsor agency to let them know what the approximate study costs would be for the next phase.

JAMES RIVER BASIN, VIRGINIA
FISH & WILDLIFE RESTORATION STUDY

INTERAGENCY MEETING
April 15, 1992

Attendees

Name	Agency
Helene Haluska	Corps of Engineers
Jim Melchor	Corps of Engineers
Craig Seltzer	Corps of Engineers
Al Bourgeois	Va. Department of Game and Inland Fisheries
Steve Capel	Va. Department of Game and Inland Fisheries
Ray Fernald	Va. Department of Game and Inland Fisheries
Tom Gunter	Va. Department of Game and Inland Fisheries
Phil Lawnes	Va. Department of Game and Inland Fisheries
Fred Leckie	Va. Department of Game and Inland Fisheries
Gary Martel	Va. Department of Game and Inland Fisheries
Doug Plasencia	Va. Department of Conservation and Recreation (Bureau of Flood Protection)
Deborah Southard	Va. Department of Conservation and Recreation (Nonpoint Source Pollution)
Phil Stevenson	Va. Department of Conservation and Recreation (Division of Natural Heritage)
Leslie Trew	Va. Department of Conservation and Recreation (Division of Natural Heritage)
Collin Powers	Va. Dept. of Environmental Quality
Greg Garman	Virginia Commonwealth University

attachment 1

James River Basin Fish and Wildlife Restoration Study
Potential Projects

1. Anadromous Fish Passage @ Bosher's Dam - The state expects to construct a vertical slot fishway at Bosher's Dam sometime in the near future, although the complete details on timing and funding are not certain at this time. The Corps could include the first Bosher's fishway in this reconnaissance study, at the discretion and recommendation of the VDGIF. If not, a second fishway at Bosher's, which VDGIF says will eventually be needed, could be included as part of this study. We have requested and are waiting for information from VDGIF that would clearly support the need for a second fishway. Also, we are looking for any design or cost information related to the fishway that we can get from VDGIF.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

2. Fish Passage Modifications - Brown's Island and Manchester Dams have recently been breached but are not being used by some anadromous fish species (river herring). This will be evaluated this spring by Virginia Commonwealth University (G. Garman). Depending on results of these investigations, modifications to the breaches may be required to accommodate passage for river herring.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

3. Scott's Mill Dam - Investigate the possibility of acquiring privately-owned Scott's Mill Dam (Lynchburg) and breaching, removing or constructing a fishway at this impediment to fish migration.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

4. Hatchery - A shad hatchery is needed on the James River to help restore American and Hickory shad populations in Virginia. We have requested from VDGIF approximate location or locations (e.g., a mile reach of the river) where an anadromous fish hatchery and ponds should be sited. Also, we have requested information on the approximate size and type of facility that would be envisioned. From our discussions with VDGIF, it does not appear that there will be any additional anadromous fisheries facilities needed at the King and Queen State Fish Hatchery at Stevensville at this time. However, hatchery improvements related to the anadromous fishery at King and Queen, if recommended by VDGIF, could be addressed within the scope of this study.
Contacts: David Whitehurst, Gary Martel, and Price Smith (VDGIF)

5. Endangered Species Restoration/Protection -

- *Mussels* - According to Virginia's Division of Natural Heritage (DNH), the James River spinymussel is declining throughout the basin primarily due to water quality concerns. Restoration/protection for the spinymussel may be available on the south fork of the Rivanna River, a tributary to the James. Structural restoration measures that would help improve water quality include replanting of riparian vegetation, development of storm water filtering system (such as artificial wetlands), fencing of streams to reduce access to livestock, and development of alternative livestock water sources. DNH is developing a proposal for work to be accomplished during the reconnaissance study that would help identify problems and needs.
- *Bats* - One cave in particular in the James River Basin harbors hibernacula for Federally threatened /endangered bats and also is experiencing enough pressure to warrant gating it. The cave is located on a small tributary of the upper Jackson River.
Contact: Phil Stevenson (DNH); Steve Capel (VDGIF)

Attachment 2

6. Amelia WMA Restoration - Restoration of wetland adjacent to the Appomattox River, a tributary to the James. This is a proposal that has been under discussion with Ducks Unlimited, however the proposal has been placed on hold pending DU funding.
Contact: Steve Capel (VDGIF)

7. James River WMA Restoration - Both on the newly acquired parcel and the existing acreage of this WMA there are prior-converted wetlands that can be restored to useful wetland function with the installation of appropriate water control structures and berm construction. Projects would include: a) silt removal from existing impoundment, and, b) wetland renovation of a 10 acre site in PC wetlands.
Contact: Steve Capel (VDGIF)

8. Gathright WMA Clearing Development - Develop permanent upland herbaceous clearings to compensate for loss of this habitat type when Lake Moomaw was created. Would develop 15 acres of forest openings and plant grass/legume mixtures.
Contact: Steve Capel (VDGIF)

9. George Washington National Forest - Several projects have already been completed. At least five sites remain that offer similar wetland restoration opportunity -- Hidden Valley (5 ac), Evans (2 ac), Wallace (8 ac), Walton (3 ac), and Marshall (3 ac).
Contact: Ed Haverlack (USFS), Al Bourgeois (VDGIF), or Steve Capel (VDGIF)

10. Lake Moomaw - Establish emergent vegetation. Plant or seed emergent aquatic vegetation in the shallow areas and nesting islands in the upper reaches of the lake.
Contact: Steve Capel (VDGIF)

11. Lake Moomaw - Misc. (other) projects:

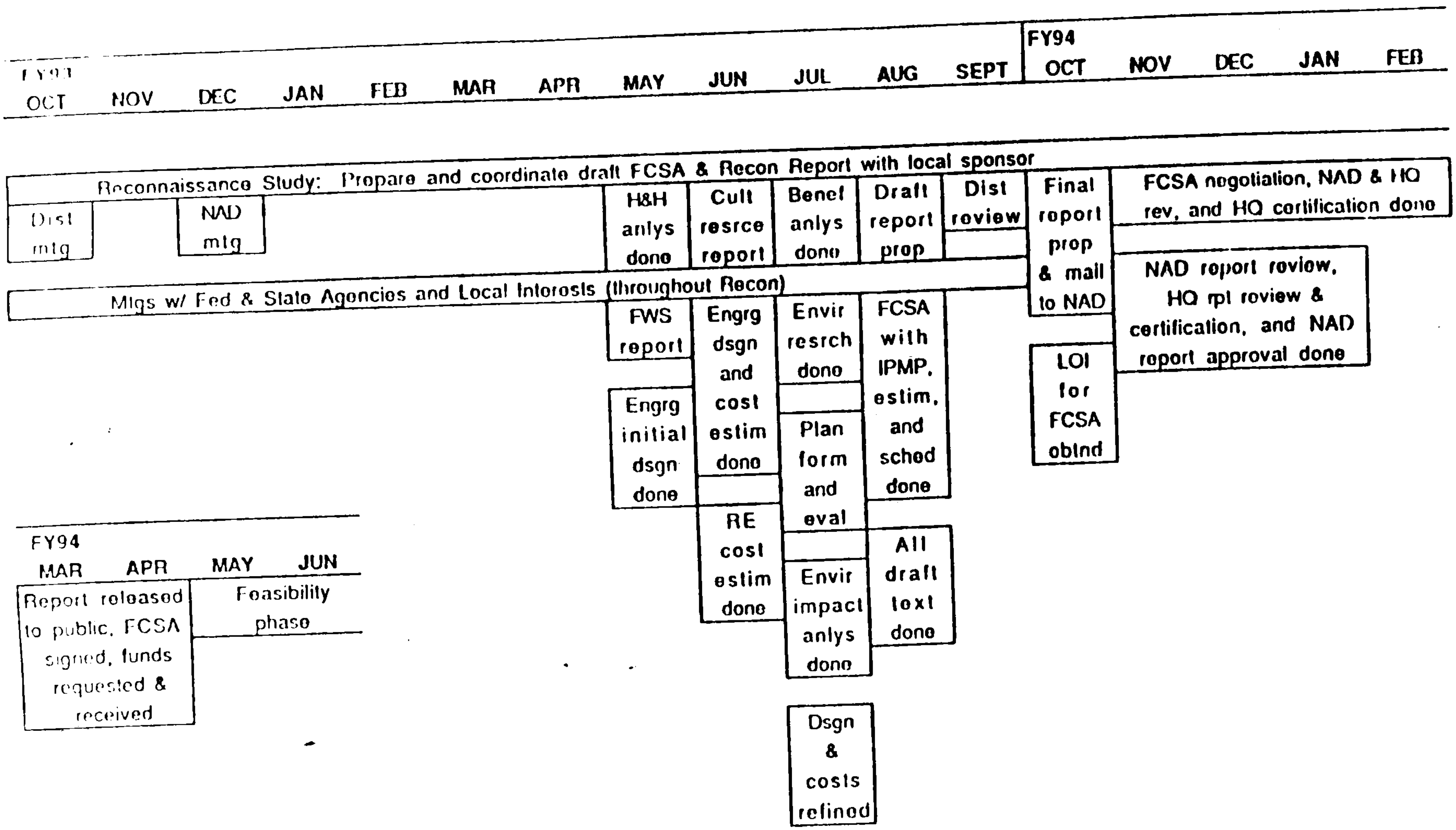
- Island creation for waterfowl and wetlands
- Changes in water releases
- Wildlife enhancement through:
  - Creating bald eagle nesting sites
  - Controlling beavers
  - Habitat development through increased public access, creation of linear strips, and creation of brood strips
- Reducing erosion along the shoreline of the lake
- Enhancing the fishery through creation of artificial reefs (structures) using natural materials
- Construction of a sill structure at upper end of Lake Moomaw to maintain aquatic habitat/wetlands during draw-downs

Contact: Ed Haverlack (USFS), Dawn Kirk (USFS), Al Bourgeois/Kenny Sexton (VDGIF)

12. Misc. - Communication was received from Al Bourgeois, VDGIF, Staunton, Virginia, dated 6 April, 1993 which elaborates on previously discussed projects in the Gathright Dam/Lake Moomaw project area. These projects were generated from a work-group of U.S. Forest Service and VDGIF representatives having jurisdiction in this project area. Several addition projects were proposed in this communication, but have not been thoroughly evaluated yet.
Contact: Al Bourgeois (VDGIF), Ed Haverlack (USFS)

attachment 2 (cont'd)

JAMES RIVER BASIN, VA - FISH AND WILDLIFE RESTORATION - STUDY SCHEDULE



NAD - Corps No. Atlantic Div HDQS
FCSA - Feasibility Cost Sharing Agreement
IPMP - Initial Project Mgmt. Plan
LOI - Letter of Intent
FWS - US Fish & Wildlife Service

ESTIMATED BENEFITS OF ANADROMOUS RESTORATION ON THE JAMES RIVER "RICHMOND TO LYNCHBURG"

Habitat Available:

James River - Richmond to Lynchburg	9,318.0 ac.
Willis River	100.5
Rivanna River (728.0) + N.F.(122.2) + S.F.(61.8)	912.0
Slate River	344.0
Hardware River	284.5
Rockfish River	305.5
Tye River	384.0
Other Small Tributaries	282.2
TOTAL	11,930.7

Habitat Available by Species:

Striped Bass	9,318.0
American Shad	11,364.0
River Herring	11,746.7

Population Estimates

Based on the above habitat figures, an estimate of the number of anadromous fish that could be supported can be obtained. The following figures were utilized to generate the population estimates: striped bass, 16.7/ac (based on figures from the Dan & Roanoke Rivers); American shad, 50/ac (based on figures from the Connecticut River); river herring 10 X shad estimate (based on population mix in Connecticut River).

Striped bass numbers	155,610.6
American shad numbers	568,200.0
River herring numbers	5,873,350.0

Economic value:

Using the following assumptions to determine the commercial, recreational, and total economic values of re-establishing the American shad and river herring populations in the middle James River, a reasonable estimate of the benefits of the anadromous runs for these two species can be obtained. The recreational and commercial harvest of American shad equals 10% and 25% respectively, of the total estimated stock; the value of an angler day for this species equals \$43-\$62 (using 24% inflation rate for 1986-1991) with an angler day equalling one harvested shad (average weight 4 pounds). The commercial value of American shad (1992 value) is \$0.50/lb. (dockside value) and \$0.17/lb. for river herring (dockside value). This dockside value is increased seven times to reflect the market place economic impact.

American shad	
Recreational 10%	56,820.0 Fish
Value High @ \$62.00	\$3,522,840.00
Low @ \$43.00	\$2,443,260.00
Commercial 25%	142,050.0 Fish
Avg. weight 4 lbs.	568,200.0 Pounds
1991 values (\$0.50/lb.) X (7 multip.)	\$1,988,700.00
Shad total High	\$5,511.540.00
Low	\$4,431,960.00
River Herring (estimate 25% of shad values)	
Recreational High	\$880,710.00
Low	\$610,815.00
Commercial	\$497,175.00
River Herring Total	
High	\$1,377,885.00
Low	\$1,107,990.00
Total Economic Value Both Species	
High	\$6,889,425.00
Low	\$5,539,950.00

B:\DOLESTFR.lst

May 4, 1993

Environmental Analysis Branch

Mr. Paul Perra
Management Plan Coordinator
Mid-Atlantic Fisheries Management Commission
1776 Massachusetts Avenue NW
Washington, D.C. 20036

Dear Mr. Perra:

This letter is in regard to your recent phone conversation with Mr. Craig Seltzer of my staff on the James River Basin, Virginia, fish and wildlife restoration study. This study is currently being conducted by the Norfolk District, Corps of Engineers, with the Virginia Department of Environmental Quality acting as local sponsor.

As discussed with you, a major emphasis of these studies ~~have~~ has been on the anadromous fisheries concerns in the basin. We are coordinating our efforts with the Virginia Department of Game and Inland Fisheries and the Virginia Marine Resources Commission. A variety of issues related to anadromous fisheries are being investigated, including: 1) fish passage at dams in Richmond and Lynchburg; 2) fish hatchery improvements to include shad hatching and grow-out facilities; and, 3) improvements in upstream spawning habitat, to mention a few.

You indicated that an annual workshop would be conducted to discuss recent developments regarding shad/river herring restoration on the east coast. It is requested that Mr. Seltzer be placed on the mailing list for this workshop.

If you have questions, or if we can provide additional information regarding this study, please contact Mr. Craig Seltzer, project manager, at (804) 441-7767.

Sincerely,

Robert V. Ogle, P.E.
Chief, Planning Division

CF: RECORDS (1105)
READING
PLANNING

Seltzer
Melchor
Rountree
Ogle

Norfolk District, Corps of Engineers
James River Basin Fish & Wildlife Restoration Study
Proposed Study Approach - May 14, 1993

Follow-Up to Interagency Meeting of April 15,1993:
The feasibility study costs for the larger projects are shown on the attachment, for your information. If recommended, these projects would be pursued as traditional feasibility studies with 50/50 (Federal/Non-Federal) cost-sharing during the feasibility phase and 75/25 cost-sharing during the construction phase. However, at this time, we have not been able to establish a strong Federal interest in pursuing the larger projects.

Discussions with our higher authority indicate that the smaller projects, even when grouped together (attachment), do not warrant a traditional feasibility study effort. The reason for this is two-fold. One, since the projects are smaller and are not technically complicated, a traditional 2-3 year feasibility study is not needed. Second, since costs to construct these smaller projects are relatively low, there is a need to keep study costs equally low. Our "rule-of-thumb" is that feasibility study costs should not exceed 10-20% of construction costs. The feasibility study process involves certain fixed costs and requirements including a fairly lengthy review procedure. Since this process cannot be abbreviated, and there is a fixed time and cost regardless of project size, projects must be large enough to justify a traditional feasibility study effort. Only the first two projects (see attachment) qualify under these conditions.

Since a traditional feasibility study would not accommodate the smaller projects we are pursuing, an alternate approach for getting these approved and constructed quickly is through Section 1135 (b) of the Water Resources Development Act (P.L. 99-662) of 1986, as amended. Section 1135 reads as follows:

Sec. 1135. Project Modifications for Improvement of Environment

(a) The Secretary (of the Army) is authorized to review the operation of water resources projects constructed by the Secretary to determine the need for modifications in the structures and operations of such projects for the purpose of improving the quality of the environment in the public interest.

(b) The Secretary is authorized to carry out a program for the purpose of making such modifications in the structures and operations of water resources projects constructed by the Secretary which the Secretary determines (1) are feasible and consistent with the authorized project purposes, and (2) will improve the quality of the environment in the public interest. The non-Federal share of the cost of any modifications carried out under this section shall be 25 percent. No modification shall be carried out under this section without specific authorization by Congress if the estimated cost exceeds $5,000,000.

(c) The Secretary shall coordinate any actions taken pursuant to this section with appropriate Federal, State, and local agencies.

(d) Beginning in 1992 and every 2 years thereafter, the Secretary shall transmit to Congress a report on the results of reviews conducted under subsection (a) and on the program conducted under subsection (b).

(e) There is authorized to be appropriated not to exceed $25,000,000 annually to carry out this section.

The 1135 process is attractive to the Corps and the non-Federal sponsor because:

1) It reduces the amount of time to study and get to construction smaller restoration projects ;

2) The local sponsor is not required to pay any up-front costs for the feasibility study. Funding contributions of the non-Federal sponsor for feasibility studies are only required if the project is authorized for construction.

We are now in the process of preparing proposals to submit for 1135 funding to evaluate these smaller projects. You will be contacted as we require more information (i.e., maps, plans, narrative, etc.) on specific projects.

The Reconnaissance Study will continue, but without larger projects that are in the Federal interest, the reconnaissance report recommendations will primarily focus on Section 1135 proposals.

James River Basin Fish and Wildlife Restoration Study
Potential Projects (May'93)

"Large" Projects	Approx. Constr. Cost	Approx. (total) Feasib. Study Cost
1. Trout Hatchery Restoration	$12,500,000	$2.0 million
2. Threatened & Endangered Species Propagation & Research Station	$10,000,000	$1.5 million

"Small" Projects

Wetland Creation/Restoration	
1. Waterfowl Marsh Developments	$250,000
2. Amelia WMA Wetlands Creation	$25,000
3. James R. WMA Wetlands Restoration	$50,000
4. Hardware R. WMA Wetlands Restr.	$50,000
Subtotal	*$375,000*

Upland/Riparian Restoration	
5. Bank/Soil Stabilization	$1,000,000
6. Woodcock Habitat Development and/or Enhancement	$200,000
7. Herbaceous Wildlife Habitat Development	$150,000
8. Endangered Species Restoration/Protection	
• Mussels	$80,000
• Bats	$15,000
Subtotal	***$1,445,000***

Aquatic Habitat/Fisheries	
9. Fish Passage (Lynchburg)	$250,000
10. Acid Rain Mitigation	$100,000
11. Trout Stream Structures	$200,000
12. Fish Passage Modifications (Richmond)	$150,000
13. Harrision Lake Hatchery Retrofit for Shad	$300,000
14. Fish Trap @ Bosher's Dam (Richmond)	$50,000
Subtotal	***$1,050,000***

Gathright/Lake Moomaw	
15. Herbaceous Wildlife Habitat Development	$100,000
16. Fish Habitat Enhancement	$50,000
17. Waterfowl Habitat	$50,000
18. Erosion Control	$500,000
Subtotal	***$700,000***

attachment

Virginia Commonwealth University

MEMORANDUM

TO: Craig Seltzer, Army Corps of Engineers

FROM: Dr. Greg Garman, VCU Greg

DATE: May 17, 1993

SUBJECT: herring telemetry

Thought it was time for another update on our activities...

Today (Monday) and tomorrow I'll be on the river doing the last set of transmitter implants and monitoring of fish movements. I'll call you by week's end to discuss a timetable for data analysis and preparation of a report to the Corps. If you have any questions before then, I can probably be reached at VCU on Wednesday.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

Memo to: Ray Fernald, Virginia Dept. of Game & Inland Fisheries (VDGIF)
From: Craig Seltzer, Corps of Engineers (COE)
Date: June 2, 1993

Re: James River Basin F&W Restoration, Requests for Information on Proposed Section 1135 Projects

1. A FAX was sent and follow-up phone conversation took place between Al Bourgeois (VDGIF) and Dave Cleland (COE). Dave is working with me to prepare Section 1135 proposals for submission to Corps higher authority. A request for more specific information was made for the following proposed restoration projects:

- Lake Moomaw Waterfowl Habitat
- Herbaceous Wildlife Habitat Development @ Gathright WMA & vicinity
- Trout Stream Structures

2. A similar request was sent to Steve Capel (VDGIF) for the following projects:

- Bat Cave Fencing
- James River WMA Wetlands Restoration
- Hardware River WMA Wetlands Restoration

3. Dawn Kirk (U.S. Forest Service, Warm Springs Ranger District) was asked to provide information on Fish Habitat Enhancement Project in Lake Moomaw.

4. We are continuing to evaluate the other projects to see which additional projects can be pursued under Section 1135.

5. Your assistance in prioritizing the project proposals would be very helpful and would aid us in knowing which ones we should pursue more vigorously.

Virginia Commonwealth University

MEMORANDUM Craig

TO: Craig Seltzer

FROM: Greg Garman, VCU Greg

DATE: June 4, 1993

SUBJECT: Telemetry report

The final report on the blueback herring telemetry project is being copied and bound. I will send it by overnight mail on Monday the 7th, and you should receive it on Tuesday. Please let me know if this timing is not acceptable, or if you want a FAX version sooner. I'll talk to you by phone when you've received the report.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

Virginia Commonwealth University

MEMORANDUM

TO: Craig Seltzer, Environmental Analysis, COE

FROM: Dr. Greg Garman, VCU

DATE: June 6, 1993

SUBJECT: Final report-telemetry project

Enclosed are six bound copies of a final report on the blueback herring telemetry project. If you have any questions concerning the findings or my recommendations, please give me a call. Thank you for this opportunity. I would look forward to a continuing involvement in the James River Habitat Restoration effort.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

Virginia Commonwealth University

MEMORANDUM

TO: Craig Seltzer

FROM: Greg Garman

DATE: June 28, 1993

SUBJECT: herring telemetry

I've received only a single response to my requests for reports to the few other researchers who have done telemetry studies with blueback herring and alewife. Attached is a copy of the note from Brian Jessop; I will call several other individuals today to prod them.

Department of Biology · College of Humanities and Sciences · Box 2012 · 816 Park Avenue
Richmond, Virginia 23284-2012 · (804) 367-1562 · VOICE TDD (804) 367-0100

Government of Canada Gouvernement du Canada

MEMORANDUM NOTE DE SERVICE

To
Dr. Greg Garman
Virginia Commonwealth University
Richmond, Virginia

From
Brian M. Jessop
Department of Fisheries and Oceans
Halifax, Nova Scotia

Security Classification - Classification de sécurité
Our File - Notre référence
Your File - Votre référence
Date

Subject / Objet **Blueback herring movements**

Your recent radio telemetry study of blueback herring movements through breached dams sounds very interesting. Unfortunately, I have not investigated the velocities preferred by alewives or blueback herring during upstream movement through a fishway and have no reports on the subject. Our fishway engineer, Vern Conrad, informs me that the design criteria that he uses for pool and weir fishways (and which seems quite successful) is a velocity of about 0.3 $m \cdot sec^{-1}$ in the pools and 1.2 $m \cdot sec^{-1}$ (range 0.9-1.5 $m \cdot sec^{-1}$) in the chutes (length about 0.5 m). The origin of these choices is probably some early fishway study coupled with local observations by our one-time fish passage biologist.

Sorry I couldn't be of more help. I'd be interested in a copy of your report when available.

BMJessop

Canada

Field Investigation
Warrenton, Virginia
June 29, 1993

Attendees

Kenny Sexton	VDGIF	
Paul	VDGIF	
Dawn Kirk	USFS	
John Gill	F&WS	
Jim Blodgett	SCS	(703) 434-1404
George Sutton	SCS	(703) 347-3120
Craig Seltzer	COE	

Wetland Mitigation Project

The wetland site which was visited was constructed as compensatory mitigation for a reservoir project in Warrenton, Virginia in 1991. The cooperating federal agency on construction of this project was the Soil Conservation Service. The 60 acre lake was built as a duel purpose flood control/water supply project.

The meeting took place to discuss this project and was attended by representatives of the Fish and Wildlife Service, Soil Conservation Service, Corps of Engineers, U.S. Forest Service, and the Virginia Department of Game and Inland Fisheries (VDGIF). The primary Corps and F&WS interest is how this type of project may be applied to Gathright (i.e., use of sill structures to impound water and create and sustain freshwater wetlands).

The wetland creation site is 17 acres in size and was constructed in fields previously used as pasturelands (i.e., not wetlands). The site was built on the main tributary (a small stream) into the reservoir, called Cedar Run. Approximately 99% of the water coming into the reservoir passes through this created wetland. The wetland is composed of six cells which are separated by six longitudinal dikes or sills which run perpendicular to the stream. The sills were constructed by excavating a 6 foot trench, backfilling and building a 4-5 foot earthen berm covered with geotextile fabric and riprap. There are no weir structures but the dike is pervious above ground level. Also, water flows over the top of the sills during storm events.

The vegetation growing in the cells is a combination of artificially and naturally propagated material. There is good heterogeneity of wetland plant types. Many of the trees which were left standing at the time of inundation have been felled by active beaver populations.

The construction of a sill or levee structure for impounding water to maintain a permanent wetland was discussed as applicable to Gathright Dam/Lake Moomaw. The present situation at Lake Moomaw is that no vegetated wetlands can be permanently maintained because draw-downs, which take place during the summer months, leave the perimeter lake areas high and dry (i.e., unable to sustain wetland plants). Dawn, Paul, and Kenny were very much interested in the possible application of this idea to Gathright. They identified several areas around the lake that may be acceptable (i.e., are shallow enough during full pool). They will conduct some field investigations this week and let us know more specifically where some potential sites are located.

The SCS can provide as much information as we need on project plans & specifications and costs.

United States Department of Agriculture
Forest Service
George Washington National Forest
Warm Springs Ranger District
Route 2, Box 30
Hot Springs, VA 24445

Reply To: 2600

Date: July 19, 1993

Subject: Possible wetland sites at Moomaw

To: Craig Seltzer
US Army Corps of Engineers
803 Front Street
Norfolk, VA 23510-1096

Dear Craig,

Please find attached copies of Lake Moomaw maps showing possible areas to develop wetlands using a low checkdam. The maps are at a 1:24,000 scale. Paul Bugas and I surveyed the lake on July 8. At that time it was 3.5 feet below full pool. The following are brief descriptions of each area:

1) Surrounding the current duck islands, it is approximately 5-6 acres. Water during low flow would have to be siphoned off the nearby main river. Access with heavy equipment would not be a problem.

2) Large flat, approximately 8 acres. Water during low flow may be a problem, unless the tributary at Buckeye Hollow could be incorporated, or water obtained from the main channel. Access with heavy equipment would be a problem.

3) A less than 5 acre flat, with some vegetation established already. A small tributary could supply water during low flow. Access with heavy equipment would be a problem.

4) Approximately 5 acres. Water during low flow, as well as access with heavy equipment may be a problem.

If you have any other questions, please contact me at (703) 839-2521. Thank you!

Dawn Kirk

Dawn Kirk
USFS Fisheries Biologist

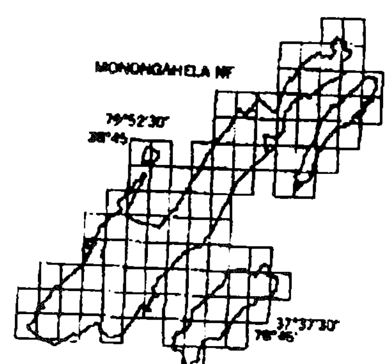
cc: Paul Bugas
Al Bourgeois

SCALE 1:24,000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Primary Highway
Secondary Highway
Improved Road, Paved
Improved Road, Gravel
Improved Road, Dirt
Unimproved Road, Dirt

Interstate Highway
U.S. Highway
State Highway
Secondary State Highway
Primary Forest Route
Forest Road



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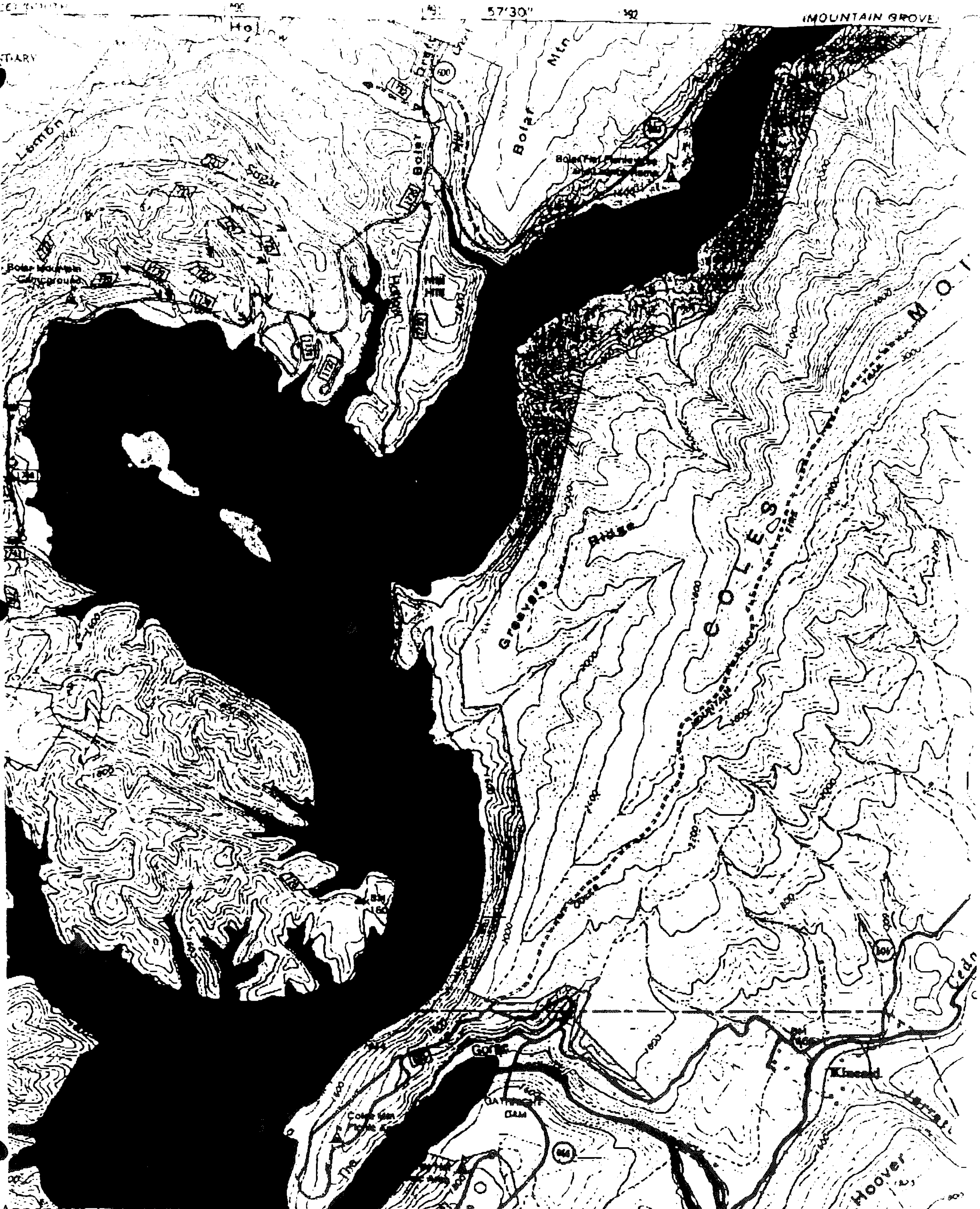
AL SURVEY
A FOREST SERVICE USE

GEORGE WASHINGTON NATI
JAMES RIVER - WARM SPRINGS RA



-eltzer

COMMONWEALTH of VIRGINIA

Department of Game and Inland Fisheries

August 25, 1993

Mr. Robert V. Ogle, Chief 9/1
Planning Division, Norfolk District
USACOE
803 Front Street
Norfolk, Virginia 23510-1096

Re: James River Basin Fish and Wildlife
Restoration Reconnaissance Study
ESSLOG # 4977

Dear Mr. Ogle:

The Department (VDGIF) fully supports efforts to restore and enhance fish and wildlife resources in the James River Basin, and specifically recommends Corps funding of the following eight projects via Section 1135 of the Water Resources Development Act:

1. Fish passage modifications and truck/transport operations at Brown's Island and Manchester dams - $150,000 total project cost;

2. Bat cave gating at Indiana bat cave in Bath County - $15,000 total project cost;

3. Coursey Springs trout hatchery spring containment restoration - $150,000 total project cost;

4. Lake Moomaw / Gathright Wildlife Management Area herbaceous wildlife habitat development - $30,000 total project cost;

5. Fish trap at Bosher's Dam, subject to budget addendum approval, and subject to construction of fish passage facilities via other funding - $50,000 total project cost;

6. Coursey Springs trout hatchery pond renovation - $500,000 total project cost;

7. James River Wildlife Management Area wetlands restoration - $50,000 total project cost;

8. Lake Moomaw / Gathright Wildlife Management Area waterfowl habitat creation - $100,000 (over 2 years) total project cost.

We anticipate being able to provide the local share of funding for these eight projects, which are prioritized as listed. The Department of Game and Inland Fisheries understands that, as the non-federal sponsor, the cost share partner percentages are:

1. 25% non-federal, and 75% federal;

2. 100% non-federal for incremental operations, maintenance, repair, rehabilitation, and replacement (OMRRR) associated with project modification; and

3. 100% non-federal for any additional lands, easements, right-of-ways, relocations and disposal areas (LERRD) required for implementation of the proposed modifications.

We also encourage the Corps to fund implementation of the following unprioritized projects which we do not anticipate our Department being able to fund within the next 2 years. We encourage implementation of these projects if another local sponsor can be found. Alternatively, we may be able to provide appropriate funding for some of these projects in the future.

convers. w/ Ray F.:
add: Hardware River WMA- Wetlands restoration

1. Riparian bank/soil stabilization and fencing along the Rivanna River to protect and restore habitat for the federally *Endangered* James spinymussel. While we are supportive of this project, it is currently not fundable by VDGIF during the next 18-24 months. Funding and support for this project may be obtainable from other sources.

2. Assess feasibility of using Harrison Lake National Fish Hatchery for hatching and rearing of shad. Significant interagency coordination between the U.S. Fish and Wildlife Service, VDGIF, and the Virginia Marine Resources Commission would be required. USFWS plans for future operations at this hatchery, and the role of VDGIF in operation and management of hatchery would require clarification before we could commit funds to this project.

3. Restore floodplain communities dominated by fescue to native warm season grass communities - This could be partially implemented by using Corps funds to provide a relatively greater subsidy to landowners who plant native warm season grasses in herbaceous filter strips or other conservation plantings, as opposed to seeding with fescue. We endorse implementation of this project, and we could provide technical assistance and consultation for this project. We are currently unable, however, to fund this project.

4. Reintroduce river otter (or fishers) to historic James River range - We are supportive of these projects as the regulatory and management authority for these species, but we currently are not able to fund them. We would be supportive of implementing these projects if the local cost, however, is provided by another source.

5. Amelia Wildlife Management Area wetlands restoration - We wish to further consider this project, but we do not anticipate being able to fund it within the next couple of years.

6. Wetland restoration on George Washington National Forest - We support wetland restoration projects, and are recommending several for funding. We do not anticipate being able to fund these particular projects within the timeframe under consideration.

7. Purple loosestrife control - This project is feasible and worthy of implementation. We currently cannot fund this project, but we endorse this project if another local sponsor can be found.

We previously have provided your staff with background information regarding each of these proposals, for their use in completion of the reconnaissance study. We look forward to working with you in this effort to enhance and restore the fish and wildlife resources of the James River Basin. Please do not hesitate to call if you desire any additional information regarding these projects, or if we may be of further assistance.

Sincerely,

Bud Bristow
Director

BB/RTF/m

ASSOCIATE MEMBERS
SIDNEY H. CAMDEN
Eastville, Virginia
GEORGE S. FORREST
Poquoson, Virginia
JOHN W. FREEMAN, SR.
Hampton, Virginia
TIMOTHY G. HAYES
Richmond, Virginia
WILLIAM A. HUDNALL
Heathsville, Virginia
DONALD L. LIVERMAN, SR.
Virginia Beach, Virginia
PETER W. ROWE
Chesapeake, Virginia
JANE C. WEBB
Newport News, Virginia

WILLIAM A. PRUITT
Commissioner
ROBERT D. CRAFT
Chief, Administration and Finance
ROBERT W. GRABB
Chief, Habitat Management
ROBERT J. MARKLAND
Chief, Law Enforcement
JACK G. TRAVELSTEAD
Chief, Fisheries Management

COMMONWEALTH of VIRGINIA
Marine Resources Commission
P. O. Box 756
2600 Washington Avenue
Newport News, Virginia 23607-0756

September 22, 1993

Mr. Craig Seltzer
U.S. Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, VA 23510-1096

Dear Mr. Seltzer:

This is in response to the Norfolk District's proposal under the Section 1135 Program to restore subtital and intertidal oyster grounds on the James River, the Piankatank River, the seaside of Virginia's Eastern Shore and all other areas where oysters currently or previously existed. Our agency supports and actively pursues efforts to restore vital resources for the entire Chesapeake Bay ecosystem.

If the areas have potential within the current constraints of the oyster disease environment and within our current management strategies, we would agree to be a cost share partner. If the projects are funded, we understand that the cost share percentage is at 25% non-federal and 75% federal. Jim Wesson is our Conservation and Replenishment Officer and he would be your direct contact within the agency (804-247-2121).

Sincerely,

William A. Pruitt

WAP:kmh
CO
CC: Jack G. Travelstead - Chief, Fisheries Division
James Wesson, Conservation and Replenishment Officer

Appendix C

Telephone (804) 247-2200 (804) 247-2292 V/TDD Information and Emergency Hotline 1-800-541-4646 V/TDD

VIRGINIA COMMONWEALTH
UNIVERSITY REPORT

APPENDIX D

AN EVALUATION OF ANADROMOUS BLUEBACK HERRING MOVEMENTS IN THE JAMES RIVER, VIRGINIA, USING RADIO TELEMETRY

A REPORT SUBMITTED TO THE ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
ENVIRONMENTAL ANALYSIS BRANCH

Dr. Greg C. Garman

Associate Professor
Department of Biology
Virginia Commonwealth University
Richmond, Virginia 23284-2012

June 3, 1993

BACKGROUND

Historically a dominant component of the James River fish assemblage and the highest-value component of the Chesapeake fishery, stocks of anadromous alosid fishes, including the American shad, blueback herring and alewife, have declined drastically since the mid-1970's. The two major reasons for the decrease in the James River are overfishing by a relatively recent commercial "intercept" fishery, and the loss of over 5,000 hectares of historical spawning habitat above the Richmond and Lynchburg dams.

Although biological records of anadromous fish distribution and abundance in the James prior to dam construction are scant and mostly anecdotal, an account written in the spring of 1705 describes "multitudes" of herring, shad, striped bass and sturgeon in Virginia rivers. As recently as the late 1920's, 3.6 million kilograms of American shad were harvested by the Virginia bay fishery, compared to less than 0.1 million kg in 1986.

Archeological evidence from sites at Eagle Rock, Virginia suggests that American shad historically spawned within the entire length of the non-tidal James River (Tom Whyte, JMU, personal communication). Establishment of fish passage to Lynchburg would make available over 260 km of river and tributary habitat to spawning American shad, and possibly blueback herring, for the first time in a century. Re-establishment of American shad and river herring species (alewife and blueback herring, collectively) above Richmond would represent a significant return to the fish community structure that characterized the tidal and non-tidal James River prior to the construction of barriers and would establish an economically valuable recreational resource (Garman and Nielsen 1991).

As a result of declining stock abundance in all migratory alosid species within the James River basin, an ambitious effort toward re-establishment of anadromous fishes above Richmond, Virginia has recently begun. To this end, breaches were constructed during 1989 in Manchester and Brown's Island dams -- the two lowermost barriers to fish passage in the James River. Extensive biological monitoring conducted by Virginia Commonwealth University during the period 1989-1992 documented utilization of these breaches by American shad and striped bass (Garman and Eareckson 1990). In contrast, however, no blueback herring or alewife have been collected above the breaches since monitoring began, in spite of large numbers of these species just below the breaches and limited anecdotal evidence that, prior to construction of barriers, river herring migrated upstream to Tuckahoe Creek (Goochland County). These findings strongly suggest that both species of river herring have failed to use the Manchester/Brown's Island breaches since their installation.

In the most general terms, reasons for the lack of passage probably relate to either a lack of "motivation" to swim further upstream, or an inability to negotiate the hydrologic conditions within one or both breaches. Within the former category, motivation may be controlled by biological characteristics of the population in question. Specifically, homing in anadromous alosid fishes is thought to involve both genetic (i.e., inherited) and behavioral (i.e., imprinted) factors that result in upstream migration to a specific location, but which may be affected over time if fish movements are constrained by barriers such as dams. Alternatively, modifications of the breaches may allow passage by large numbers of spawning river herring, which have heretofore been blocked by an inadequate passage structure.

The present study attempted to test the null hypothesis that the observed distribution of blueback herring and alewife in the vicinity of Richmond, Virginia is the result of intrinsic biological factors (e.g. a lack of imprinting to locations above existing breaches), and has nothing to do with the breach structures , per se. To test this hypothesis, we collected anadromous blueback herring from the tidal James River, implanted healthy, pre-reproductive fish with radio transmitters, and monitored movements in relation to the Manchester/Brown's Island breaches. Significant upstream movement of blueback herring to an area immediately below the breaches would allow rejection of the hypothesis (i.e., upstream passage was constrained by population characteristics), and suggest that the breached dams continue to act as barriers to migration by blueback herring and alewife.

The use of radio telemetry was necessary in this case because biological sampling in the immediate vicinity (within 1-2 km) of the dams is difficult or impossible, due to the presence of large rocks and strong rapids during normal spring river levels. Hence, under present conditions, telemetry represents the only method available to gather information on the distribution and movements of blueback herring in the vicinity of the Manchester location. Earlier telemetry studies by VCU attempted to transport implanted blueback herring around the breaches and monitor subsequent movements. However, the dual handling stresses of implantation and transport resulted in unacceptable mortality levels for tagged blueback herring and this approach was abandoned, particularly in light of budgetary limitations and the relatively high cost of transmitters.

STUDY LOCATION AND METHODS

Anadromous blueback herring were collected by modified boat electrofishing (Smith-Root; 1-2 amps output DC, 30 pps) from the tidal James River in the vicinity of Mayo's Island and held temporarily in fresh riverwater with slightly elevated salinity to reduce handling stress. The two capture locations were approximately 1.5-2.0 km downstream of the Manchester breach.

Fish that had recovered fully from the effects of electrofishing and that were judged to be in pre-reproductive condition (i.e., not spent) were implanted with an intragastric radio transmitter (Custom Telemetry; 9x19 mm) and released to the river in the vicinity of capture. Fish that did not immediately orient to the current and swim away from the boat were retrieved and the transmitter recovered. Signals from individual fish were identified by scanning a range of frequencies (40.600-40.720 MHz); positions or "fixes" were determined with a directional receiver. Ten tagged blueback herring were released at approximately 0900 h on each of the following dates: April 21, 28; May 3, 1993, for a total of 30 tagged fish. Of these, signals from 27 functional transmitters could be identified within 1 h of release. In addition to the dates above, preliminary sampling for blueback herring was conducted on April 14 and 19, 1993.

During three, 3-day periods (April 21-23; April 28-30; May 3-5, 1993), fixes were determined at 1000 h and 1600 h on each date, resulting in a total monitoring period of 54 h for each release. Due to the necessary small size of transmitters, functional battery life was limited to less than three days. Fish that did not change their position during a 24-h or greater period were judged to be dead, and were not included in the analyses. Each position was expressed as representing either net upstream movement, net downstream movement, or no net movement, relative to the previous position for an individual fish. The null hypothesis of no net upstream movement for the combined fixes from each monitoring period was tested using a nonparametric statistical procedure (Sign Test; $\alpha=0.05$; Hollander and Wolfe 1973).

FINDINGS

A total of 92 positional fixes on 27 blueback herring were obtained during three, 3-day periods of late April and early May, 1993. Positional fixes ranged between the Interstate 95 bridge and just below the Manchester dam, and were concentrated within the northern half of the James River. Maps showing the location of individual fixes, relative to the release location and to the previous fix for that fish, are shown by Figures 1-3. A slight majority of these fixes (48 vs. 44) indicated no net upstream movement by an individual fish, compared to its previous position. Based on statistical analyses, the degree of upstream movement within each of three groups of tagged fish was not significant, and the null hypothesis relating to overall upstream movement could not be rejected. In spite of this lack of statistically significant upstream movement within sampling periods, several fixes were within 100 m of Manchester dam, indicating substantial upstream movement by some individual blueback herring.

CONCLUSIONS

The above findings provide evidence that upstream movements of anadromous blueback herring within the James River fall line may currently be constrained by intrinsic biological factors such as a lack of imprinting to river reaches above the Manchester dam. During the years prior to 1989, an intact Manchester dam would have prevented spawning by blueback herring further upstream and may have resulted in the gradual elimination of that segment of the population that historically spawned above the barriers. If true, re-establishment of river herring to that section of the James River above the existing breaches will be accomplished most effectively by "trap-and-transport" of pre-reproductive adults, possibly resulting in behavioral imprinting of juvenile fish to upstream waters.

In the above scenario, further structural modifications to the Manchester/Brown's Island breaches would not directly impact migratory movements of river herring, simply because individuals within the population are not predisposed to swim beyond the present limits of their distribution. However, studies of fish movements using radio telemetry, including the present investigation, may be limited by specific problems, including relatively small sample sizes and the high likelihood of abnormal behavior by recently-tagged individuals. Hence, any contradictory information that bears on the question should also be considered, including evidence that modified barriers *may*, in fact, facilitate upstream passage at the site. Two such lines of evidence are presented below:

1. The most compelling circumstantial evidence in favor of breach modifications is the successful passage, during the period 1989-1993 and through the existing breaches, of three larger anadromous fishes, including American shad, striped bass and sea lamprey. All three species (but none of the smaller blueback herring or alewife) are collected consistently above the Manchester breaches since the breaches were installed (Garman 1992), even though population abundances for these taxa in the vicinity of Richmond are substantially lower that abundance values for river herring species in the same area. In addition, American shad are generally thought to have more rigorous criteria for an acceptable passage structure, compared to blueback herring. Hence, most passage structures that are useful for American shad *should* also be useful for blueback herring and alewife. Finally, during the period prior to the construction of breaches in Manchester/Brown's Island dams, all anadromous fishes were presumably prevented from spawning further upstream, and yet three of the five species involved used the breaches immediately after their construction.

Because the maximal burst speeds attainable by a fish are directly related to its length, it's reasonable to conclude that only the larger, hence faster, migrants are presently able to negotiate current velocities within the breaches during spring flows. Maximum acceptable breach velocities for blueback herring and alewife range between 0.31 and 0.61 m/s (1-2 ft/s). No measurements of breach velocities during spring months were available for comparison from the Manchester and Brown's Island sites. However, the evidence above suggests that wider and/or deeper breaches at the above locations could reduce breach velocities to those within acceptable limits for the smaller alosid migrants, and facilitate passage for these species.

2. A second point of evidence that argues against the project's null hypothesis, above, involves the expectation of distributional "straying" by at least some blueback herring. Within all populations of anadromous fishes, a small segment of that population will consist of individuals that do not home to an imprinted location. If straying does occur in blueback herring populations, and if the existing breaches are, in fact, passable by the species, the intensive sampling by VCU and VDGIF above the breaches since 1989 should have encountered some of these strayers, particularly because these would have been concentrated by the next upstream barrier at Williams dam. However, biological sampling has collected no river herring at this location, suggesting that the fish are not presently able to swim farther upstream than Manchester dam and breach modifications could correct this condition.

Occasionally, there are reports by anglers of "herring" in the James River above the breaches (R. White, James River Parks, personal communication). Because river herring are easily confused with the nonmigratory gizzard shad, however, and none of these reports have been confirmed by biologists, the sightings must be considered unreliable at present.

RECOMMENDATIONS

Results of the present study showed that the overall degree of upstream migration by 27 anadromous blueback herring within the James River at Richmond was not significant, but did indicate movements by some individuals to a region immediately below the breaches. Whether or not these, or other, blueback herring were prevented by Manchester dam from further movement upstream cannot be determined with certainty, based on the available information. A conclusion concerning breach modification that considers only the telemetry findings would recommend against structural changes, in favor of re-establishment tactics such as trap-and-transport of migrating adult river herring.

However, a judgement based on a wider range of available and pertinent information, some of which was presented above, would support modifications to the present breaches that reduce current velocities to less than approximately 0.6 m/s during the spawning run (March-May). There is a reasonable probability that such modifications would immediately allow passage of some river herring, and a high probability that the changes would, in several years, enhance the passage of blueback herring and/or alewife that result from alternate restoration tactics. In addition, the proposed modifications to the Manchester and Brown's Island structures would probably result in greater numbers of American shad at the proposed fish passage facility at Bosher's dam on the James River.

LITERATURE CITED

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Garman, G. and M. Eareckson. 1990. Temporal and spatial distribution of anadromous fishes in relation to barriers of the James River, Virginia. Final report, Virginia Council on the Environment. 75 p.

Garman, G. and L. Nielsen. 1991. Medium-sized rivers of the Atlantic Coastal Plain. In: C. T. Hackney, et al., eds. Biodiversity of the Southeastern United States. Wiley-Interscience, New York.

Figure 1 a-f. Positional fixes of individual blueback herring in the James River, Richmond during the period April 21-23, 1993. Filled circles represent net upstream movement since the last position of the fish and open circles represent downstream movement, or no movement, relative to the most recent prior position. A star indicates the release location.

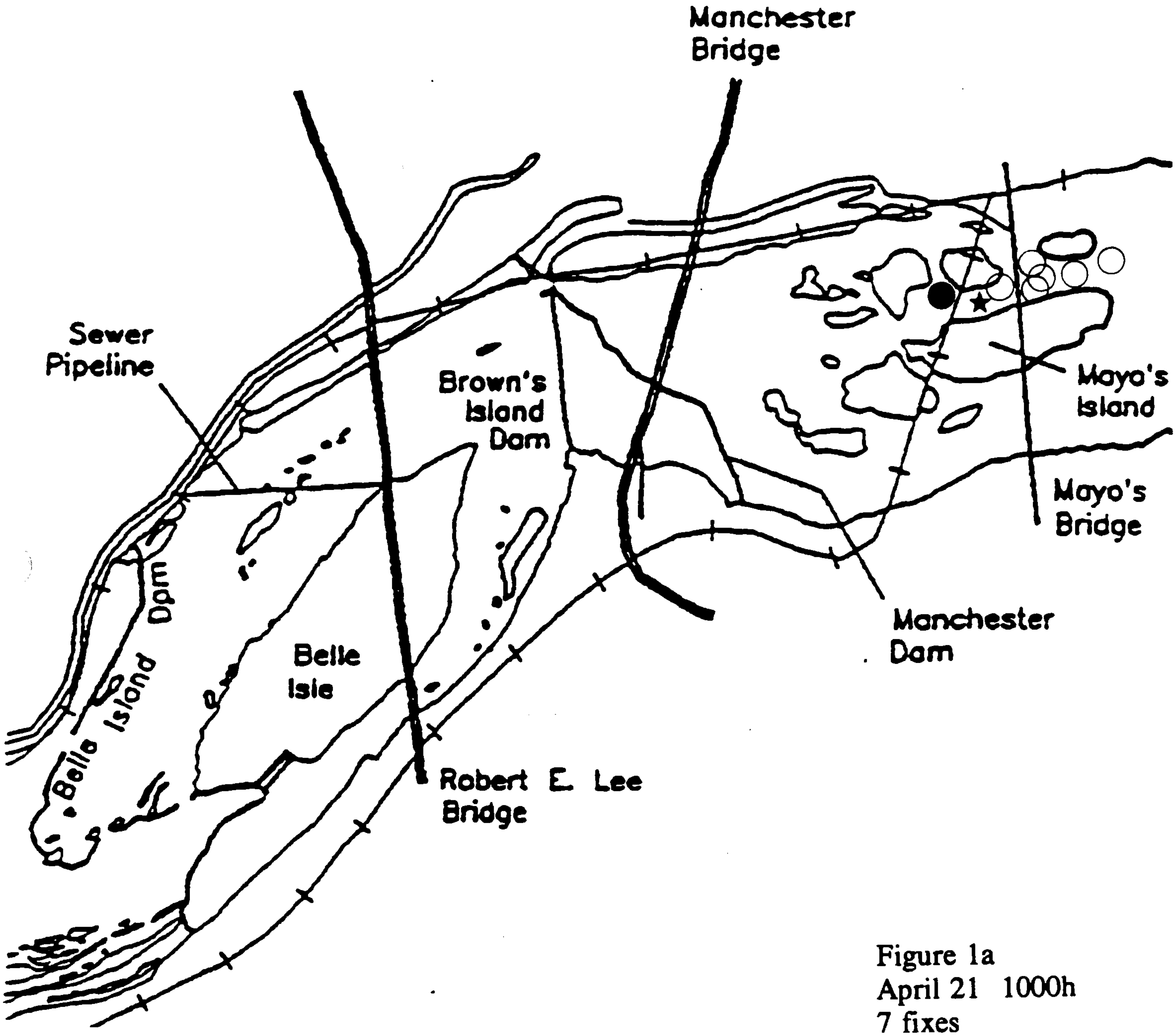

Figure 1a
April 21 1000h
7 fixes

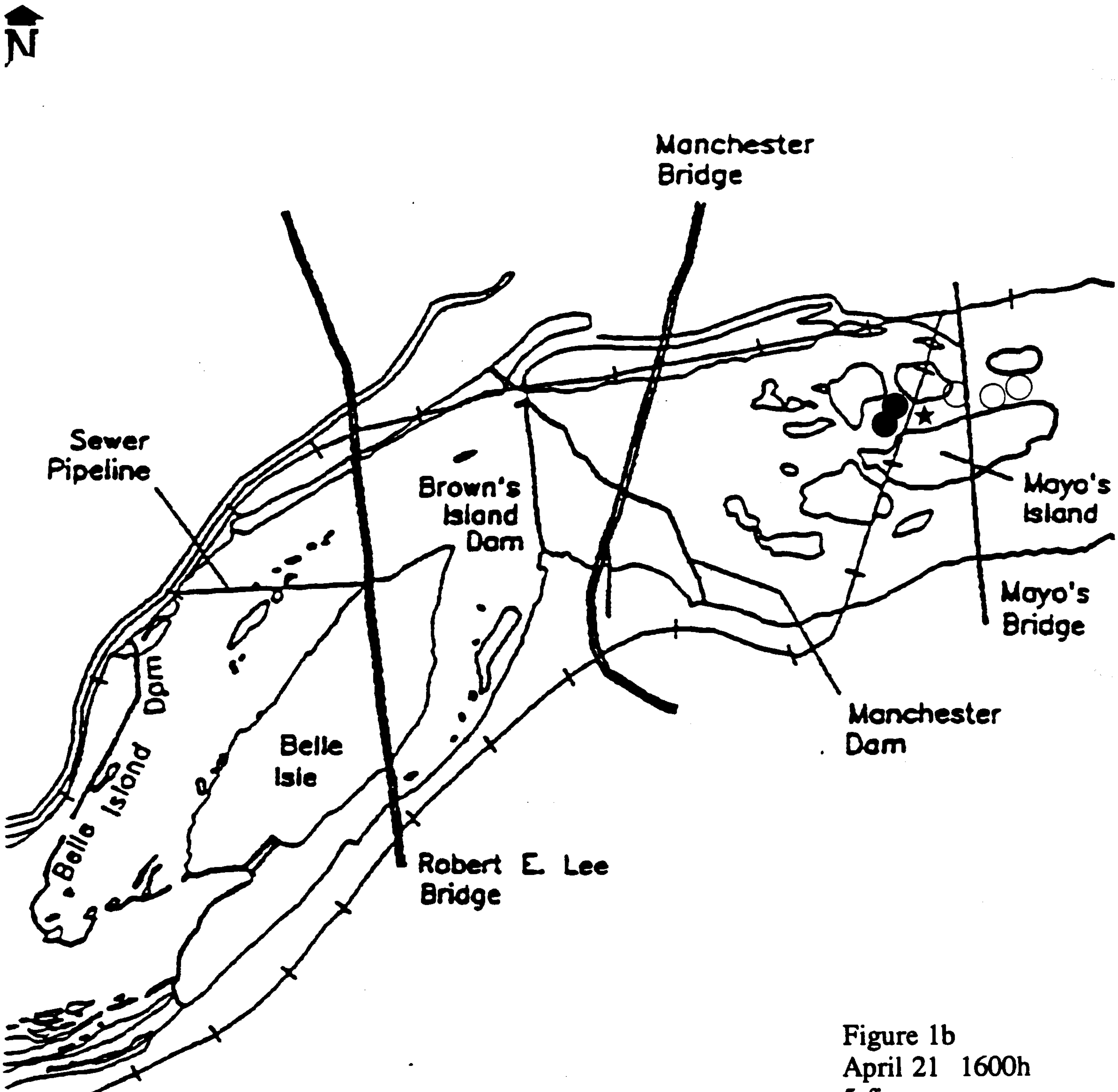

Figure 1b
April 21 1600h
5 fixes

Appendix D

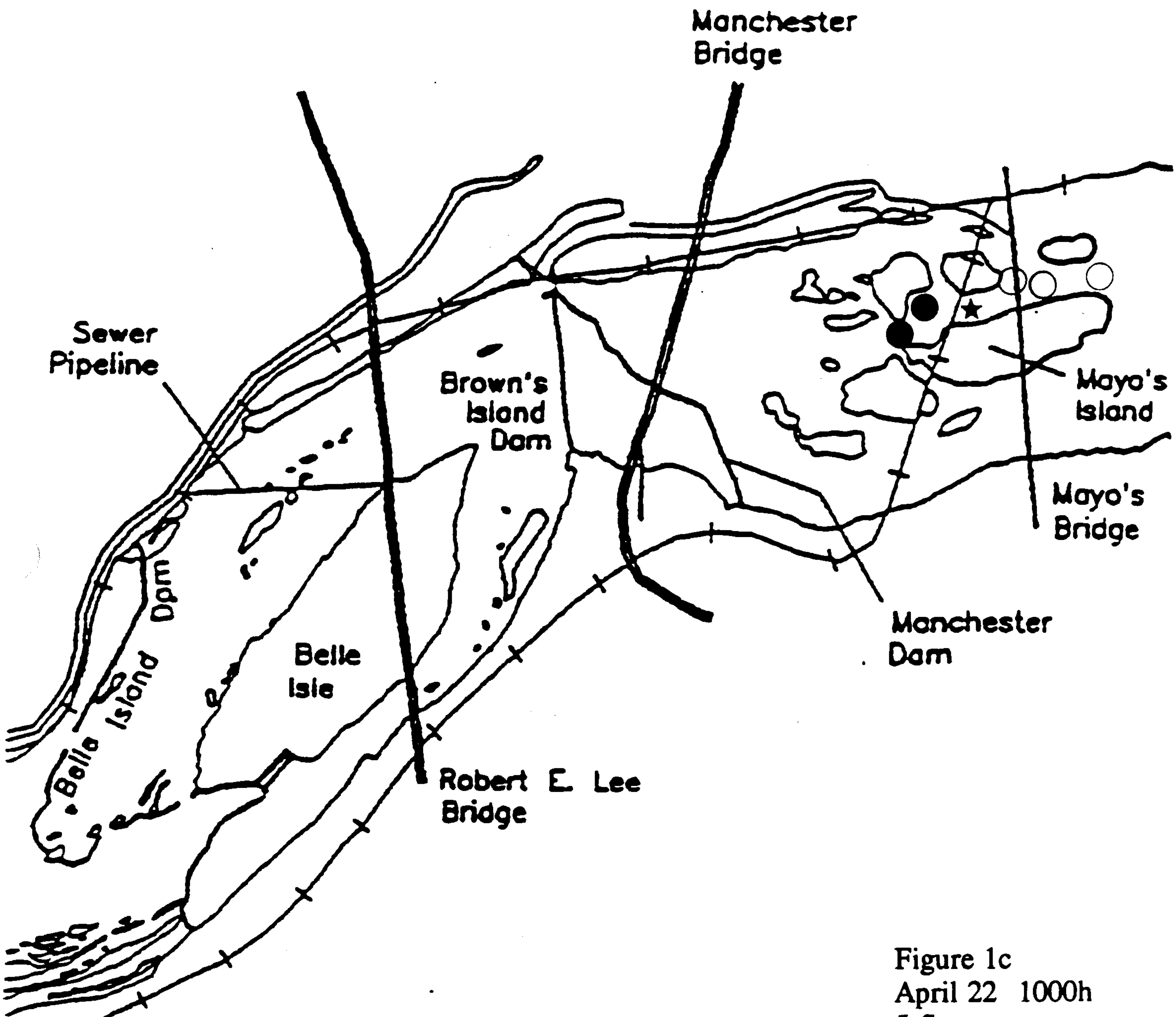

Figure 1c
April 22 1000h
5 fixes

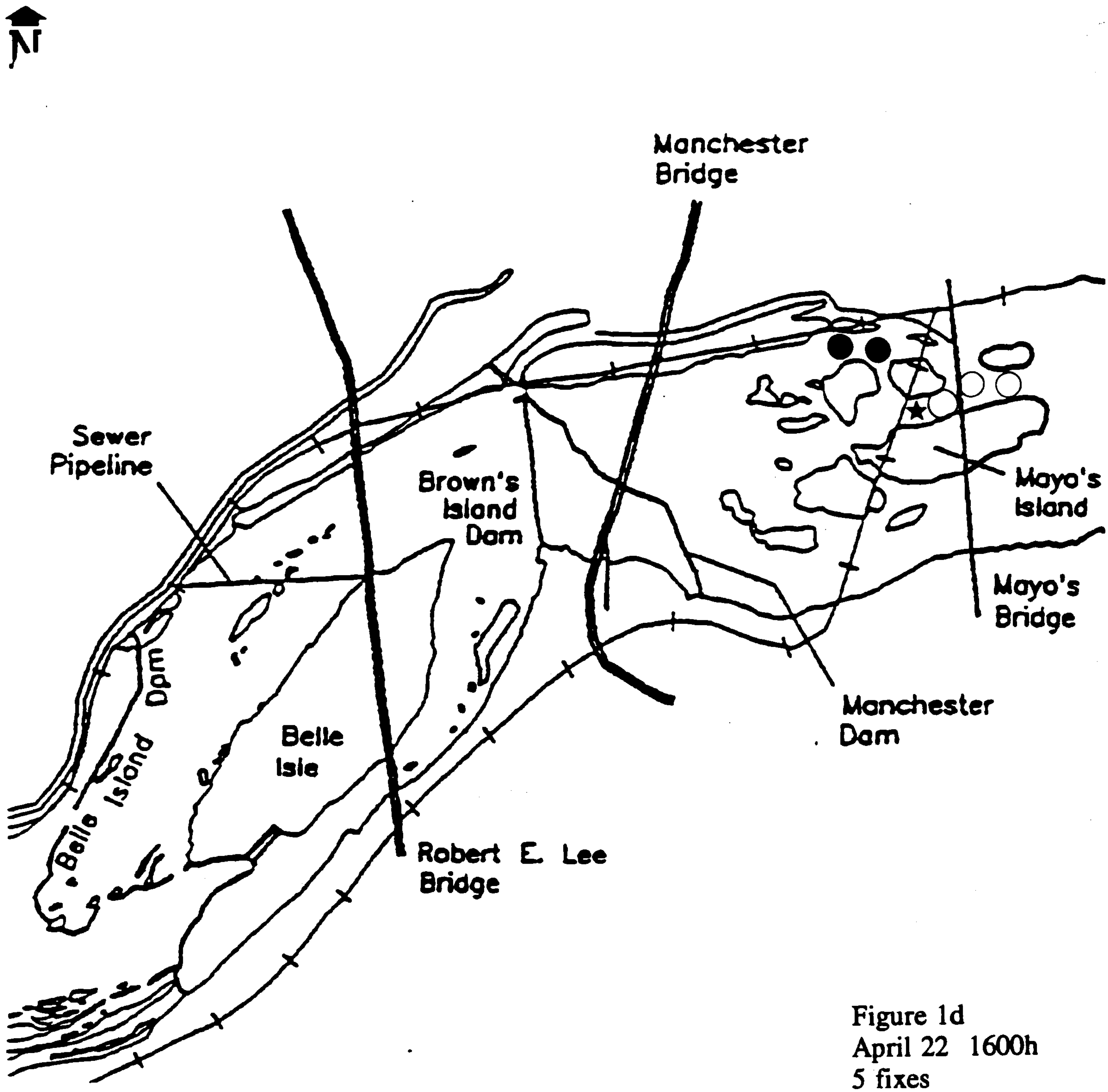

Figure 1d
April 22 1600h
5 fixes

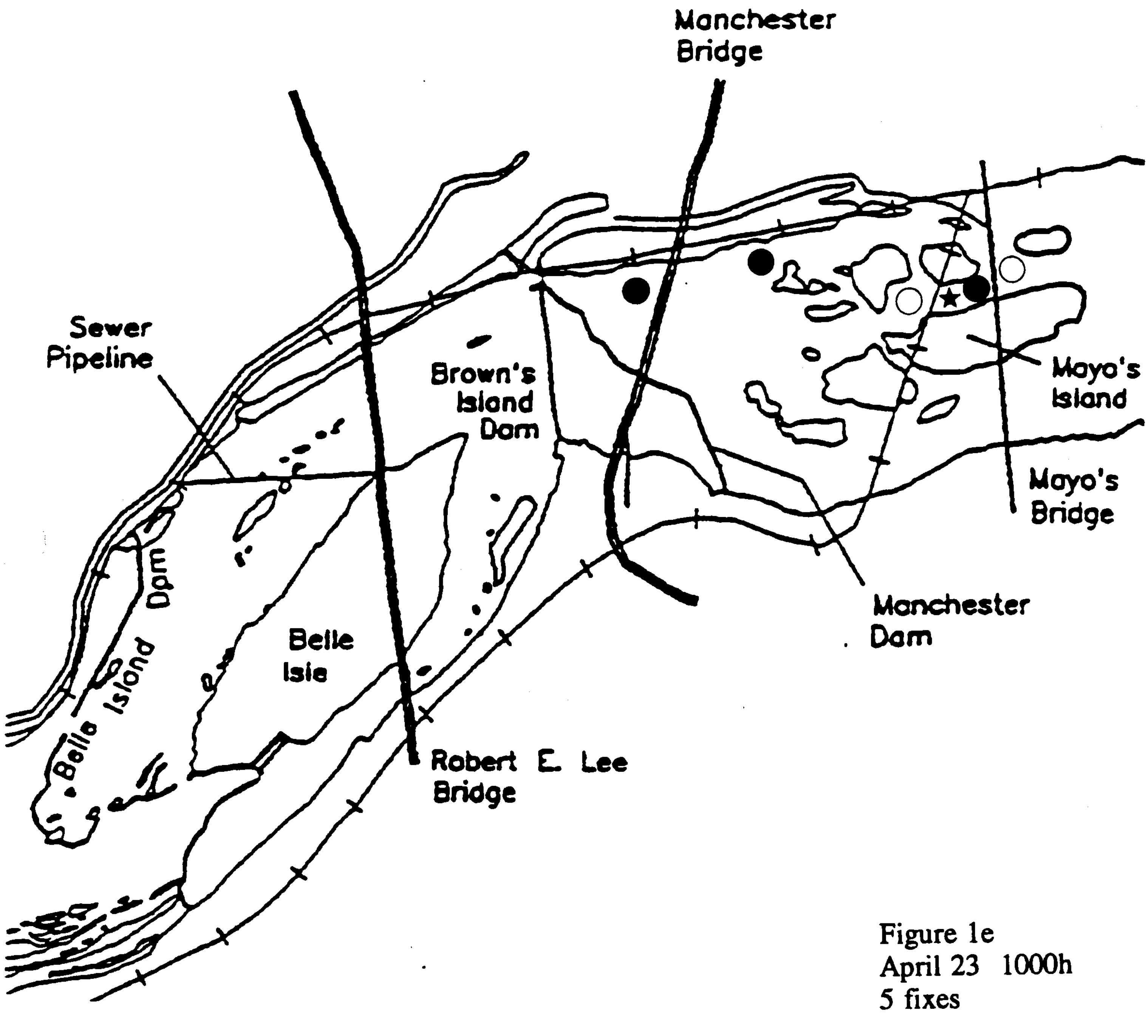

Figure 1e
April 23 1000h
5 fixes

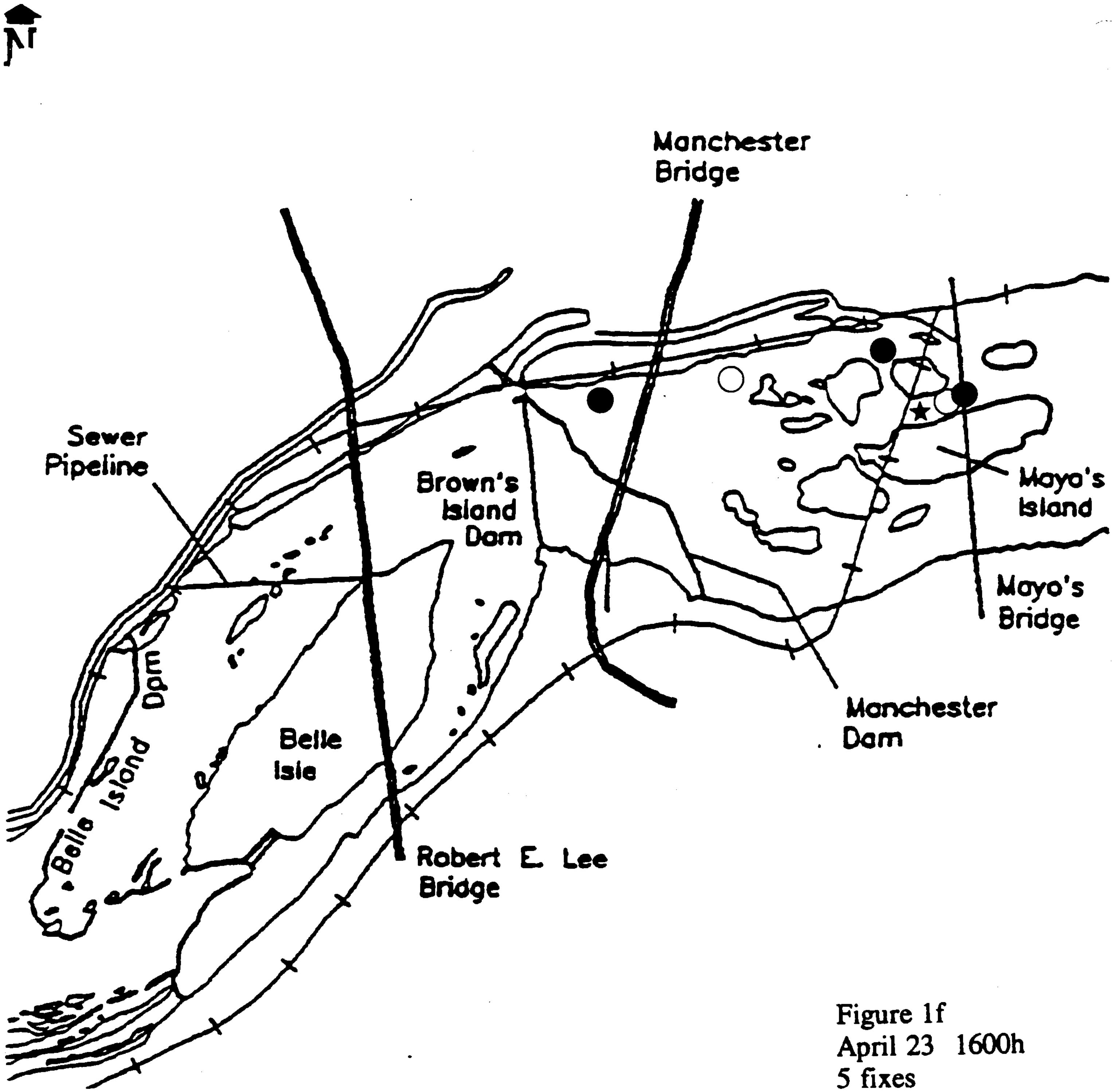

Figure 1f
April 23 1600h
5 fixes

Figure 2 a-f. Positional fixes of individual blueback herring in the James River, Richmond during the period April 28-30, 1993. Filled circles represent net upstream movement since the last position of the fish and open circles represent downstream movement, or no movement, relative to the most recent prior position. A star indicates the release location.

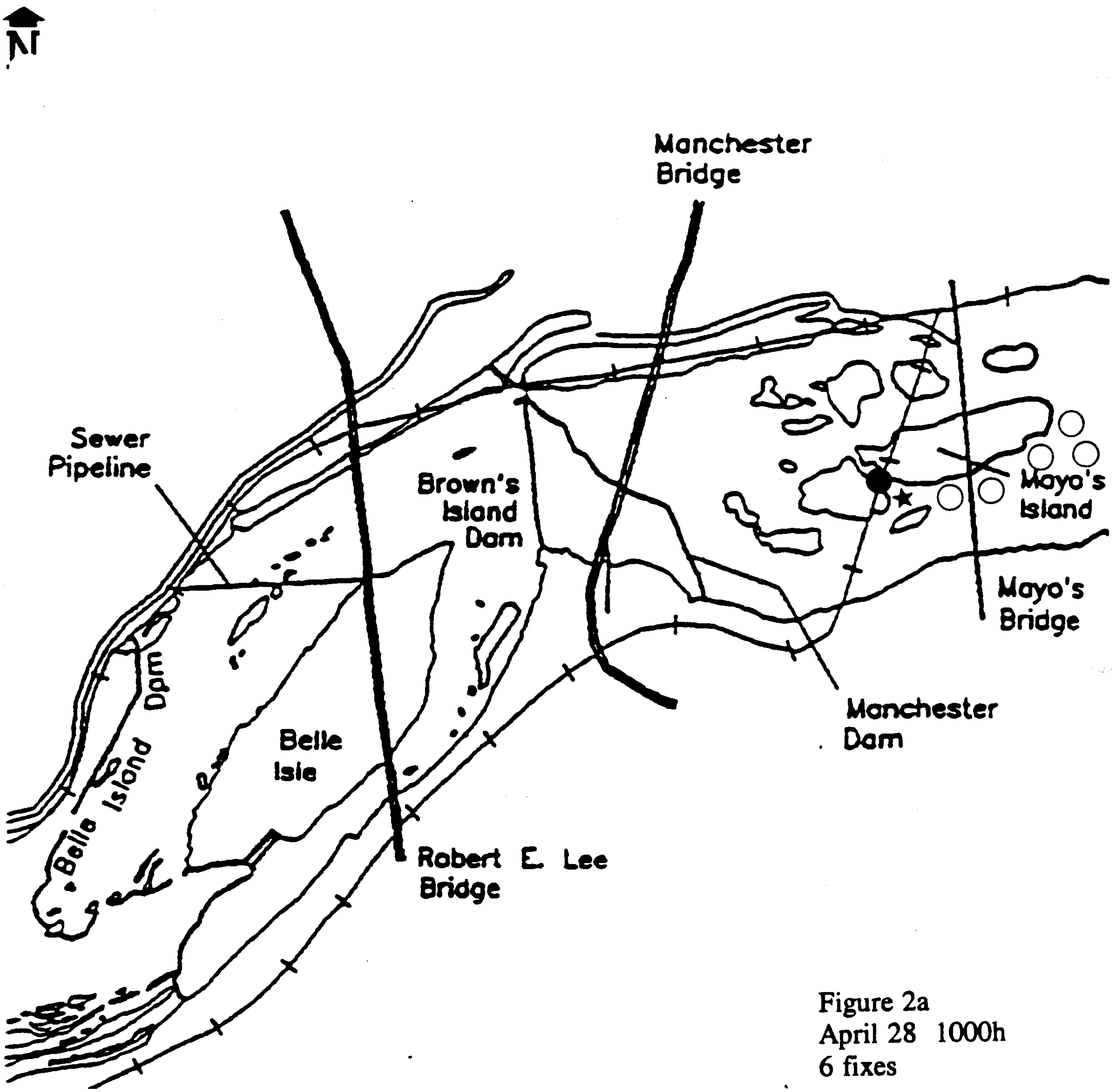

Figure 2a
April 28 1000h
6 fixes

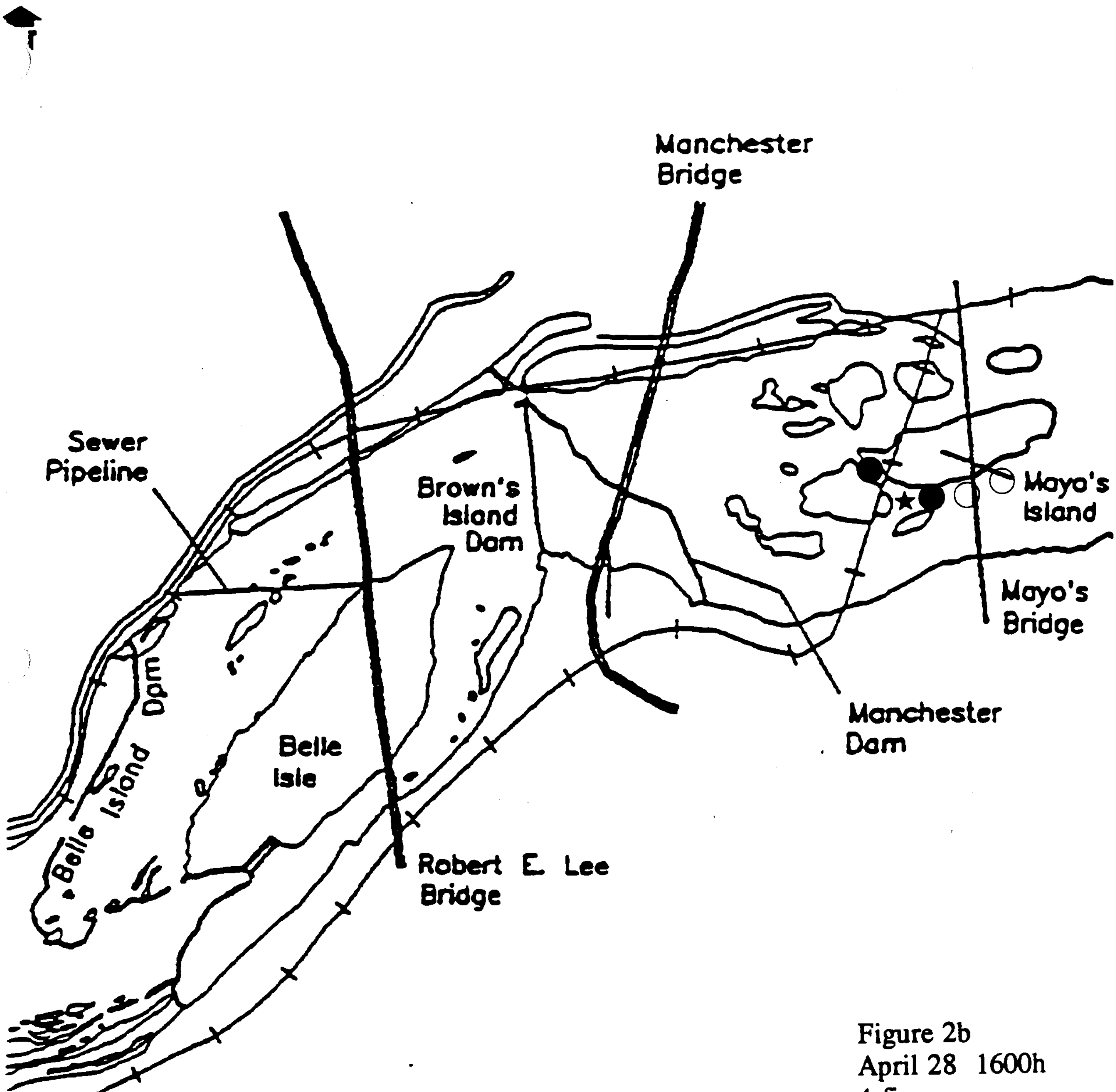

Figure 2b
April 28 1600h
4 fixes

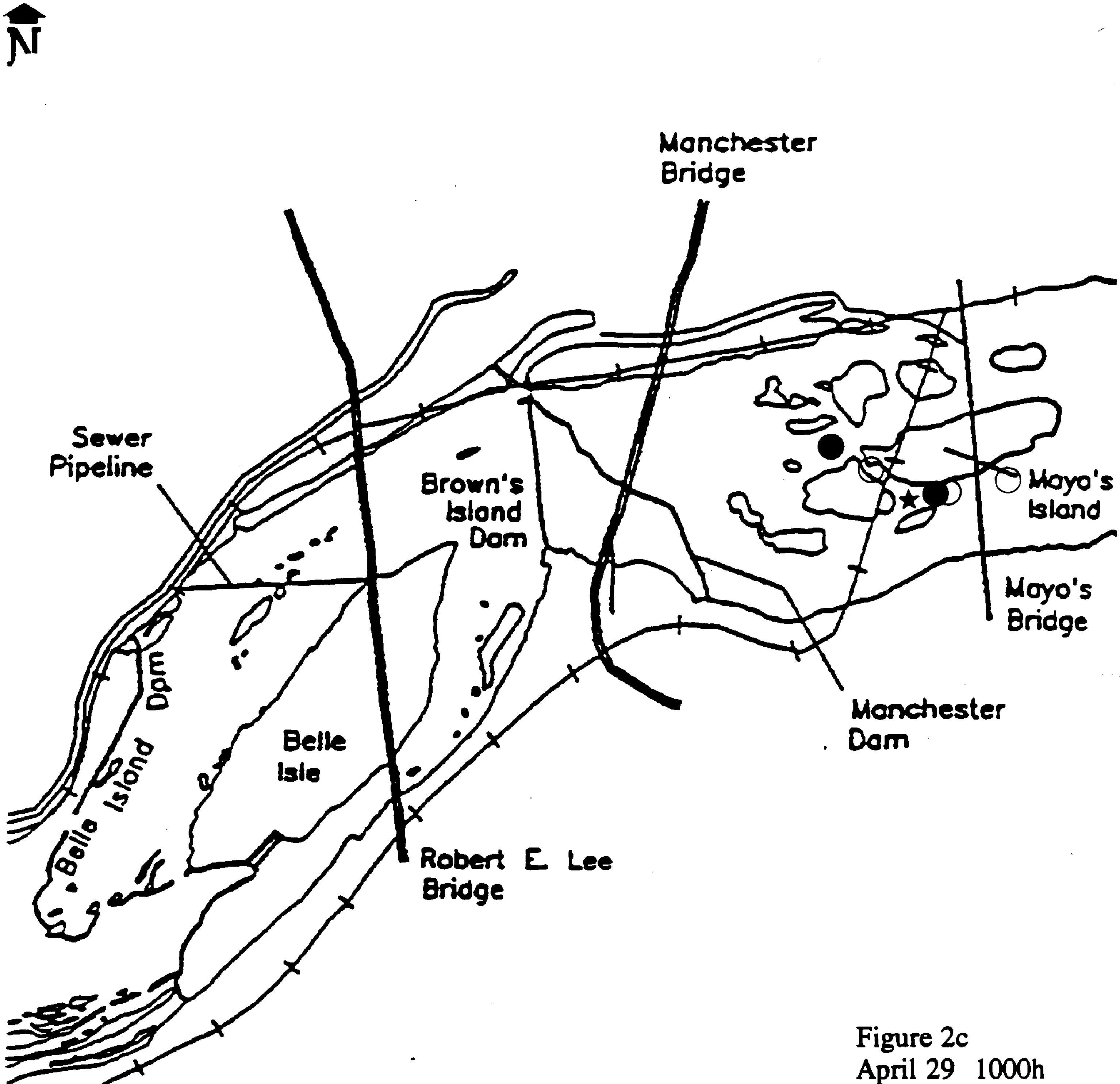

Figure 2c
April 29 1000h
5 fixes

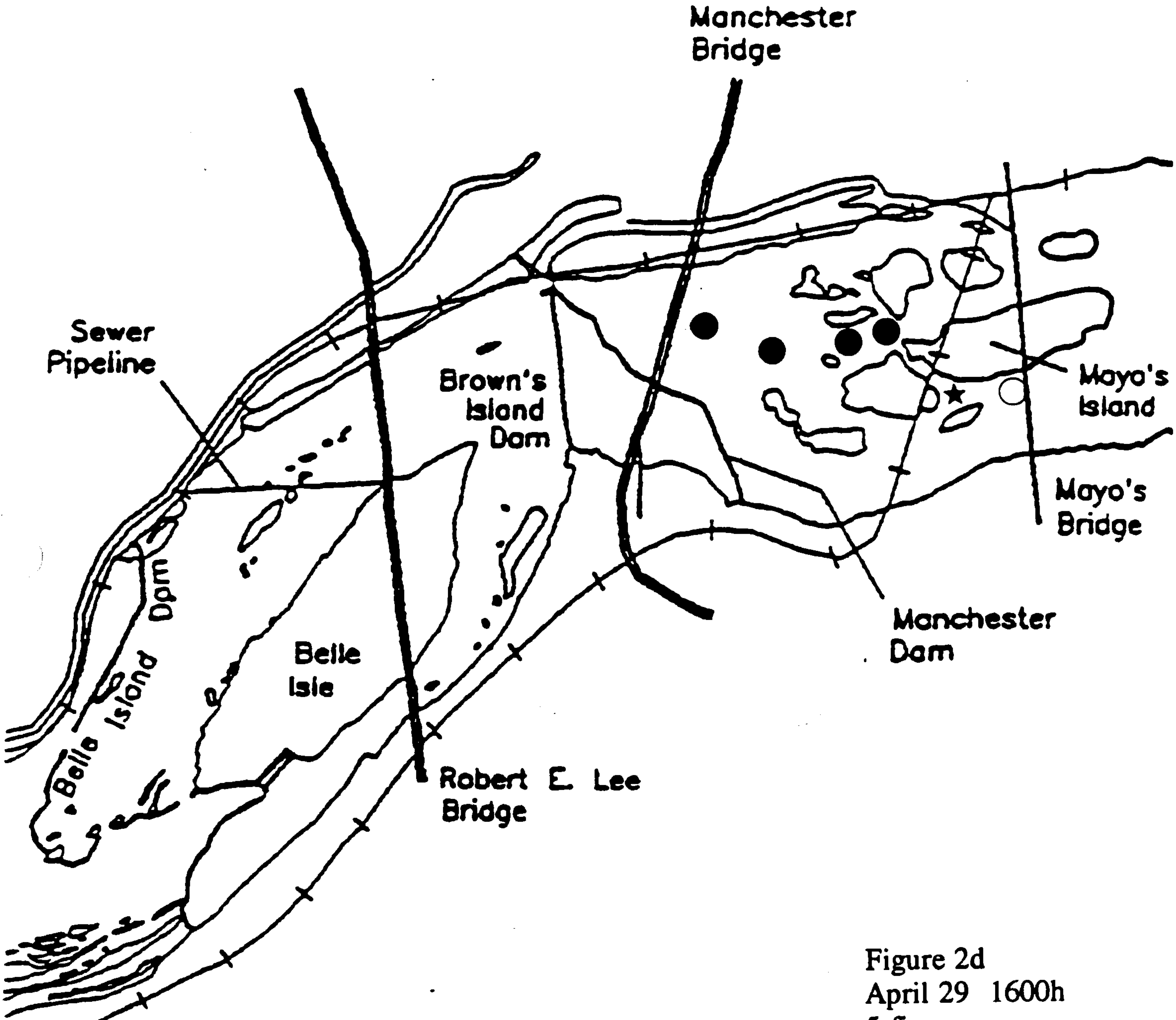

Figure 2d
April 29 1600h
5 fixes

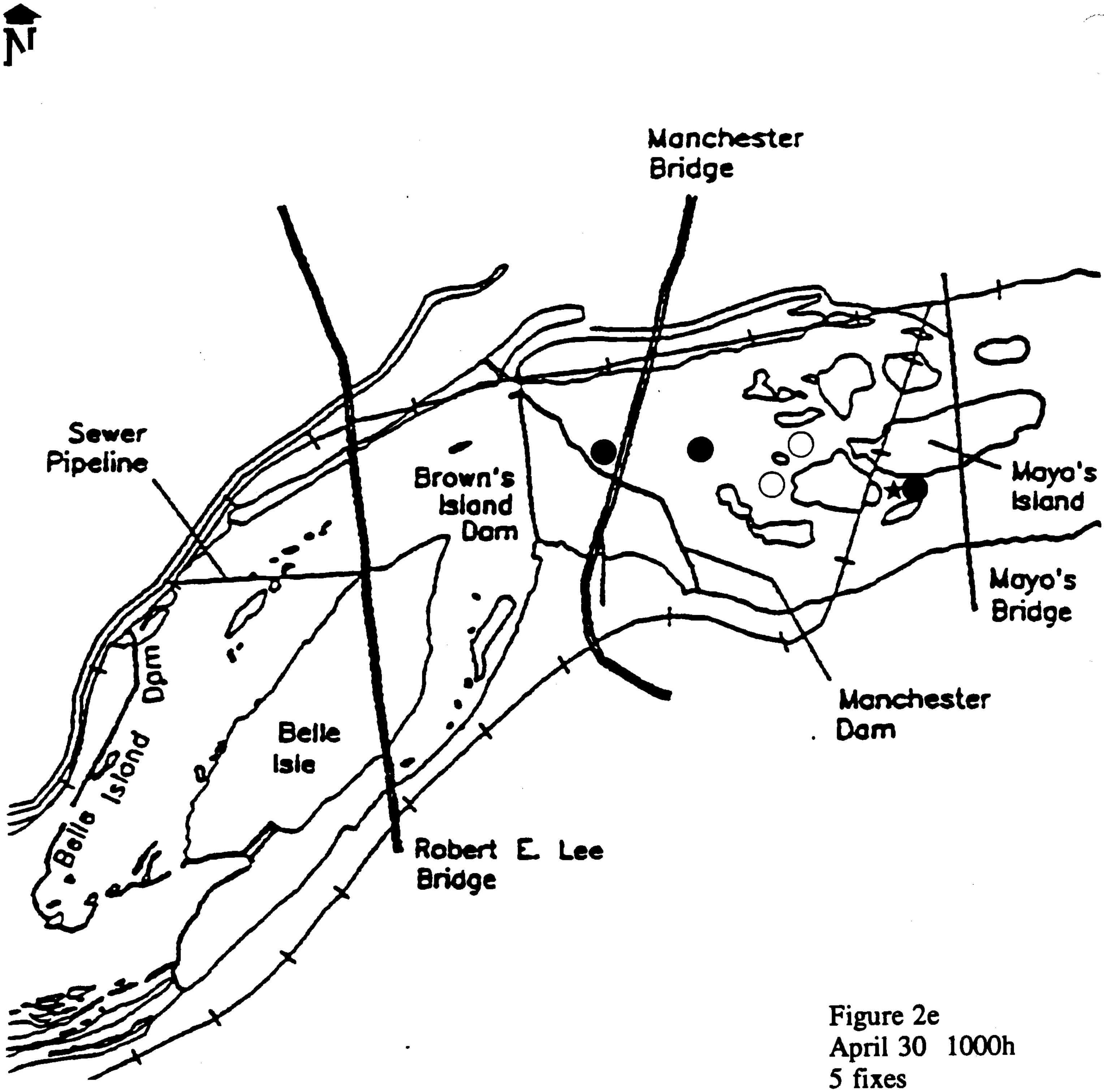

Figure 2e
April 30 1000h
5 fixes

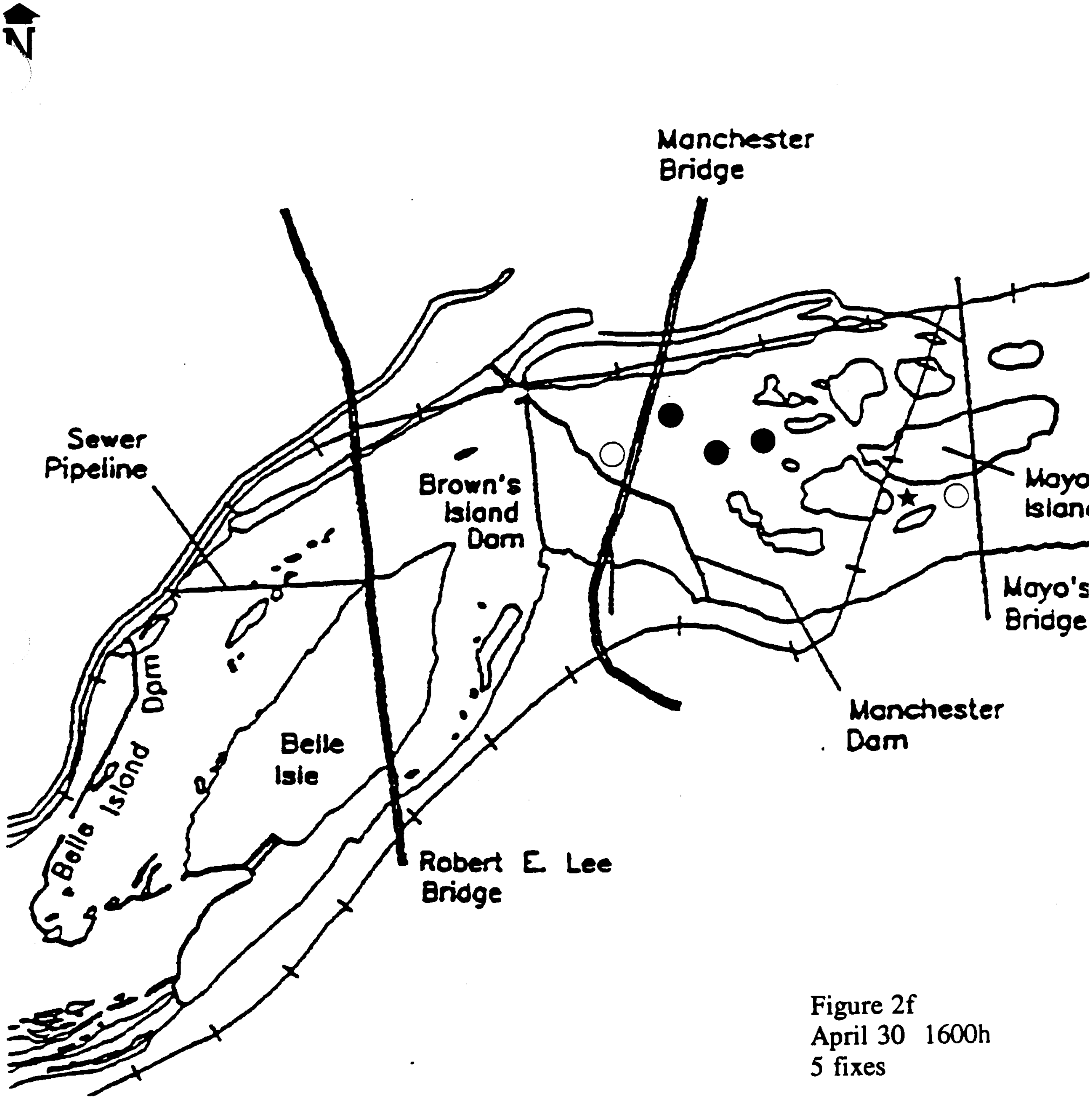

Figure 2f
April 30 1600h
5 fixes

Figure 3 a-f. Positional fixes of individual blueback herring in the James River, Richmond during the period May 3-5, 1993. Filled circles represent net upstream movement since the last position of the fish and open circles represent downstream movement, or no movement, relative to the most recent prior position. A star indicates the release location.

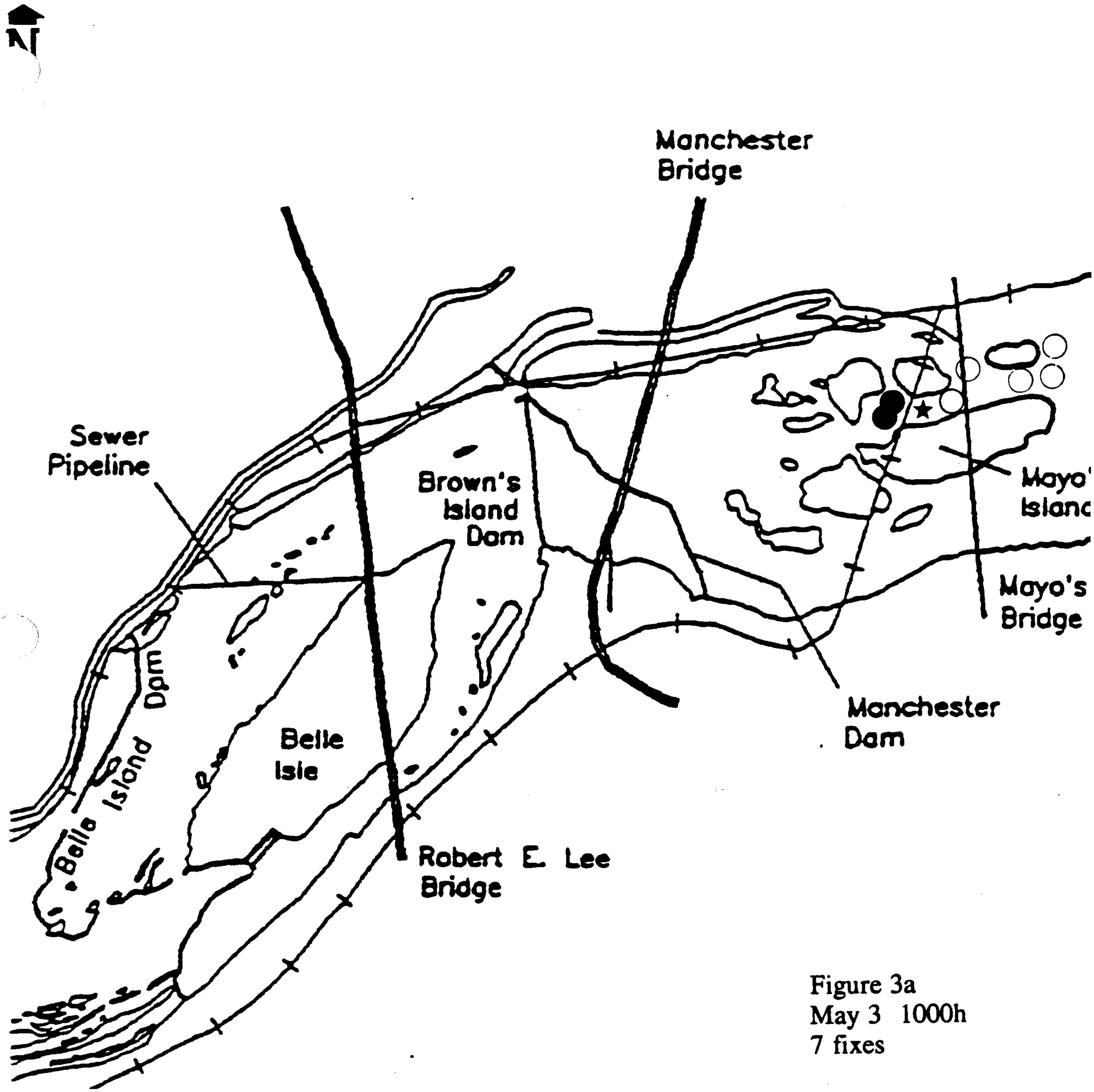

Figure 3a
May 3 1000h
7 fixes

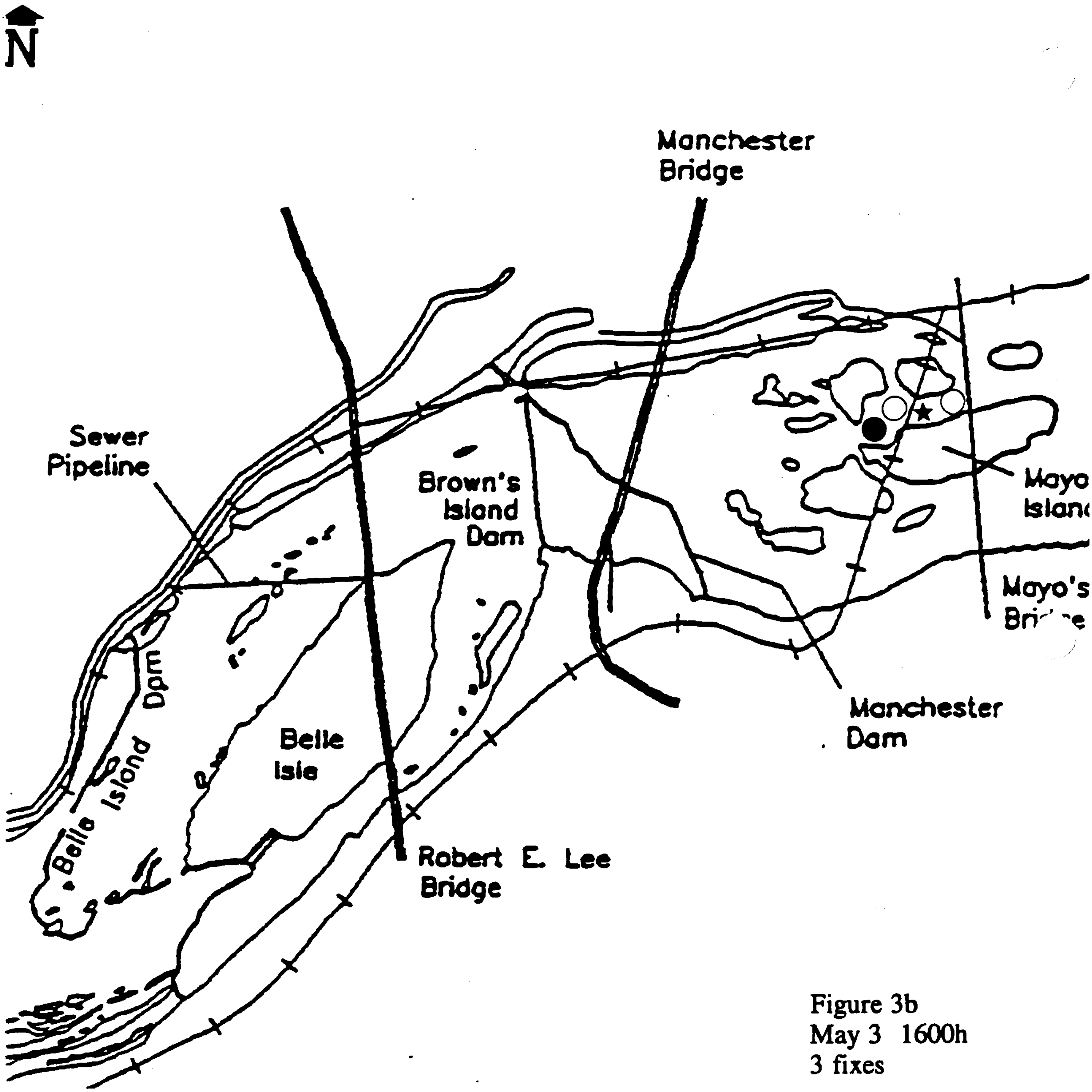

Figure 3b
May 3 1600h
3 fixes

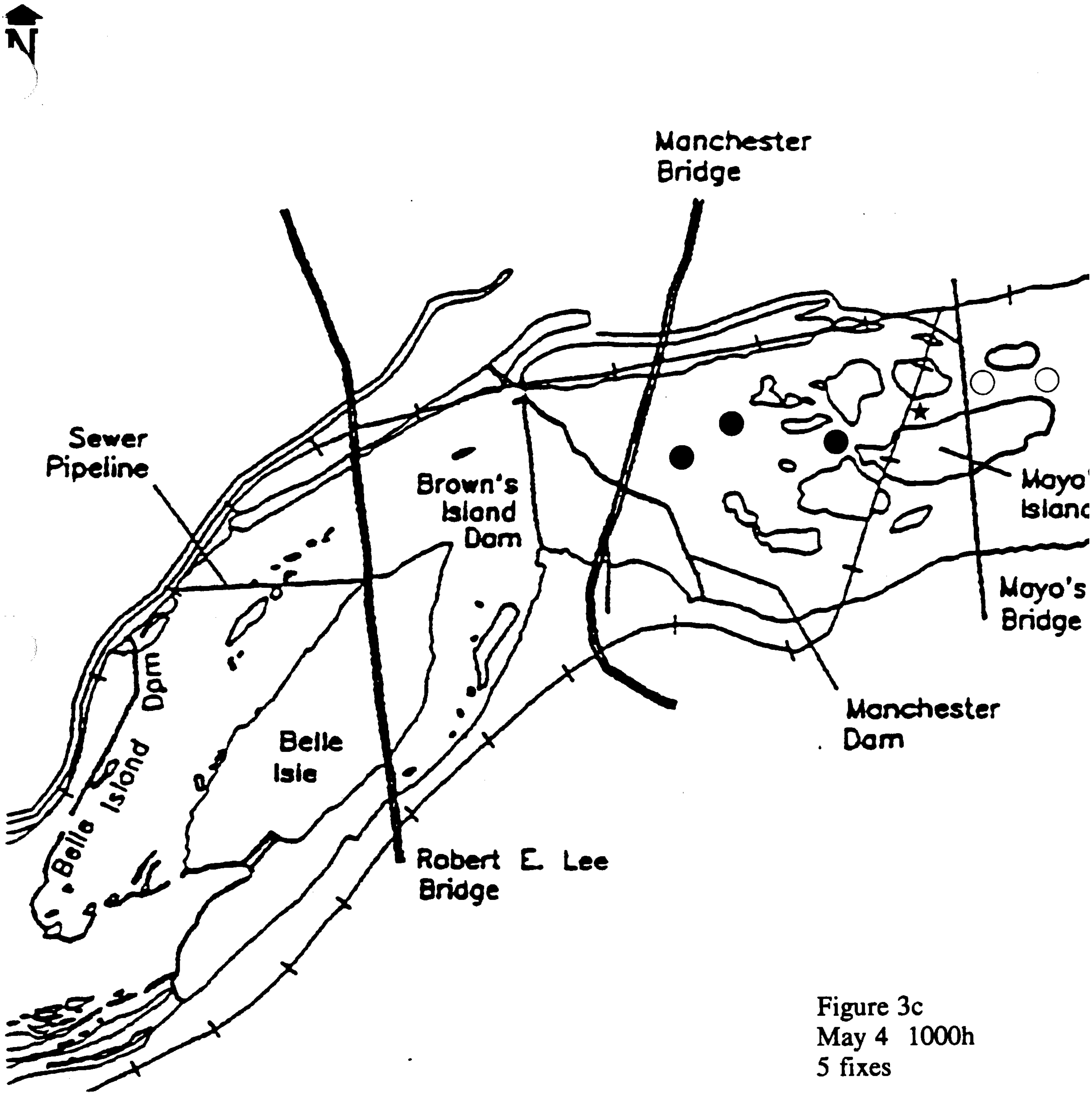

Figure 3c
May 4 1000h
5 fixes

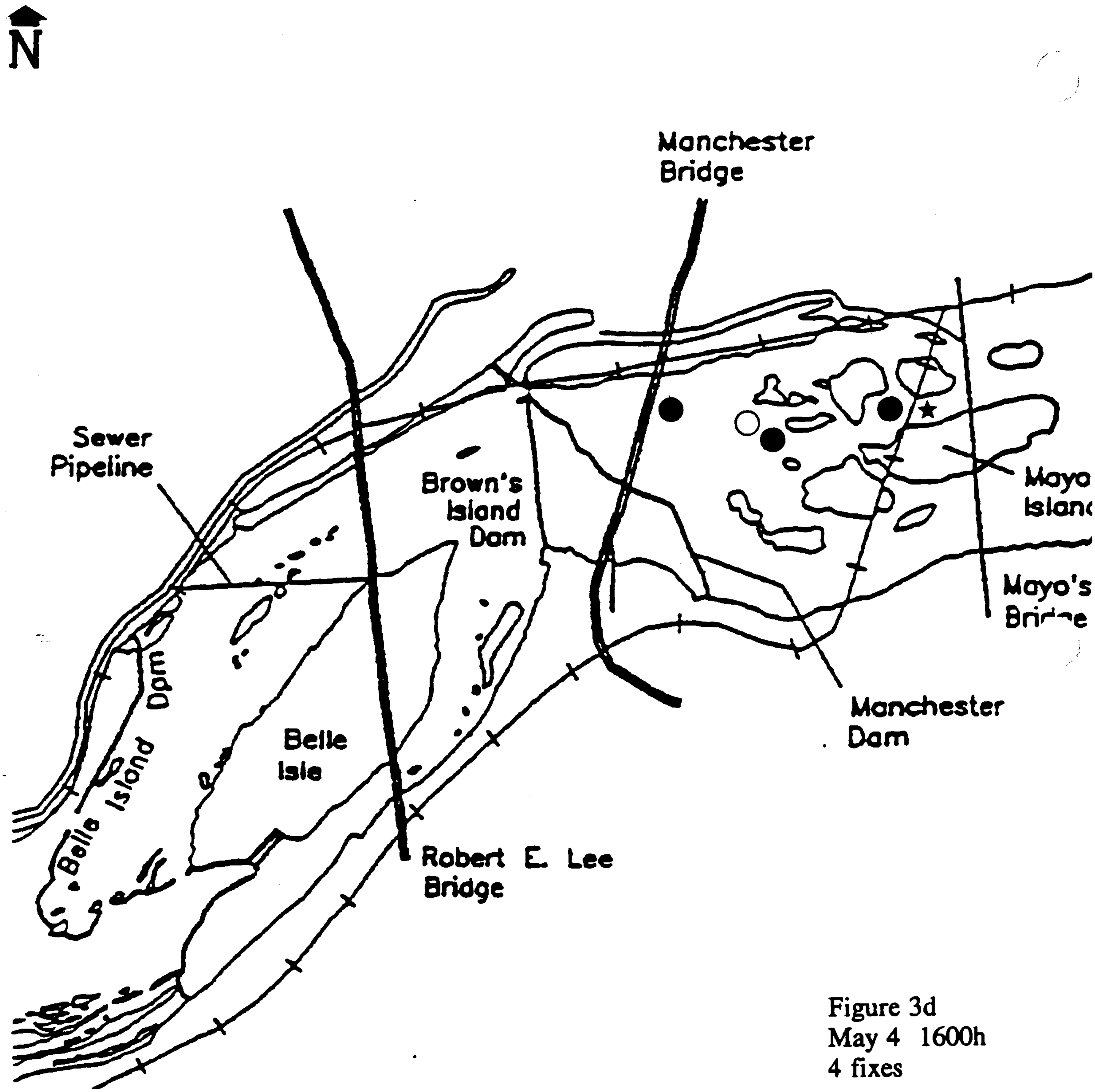

Figure 3d
May 4 1600h
4 fixes

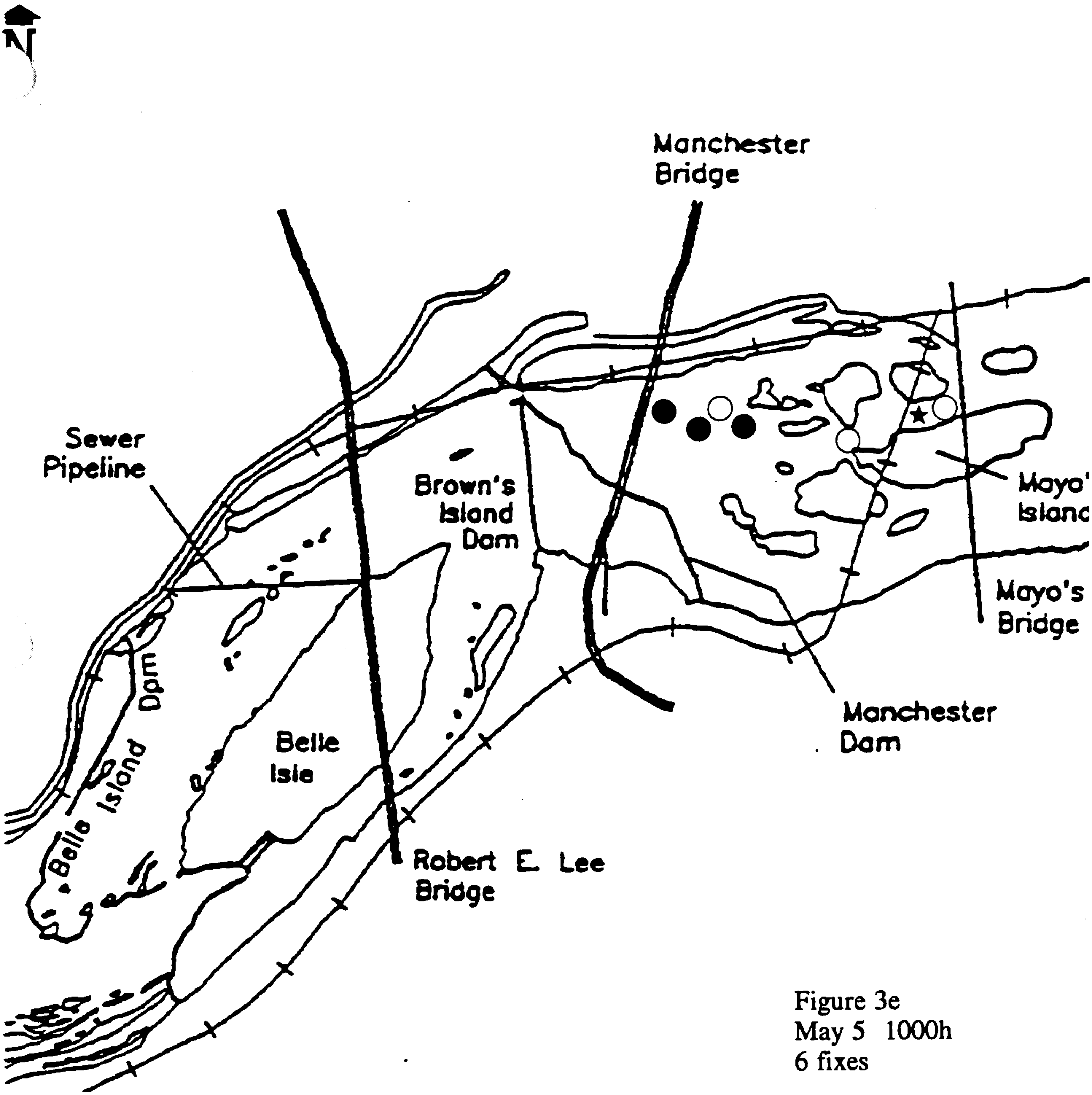

Figure 3e
May 5 1000h
6 fixes

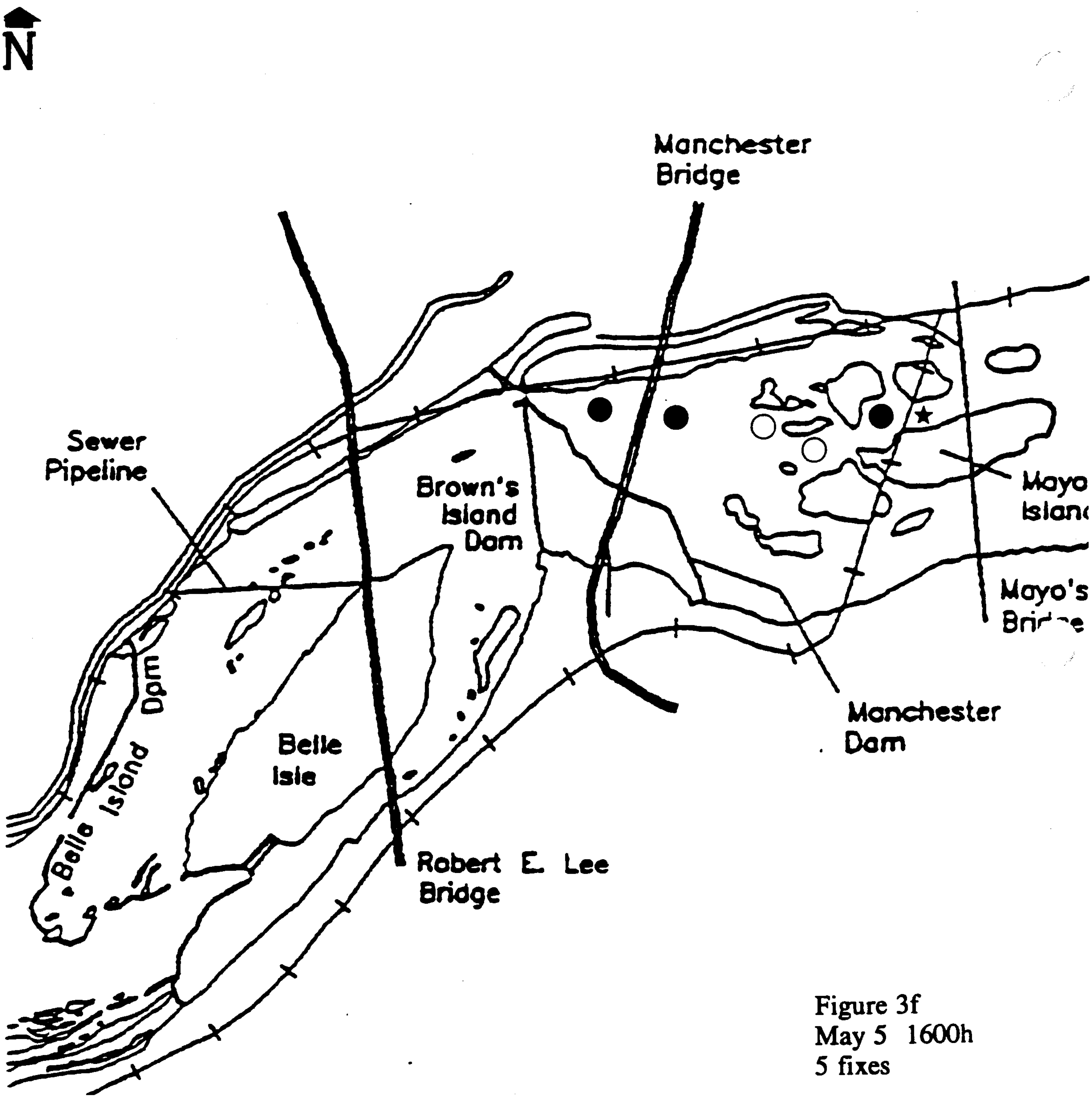

Figure 3f
May 5 1600h
5 fixes

A
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X

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CERCLA INFORMATION SYSTEM (CERCLIS) - VIRGINIA

Appendix E

1

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988201976	ALEXANDRIA TOWN GAS 5 ORONOCO OUTFALL		00	DS1			04/29/91	EPA (FUND)
	ORONOCO STREET			PA1			03/17/93	STATE(FUND)
	ALEXANDRIA CITY	VA 22314		PA2	NFA	09/18/86	09/18/86	EPA (FUND)
	510 ALEXANDRIA			YA1		05/13/91	07/08/92	EPA (FUND)
VAD988166500	CHERRY HILL LANDFILL		00	DS1			10/17/88	EPA (FUND)
	ST RTE 783			PA1			10/05/89	STATE(FUND)
	POTOMAC RIVER	VA 22301		SI1			10/05/89	STATE(FUND)
	510 PRINCE WILLIAM							
VAD988227781	CHEVRON USA INC.		00	DS1			06/29/93	EPA (FUND)
	3790 PICKETT RD.							
	FAIRFAX	VA 22030						
	510 FAIRFAX							
VAD981939507	R. H. BOGLE SITE		00	DS1			09/14/87	EPA (FUND)
	FOOT OF ORONOCO STREET			PA1	NFA	05/23/83	07/14/83	EPA (FUND)
	ALEXANDRIA	VA 22313		SI1	NFA		06/04/92	STATE(FUND)
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VAD020312013	RICHMOND, FREDRICKSBURG & POTOMAC RAILRD		00	RV1		09/22/92		RESP. PARTY
	JEFFERSON DAVIS 5 HUME			DS1			12/31/87	EPA (FUND)
	ALEXANDRIA	VA 22301		PA1			04/19/88	EPA (FUND)
	510 ALEXANDRIA			SI1			04/07/89	STATE(FUND)
VAD988136861	SOUTH NORFOLK AIRPORT		00	DS1			04/10/91	EPA (FUND)
	1426 TINTURN ROAD			PA1	NFA		10/18/91	STATE(FUND)
	CHESAPEAKE	VA 22320						
	510 CHESAPEAKE							
VA4210220139	USA CAMERON STATION		00	DS1			12/01/79	EPA (FUND)
	5010 DUKE ST			PA1		05/19/91	06/12/92	FED. FAC.
	ALEXANDRIA	VA 22304		PA2		10/15/89		FED. FAC.
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SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

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VAD980551619	OLD CITY SHOP FENCED AREA GROVE ST BEDFORD 515 BEDFORD	VA 24523	00	DS1 PA1	 NFA		06/01/81 03/01/83	EPA (FUND) STATE(FUND)
VAD980551733	RUBATEX CORP WA HOLLAND FARM STATE RTE 804 BEDFORD 515 BEDFORD	VA 24523	00	DS1 PA1 SI1	 NFA	 06/01/84	06/01/81 06/01/83 09/01/84	EPA (FUND) EPA (FUND) EPA (FUND)
VAD982364143	BIRDSONG PROPERTY 105 BREEZY HILL DR COLONIAL HEIGHTS 520 COLONIAL HEIGHTS	VA 24201	00	DS1 PA1 SI1			11/30/87 06/02/88 06/02/88	EPA (FUND) EPA (FUND) EPA (FUND)
VAD096372974	BRISTOL COMPRESSORS 649 INDUSTRIAL PARK RD. BRISTOL 520 BRISTOL	VA 24201	00	DS1			06/29/93	EPA (FUND)
VAD990710675	ELECTROLUX CORP VALLEY RD BRISTOL 520 BRISTOL	VA 24201	00	DS1 PA1	 NFA		06/01/81 03/01/83	EPA (FUND) EPA (FUND)
VAD058659210	MORRISON MOLDED FIBER GLASS CO 400 COMMONWEALTH AVE BRISTOL 520 BRISTOL	VA 24201	00	DS1 PA1	 NFA	 08/22/86	06/01/81 08/22/86	EPA (FUND) STATE(FUND)

Appendix E
3

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

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	STATE ST			PA1			08/02/88	EPA (FUND)
	BRISTOL	VA 24201		SI1			05/28/92	STATE(FUND)
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	1000 FAIRVIEW ST			PA1		08/22/86	08/22/86	STATE(FUND)
	BRISTOL	VA 24201		SI1			07/20/88	EPA (FUND)
	520 BRISTOL							
VAD980539753	BUENA VISTA CY LANDFILL		00	DS1			06/01/81	EPA (FUND)
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VAD003125713	GEORGIA BONDED FIBERS INC		00	DS1			08/01/84	EPA (FUND)
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	BUENA VISTA	VA 24416						
	530 BUENA VISTA							
VAD980539811	REEVES BROTHERS FARM		00	DS1			06/01/81	EPA (FUND)
	OFF RTE 631			PA1	NFA	09/01/84	11/01/84	STATE(FUND)
	BUENA VISTA	VA 24416						
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SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

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	540 CHARLOTTESVILLE							
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	PROFFIT	VA 22901		SI1		08/26/90	09/29/92	STATE(FUND)
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	1300 SMITH DOUGLAS ROAD			PA1	NFA	09/05/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD000650556	BERNUTH LEMBECKE		00	DS1			10/01/83	EPA (FUND)
	END OF FREEMAN AV			PA1	NFA	11/01/84	05/08/85	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988197125	BP LUMBER SITE		00	DS1			04/12/91	EPA (FUND)
	500 HILL STREET			PA1	NFA		10/26/92	STATE(FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988197042	CEDAR WORKS ROAD SITE		00	DS1			04/10/91	EPA (FUND)
	END OF RICHMOND CEDAR WORKS RD			PA1	NFA	08/19/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988227640	CHESAPEAKE ASBESTOS SITE		00	DS1			05/20/93	EPA (FUND)
	3923,3741 SOUTH MILITARY HIGHW			YA1		05/18/93		EPA (FUND)
	CHESAPEAKE	VA 23321		YA2		05/08/93		EPA (FUND)
	550 CHESAPEAKE			YA3		05/19/93		EPA (FUND)
VAD980705453	CHESAPEAKE CY LANDFILL		00	DS1			11/01/79	EPA (FUND)
	ALBEMARLE ST			PA1		12/01/84	12/31/84	STATE(FUND)
	CHESEPEAKE	VA 23320		SI1		08/30/88	12/20/88	EPA (FUND)
	550 CHESAPEAKE			ES1			05/14/93	STATE(FUND)
VAD988197117	CHESAPEAKE DPW SITE		00	DS1			04/12/91	EPA (FUND)
	GREENBRIER PARKWAY			PA1	NFA		10/15/92	STATE(FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988197182	CHESAPEAKE HARDWOOD SITE		00	DS1			04/15/91	EPA (FUND)
	201 WEST DEXTER STREET			PA1	NFA		07/11/92	STATE(FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988220227	CHESAPEAKE JUNKYARD FIRE		00	DS1			07/02/92	EPA (FUND)
	319 SAINT LUKE'S CHURCH ROAD			VA1		07/03/93		EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD001704808	CHESAPEAKE PLT		00	RV1		03/11/87	07/15/87	RESP. PARTY
	1316 SMITH DOUGLAS RD			DS1			11/01/79	EPA (FUND)
	CHESAPEAKE	VA 23320		PA1	NFA		06/09/86	EPA (FUND)
	550 CHESAPEAKE			PA2	NFA		04/09/86	EPA (FUND)
				AR1		07/23/92		FED ENFORCE
VAD980197141	CITY IF CHESAPEAKE SITE		00	DS1			04/12/91	EPA (FUND)
	4025 ROBERTSON BOULEVARD			PA1	NFA	08/28/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD000647560	CROWN CENTRAL PETROLEUM CORP		00	DS1			06/01/81	EPA (FUND)
	801 FOOT OF HUTT ST			PA1	NFA		03/01/84	STATE(FUND)
	CHESAPEAKE	VA 23324						
	550 CHESAPEAKE							
VAD988197190	ELIZABETH RIVER TERMINALS SITE		00	DS1			04/15/91	EPA (FUND)
	4100 BUELL STREET			PA1	NFA		03/31/92	STATE(FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD002352151	EPPINGER & RUSSELL CO INC		00	DS1			06/01/81	EPA (FUND)
	4010 BUELL ST MONEY POINT			PA1			12/01/81	EPA (FUND)
	CHESAPEAKE	VA 23324		SI1		11/01/83	11/10/86	EPA (FUND)
	550 CHESAPEAKE							
VAD008956062	FIELDS ESTATE PROP		00	DS1			11/01/79	EPA (FUND)
	BUELL ST			PA1			02/01/80	STATE(FUND)
	CHESAPEAKE	VA 23324		SI1	NFA	04/01/80	05/01/80	EPA (FUND)
	550 CHESAPEAKE							

Appendix E

RUN DATE: 10/07/93 18:05:59
CERCLIS DATA BASE DATE: 10/06/93
CERCLIS DATA BASE TIME: 17:22:02
VERSION 3.00

** PROD VERSION **
U.S. EPA SUPERFUND PROGRAM
** C E R C L I S **
LIST-8: SITE/EVENT LISTING

PAGE: [illegible]
CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980554976	FISHERMAN'S ISLAND NAT'L WILDLIFE REFUGE		00	DS1			06/01/81	EPA (FUND)
	OFF CHSPK BAY BRG TUNNEL			PA1			03/01/83	FED. FAC.
	HAMPTON	VA 23320		PA2	NFA		02/06/90	FED. FAC.
	550 NORTHAMPTON			SI1	NFA		02/06/90	FED. FAC.
VAD981740525	GILMERTON CUT - DEEP CREEK		00	DS1			10/03/86	EPA (FUND)
	FIRMAN ST.			PA1	NFA	04/06/87	04/06/87	STATE(FUND)
	CHESAPEAKE	VA 23323						
	550 CHESAPEAKE							
VAD003176104	GOWEN CHEMICAL CO		00	DS1			02/01/83	EPA (FUND)
	1312 MCCLOUD RD			PA1	NFA	09/01/84	11/01/84	STATE(FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988196945	HAMPTON ROADS SANITATION SITE		00	DS1			04/11/91	EPA (FUND)
	PARCEL DUE EAST OF 2025 MAYWOO			PA1	NFA	08/23/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988197103	INTERCOASTAL STEEL SITE		00	DS1			04/12/91	EPA (FUND)
	1500 STEEL STREET			PA1			03/05/93	STATE(FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD055482061	JACOBSON METAL CO		00	DS1			12/16/85	EPA (FUND)
	OFF BAINBRIDGE, IN PORT LOCK			PA1	NFA	05/13/87	05/13/87	STATE(FUND)
	CHESAPEAKE	VA 23324						
	550 CHESAPEAKE							
VAD136087718	N & W RAIL SITE - PORTLOCK YARD		00	DS1			06/09/87	STATE(FUND)
	MYERS RD & ATLANTIC AVE			PA1	NFA	06/08/87	06/08/87	STATE(FUND)
	CHESAPEAKE	VA 23324						
	550 CHESAPEAKE							

SELECTION: ** SPECIAL **
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EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VA5170027267	NAVAL SECURITY GROUP ACTIVITY		00	DS1			07/25/91	FED. FAC.
	NORTHWEST							
	CHESAPEAKE	VA 23322						
	550 CHESAPEAKE							
VAD154441659	NORFOLK STEEL		00	DS1			09/08/89	STATE(FUND)
	1500 STEEL STREET			PA1			04/24/90	STATE(FUND)
	CHESAPEAKE	VA 23323		SI1		03/12/92	03/22/93	STATE(FUND)
	550 CHESAPEAKE							
VAD980705694	NORFOLK SUPER PHOSPHATE PLANT		00	DS1			11/01/79	EPA (FUND)
	POB 7537 FREEMAN AVE			PA1		06/30/85	09/30/85	STATE(FUND)
	CHESEPEAKE	VA 23324		SI1	NFA	02/19/91	08/30/91	STATE(FUND)
	550 CHESAPEAKE							
VAD988196936	OLD GREENBRIER SITE		00	DS1			04/10/91	EPA (FUND)
	VOLVO PENTA DRIVE			PA1	NFA	08/26/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988196944	OLD HOECHST AND FOSTER SITE		00	DS1			04/10/91	EPA (FUND)
	5100 BAINBRIDGE BOULEVARD			PA1		01/16/92		EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD988196937	OLD ROBERTSON CHEM. SITE		00	DS1			04/11/91	EPA (FUND)
	120 REPUBLIC ROAD			PA1	NFA	08/30/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD980551980	REPUBLIC CREOSOTING CO		00	DS1			06/01/81	EPA (FUND)
	PORTLOCK S NORFOLK BOROUGH			PA1			04/01/83	EPA (FUND)
	NORFOLK	VA 23325		SI1		05/01/84	09/01/84	EPA (FUND)
	550 CHESAPEAKE							

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SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD003178126	ROYSTER CO		00	DS1			09/23/88	EPA (FUND)
	MONEY POINT PRATT ST			PA1			09/06/89	EPA (FUND)
	CHESAPEAKE	VA 23324						
	550 CHESAPEAKE							
VAD003737346	SAFETY KLEEN 3-121-01		00	DS1			09/17/90	EPA (FUND)
	777 BIG TIMBER ROAD			PA1			10/18/91	STATE(FUND)
	CHESAPEAKE	VA 23323						
	550 CHESAPEAKE							
VAD988197158	TIDEWATER HOSPITAL LAUNDRY SITE		00	DS1			04/12/91	EPA (FUND)
	3530 ELMHURST LANE			PA1	NFA	08/30/91	11/01/91	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VA8170030015	USN AUXILIARY LANDING FIELD FENT		00	DS1			06/01/81	EPA (FUND)
	3-4 MLE S PRINCESS ANN CTHOUSE			PA1			03/01/83	FED. FAC.
	CHESAPEAKE	VA 23322						
	550 CHESAPEAKE							
VAD988197018	VEPCO COAL PILE		00	DS1			04/10/91	EPA (FUND)
	VEPCO STREET			PA1	NFA	02/24/93	08/09/93	EPA (FUND)
	CHESAPEAKE	VA 23320						
	550 CHESAPEAKE							
VAD042197772	BENJAMIN MOORE		00	DS1			10/15/91	EPA (FUND)
	880 ROSLYN ROAD WEST			PA1		07/01/91	06/16/92	STATE(FUND)
	COLONIAL HEIGHTS	VA 23834						
	570 COLONIAL HEIGHTS							
VAD023700032	COBURN OPTICAL		00	DS1			01/27/89	EPA (FUND)
	WEST ROSLYN INDUSTRIAL PARK			PA1	NFA		02/05/90	EPA (FUND)
	COLONIAL HEIGHTS	VA 23834						
	570 COLONIAL HEIGHTS							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA_ID_NO.	SITE NAME / STREET / CITY / COUNTY_CODE_AND_NAME	STATE ZIP CONG_DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT_LEAD
VAD981109341	COLONIAL HEIGHTS LANDFILL		00	DS1			01/14/86	STATE(FUND)
	ROSLYN AVE W			PA1		03/24/86	03/24/86	STATE(FUND)
	COLONIAL HEIGHTS	VA 23834		SI1		09/29/87	09/30/87	EPA (FUND)
	570 COLONIAL HEIGHTS							
VAD981110729	COLONIAL HEIGHTS RESIDENCY DUMPSITE		00	DS1			03/27/86	STATE(FUND)
	PINE FOREST DR			PA1	NFA	12/31/86	12/31/86	STATE(FUND)
	COLONIAL HEIGHTS	VA 23834						
	570 COLONIAL HEIGHTS							
VAD980705511	ALLIED CHEM CORP COVINGTON WKS		00	DS1			11/01/79	EPA (FUND)
	607 N MAGAZINE AVE POB 432			PA1	NFA		02/01/80	EPA (FUND)
	COVINGTON	VA 24426						
	580 COVINGTON							
VAD083057687	COVINGTON CITY LANDFILL		00	DS1			11/01/79	EPA (FUND)
	RTE 154			PA1	NFA	11/01/84	12/01/84	STATE(FUND)
	COVINGTON	VA 24426						
	580 COVINGTON							
VAD980705347	COVINGTON CYANIDE SLUDGE DUMP		00	DS1			11/01/80	EPA (FUND)
	UNOBTAINABLE			PA1	NFA	11/01/84	12/01/84	STATE(FUND)
	COVINGTON	VA 24426						
	580 COVINGTON							
VAD980705529	COVINGTON PLT		00	DS1			11/01/79	EPA (FUND)
	EDGEMONT DR			PA1	NFA		03/01/83	STATE(FUND)
	COVINGTON	VA 24426						
	580 COVINGTON							
VAD003132018	HERCULES INC		00	DS1			06/01/81	EPA (FUND)
	EDGEMONT DR			PA1	NFA	11/01/84	12/01/84	STATE(FUND)
	COVINGTON	VA 24426						
	580 COVINGTON							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD982367898	JACKSON RIVER SPILL		00	DS1			05/19/88	FED ENFORCE
	WESTVACO CORP FACILITY			PA1	NFA		10/18/89	EPA (FUND)
	COVINGTON	VA 24426		OH1		05/19/88		STATE(FUND)
	580 COVINGTON							
VAD988224044	PETERS MOUNTAIN LANDFILL		00	DS1			01/29/93	EPA (FUND)
	PETERS MOUNTAIN							
	COVINGTON	VA 24426						
	580 COVINGTON							
VAD980714463	WESTVACO SOLID WASTE DISP AREA		00	DS1			06/01/81	EPA (FUND)
	N E QUAD WESTVACO PROP			PA1	NFA		04/01/83	EPA (FUND)
	COVINGTON	VA 24426						
	580 COVINGTON							
VAD980514244	AIRPORT DUMP		00	DS1			11/01/79	EPA (FUND)
	AIRPORT AVE			PA1	NFA		05/01/84	STATE(FUND)
	DANVILLE	VA 24541						
	590 DANVILLE							
VAD001807031	CORNING GLASS - DANVILLE		00	DS1			11/01/84	EPA (FUND)
	RTE 4			PA1	NFA	01/17/86	05/28/87	EPA (FUND)
	DANVILLE	VA 24541						
	590 DANVILLE							
VAD980690564	DANVILLE BRANCH PLT		00	DS1			11/01/79	EPA (FUND)
	US 360 & PO BOX 111			PA1	NFA		03/01/84	EPA (FUND)
	DANVILLE	VA 24541						
	590 DANVILLE							
VAD980514319	DANVILLE CY DUMP		00	DS1			11/01/79	EPA (FUND)
	BRANTLEY STEAM PLT AREA			PA1	NFA		05/01/84	STATE(FUND)
	DANVILLE	VA 24541						
	590 DANVILLE							

SELECTION: ** SPECIAL **
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EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988227765	DANVILLE LANDFILL AIRPORT RD. SOUTH OF U.S. 58/3 DANVILLE 590 DANVILLE	VA 24543	00	DS1			06/29/93	EPA (FUND)
VAD980693097	DANVILLE TOWN GAS CRAGHESS ST RR DEPOT DANVILLE 590 DANVILLE	VA 24541	00	DS1 PA1	 NFA		10/01/82 06/01/83	EPA (FUND) EPA (FUND)
VAD980705362	DISSTON LAGOON RTE 29 DANVILLE 590 PITTSYLVANIA	VA 24541	00	DS1 PA1 SI1		 10/01/80	11/01/79 10/01/80 11/01/80	EPA (FUND) EPA (FUND) EPA (FUND)
VAD043342971	GOODYEAR TIRE & RUBBER GOODYEAR BLVD DANVILLE 590 DANVILLE	VA 24541	00	DS1 PA1	 NFA	 12/11/86	11/01/84 12/11/86	EPA (FUND) STATE(FUND)
VAD001725167	MARSHALL CONST DUMP US 360 EAST ST DANVILLE 590 PITTSYLVANIA	VA 24541	00	DS1 PA1	 NFA		11/01/79 04/01/82	EPA (FUND) EPA (FUND)
VAD988170239	PAUL'S AUTO PARTS AND CHEMICAL CO. KENT ST. OFF RT. 58 (DUNVILLE DANVILLE 590 DANVILLE	VA 24540	00	DS1 PA1	 NFA		09/08/89 10/01/90	STATE(FUND) STATE(FUND)
VAD980705776	WRENN DRIVE SITE WRENN DRIVE SITE DANVILLE 590 DANVILLE	VA 24541	00	DS1 PA1	 NFA		11/01/79 04/01/82	EPA (FUND) EPA (FUND)

RUN DATE: 10/07/93 18:05:59
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CERCLIS DATA BASE TIME: 17:22:42
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** PROD VERSION **
U.S. EPA SUPERFUND PROGRAM
** C E R C L I S **
LIST-8: SITE/EVENT LISTING

CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD049952252	GEORGIA PACIFIC PLYWOOD PLANT		00	DS1			07/30/86	EPA (FUND)
	611 STATE RD			PA1	NFA	10/14/87	10/14/87	EPA (FUND)
	EMPORIA	VA 23847						
	595 EMPORIA							
VAD980832653	ANNANDALE GRAVEL PITS		00	DS1			09/01/82	EPA (FUND)
	BEULAH ST			PA1		07/01/83	09/01/84	EPA (FUND)
	FAIRFAX	VA 22030		SI1		07/01/83	09/01/84	EPA (FUND)
	600 FAIRFAX							
VAD988178190	STAR ENTERPRISE		00	RV1		05/08/92		RESP. PARTY
	3800 PICKETT ROAD			DS1			05/29/91	EPA (FUND)
	FAIRFAX	VA 22030		YA1		05/29/91		EPA (FUND)
	600 FAIRFAX							
VAD988166518	WASHINGTON NATIONAL AIRPORT DRUM SITE		00	RV1		06/24/92		RESP. PARTY
	SOUTH END OF AIRPORT			DS1			10/18/88	EPA (FUND)
	ARLINGTON	VA 22030		PA1			03/29/89	FED. FAC.
	600 ARLINGTON			AR1		02/05/93		FED ENFORCE
				YA1		10/11/91		EPA (FUND)
VAD988166098	JEFFERSON STREET DUMP		00	DS1			08/12/88	EPA (FUND)
	215 E JEFFERSON ST			PA1	NFA		03/29/89	STATE(FUND)
	FALLS CHURCH	VA 22041						
	610 FALLS CHURCH							
VAD044820652	TRANS CIRCUITS INC		00	DS1			02/01/85	EPA (FUND)
	3503 CARYLIN SPRING RD			PA1	NFA	12/31/86	12/31/86	STATE(FUND)
	FALLS HILLS	VA 22043						
	610 FAIRFAX							
VAD003122165	HERCULES FRANKLIN PT		00	DS1			11/01/79	EPA (FUND)
	RTE 371 (3 MI SW FRANKLIN)			PA1	NFA		10/01/82	EPA (FUND)
	FRANKLIN	VA 23851						
	620 SOUTHAMPTON							

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EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD981037336	LEES MILL ROAD LANDFILL		00	DS1			01/01/85	EPA (FUND)
	LEES MILL RD			PA1		09/15/86	09/18/86	EPA (FUND)
	FRANKLIN	VA 23851		SI1	NFA	02/23/89	04/06/89	EPA (FUND)
	620 FRANKLIN							
VAD980551808	MARTIN MARIETTA CORP		00	DS1			06/01/81	EPA (FUND)
	311 E FOURTH AVE			PA1	NFA		03/01/83	EPA (FUND)
	FRANKLIN	VA 23851						
	620 FRANKLIN							
VAD988203716	A.R. KLOTZ JUNKYARD		00	DS1			12/04/91	STATE(FUND)
	1123 SUMMIT AVENUE							
	FREDERICKSBURG	VA 22401						
	630 FREDERICKSBURG							
VAD988166153	CHUCK'S FRAME & AUTO BODY (SMOOT HOME)		00	DS1			08/17/88	EPA (FUND)
	JACKSON TRAIL EAST			PA1	NFA		09/06/89	STATE(FUND)
	CHANCELLORSVILLE	VA 22401						
	630 FREDERICKSBURG							
VAD980692974	FREDERICKSBURG TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	400 CHARLES ST			PA1	NFA		04/01/83	EPA (FUND)
	FREDERICKSBURG	VA 22401						
	630 FREDERICKSBURG							
VAD091222588	G M C DELCO MORAINE DIV.		00	DS1			01/10/90	STATE(FUND)
	3401 TIDEWATER TRIAL			PA1			01/19/90	STATE(FUND)
	FREDERICKSBURG	VA 22401						
	630 SPOTSYLVANIA							
VAD982366767	GENERAL PRODUCTS COMPANY, INC		00	DS1			02/02/88	EPA (FUND)
	(RTS 608 & 636) PO BX 7387			PA1			06/24/88	EPA (FUND)
	FREDERICKSBURG	VA 22401		SI1		04/30/91	06/24/92	STATE(FUND)
	630 FREDERICKSBURG							

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EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD058302183	UNDULINE USA INC		00	DS1			06/01/81	EPA (FUND)
	US RTE 1 S US RTE 95			PA1	NFA		04/01/84	STATE(FUND)
	MASSAPONAX	VA 22401						
	630 FREDERICKSBURG							
VAD982363798	POINT OF ROCKS		00	RV1		10/26/87	10/14/88	EPA (FUND)
	RUFFIN MILL RD			DS1			10/26/87	EPA (FUND)
	ENON	VA 22401		PA1	NFA		10/01/90	STATE(FUND)
	630 CHESTERFIELD			AR1		08/22/91		EPA (FUND)
VAD003124161	DIXON LUMBER		00	DS1			05/13/87	EPA (FUND)
	152 BOYER RD			PA1			09/03/88	EPA (FUND)
	GALAX	VA 24333		SI1	NFA		03/28/90	STATE(FUND)
	640 GALAX							
VAD980514350	ANDREWS ST		00	DS1			11/01/79	EPA (FUND)
	ANDREWS ST			PA1	NFA		01/01/80	STATE(FUND)
	HAMPTON	VA 23670						
	650 HAMPTON							
VAD988212427	BASIC TOOL COMPANY		00	RV1		09/17/92		EPA (FUND)
	2133 56TH STREET			DS1			02/07/92	STATE(FUND)
	HAMPTON	VA 23661		PA1	NFA		12/31/92	STATE(FUND)
	650 HAMPTON			AR1		03/02/93		FED ENFORCE
				YA1		09/15/92	09/17/92	EPA (FUND)
VAD980705537	CARYS CHAPEL RD & WYTHE CRK LANDFILL		00	DS1			11/01/79	EPA (FUND)
	CARYS CHAPEL RD & WYTHE CRK			PA1	NFA		02/01/80	EPA (FUND)
	POQUOSON	VA 23662						
	650 POQUOSON							
VAD081057697	COMMONWEALTH WOOD PRESERVERS INC		00	DS1			08/01/80	EPA (FUND)
	5604 CITY LINE RD			PA1			03/01/84	STATE(FUND)
	HAMPTON	VA 23661		SI1			10/05/89	STATE(FUND)
	650 HAMPTON							

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VAD000748608	GIBBS SUNOCO SER STA		00	DS1			06/01/81	EPA (FUND)
	2311 W MERCURY BLVD			PA1	NFA	08/01/84	09/01/84	STATE(FUND)
	HAMPTON	VA 23666						
	650 HAMPTON							
VAD003146982	HAMPTON PAINT MFG CO		00	DS1			09/01/80	EPA (FUND)
	PO DRAWER E			PA1	NFA		04/01/82	EPA (FUND)
	HAMPTON	VA 23669						
	650 HAMPTON							
VA2800005033	NASA -LANGLEY RESEARCH CENTER		00	DS1			10/17/89	FED. FAC.
	MAIL CODE 429			PA1			11/21/89	FED. FAC.
	HAMPTON	VA 23665		NP1			05/10/93	EPA (FUND)
	650 HAMPTON			SI1			11/21/89	FED. FAC.
VAD988213229	PLUM TREE ISLAND NAT'L WILDLIFE REFUGE		00	DS1			07/09/91	FED. FAC.
	JUST E. OF THE CITY OF POQUOSO							
	POQUOSON	VA 23662						
	650 HAMPTON							
VAD981037393	POQUOSON LANDFILL		00	DS1			02/01/85	EPA (FUND)
	RIDGE			PA1		09/23/86	09/23/86	STATE(FUND)
	POQUOSON	VA 23662		SI1		09/29/88	10/18/88	STATE(FUND)
	650 POQUOSON							
VAD980705826	RIDGE RD		00	DS1			11/01/79	EPA (FUND)
	OFF RIDGE RD			PA1	NFA		02/01/80	STATE(FUND)
	POQUOSON	VA 23662						
	650 YORK							
VAD049956923	SEWER CONNECTION		00	DS1			11/01/79	EPA (FUND)
	411 ROTARY ST			PA1	NFA		06/01/80	EPA (FUND)
	HAMPTON	VA 23663						
	650 HAMPTON							

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VA7213720603	USA FT MONROE ENTOMOLOGY SHOP		00	DS1			06/01/81	EPA (FUND)
	FENWICK RD			PA1			04/01/83	FED. FAC.
	FT MONROE	VA 23651						
	650 HAMPTON							
VA4570024477	USAF LANGLEY AFB		00	DS1			12/01/78	EPA (FUND)
	LANGLEY AFB			PA1			03/01/83	FED. FAC.
	HAMPTON	VA 23665		HR1			03/25/88	EPA (FUND)
	650 HAMPTON			SI1		06/01/85	06/03/85	FED. FAC.
VAD023761653	WILLIAMS PAVING CO LANDFILL		00	DS1			11/01/79	EPA (FUND)
	2972 N ARMISTEAD AVE			PA1	NFA	09/23/86	09/23/86	EPA (FUND)
	HAMPTON	VA 23666						
	650 HAMPTON							
VAD988227708	ROCKINGHAM COUNTY SANITORY LANDFILL		00	DS1			06/29/93	COAST GUARD
	NEAR ROUTE 710 & 67							
	HARRISONBURG	VA 22801						
	660 HARRISONBURG							
VAD000485078	VICTOR INDUSTRIES		00	DS1			11/09/90	STATE(FUND)
	810 NORTH STREET			PA1		05/31/91	04/06/92	STATE(FUND)
	HARRISONBURG	VA 22801						
	660 HARRISONBURG							
VAD980829071	CONTINENTAL FOREST DUMP		00	DS1			04/01/83	EPA (FUND)
	OFF RTE 156			PA1			03/01/84	STATE(FUND)
	HOPEWELL	VA 23860		SI1	NFA	08/24/88	12/09/88	EPA (FUND)
	670 HOPEWELL							
VAD003112588	FIRESTONE - CELANESE SITE		00	DS1			02/01/82	EPA (FUND)
	E MAIN ST			PA1	NFA	03/01/85	05/13/85	EPA (FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							

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VAD003132636	HOPEWELL ALUM WORKS		00	DS1			06/01/82	EPA (FUND)
	POB 759			PA1	NFA		06/01/82	STATE(FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD065385296	HOPEWELL CHEM PLANT		00	DS1			11/01/79	EPA (FUND)
	ST RTE 10			PA1	NFA	04/01/84	07/01/84	EPA (FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD980552639	HOPEWELL CY SAN LANDFILL #2		00	DS1			06/01/81	EPA (FUND)
	DELROSE DR			PA1			05/01/82	EPA (FUND)
	HOPEWELL	VA 23860		SI1		08/26/88	01/18/89	EPA (FUND)
	670 HOPEWELL							
VAD980830913	HOPEWELL INDUSTRIAL METALS		00	DS1			02/01/84	EPA (FUND)
	ADJ TO ALLIED CHEM-ALUM PH			PA1	NFA	08/01/84	09/01/84	STATE(FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD003121928	HOPEWELL PLT AQUALON CO.		00	DS1			01/10/90	STATE(FUND)
	PLANT AREA			PA1			10/01/90	STATE(FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD980716203	HOPEWELL REGIONAL PLANT		00	DS1			04/01/84	EPA (FUND)
	RTE 10			PA1	NFA	11/01/84	12/01/84	STATE(FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD980705750	LOT ADJACENT TO JOHN RANDOLPH		00	DS1			11/01/79	EPA (FUND)
	4TH ST			PA1	NFA		03/01/82	EPA (FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							

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VAD980705875	NORWOOD WILSON SR FARM		00	DS1			11/01/79	EPA (FUND)
	HWY #16			PA1			04/01/83	EPA (FUND)
	HOPEWELL	VA 23860		SI1		08/17/88	12/19/88	EPA (FUND)
	670 HOPEWELL							
VAD981035795	NORWOOD WILSON, SR LOT		00	DS1			11/01/79	EPA (FUND)
	OFF EAST POYTHRESS ST			PA1	NFA	09/18/86	09/18/86	EPA (FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD980690622	PLANT LANDFILL		00	DS1			11/01/79	EPA (FUND)
	HERCULES RD POB 271			PA1	NFA		04/01/82	STATE(FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD988202586	REGIONAL ENTERPRISES INC		00	RV1		08/11/91	08/15/91	EPA (FUND)
	410 WATER STREET			DS1			08/11/91	EPA (FUND)
	HOPEWELL	VA 23860		PA1		08/10/91	08/11/91	EPA (FUND)
	670 HOPEWELL							
VAD003112448	STONE CONTAINER		00	DS1			03/01/84	EPA (FUND)
	RTE 10			PA1	NFA	07/01/84	09/19/85	STATE(FUND)
	HOPEWELL	VA 23860						
	670 HOPEWELL							
VAD988166096	LEXINGTON FARM		00	DS1			08/12/88	EPA (FUND)
	RTE 4 BX 342			PA1	NFA		03/29/89	STATE(FUND)
	LEXINGTON	VA 24450						
	678 ROCKBRIDGE							
VAD003119286	ALLEN MORRISON, INC.		00	DS1			06/29/93	EPA (FUND)
	RUTHERFORD STREET							
	LYNCHBURG	VA 24506						
	680 LYNCHBURG							

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VAD981037930	ARCHER CREEK LANDFILL		00	DS1			10/01/84	EPA (FUND)
	STATE ROUTE 726 (MT. ATHOS ROA			PA1	NFA	08/25/86	10/15/87	EPA (FUND)
	LYNCHBURG	VA 24501						
	680 LYNCHBURG							
VAD046960449	BABCOCK + WILCOX CO NNFD		00	DS1			08/01/80	EPA (FUND)
	SIX MLE BRG OFF 460E			PA1	NFA		05/01/84	STATE(FUND)
	LYNCHBURG	VA 24505						
	680 LYNCHBURG							
VAD074744228	FALWELL AVIATION INC		00	DS1			06/01/81	EPA (FUND)
	RICHMOND HWY RTE 460 E			PA1			04/01/84	STATE(FUND)
	LYNCHBURG	VA 24506		SI1	NFA	05/28/85	10/10/85	EPA (FUND)
	680 LYNCHBURG							
VAD003119070	FOREST INDUSTRIES		00	DS1			01/01/85	EPA (FUND)
	RTE 221 W			PA1	NFA	10/06/86	10/06/86	EPA (FUND)
	LYNCHBURG	VA 24502						
	680 LYNCHBURG							
VAD980551790	LYNCHBURG CITY MUN LANDFILL		00	DS1			06/01/81	EPA (FUND)
	RICHMOND HWY RTE 460 E			PA1			03/01/83	EPA (FUND)
	LYNCHBURG	VA 24504		SI1		01/31/89	05/01/89	EPA (FUND)
	680 LYNCHBURG			ES1	NFA		10/15/92	STATE(FUND)
VAD981034663	LYNCHBURG FOUNDRY - TYREEANA #3		00	DS1			03/01/85	EPA (FUND)
	CONCORD TPK. & ROUTE 460 EAST			PA1		12/01/84	03/01/85	EPA (FUND)
	LYNCHBURG	VA 24504		SI1	NFA	12/01/84	03/01/85	EPA (FUND)
	680 LYNCHBURG							
VAD981035844	LYNCHBURG FOUNDRY - TYREEANNA #2		00	DS1			04/01/84	EPA (FUND)
	NORTH SIDE OF KAVANAUG ROAD			PA1		06/09/87	06/09/87	STATE(FUND)
	LYNCHBURG	VA 24504		SI1	NFA	05/28/85	10/30/85	EPA (FUND)
	680 LYNCHBURG							

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VAD000820522	LYNCHBURG FOUNDRY WASTE DISPOSAL SITE		00	DS1			08/01/80	EPA (FUND)
	FLORIDA AVE & RTE 501			PA1			04/01/84	STATE(FUND)
	LYNCHBURG	VA 24505		SI1		04/25/85	08/28/85	EPA (FUND)
	680 LYNCHBURG			SI2	NFA		09/28/92	STATE(FUND)
VAD000820514	LYNCHBURG FOUNDRY-TYREEANNA		00	DS1			04/01/84	EPA (FUND)
	OFF STATE RD 1013			PA1			04/01/84	STATE(FUND)
	LYNCHBURG	VA 24504		SI1	NFA	11/11/85	03/24/88	EPA (FUND)
	680 LYNCHBURG							
VAD980692792	LYNCHBURG TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	BLACK WATER ST			PA1	NFA		03/01/83	STATE(FUND)
	LYNCHBURG	VA 24501						
	680 LYNCHBURG							
VAD023794910	AIR DISTRIBUTING CO		00	DS1			05/29/86	STATE(FUND)
	10105 RESIDENCY RD			PA1	NFA	06/26/86	06/26/86	STATE(FUND)
	MANASSAS	VA 22110						
	683 PRINCE WILLIAM							
VAD048581300	AMERICAN PECCO CORP.		00	DS1			08/22/86	EPA (FUND)
	10108 RESIDENCY RD			PA1	NFA	11/03/86	11/03/86	STATE(FUND)
	MANASSAS	VA 22110						
	683 PRINCE WILLIAM							
VAD003093200	GEORATOR CORP		00	DS1			05/30/86	STATE(FUND)
	RTES 668 & 28 (9617 CENTER ST)			PA1	NFA	09/18/86	09/18/86	EPA (FUND)
	MANASSAS	VA 22110						
	683 MANASSAS							
VAD064872575	IBM CORP (MANASSAS PLANT SPILL)		00	DS1			12/01/82	EPA (FUND)
	9500 GODWIN DRIVE			PA1			02/01/85	EPA (FUND)
	MANASSAS	VA 22110		HR1			10/01/84	OTHER
	683 MANASSAS			NP1			10/01/84	EPA (FUND)

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VAD064872575 (CONTINUED)	IBM CORP (MANASSAS PLANT SPILL)		(00)	SI1		10/01/84	02/01/85	EPA (FUND)
				NR1			10/04/89	EPA (FUND)
VAD100558444	INDEPENDENT HILL SITE (SP ED SCH)		00	DS1			05/30/86	STATE(FUND)
	JOPLIN & ADEN RDS			PA1		12/11/86	12/11/86	STATE(FUND)
	INDEPENDENT HILL	VA 22110		SI1			05/04/90	EPA (FUND)
	683 MANASSAS							
VAD981103781	J & H PLUMBING SUPPLY		00	DS1			10/22/85	STATE(FUND)
	RESIDENCY RD			PA1		06/25/86	06/30/86	STATE(FUND)
	MANASSAS	VA 22110		SI1	NFA	09/29/87	09/30/87	EPA (FUND)
	683 PRINCE WILLIAM							
VAD981937873	PRINCE WILLIAM COUNTY LANDFILL		00	DS1			05/04/87	EPA (FUND)
	RT 234 - INDEPENDENT HILL			PA1			03/29/89	STATE(FUND)
	MANASSAS	VA 22111		SI1			10/05/89	STATE(FUND)
	683 PRINCE WILLIAM							
VAD093011724	ROY'S AUTO MACHINE		00	DS1			10/22/85	EPA (FUND)
	RESIDENCY RD			PA1		06/25/86	06/30/86	STATE(FUND)
	MANASSAS	VA 22110		SI1		09/01/87	10/14/87	EPA (FUND)
	683 PRINCE WILLIAM							
VAD981038953	SMITTY'S AUTO		00	DS1			10/21/85	STATE(FUND)
	RESIDENCY RD			PA1		09/18/86	09/18/86	STATE(FUND)
	MANASSAS	VA 22110		SI1		09/01/87	10/14/87	EPA (FUND)
	683 PRINCE WILLIAM							
VAD981736044	WOODBINE ELEM. SITE		00	DS1			11/04/86	EPA (FUND)
	13225 DUMFRIES RD			PA1		04/06/87	04/06/87	STATE(FUND)
	MANASSAS	VA 22111		SI1	NFA	10/01/90	12/12/90	STATE(FUND)
	683 PRINCE WILLIAM							
VAD003114865	DUPONT MARTINSVILLE		00	DS1			06/01/81	EPA (FUND)
	POB 4831 DUPONT RD			PA1	NFA		07/01/82	EPA (FUND)
	MARTINSVILLE	VA 24112						
	690 HENRY							

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VAD980539274	MARTINSVILLE CY LANDFILL		00	DS1			06/01/81	EPA (FUND)
	CLEAR VIEW DR			PA1		11/01/84	04/22/85	EPA (FUND)
	MARTINSVILLE	VA 24112		SI1	NFA	01/31/89	03/27/89	EPA (FUND)
	690 HENRY							
VAD980551725	PRILLAMAN COMPANY INC LOT		00	DS1			01/10/90	STATE(FUND)
	FISHER ROAD			PA1			10/18/91	STATE(FUND)
	MARTINSVILLE	VA 24112						
	690 MARTINSVILLE							
VAD980552152	SOUTHERN RAILWAY CO DERAILMENT SITE		00	DS1			06/01/81	EPA (FUND)
	MLE POST 411			PA1	NFA		04/01/83	EPA (FUND)
	MARTINSVILLE	VA 24112						
	690 PITTSYLVANIA							
VAD988189197	KMART CORPORATION		00	DS1			12/04/91	EPA (FUND)
	401 ORIANA ROAD			PA1			09/22/92	STATE(FUND)
	NEWPORT NEWS	VA 23602		PA2			09/22/92	STATE(FUND)
	700 NEWPORT NEWS							
VAD054042296	LIEBHERR AMERICA INC PLT #1		00	DS1			06/01/81	EPA (FUND)
	4100 CHESTNUT AVE			PA1	NFA	09/01/84	11/01/84	STATE(FUND)
	NEWPORT NEWS	VA 23605						
	700 NEWPORT NEWS							
VAD980927271	NEWPORT NEWS MENCHVILLLE SITE		00	DS1			03/01/84	EPA (FUND)
	275 MENCHVILLE RD			PA1	NFA	09/01/84	11/01/84	STATE(FUND)
	NEWPORT NEWS	VA 23602						
	700 NEWPORT NEWS							
VAD980692677	NEWPORT NEWS TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	TERMINAL BLVD & 22ND ST			PA1	NFA		04/01/83	EPA (FUND)
	NEWPORT NEWS	VA 23601						
	700 NEWPORT NEWS							

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VAD981938517	OLD MENCHVILLE LANDFILL		00	DS1			05/04/87	EPA (FUND)
	OLD MENCHVILLE LANDFILL			PA1	NFA	05/13/87	05/13/87	STATE(FUND)
	NEWPORT NEWS	VA 23602						
	700 NEWPORT NEWS							
VAD980830483	PATRICK HENRY AIRPORT		00	DS1			10/01/83	EPA (FUND)
	BLAND BLVD			PA1		04/08/87	04/08/87	EPA (FUND)
	NEWPORT NEWS	VA 23602		SI1		08/07/85	03/19/86	EPA (FUND)
	700 NEWPORT NEWS							
VA6210020321	USA FT EUSTIS		00	DS1			12/01/79	EPA (FUND)
	FT EUSTIS			PA1			02/01/85	FED. FAC.
	NEWPORT NEWS	VA 23604		SI1			09/28/90	FED. FAC.
	700 NEWPORT NEWS			YA1		08/16/89	08/16/89	EPA (FUND)
VA5570090014	USAF OYSTER PT DEVEL CORP		00	DS1			06/01/81	EPA (FUND)
	603 PILOT HOUSE DRIVE			PA1	NFA		02/07/92	FED. FAC.
	NEWPORT NEWS	VA 23606						
	700 NEWPORT NEWS							
VAD988196853	ALLIED MARINE SITE		00	DS1			04/11/91	EPA (FUND)
	500 INDIAN RIVER ROAD			PA1	NFA	09/11/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD980829774	CAMPOSTELLA RD LANDFILL		00	DS1			06/01/83	EPA (FUND)
	CAMPOSTELLA RD			PA1	NFA	09/01/84	11/01/84	STATE(FUND)
	NORFOLK	VA 23523						
	710 NORFOLK							
VAD988196903	CARROLL TRUCKING SITE		00	DS1			04/11/91	EPA (FUND)
	6300 TIDEWATER DRIVE			PA1	NFA	09/11/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							

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EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988184552	ECOLOCHEM		00	DS1			04/10/91	EPA (FUND)
	4545 PATENT ROAD			PA1	NFA	08/19/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD988197000	F & C CAROLINA		00	DS1			04/10/91	EPA (FUND)
	SOUTH OF & ADJACENT TO 2628 TI			PA1	NFA	08/23/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD023837628	FINE PETROLEUM/MARINER HI TECH		00	RV1		08/25/92		EPA (FUND)
	2801 ST JULIAN AVE			RV2		11/05/92	03/03/93	RESP. PARTY
	NORFOLK	VA 23504		RV3		03/03/93	08/13/93	EPA (FUND)
	710 NORFOLK			DS1			02/14/86	STATE(FUND)
				PA1		09/21/87	09/21/87	STATE(FUND)
				SI1	NFA	01/31/89	03/28/89	EPA (FUND)
				AR1		11/19/92		FED ENFORCE
				YA1		07/27/92	08/25/92	EPA (FUND)
VAD058619677	FORD AEROSPACE & COMMUNICATIONS CORP		00	DS1			06/01/81	EPA (FUND)
	2715 NEVADA AVE			PA1	NFA	09/01/84	11/01/84	STATE(FUND)
	NORFOLK	VA 23513						
	710 NORFOLK							
VAD003177391	FORD MOTOR CO		00	DS1			06/01/81	EPA (FUND)
	PO BOX 780			PA1	NFA	06/09/87	06/09/87	STATE(FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD988197026	GENERAL FOAM PLASTIC CORP.		00	DS1			04/10/91	EPA (FUND)
	PRODUCTION ROAD			PA1	NFA	08/23/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD988197133	HAMPTON ROADS WELDERS SITE		00	DS1			04/12/91	EPA (FUND)
	2330 BOWDENS FERRY ROAD			PA1	NFA	09/05/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD041447111	INDUSTRIES MARINE SERVICE		00	DS1			04/11/91	EPA (FUND)
	1301 MARSH STREET			PA1			01/31/92	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD049184690	LAMBERT'S POINT TERMINAL		00	DS1			05/04/87	EPA (FUND)
	ONE COMMERCIAL PLACE			PA1	NFA	05/13/87	05/13/87	STATE(FUND)
	NORFOLK	VA 23514		SI1	NFA		10/05/89	STATE(FUND)
	710 NORFOLK							
VAD980918163	MOOR-FITE		00	IR1		06/20/83	01/25/84	EPA (FUND)
	TO BE OBTAINED			DS1			01/01/85	EPA (FUND)
	HAMPTON	VA 23511		PA1	NFA	09/24/86	09/24/86	EPA (FUND)
	710 NORFOLK							
VAD980539217	NORFOLK ASPHALT PLANT		00	DS1			06/01/81	EPA (FUND)
	BAINBRIDGE BLVD S ELIZA RVR			PA1	NFA	09/18/86	09/18/86	STATE(FUND)
	S NORFOLK	VA 23523						
	710 NORFOLK							
VAD980692735	NORFOLK TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	MONTICELLO & VA BEACH RD			PA1	NFA		04/01/83	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD988196911	TIDEWATER DRIVE SITE		00	DS1			04/11/91	EPA (FUND)
	6969 TIDEWATER DRIVE			PA1	NFA	09/11/91	11/01/91	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							
VAD988196929	TIDEWATER TRENCHES		00	DS1			04/11/91	EPA (FUND)
	8500 TIDEWATER DRIVE			PA1	NFA		02/03/92	EPA (FUND)
	NORFOLK	VA 23501						
	710 NORFOLK							

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** PROD VERSION **
U.S. EPA SUPERFUND PROGRAM
** C E R C L I S **
LIST-9: SITE/EVENT LISTING

CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME STREET CITY COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988204541	U.S. MARITIME ADMINISTRATION SOUTH ATLANTIC REGION 7737 HAM NORFOLK 710 NORFOLK	VA 23505	00	DS1			10/15/91	EPA (FUND)
VA5170022482	USN NAVAL AMPHIBIOUS BASE/LITTLE CREEK AMPHIBIOUS BASE NORFOLK 710 VIRGINIA BEACH	VA 23521	00	DS1 PA1			12/01/79 07/15/91	EPA (FUND) FED. FAC.
VA6170061463	USN NORFOLK NAVAL BASE HELMICK ST NORFOLK 710 NORFOLK	VA 23511	00	DS1 PA1 SI1	 NFA	 03/01/85	06/01/81 02/01/85 03/29/85	EPA (FUND) FED. FAC. FED. FAC.
VAD988196952	VISTA STREET SITE 1048 VISTA STREET NORFOLK 710 NORFOLK	VA 23501	00	DS1 PA1	 NFA	 09/11/91	04/11/91 11/01/91	EPA (FUND) EPA (FUND)
VAD980692917	PETERSBURG TOWN GAS BANK & MADISON STS PETERSBURG 730 PETERSBURG	VA 23803	00	DS1 PA1 SI1	 NFA	 08/01/84	10/01/82 03/01/83 09/01/84	EPA (FUND) EPA (FUND) EPA (FUND)
VAD988224135	PETERSBURG-DINWIDDIE REGIONAL AIRPORT AIRPORT ROAD PETERSBURG 730 DINWIDDIE	VA 23803	00	DS1			02/16/93	EPA (FUND)
VAD980552871	RANDOLPH FARM RIVER RD ETTRICK 730 CHESTERFIELD	VA 23803	00	DS1 PA1	 NFA		06/01/81 03/01/83	EPA (FUND) STATE(FUND)

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980551683	ABEX CORP		00	RS1		08/11/86	08/11/86	EPA (FUND)
	RANDOLPH + GREEN ST			RS2		06/27/90	06/27/90	EPA (FUND)
	PORTSMOUTH	VA 23704		RV1		08/11/86	02/28/90	RESP. PARTY
	740 PORTSMOUTH			RV3		06/26/92	09/28/93	RESP. PARTY
				DS1			06/01/81	EPA (FUND)
				PA1			05/01/83	EPA (FUND)
				NP1			06/16/88	EPA (FUND)
				NF1			08/30/90	EPA (FUND)
				SI1		10/11/85	03/25/86	EPA (FUND)
			01	CR1		10/10/89		STATE(FUND)
				AR1		04/28/92		FED ENFORCE
				CO1		10/10/89	09/29/92	OTHER
				RO1			09/29/92	FED ENFORCE
VAD990710410	ATLANTIC WOOD INDUSTRIES INC		00	RS1		05/11/90	05/11/90	EPA (FUND)
	3550 ELM ST			RS2		06/17/91	06/17/91	EPA (FUND)
	PORTSMOUTH	VA 23704		RV1		07/23/87		RESP. PARTY
	740 PORTSMOUTH			DS1			08/01/80	EPA (FUND)
				PA1			03/01/83	EPA (FUND)
				NP1			06/01/86	EPA (FUND)
				NF1			06/01/86	EPA (FUND)
				SI1		03/29/85	03/29/85	EPA (FUND)
				SI2		02/25/85	03/28/86	EPA (FUND)
			01	CR1		07/23/87		EPA (FUND)
				CO1		07/23/87		RESP. PARTY
				MA1		06/12/91		FED ENFORCE
				TA1		10/01/87	09/30/89	FED ENFORCE
VAD003174042	CPC INTERN INC		00	DS1			06/01/81	EPA (FUND)
	500 CONFEDERATE AVE			PA1	NFA		01/01/83	STATE(FUND)
	PORTSMOUTH	VA 23704						
	740 PORTSMOUTH							
VAD988197174	GREENWOOD DRIVE SITE		00	DS1			04/15/91	EPA (FUND)
	GREENWOOD DRIVE			PA1			06/30/92	STATE(FUND)
	PORTSMOUTH	VA 23701		PA2			06/30/92	STATE(FUND)
	740 PORTSMOUTH							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD003174018	MURRO CHEMICAL CO.		00	DS1			04/10/91	EPA (FUND)
	1520 & 1510 COLUMBUS AVENUE			PA1	NFA	08/26/91	11/01/91	EPA (FUND)
	PORTSMOUTH	VA 23701		YA1		04/08/92	04/08/92	EPA (FUND)
	740 PORTSMOUTH							
VAD988196978	PENINSULA AVENUE SITE		00	DS1			04/10/91	EPA (FUND)
	800 PENINSULA AVENUE			PA1	NFA	08/21/91	11/01/91	EPA (FUND)
	PORTSMOUTH	VA 23701						
	740 PORTSMOUTH							
VAD980692859	PORTSMITH TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	GUST LN			PA1			03/01/83	EPA (FUND)
	PORTSMOUTH	VA 23701		SI1	NFA	01/01/85	03/01/85	EPA (FUND)
	740 PORTSMOUTH							
VAD980918106	PORTSMOUTH CITY LANDFILL		00	DS1			08/01/84	EPA (FUND)
	CEDAR LANE			PA1	NFA	11/01/84	01/01/85	EPA (FUND)
	PORTSMOUTH	VA 23703						
	740 PORTSMOUTH							
VAD061177697	PORTSMOUTH DAY CARE CENTER		00	DS1		02/06/87	02/15/87	EPA (FUND)
	LINCOLN & 5TH STS			PA1			06/12/87	EPA (FUND)
	PORTSMOUTH	VA 23704		SI1			09/28/87	EPA (FUND)
	740 PORTSMOUTH							
VAD008956393	PORTSMOUTH LUMBER CORP		00	DS1			01/01/85	EPA (FUND)
	2511 HIGH ST			PA1	NFA	08/25/86	10/02/86	EPA (FUND)
	PORTSMOUTH	VA 23707						
	740 PORTSMOUTH							
VAD063418610	PORTSMOUTH LUMBER TREATING, INC		00	DS1			01/01/85	EPA (FUND)
	1501 HARPER AVE			PA1	NFA	04/22/86	07/03/86	EPA (FUND)
	PORTSMOUTH	VA 23707						
	740 PORTSMOUTH							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988197166	PORTSMOUTH WETLANDS SITE		00	DS1			04/12/91	EPA (FUND)
	ONE VICTORY CT, 3209 VICTORY B			PA1	NFA	08/26/91	11/01/91	EPA (FUND)
	PORTSMOUTH	VA 23701						
	740 PORTSMOUTH							
VAD003174810	PROCTOR & GAMBLE MFG CO PORTS		00	DS1			09/12/88	EPA (FUND)
	3600 ELM AVE			PA1	NFA		08/17/89	STATE(FUND)
	PORTSMOUTH	VA 23705						
	740 PORTSMOUTH							
VAD988228128	SCOTT CREEK DUMP		00	DS1			05/28/93	EPA (FUND)
	LONDON BLVD. AND JAMESTOWN AVE							
	PORTSMOUTH	VA 23704						
	740 PORTSMOUTH							
VAD988218871	SCOTT STREET SITE		00	DS1			07/20/92	STATE(FUND)
	817 WSCOTT STREET							
	PORTSMOUTH	VA 23704						
	740 PORTSMOUTH							
VAD982366775	SEAGUARD CORPORATION		00	DS1			03/07/88	STATE(FUND)
	4030 SEAGUARD AVE			PA1			03/29/89	STATE(FUND)
	PORTSMOUTH	VA 23705		SI1	NFA		12/12/89	EPA (FUND)
	740 PORTSMOUTH							
VAD988218178	SLOWEY PROPERTY		00	DS1			05/20/92	EPA (FUND)
	3301 DOGWOOD DRIVE			YA1		05/19/92		EPA (FUND)
	PORTSMOUTH	VA 23703						
	740 PORTSMOUTH							
VA4690320235	U.S. COAST GUARD SUPPORT CENTER		00	DS1			04/09/91	FED. FAC.
	4000 COAST GUARD BLVD.			PA1	NFA	05/09/91	05/11/92	FED. FAC.
	PORTSMOUTH	VA 23703						
	740 PORTSMOUTH							

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** PROD VERSION **
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** C E R C L I S **
LIST-8: SITE/EVENT LISTING

CERHELP DATA BASE DATE: N/A
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SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME STREET CITY COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VA7170022472	USN CRANEY IS FUEL TER		00	DS1			06/01/81	EPA (FUND)
	CRANEY ISLAND			PA1			07/15/91	FED. FAC.
	PORTSMOUTH	VA 23703						
	740 PORTSMOUTH							
VA6170024818	USN NAVAL HOSPITAL		00	DS1			01/23/90	FED. FAC.
	EFFINHAM AVE.			PA1	NFA		04/15/90	FED. FAC.
	PORTSMITH	VA 23708						
	740 PORTSMOUTH							
VA1170024813	USN NAVAL SHIPYARD NORFOLK		00	DS1			04/01/83	EPA (FUND)
	NORFOLK SHIPYARD			PA1			07/15/91	FED. FAC.
	PORTSMOUTH	VA 23709						
	740 PORTSMOUTH							
VA5170000181	USN ST JULIENS CREEK ANNEX		00	DS1			06/01/81	EPA (FUND)
	ST JULIENS CREEK ANNEX			PA1			04/01/83	FED. FAC.
	CHESAPEAKE	VA 23702						
	740 CHESAPEAKE							
VAD988197091	VICTORY BOULEVARD SITE		00	DS1			04/12/91	EPA (FUND)
	1141 VICTORY BOULEVARD			PA1	NFA		06/18/92	STATE(FUND)
	PORTSMOUTH	VA 23701						
	740 PORTSMOUTH							
VAD003175262	VIRGINIA CHEM INC		00	DS1			11/01/79	EPA (FUND)
	3340 W NORFOLK RD			PA1		06/30/85	09/30/85	STATE(FUND)
	PORTSMOUTH	VA 23703		SI1	NFA	08/31/88	12/01/88	EPA (FUND)
	740 PORTSMOUTH							
VAD981109861	WYCKOFF PIPE & CREOSOTING CO		00	DS1			02/13/86	EPA (FUND)
	OFF ELM AVE			PA1	NFA	04/02/86	07/02/86	EPA (FUND)
	PORTSMOUTH	VA 23704						
	740 PORTSMOUTH							

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** PROD VERSION **
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** C E R C L I S **
LIST-8: SITE/EVENT LISTING

CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD010063006	LYNCHBURG FOUNDRY RADFORD PLANT		00	DS1			08/01/80	EPA (FUND)
	FIRST ST			PA1	NFA		11/06/87	STATE(FUND)
	RADFORD	VA 24141		SI1	NFA		11/06/87	EPA (FUND)
	750 RADFORD							
VA1210020730	USA RADFORD AMMUNITION PLT		00	DS1			12/01/79	EPA (FUND)
	STATE RTE 114			PA1			07/28/86	FED. FAC.
	RADFORD	VA 24141		PA2		03/15/92		FED. FAC.
	750 RADFORD							
VAD003110087	A. H. ROBIN		00	DS1			01/11/91	EPA (FUND)
	1407 CUMMINGS DRIVE			PA1			10/01/90	STATE(FUND)
	RICHMOND	VA 23220						
	760 RICHMOND							
VAD066013731	ACME SCIENTIFIC CO, INC		00	DS1			09/08/86	EPA (FUND)
	11 S 15TH ST			PA1	NFA	10/10/86	10/10/86	STATE(FUND)
	RICHMOND	VA 23219						
	760 RICHMOND							
VAD046253225	AMF INC UNION MACHINERY DIV		00	DS1			06/01/81	EPA (FUND)
	2115 W LAUBURNUM AVE			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23227						
	760 RICHMOND							
VAD066000993	AT&T TECHNOLOGY SYSTEMS		00	DS1			09/12/88	EPA (FUND)
	4500 LABURNAM AVE			PA1	NFA		09/29/89	STATE(FUND)
	RICHMOND	VA 23231						
	760 HENRICO							
VAD988225975	ATLANTIC PUMP PCP SITE		00	DS1			04/02/93	EPA (FUND)
	301 JEFFERSON HIGHWAY			PA1		04/21/93	07/09/93	EPA (FUND)
	RICHMOND	VA 23224						
	760 RICHMOND							

Appendix E

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980514285	BON AIR LANDFILL		00	DS1			11/01/79	EPA (FUND)
	OLD BON AIR RD (STATE RTE 718)			PA1			02/01/82	EPA (FUND)
	BON AIR	VA 23235		PA2		09/18/85	10/01/85	STATE(FUND)
	760 CHESTERFIELD			SI1		10/01/82	10/01/82	EPA (FUND)
VAD103793857	BYRD INTERNATIONAL AIRPORT		00	DS1			10/21/85	EPA (FUND)
	WILLIAMSBURG RD			PA1		05/14/86	05/14/86	STATE(FUND)
	RICHMOND	VA 23231		SI1	NFA	08/27/87	08/27/87	STATE(FUND)
	760 HENRICO							
VAD049957913	C & R BATTERY CO INC		00	RS1		05/02/90	05/02/90	EPA (FUND)
	1320 BELLWOOD RD			RS2		06/10/91	06/10/91	EPA (FUND)
	RICHMOND	VA 23234		RS3		07/08/93	08/03/93	EPA (FUND)
	760 CHESTERFIELD			RV1		07/15/86	08/26/87	EPA (FUND)
				DS1			02/01/84	EPA (FUND)
				PA1		12/01/84	12/01/84	EPA (FUND)
				PA2		12/01/84	12/01/84	STATE(FUND)
				NP1			01/22/87	EPA (FUND)
				NF1			07/01/87	
				SI1		02/24/86	01/12/87	EPA (FUND)
				CR1		03/31/88		EPA (FUND)
			01	AR1		01/23/90		EPA (FUND)
				CO1		03/31/88	03/30/90	EPA (FUND)
				RO1			03/30/90	EPA (FUND)
				RD1		09/27/90	03/27/92	EPA (FUND)
				RA1		04/28/92		RESP. PARTY
				TA1		01/30/89	03/30/90	EPA (FUND)
VAD981735996	C & R BATTERY MERRIEWOOD		00	DS1			10/24/86	STATE(FUND)
	7001 JEFFERSON DAVIS HWY			PA1	NFA	10/24/86	10/24/86	STATE(FUND)
	RICHMOND	VA 23237						
	760 CHESTERFIELD							
VAD980690689	CHARLES CITY RD SITE		00	DS1			11/01/79	EPA (FUND)
	4005 CHARLES CITY RD			PA1	NFA		06/01/82	STATE(FUND)
	RICHMOND	VA 23231						
	760 HENRICO							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD003136736	CROWN CENTRAL PETROLEUM CORP		00	DS1			06/01/81	EPA (FUND)
	4401 E MAIN ST			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23202						
	760 RICHMOND							
VAD003112824	DOUGLAS CHEMICAL CO		00	DS1		02/13/87	02/15/87	EPA (FUND)
	5012 WALLER RD			PA1		05/13/87	05/13/87	STATE(FUND)
	RICHMOND	VA 23230		SI1		10/01/90	10/01/90	STATE(FUND)
	760 HENRICO							
VAD980705769	DUPONT SPRUANCE FIBERS PLT		00	DS1			11/01/79	EPA (FUND)
	JEFFERSON DAVIS HGY POB 27222			PA1			06/01/83	EPA (FUND)
	RICHMOND	VA 23261		SI1	NFA	06/01/83	08/01/84	EPA (FUND)
	760 CHESTERFIELD							
VAD980552582	EAST RICHMOND RD LANDFILL		00	DS1			06/01/81	EPA (FUND)
	3500 E RICHMOND RD			PA1			03/01/83	EPA (FUND)
	RICHMOND	VA 23223		SI1		08/01/84	09/01/84	EPA (FUND)
	760 RICHMOND							
VAD980539993	FT DARLING LANDFILL		00	DS1			06/01/81	EPA (FUND)
	BELLWOOD RD			PA1			03/01/83	EPA (FUND)
	BELLWOOD	VA 23234		SI1	NFA	03/01/85	06/28/85	EPA (FUND)
	760 RICHMOND							
VAD980693212	FULTON BOTTOM TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	FULTON & WILLIAMBURG RD			PA1	NFA		04/01/83	STATE(FUND)
	RICHMOND	VA 23201						
	760 RICHMOND							
VAD091218255	HASKELL CHEMICAL PLANT		00	DS1			10/22/85	EPA (FUND)
	6101 STAPLES MILL RD			PA1	NFA	04/06/87	04/06/87	STATE(FUND)
	RICHMOND	VA 23229						
	760 HENRICO							

RUN DATE: 10/07/93 18:05:59
CERCLIS DATA BASE DATE: 10/06/93
CERCLIS DATA BASE TIME: 17:22:42
VERSION 3.00

** PROD VERSION **
U.S. EPA SUPERFUND PROGRAM
** C E R C L I S **
LIST-8: SITE/EVENT LISTING

PAGE: 81
CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980552160	HENRICO CTY CHARLES CY LANDFILL #3		00	DS1			06/01/81	EPA (FUND)
	CHARLES CY RD			PA1			04/01/83	EPA (FUND)
	RICHMOND	VA 23231		SI1		04/29/85	08/28/85	EPA (FUND)
	760 HENRICO							
VAD980552350	HENRICO CTY NINE MILE LANDFILL #2		00	DS1			06/01/81	EPA (FUND)
	TUXEDO BLVD			PA1			03/01/83	EPA (FUND)
	RICHMOND	VA 23223		SI1		06/17/85	02/06/86	EPA (FUND)
	760 RICHMOND							
VAD980552400	HENRICO CTY SPRINGFIELD RD LANDFILL #1		00	DS1			06/01/81	EPA (FUND)
	NUCKOLS RD			PA1			04/01/83	EPA (FUND)
	RICHMOND	VA 23229		SI1			10/01/85	EPA (FUND)
	760 HENRICO							
VAD003112364	HYMAN VIENER & SONS		00	DS1			02/01/85	EPA (FUND)
	5300 HATCHER ST			PA1		04/30/85	09/30/85	STATE(FUND)
	RICHMOND	VA 23231		SI1			08/26/88	EPA (FUND)
	760 RICHMOND			YA1		04/12/93		EPA (FUND)
VAD980552467	MARTIN MARIETTA CORP		00	DS1			06/01/81	EPA (FUND)
	1400 GORDON AVE			PA1	NFA		03/01/83	EPA (FUND)
	RICHMOND	VA 23224						
	760 RICHMOND							
VAD003115706	NELSON ELECTRIC CO		00	RV2		06/22/90		RESP. PARTY
	1010 HOLLY SPRING AVE			DS1			04/18/89	EPA (FUND)
	RICHMOND	VA 23214		PA1	NFA		10/18/89	EPA (FUND)
	760 RICHMOND			SI1	NFA		03/12/92	STATE(FUND)
				AR1		09/12/90		FED ENFORCE
VAD000819474	PHILIP MORRIS USA JAMES RIVER CENTER		00	DS1			06/01/81	EPA (FUND)
	4200 DEEPWATER TERM RD			PA1	NFA	05/13/87	05/13/87	STATE(FUND)
	RICHMOND	VA 23234						
	760 RICHMOND							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD089028377	REHIG INTERNATIONAL INC		00	DS1			09/12/88	EPA (FUND)
	901 N LOMBARDY ST			PA1			08/17/89	STATE(FUND)
	RICHMOND	VA 23220						
	760 RICHMOND							
VAD071040752	RENTOKIL INC VA WOOD PRESERVING DIV		00	RS1		01/15/92		EPA (FUND)
	OAKVIEW AVE & PEYTON STS			RS2		07/08/93	08/17/93	EPA (FUND)
	RICHMOND	VA 23228		RV1		06/22/92	09/29/92	RESP. PARTY
	760 HENRICO			DS1			08/01/80	EPA (FUND)
				PA1			03/01/84	STATE(FUND)
				HR1			01/22/87	EPA (FUND)
				NP1			01/22/87	EPA (FUND)
				NF1			03/31/89	EPA (FUND)
				SI1		08/05/85	03/24/88	EPA (FUND)
				AR1		03/24/92		FED ENFORCE
				XC1			09/19/89	EPA (FUND)
			01	CR1		05/16/85		FED ENFORCE
				AR1		11/01/89		FED ENFORCE
				CO1		12/31/87		RESP. PARTY
				RO1			06/22/93	FED ENFORCE
				TA1		02/05/88		STATE(FUND)
VAD065375735	REYNOLDS METAL CO		00	DS1			06/01/81	EPA (FUND)
	11TH & BYRD ST			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23219						
	760 RICHMOND							
VAD000819532	REYNOLDS METAL CO - BELLWOOD EXTR PLANT		00	DS1			06/01/81	EPA (FUND)
	1901 REYMET RD			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23234						
	760 CHESTERFIELD							
VAD000819540	REYNOLDS METAL CO - BELLWOOD PLANT #44		00	DS1			06/01/81	EPA (FUND)
	1701 REYMET RD			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23234						
	760 CHESTERFIELD							

Appendix E
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SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD039048103	REYNOLDS METAL CO BELLWOOD PRINT PLANT		00	DS1			06/01/81	EPA (FUND)
	2001 REYMET RD			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23234						
	760 CHESTERFIELD							
VAD039048046	REYNOLDS METAL CO BELLWOOD RECLAIM PLANT		00	DS1			06/01/81	EPA (FUND)
	1711 REYMET RD			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23234						
	760 CHESTERFIELD							
VAD039048160	REYNOLDS METAL CO RICHMOND S PLT		00	DS1			06/01/81	EPA (FUND)
	7TH BAINBRIDGE STS			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23224						
	760 RICHMOND							
VAD980552285	REYNOLDS METALS CO SOUTHERN GRAVURE		00	DS1			06/01/81	EPA (FUND)
	POB 25131 SPROUSE DR			PA1	NFA		03/01/84	STATE(FUND)
	RICHMOND	VA 23231						
	760 HENRICO							
VAD000620393	RICHMOND BARREL & BOX CO INC		00	DS1			04/25/86	STATE(FUND)
	2012 DABNEY RD			PA1	NFA	10/06/86	10/06/86	EPA (FUND)
	RICHMOND	VA 23230						
	760 HENRICO							
VAD980831150	RICHMOND METRO AUTHORITY QUARRY		00	DS1			02/01/84	EPA (FUND)
	W OF BLVD BRIDGE			PA1	NFA	06/30/85	09/30/85	STATE(FUND)
	RICHMOND	VA 23224						
	760 RICHMOND							
VAD988217532	SAUNDERS AVENUE SITE		00	DS1			05/21/92	EPA (FUND)
	SAUNDERS AVENUE							
	RICHMOND	VA 23227						
	760 RICHMOND							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988224556	SAUNDERS OIL COMPANY		00	DS1			11/12/92	EPA (FUND)
	1200 W. MARSHALL ST.			TA1		12/03/92	02/10/93	EPA (FUND)
	RICHMOND	VA 23220						
	760 RICHMOND							
VAD980691034	SCHNEIDER LANDFILL		00	DS1			11/01/79	EPA (FUND)
	PO BOX 1-S CHARLES CITY RD			PA1			03/01/82	STATE(FUND)
	RICHMOND	VA 23202		SI1		05/10/85	12/03/85	EPA (FUND)
	760 HENRICO							
VA3971520751	U.S. DEFENSE GENERAL SUPPLY CENTER		00	DS1			06/01/81	EPA (FUND)
	JEFFERSON DAVIS HGY			PA1			04/25/88	FED. FAC.
	RICHMOND	VA 23297		HR1			10/01/84	OTHER
	760 CHESTERFIELD			NP1			10/01/84	EPA (FUND)
				NF1			07/01/87	
				SI1			04/25/88	FED. FAC.
				CR1		10/09/91		FED. FAC.
			01	CO1		08/15/87	05/15/92	FED. FAC.
				RO1			05/15/92	FED. FAC.
				TA1		02/05/88		STATE(FUND)
			02	CO1		09/21/90		FED. FAC.
			03	CO1		09/21/90		FED. FAC.
			04	CO1		09/21/90		FED. FAC.
			05	CO1		08/15/87	03/25/92	FED. FAC.
				RO1			03/25/92	FED. FAC.
				RD1		07/31/92	07/30/93	FED. FAC.
			06	CO1		10/11/91		FED. FAC.
			07	CO1		10/11/91		FED. FAC.
			08	CO1		10/11/91		FED. FAC.
			09	CO1		10/11/91	09/29/93	FED. FAC.
				RO1			09/29/93	FED. FAC.
VAD980832836	VALLEY PLATING		00	RV1		04/06/90	04/26/91	EPA (FUND)
	920 EAST LABURUM AVENUE			DS1			02/12/86	EPA (FUND)
	RICHMOND	VA 23222		PA1		04/08/86	04/08/86	STATE(FUND)
	760 HENRICO			HR1			04/21/87	EPA (FUND)

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980832836	VALLEY PLATING							
(CONTINUED)			(00)	SI1		09/12/86	01/22/87	EPA (FUND)
				YA1		04/06/90	04/06/90	EPA (FUND)
VAD000621235	VEPCO FACILITY - CASTLEWOOD RD		00	DS1			05/01/84	EPA (FUND)
	CASTLEWOOD RD			PA1	NFA	09/18/86	09/18/86	STATE(FUND)
	RICHMOND	VA 23234						
	760 RICHMOND							
VAD075656801	VIRGINIA SAW & KNIFE		00	DS1			03/04/88	EPA (FUND)
	11 S PROVIDENCE RD			PA1	NFA		05/19/88	EPA (FUND)
	RICHMOND	VA 23236						
	760 RICHMOND							
VAD981736572	WALLER DEPOT		00	DS1			01/05/87	EPA (FUND)
	WALLER RD			PA1	NFA	01/02/87	01/02/87	STATE(FUND)
	RICHMOND	VA 23230						
	760 HENRICO							
VAD000766113	WHITTAKER SCIENTIFIC		00	DS1			09/12/88	EPA (FUND)
	8741 LANDMARK RD			PA1			09/06/89	EPA (FUND)
	RICHMOND	VA 23228						
	760 HENRICO							
VAD980173217	YOUNG DRUM SITE		00	DS1			07/23/90	EPA (FUND)
	STATE ROUTE 608			PA1	NFA	06/21/91	03/25/92	STATE(FUND)
	BROOKES	VA 22401		YA1		05/18/90	05/18/90	EPA (FUND)
	750 STAFFORD							
VAD981736119	3400 DEEPWATER TERMINAL RD		00	DS1			10/24/86	STATE(FUND)
	3400 DEEPWATER TERMINAL RD			PA1	NFA		10/24/86	STATE(FUND)
	RICHMOND	VA 23234						
	760 RICHMOND							
VAD980927032	AMERICAN VISCOSE CO		00	DS1			03/01/84	EPA (FUND)
	1912 9TH ST SE			PA1		03/14/86	03/14/86	EPA (FUND)
	ROANOKE	VA 24046		SI1			07/08/88	EPA (FUND)
	770 ROANOKE							

RUN DATE: 10/07/93 19:05:59
CERCLIS DATA BASE DATE: 10/06/93
CERCLIS DATA BASE TIME: 17:22:42
VERSION 3.00

** PROD VERSION **
U.S. EPA SUPERFUND PROGRAM
** C E R C L I S **
LIST-9: SITE/EVENT LISTING

PAGE: 86
CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980539514	CROWN CENTRAL PETROLEUM CORP		00	DS1			06/01/81	EPA (FUND)
	1019 S JEFFERSON ST			PA1	NFA		03/01/84	STATE(FUND)
	ROANOKE	VA 24016						
	770 ROANOKE							
VAD980552335	EASTERN DEVELOPERS		00	DS1			06/01/81	EPA (FUND)
	STATESMAN IND PARK			PA1			04/01/83	STATE(FUND)
	ROANOKE	VA 24012						
	770 ROANOKE							
VAD003123072	I T T ROANOKE - ELEC OPTICAL PROD DIV		00	DS1			10/22/85	EPA (FUND)
	7635 PLANTATION RD			PA1	NFA	03/24/86	03/24/86	STATE(FUND)
	ROANOKE	VA 24019						
	770 ROANOKE							
VA5170090026	NAVY AND MARINE CORPS RESERVE		00	DS1			04/09/91	FED. FAC.
	5301 BARNES AVE. NW			PA1	NFA		02/07/92	FED. FAC.
	ROANOKE	VA 24019						
	770 ROANOKE							
VAD981037450	ROANOKE REGIONAL LANDFILL		00	DS1			02/01/85	EPA (FUND)
	P.O. BOX 27			PA1	NFA	09/23/86	09/23/86	EPA (FUND)
	ROANOKE	VA 24001						
	770 ROANOKE							
VAD981736366	ROANOKE RIVER DRUM SITE		00	IR1		11/22/85	03/05/87	EPA (FUND)
	ROANOKE RIVER VALLEY&SMITH MT.			DS1			11/24/85	EPA (FUND)
	ROANOKE	VA 24001-0050		PA1	NFA		11/16/87	EPA (FUND)
	770 SALEM							
VAD980692610	ROANOKE TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	NE KIMBELL S RUTHERFORD AVE			PA1	NFA		11/01/83	EPA (FUND)
	ROANOKE	VA 24001						
	770 ROANOKE							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME STREET CITY COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980552277	STAUFFER CHEM CO		00	DS1			06/01/81	EPA (FUND)
	GREENBRIER AVE S KENWOOD BLVD			PA1	NFA		08/01/83	STATE(FUND)
	ROANOKE	VA 24013						
	770 ROANOKE							
VAD980552095	DIXIE CAVERNS COUNTY LANDFILL		00	RS1		01/15/91	01/15/91	EPA (FUND)
	RTE 778			RS2		03/04/92		EPA (FUND)
	SALEM	VA 24153		RV1		10/26/87	06/16/93	RESP. PARTY
	775 SALEM			RV2		08/28/92		RESP. PARTY
				DS1			06/01/81	EPA (FUND)
				PA1			04/01/83	EPA (FUND)
				NP1			01/22/87	EPA (FUND)
				NF1			10/04/89	EPA (FUND)
				SI1		04/03/85	06/20/85	EPA (FUND)
				AR1		01/20/92		FED ENFORCE
			01	CR1		08/29/89		EPA (FUND)
				AR1		08/15/91		EPA (FUND)
				RI1		08/29/89	09/28/92	EPA (FUND)
				FS1		08/29/89	09/30/91	EPA (FUND)
				RO1			09/30/91	EPA (FUND)
				RD1		07/01/93		RESP. PARTY
				TA1		02/05/88		STATE(FUND)
			02	AR1		08/20/92		EPA (FUND)
				FS1		08/29/89	09/28/92	EPA (FUND)
				RO1			09/28/92	EPA (FUND)
VAD988207039	HUTCHINS, LE - SALEM		00	DS1			10/30/91	EPA (FUND)
	SHAWNEE DRIVE			PA1			03/26/92	STATE(FUND)
	SALEM	VA 24153						
	775 SALEM							
VAD980552293	KOPPERS CO ROANOKE VLY PLT		00	DS1			06/01/81	EPA (FUND)
	RTE 460 4 MI W OF SALEM			PA1	NFA		04/01/83	STATE(FUND)
	SALEM	VA 24153						
	775 ROANOKE							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD980712970	MATTHEWS ELECTRIC PLATING		00	RS1		06/14/90	06/14/90	EPA (FUND)
	RTE 796			RV1		03/26/88	08/16/88	EPA (FUND)
	ROANOKE	VA 24153		DS1			09/01/80	EPA (FUND)
	775 ROANOKE			PA1			09/01/80	EPA (FUND)
				HR1			12/01/82	OTHER
				NP1			10/01/81	EPA (FUND)
				NF1			09/01/83	EPA (FUND)
				SI1		08/01/82	08/01/82	EPA (FUND)
				AR1		07/20/93		EPA (FUND)
				ND1		07/20/88	01/19/89	EPA (FUND)
			01	AR1		02/16/88		EPA (FUND)
				WP1			09/01/82	EPA (FUND)
				CO1		09/30/81	06/02/83	EPA (FUND)
				RO1			06/02/83	EPA (FUND)
				TA1		01/26/83	06/02/83	EPA (FUND)
				RD1		09/20/83	07/30/84	EPA (FUND)
				RA1		12/28/83	01/30/86	EPA (FUND)
				OM1		07/30/86		STATE(FUND)
VAD980551972	HOWLES SPRING PARK LANDFILL		00	DS1			06/01/81	EPA (FUND)
	OFF TWELVE O'CLOCK KNOB RD			PA1			04/01/83	EPA (FUND)
	SALEM	VA 24153		SI1	NFA	04/01/84	09/01/84	EPA (FUND)
	775 SALEM							
VAD988170437	OLD SALEM TANNERY		00	RV1		09/03/92	11/24/92	EPA (FUND)
	BEHIND THE WEST SALEM PLAZA			RV2		11/24/92		RESP. PARTY
	SALEM	VA 24153		DS1			12/07/89	STATE(FUND)
	775 SALEM			PA1			10/18/91	STATE(FUND)
				SI1		10/18/91	06/16/92	STATE(FUND)
				AR1		12/07/92		FED ENFORCE
				YA1		02/14/92	09/03/92	EPA (FUND)
VAD980552038	SALEM CY LANDFILL		00	DS1			06/01/81	EPA (FUND)
	OFF ROWE ST			PA1	NFA		04/01/83	EPA (FUND)
	SALEM	VA 24153						
	775 SALEM							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME STREET CITY COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988167895	SALEM ELECTRIC DEPARTMENT PO BX 869 (ON WEST MAIN) SALEM 775 SALEM	VA 24153-0869	00	DS1 PA1	 NFA		12/28/88 10/18/89	EPA (FUND) EPA (FUND)
VAD089022685	C-K CO STATE RD SOUTH BOSTON 780 SOUTH BOSTON	VA 24592	00	DS1 PA1	 NFA		11/01/84 12/16/87	EPA (FUND) STATE(FUND)
VAD000799437	S BOSTON CY SAN LANDFILL WILLIAM ST S BOSTON 780 SOUTH BOSTON	VA 24592	00	DS1 PA1	 NFA		05/01/81 03/01/84	EPA (FUND) STATE(FUND)
VAD074757394	S BOSTON SLUDGE DISP UNOBTAINABLE SOUTH BOSTON 780 SOUTH BOSTON	VA 24592	00	DS1 PA1	 NFA		11/01/79 03/01/84	EPA (FUND) STATE(FUND)
VAD044736726	WESTINGHOUSE - SOUTH BOSTON RTE 58 W SOUTH BOSTON 780 HALIFAX	VA 24592	00	DS1 PA1 SI1			02/12/86 04/06/87 03/01/88	EPA (FUND) STATE(FUND) STATE(FUND)
VAD003130127	AMERICAN SAFETY RAZOR POB 500 STAUNTON 790 STAUNTON	VA 24401	00	DS1 PA1 SI1		 11/01/80	09/01/80 11/01/80 11/01/80	EPA (FUND) STATE(FUND) EPA (FUND)
VAD988224085	AUGUSTA COUNTY LANDFILL JOLLIVUE STAUNTON 790 STAUNTON	VA 24401	00	DS1 PA1	 NFA	 07/01/93	01/29/93 09/27/93	EPA (FUND) EPA (FUND)

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD988189320	BEVERLY EXXON		00	DS1			01/03/91	EPA (FUND)
	163 GREENVILLE AVENUE			PA1			10/18/91	STATE(FUND)
	STAUNTON	VA 24401		SI1		03/19/92		STATE(FUND)
	790 STAUNTON							
VAD980705693	HEINRICH FARM		00	DS1			11/01/79	EPA (FUND)
	RTE 254 & INTERSTATE 81			PA1	NFA		06/01/80	EPA (FUND)
	STAUNTON	VA 24401						
	790 AUGUSTA							
VAD041285966	KLOTZ BROTHERS COURTYARD		00	DS1			08/13/86	STATE(FUND)
	202 S LEWIS ST			PA1		01/02/87	01/02/87	STATE(FUND)
	STAUNTON	VA 24401		SI1		07/23/87	08/05/87	STATE(FUND)
	790 STAUNTON			AR1		02/08/91		FED ENFORCE
				YA1		08/16/89	08/16/89	EPA (FUND)
VAD981735954	KLOTZ BROTHERS JUNKYARD		00	RV1		11/30/88		RESP. PARTY
	BRIDGE ST & MIDDLEBROOK			DS1			01/05/87	EPA (FUND)
	STAUNTON	VA 24401		PA1		01/02/87	01/02/87	STATE(FUND)
	790 STAUNTON			SI1		05/08/91	03/26/92	STATE(FUND)
				YA1		04/08/92		EPA (FUND)
VAD083045823	SHENANDOAH RECYCLING		00	DS1			10/15/91	EPA (FUND)
	INTERSTATE 81 & SR254			PA1			03/25/92	STATE(FUND)
	STAUNTON	VA 24401						
	790 STAUNTON							
VAD023972581	ADVANCED WOOD PRODUCTS		00	DS1			01/01/85	EPA (FUND)
	1209 CAROLINE RD			PA1	NFA	08/25/86	02/19/87	EPA (FUND)
	SUFFOLK	VA 23434						
	800 SUFFOLK							
VAD981937931	CSX TRANSPORTATION		00	DS1			05/04/87	EPA (FUND)
	HILL STREET			PA1			03/29/89	STATE(FUND)
	SUFFOLK	VA 23434		SI1	NFA	06/19/90	02/08/91	STATE(FUND)
	800 SUFFOLK							

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE ZIP / CONG DIST.	OPRBLE UNIT	EVENT TYPE	EVENT QUAL	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
VAD003120739	DIXIE GUANA CO		00	DS1			05/04/87	EPA (FUND)
	611 FACTORY ST			PA1	NFA		08/02/88	EPA (FUND)
	SUFFOLK	VA 23434						
	800 SUFFOLK							
VAD980539399	HOLLAND ENTERPRISES		00	DS1			06/01/81	EPA (FUND)
	NANSEMOND PKWY			PA1	NFA	08/01/84	09/01/84	STATE(FUND)
	SUFFOLK	VA 23434		YA1		03/10/92	04/29/92	EPA (FUND)
	800 SUFFOLK							
VAD003117389	SAUNDERS SUPPLY CO		00	RS1		05/22/90	05/22/90	EPA (FUND)
	KINGS HWY BY CRITTENDEN & GODW			RS2		06/04/91	06/04/91	EPA (FUND)
	CHUCKATUCK	VA 23432		RS3		08/25/93	09/03/93	EPA (FUND)
	800 SUFFOLK			DS1			04/01/82	EPA (FUND)
				PA1		08/01/84	09/01/84	STATE(FUND)
				NP1			01/22/87	EPA (FUND)
				NF1			10/04/89	EPA (FUND)
				SI1		08/30/85	03/20/86	EPA (FUND)
			01	CR1		03/31/89		EPA (FUND)
				AR1		03/13/90		EPA (FUND)
				CO1		08/05/87	09/30/91	EPA (FUND)
				TS1		07/03/90	03/08/91	EPA (FUND)
				RO1			09/30/91	EPA (FUND)
				RD1		07/22/92		EPA (FUND)
				MA1		02/13/91		STATE(FUND)
				TA1		02/05/88		STATE(FUND)
VAD072848849	SUFFOLK CHEM CO		00	DS1			09/01/80	EPA (FUND)
	SURBURBAN DR			PA1	NFA		07/01/82	EPA (FUND)
	SUFFOLK	VA 23434						
	800 SUFFOLK							
VAD980917983	SUFFOLK CITY LANDFILL		00	RS1		08/16/89	11/29/89	EPA (FUND)
	UNOBTAINABLE			RS2		02/10/90	03/14/90	EPA (FUND)
	SUFFOLK	VA 23434		DS1			09/01/84	EPA (FUND)
	800 SUFFOLK			PA1		11/01/84	04/19/85	EPA (FUND)

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SEQUENCE: STATE, CNTY CODE, SITE NAME

EVENTS: ALL

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VAD980917983	SUFFOLK CITY LANDFILL							
(CONTINUED)			(00)	NP1			06/16/88	EPA (FUND)
				NF1			02/21/90	EPA (FUND)
				SI1		03/26/86	07/02/86	EPA (FUND)
				XC1			02/09/90	EPA (FUND)
			01	CR1		05/11/89		OTHER
				AR1		08/13/92		FED ENFORCE
				CO1		06/30/89	09/30/92	OTHER
				RO1			09/30/92	FED ENFORCE
VAD980693030	SUFFOLK TOWN GAS		00	DS1			10/01/82	EPA (FUND)
	HILL ST			PA1			03/01/83	EPA (FUND)
	SUFFOLK	VA 23434		SI1		04/30/85	06/10/85	EPA (FUND)
	800 SUFFOLK							
VAD980257067	SWIFT AGRI CHEM CORP		00	DS1			11/01/79	EPA (FUND)
	BOX 1609			PA1	NFA		03/01/84	STATE(FUND)
	SUFFOLK	VA 23434						
	800 SUFFOLK							
VAD123933426	TIDEWATER COMM COLLEGE-FREDERICK CAMPUS		00	RV1		04/22/87	04/27/87	EPA (FUND)
	STATE RTE 135			RV2		10/23/87		RESP. PARTY
	SUFFOLK	VA 23434		DS1			05/13/87	EPA (FUND)
	800 SUFFOLK			PA1			07/27/88	EPA (FUND)
				AR1		11/21/90		EPA (FUND)
				AR2		05/10/91		FED ENFORCE
VA9170022488	USN RADIO TRANSMITTING FACILITY		00	DS1			06/01/81	EPA (FUND)
	3300 SLEEPY HOLE RD			PA1			02/01/85	FED. FAC.
	SUFFOLK	VA 23434		PA2			10/31/87	FED. FAC.
	800 SUFFOLK			SI1			09/28/90	FED. FAC.
VAD988197083	DAM NECK BORROW PIT SITE		00	DS1			04/12/91	EPA (FUND)
	DAM NECK ROAD			PA1	NFA		03/31/92	STATE(FUND)
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							

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EVENTS: ALL

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VAD988197059	EUCLID ROAD ASPHALT SITE		00	DS1			04/10/91	EPA (FUND)
	4985 EUCLID ROAD			PA1	NFA	08/30/91	11/01/91	EPA (FUND)
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							
VAD988213062	HILLTOP PLAZA		00	DS1			02/11/92	EPA (FUND)
	VIRGINIA BEACH BOULEVARD			PA1	NFA	07/01/93	09/16/93	STATE(FUND)
	VIRGINIA BEACH	VA 23452						
	810 VIRGINIA BEACH							
VAD981739238	LYNN HAVEN BAY SITE		00	RV1		03/10/87	06/30/87	COAST GUARD
	UNOBTAINABLE			DS1			06/30/87	EPA (FUND)
	LYNN HAVEN SHORES	VA 23451		PA1	NFA		10/22/92	STATE(FUND)
	810 VIRGINIA BEACH							
VAD988196895	LYNNHAVEN PARK SITE		00	DS1			04/10/91	EPA (FUND)
	1250 HAYNE DRIVE			PA1	NFA	08/19/91	11/01/91	EPA (FUND)
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							
VAD988196739	MT. TRASHMORE		00	DS1			03/05/91	EPA (FUND)
	300 EDWIN DRIVE/NEAR INDEPENDE			PA1			03/31/92	STATE(FUND)
	VIRGINIA BEACH	VA 23464		YA1		03/20/91		EPA (FUND)
	810 VIRGINIA BEACH							
VAD988197034	MURRAY DEBRIS LANDFILL		00	DS1			04/10/91	EPA (FUND)
	SOUTH MILITARY HIGHWAY			PA1	NFA	09/05/91	11/01/91	EPA (FUND)
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							
VAD988197067	OLD DAM NECK ROAD SITE		00	DS1			04/10/91	EPA (FUND)
	632 OLD DAM NECK ROAD			PA1	NFA	08/19/91	11/01/91	EPA (FUND)
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							

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EVENTS: ALL

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VAD988197075	STERLING MONTGOMERY SITE		00	DS1			04/12/91	EPA (FUND)
	4233 PRINCESS ANNE ROAD			PA1	NFA		04/16/92	EPA (FUND)
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							
VA6210020975	USA FT STORY		00	DS1			12/01/79	EPA (FUND)
	BLDG 6300			PA1			02/01/85	FED. FAC.
	VIRGINIA BEACH	VA 23450						
	810 VIRGINIA BEACH							
VA1170090012	USN CAMP PENDLETON		00	DS1			06/01/81	EPA (FUND)
	BIRDNECK RD S & GEN BTH BLD			PA1			03/01/83	FED. FAC.
	VIRGINIA BEACH	VA 23453						
	810 VIRGINIA BEACH							
VA5170022938	USN FLEET COMBAT TRAINING CENTER		00	DS1			06/01/81	EPA (FUND)
	REGULUS AVE			PA1			03/01/85	FED. FAC.
	VIRGINIA BEACH	VA 23461						
	810 VIRGINIA BEACH							
VA2170024606	USN NAVAL AIR STN OCEANA		00	DS1			12/01/79	EPA (FUND)
	NAS			PA1			07/15/91	FED. FAC.
	OCEANA	VA 23460						
	810 VIRGINIA BEACH							
VAD988196887	VIRGINIA BEACH GARDEN PARK		00	DS1			04/11/91	EPA (FUND)
	PARK LOCATED OFF HOLLY ROAD			PA1		08/23/91	11/01/91	EPA (FUND)
	VIRGINIA BEACH	VA 23450		SI1		01/07/92		STATE(FUND)
	810 VIRGINIA BEACH							
VAD988196960	VIRGINIA BEACH LANDFILL #2		00	DS1			04/12/91	EPA (FUND)
	1989 JAKE SEARS ROAD (LANDFILL			PA1		08/30/91	11/01/91	EPA (FUND)
	VIRGINIA BEACH	VA 23450		SI1		07/29/92		STATE(FUND)
	810 VIRGINIA BEACH							

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VAD098446768	CROMPTON CO INC SHENANDOAH PLT		00	DS1			06/01/81	EPA (FUND)
	400 RACE ST			PA1	NFA	12/31/86	12/31/86	STATE(FUND)
	WAYNESBORO	VA 22980						
	820 WAYNESBORO							
VAD003132438	GENERAL ELECTRIC-WAYNESBORO		00	DS1			06/01/81	EPA (FUND)
	GENERAL ELECTRIC DR			PA1			02/01/84	EPA (FUND)
	WAYNESBORO	VA 22980		SI1		09/30/88	01/24/89	EPA (FUND)
	820 WAYNESBORO							
VAD980552947	WAYNESBORO MUN LANDFILL		00	DS1			06/01/81	EPA (FUND)
	COMMERCE AVE			PA1		11/13/85	04/08/86	EPA (FUND)
	WAYNESBORO	VA 22980		SI1			08/22/88	EPA (FUND)
	820 WAYNESBORO							
VAD024000374	WAYNESBORO NURSERIES		00	DS1			11/01/79	EPA (FUND)
	BOX 987			PA1		08/29/85	03/13/86	EPA (FUND)
	WAYNESBORO	VA 22980		SI1	NFA	02/04/86	05/05/86	EPA (FUND)
	820 WAYNESBORO							
VA1170024698	CAMP PEARY DOD		00	DS1			06/01/81	EPA (FUND)
	INTERSECTION I-64 & RTE 143			PA1			04/01/83	FED. FAC.
	WILLIAMSBURG	VA 23185						
	830 YORK							
VAD980552764	JAMES CITY COUNTY LANDFILL		00	DS1			06/01/81	EPA (FUND)
	RTE 611			PA1	NFA		04/01/83	STATE(FUND)
	WILLIAMSBURG	VA 23185						
	830 JAMES CITY							
VA3170024605	NSC CHEATHAM ANNEX		00	DS1			05/02/86	FED. FAC.
	CHEATHAM ANNEX			PA1			05/08/86	FED. FAC.
	WILLIAMSBURG	VA 23185						
	830 YORK							

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EVENTS: ALL

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VAD981035314	WALTRIP LANDFILL		00	DS1		04/01/85	02/15/87	STATE(FUND)
	MARCLAY RD			PA1	NFA	09/24/85	09/24/85	STATE(FUND)
	WILLIAMSBURG	VA 23185						
	830 WILLIAMSBURG							
VAD990710642	WILLIAMSBURG PLT LANDFILL BADISCHE CORP		00	DS1			06/01/81	EPA (FUND)
	RTE 60 W OF LEE HALL			PA1	NFA		05/01/83	STATE(FUND)
	WILLIAMSBURG	VA 23185						
	830 WILLIAMSBURG							
VAD980551758	FREDERICK CTY SAN LANDFILL		00	DS1			06/01/81	EPA (FUND)
	SULPHUR SPRING RD			PA1			04/01/83	EPA (FUND)
	WINCHESTER	VA 22601		SI1	NFA	06/14/85	01/14/86	EPA (FUND)
	840 WINCHESTER							
VAD981038490	PAPERMILL RD LANDFILL		00	DS1			11/01/84	EPA (FUND)
	W OF PAPERMILL RD			PA1	NFA	09/10/86	10/04/86	EPA (FUND)
	WINCHESTER	VA 22601						
	840 WINCHESTER							
VAD980831796	RHINEHART TIRE FIRE DUMP		00	RS1		06/13/90	06/13/90	EPA (FUND)
	MT FALLS			RS2		05/15/91	05/15/91	EPA (FUND)
	WINCHESTER	VA 22601		RV1		11/01/83	05/02/84	EPA (FUND)
	840 FREDERICK			RV2		02/13/84	11/01/84	RESP. PARTY
				DS1			11/01/83	EPA (FUND)
				PA1		03/01/84	09/01/84	EPA (FUND)
				HR1			10/01/84	OTHER
				NP1			10/01/84	EPA (FUND)
				NF1			06/01/86	EPA (FUND)
				SI1		08/01/84	09/01/84	EPA (FUND)
			01	CR1		09/26/85		EPA (FUND)
				AR1		04/01/88		EPA (FUND)
				WP1			05/19/86	EPA (FUND)
				CO1		04/23/85	06/30/88	EPA (FUND)

RUN DATE: 10/07/93 10:05:59
CERCLIS DATA BASE DATE: 10/06/93
CERCLIS DATA BASE TIME: 17:22:42
VERSION 3.00

** PROD VERSION **
U.S. EPA SUPERFUND PROGRAM
** C E R C L I S **
LIST-8: SITE/EVENT LISTING

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CERHELP DATA BASE DATE: N/A
CERHELP DATA BASE TIME: N/A

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EVENTS: ALL

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VAD980831796 (CONTINUED)	RHINEHART TIRE FIRE DUMP							
			(01)	RO1			06/30/88	EPA (FUND)
				RD1		09/28/88	07/17/89	EPA (FUND)
				RA1		09/29/89		EPA (FUND)
				TA1		04/23/85	06/30/88	STATE(FUND)
				TA2		02/05/88	06/30/88	STATE(FUND)
			02	AR1		08/13/92		EPA (FUND)
				CO1		09/28/88	09/29/92	EPA (FUND)
				RO1			09/29/92	EPA (FUND)
				RD1		09/30/93		EPA (FUND)
				MA1		07/17/91		EPA (FUND)
VAD988208708	VALLEY FERTILIZER & CHEMICAL PROPERTY ROUTE 837 WINCHESTER 840 WINCHESTER	VA 22601	00	DS1			12/04/91	EPA (FUND)
VAD070360219	WINCHESTER LAMP PLANT GEN ELEC RT 3 BOX 310 WINCHESTER 840 WINCHESTER	VA 22601	00	DS1			09/17/90	EPA (FUND)
				PA1			10/18/91	EPA (FUND)