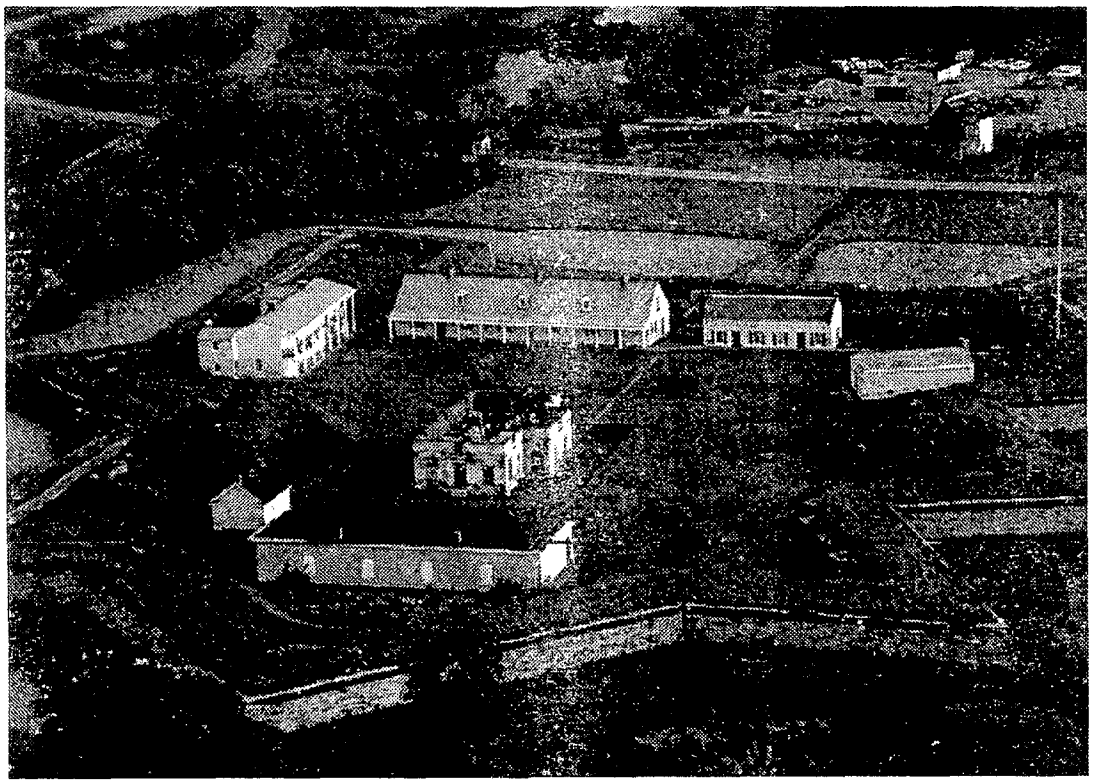
MASTER PLAN



FORT MIFFLIN

☆ On The Delaware ☆

2 October 1995

prepared for : Fort Mifflin on the Delaware

prepared by : CLRdesign inc.

Pennsylvania Coastal Zone Management Program

FORT MIFFLIN ON THE DELAWARE MASTER PLAN

JUNE, 1995

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A REPORT OF THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES TO THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION PURSUANT TO NOAA AWARD NO. _____

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MASTER PLAN

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1 Executive Summary

Originally sited strategically on the Delaware River south of the City of Philadelphia, Fort Mifflin now is set within a dramatically altered social and physical context. Credited by historians with a critical defensive role during the American War of Independence, the Fort has endured urban change, industrial growth, and developments in military warfare which, over the years, have threatened to relegate it to the status of relic rather than resource. In 1962 Fort Mifflin was deeded to the City of Philadelphia, though plans for the restoration of the Fort as a historic site were not fully implemented at that time.

In 1992, a non-profit organization, **Fort Mifflin on the Delaware**, assumed administration of the site in a year-to-year lease from the City of Philadelphia. Since that time, notable gains have been made at the Fort. Improved maintenance and physical repairs, as well as establishment of a regular schedule of educational, interpretive and special event programs figure among the indications of a turning of the tide of fortune at Fort Mifflin.

In the spring of 1994, CLRdesign inc. (CLR) was contracted to prepare a physical Master Plan for **Fort Mifflin on the Delaware**. The Master Plan presents a broad summary of operations and facilities at the Fort, assessing current status and establishing goals for the future. Elements of the Master Plan have been prepared by Fort staff and address Fort programming and activities, as well as Fort operations and physical plant. Architectural survey, historical restoration and building condition analysis are not included in the scope of this master planning effort. Conclusions and recommendations from previous historic surveys prepared by others have been included in this report.

The physical Master Plan prepared by CLR in close cooperation with Fort staff evaluates existing site conditions and makes proposals for facilities improvements to accommodate increased visitation, provides an in-depth examination of land use issues, and suggests methods to improve interpretation of Fort Mifflin as a unique historic and environmental resource. The Master Plan establishes a long-range vision for the Fort property which can be approached as a series of discrete projects to be prioritized and implemented over time. To this end, consideration is given not only to the historic aspects of Fort Mifflin, but to its valuable waterfront, and the undeveloped southern half of the approximately fifty acre site.

The Plan makes recommendations for building, landscape, site, and environmental improvements at three levels: addressing existing problems related to the physical site; remedying aesthetic issues; and enhancing educational and recreational opportunities at the Fort through development of interpreted landscape and historic areas.

The final section of the Master Plan describes its recommendations as discrete projects, and prioritizes them according to immediate requirements, short-term needs, and long-term recommendations.

Immediate Action Projects include:

- Moat Improvements
- Wayfinding Sign Installation
- Gatehouse and Entry Improvements
- Visitor Parking
- Historic Fort Perimeter Parade Ground Paving
- North Sallyport Access Improvements

Short-term Action Projects include:

- Improvements to Fort Mifflin Road Access
- Dock Reconstruction
- Battery Boardwalk
- Historic Fort Parapet Viewing
- Wood Foot Bridges
- Moat Boardwalk
- Nature Trail Access Path
- Primary Nature Trail
- Interpretive Signage
- Self-Guiding Brochures

Long-term Action Projects include:

- Visitor Services Building
- Visitor Services Plaza
- Storehouse Restroom Improvements
- Fort Satellite Sales Shop
- Secondary Nature Trails
- Interpretive Video Program
- Interpretive Audio Program
- Memorial to Defenders of the Fort

2 Existing Conditions at Fort Mifflin

2.1 Chronology of the Existing Fort

Fort Mifflin was originally constructed in 1771 on what was called Mud Island, located in the Delaware River approximately 500 feet from the Pennsylvania shore. Captain John Montressor, working for the King of England, laid out three plans for the fortification. The one chosen was a modified star, formed out of stone, with bastions facing the east. The rest of the Fort was constructed of racines and stockade fence.

Destroyed by the British during a seven week siege in 1777, the Fort was reconstructed in 1779; the first buildings being the Bombproofs and the Citadel (now the Commandant's House). Eventually, the Soldiers' and Officers' Quarters, Artillery Shed, Powder Magazine and Blacksmith Shop were built inside the Fort. The Hospital Building was built outside the Fort to the northeast. Lastly, the Torpedo Casemate was constructed in 1867. South of the Fort, the High Water Battery was begun during the Civil War, but never completed.

The Blakely House (Cannonball House) was originally located about one mile northwest of the Fort and was moved by the Water Department in the 1970's, when they were mandated by the EPA to expand their facilities. It is currently located directly north of the Fort and west of the Hospital Building. It is an historic intrusion that in no way is relevant to the interpretive plan of Fort Mifflin, and is deteriorating at a rapid rate.

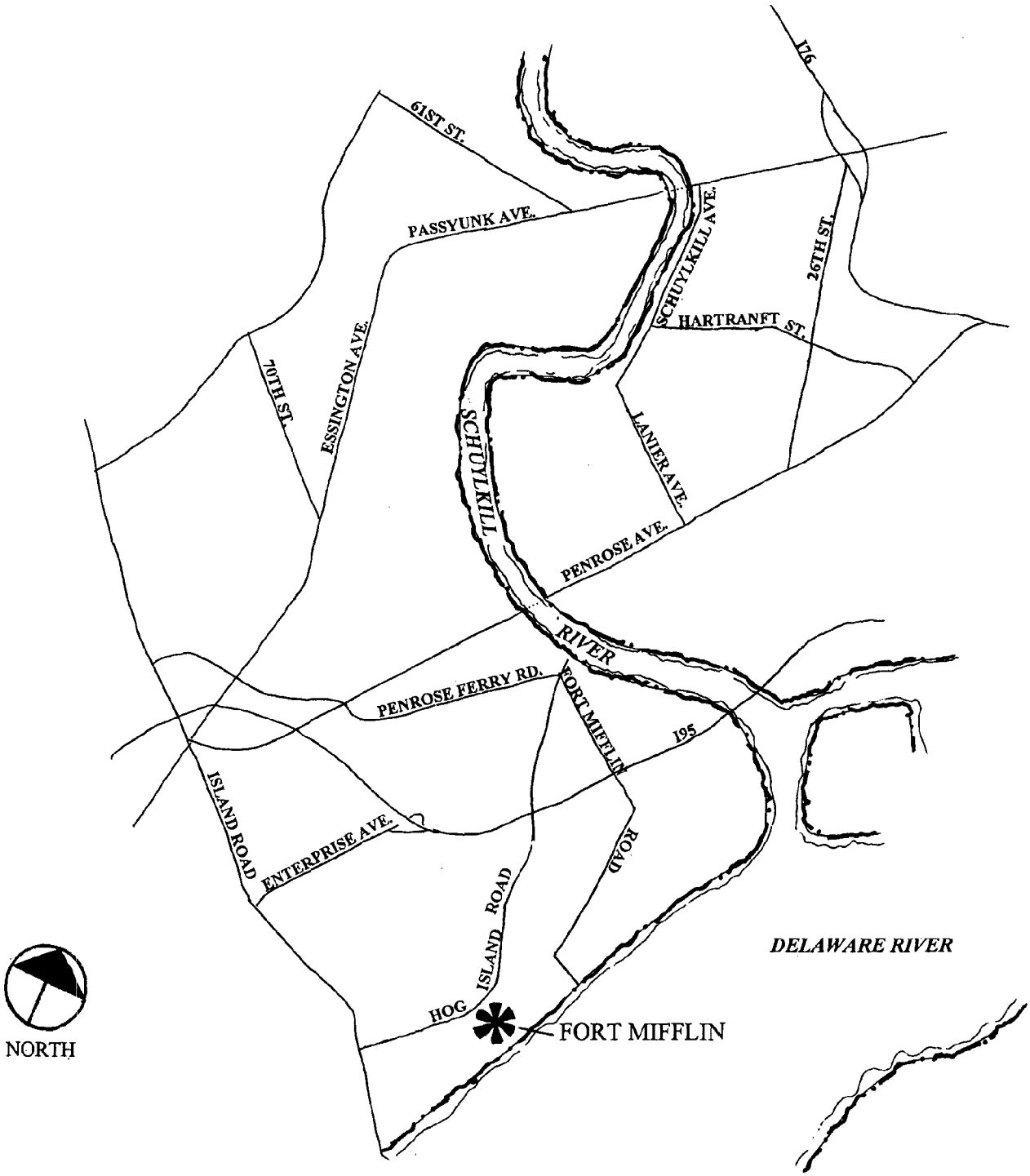
The Fort Mifflin Historic Landmark is presently run by the non-profit organization **Fort Mifflin on the Delaware** which assumed control of the site from the City of Philadelphia in 1992. Before the creation of the non-profit organization, the site was kept open by the **Olde Fort Mifflin Historical Society**, a group of individuals devoted to the historic nature of the Fort. As fundraising and administration became an ever more important issue, the Society agreed to the formation of the non-profit organization for administration of the site.

Archaeological materials are constantly found on the site, either during supervised digging or as they surface due to changing ground conditions. The original base of both a Revolutionary War structure (located in the northeast corner of the front parade ground) and the Guard Shack (just east of the Storehouse) are still visible on the grounds.

The entire area of open space from Hog Island (south of Mud Island) to the Schuylkill River is Fort Mifflin. However, when the army left the historic Fort in 1954, the amount of acreage ceded to the City was approximately 46 acres, including the Fort, the moat and front parade areas, demilune and High Water Battery. In actuality, the acreage of historic Fort Mifflin runs over Island Avenue and into the Airport property. The Army Corps provides an access easement for use of the dock on the Delaware River (which remains Army Corps property) and for the Hospital Building and surrounding ground, located northeast of the Fort. This area represents an additional 3.8 acres beyond the original historic property. The Fort is bordered on the east by the Delaware River, on the north by the Army Corps and Police Impoundment Lot, on the west by the Philadelphia International Airport, and on the south by the Fort Mifflin Terminal. All aforementioned organizations are often considered "Fort Mifflin" and are referred to in various documents as the Fort Mifflin Army Corps Project, Fort Mifflin Auto Pound, and Fort Mifflin Terminal. These adjoining properties are not considered historic and for the most part are located on man-made land that once was part of the Delaware River or a back channel.

Today, the property totals approximately 49.8 acres, including significant wetland area, approximately 25 acres of wooded area, a moat, 14 historic buildings, and a dock. An access road to the Army Corps and National Guard Installation crosses the property. The site is secured by a chain link fence and the Delaware River.

SITE LOCATION PLAN



2.2 The Existing Site

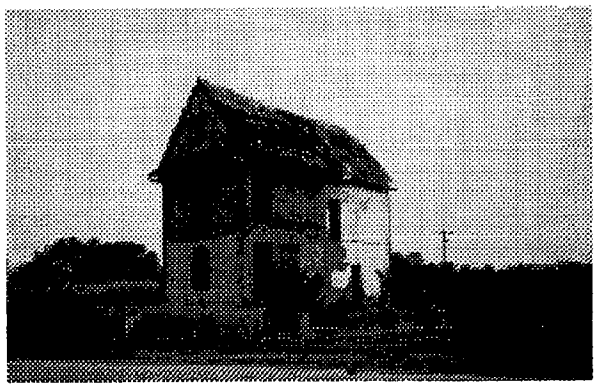
- **The Arrival Experience**

Fort Mifflin represents a unique resource for the City, given the history of its site, and the extent to which its historical buildings have remained intact. The industrial context which has developed around the Fort, however, poses obstacles to the Fort's image.

The Fort, adjacent to major regional and local highways at the southern edge of the City, is located within convenient driving distance for Philadelphia residents, as well as for visitors. The Fort does suffer though from being isolated from other historic and recreational resources by its industrial neighbors. Currently, no public transportation is available in the vicinity of the Fort. The actual approach to the Fort, bypassing industrial complexes and the Philadelphia International Airport, gives little indication of the presence of the historic site. Existing directional signage to the Fort is inadequate for overcoming this situation. Even the vehicular entry for the Fort property, a shared entry with the Army Corps of Engineers, presents a weak image of the historic resource located just beyond.

The Fort's immediate neighbors, the Philadelphia International Airport and the Army Corps of Engineers, have a significant effect on the Fort environment. The presence of the Airport is constantly audible and visible, as planes fly directly over Fort Mifflin at regular, frequent intervals. Unscreened views into the Army Corps service yards also detract from the historic and aesthetic atmosphere at the Fort.

Among these conflicting first impressions of Fort Mifflin, the visitor's arrival experience includes some confusion in parking and ticketing. A guard is employed to greet and ticket visitors at the vehicular entry only on weekends and during periods of anticipated high visitation. During the week, ticketing and security depend on Fort staff being in the administration building and alert to activity outside. The informal parking area now provided for visitors is unpaved, un-edged, and undersized for anything more than minimal visitation. This lot is adjoined by the Cannonball House which is in a significantly deteriorated condition.

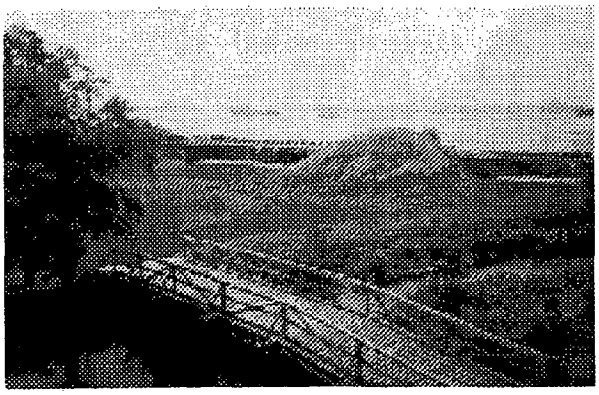


The Cannonball House is in an extremely deteriorated condition, and is proposed for removal from the site.

Fort Mifflin's strongest asset relative to visitor arrival is the Fort itself. The entry view of the Fort walls is unarguably powerful and compelling.

- **The Historic Fort**

Current use of the fifty-acre site is confined to approximately half of the site - the historic Fort, the Hospital Building area, and the recently developed picnic area adjacent to the Water Battery. Both of these areas provide significant attractions. The Water Battery affords impressive views overlooking both the Delaware River and the Fort itself. Although this relationship to the Delaware River is elemental in the establishment of the original Fort, there no longer is access to the Fort from the River, as the existing Fort dock is in unstable condition. The Fort itself includes a number of intact historic structures. The northeastern parapet provides an excellent vantage from which to view both the Fort compound and the Delaware River.



The northeast parapet affords excellent views of the Delaware River, as well as views across the historic Fort itself.

Although there are new gravel walks at the picnic area, there is no clear, continuous or fully accessible circulation route for the visitor. Site orientation depends on interpretation provided either by a Fort guide or by brochure. Access to many portions of the site is occasionally limited by wet ground conditions.

The Fort is sited below the level of the Delaware River, resulting in significant water buildup, poor surface drainage, and water related stresses on Fort structures. Site water problems are compounded during rainy periods by large volumes of water shed from I-95 and the Airport due to inappropriate road and runway drainage.

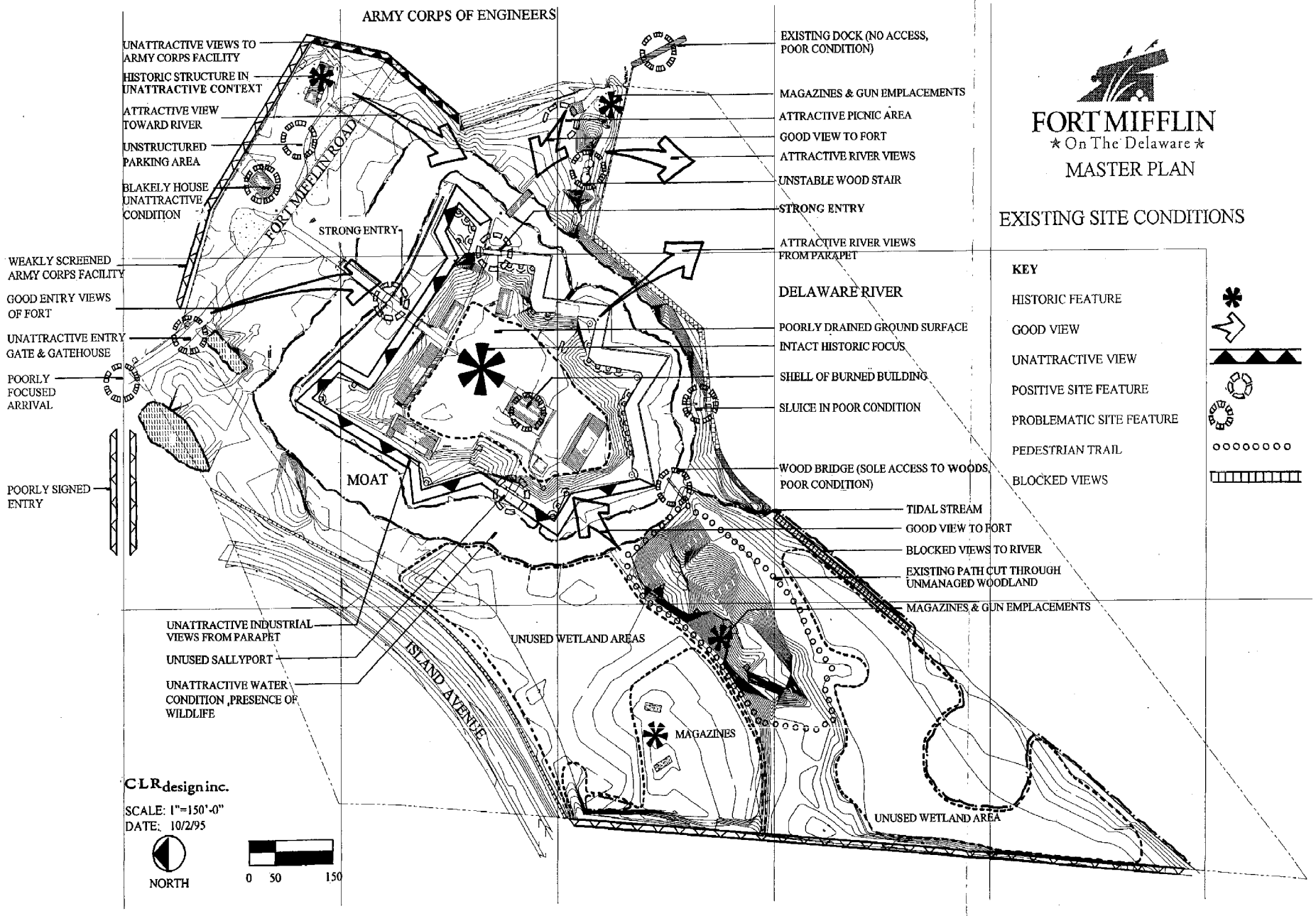
- **The Moat**

Fort Mifflin provides features of significant environmental interest in addition to its historic resources. The Fort moat is interesting from both perspectives, being home to a variety of wildlife, including a Pennsylvania threatened species of turtle. The condition of the moat is quickly deteriorating, however, due to siltation and an unchecked spread of vegetation. The sluicegate which at one time provided for flushing action of the moat by the Delaware River is now inoperable. The moat presently collects drainage from the Fort and surrounding land. There is significant flooding during and after any large rainfall.

- **The Nature Walk**

Across the moat at the southern half of the property, a path is marginally maintained through a large tract of otherwise unmanaged vegetation. Much of this area is wetland, and provides an accommodating habitat for wildlife species. This is a pleasant area, but it is neither significant nor distinctive in terms of its vegetation, and it is difficult to access.

The southern half of the site is difficult to access, and given over to unmanaged vegetation.


ARMY CORPS OF ENGINEERS
UNATTRACTIVE VIEWS TO ARMY CORPS FACILITY
HISTORIC STRUCTURE IN UNATTRACTIVE CONTEXT
ATTRACTIVE VIEW TOWARD RIVER
UNSTRUCTURED PARKING AREA
BLAKELY HOUSE UNATTRACTIVE CONDITION
FORT MIFFLIN ROAD
STRONG ENTRY
WEAKLY SCREENED ARMY CORPS FACILITY
GOOD ENTRY VIEWS OF FORT
UNATTRACTIVE ENTRY GATE & GATEHOUSE
POORLY FOCUSED ARRIVAL
POORLY SIGNED ENTRY
MOAT
UNATTRACTIVE INDUSTRIAL VIEWS FROM PARAPET
UNUSED SALLYPORT
UNATTRACTIVE WATER CONDITION ,PRESENCE OF WILDLIFE
ISLAND AVENUE
UNUSED WETLAND AREAS
MAGAZINES
UNUSED WETLAND AREA
EXISTING DOCK (NO ACCESS, POOR CONDITION)
MAGAZINES & GUN EMPLACEMENTS
ATTRACTIVE PICNIC AREA
GOOD VIEW TO FORT
ATTRACTIVE RIVER VIEWS
UNSTABLE WOOD STAIR
STRONG ENTRY
ATTRACTIVE RIVER VIEWS FROM PARAPET
DELAWARE RIVER
POORLY DRAINED GROUND SURFACE
INTACT HISTORIC FOCUS
SHELL OF BURNED BUILDING
SLUICE IN POOR CONDITION
WOOD BRIDGE (SOLE ACCESS TO WOODS, POOR CONDITION)
TIDAL STREAM
GOOD VIEW TO FORT
BLOCKED VIEWS TO RIVER
EXISTING PATH CUT THROUGH UNMANAGED WOODLAND
MAGAZINES & GUN EMPLACEMENTS
CLRdesign inc.
SCALE: 1"=150'-0"
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NORTH
0 50 150
FORT MIFFLIN
On The Delaware
MASTER PLAN
EXISTING SITE CONDITIONS
KEY
HISTORIC FEATURE
GOOD VIEW
UNATTRACTIVE VIEW
POSITIVE SITE FEATURE
PROBLEMATIC SITE FEATURE
PEDESTRIAN TRAIL
BLOCKED VIEWS

2.3 Use of Historic Facilities

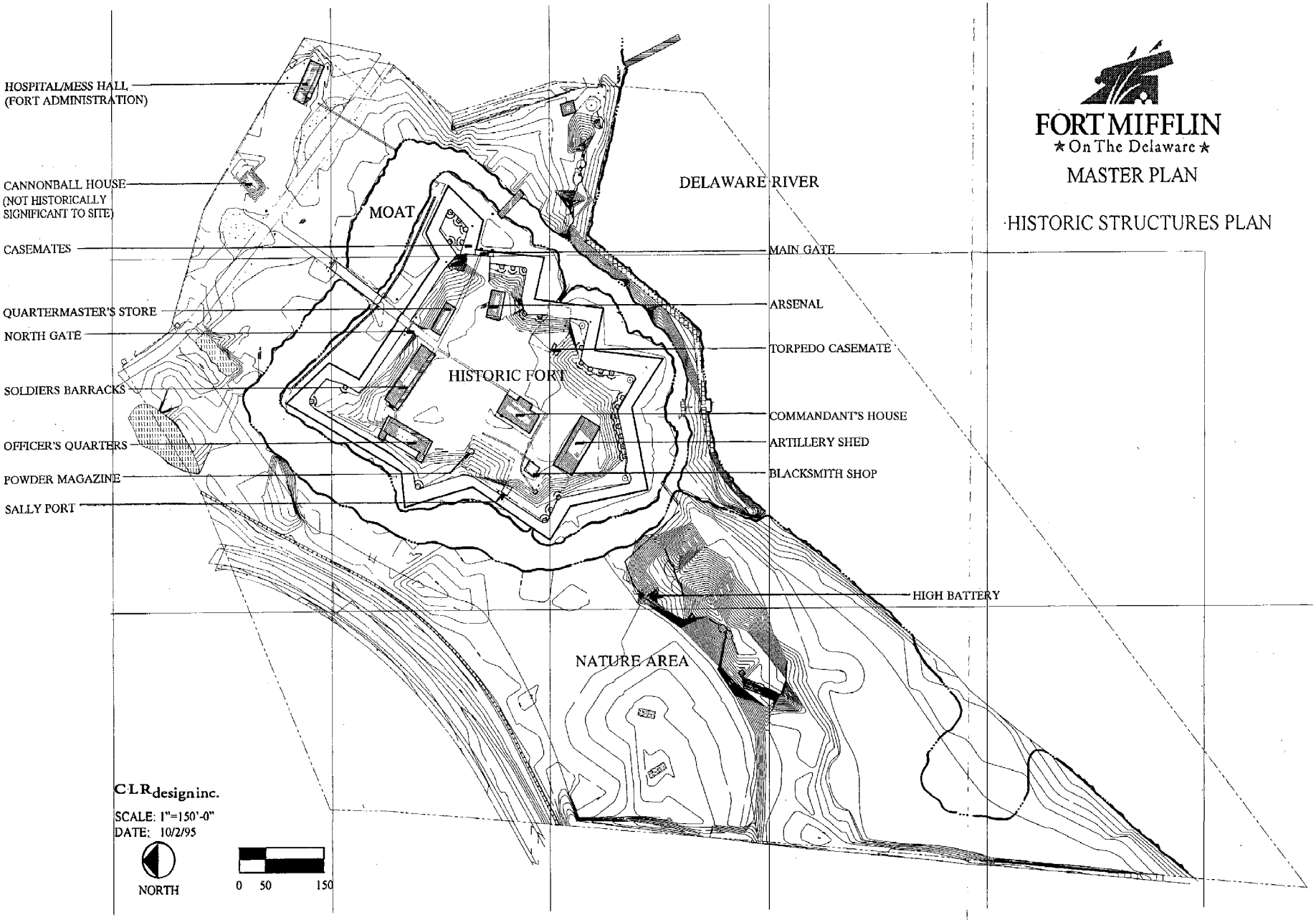
The current use of Fort Mifflin's historic structures is itemized below. Staff have noted that one thousand visitors is the maximum that can be accommodated within the Fort at any one time. Buildings have poor ventilation and no seasonal climate control. Building spaces are small. Few historic interiors are interpreted through the presence of furniture, fixtures and/or artifacts.

Inside the Fort, there are three bathroom stalls for women, and two for men, in addition to limited retail facilities located in the Quartermaster's Store.

- **Facilities Usage Chart**

Building	Historic Use	Current Use	Proposed Use
Hospital/Mess Hall			
Downstairs	Mess Hall	Meeting Space Kitchen Area Office Space	Visitor Activities Offices
Upstairs	Post Hospital Residential Area	Office Space	Office Space
Officers' Quarters			
Upstairs	Officers' Living Space	Break Room Changing Room	Break Room/Storage Changing Room/Vault
Downstairs		Display Areas	Interpreted Exhibit Rooms
Soldiers' Barracks			
Upstairs	Soldiers' Living Space/ Laundress's Room	Maintenance Room	Maintenance Room
Downstairs	Soldiers' Bunk Room Soldiers' Bunk Room Mess Hall Sutler's Shop Day Sergeant's Room	Soldier's Bunk Room Diorama Room Empty Storage Medical Display	Soldiers' Bunk Room Exhibit Space Meeting Space Electrical Switches Satellite Sales Shop/ Beverages
Storehouse	Commissary	Sales Shop/Restrooms	Enlarged Restrooms
Casemate #1/Bombproof	Prison	Interpreted	Interpreted
Casemate #2-3-4-/Bombproof	Officer's Prison	Interpreted	Interpreted
Casemate #5/Bombproof	Prison	Interpreted	Lectures/Music
Bakeoven	Bakeoven/Prison	Interpreted	Lectures/Music
Artillery Shed	Cannons/Carriages	Interpreted Equipment Storage	Artillery Shed/Stables

Building	Historic Use	Current Use	Proposed Use
Blacksmith Shop	Same	Interpreted	Blacksmith Shop
Powder Magazine	Same	Interpreted	Powder Magazine
Water Battery	Gun Mounts and Powder Mags	Picnic Area	Picnic Area Food Concessions Black Powder Storage
North Sallyport			Exit
West Casemate	Guard Room	Transformer Room	Transformer Room
East Casemate	Guard Room	Security Dogs	Security Dogs
East Sallyport	Main Entrance	Pathway to Demilune	Main Entrance Pathway to Demilune
West Sallyport			New Entry to Nature Trail
South Casemate	Guard Room	Unused	Interpreted
North Casemate	Guard Room	Unused	Interpreted
Commandant's House	Home of Commander	Ruin	Interim Stabilization & Protection Future Restoration
Arsenal	Guardhouse/ Small Arms Arsenal	Maintenance Storage Display	Interpreted
Torpedo Casemate	Torpedo Casemate	Interpreted	Interpreted
Cannonball House	Farm House	Ruin	To Be Removed



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MASTER PLAN

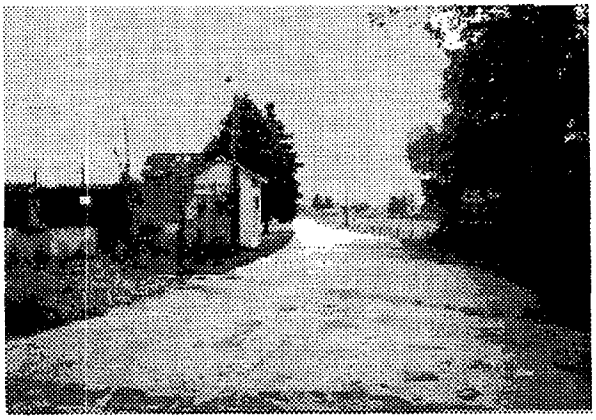
HISTORIC STRUCTURES PLAN

3 Master Plan Concept

The Master Plan concept makes recommendations for improving site conditions and operations at Fort Mifflin, and identifies opportunities for enhancement and expansion of recreational and interpretive programs. Relative to development goals, no maximum figure has been established for Fort visitation, and no analysis has been performed to determine specific staff or facilities needed to accommodate various levels of increased visitation.

3.1 Visitor Arrival

Given the local context of the Fort, it is important that the image and visibility of the site be strengthened. The Master Plan suggests that wayfinding signage be introduced in a consistent manner and that aesthetic improvements be made to the immediate approach to the site. Such improvements include screen and aesthetic feature planting, new entry gates and a gatehouse for ticketing and security. The planned relocation of the Army Corps entry drive extends an opportunity for Fort Mifflin to establish its own identity at the entrance to its site.



The existing entry to the Fort property is unimproved and conveys a poor first impression of the historic site.

3.2 Visitor Parking

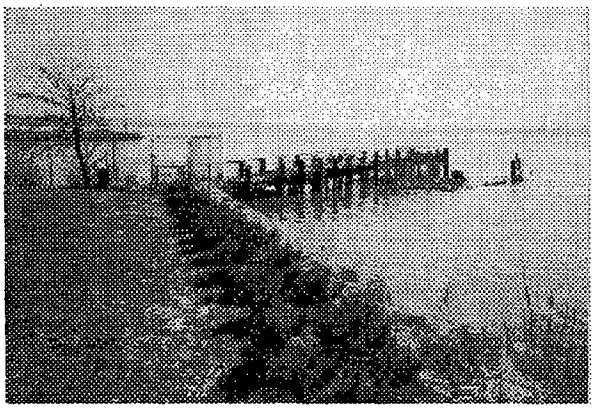
Assuming the removal of the deteriorating Cannonball House, the Plan provides for appropriate visitor parking at the vehicular entry to the Fort, to accommodate individual visitors and bus tours. Parking improvements incorporate new plantings to provide shade as well as visual screening of the Army Corps facility to the east and views of the lot itself from other locations on the Fort property. Given space constraints on the Fort property, overflow parking during large events will continue to be located on the Army Corps lot and to some extent along the Fort Mifflin access road.

3.3 Visitor Services Building

As a general guideline, no new construction is suggested by the Master Plan within the Fort walls. The Plan does suggest that the limited visitor services now provided at Fort Mifflin be expanded with eventual construction of a new visitor services building that will offer food service, a retail shop, and visitor orientation and education/interpretation space. This new building will be constructed adjacent to the Hospital Building in an "L" shaped configuration visually buffering the Army Corps of Engineers site. A plaza will link the two buildings and provide an identifiable location for tour groups to gather for orientation, as well as an outdoor site for conducting interpretive programs in good weather.

3.4 Waterfront Access

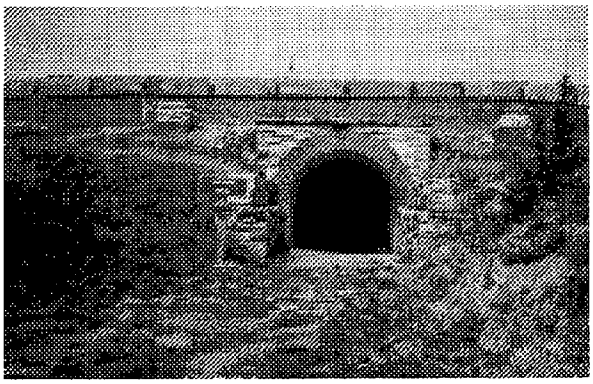
The Master Plan recommends that the existing dock on the Delaware be repaired to re-establish the Fort's vital link with the water. In the future, this dock will function as an entry point for waterfront tours. The Master Plan highlights the importance of providing for pedestrian circulation to and from the dock along the Water Battery. This is a key feature of the site, and critical to interpretation of Fort history.



Reconstruction of the dock at the Delaware River and introduction of a boardwalk along the Water Battery offer new opportunities for site access and interpretation of Fort history.

3.5 Fort Interpretive Loop

With planned increase in Fort visitation, it is critical to establish clear patterns for pedestrian circulation within the Fort. Proper paving and paths are important for the safety and orientation of visitors, and for maintenance of the site, affording access even when ground conditions are wet, and protection of the site from erosion and compaction caused by foot traffic. The Master Plan designates a discrete loop which links major interpreted sites within the Fort. This pedestrian circulation system within the Fort includes a stair access and paved viewing terrace on the northeast parapet.

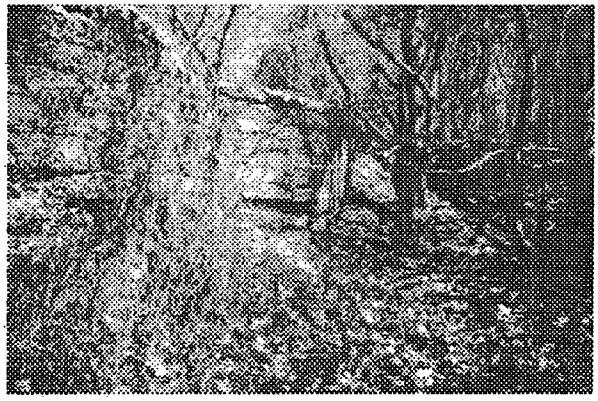


The West Sallyport should be reopened, improving access to the natural area at the southern portion of the site.

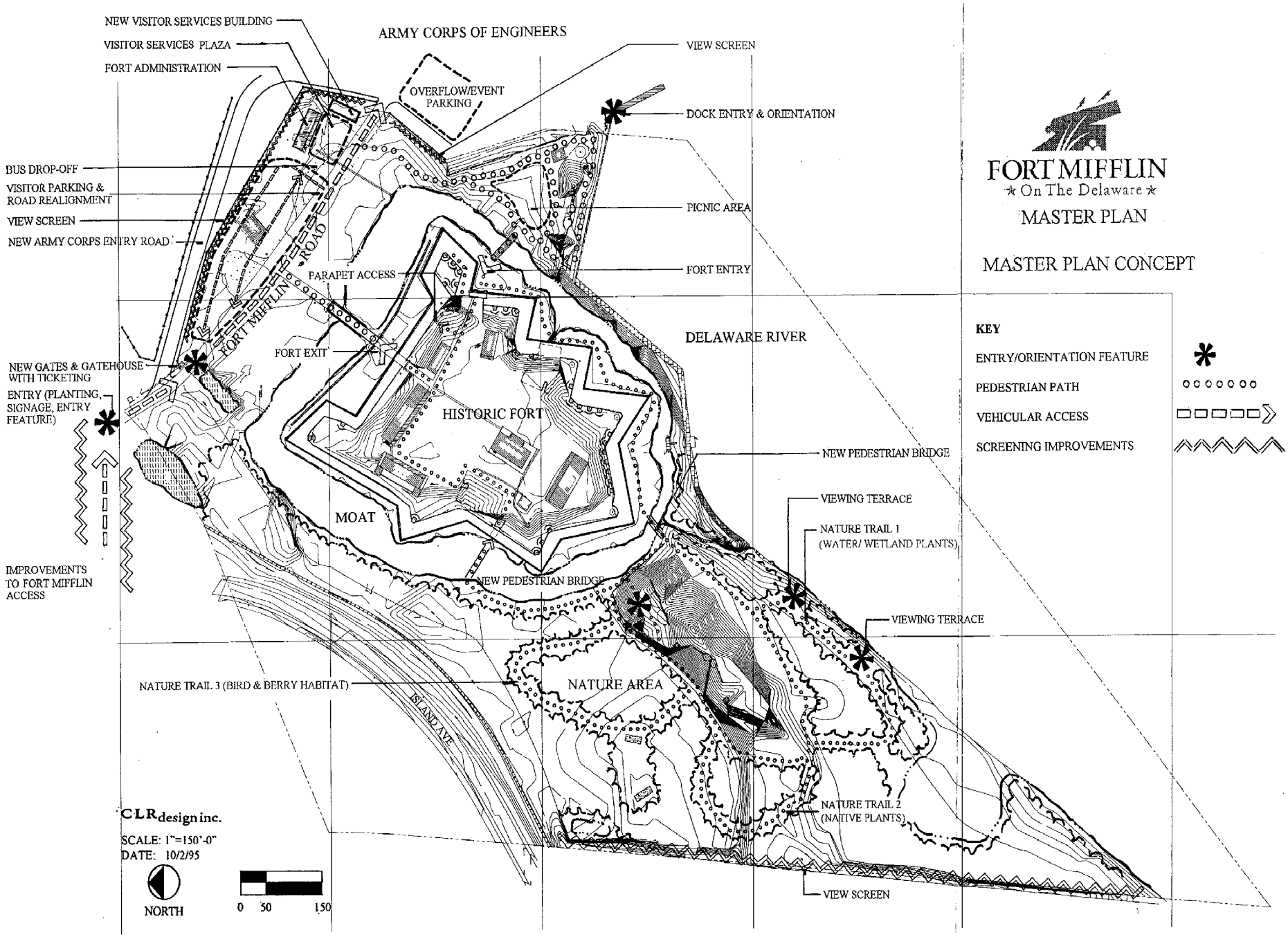
3.6 Nature Trail System

The Master Plan identifies an interpreted nature trail system to be developed on the southern half of the Fort Mifflin property. Visitors are provided several trail options. It is envisioned that this environmental area eventually will draw its own audience to the Fort, offering visitors the option of touring either or both the historic Fort and nature area. The nature trail system begins at the East Sallyport, the Main Gate of the Fort, and is routed along the original Fort walls and the moat.

A new pedestrian bridge across the moat accesses the natural area of the property, which is to be improved to provide environmental interpretation. The Plan designates development of one trail featuring wetland plants and providing views out to the Delaware; a second trail devoted to display of native Pennsylvania plants; and a third trail providing bird and berry habitat, where new plantings will be selected to attract wildlife. The natural trail system includes installation of a boardwalk along the southwestern edge of the moat, and erection of a new bridge link to the now-closed West Sallyport of the Fort.



Selective clearing of invasive vegetation and weed species in the site's natural area will also improve interpretation opportunities at the High Water Battery.


FORT MIFFLIN
On The Delaware
MASTER PLAN
MASTER PLAN CONCEPT
KEY
ENTRY/ORIENTATION FEATURE
PEDESTRIAN PATH
VEHICULAR ACCESS
SCREENING IMPROVEMENTS
NEW VISITOR SERVICES BUILDING
VISITOR SERVICES PLAZA
FORT ADMINISTRATION
ARMY CORPS OF ENGINEERS
OVERFLOW/EVENT PARKING
VIEW SCREEN
DOCK ENTRY & ORIENTATION
BUS DROP-OFF
VISITOR PARKING & ROAD REALIGNMENT
VIEW SCREEN
NEW ARMY CORPS ENTRY ROAD
PICNIC AREA
FORT MIFFLIN ROAD
PARAPET ACCESS
FORT ENTRY
DELAWARE RIVER
FORT EXIT
NEW GATES & GATEHOUSE WITH TICKETING
ENTRY (PLANTING, SIGNAGE, ENTRY FEATURE)
HISTORIC FORT
NEW PEDESTRIAN BRIDGE
VIEWING TERRACE
NATURE TRAIL 1 (WATER/ WETLAND PLANTS)
MOAT
IMPROVEMENTS TO FORT MIFFLIN ACCESS
NEW PEDESTRIAN BRIDGE
VIEWING TERRACE
NATURE TRAIL 3 (BIRD & BERRY HABITAT)
NATURE AREA
ISLAND AVE
NATURE TRAIL 2 (NATIVE PLANTS)
VIEW SCREEN
CLR design inc.
SCALE: 1"=150'-0"
DATE: 10/2/95
NORTH
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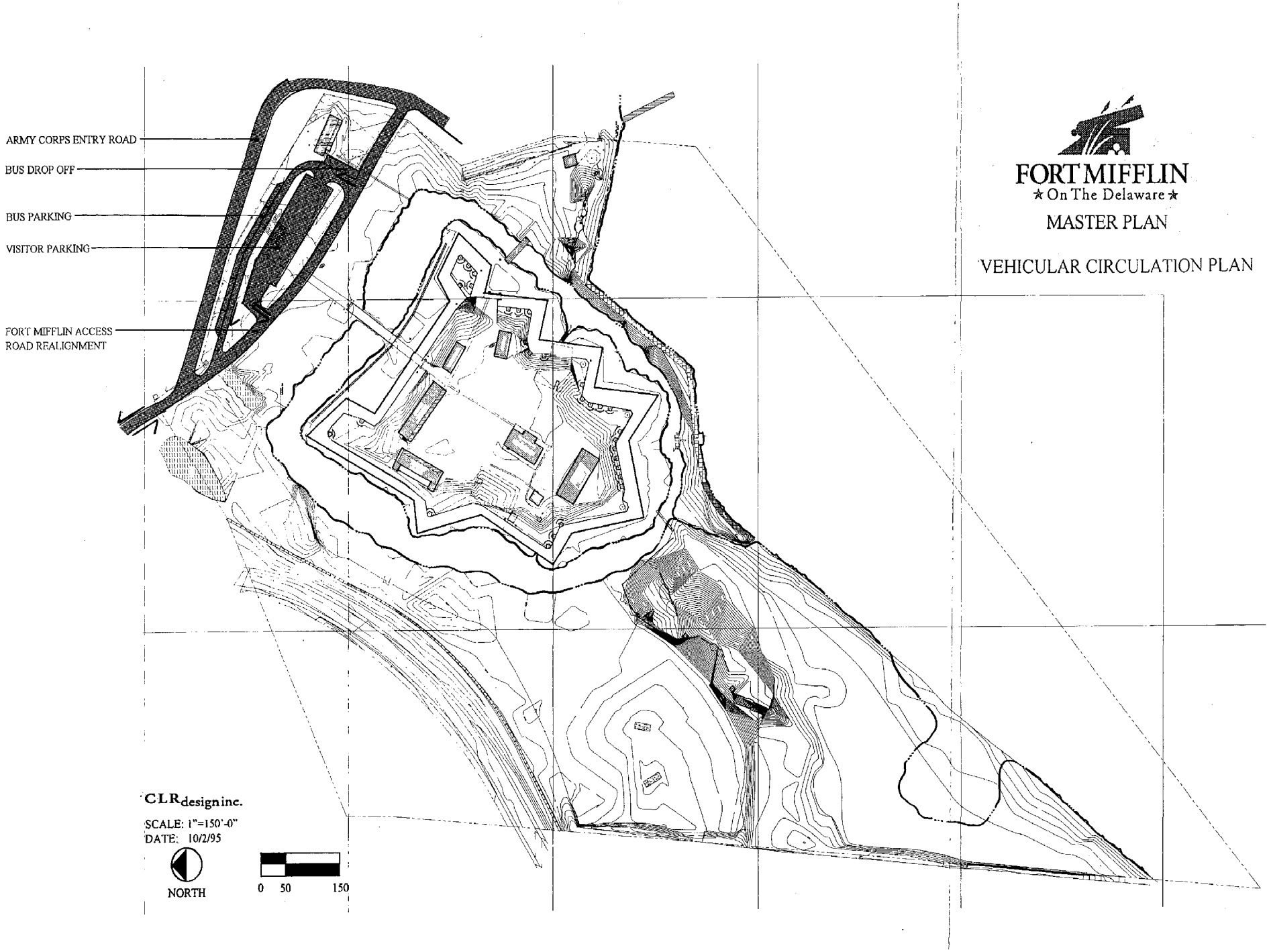
4 Master Plan Components

4.1 Vehicular Circulation

The Vehicular Circulation Plan highlights improvements to be made at the Fort to improve vehicular access to and circulation through the site. The plan indicates the new alignment for the Army Corps entry north of the existing shared site entry. This allows for new paving and entry improvements to be made at the vehicular entry to the Fort Mifflin property. A slight realignment of the existing Fort Mifflin access road is indicated to accommodate construction of a visitor and bus parking lot. Bus circulation is accommodated with a drop-off at the visitor services courtyard. Five bus parking spaces are located along the northeastern property boundary. Visitors to the site will return to the bus parking area to reboard their designated bus.

Fifty-two visitor and staff parking spaces are provided with full lot build-out. The lot can be accessed either at the visitor services courtyard, or near the vehicular entry to the Fort property.

Vehicular access through to the Army Corps facility is to be maintained with gated access. Given space limitations on the Fort Mifflin site, access to the Army Corps site will continue to be required for overflow and event parking.



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MASTER PLAN

VEHICULAR CIRCULATION PLAN

4.2 Pedestrian Circulation

The Pedestrian Circulation Plan identifies path systems to be introduced to provide clear pedestrian access to all interpreted areas of the property. Four different types of path construction are recommended, in keeping with the varying character and construction conditions across the site. Accommodation for physically challenged visitors must be provided and considered in all areas of the site.

- **Visitor Services Plaza**

A paved plaza links the existing Hospital Building and the new visitor services center, affording an area for visitor orientation and outdoor events. Unit pavers should be used in this high visibility area.

- **Picnic Area**

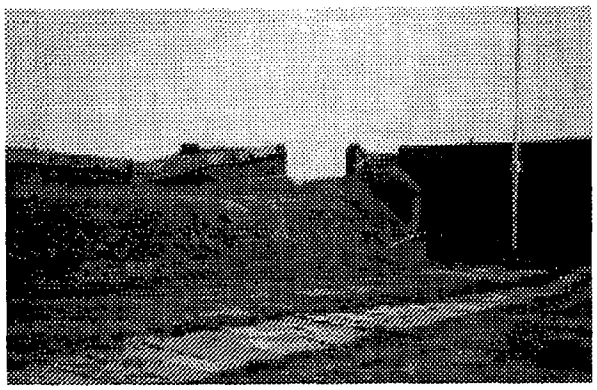
The existing gravel paving is to remain within the picnic area. This path is extended at its north end to meet the visitor services plaza.

- **Dock and Water Battery**

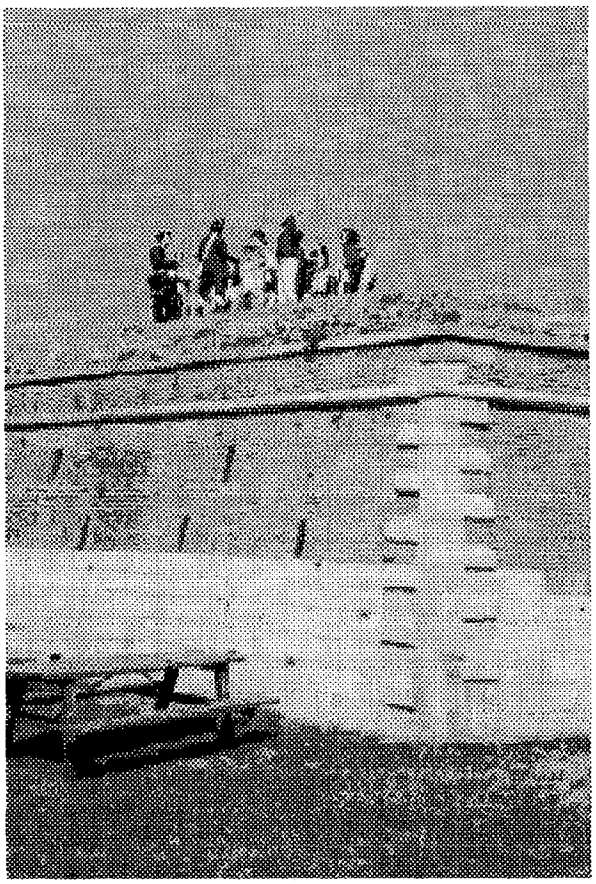
The new dock will be wood construction. The Plan recommends extending this to include a boardwalk/ wood deck along the Water Battery for viewing and interpretation. A new wood stair is required to return visitors to the picnic area.

- **The Historic Fort**

The Master Plan recommends a continuation of the brick and stone paving vocabulary now in place inside the historic Fort. Many of the existing paths are in poor condition, however, and require re-laying and minor realignment to achieve a clear and continuous path system from the Main (East) Gate of the Fort, around the north perimeter of the Fort, and out the West Sallyport. Paving is limited to this area, as it is this area of the Fort which contains the majority of interpreted historic structures. Access to the northeast parapet is to be improved with the construction of steps east of the existing Storehouse, and construction of a paved viewing area on the parapet itself. This viewing area will be surrounded by a guardrail which will protect visitors, and discourage unauthorized access to the remainder of the Fort parapet.



New stair construction is required to improve access to a viewing terrace at the northeast parapet of the Fort.

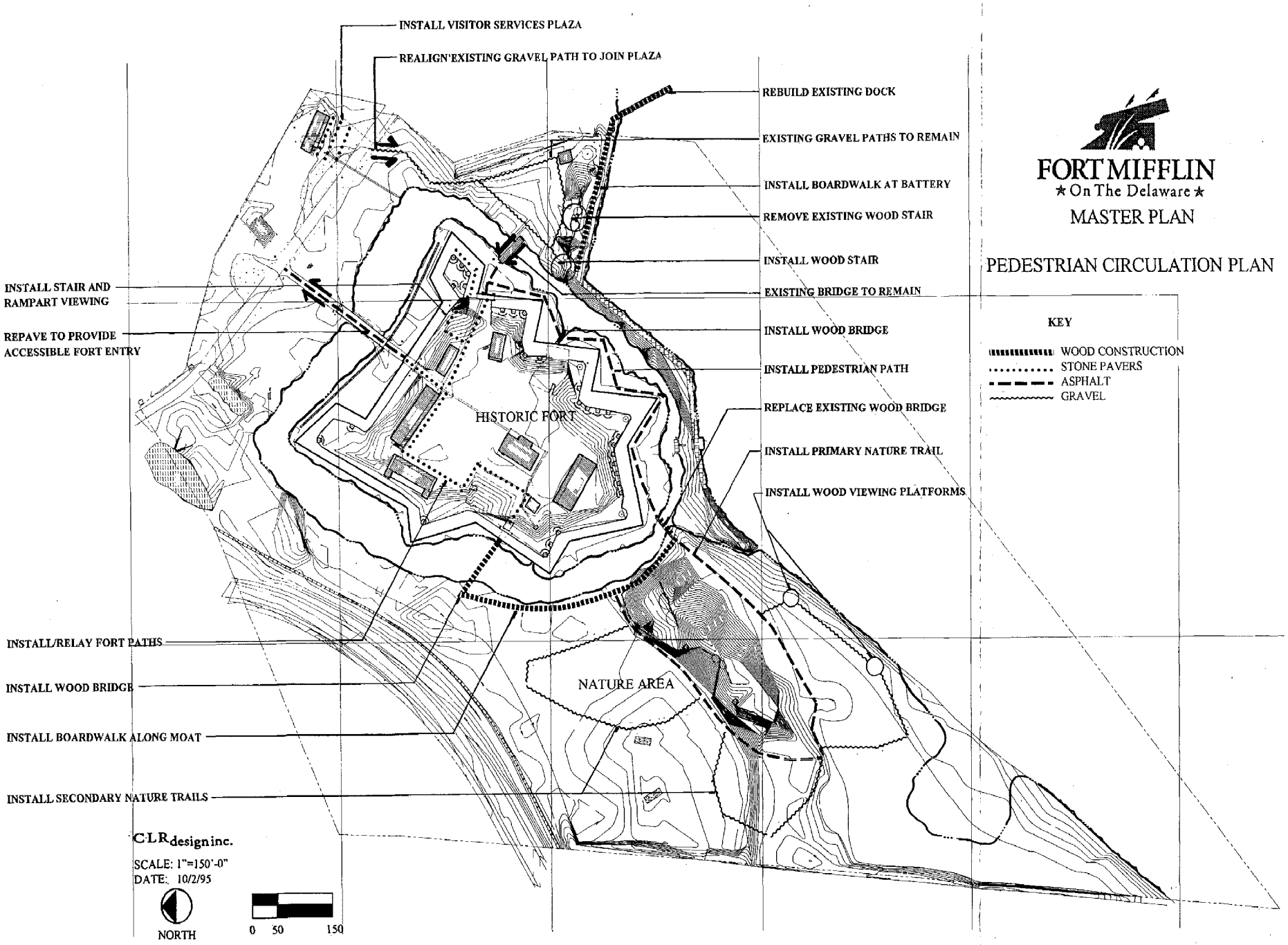


A viewing terrace is proposed to provide improved and safe visitor access to the northeast parapet of the Fort.

- **The Nature Trail System**

The nature trail system introduces various paving types, given the changing site conditions within the nature area. The primary path is to be asphalt, with red stone aggregate. This custom color will match the color and character established by the stone paving in the picnic area.

Secondary nature trails are to be gravel paths, in response to the more sensitive nature of the wetlands in this area. Limited specific areas will require boardwalk construction, due to wet ground conditions, such as the river viewing platforms, and the boardwalk along the southwest moat perimeter. New moat bridge construction will also be wood, linked to the moat boardwalk.



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MASTER PLAN

PEDESTRIAN CIRCULATION PLAN

4.3 Facilities Improvements

The Master Plan does not make extensive recommendations for construction of new buildings on this historic site, although improvements to specific existing structures are recommended. As a general guideline, no new building construction is to be permitted within the confines of the walls of the historic Fort.

- **Gatehouse at Vehicular Entry**

The Master Plan includes a new gatehouse as part of the Fort entry improvements proposed. The construction of this gatehouse should be sympathetic to the style and materials of the Fort's historic structures, establishing the perception for the visitor that one is entering a special, historic district. A new gate and security fence should be developed in conjunction with the gatehouse. Square footage requirements for the gatehouse are minimal, accommodating only gate security and ticketing services with approximately 100 square feet.

- **Visitor Services Center**

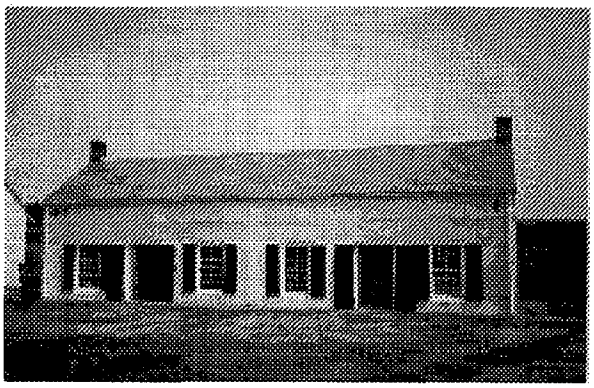
A visitor services center is the primary facility required for future development and program expansion at the Fort. The plan sites a single story structure of approximately 1400 square feet adjacent to the existing Hospital (administration) Building. The structures accommodates education/ interpretation space (500 SF) food service and retail space (700 SF) and restroom facilities (200 SF). With interpretive and educational facilities provided in the first floor of the existing Hospital (administration) Building, visitor services are concentrated in this key location. It is recommended that additional education/interpretation space be accommodated within available historic facilities inside the Fort. The Mess Hall inside the Soldiers' Barracks has been identified as a suitable site for this use. It is intended that the visitor services center replace the existing minimal retail facility inside the Fort.

- **Commandant's House**

Restoration of the fire-damaged Commandant's House, recommended by previous architectural, historical and building condition analysis, is a priority for securing the historical integrity of the Fort.

- **Restrooms**

The Fort Storehouse should be entirely devoted to restroom facilities, increasing the number of fixtures available to visitors.

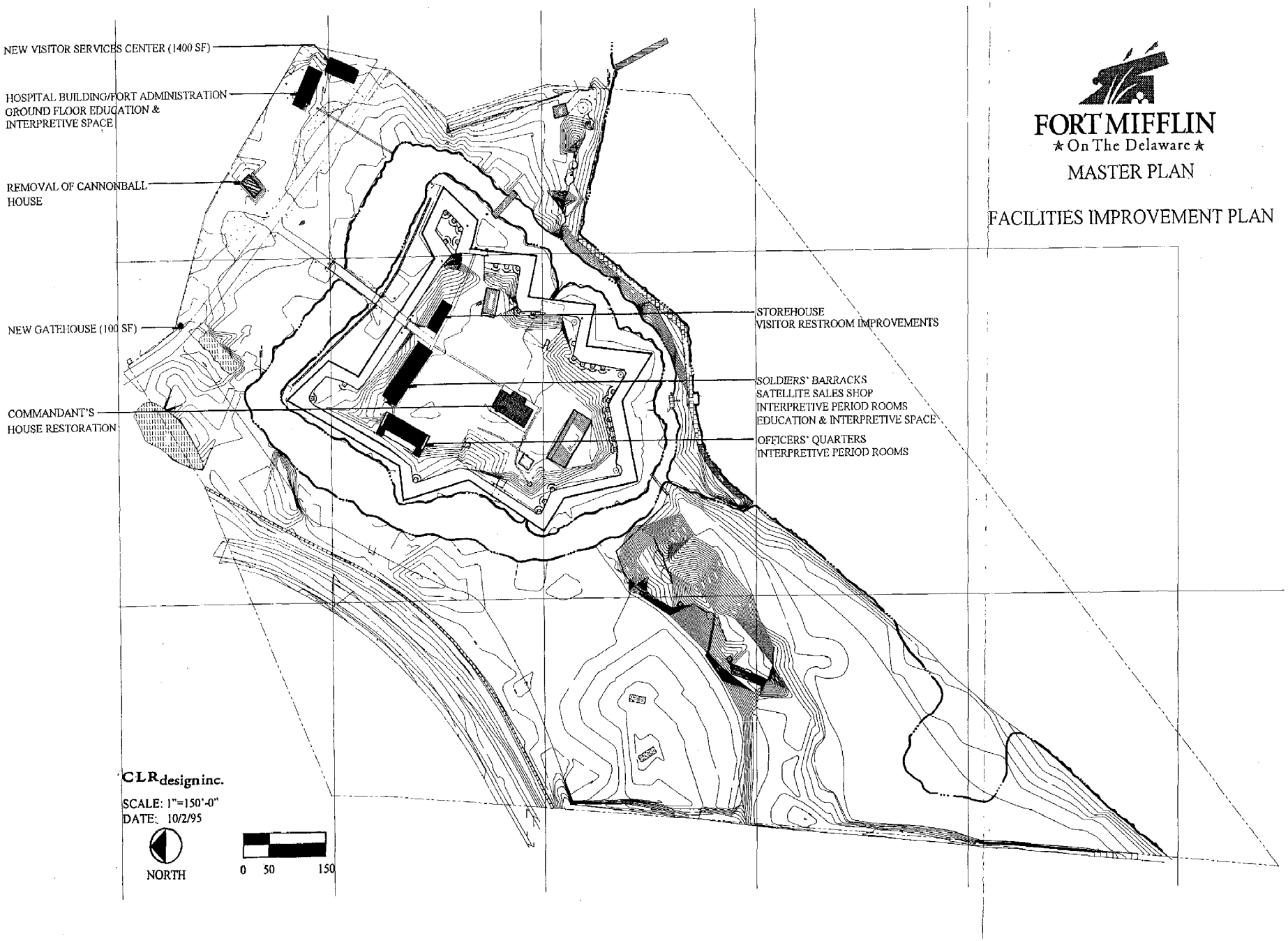


The Storehouse is to be improved to expand restroom facilities within the entire building.

- **Sales Shop**

It is important that limited retail facilities be maintained inside the Fort, particularly to provide refreshments for visitors during the warm summer months. The Master Plan proposes that a small retail facility be created at the east end (Master Sergeant Room) of the Soldiers' Barracks for this purpose.

A satellite sales shop is proposed for the east end of the Soldiers' Barracks to maintain limited retail facilities inside the historic Fort.



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MASTER PLAN

FACILITIES IMPROVEMENT PLAN

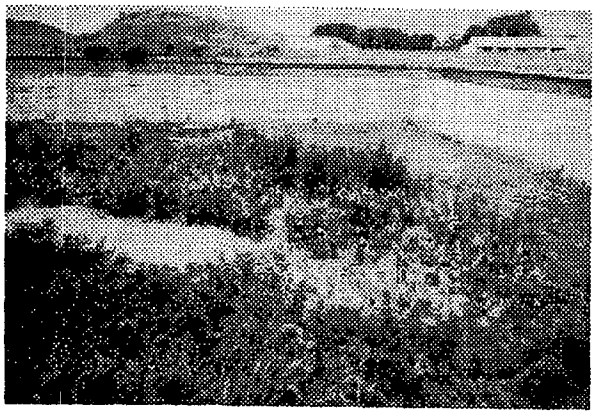
4.4 Landscape & Environmental Improvements

The Master Plan utilizes landscape and environmental improvements to remedy existing physical problems on the site; to improve aesthetic problems; and to develop and enhance Fort interpretive and recreational programs.

- **Site and Environmental Improvements**

The Moat

The poor quality of the moat at the Fort represents one of the single most pressing issues relative to the physical condition of the existing site. Due to the inoperable condition of the sluicegate, flushing action no longer occurs in the moat. The quality of the moat is rapidly deteriorating due to siltation and the unchecked spread of vegetation. In order to preserve water quality in the moat, it is imperative to dredge the moat not only to remove siltation and decayed vegetation, but to increase the water depth, which will in turn discourage regeneration of vegetation which is now choking the moat. Hydraulic dredging is recommended. Any dredging activity should occur in the summer months, so that animals living in the moat are free to move away temporarily from the area of activity. Vegetative removal from the moat will involve some routine maintenance following initial dredging.



Actions are required to improve water quality at the Fort moat, which is stagnant and choked with vegetation.

Tidegate

In lieu of repair of the existing sluicegate - a procedure deemed excessively expensive and complicated - the Master Plan recommends installation of a tidegate at the existing stream located adjacent to the bridge access to the nature area. If this stream were cleaned, it is anticipated that tidal flushing of the moat could occur here.

Bank Stabilization

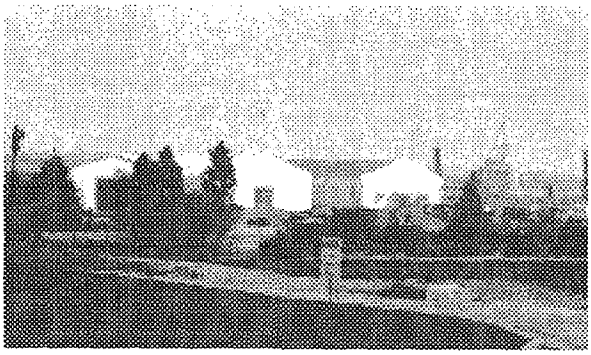
Bank stabilization is recommended due to ongoing erosion of the bank adjacent to the Fort. This can be accomplished by vegetative methods.

Fort Ground Conditions

Lowering of the moat water level through increase in moat depth and tidal flushing will effectively lower the water table in adjacent areas. This will afford a degree of drying of soil conditions inside the Fort, where the high water table and wet ground conditions often restrict visitor circulation.

- **Landscape Screening**

The introduction of landscape buffers is recommended particularly at the northern edge of the site, separating the Fort from the Army Corps site. Additional planting at the edge of the new visitor parking lot will screen direct views of parked cars and buses from other areas of the site. Perimeter screening is also suggested at the southern boundary of the site, which juxtaposes the Airport.



Views of the Army Corps facility intrude on the historic and aesthetic atmosphere of the Fort.

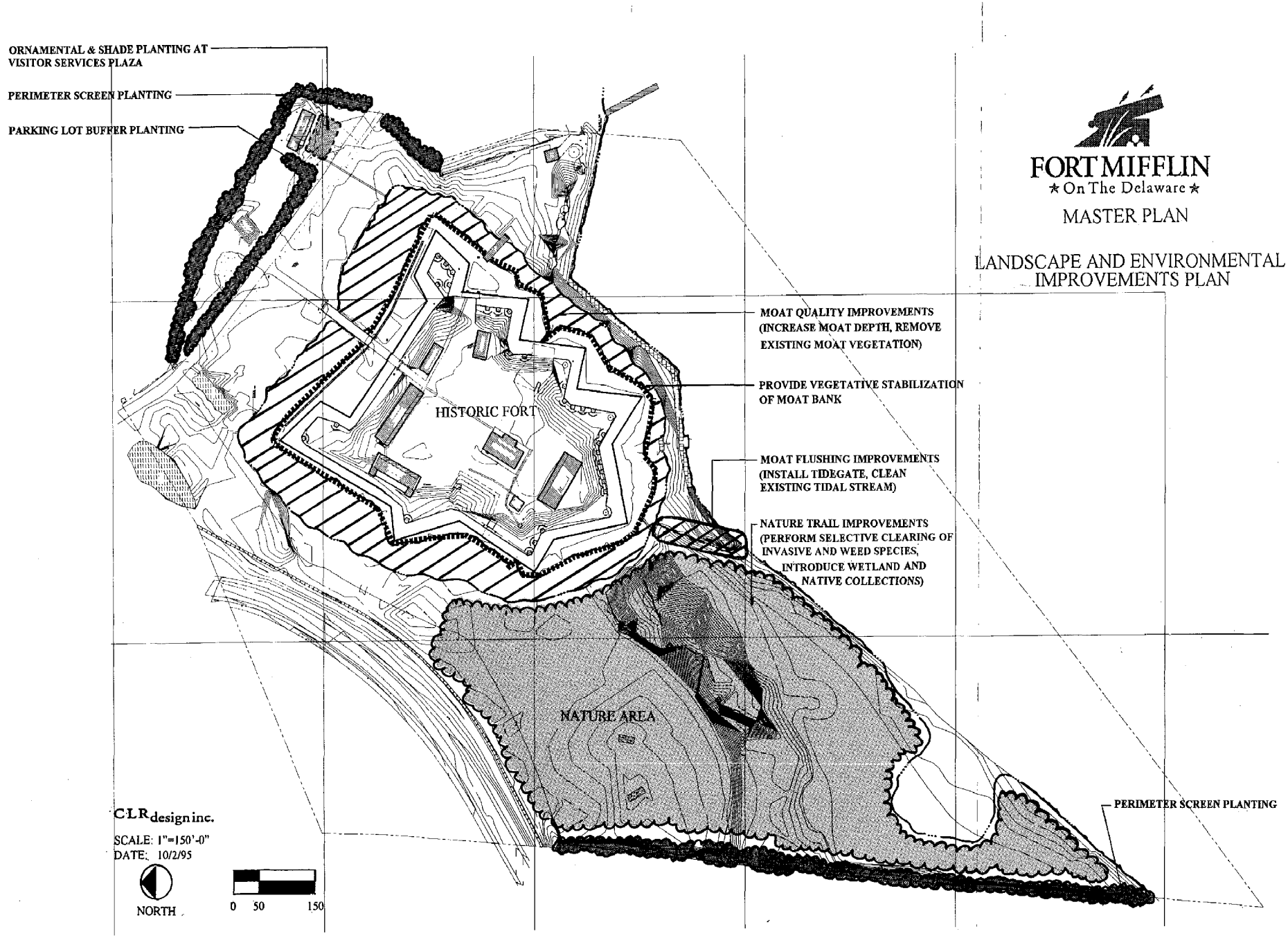
- **Landscape Enhancements**

Vehicular Entry

The Master Plan identifies areas along the vehicular approach to the Fort which can be improved with landscape treatments. Specifically, the drive into the Fort along the Philadelphia Airport property should be improved with shade trees and roadside ornamental planting. A new sign should be installed with ornamental planting at Fort Mifflin Road, as the visitor passes into the entrance of the Fort property itself.

The Nature Trail

The principle environmental and landscape enhancement suggested for the Fort involves development of the southern half of the site to provide a new regional environmental resource. The Master Plan suggests development of specific types of nature trails appropriate to the environmental conditions at the Fort, and of interest to a little-tapped audience of Fort visitors. The Plan recommends selective clearing of invasive weed species in the natural and wetland areas of the property, and replanting to create distinct natural areas for recreational walks, environmental education and interpretation.



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MASTER PLAN

LANDSCAPE AND ENVIRONMENTAL IMPROVEMENTS PLAN

5 Wayfinding & Interpretive Programming

Wayfinding and interpretive programming are important aspects of the Master Plan, dealing with reinforcement of Plan site improvement concepts through the development of an effective orientation and interpretation system. This section describes in detail wayfinding and interpretive programming for **Fort Mifflin on the Delaware.**

5.1 Wayfinding

- **Existing Signs**

The existing Fort Mifflin signs both on and off the site vary greatly in size, typeface, color and materials, creating a somewhat confusing image. While some signs are certainly readable, their location may not be the most effective. There will be a need for new signs with the implementation of the Master Plan. These signs will guide visitors, provide basic orientation, note regulations and identify buildings and services where necessary. Effective wayfinding directs a visitor to and around the site with a minimum of difficulty and time spent by staff in giving directions.

It is recommended that Fort Mifflin undertake a specific study of wayfinding and signing needs that is coordinated with site, landscape and interpretive planning to guide the creation of a consistent, effective series of sign designs and locations. The preliminary signs and graphics location plan indicated in this Master Plan identifies general areas where signage will be required to provide visitor wayfinding.

- **Identity**

Used by the marketing and graphic design industries, the word identity refers in part to the consistent visual and verbal means by which an entity (individual, institutional or corporate) becomes known and immediately recognizable to the general public or a target audience. The basic component is usually a logo, an entity's name and/or symbol presented in consistent form and colors, and used on communication materials from letterhead to signs. Consistent use increases a visitor's recognition, whether the purpose is to draw attention to advertising or to direct the visitor to a certain site. Effective use of an identity increases the perception of an organized and well-run institution or facility.

Fort Mifflin has begun the important process of developing a consistent visual identity through the creation of a logo (cannon with cattails) and a color scheme (green and white). It is important that this basic component be used in a consistent manner on wayfinding signs where necessary and appropriate.

For example, it would be ideal if signs directing visitors into the site from I-95 employed the logo and the green and white colors of Fort Mifflin. While the interstate system and the City of Philadelphia have strict regulations governing road signs with regulations as to sign size, typeface and color, conversation with the Department of Licenses and Inspections has indicated that some flexibility is possible, i.e. the standard green rather than brown may be used and the logo would be considered, if their equipment were able to reproduce it. The City would require submission of sketches to determine approval of a custom sign of this type.
Comparatively few wayfinding signs would require the use of the logo; others may only use the typeface and color scheme. A system of standard sizes for different purposes would be determined, making it easier to order signs on an ongoing basis. These and other issues would be addressed in the study mentioned above.

5.2 Interpretive Programming

- **Mission Statement**

The Board of **Fort Mifflin on the Delaware** has adopted the following mission statement:

To develop, preserve and interpret Fort Mifflin as a National Historic Landmark whose unique history, original fabric and surrounding environment will be protected and used to educate and enrich students and families and serve as a significant regional tourist resource.

- *Physical and Architectural Preservation will be to the period of 1771-1875*
- *Historical Interpretation will be inclusive of the Fort's service during each of America's major wars: Revolutionary, War of 1812, Civil War, World War I and World War II*
- *Environmental Interpretation will be inclusive of the Fort's river siting, wetland habitat and wooded areas.*

- **Existing Interpretation**

This section deals with interpretation for the general public visiting Fort Mifflin, as distinct from visitors involved in education programs.

Currently, interpretation is a record of the human history of the site, with little reference to natural history and the environment; and it is conveyed in the following ways:

a) a printed self-guiding brochure,
b) a slide-tape presentation on the events of the Revolutionary period,
c) a series of wayside graphics within the walls of the Fort,
d) guided tours,
e) a scale diorama representing the siege of 1777,
f) historical furnishings.

A book, Fort Mifflin, Valiant Defender of the Delaware by John W. Jackson, detailing the history of the Fort is available for sale in the gift shop. An update of this book, Fort Mifflin, Philadelphia's Great Island Fortification, by Jeffrey M. Dorwart, Ph.D. is to be published in the fall of 1995.

- **Overview**

The Master Plan recommends developing and enhancing the Fort's interpretive programming. Initial focus is on the historical programming, followed by recommendations for environmental interpretive programming. The combination of these interpretive themes will expand the base of potential visitors and offer visitors attracted by the historical significance of the site more options and a richer experience. In general, both **historical and environmental themes** will be strengthened by systematic cross-referencing, since natural conditions had great influence on the siting and engineering of the Fort, while historical alterations have had tremendous impact on the local terrain and environment.

A critical next task for Fort Mifflin's board and staff is to review the proposed interpretive themes, evaluate them, and refine them. Part of this process should involve piloting the proposed tour routes, incorporating first-person narratives and additional examples of historical vocabulary into tours and programs, and clearly articulating the basic themes so that they are accessible to visitors. Evaluation of these efforts will guide the staff in revising both themes and programs so that they are engaging, enjoyable, and informative for visitors of various background, ages and interests.

- **Historical Programming**

Fort Mifflin is a national historic site whose interpretation is influenced by two key factors. First, memory and history, commemoration and interpretation are necessarily so entangled that they must be developed together: it is essential for visitors to understand the site in order to share in its commemoration. Remembrance is integral to telling Fort Mifflin's historical story.

Second, the site's historical significance relates primarily to the crucial struggles of Autumn 1777, while virtually all of the historic fabric which remains today dates from later periods of history. These two issues must be addressed, resolved, and expressed in the Fort's interpretive themes and programs

Because of its historical significance, long history, rich resources and large scale, **Fort Mifflin on the Delaware** could undertake a virtually limitless number of interpretive initiatives. However, both practical and qualitative considerations dictate that a few primary or core themes be selected and that programs, activities, and special events be developed around a few basic ideas. **In this section of the Master Plan, three themes have been identified to help staff and visitors grapple with the complexities of the site.** Also identified are a number of historical and environmental resources that can be used to develop these themes.

Historical Interpretive Themes

Most people who visit historic sites bring with them a few basic questions. What is this place? How does it work? What happened here? Why is it important (to me)? Visitors take cues from the site and its structures in order to answer these key questions. The scale and complexity of Fort Mifflin's site and structures can both mislead and inform, so it is especially important to select interpretive themes which emerge from the environment, terrain, and material evidence that visitors actually experience at the Fort.

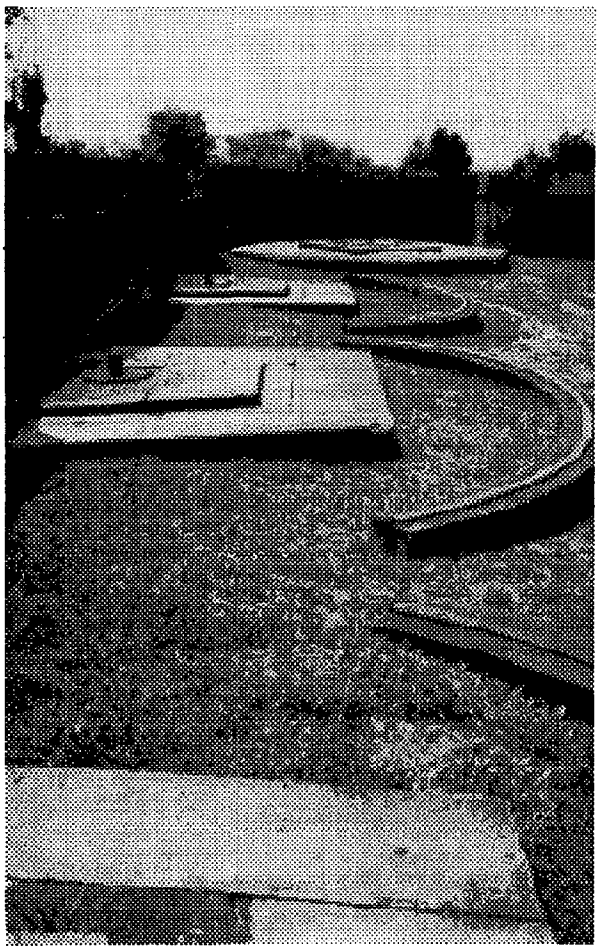
Three aspects of the story are especially striking–the place of Fort Mifflin in American historical memory, its social history, and the challenges of establishing a fort on Mud Island. These primary or core themes can engage many of the most dramatic and interesting structures and stories at Fort Mifflin on the Delaware. If they are effectively interpreted, severally or together, they will go far toward answering the threshold questions which visitors bring with them to the site. These three themes can be summarized as follows: **A Crucial Chokehold**: commemorates the role of Fort Mifflin in 1777 when its protracted defense purchased essential time for the Continental Army; **A Self-Contained Community**: interprets the life of Fort Mifflin in the 19th-century, with special emphasis on its social history; **An Engineering Challenge**: explains how ingenuity and technology were used to respond to the uses of sea power, the evolution of naval artillery, and the problems of site and terrain.

1) **A Crucial Chokehold**: Fort Mifflin's history as a military site extends for nearly two centuries, beginning in 1772 and extending into the era of the Cold War. Its principal historical significance rests, however, on the events of its first years of development and use, most notably in the heroic defense of the Fort during the Autumn of 1777. The prolonged siege and ultimate destruction of Fort Mifflin were of critical importance to the survival of the Continental Army in the first part of the War for Independence. By denying the British water-borne access to Philadelphia for weeks and then months, Fort Mifflin and its sister fortifications prevented the occupying army in Philadelphia from re-grouping and either moving north to link up with General Burgoyne's army or moving west to attack Washington's battered forces. In the long struggle to defend Fort Mifflin, a majority of its defenders (estimated at from 50% to 70%) became casualties of the battle, and only a small number of the garrison and its reinforcements were able to make their escape to the Jersey shore. This heroic and historically significant defense of a key chokehold demands–and deserves–interpretation and commemoration: it is a vital part of American historical memory.

2) **A Self-Contained Community:** This singular event, however, does not exhaust the story and significance of the site. Fort Mifflin is also notable as one of the oldest, continuously-used forts in North America. It is an outstanding example of an important type of self-contained community. At this site, soldiers, sailors and civilians lived and worked. Here they washed and dressed, cooked and ate, cleaned and slept. Here they exercised and practiced crafts, pursued sports and recreation, got sick and died. The history of Fort Mifflin as a self-contained community, especially as it functioned in the mid-19th century, is another important theme for interpretation, one that is amply dramatized in the Fort's surviving fabric and structures.

3) **An Engineering Challenge**: The third theme links the two others: the challenge of engineering at the Fort on Mud Island. The evolution and use of the Fort's physical fabric over its period of occupation was determined by changes in both military and

civil engineering. Eighteenth-century military engineering dictated the siting of the Fort on Mud Island and its basic form. Two prominent features of the site–the casemates and the magazines–were responses to the power of naval armaments. This continuing progress of naval guns made Fort Mifflin obsolete during the 19th century. The theme of engineering also brings out the importance of sea power: Fort Mifflin is an integral part of the long, enduring tradition of American coastal defense. By the end of the 19th century, of course, new fortifications closer to the mouth of the Delaware had made Fort Mifflin redundant.



Gun emplacements offer opportunities for placement of historic armaments and interpretation at the historic Fort.

Civil engineering also helped to shape the Fort as we see it today. One of the basic engineering challenges was designing, building, and maintaining a fortress and a community on what was essentially a tidal mud flat. All the usual problems of establishing a defensive fortification in the 1770's were compounded by the nature of Mud Island: it was soft, wet and unstable. When strong walls were erected, water from tides, rain, and seepage rushed into the center of the Fort, creating vast pools of standing water. Many of the prominent features of Fort Mifflin, including its dikes, drainage system and sluicegates, were installed in order to deal with the sponge-like character of the terrain. Other features, since lost, such as the "parades and walks" cited in Joseph Plumb Martin's account of the 1777 siege, were installed for the same purpose. Crosswalks are shown in the map of the central Parade Ground sketched by Lt. Col. Charles Smith in 1777: postholes that contained the supports for these wooden walks were excavated in 1959. In addition, the Fort's location in a marshy area down river from a large urban center multiplied the risks of illness, both viral and bacterial. It is no accident that a large hospital was established to deal with the sick, rather than the wounded! This aspect of engineering also introduces the Fort's relationship to its natural environment.

Historical Interpretive Resources and Opportunities

Fort Mifflin occupies a large, rich, and complex site. Visitors to the site are confronted with unexpected–and sometimes telling–juxtapositions and disjunctions. Within minutes one could observe an 18th-century fortified wall, several adult turtles basking on a log, a 19th-century sluicegate, a recent slide-tape presentation, a re-enactment or a demonstration, and a jumbo jet taking off just overhead. All of these phenomena and more can be deployed as resources for interpretation. Fort Mifflin needs to refurbish its current resources, exhibitions and media presentations, revise and re-publish its brochures and guides, and focus its educational programs on the same kinds of interpretive themes as are used in the tour program. The current long-range plan for education incorporates many services and activities which comport well with the interpretive themes proposed here: the more closely integrated the interpretive and education programs are, the stronger and more effective both will be.

The following list of resources and opportunities is necessarily suggestive rather than definitive, providing some ideas for extending the interpretive program that is currently in place.

1) **Historical Documentation**: The Historic American Buildings Surveys, several planning reports, books, and articles, constitute a rich resource for interpretation and commemoration. These sources provide excellent documentation of the layout and elevations of the original Fort destroyed in 1777. One area which could be more fully exploited are military records such as muster and casualty lists: it would be important to know if the names of soldiers at the garrison in 1777 could be identified, especially the names of those who fell in its defense.

2) **Visual Representations**: The sources noted above provide ample documentation with which to create a new generation of interpretive visuals. To understand the strategic position that the Fort occupied, a detailed scaled map is needed. A large-scale bird's eye view is also badly needed in order to show the actual character of the defenses–part stone-clad walls, part wooden palisades, part blockhouses and strong points. Introduction of soldiers in the image would help to establish a sense of scale and to enliven the scene. A set of maps and views–based on documentary research–could be commissioned for use in waysides, publications, exhibits and media productions.

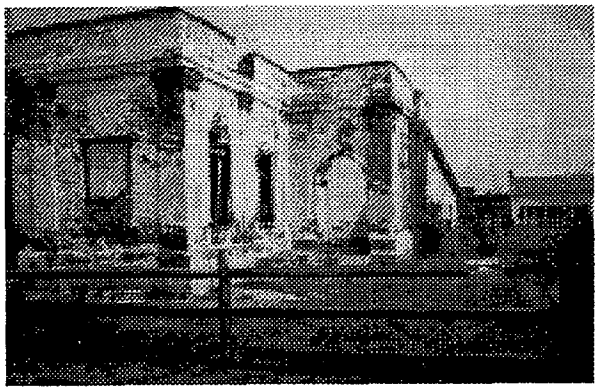
3) **First Person Narratives**: There are some wonderful first-person accounts included in existing planning reports. It would be easy and effective to make use of some of these texts in the tour program, dramatic living history, media productions, special events, publications and exhibits. Few interpretive tools are as powerful as a good story, especially told in the first-person. Use of multiple sources–that is, multiple characters' accounts–would enable interpreters to juxtapose two or more responses to the same event or issue: this can reveal the complexity of the situation, often with humor, irony, or both.

4) **Historical Vocabulary**: One of the most engaging and informative aspects of the guided tour is an explanation of how phrases such as 'hit the sack,' 'sleep tight,' and 'don't let the bed-bugs bite' came into our contemporary vocabulary. In addition to such domestic terminology, the jargons of the military, sailing and commerce, hand crafts such as smithing, and medicine offer rich resources for interpretation. Naval usages give us 'boarding party' and 'close quarters' and many others as well. The following phrases from our contemporary usage all come from the age of sail, especially relevant in interpreting Fort Mifflin which was designed to close off a key waterway to sailing vessels:

batten the hatches	trim the sails
by and large	elbow room
plain sailing	gathering way
come about	chock-a-block
give a wide berth	fag end
hand over fist	know the ropes
squared away	try a new tack
hard and fast	weather the storm

5) **Preservation and Archaeology**: People are usually very interested in ongoing processes, as

well as those that have been completed in the past. Historical preservation and archaeology offer Fort Mifflin an exceptional opportunity to interpret ongoing research, study, planning and interpretation. The Fort is already doing this through its exhibit on restoration and its signage throughout the site. A new exhibition is now warranted, given the progress of recent years; it would also be wonderful to provide updates on current restoration projects, especially the Commandant's House. Historic preservation projects can also be linked to period craft demonstrations and special events (such as a house-raising). If there is any way to initiate additional archaeological investigation at the site, this too could provide visitors with dramatic access to history: many sites based on archaeology have made the process the primary theme for interpretation!



Reconstruction of the Commandant's House is a priority for enriching historic integrity within the Fort.

6) **The Contemporary Context**: The site's location and environment are valuable resources for interpretation. Any visitor who climbs the parapet at the Water Battery, or who walks around the outside of the perimeter wall, will see how closely Fort Mifflin is tied to the water, and how the natural environment challenged the Fort's designers and builders. The presence of tankers, freighters, and barges on the river is an active reminder of how important a waterway the Delaware is in the life of the surrounding valley. The view of Philadelphia's skyline from the Northeast Bastion confirms the Fort's strategic location relative to the metropolis. Even the jets taking off and landing can be put to interpretive use: they are the contemporary equivalent of water-borne shipping in the 18th-century, and it takes only a little imagination to see how easily Fort Mifflin's guns could cut off air traffic today, as it closed off the riverway in the 18th century.

The Historical Theme - Interpretive Strategies: Visitor Circulation

Exhibitions, media presentations, publications, workshops and lectures are all effective ways of interpreting Fort Mifflin and will continue to be important in the site's arsenal of interpretive modes. But the most critical mode of experiencing Fort Mifflin is likely to be the tour, guided or self-guided. At present, both guided and self-guided tours are offered to visitors; in the future, both forms of tours will need to be provided, perhaps with the addition of a self-guided audio tour. An audio tour can be a dramatic and engaging new form of interpretation. At Fort Mifflin, the basic overview tour of the site should encompass all three of the basic themes outlined previously, whether guided or self-guided using a printed brochure or an audio tape.

Guided tours and re-enactments of Fort history are effective strategies for interpretation and education.

For a tour of the site to achieve its full potential, the storylines and themes need to be clear and comprehensible, the circulation routes have to be well-defined and accessible, and the interpretation has to connect visitors to what they are actually experiencing at each moment on the tour. We have all

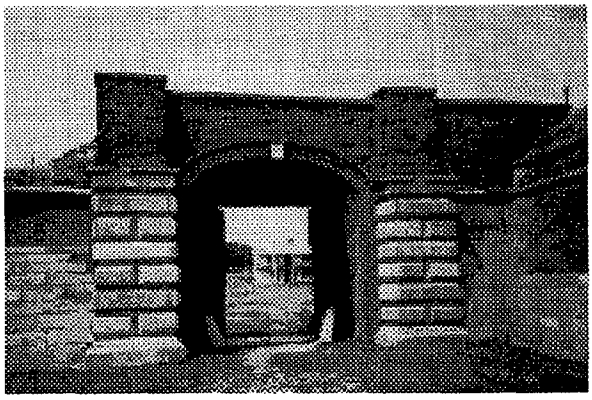
been on tours with guides or brochures that ask us to imagine what would have been here or–just as bad–to imagine that a standing structure isn't here, or worse yet, some combination of the two. The tour program needs to be carefully orchestrated to develop the core themes at the places where visitors can experience the history being interpreted.

At present, both the guided and the self-guided tours begin with visitors entering the Fort from the north side. Visitors are encouraged to see the slide-tape presentation and the large-scale diorama at the outset of their tour. These two interpretive elements tell the story of the 1777 siege; and since both experiences are indoors, they avoid the confusion of telling the story of the 18th-century Fort (destroyed in the 1777 battle) in the misleading context of a 19th-century fortress. The self-guiding brochure also tells the story of the 1777 battle on one side of the sheet, and then tours visitors around the post-1777 Fort on the other side of the sheet.

The interpretive program would gain much from driving home the distinction between the 1777 Fort and the Fort which visitors experience at the site today. The only remaining fabric that survives from the 1777 Fort is a section of the stone-clad southeast wall (now surmounted with later brickwork). To re-capture Fort Mifflin in the crucial year of 1777, it is important to begin both guided and self-guided tours outside the walls, approaching the Fort from the northeast via the Water Battery. This line of approach will orient visitors to the Fort's strategic location on the Delaware, offer a compelling view of the 18th-century fortifications, and allow time to tell why the Fort was placed here and what happened during the siege.

Once the guided and self-guided tours begin near the picnic area or the Water Battery–ideally at the restored dock, the visitor should proceed through the Water Battery (and, if possible, the dock) toward the Fort, and then south for a bit along the 18th-century wall. A self-guiding brochure and a series of wayside signs can explain the critical situation in which the Continental Army found itself after a succession of losses and the occupation of Philadelphia by General Howe. Maps, plans, and a bird's eye view of the Fort, linked to first-person narratives, will show how Fort Mifflin closed off the waterway to British shipping.

As visitors move from the river toward the Fort, two or three waysides should interpret the siege. Crossing the bridge over the moat, visitors approach the walls of the Fort: here they should learn about the Fort's reduction and evacuation. Directly under the walls, visitors should encounter some kind of a memorial which commemorates the heroism of the defenders and details the terrible casualties which they suffered. Commemoration is integral to site interpretation, and the Master Plan recommends that a memorial be erected in the shadow of the walls that survived the siege.



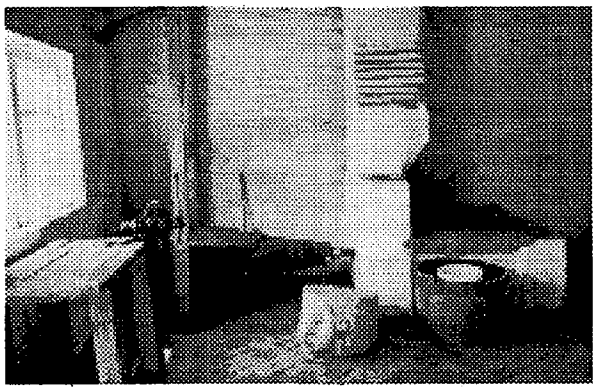
The Master Plan proposes primary entry to the historic Fort at the Main (East) Gate, highlighting the strategic location of the original fortifications on the Delaware.

The 1777 reduction of Fort Mifflin provides a good opportunity to move into the theme of engineering on Mud Island. In response to the Fort's destruction, the next generation of fortifications incorporated a fully-developed perimeter wall (bigger and higher than the original walls), re-vamped bastions, heavily

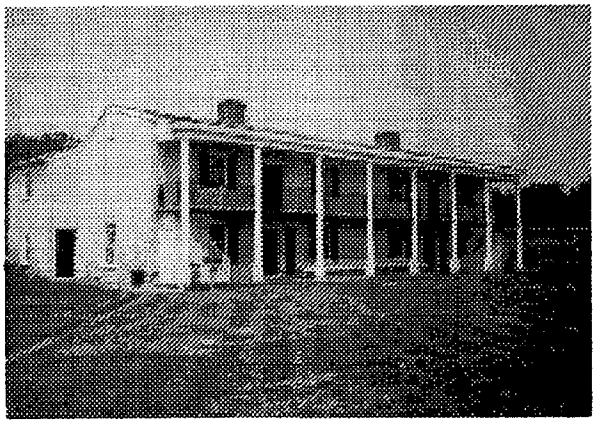
reinforced casemates and magazines, erected a central citadel, extended dikes and a full moat, and installed various systems for water control and disposal. Visitors entering the Main (East) Gate can visit the monumentally-scaled casemates and ascend onto the northeast bastion. The views from this high point will support all three of the core themes: views toward Philadelphia will show how the Fort was placed to cut off water-borne supplies to the City (whose skyline is clearly visible); views toward the river will show the many engineering challenges; and those over the interior of the Fort will show visitors a distinct sense of the self-contained community that existed in the Fort throughout the 19th century. The theme of engineering can be picked up in waysides and exhibit panels strategically placed in relation to standing structures and features.

The theme of self-contained community is well-supported by standing structures. A clockwise walk around the interior of the Fort, starting at the Arsenal or the Storehouse, will bring visitors to the Artillery Shed, the Blacksmith Shop, the Commandant's House, the Parade Ground, and then to the Officers' Quarters and the Soldiers' Barracks. This kind of routing continues to reinforce the river orientation of the Fort and the primacy of its defensive function: it was there to block enemy navies moving upstream toward Philadelphia. The clockwise route also helps visitors to understand that the Fort was an artillery base and that structures like the Powder Magazines, Artillery Shed, and Blacksmith Shop were functionally critical, while the living accommodations for the garrison were primarily for peacetime use, to be abandoned for the casemates in time of battle. Daily life in the Fort, especially in the living quarters, would make a good subject for an exhibition, or, even better, a media presentation. This would give visitors a compelling climax experience.

Several qualifications have to be added at this point. First, the site will always need some kind of a media presentation that tells the story of the 1777 Fort and siege in order to accommodate visitors who cannot walk the proposed tour route because of time constraints, physical disability, inclement weather, etc. Second, guided tours need not follow the suggested tour by rote: costumed interpreters should have the knowledge and ability to tailor each tour to the interests of visitors by emphasizing one or another theme. Third, self-guided thematic tours should be made available on request: this means that visitors should be able to access specific structures and features in various sequences.



Period interpretation, such as currently exists at the Blacksmith Shop, should be expanded as an interpretive strategy for the historic Fort.



Unused square footage in the Officers' Quarters offers opportunities for period interpretation of historic interiors.

- **Environmental Interpretive Programming for the Nature Trail**

This section describes the interpretive planning strategies that relate to the environmental theme. For the purposes of this Master Plan, these strategies are incorporated in the proposed nature trail.

The natural setting of Fort Mifflin is an essential part of its history as well as an important wetland ecosystem. **Three major interpretive themes have been identified that will in some instances enhance the human history of Fort Mifflin,** as well as increase the visitors' enjoyment of this surprisingly refreshing island of green in a heavily industrialized urban area.

Environmental Interpretive Themes

The themes are broken down into several interpretive storylines which may be presented on interpretive graphic panels and/or used as the basis for developing self-guiding handouts and guided tours. These three themes can be summarized as follows: **The Nature of Fort Mifflin: Then and Now:** contrasts the eighteenth century with the contemporary natural environment of Fort Mifflin; **An Island of Green:** interprets Fort Mifflin as an isolated green area and wetland within a heavily industrialized area; **The Plants and Animals of Fort Mifflin:** emphasizes very specific plants and animals at the Fort.

1) **The Nature of Fort Mifflin: Then and Now:**
The theme of 'Then and Now' describes historical human impact and the changing shape of the site over two hundred years. It deals with changing attitudes: the idea of humans struggling to conquer natural forces in contrast with the contemporary idea of preserving nature.

a) Describe the tidal riverine mud flats around Fort Mifflin and adjacent wetlands of the late eighteenth century as an ecosystem.

b) Fort Mifflin has changed its shape radically since the eighteenth century. Describe its evolution from an island to its current state over the intervening years. Represent the populated vs. natural areas of the time and contrast with the present day.

c) Discuss the European attitudes towards nature in the eighteenth century (something to be feared, mastered, used and controlled). For example, the prevalent belief that a marsh was not only gloomy and unsightly but a threat to health as a natural source of pestilence. Show how, from the nineteenth century on, this most industrial of cities has changed the sizes and shapes of its river edges and wetlands.

d) Describe eighteenth century use of wetlands as a source of food and medicine (both plant and animal), household items (bedstraw), etc. Touch on the specific impact Fort Mifflin had on its natural surroundings through sewage and waste disposal and the effects of Fort construction, etc. Discuss Philadelphia as an upriver source of contagion.

e) There is an opportunity to contrast all this heavily European impact with the Native American (Leni Lenape) use of the land and point of view.

2) **An Island of Green:**
The theme of the 'Island of Green' focuses on the Fort Mifflin ecosystem today and problems associated with small, isolated tracts of green space (i.e. fewer species, less buffer or protection against elements which tends to further reduce the size of green areas). Emphasize positive reasons for preserving these isolated areas: essential to migrating birds; can be critical habitat for endangered species; may connect with greenways in the future.

a) Show Fort Mifflin in its surroundings as a green haven hemmed in by industrial sprawl. Describe the encroachment of industry on the site – an illustration of how big cities have traditionally used and misused their rivers.

b) Describe the site as having wetland and upland habitats and the differences between these.

c) Define and describe wetlands, touching on the different types and how to recognize them. Describe the Fort Mifflin type, tidal riverine wetland, as one of richest and densest of living communities outside of a tropical rain forest.

d) Wetlands are critical habitat for migrating birds. They produce a great deal of food and provide a safe haven and nesting place. Wetlands support many and diverse plant and animal species.

Discuss wetlands as potential links in greenway systems.

e) Wetlands are crucial filters of toxic materials.

3) **The Plants and Animals of Fort Mifflin:** The 'Plants and Animals' theme describes the native plant species and contrasts them with invasive species. Their value to other wildlife is explained as well their contribution to our understanding of the eighteenth-century landscape. Wildlife-attracting species and easily observable species (such as the black walnut tree, which is both) are specified.

   a) Provide an overview (but not an exhaustive description) of the animal species that may be seen at Fort Mifflin. Include the common as well as the spectacular. Avoid identifying the endangered species on site as such. There is concern that this may actually encourage interference with these plants and animals.

   b) Describe the function of a tidal moat and adaptations that selected, potentially observable plant and animal species have made to tidal fluctuation.

   c) Describe the encroachment and effects of invasive plant species, how they got here, and why they create a problem. Contrast this with the process and value of returning natural areas to native species.

   d) Note the efforts Fort Mifflin is making to increase the value of its green space as a wildlife habitat.

   e) Establish a calendar of Natural Events: Fort Mifflin changes with the seasons. Describe what one may see when returning in spring, summer, fall or winter. Suggest best times for birding or seeing certain plant species in bloom, etc. This may be developed as a simple handout and may be displayed in a larger format at the visitor services building.

- **Interpretive Programming/Site Development**

Following is a list of strategies for incorporating wayfinding and interpretive strategies with recommended site improvements:

Reception and Orientation:
More and better signage is required to help visitors find their way to the reception and admissions area and from there to the starting point of guided or self-guided tours and other interpretive programs. A new visitor services building is proposed in the Master Plan.

Screening and Refurbishing the Site:
Thick screens of trees and shrubs are needed to close off views of the Army Corps complex to the northeast of Fort Mifflin. These views, unlike the river views or even the passing aircraft, are intrusions on the site and obstacles to interpretation. Refurbishing of housekeeping items such as the replacement of worn and tattered exhibit elements and labels, and re-siting the guns at the Water Battery are included here.

Dock Entry:
The Master Plan recommends that the dock be stabilized and/or restored. This could be a wonderful starting point for tours. It would give visitors a clear orientation to the strategic importance of the site and allow them to experience directly the waterway and river views. Dock access is also important, if the site is to develop water-borne traffic from Philadelphia.

Tour Access:
Two points on the proposed tour route will require easier access. Currently, if visitors move along the Water Battery from east to west, they find themselves standing at the southwest rampart of the Water Battery with a somewhat difficult descent. The Master Plan proposes a new wood stair in this area. Inside the Main (East) Gate, the Master Plan includes construction of a new ascent to the top of the northeast bastion.

Interpretive Graphics/Wayside Exhibits:
The proposed tour route requires researching,

planning, designing and installing sequences of interpretive graphics running from the dock or Water Battery to the southeast wall of the Fort, through the Main (East) Gate and into the northeast bastion, and then around the inside perimeter of the Fort. New interpretive graphics (including first-person quotes) should be placed in the interiors of the Casemates, Magazines, Barracks, Smithy, etc. Commemorative and interpretive initiatives at the southeast wall are imperative at this important corner of the site.

Pathways:

Other than the access points noted above, the suggested tour routes are currently accessible to visitors. It is recommended that stable walkways be installed in the interior of the Fort in response to continuing wet conditions. It is also desirable to improve the perimeter path along the Fort's exterior, especially along the eastern side of the Fort: the path is uneven and somewhat undefined on this side of the site.

Exhibitions, Media, and Publications:

Revising these elements will be complex and costly: these efforts can be put on hold while the thematics are being worked through. It is recommended that revision of the self-guiding brochure be undertaken in the near future, as this may take a significant amount of time to produce.

Descriptive Key to Signs and Graphics (see Location Plan)

Wayfinding Signs

S1 Fort Mifflin Vehicular Entrance
S2 Fort Entrance (arrow)
S3 Parking
S4 Visitor Services, Ticketing (arrow)
S5 Visitor Services
S6 Daily/Weekly Events/Orientation Map
S7 Administration Offices
S8 Fort Entrance (arrow)
S9 Nature Trail
S10 Nature Trail
S11 Nature Trail
S12 Restrooms
S13 Gift Shop
S14 Exit/Exit Message

Interpretive Graphics - Historical

GH1 Introduction to Fort Mifflin
GH2 Overview of Military Situation in 1777
GH3 Strategic Importance of Mud Island/Coastal Batteries
GH4 Siege - Part 1
GH5 Siege - Part 2
GH6 The Original Wall
GH7 Overview of Reconstruction: What You See Today
GH8 Water Battery

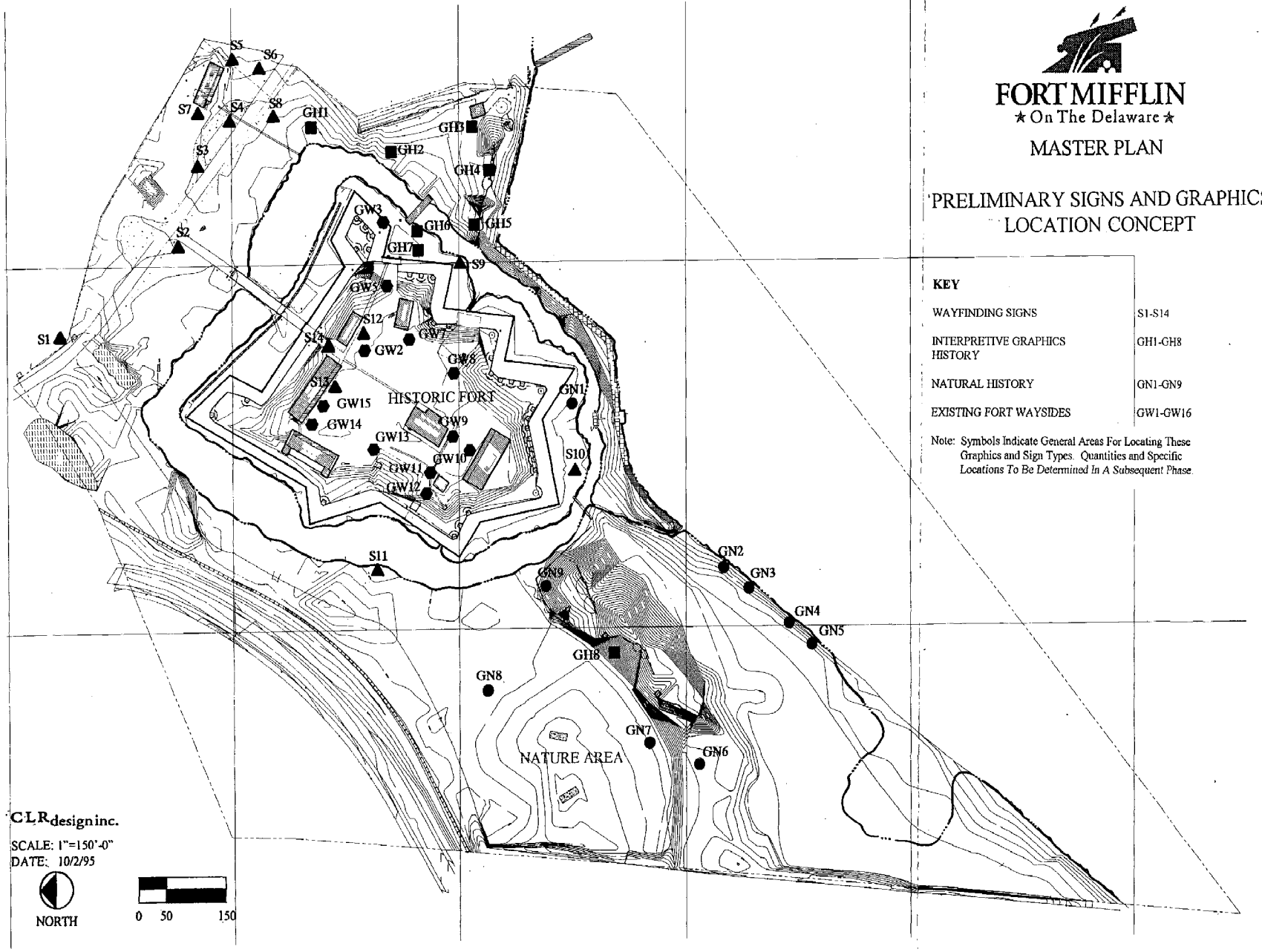
Interpretive Graphics - Environmental

GN1 Tidal Moat
GN2 Fort Mifflin Area Ecosystem: Then & Now
GN3 What is a Wetland?
GN4 Why are Wetlands Important?
GN5 Tidal Adaptations of Plants & Animals
GN6 An Island of Green/Fort Mifflin's Landscape Restoration
GN7 Native Plants
GN8 Animals of Fort Mifflin
GN9 Seasonality

Existing Fort Waysides

GW1* Fort Mifflin on Mud Island
GW2 Storehouse/Preexisting Buildings
GW3 Casemates or Bombproof
GW4* Artillery
GW5 Main (East) Gate/Flag
GW6* The Siege of Fort Mifflin
GW7 Arsenal
GW8 Torpedo Casemate
GW9 Citadel/Commandant's House
GW10 Artillery Shed
GW11 Blacksmith Shop
GW12 West Sallyport
GW13 Powder Magazine
GW14 Officers' Quarters
GW15 Soldiers' Barracks
GW16* Hospital & Mess Hall

* Existing waysides may be replaced in subsequent phase



FORT MIFFLIN
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MASTER PLAN

PRELIMINARY SIGNS AND GRAPHICS LOCATION CONCEPT

KEY

WAYFINDING SIGNS	S1-S14
INTERPRETIVE GRAPHICS HISTORY	GH1-GH8
NATURAL HISTORY	GN1-GN9
EXISTING FORT WAYSIDES	GW1-GW16

Note: Symbols Indicate General Areas For Locating These Graphics and Sign Types. Quantities and Specific *Locations To Be Determined In A Subsequent Phase.*

C.L.R design inc.

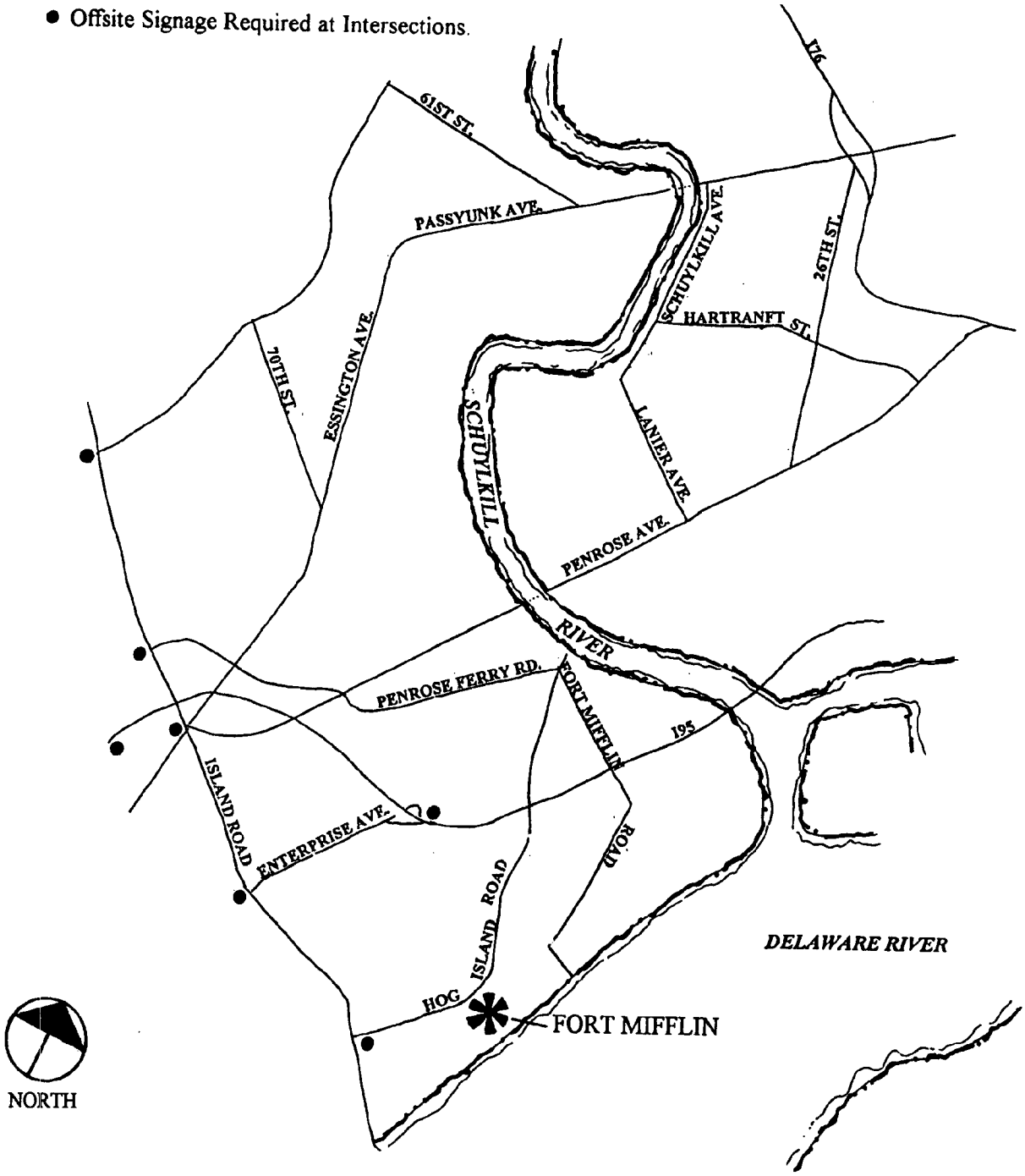
SCALE: 1"=150'-0"
DATE: 10/2/95

NORTH

0 50 150

OFFSITE SIGNS LOCATION CONCEPT

- Offsite Signage Required at Intersections.



6 Master Plan Development Projects

Work identified through the Master Plan is defined in the following chart as discrete projects which are prioritized according to **immediate action, short-term action, and long-term action** projects. Preliminary costs for construction of these projects have been estimated using 1995 dollars. These costs do not include design fees. Standard contractor costs are assumed for the purposes of estimating general costs. In most cases a range of cost has been identified due to the conceptual level of planning and minimal detailed design information. Many of the projects listed below can be phased over a period of time, as funds are available. Volunteer labor can also be utilized as available, with an eye to reducing construction costs.

The projects listed below include only new work identified within the Master Plan. Current maintenance and building restoration needs have been identified by the Fort staff, and costs for their implementation have been addressed separately in the Appendix of this document.

6.1 Immediate Action Projects

Project	Probable Cost Of Construction
1. Moat Improvements	
Dredging	$60,000 - $100,000
Bank Stabilization	$40,000 - $50,000
Tidegate Installation	$50,000 - $70,000
2. Wayfinding Sign Installation	
Offsite Signs	$3,000 - $4,000
Onsite Signs	$9,000 - $13,000
3. Gatehouse and Entry Improvements	
Demolition & New Gatehouse @ 100 SF.	$15,000 - $20,000
New Entry Gate	$10,0000
Entry Planting	$2,500
4. Visitor Parking	
Removal of Cannonball House by Others	----
Lot Paving & Curb/Access Road/Drop-off, Custom Color Asphalt Paving	$135,000 - $165,000
Army Corps Edge & Lot Screen Planting	$35,000 - $50,000
5. Historic Fort Perimeter Parade Ground Paving	
Unit Pavers	$50,000 - $75,000
6. North Sallyport Access Improvements	
Custom Color Asphalt Paving with Edging	$11,000 - $15,000

6.2 Short-term Action Projects

Project	Probable Cost Of Construction
1. Improvements to Fort Mifflin Road Access	
500 LF. planting, both sides of road	$15,000 - $25,000
2. Dock Reconstruction	$500,000
3. Battery Boardwalk	
6' boardwalk, guardrail, steps	$25,000 - $35,000
4. Historic Fort Parapet Viewing	
6' gravel landing, guardrail, steps	$10,000 - $12,000
5. Wood Foot Bridges	
Torpedo Channel	$2,500 - $3,500
South Nature Trail	$12,000 - $15,000
West Sallyport	$20,000 - $25,000
6. Moat Boardwalk	$50,000 - $65,000
7. Nature Trail Access Path	
Custom Color Asphalt	$10,000 - $12,000
8. Primary Nature Trail	
Custom Color Asphalt	$15,000 - $20,000
Selective Clearing	$2,000 - $3,000
Planting	$30,000 - $40,000
9. Interpretive Signage	
Historical Signage	$35,000 - $45,000
Environmental Signage	$35,000 - $45,000
10. Self-Guiding Brochures	$5,000 - $10,000

6.3 Long-term Action Projects

Project	Probable Cost Of Construction
1. Visitor Services Building	$200,000 - $225,000
2. Visitor Services Plaza	$100,000
3. Storehouse Restroom Improvements	$50,000 - $75,000
4. Fort Satellite Sales Shop	$10,000 - $15,000
5. Secondary Nature Trails	
Trail 1/Water & Wetland	
Gravel Path	$12,000 - $15,000
View Terrace 1&2	$25,000 - $30,000
Selective Clearing	$2,000
Planting	$30,000 - $40,000
Trail 2/Native Plants	
Gravel Path	$12,000 - $15,000
Selective Clearing	$4,000
Planting	$50,000 - $60,000
Trail 3/Bird & Berry	
Gravel Path	$15,000 - $18,000
Selective Clearing	$3,000
Planting	$40,000 - $50,000
6. Interpretive Video Program	$50,000 - $75,000
7. Interpretive Audio Program	$10,000 - $20,000
8. Memorial to Defenders of the Fort	$10,000 - $20,000

FORT MIFFLIN
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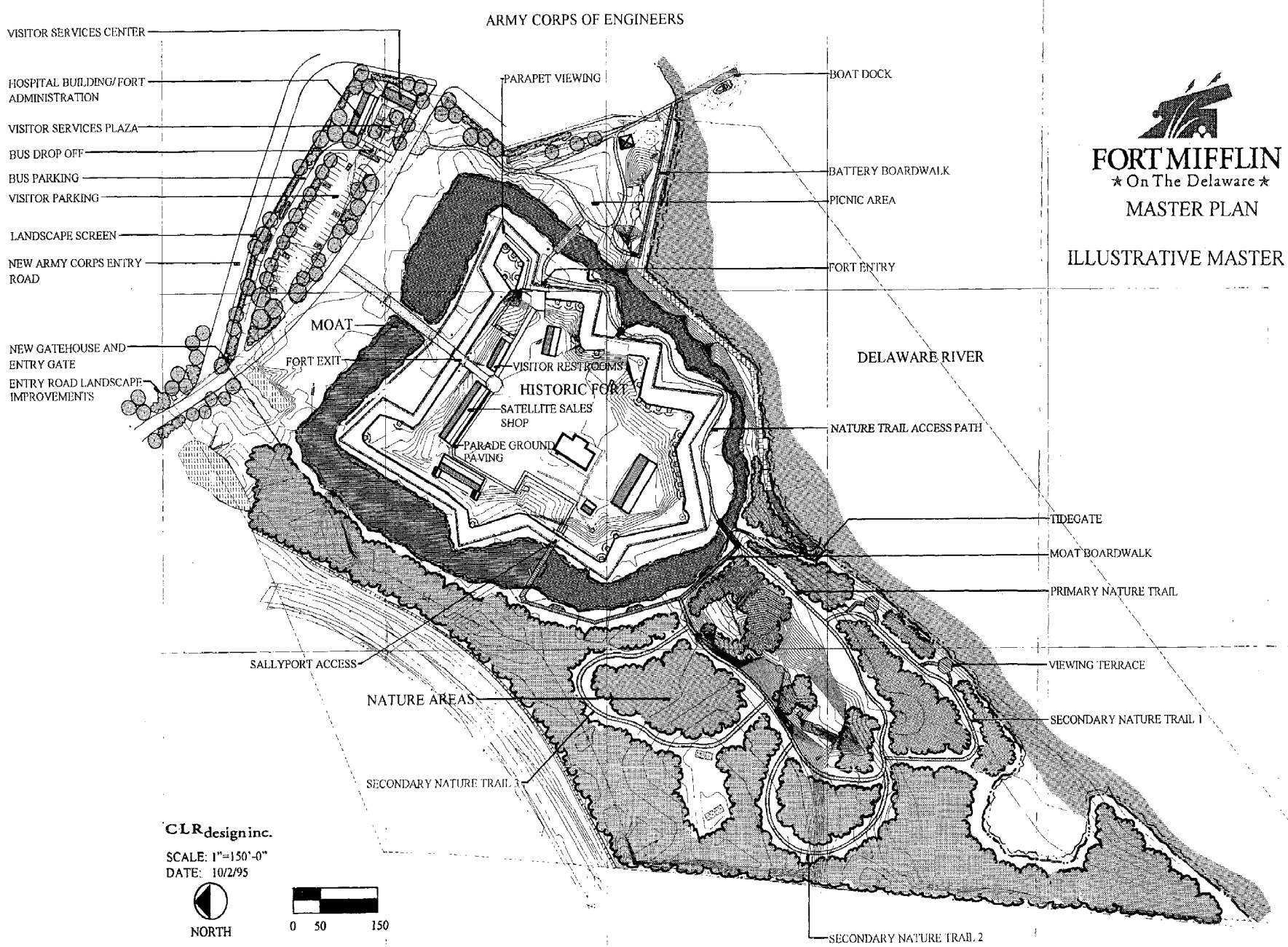
MASTER PLAN

ILLUSTRATIVE MASTER PLAN



7 Appendix

The Master Plan Appendix contains various documents which were instrumental as background for the planning process. The detail of these documents also serves as a point of departure for implementation of the Master Plan recommendations. Many of these documents have been compiled by the staff of Fort Mifflin and include summaries of Programming and Activities, Education Planning through the Year 2000, and Operations and Physical Plant. Attached as the final portion of the Appendix is the "Environmental and Engineering Evaluation of Fort Mifflin on the Delaware", prepared by Pennoni Associates Inc. that identifies environmental issues and conditions; permitting considerations and requirements; and site/moat engineering options.

7.1 Programming & Activities

• Visitor Information

Hours of Operation:

April 1 through November 30	Wednesday through Sunday 10:00 a.m. to 4:00 p.m.
December 1 through March 30	Monday through Friday Performed Group Tours only

Admission Prices:

Adult:	$4.00
Children/Students:	$2.00
Seniors:	$3.50
Education Programs:	$1.00

Group Pricing:

Receptive Operator:	$3.25 per adult 10% discount in Sales Shop
Bus Tours	$3.50 per adult 10% discount in Sales Shop
Group Leaders:	$3.75 per adult

Security	Gate is locked from 5:00 PM to 7:00 am and monitored by the Army Corps of Engineers
Maintenance:	Grounds Maintenance, use of seasonals, Chief of Maintenance, Cleaning Crews, Volunteers and Community Service Corps

• Visitor Profile

Visitors to Fort Mifflin currently fall into broad identifiable groups: special event visitors, weekday and weekend visitors. Visitation occurs primarily during ten months of the year - March through December. The Fort is closed to visitors on Monday and Tuesday.

All visitors generate ticket sales and rental fees for the Fort, with the exception of visitors for the Freedom Blast (a free City-wide celebration), Mothers on Mothers Day, and Fathers on Fathers Day.

Following is a summary of current visitation trends, based on staff observation rather than survey figures. This summary does not address seasonal trends in visitation, although the Fort staff notes an increase in visitation on Sundays, and in the fall.

1994 Annual Visitation		**15,000**	
Special Events		6,400	
Site Rentals	500		
April History Alive (day)	250		
June/July Freedom Blast (day)	5000		
Oct. Garrison Days (2 days)	550		
Nov. Siege of 1777 (2 days)	100		
No figures generated for smaller programs			
60% School Children		5,160	1 bus/day
Principally grades 4 & 5			
40 children/bus			
10 months: March-Dec.			
Weekday visitation W-F			
(Dec. & March visitation M-F)			
Includes summer camp groups			
30% Families		2,580	4 cars/day
Average 4/car			
8 months: April-Nov.			
Visitation: Wednesday-Sunday			
Heavy Sunday visitation			
10% Other		860	27 cars/week
8 months: April-Nov.			
Young Adults			
Seniors - individual & groups			
Bus Tours			

• Collections and Collections Care

The collection policy of Fort Mifflin on the Delaware is limited to objects, artifacts, documents and books related to coastal fortifications or military history with direct association to military life as it would have existed at Fort Mifflin or the people who lived there. All other collections will be limited to those required for interpretation of the Fort.

Fort Mifflin on the Delaware is only interested in exhibits reflective of the Fort's history and is not interested in exhibits not related to the topic.

In order to preserve and protect such objects, artifacts, documents and books, a proper storage environment will be created and maintained.

• Interpretive Programming

Current Operation

Presently the Fort Interpretive Staff offers regularly scheduled visitor tours at 1:00 PM and 3:00 PM on weekdays and 11:00, 1:00 and 3:00 on weekends. Uniform and Weapons demonstrations are held at 2:00 PM on weekdays and 10:00, 12:00 and 2:00 on weekends. Visitors may take a self-guided tour by using the Fort brochure which is provided to them when admission is paid.

Pre-formed Groups are offered tours at 10:00, 11:00, 12:00 and 1:00.

The Interpretive Staff at Fort Mifflin is very knowledgeable of both the Revolutionary War and the Civil War. Additionally, the guides can speak adequately on social and geographic issues, world and ethnic issues as they were affected by the different wars. Their interpretation includes the buildings of the Fort, their use, evolution and restoration.

Artillery Demonstrations are offered on Sunday afternoons and/or if paid for by a pre-formed group.

Pre-formed Groups:
The Fort currently offers two different programs: Revolutionary War and Civil War. Future programming should include the quasi 1798 Naval Battle with France and the War of 1812 and Ethnic Military History.

Each tour includes:
- Tour of the Fort
- Description of the Battle of 1777
- Uniform and Weapons Demonstration

Groups can request a cannon demonstration at $20.00 and/or a Treasure Hunt at $20.00 for the first 30 children under seven.

Interpretive Programming (continued)

Anticipated Future Operation

Additional tours will include:

Architecture
- Historic Fort Architecture
- Military Architecture
- Coastal Fortification Architecture

Exhibits
- The Building of Fort Mifflin - The Montressor Papers
- The Siege of Fort Mifflin
- Artifacts and Historic Archaeology
- The Commandant's House
- The French Connection to Fort Mifflin
- Uniforms of America's Military
- Environmental Pressures

Environmental
- Self-Guided tour of Flora and Fauna
- Waysides explaining wooded and wetland area
- River Walk
- Bicycle Path as part of Schuylkill River Heritage Park

Living History
- Music Programming
- Period Re-enactors - War of 1812, Revolutionary War, Civil War
- Role Playing of Characters from Historic Periods
- Stage Interpretation of Historic Events and Personages

• Educational Programming

The objective of the education program is to make the Fort more interactive for students and to facilitate their understanding of how history plays a real and significant part in people's lives. Additionally, the goal is to help students understand preservation issues along with historical and human issues.

Education Programs are offered to pre-formed groups seeking specific programming during the time period of Monday through Friday. Programs are designed for particular age groups and involve lecture, discussion and hands-on activities. An Education Coordinator organizes and directs the educational activities. The Education Committee, made up of Bodard Members and other interested parties (largely associated with the Philadelphia School District) is involved in the creation of an Education Plan and meets regularly.

Cost of Education Programs: $1.00 in addition to normal admission
Programming will begin in September of 1994

Working Themes (Autumn 1994):

19th Century Medical Program (*Blood, Sweat and Tears*)
Multi-cultural role playing (*World of Diversity, A Common Cause*)
Flag Program - History of the American Flag, Regimental Flags (*Old Glory*)
Environmental - Mapping, water testing, etc. (FORTscapes)
Architecture for Young Folks (Fort FUNdamentals)

Teachers will be provided with pre and post visit activities.

Additional Programming:

Science and Engineering
Women - Family Life and Military
W.W.I and W.W.II
Summer History Camp
Lecture Series

• Other Activities

Current Volunteer Activities

Re-enactment/Activity	
The Mifflin Guard	300 members
W.W.I Re-enactors	75 members
War of 1812	Fort McHenry Guard
Old Fort Mifflin Historical Society	12 members
Crew of the Victoria	10 members (Naval Programs)
Battery B 1st PA Artillery	9 members

Maintenance/Administrative	
Bell Pioneers	200 members
US Butte	100 members
US National Guard	
Various Boy/Girl Scout Troops	
Community Service Corps	
Young Marines	

Facility Rentals
- Corporate Retreats
- Fundraising Activities
- Company Picnics
- Reunions
- Military Reunions

Auxiliary Services
- Food Service
- Vending Machines
- Sales
- Acoustiguide
- Changing Exhibit Gallery
- Video

• Special Events Programming

Currently Fort Mifflin hosts four annual special events which are considered the core of the interpretive programming of the Fort. These events specifically commemorate the most significant points of the Fort's history. The one exception is the Freedom Blast which is sponsored by the City of Philadelphia as part of the Freedom celebration of July 4th.

:	History Alive	-	April
:	Freedom Blast!	-	July
:	Civil War Garrison Days	-	October
:	Siege of 1777	-	November

In addition to the above, the Fort also hosts other events throughout the season but not on a regular date basis which are supplementary to the interpretation of the Fort:

:	Artillery Programs	-	June, July, August, Sept.
:	Summer Music Programs	-	July, August
:	War of 1812	-	September
:	Civil War Naval Program	-	April, July
:	School of the Musician	-	April, May, Oct., Nov.
:	School for Artillery	-	Spring
:	Revolutionary Garden Party	-	May

(these dates may vary from year to year)

Special occasion events will include:

:	VE Day Commemoration	-	May, 1995
:	Fund-raiser (Annual)		
:	World War I		
:	African-American Military Experiences		
:	Civil War Wedding	-	September 1994
:	1996 - 225th Anniversary of the Building of Fort Mifflin		
:	2002 - 225th Anniversary of the Siege of Fort Mifflin		

• Marketing

Goal:		***Increase visitation at a rate of 35% per year through the year 2005*** ***Increase revenue generated per person to $5.00 by year 1996***
Challenge:		**Create Greater Recognition and Visibility Among Tourists and Local Residents**
Strategy:	1.	Inclusion of Fort Mifflin in all publications relating to tourism, historic sites, educational venues, environmental interests, special events, sites of interest, etc.
	2.	Maintaining stack brochures and other pertinent information at areas of high public visibility
	3.	Develop and maintain relationship with bus tours leaders, group leaders, hotels, receptive operators, convention and visitor bureaus
	4.	Use of newspapers, magazines and television in the most optimal way for increased visibility
	5.	Participation in local events recognizing historic/Philadelphia sites
	6.	Alignment with Historic Philadelphia and the Historic Neighborhood Consortium, Schuylkill River Heritage Park, Delaware River Heritage Park, the Schuylkill River Coalition, Tri-State Coalition of Historic Places.
Challenge:		**Expand Programming to Increase Visit Desirability**
Strategy:	1.	Selective use of special event programming
	2.	Creation of living history program on daily basis
	3.	Initiation of Historic Lecture Series
	4.	Continuation of "Fiddlin' At the Fort" music series
	5.	Use of permanent and rotating exhibits
	6.	Continuation of small weekend events
Challenge:		**Improve and Increase Accessibility to Site**
Strategy:	1.	Improved road signage
	2.	Renaming of Island Avenue to Fort Mifflin Road
	3.	Initiation of Ferry tour: - Fort to Fort - Schuylkill River - Delaware River
	4.	Increase in Bus Tour visitation
	5.	Cooperative effort with train operators

• Surrounding Influences & Collaborative Efforts

Philadelphia International Airport
The Philadelphia International Airport, Fort Mifflin's neighbor to the west, is currently executing plans for expansion of their commuter runway. This proposed area will run directly north of the Airport and west-northwest of Fort Mifflin. In order to secure the Pennsylvania Historic and Museum Commission's approval of the runway and mitigate any concerns over infringement on historic property or damage to buildings, the Airport has agreed to provide a certain amount of monetary compensation to the Fort which will provide funding for underground wiring outside the Fort, repair of the sluicegate, and sewer connection into the Army Corps line. Currently the Fort is working with the Philadelphia Department of Recreation and the Water Department to determine an equitable means of payment for maintenance of the connection. The project will reroute the large plane approach over the southern end of the Fort site and will impact alignment of roadways in the area.

US Army Corps of Engineers
The Army Corps controls the area along the river directly east and north of the historic Fort. Their interaction with the Fort is limited, however, they do provide gate security, overflow parking area, dock privileges and snow removal to the old Fort. Correction to the Corp's surface water runoff situation is being negotiated. A plan has been prepared to provide for relocation of the Corp's entry road, affording Fort Mifflin a private vehicular entry that can be controlled and monitored, particularly when the Fort is closed to visitors.

Delaware River/Schuylkill River Ferry
Historically, the Delaware River was the only way to get to Fort Mifflin. Currently, due to the deteriorated condition of the dock there is no easy access to the site from the river. However, there is current movement by Fort Mifflin on the Delaware to restore the dock and create a river trip from Penn's Landing in Philadelphia to Deptford, NJ (location of historic Fort Mercer) and sites along the Schuylkill River.

United Parcel Service
UPS is located approximately two miles southwest of the Fort. Fort Mifflin on the Delaware's objective is to develop a stronger "neighborhood" relationship with UPS.

Southeast Water Treatment Plant
Just northwest of the Fort, this site causes significant odor when the winds are blowing south. This only happens occasionally, however, it could prove to be a long term concern as it could affect the Fort's ability to attract corporate meetings, receptions, and other site rentals. According to local historians, there are the remains of British batteries constructed during the Siege of Fort Mifflin located on the property.

The Schuylkill River Bike Trail
In process for 30 years, the Schuylkill River Bike Trail will run from Reading, PA to Fort Mifflin, and is significantly completed in parts. It is anticipated that the trail will reach to the vehicular entry of Fort Mifflin within the next 10 years.

Surrounding Influences & Collaborative Efforts (continued)

Fort Mifflin Boulevard
In order to have Fort directional signage placed on I-95, it is necessary to account for 200,000 visitors per year on site. Since Fort Mifflin does not yet accommodate this amount of tourists, an alternative is to have Island Avenue, south of SR291, renamed to Fort Mifflin Boulevard. With this in place road/directional signage can then be installed on I-95 in place of signs now reading 'Island Avenue'. Fort Mifflin on the Delaware is in the process of gathering preliminary approval and approaching the appropriate politicians. Some resistance to this concept has been encountered. Chief among the objections are the historic nature of the existing name, as well as the cost and inconvenience to Island Avenue businesses resulting from an address change. It is considered a possibility that the road could be double-named.

Signage
In order to facilitate the arrival of visitors to the site and guide them once they are at the Fort a signage plan and execution is under way. The Philadelphia Streets Department has signaled their agreement to help with sign fabrication and placement for street signs. Onsite signs will be created to identify ticket prices, sales shop, parking, accessible parking, hours of operation and other necessary information.

Forts and Other Military Sites
Fort Mifflin on the Delaware is eager to develop working relationships with other forts in the area, including Forts Mercer, Delaware and Mott. Contact has been made with Forts Mercer and Delaware to begin programmatic initiatives and share information. Fort Mercer will participate in joint programming when the river ferry is initiated.

Fort Delaware has expressed interest in creating an all-day tour which would involve tours, overnight stays, eating and other tourist attraction initiatives.

Brandywine Battlefield is currently working on a Revolutionary War Tour which will include the Fort.

River Sites
Collaborative efforts are under way with Bartram's Gardens in regards to the Revolutionary Garden Party, Guns and Roses Tour, and Guns and Gardens. Future plans include the river tour which will also encompass the Waterworks at the Art Museum.

Historic Attractions
Affiliation with other historic sites such as those located in the Historic Mile in Philadelphia will benefit this site enormously in regard to exposure, networking and fundraising.

Cannonball House
The Philadelphia Historic Commission has been requested to dismantle and remove the Cannonball House from Fort Mifflin, as this building is not part of the site's historic structures and is in disrepair.

Airport Shuttle Bus
The introduction of shuttle to transport visitors between the Airport and the Fort is under discussion.

7.2 Operations & Physical Plant

- **Staffing**

Current Staffing:

Executive Director
Development Consultant (part time -full time)
Bookkeeper (Consultant)
Office Assistant
Education Director
Marketing Assistant (PT)
Chief of Maintenance
Interpretive Guides (2)

Anticipated Staffing:

Executive Director
Marketing Director
Development Director
Education Director
Volunteer Coordinator
Chief of Interpretation
Interpretive Guides (2)
Chief of Maintenance
Maintenance Seasonals (2)
Administrative Assistant
Bookkeeper (Consultant)
Sales Clerk (Volunteer)
Admissions Clerk (Volunteer)

• Maintenance

Statement of Intent
Due to the establishment of Fort Mifflin on the Delaware, Inc., Fort Mifflin is now in a stabilized condition, for the first time since its decommissioning. The following list prepared by Fort Mifflin staff addresses the maintenance issues for each building. Priority assignments have been identified as:

Life and Safety Issues	Property Loss	Prevention

Personnel

Chief of Maintenance	Service Personnel
Seasonal	Bell Telephone Pioneers of America
Community Service Corps	Volunteer Program

Funding
Future development issues include the "Adopt a Building" concept to allow for one or more groups to make contributions in support of a particular building. To date, the following buildings have been sponsored:

Blacksmith Shop:	Military Order of Foreign Wars	$1,000
Officer's Quarters:	Sons of Cincinnati	$2,500

Use of volunteers, donated goods and services from local businesses, and diverting current income to individual projects will help with the immediate maintenance needs of the site.

Maintenance Schedules

Building		
	Lime and Ochre	every two years
	Whitewash	every two years
	Pillar Replacement	approximately every ten years
	Cleaning	once a month
	Painting (shutters/doors)	every two years
Brick Drain - Fort Walls - Seawall Maintenance		
	Weeding/Application of Weed Killer	once a year
	Pointing	every five to ten years
Moat		
	Cleaning	once a year
	Dredging	needed immediately, then intermittently
Parking Lot		
	Leveling and Restoning	every year, if not paved
Road		
	Repaving	repair as needed
Parade Grounds/Demilune/Hospital Area		
	Cutting	once a week in season
	Reseeding	as necessary
Nature Walk		
	Pruning and Clearing	once a year, or as needed

• Restoration Projects

Over the years, several studies have been prepared for Fort Mifflin, directed specifically toward the assessment and restoration of historic structures. CLR did not carry out any historic structure survey as part of their physical master plan assignment. The following is a summary of restoration project status prepared by others for these historic structures, as well as infrastructure improvements needed on the property.

Building	Status	Funds Available	Funds Needed	Time Line
Hospital/Mess Hall	Restored Maintenance Required*		$10,000	1995 - Fall
Officer's Quarters	Restored Requires electrical work Maintenance Required*	$2,500		Completed
Soldier's' Barracks				
First Floor	Restored			
Second Floor	Unrestored	None		None
Storehouse	Restored			
Casemate #1	Maintenance Required*	Airport	$0	1995 - Fall
Casemate #2	Maintenance Required*	Airport	volunteer	
Casemate #3	Maintenance Required*	Airport	labor	
Casemate #4	Maintenance Required*	Airport		
Casemate #5	Maintenance Required*	Airport		
Bakeoven	Maintenance Required*	$1,000		
Artillery Shed	Restored Maintenance Required*			1995 -Fall
Blacksmith's Shop	Restored Maintenance Required*	$1,000		Completed
Powder Magazine	Maintenance Required*		$0	Completed w/volunteers
Water Battery	Unrestored			
North Sallyport	Unrestored			
East Sallyport	Unrestored			
Northwest Sallyport	Unrestored			
Commandant's House	Unrestored	$160,000	$1.2 million	In Process
Sub Total Funds Available		**$164,500**		
Sub Total Funds Needed			**$1,210,000**	

• RESTORATION PROJECTS, continued

Building	Status	Funds Available	Funds Needed	Time Line
Torpedo Casemate	Restored Maintenance Needed*		$0	Completed w/volunteers
Fort Walls	Restored Maintenance Needed		$125,000	None
Total Funds Available		**$164,500**		
Total Funds Needed			**$1,335,000**	

* Maintenance required approximately every two to three years

• Other Improvements Needed

Improvement	Status	Funds Available	Funds Needed
Electrical Rehab.			
- Underground Wires Phase I	Pending	$0	Completed by City
- Building Distribution Phase II	Pending		Completed by City
- Casemate Distribution Phase III	Not Scheduled		Completed by City
Sewer	Not Scheduled	none	
Watertight Casemates	Not Scheduled	none	$126,000
Moat	Dredging Needed	none	$200,000
Sluicegate	Repairs needed	none	
Road Relocation	Pending		
Seawall	Repairs needed	none	$6,000
Dock	Major Repairs	none	$200,000
Total Funds Available		**$0**	
Total Funds Needed (as known)			**$532,000**

7.3 Education Plan Fiscal Years 1995 - 2000

The following document was prepared by Fort Mifflin on the Delaware:

FORT MIFFLIN ON THE DELAWARE
EDUCATION PLAN

Fiscal Years
1995 - 2000

November 7, 1994
Lori Dillard
Education Director

INTRODUCTION

Education programs play an important role in fulfilling the mission of Fort Mifflin. "To educate and enrich students and families" is the primary goal of the education plan in order to engage learning and involve people, and to help insure the preservation and understanding of this important historical resource.

The following education plan provides an outline and direction for the Education Program during the period of January 1995 to December 2000. In addition, it sets a direction by identifying programs and strategies currently under consideration for possible application and execution. The following strategies are not exclusive of other options, not mentioned here, that may be considered at another time. Target date schedules are also subject to change.

Education programming at Fort Mifflin is a complement to but separate from Interpretive Programming. Interpretive Programming includes tours of the Fort, uniform and weapons demonstrations, and special event programming. Education programming, although it is frequently combined with Interpretive Programming, is considered a separate entity.

A review date of April 1995 will address any needed changes to this document.

EDUCATION GOALS

I.

To position Fort Mifflin as the destination of choice for every regional school district's field trip schedule.

II.

Develop and implement educational programs that define Fort Mifflin as a National Historical Landmark and a diverse resource for military, architectural, 18th century and 19th century history.

III.

Develop and implement educational programs that utilize Fort Mifflin as a rich environmental resource.

EDUCATION OBJECTIVES

- Develop a range of educational programs that address and complement the region's school curriculum.
- Develop support materials that complement education programming at Fort Mifflin.
- Provide education programs to an audience consisting of children, adults, seniors and families.
- Increase visitation through quality programs that will bring in new audiences and promote repeat visitation.
- Increase regional educators' awareness of the Fort and its history.

EDUCATION OBJECTIVES

OBJECTIVE:

Develop a range of educational programs that address and complement the region's school curriculum.

CURRENT PROGRAM:

The following education programs are provided independently or combined with an optional interpretative tour of Fort Mifflin. Each education program lasts one hour and consists of a lecture, hands-on activities and discussion.

Grade level: Kindergarten - 3rd grade

FORT FUNdamentals
An exploration of the Fort's architecture

This program will teach FUNdamental features of buildings and architecture while students explore the texture, materials, shapes, construction, function, and decoration of the diverse architecture of the Fort. Using pre-cut shapes, students make a collage of their own FORTscape.

Grade level: 4th - 7th

A WORLD OF DIFFERENCE AND A COMMON PURSUIT
Ethnic Diversity During the Revolutionary War

Students explore the important role ethnic groups played in shaping our nation. Students discover the diverse culture of the colonies and how these groups came together as one, a voice united for Liberty, while re-enacting the roles of historical figures who contributed to the Revolutionary War.

STARS AND STRIPES: The Story of the American Flag

Students learn about the history of our American flag, from the British Union Jack, to colonial and regimental flags. Students discover the real story behind "Old Glory". Students then attend our flag workshop and make their own flag with symbols to represent themselves.

CURRENT PROGRAM, Continued

Grade level: 5th - 12th grade

BLOOD, SWEAT AND TEARS
An Examination of Medical Practices of the 19th Century

Students examine a doctors kit and learn about surgeons serving during the Civil War as they explore the common medical practices of the 19th century. Activities include prescribing treatment to an ailing soldier.

FORTscapes: An Environmental Look at Fort Mifflin

Using Fort Mifflin's surrounding natural environment and its location on the Delaware River, students develop an awareness of man's alteration of the environment and its effect on topography and nature. Activities include map reading and water testing.

FUTURE PROGRAM:

The following proposed actions will be implemented within the next five years. Two historical periods are emphasized in the programming, Revolutionary War and Civil War.*

Starting September 1995 at least one new program will be implemented every new school year, from 1995 to 2000. Therefore, five new programs will be implemented during that time.

- REMEMBER THE LADIES
  The Contribution Woman Made in the Revolutionary War
- ON THE LOOM AND IN THE FACTORY
  Working Women in the 1800s
- HOMESPUN BLUE AND GRAY
  The Role of Women in the Civil War
- FROM SLAVERY TO FREEDOM
  African-American Program
- BROTHERS AT WAR
  Ethnic Diversity in the Civil War
- PRIVATE YANKEE DOODLE
  Diary Activity
- 18th CENTURY MEDICINE

FUTURE PROGRAM, Continued

- OUT WITH THE OLD AND IN WITH THE NEW
  Comparing objects of the 18th, 19th and 20th centuries
- THE DELAWARE RIVER: A MAJOR HIGHWAY IN THE 1700s
  Travel, Commerce and Shipping on the Delaware River
- THE ENGINEERING FEAT OF FORT MIFFLIN

*Some of the programs will be similar in theme but adapted to each of the two historical periods, 18th and 19th century, to provide more options to teachers.

OBJECTIVE:

Develop support materials that complement education programming at Fort Mifflin.

CURRENT PROGRAM:

Teacher materials accompany each program with pre- and post-visit activities to be conducted in the classroom by the teacher to enhance learning and Fort programming. Packets for each program are provided for this purpose.

FUTURE PROGRAM:

Materials will be developed to compliment each new program as they are implemented.

- Develop teacher materials for each new program and publish for distribution to teachers.

Starting in 1997, funding will be pursued to develop audio-visual presentations.

- Produce slide presentations to use as an introduction to specific education programs.

Beginning in 1997, funding will be pursued for self-guided teaching materials.

- Develop a walking brochure\handout to coincide with the nature walk rehabilitation and environmental initiatives at the Fort. The handout will encourage visitors to explore the Fort's natural surroundings and learn more about its environmental history.

OBJECTIVE:

Provide education programs to an audience consisting of children, adults, seniors, and families.

CURRENT PROGRAM:

Programming at Special Events, such as living history demonstrations, and children's games and activities, currently address some of the needs in this area. However, event programming is the responsibility of Interpretation and not that of Education.

Note: This does not exclude the possibility of adding education programs to Special Events in the future.

FUTURE PROGRAM:

Initiated in Summer 1995 to be continued through 2000.

- Summer History Camp:

Implement three camp sessions to last one week each, Monday - Friday from 10:00 - 4:00. Day camps will provide hands-on lessons in an active and fun summer camp environment. The camp will educate groups of young people not necessarily targeted through schools and other youth group organizations.

Suggested Camp:

The camp will be set up similar to an army training camp (except it will be much more fun). Kids will be recruited, enlisted and then fall into roll call. The young recruits upon entering the garrison, will be given a tour of their facilities.

Each day will include activities that Revolutionary War soldiers had to participate in, such as preparing for battle, musket drills, making cartridges, mending clothes, cooking, writing letters, making candles, etc. At the end of the camp, each of the good soldiers will be promoted to Private First Class in a ceremony that parents will be invited to attend.

Mother's Day, May 14, 1995. Program will coincide with National Wetlands Month and marketing efforts, mothers will be admitted free of charge. The program will continue on each Mother's Day through the year 2000.

Father's Day, June 18, 1995. Program will coincide with Flag Day and marketing efforts, fathers will be admitted free of charge. The program will continue on each Father's Day through the year 2000.

- Family Programs

Implement weekend programs designed for families, where parents and their children are encouraged to participate together in hands-on learning. Programs will be thematic and may or may not coincide with special events. Special programs for Mother's Day and Father's Day are of particular interest where activities are developed to enhance the parent\child relationship as well as learning at Fort Mifflin.

Starting in 1996, funding will be pursued for adult education initiatives.

- Lecture Series

Plan weekend or evening lectures to promote continuing adult education and interest of topics relating to Fort Mifflin, the Revolutionary War period and Civil War period.

Starting in 1998, funding will be pursued for senior education programs.

- Senior Groups

  Collaborate with Elder hostels, to provide a site where a lecture or visit to Fort Mifflin is part of their schedule.

  Design lecture series especially suited for an elder audience to be held during the day.

  Develop outreach programs for community groups and nursing homes.

  Plan workshops held during the day, that would teach a craft or pastime.

OBJECTIVE:

Increase regional educators awareness of the Fort and its history.

CURRENT PROGRAM:

Education Brochure

A three-fold brochure that advertises and describes the education program. Education brochures are mailed to all area schools and youth group organizations, within a 100 mile radius, describing and promoting Fort Mifflin's education programs.

Curriculum Fairs

Information booths set up to distribute brochures and information about Fort Mifflin to teachers and youth organizations.

Flyers

Additional information about the Fort's education program used as a hand-out to walk-in visitors, mailings and requests for information.

Corporate Packages

Press Packages

FUTURE PROGRAM:

Continuing efforts from January 1, 1995 through December 31, 2000.

The following actions will be performed in conjunction with the Marketing efforts of Fort Mifflin:

- Mail press releases to all area newspapers announcing new education initiatives.
- Mail press releases to all area newspapers announcing special education programs.
- Annually, as an overview, announce education programs and activities to members and people on the Fort's general mailing list.
- Make announcements in the Fort Quarterly and other organization newsletters.
- Distribute printed materials at conventions and fairs.
- Make oral presentations to principals, community organizations, PTA meetings and other appropriate venues.

FUTURE PROGRAM, Continued

- Expand mailing list to include homeschoolers to distribute information and education program brochures.
- Approach local and regular public service organizations for air time.

SUPPORTING RESOURCES

PERSONNEL

CURRENT PERSONNEL:

- Professional Staff

Education Director

The Education Director is responsible for the development and execution of education programming as defined within the education mission and goals of Fort Mifflin.

The Education Director will report directly to the Executive Director and will work in conjunction with the Interpretive Guides of Fort Mifflin and the Marketing personnel.

FUTURE PERSONNEL:

Additional staff may be needed as programs expand and visitation increases.

- PROFESSIONAL

Education Assistant/Coordinator

Primary responsibilities will be to work with the Education Director to help implement school and youth programs, a summer history camp and family programs. In addition, he/she will schedule tours and education programs, and perform related tasks.

The Education Assistant will report directly to the Education Director and will work in conjunction with the Interpretive Guides of Fort Mifflin.

- SEASONAL/PART TIME

Summer History Camp Assistant

Primary responsibilities will be to help staff plan and implement a summer history camp including recruiting visitation, designing activities and conducting the program.

This position will be necessary if the program expands; based on demand and interest, requiring an increase in available weeks of camp and campers admitted.

FUTURE PERSONNEL, Continued

- VOLUNTEERS

Volunteer Activity Guide

Volunteer guides are responsible, in conjunction with the Education Director, for conducting school and youth group education programs and providing office support as needed.

The Volunteer Activity Guide will report directly to the Education Director and will work in conjunction with the Interpretive Guides of Fort Mifflin.

Volunteer Summer History Camp Counselor

Camp Counselors will work with staff to direct camp activities and help with daily preparations and clean up.

Camp Counselors will report directly to the Education Director.

STAFF DEVELOPMENT

Training

Staff are encouraged to participate in field trips, attend local lectures, visit historical sites and attend conferences and workshops for professional development and enrichment. A small budget will be set aside for travel and registration fee costs.

Volunteers will be trained for specific tasks on an individual basis. Volunteers are encourage to follow the same goals for enrichment as the staff.

Annual field trips to other institutions will be arranged for the staff to increase awareness of other programs and to offer improvement of our own.

Membership

Staff are encouraged to obtain individual memberships to regional and national organizations that serve historic sites and museum education. Fort Mifflin will maintain organizational memberships to selected local, regional, and national organizations.

FACILITIES

Fort Mifflin consists of 13 restored and interpreted buildings. Although all of the buildings and spaces can be used for lessons, the primary space will be a 19th century mess-hall that provides ample room for tables, set up and movement. Future activities may require a space for AV presentations.

EVALUATION

CURRENT PROGRAM:

None

FUTURE PROGRAM:

Beginning January 1, 1995 the following actions will be implemented.

- Design an evaluation survey to be given to every teacher or contact person who books an education program.
- Record numbers who participate in each program from year to year as a comparison.
- Prepare an easy evaluation card to hand out to participating students asking how they liked the program they received. These would be handed out to groups randomly.
- Design an evaluation survey for teacher materials to be included in every packet.

APPENDIX

ADMISSION INFORMATION

Teachers will choose one of the following options:

Interpretive Tour/Uniforms and Weapons Demonstration Education Program and Activity	$2.00 per student
Interpretive Tour/Uniforms and Weapons Demonstration	$1.00 per student
Education Program and Activity	$1.00 per student
Teachers and Chaperones	$4.00 per person or $3.00 per person (if there is 1 chaperone per every 10 students)

Fees will be assessed each year for rate increases.

7.4 Environmental & Engineering Evaluation

The following document was prepared by
Pennoni Associates.

Pennoni Associates Inc.
1600 Callowhill Street, Philadelphia, PA 19130, Tel: 215-561-0460, Fax: 215-496-0063

John Scott Rodgers, AIA, Principal
CLR Design, Inc.
115 North Third Street
Philadelphia, PA 19106

August 9, 1995

Re: Fort Mifflin on the Delaware
Philadelphia, PA
Environmental and Engineering Evaluation
CLRR-92A7.004.01

Dear Mr. Rodgers:

In accordance with our proposal M100, dated January 25, 1995, and revised March 20, 1995, Pennoni Associates Inc. is pleased to present this letter report of our environmental and engineering evaluation for Fort Mifflin on the Delaware ("Fort Mifflin"). The following numbering system follows the Scope as presented in the proposal.

INTRODUCTION

Pennoni Associates Inc. was contracted to provide environmental consultations. Within the services to be provided are inventories of vegetation, wildlife and aquatic species, a preliminary wetland evaluation, summarization of various environmental permits that are associated with proposed improvements, identification of impacts associated with the sluice gate repair and dredging of the moat, and an evaluation of dredging alternatives.

Fort Mifflin is a 40 acre tract situated between the Delaware River and Philadelphia International Airport in Philadelphia, PA. This area was developed in the 1770's for military purposes. A review of the landscape indicates that there has been minimal recontouring of the land since it's original development. The nature area of the tract (southern side) can be characterized as successional woods, with secondary growth hardwoods overgrowing the historic Batteries.

1.1 VEGETATIVE INVENTORY

Pennoni Associates Inc. preformed on-site inspections at Fort Mifflin during April and May 1995. Table 1 is a listing of vegetation identified on-site, with both the common and scientific species. A Vegetative Association Plan has been prepared, depicting the dominant vegetative associations. Impact to the each associations has been identified by the proposed activities (nature trail, new crossing of moat, boardwalk, vegetative removal in moat, dredging of moat, long term maintenance of moat and interior site drainage improvements).

1.1.1 BACKGROUND

Fort Mifflin has been in existence since 1772 and was used by the Army until the 1950's. With the long standing development of Fort Mifflin and surrounding areas, the vegetation is indicative of disturbed areas. The nature area supports the High Battery and Mortar Battery built in 1871 on what was historically Hog Island. A first successional forested area occupies the majority of the uplands beyond the Fort proper.

The wetland vegetation is also indicative of disturbance, but of a more recent nature. The dominant species, common reed and rice cutgrass, occupy not only a large area at Fort Mifflin, but the historic Delaware Estuary in lower Philadelphia/upper Delaware Counties.

There is open water, with limited vegetative species associated with Fort Mifflin's moat. The dominate species in this area are arrow arum and blatter wort.

The Delaware River is a slightly vegetated estuary at Fort Mifflin.

1.1.2 VEGETATIVE AREAS - refer to Vegetative Association Plan (Figure 1)

1.1.2.1 Black Cherry - AREA A

The 4.5 acre portion of the property south of the moat and east of the wetlands is a forested upland area dominated by secondary growth black cherry with some sassafras and common sumac interspersed throughout. Black cherry is also found growing on top of the High Battery and Mortar Battery. Dense understories of wild rose are located throughout this area.

1.1.2.1.1. Project Impacts

The nature trail will extend through this region. Some selective clearing of trees, understory and herbaceous species may be required to construct and maintain the trail.

1.1.2.2 Common Reed - AREA B

There are two large areas of common reed with some smaller areas in low lying portions of the property. This combined five (5) acre area is very thick and tends to dominate, restricting other species from establishing themselves.

1.1.2.2.1 Project Impacts

The nature trail boardwalk coming from the Sally Port will cover a 10' wide strip of Common Reed adjacent to the moat. It is desirable to replace Common Reed with more valuable wetland species.

1.1.2.3 Rice Cutgrass - AREA C

A small pocket of rice cutgrass is situated in the northwest area of the tract in the wetland.

1.1.2.3.1 Project Impacts

There are no project impacts to this vegetative community.

1.1.2.4 Sumac - AREA D

Stands of common sumac were observed in the southern portion of the property with some areas having a thick understory of wild rose.

1.1.2.4.1 Project Impacts

The nature trail will extend around this region. Some selective clearing of trees, understory and herbaceous species may be required to construct and maintain the trail. If desired, this community can be replaced with more desirable species (oaks, hickories).

1.1.2.5 Sassafras - AREA E

These small areas are dominated by sassafras in upland areas at the southern end of Fort Mifflin, adjacent to the pipeline terminal. Isolated sassafras was also observed in the black cherry dominated area of the property.

1.1.2.5.1 Project Impacts

There are no project impacts to this vegetative community.

1.1.2.6 **River Birch** - AREA F

A small stand of river birch with distinctive exfoliating bark was observed along a steep slope at the northwestern fenced-in portion of the property, adjacent to Island Avenue.

1.1.2.6.1 **Project Impacts**

There are no project impacts to this vegetative community.

1.1.2.7 **Large Tooth Poplar** - AREA G

An area of large-tooth poplar is present at the southernmost tip of the property adjacent to the pipeline terminal. Some of the trees are very large, achieving a diameter of approximately 18".

1.1.2.7.1 **Project Impacts**

There are no project impacts to this vegetative community.

1.1.2.8 **Maintained Open Space** - AREA H

There are two actively maintained areas at the property. The maintained areas are:

1) the area within the bounds of the moat, which includes the fort itself and the buildings; and

2) the areas to the north and east of the moat. This area includes lawn which is cut on a regular basis and some ornamental shrubs, located in the "water battery" area on the eastern most portion of Fort Mifflin.

1.1.2.8.1 **Project Impacts**

This areas to the north and east of the moat may be used for staging construction equipment, for dewatering of dredged and silt material, and for temporary stockpiling of dredged and silt material. These activities will result in temporary loss of grass. The bank stabilization activity will result in additional maintained open space.

1.1.2.9 Open Water, tidal and nontidal - AREAS I & J

This area is the Delaware River and the Fort Mifflin Moat. Vegetation identified in the moat is discussed in the wetland section of this report.

1.1.2.9.1 Project Impacts

Nontidal - Vegetative removal by dredging or moat mowing. Long term maintenance requires vegetative control.

Tidal - Riverward side pipe extension and silt removal for existing sluice gate may impact tidally influenced vegetation. Construction new sluice gate will introduce new tidal habitat. Construction of new tide gate will remove herbaceous "weedy" species. Construction access to reconstruct sluice gate or new tide gate will require some vegetative removal.

1.2 PRELIMINARY WETLAND EVALUATION

A preliminary wetlands evaluation was made at Fort Mifflin during April and May 1995 to determine the presence or absence and approximate configuration of wetlands, which are regulated by the United States Army Corps of Engineers ("COE") under Section 404 of the federal Clean Water Act and Pennsylvania Department of Environmental Protection ("PaDEP") under Title 25, Chapter 105, relating to Dam Safety and Waterway Management.

Criteria used for determining the presence of freshwater wetlands was taken from the Corps of Engineers Wetlands Delineation Manual ("Corps Manual"). To satisfy this legal definition of wetlands, the following parameters should be met.

1. 50% or greater of the vegetation must have a Regional Wetlands Indicator Status of Facultative (FAC), Facultative-Wet (FACW) or Obligate (OBL). If a dominance of the vegetation within an association is listed as Obligate, this area is to be classified as wetlands with no further synthesis of data required.

2. The area is inundated either permanently or periodically at mean water depths <6.6', or the soil is saturated to the surface at some time during the growing season. Indicators of wetland hydrology are presented in Section III of the Corps Manual.

3. Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. Indicators of soils developed under reducing conditions are presented in Section III of the Corps Manual.

It should be noted that there are other indicators also used to determine if the hydrophytic vegetation and hydrology criteria for freshwater wetlands has been satisfied. These criteria are presented in the above mentioned Corps Manual in decreasing order of reliability. If a site is considered disturbed (e.g., farmed, recent tree harvesting, removal of soil layer), wetlands may be present without one or more of the criteria having a positive indicator.

References used to perform this evaluation include the following:

- United States Geologic Survey 7.5′ Topographic Quadrangles for Philadelphia PA-NJ and Woodbury NJ-PA
- USDOI National Wetland Inventories for Philadelphia PA-NJ and Woodbury NJ-PA
- Soil Survey of Philadelphia and Bucks Counties, Pennsylvania
- National Technical Committee on Hydric Soils (NTCHS), List of Hydric Soils
- Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1

Fort Mifflin was also evaluated using the Federal Manual for Identifying and Delineating Jurisdictional Wetlands ("the Federal Manual"). This is the methodology used by PaDEP in establishing wetlands. The extend and presence of wetlands line remains consistent under the Federal Manual.

The presence of regulated waters of the United States/Commonwealth and their adjacent wetlands was confirmed during our inspection. The regulated areas are to the north and south of the Fort as well as situated in the moat. The approximate configuration of the limit of wetlands is shown on the Wetlands Plan (Figure 2). The following is a summary of these areas.

1) Moat - The moat surrounds the Fort structure. This is an open water habitat that has Palustrine Emergent (PEM) vegetation on the northeast and southeast sides. Dominant species identified in this area include arrow arum and blatter

wort. Considering the emergent vegetation as an invasion species, this area is classified as Palustrine-Open Water (POW) under the Cowardin Classification of Wetlands and Deepwater Habitats of the United States, United States Fish and Wildlife Service ("Cowardin").

2) Common Reed and Rice Cutgrass - The remainder of the wetlands is Palustrine Emergent, persistent (PEM-"Cowardin") ecosystem dominated by "weedy species". This aggregate five acre area is located on the western portion of the tract.

3) Delaware River - To the southeast of the land mass is the Delaware River. This tidally influenced area, while not a wetland, is regulated by both the PaDEP (under Chapter 105) and Corps of Engineers (under Section 10 of the Rivers and Harbors Act and Section 404 of the federal Clean Water Act). This area is classified as Estuarine tidal (E1-"Cowardin") and subtidal (E2-"Cowardin").

While no vegetation has been identified in the Delaware River, there is record one Pennsylvania Endangered species (Wrights spike rush-Eleocharis obtusa var.peasei) and two Pennsylvania Rare species (Waterhemp ragweed-Amaranthus cannabinus and Indian wild rice-Zizania aquatica) are identified in the tidal flat of the fort Mifflin region. we have not been able to confirm the location of these species.

1.3 APPROVALS

There are a number of federal, state, county and local approvals that may be required as a result for the proposed improvements to Fort Mifflin. These approvals are listed on the following pages. Depending on the design of any improvements, some or all of the approvals are necessary.

When the United States Army Corps of Engineers and Pennsylvania Department of Environmental Protection review their Section 404/10 and Chapter 105 applications respectively, there are a number of environmental concerns they will be focusing on in order to render a decision for this project. There are two areas of significant concern at Fort Mifflin.

1) Impacts to shallow water habitat, which is the area from the mean low water line to minus ten (-10) feet below mean sea level. Shallow water habitat exists adjacent to the shoreline and seawall.

2) Impacts to wetlands and the moat/storm drainage system at Fort Mifflin.

1.3.1 Dredging

To document that dredging will have a minimal impact on the moat, it should be demonstrated that the activity is limited to restore original elevations. The suspension of contaminated sediments and ultimate disposal of spoils attributed to the dredging operations is an issue that will have to be addressed. Contaminants such as heavy metals and petroleum hydrocarbons may be contained in the moat sediments, and eventually released into the river, thereby impacting water quality and aquatic organisms. Mitigative measures should be undertaken, such as using dredging techniques which result in minimal turbidity levels; seasonal construction so as to not disturb migration patterns; impact to threatened or endangered species; and the erection of silt curtains around the work area to contain turbidity levels and sediments from migrating from the construction area. Testing of the moat bottom sediments will be required to determine the degree of toxicity of these sediments. The results of this testing will determine where disposal of dredged spoils may occur.

Under Section 7 of the Endangered Species Act, the United States Army Corps of Engineers will evaluate the impact of the project on threatened and endangered plant and wildlife species. There is a high likelihood that the red-bellied turtle is present in

the moat. There has been sightings by Fort Mifflin personnel. It must be demonstrated that the project will not have an impact on threatened or endangered species; nor will it generate impacts that may deter the species from occupying this habitat. It will be necessary to maintain habitat by the mitigative measures during dredging. It must be demonstrated that contaminated river bottom sediments will not be suspended into the water column at a concentration that will have a detrimental impact to threatened or endangered species.

The project cannot have an adverse impact on cultural resources, including historic and pre-historic resources. At this point, we have contacted the Pennsylvania State Historic and Museum Commission to determine whether they have concerns about cultural resources in the area besides the Fort, and we anticipate documentation from their office stating their concerns. If other cultural resources are identified on the site besides the Fort, a determination has to be made whether these resources meet the criteria for a candidate site on the National Register of Historic Places. This can be determined under a Phase I and II Cultural Resource Study.

1.3.2 Nature Trail

It is our understanding that the nature trail will use an upland footprint of disturbance with the exception of the rehabilitation of the existing, dilapidated bridge. There are no known threatened or endangered species within this region. The construction of the bridge from the Sally Port across the moat and building the boardwalk in the Common Reed area will require authorization by Pennsylvania Department of Environmental Protection and Corps of Engineers.

The removal of vegetation in wetlands or uplands is not regulated by either the Corps of Engineers or Department of Environmental Protection. However, careful considerations should be given to preserve adequate habitat for the fauna at Fort Mifflin. A review of the property and discussions with knowledgeable people indicates that the birding population is of high quality and special in the Philadelphia region. The design of the Nature Trail should be made in accordance with ornithological protection.

Handicapped usage of the nature trail would be facilitated by asphalt surfacing. However construction in asphalt requires the following equipment:

- modified paving machine for narrow paths

- small paving roller
- dump trucks to haul asphalt and store base material
- small bulldozer to prepare surface for pavement

We see no land based route to get to the nature trail site. Thus, this equipment must be barged into the site which increases construction costs.

1.3.3 Sluice Gate Repair

The repair to the sluice gates may require extending piping into the Delaware River. This activity requires authorization by PaDEP and Corps of Engineers and possibly by the United States Coast Guard. Impacts to the aquatic species of special concern identified in Section 2.1 of this report will require an absence or presence determination.

1.3.3.1 New Tide Gate

Constructing a new tide gate in the south ditch will require authorization by PaDEP and Corps of Engineers and possibly by the United States Coast Guard.

1.3.4 Interior Stormwater Modification

The interior stormwater modifications and other activities within the Fort structure should not require authorization by Pennsylvania Department of Environmental Protection or Corps of Engineers.

1.3.5 New Construction and Parking Lots

The construction of a new building and new parking lots in the upland areas near the existing administrative building may require PaDEP authorization under Chapter 106 for fill in a flood plain. There are no identifiable impacts by these actions on vegetative or animal resources.

We recommend that when conceptual plans are formulated for this project, a preapplication meeting be held with federal and state regulatory agencies at either the Joint Permit Processing Meeting (United States Army Corps of Engineers), or the

Environmental Resource Council Meeting (Pennsylvania Department of Environmental Protection) to discuss the feasibility of this project. The issues, discussed in this report, can be elaborated upon, and we can further define the level of studies that will be needed to satisfy their concerns.

PERMIT:	**Section 404 of the Federal Clean Water Act**
PURPOSE:	Regulates the placement of fill and dredge material into waters of the United States, including adjacent wetland areas.
AGENCY:	United States Army Corps of Engineers Regulatory Branch Wanamaker Building 100 Penn Square East Philadelphia, PA c/o Richard Hassel (215) 656-6732
FEE:	$100, no fee if applicant is government entity
SCHEDULE:	Approval is issued 60 days from being deemed complete for review.
SUBMISSION REQUIREMENTS:	Corps of Engineers Standard Application Form, Environmental Questionnaire, Engineering Plans including Site Plan, Dredge Plan and Dredge Spoils Disposal Plan, Photographs, Aquatic Resource Study, Dredge Spoils Analysis, Alternative Analysis. A coordination with the State Historical Preservation Officer, Philadelphia Historical Commission and the National Advisory for Historic Preservation is required.

PERMIT:	**Section 10 of the U.S. Rivers and Harbors Act**
PURPOSE:	Regulates the placement of structures into navigable waters of the United States. [For this project it includes the Delaware River area.]
AGENCY:	United States Army Corps of Engineers Regulatory Branch Wanamaker Building 100 Penn Square East Philadelphia, PA c/o Richard Hassel (215) 656-6732
FEE:	$100, no fee if applicant is government entity
SCHEDULE:	Approval is issued 60 days from being deemed complete for review.
SUBMISSION REQUIREMENTS:	Corps of Engineers Standard Application Form, Environmental Questionnaire, Engineering Plans including Site Plan, Dredge Plan and Dredge Spoils Disposal Plan, Photographs, Aquatic Resource Study, Dredge Spoils Analysis, Alternative Analysis.

PERMIT:	**Private Aids to Navigation under Section 10 of the Rivers and Harbors Act**
PURPOSE:	Regulates the placement of warning lights on outfall structures in navigable waters of the United States. [For this project it includes the Delaware River area.]
AGENCY:	United States Coast Guard Fifth Coast Guard District Planning and Waterways Management Section Aids to Navigation and Waterways Branch 431 Crawford Street Portsmith, VA 23705 c/o John R. Walters, Chief (804) 398-6229
FEE:	None
SCHEDULE:	Approval is issued after Department of Army provisional permit.
SUBMISSION REQUIREMENTS:	Department of Army provisional permit, U.S. Coast Guard Form CG-2554 (Private Aids to Navigation Application), Navigation warning lights location map, Engineering Plans including Site Plan,

PERMIT: **Chapter 105 of the Pennsylvania Dam Safety and Waterway Management Act**

PURPOSE: Regulates dams, water obstructions and encroachments located in, along, across or projecting into regulated waters of the Commonwealth. For this project it includes open water, wetlands and the Delaware River.

AGENCY: Pennsylvania Department of Environmental Protection
Bureau of Water Management Program
Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428
c/o Charles Rheem, Regional Manager
(610) 832-6130

FEE:

Stream Enclosure	$350
Channel Change	300
Commercial Dredging	300
Fills, Floodwalls	350
Bridges & Other Obstructions & Encroachments	200

No fee if applicant is government entity

SCHEDULE: Approval is issued 60 - 90 days from being deemed complete for review.

SUBMISSION REQUIREMENTS: Chapter 105 Application Form, Project Description, Wetlands Evaluation, Environmental Assessment, Mitigation Plan, Alternative Analysis, Photographs, Engineer's Certification, Approved Erosion and Sediment Control Plan, Letter from the Municipality that the project conforms with their Flood Control and Stormwater Management Ordinances.

PERMIT:	**Chapter 106 of the Pennsylvania Flood Plain Management Act**
PURPOSE:	Regulates flood plain obstructions constructed, owned or maintained by the Commonwealth or a political subdivision of the Commonwealth.
AGENCY:	Pennsylvania Department of Environmental Protection Bureau of Water Management Program Lee Park, Suite 6010 555 North Lane Conshohocken, PA 19428 c/o Charles Rheem, Regional Manager (610) 832-6130
FEE:	No fee if applicant is government entity
SCHEDULE:	Approval is issued 60 - 90 days from being deemed complete for review.
SUBMISSION REQUIREMENTS:	Project Description, Wetlands Evaluation, Environmental Assessment, Mitigation Plan, Alternative Analysis, Photographs, Engineer's Certification, Approved Erosion and Sediment Control Plan, Letter from the Municipality that the project conforms with their Flood Control and Stormwater Management Ordinances.

PERMIT: **Chapter 401 Water Quality Certification**

PURPOSE: Regulates the quality of fill or dredge material placed in areas regulated under Section 404 of the Clean Water Act.

AGENCY: Pennsylvania Department of Environmental Protection
Bureau of Water Management Program
Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428
c/o Charles Rheem, Regional Manager
(610) 832-6130

FEE: No Fee

SCHEDULE: Approval is issued 30 days from being published in the PA Bulletin.

SUBMISSION REQUIREMENTS: Chapter 105 Application Form, Project Description, Wetlands Evaluation, Environmental Assessment, Mitigation Plan, Alternative Analysis, Photographs, Engineer's Certification, Approved Erosion and Sediment Control Plan, Letter from the Municipality that the project conforms with their Flood Control and Stormwater Management Ordinances.

PERMIT:	**Water Connection Permit**
PURPOSE:	Regulate connections to City water mains. For this project it would include any new buildings.
AGENCY:	Philadelphia Water Department Drainage Information Unit One Reading Center, 1100 Market Street Philadelphia, PA 19107 Contact Greg McCollough (215) 592-6276
FEE:	Dependent upon number and size of connections.
SCHEDULE:	One (1) week from time of submission.
SUBMISSION REQUIREMENTS:	Permit Form, six (6) sets of plans and profiles. Preliminary Review is suggested. Contractor must be applicant.

PERMIT:	**Drainage Connection**
PURPOSE:	Regulate connections to City drainage lines. Probably not applicable for Fort Mifflin, as storm water it not directed toward city storm sewers.
AGENCY:	Philadelphia Water Department Drainage Information Unit One Reading Center 1100 Market Street Philadelphia, PA 19107 Contact Rich Williams (215) 592-6270
FEE:	Dependent upon number and size of connections.
SCHEDULE:	One (1) week from time of submission.
SUBMISSION REQUIREMENTS:	Permit Form, six (6) sets of plans and profiles. Preliminary Review is suggested. Contractor must be applicant.

PERMIT:	**Building, Plumbing, Electrical**
PURPOSE:	Regulate building construction.
AGENCY:	Philadelphia Department of Licenses and Inspections 1600 Arch Street Philadelphia, PA 19102 (215) 686-2392
FEE:	Dependent upon building size and complexity.
SCHEDULE:	Dependent upon building size and complexity
SUBMISSION REQUIREMENTS:	Permit Form, three (3) sets of plans Contractor must be the applicant.

PERMIT:	**Site Plan Review**
PURPOSE:	Regulate planning and zoning issues.
AGENCY:	Philadelphia Department of Licenses and Inspections 1600 Arch Street Philadelphia, PA 19102 (215) 686-2392 City Planning Commission 1515 Market Street, 17th Floor Philadelphia, PA 19102 (215) 686-4607
FEE:	Dependent upon information and extent of plan.
SCHEDULE:	Philadelphia Department of Licenses and Inspections - 3 to 4 weeks. City Planning Commission - 4 weeks.
SUBMISSION REQUIREMENTS:	Permit Form, Completed Site Plans

PERMIT:	**Delaware River Basin Commission Section 3.8 Approval**
PURPOSE:	Responsible for the conservation and best utilization of water resources for the Delaware River Basin. All public and private projects proposed that will substantially affect water resources must obtain approval from the Commission.
AGENCY:	Delaware River Basin Commission 25 State Police Drive Box 7360 West Trenton, NJ 08625 c/o George Elias, Executive Director (609) 883-9500
FEE:	0.1% of construction cost, up to $1,000,000 0.025% of construction cost for the portion of the project over $1,000,000 with a cap of $50,000
SCHEDULE:	Approval is issued 60 days after all State approvals.
SUBMISSION REQUIREMENTS:	The application package submitted under the 105 submission will suffice.

PERMIT:	**Submerged Lands Agreement** (for Delaware River)
PURPOSE:	Regulate occupance of waters of the Commonwealth.
AGENCY:	Pennsylvania Department of Environmental Protection Bureau of Water Management Program Lee Park, Suite 6010 555 North Lane Conshohocken, PA 19428 c/o Charles Rheem, Regional Manager (610) 832-6130
FEE:	Dependent on submerged land area that is occupied.
SCHEDULE:	Agreement is prepared when the 105 application is approved.
SUBMISSION REQUIREMENTS:	Chapter 105 Application Form, Project Description, Wetlands Evaluation, Environmental Assessment, Mitigation Plan, Alternative Analysis, Photographs, Engineer's Certification, Approved Erosion and Sediment Control Plan, Letter from the Municipality that the project conforms with their Flood Control and Stormwater Management Ordinances.

1.4 WILDLIFE AND AQUATIC INVENTORY

A wildlife and aquatic inventory was performed using on-site inspection, review of previously published documents, interviews with Fort Mifflin personal and other local experts and consultation with resource agencies.

1.4.1 BIRDS

Appendix A includes a listing of birds common to the habitat and geographic region of Fort Mifflin. There are a variety of birds that use the Fort Mifflin area. We have contacted several local ornithologists and discussed the Fort Mifflin tract in regard to species usage.

Of the species that nest at Fort Mifflin, the most uncommon are the blue grosbeak, willow flycatcher, lesser black-backed gull, Eastern phoebe, and gray catbird. The first two of these above species nest in secondary growth scrub area (cherry). Common species known to nest at Fort Mifflin include cardinals, robins, catbird, swallow, king bird, yellow throated warbler, yellow warbler and Canadian geese. Non-nesting use of Fort Mifflin has been documented by both non-nesting species as well as migratory and wintering birds.

Interesting species recorded at Fort Mifflin include peregrine falcon, osprey, giant egret. Occasionally bald eagles have used Fort Mifflin. Wintering ducks have also been noted.

Further information on wintering species can be obtained from Keith Russell of Academy of Natural Science 1-215-299-3783. For the Pennsylvania Breeding Atlas, contact Dan Brauning, Pennsylvania Game Commission 1-717-547-6938. Two other individuals knowledgeable on bird species near and at Fort Mifflin are Ed Fingerhood, 1-215-637-2741 and John Miller, 1-610-461-4724.

1.4.1.1 Impacts

We have identified the secondary growth forests and bush as being critical for maintaining nesting areas. The reuse of the nature trail should not impact this area. Selective removal of the cherry area, with replanting, should not impact this area. The dredging of the moat may remove some feeding habitat for wading birds.

1.4.2 AMPHIBIANS/REPTILES

With the presence of water and wetlands, there is a variety of amphibians/reptiles that use Fort Mifflin. There has been confirmed use of the moat by the red-bellied turtle (Pseudemys rubventris), a Pennsylvania threatened species. There is also a potential for the southern leopard frog (Rana utrieularia) to occupy this site. The moat area is the habitat used by these species. Other species that may use Fort Mifflin are presented in Appendix A.

1.4.2.1. Impacts

The dredging or removal of vegetation in the moat requires coordination with the Pennsylvania Fish and Boat Commission (PFBC) to establish a program that will not impact the red-bellied turtle. The removal of monotypic stands of common reed by wick application of Rodeo D should not have an impact on amphibians/reptiles.

1.4.3 MAMMALS

There are no known threatened or endangered mammals at Fort Mifflin. Appendix A is a listing of mammals common to the habitat and geographic region of Fort Mifflin.

1.4.3.1 Impacts

The dredging of the moat should not impact use of Fort Mifflin by mammals. Constructing the nature trail may temporary displace species.

1.4.4 FISH

According to the Pennsylvania Fish & Wildlife Data Base, the common carp (Cyprinus carpta) is the only fish typical to the Fort Mifflin area, exclusive of the Delaware River.

1.4.4.1 Impacts

There is no impact to fish by the proposed activities.

1.4.5 THREATENED AND ENDANGERED SPECIES

Based on information contained in the Environmental Assessment for the expansion of the Philadelphia International Airport, the Great Egret, Short-Eared Owl, and the Red-Bellied Turtle are listed as threatened or endangered in this area.

- Great Egret (Casmerodius albus) has been found nesting in the area where the Schuylkill and Delaware Rivers meet. This species is listed as being threatened. It's nest was previously located at the adjacent Corps of Engineers dredge site. This species has been confirmed as using the moat for feeding.

- Short-Eared Owl (Asio flammeus) has been found nesting in grassy meadows and marsh habitat in the vicinity of the airport. This bird is listed as endangered. There has been no confirmation of the owl using Fort Mifflin

- Red-Bellied Turtle (Pseudemys rubivertris) has been found in marshy areas near the airport. Staff at Fort Mifflin has also reported seeing this species in the moat.

The following threatened or endangered plants were also referenced in the Environmental Assessment:

- Chasmanthium laxum Yates, Slender Sea-Oats, is listed as Endangered in Pennsylvania. It was collected from wet meadows along the Delaware in this area in 1932.

- Eleocharis obtusa var. peasei Svenson, Wrights Spike Rush, is also listed as Endangered in Pennsylvania. It has been found growing in a marshy area near Fort Mifflin.

- Amaranthus cannabinus Sauer, Waterhemp Ragweed, is listed as Rare in Pennsylvania. It is growing in marshy areas in the vicinity of Fort Mifflin.

- Cyperus odoratus L., Rusty Flatsedge, has been collected from marshes and mudflats west of the Airport. It is believed to be declining in Pennsylvania but more information is needed to determine its exact status. The Pennsylvania Biological Survey has suggested a listing of Tentatively Undetermined for this plant.

The Pennsylvania Natural Diversity Inventory lists Wrights spike rush-Eleocharis obtusa var.peasei, Waterhemp ragweed-Amaranthus cannabinus and Indian wild rice-Zizania aquatica as being located in the tidal flat region at or near Fort Mifflin. These species are Pennsylvania rare or endangered. The Pennsylvania Fish and Boat Commission (reptiles and amphibians) and Pennsylvania Game Commission (mammals) do not record any known threatened or endangered species.

1.4.5.1 Impacts

The only threatened or endangered species with potential impact by the proposed activity is the red-bellied turtle. As discussed in Section 1.4.2.1, coordination with PFBC is required.

2.1 STRATEGY FOR CLEARING THE MOAT

There are four major techniques for clearing vegetation from the moat:

- Dredging
- Mechanical Excavation
- Mowing
- Chemical

Each of these alternatives has sub-alternates with varying environmental and cost implications.

2.1.1 DREDGING

Dredging the moat will remove silted material and undesirable vegetation. If dredging is the selected alternative, a disposal site for vegetation and silts must be obtained, away from the Fort. The proximity of the disposal area to the dredge area is a major cost factor. Dredging can be accomplished by:

2.1.1.1 Hydraulic means

Small, portable hydraulic dredges are available which can be assembled on the site and floated in as little as 15" of water (Figure 3). These dredges will pump the dredging spoils plus vegetation either into a truck or to a remote disposal area. The return water must be allowed to drain back into the moat. Dredging should be done during the construction season.

2.1.1.2 Clam Shell

A clam shell dredge can be floated or land based operating on tracks (Figure 4). Dredging spoils can be dumped into a barge or placed on land for subsequent removal.

2.1.1.3 Drag Line Dredging

The drag line operation is similar to clam shell, except that the drag line operates off of a series of cables and must dispose of dredge spoils for rehandling, similar to the clam shell operation (Figure 5).

2.1.2 MECHANICAL EXCAVATION

Large backhoes can reach across the moat and excavate plants plus silted material. This material in turn will be disposed of on land. In this manner it is similar to clam shell and drag line dredging. This is limited to the construction season.

Mechanical excavation can also be accomplished manually, assuming the water level can be drawn down to enable access for workers. The water level must also be maintained at this low level by pumping during mechanical removal. Pumping could cost approximately $ 2,000 per month. Manual removal is best done at the time of minimum ground water flow (later summer to early fall).

2.1.3 MOWING

The same type of portable hydraulic dredges discussed in Section 2.1.1.1 can also be modified to a cutter head for mowing vegetation at the earth line. The mowed material can be discharged by pipe line into a truck, with water returning to the moat. An alternate technique is to utilize weed harvesters (Figure 6). These are essentially underwater lawn mowers which dump the cuttings in the vessel itself. The cuttings

are then off loaded to other means of ultimate disposal. The preferred period for mowing is during late spring and summer. More than one mowing per year may be required, depending on other actions taken to improve the moat.

2.1.4 CHEMICAL

Various chemicals are also available for treatment of undesirable vegetation in bodies of water. These are used quite commonly in manmade lakes used for active recreational purposes. It appears that there are no long range impacts as active recreational use can resume almost immediately after treatment.

This is a highly specialized field with chemical applicators requiring licensing. Typical treatment season is late spring and summer, while plants are growing.

2.1.5 DISCUSSION OF STRATEGIES

Any of these aforementioned techniques can cause disruption to the grounds and flow of visitors. The most significant impacts will be from dredging, mechanical excavation, or mowing. Besides unsightly and noisy equipment, there is the question of spoil disposal areas to be dealt with. At best these will be temporary piles of silt and unpleasant looking materials situated on the grounds. Additionally, hydraulic dredging requires the return of water to the dredged body of water.

Dredging techniques are the most complex as they will require an engineered plan, solicitation of proposals based on complex field conditions and monitoring the course of work to ensure that no excessive damage has taken place. There would be significant engineering costs involved with any dredging program.

Chemical treatment is the least disruptive in the short term.

Chemical treatment is also the easiest technique to employ. Essentially, an applicator must be contacted, price solicited, and the treatment performed. There may be some minimum period of time in which the environment is impacted.

2.1.6 COST IMPLEMENTATIONS

A dredging operation would be the most expensive. In consultation with the owner of appropriate dredging equipment, costs must be allowed for mobilization of equipment on site. Additionally, it is anticipated that three to four weeks would be

required to complete the work. The order of magnitude cost for this operation is $60,000.00 to $100,000.00 assuming this work must be bid under a prevailing wage contract.

At the opposite end of the cost spectrum is chemical treatment. Chemical treatment could be accomplished for five to ten thousand dollars.

2.2 LONG TERM MAINTENANCE OF THE MOAT

A plan for long term maintenance of the moat requires consideration of how the water level, depth in the moat are regulated. If it is possible to periodically flush the moat, water quality is likely to be improved. This flushing should reduce somewhat the growth of undesirable vegetation. The removal of vegetation is crucial to the health of the moat because it appears that decaying vegetation is the cause of much of the decreasing water depth. This decaying vegetation also removes oxygen from the water, decreasing the moat's value. A deepening of water in the moat also slows down plant growth. We recommend 4 feet minimum depth.

Maintenance techniques for ongoing control of vegetation are similar to those described above for initial removal:

- Dredging
- Mechanical removal
- Mowing
- Chemical

If performed on a routine basis dredging, the annual mechanical excavation and mowing costs should decrease because of less vegetation.

Chemical treatment should continue to cost the same amount on a yearly basis as for the initial treatment.

2.2.1 BANK STABILIZATION

Long term maintenance must also include the permanent stability of the banks on both sides of the moat. The bank has been receding at the southeast corner of the Fort. Continued loss of the bank adjacent to the Fort will eventually result in structural damage to the Fort. The initial stabilization of the bank could be vegetative or structural means.

The most promising structural method of controlling loss of embankment is by bulkhead installation. Ordinarily bulkhead installation requires large, heavy, noisy, and expensive equipment to drive steel sheet piling. However, in recent years plastic, aluminum, and wood bulkhead techniques have been developed. Bulkheading will cost in neighborhood of $100.00 per lineal foot.

Vegetative control of the embankment can be accomplished by techniques of "bio-engineering". Most appropriate in this case is the use of Biologs or Fiber Rolls. These are composed of a woody fiber, impregnated with client selected plant material. As they are flexible they can be anchored to match the water's edge of an embankment. In time as the Biolog degrades, the vegetation will take over to hold the slope in place. Biolog installation will cost $20 to $25 per lineal foot (Figure 7).

Either technique is appropriate to stabilize the moat. If the selection is made on the basis of aesthetics, the wooden bulk head presents a neater appearance.

After the moat embankment is stabilized at the critical locations, annual embankment maintenance should be minimal.

2.3 SITE DRAINAGE ASPECTS

The interior of the Fort can be unpleasant to walk in because of wet grounds. Additionally, water can intrude into the various structures because of poor drainage. Poor drainage of the Fort Mifflin site is due to a number of circumstances:

- Very high water table, with limited storage volume for runoff
- Flat land, with no slope to drain water
- Inherent design of Fort which forces runoff behind buildings, and must recharge into the interior grounds.

Drainage at the facility can be improved in a number of ways:

2.3.1 LOWERING THE GROUNDWATER LEVEL

The most practical way to lower the ground water level in the grounds of the Fort is to lower the water level in the moat. Lowering the water level in the moat is a major issue in this project. This will be discussed further in strategies related to the existing sluice gate.

If the water level in the moat is lowered, the storage below ground for surface runoff

will be increased. This should result in some degree of reduced saturation of the ground.

There is a practical limit to the distance the water level can be lowered.

- Lower water level, and less depth in the moat, has a negative effect on water quality.

- Lower water level, and lower ground water elevation, decreases soil pore pressures. This leads to less soil bearing capacity with potential foundation settlement.

We suggest lowering the moat by 6 to 8 inches.

2.3.2 SURFACE DRAINAGE

Modifications to surface drainage can be made by piping or by construction of surface troughs.

2.3.2.1 Piping

The Fort interior grounds are about two feet above the moat water level. This differential is too small to provide room for construction of inlets, installation of piping and pipe discharges above the water level of the moat. Piping is not feasible.

2.3.2.2 Surface Troughs

A series of surface troughs exist in the southwest corner of the Fort. These ultimately discharge into a culvert through the walls of the Fort into the west side of the moat. Surface observations indicate that there is room to lower these surface troughs and to extend the systems of troughs further out. This would have to be based on detailed topographical analysis of the Fort interior and a drainage design at a large scale. Implementing this alternative will require reconstruction of the existing troughs which total approximately 260 feet in length. Constructing new drainage troughs will cost on the order of magnitude of $30.00 to $40.00 per lineal foot. It is practical to extend the trough network to approximately 500 feet to improve drainage in the vicinity of the Officers Quarters and Soldiers Barracks.

2.3.2.3 Sump Pumps

Sump pump pits can be constructed in strategic locations adjacent to buildings. The pumps in the sump pits would then discharge through the exterior wall to drain towards the moat. For sump pits to be truly effective, under drains must be installed. However, installation of the under drains requires excavation which may endanger the structural integrity of the buildings. Sump pump installations are likely to cost an order of magnitude of $2,500 each piece, exclusive of under drainage. Underdrainage which could be 4" fabric coated plastic tubing, will cost an order magnitude of $15.00 per lineal foot, in place.

2.3.2.4 Regrading

Regrading of the Fort interior by placement of fill can improve drainage somewhat. The fill provides additional storage for rainfall. The fill should be placed to surface slopes of at least 1 1/2% to convey surface runoff to the surface troughs or drains at the periphery of the Fort interior grounds.

Regrading and placement at fill must hold the existing grades at the periphery of the interior adjacent to the buildings. Thus, fill is limited to the area between the Headquarters building, the Barracks and Storehouse. Earth elevations cannot be raised adjacent to the buildings or building dampness will increase.

For regrading to be a useful improvement, it must be considered in the reconstruction of the surface troughs. The elevations in the middle of the interior should be raised approximately 15 inches. This requires approximately 700 to 900 cubic yards of fill.

Bringing fill to the site and its placement would cost about $16 to $22 per cubic yard. Seeding the newly placed fill would cost an additional $1.00 to $1.40 per square yard.

2.4 RECOMMENDATIONS FOR MAINTENANCE OF WATER QUALITY, PLANT LIFE, CIRCULATION AND GENERAL HEALTH MAINTENANCE OF THE MOAT AREA

We have identified three basic strategies for improving, water quality in the moat. These include:

- Deepening the moat

- Removing vegetation
- Providing a means of flushing the moat

Deepening the moat and vegetation removal can be accomplished by various techniques described under 2.1 and 2.2.

Flushing the moat will improve the water circulation in the moat, and thus water quality in the moat. The following are possible strategies for improving water circulation in the moat:

- Permanently lower water level in moat
- Periodic pump down of the moat
- Reconstruct the sluice gate to flush the moat during periods of low tide
- Clean the small ditch sluice gates at the south side

2.5 THE SLUICE GATE

The sluice gates were installed years ago. At low tide, water would leave the moat and drain into the river. Subsequently, fresh ground water would recharge the moat. The sluice gates prevented the river from re-entering the moat at high tide. However, the sluice gates have been inoperable for a number of years, thus preventing water transfer.

Upgrading the sluice gates so that they would operate requires the following:

- Inspection by diver
- Remove silt on moat side of sluice gate
- Remove silt on river side of sluice gate
- Rehabilitate or replace the sluice gate valving
- Construct platforms for safe operation of the sluice gate valves.

As an alternate to dredging the silt on the river side, piping could be installed from the sluice gate crib structure into the Delaware River to a point where the river bottom is sufficiently depth for the new piping to discharge. Without a hydrographic survey, we cannot determine how long the piping must be extended. A similar installation PAI in involved with upriver is costing approximately $53,000 for 150 feet of pipe.

Rehabilitation of the sluice gate is not an easy project. Desilting the moat side of the sluice gate requires getting equipment into a difficult location. Desilting the river side of the sluice gate has the potential of environmental damage to threatened and

endangered species and disturbance and wildlife. We suggest a budget estimate of $90,000 to $120,000 dollars for this work. It should also be noted that ongoing maintenance is required if the sluice gate were rehabilitated, due to continued siltation on the river side and moat side. There would be temporary environmental impact because of the difficulty of getting equipment to this location. Equipment and material would most likely be brought in from the Delaware River, or by floating through the moat.

As an alternate means for improving water quality by flushing action, we recommend constructing a new tide gate in the small ditch which previously drains the moat to the south. A new tide gate is essentially a check valve, as opposed to a sluice gate, which is a vertically rising gate valve. The tide gate opens when the upstream water level exceed the downstream water level, as is the case for a falling tide. During rising tide conditions, the tide gate closes to prevent river water from entering the moat.

Installing a tide gate would involve deepening and widening the ditch . Additionally a structure would be constructed within the stream to support a tide gate (Figures 8 & 9). This structure, with tide gate, would replace the function of the existing, but inoperable, sluice gate. It is a preferred alternative because it will be easier to access for operation and maintenance. Additionally, it will be less subject to siltation. During low tide the tide gate would open and allow part of the moat to drain into the river. During rising tide, the tide gate closes. No river water re-enters the moat. However, the moat would be replenished by ground water recharge. We estimate that construction of a new tide gate in the small ditch would cost in the range of $50,000.00 to $70,000.00. There would be temporary environmental impact because of the difficulty of getting equipment to this location. Equipment and material would most likely be brought in from the Delaware River, or by floating through the moat.

If you should have any questions on this report, please do not hesitate to contact this office.

Very truly yours,

PENNONI ASSOCIATES INC.

Albert W. Ricciardi
Manager, Environmental Sciences

V. Richard Mariani, P.E.
Director of Engineering

DJM/tim

CLRR-92A7.004.01/report2.doc

PENNONI ASSOCIATES INC.

TO: Rick Ricciardi

FROM: Daniel Martin

DATE: August 1, 1995

RE: Ft. Mifflin
CLRR-92A7.004.01

The following information documents our research into the mean high water and mean low water elevations at Ft. Mifflin, Philadelphia Co., PA.

The vertical datum for the client provided Ft. Mifflin survey is based on a City of Philadelphia datum that is 6.019′ lower than NGVD 1929. This difference converts a reading of 0.00′ mean sea level for Fort Mifflin to a 6.019′ for NGVD 1929.

I have not been able to obtain mean low and mean high water levels at the Fort, therefore nearby gauged areas were used, with data interpolated when necessary. The information presented below is using both NGVD 1929 and Fort Mifflin vertical datum.

Mean high water — Mean high water for the mouth of the Schuylkill River (at the Delaware River) is +3.5′ msl (-2.519′ Fort Mifflin). Ft. Mifflin is approximately 1.4 miles down river. Since this is close, it is reasonable to use this figure for Ft. Mifflin.

Mean low water — Mean low water for Pier 9 (Delaware River at Race Street) is -2.36′ msl (-8.379′ Fort Mifflin). Ft. Mifflin is approximately 7 miles downriver.

Mean low water for the Raccoon Creek, Bridgeport, New Jersey is -1.78′ msl (-7.799′ Fort Mifflin). Fort Mifflin is approximately 10.5 upriver.

Interpolating the data for Pier 9 and Raccoon Creek, Mean low water for Ft. Mifflin is approximately -2.07′ msl (-8.089′ Fort Mifflin).

With this information, the difference between mean high and mean low waters for Ft. Mifflin is about 5.6′. As previously discussed, I have not seen these fluctuation in the moat.

Pennoni Associates Inc.
1600 Callowhill Street, Philadelphia, PA 19130, Tel: 215-561-0460, Fax: 215-496-0063

CLRR 92A7.004.01

October 17, 1995

John Scott Rodgers, AIA, Principal
C.L.R. Design, Inc.
115 North Third St.
Philadelphia, Pa. 19106

Attn: Mara Baird

RE: Fort Mifflin on the Delaware
Impact of Lowering Ground Water Level
Philadelphia, Pa.

Dear Mr. Rodgers:

The following has been prepared in response to the question, of impact to historic structures in the Fort, if the water level of the moat was lowered. It is presumed that the water level is lowered between six to twelve inches from existing conditions.

It is our opinion that lowering the water in the moat this depth should have no effect on the buildings and Fort's foundation. We presume that the foundations were prudently constructed to a depth of several feet below grade. Thus if the moat was lowered, the water table beneath the Fort would still be above the bottom of the foundations and the load bearing conditions for the foundations would not change.

If it were possible to dry out the foundations beneath the Fort, the pore pressures in the soil would be diminished. This diminishment would cause a settlement of the soil. Soil settlement is a slow process. Without consolidation testing the rate of settlement can not be predicted. However in this case here, there is no possibility of drying out the soil beneath the foundation.

What is critical is any differential in lowering the water table. For instance, if the water table were lowered below part of the structure but not another, there would most likely be settlement in the section bearing on the dry soils. The significant aspect here is the differences in settlement. It is the differences in settlement that cause cracking and structural problems.

If the water level in the moat was completely drawn down for cleaning or other purposes, the water table of the Fort interior would not be lowered instantaneously. However, there would be a somewhat uniform rate of soil drying under the entire Fort. Under this scenario, differential settlements is minimized. We also presume that the draw down of the moat is temporary and the water level returns as soon as practical.

To summarize again, lowering the water table in the moat by six to twelve inches, as discussed in our August 9, 1995 report, should have no effect on the Fort structure.

Very truly yours,

PENNONI ASSOCIATES INC.

V. Richard Mariani, P.E.
Registered Professional Engineer

VRM:cap

cc: Dan Martin

TABLE 1

VEGETATION IDENTIFIED ONSITE

COMMON NAME	SCIENTIFIC NAME	REGIONAL WETLANDS INDICATOR STATUS	NATIONAL WETLANDS INDICATOR STATUS
American Elm	Ulmus americana	FACW-	FAC, FACW
Arrow Arum	Peltandra virginica	OBL	OBL
Arrowwood	Viburnum dentatum	FAC	FAC
Aspen	Populus tremola	FACU	FACU,FAC+
Aster	Aster spp	-	
Bedstraw	Galium spp.	---	---
Black Cherry	Prunus serotina	FACU	FACU
Black Willow	Salix nigra	FACW+	UPL, OBL
Blackberry	Rubus allegheniensis	FACU-	FACU-, FAC-
Bull Thistle	Cirsium vulgare	FACU	UPL, FACU
Buttercup	Ranunculus spp.	---	---
Catalpa	Catalpa bignonioides	FACW	FACW
Cattail	Typha latifolia	OBL	OBL
Chickory	Cichorium intybus	UPL	UPL
Choke Cherry	Prunus virginiana	FACU	FACU-, FACU+
Clover	Trifolium spp.	----	----
Common Grape	Vitis spp.	----	----
Common Milkweed	Asclepias syriaca	UPL	----
Common Reed	Phragmites australis	FACW	FACW,FACW+
Common Violet	Viola papilionacea	FAC	FACU, FAC
Dog Bane	Apocynum sibiricum	FAC	FAC-, FAC+
Duckweed Big	Spirodela polyrhiza	OBL	OBL
Evening Primrose	Oenothera biennis	FACU-	
Garlic Mustard	Allaria petiolata	FACU-	FACU-, FACW+
Goldenrod	Solidago spp.	-------	----
Gray Birch	Betula populifolia	FAC	FAC
Greenbrier	Smilax rotundifolia	FAC	FAC
Ground Ivy	Glechoma hederacea	FACU	UPL, FACU+
Jack-In-The-Pulpit	Arisema triphyllum	FACW-	FAC, FACW
Japanese Honeysuckle	Lonicera japonica	FAC-	FACU, FAC+

Jewelweed	Impatiens capensis	FACW	FACW, FACW+
Joe-Pye Weed	Eupatoriadelphus maculatas	FACW	FACW-, OBL
Milkweed	Ascelepias variegata	OBL	OBL
Morning Glory	Ipomoea purpurea	UPL	UPL
Nine Bark	Physocarpus opulifolius	FACW-	
Onion Grass	Allium spp.	----	----
Path Rush	Juncus tenuis	FAC-	FAC-, FACW
Pokeweed	Phytolacca americana	FACU+	FACU+, FAC
Purple Loosestrife	Lythrum salicaria	FACW+	FACW+, OBL
Red Maple	Acer rubrum	FAC	FAC
River Birch	Betula nigra	FACW	FACW, OBL
Rose	Rosa multiflora	FACU	UPL, FACU
Rye Grass	Secale cereale	----	----
Sassafras	Sassafras albidum	FACU-	FACU-, FACU
Sensitive Fern	Onoclea sensibilis	FACW	---
Silky Dogwood	Cornus amonum	FACW	FACW, FACW+
Soft Rush	Juncus effusus	FACW+	FACW+, OBL
Sumac	Rhus glabra	UPL	UPL
Sycamore	Plantanus occidentalis	FACW-	FAC, FACW
Tall Boneset	Ageritina altissimum	FACU-	UPL, FAC
Tartanian Honeysuckle	Lonicera tatarica	FACU	FACU
Tulip Poplar	Liriodendron tulipifera	FACU	FACU, FAC
Violet	Viola papilionacea	FAC	FACU, FAC
Virginia Creeper	Parthenocissis quinquefolia	FACU	FACU, FAC
White Mulberry	Morus alba	UPL	UPL
Wild Carrot	Daucus carota	UPL	UPL
Wild Grape	Vitis spp.	----	----
Wild Onion	Allium spp.	----	----
Wild Strawberry	Fragaria virginia	FACU	UPL, FAC

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Rachel Carson State Office Building
P.O. Box 8552
Harrisburg, PA 17105-8552

June 28, 1995

RECEIVED
JUL 0 3 1995
PENNONI ASSOC. INC.

717/787-3444

Bureau of Forestry

Dave Fennimore
Pennoni Associates, Inc.
515 Grove Street, Suite 2C
Haddon Heights, NJ 08035

RE: PNDI Review of the Fort Mifflin Area, Philadelphia, Pennsylvania
PAI File No. CLRR 92A7.004.01

Dear Mr. Fennimore:

In response to your request of April 28, 1995, the referenced area, mapped on the *Philadelphia* quadrangle was reviewed for the presence of natural resources of special concern using the Pennsylvania Natural Diversity Inventory (PNDI) information system.

Tidal mudflats in this area support three emergent aquatic plant species of special concern. ***Eleocharis obtusa* var. *peasei*,** Wrights Spike-rush, is listed as *Endangered, and*, ***Amaranthus cannabinus***, Waterhemp Ragweed, and ***Zizania aquatica***, Indian Wild Rice, are listed as *Rare* in Pennsylvania.

Any projects which cause disturbance of tidal mudflats will negatively impact critical habitat for these species. Efforts to conserve these plants and their habitat should be included in any project planning at Fort Mifflin.

PNDI is a site specific information system which describes significant natural resources of Pennsylvania. PNDI includes data descriptive of plant and animal species of special concern, exemplary natural communities and unique geological features. This response represents the most up-to-date summary of the PNDI data files. However, an absence of recorded information does not necessarily imply actual conditions on-site. A field survey may reveal previously unreported populations.

Be advised that legal authority for Pennsylvania's biological resources resides with three administrative agencies. The enclosure titled *PNDI Management Agencies,* outlines which species groups are managed by these agencies. Please phone this office if you have questions concerning this response or the PNDI system.

Sincerely,

Edward T. Dix
Botanist
Forest Advisory Services

Enclosure

PENNSYLVANIA NATURAL DIVERSITY INVENTORY

MANAGEMENT AGENCIES

The statutory authority for Pennsylvania's animals and plants resides with three separate agencies. The Pennsylvania Department of Environmental Resources has the responsibility for management of the Commonwealth's native wild plants. The Pennsylvania Fish and Boat Commission is responsible for management of fish, reptiles, amphibians and aquatic organisms within the Commonwealth. The Pennsylvania Game Commission has the responsibility for managing the state's wild birds and mammals.

For information on current species status, please consult the appropriate agency. Requests for information should be directed to:

Plants and PNDI - general

Plant Program Manager
PA Department of Environmental Resources
Bureau of Forestry
Forest Advisory Services
P.O. Box 8552
Harrisburg, PA 17105-8552
(717) 787-3444

FISH, REPTILES, AMPHIBIANS, AQUATIC ORGANISMS

Endangered Species & Herpetology Coordinator
Pennsylvania Fish & Boat Commission
Bureau of Fisheries and Engineering
450 Robinson Lane
Bellefonte, PA 16823
(814) 359-5113

BIRDS and MAMMALS

Pennsylvania Game Commission
Bureau of Wildlife Management
2001 Elmerton Avenue
Harrisburg, PA 17110-9797
(717) 787-5529

For information on species listed under the federal Endangered Species Act of 1973 occurring in Pennsylvania, contact:

Endangered Species Biologist
U.S. Fish and Wildlife Service
315 South Allen Street, Suite 322
State College, PA 16801
(814) 234-4090

FAX 814-359-5183
Rocco
Gian

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA FISH & BOAT COMMISSION
Division of Fisheries Management
450 Robinson Lane
Bellefonte, PA 16823-9620
(814) 359-5110

RECEIVED
MAY 24 1995
PENNONI ASSOC. INC

May 22, 1995

PENNONI ASSOCIATES INC.
Dave Fennimore
515 Grove Street Suite 2C
Haddon Heights, NJ 08035

Dear Mr. Fennimore:

RE: Environmental Assessment
Fort Mifflin
Philadelphia Township, Bucks County, Pennsylvania

I have examined the map accompanying your recent correspondence which shows the location for the proposed above referenced project.

Presently, none of the fishes, amphibians, or reptiles we list as endangered or threatened are known to occur at or in the immediate vicinity of this study area.

Sincerely,

Andrew L. Shiels

Andrew L. Shiels
Herpetology, Endangered Species &
Triploid Grass Carp Coordinator

sal

COMMONWEALTH OF PENNSYLVANIA

PENNSYLVANIA GAME COMMISSION

2001 ELMERTON AVENUE
HARRISBURG, PA 17110-9797

ADMINISTRATIVE BUREAUS:

ADMINISTRATION	717-787-5670
AUTOMOTIVE AND PROCUREMENT DIVISION	717-787-6594
LICENSE DIVISION	717-787-2084
PERSONNEL DIVISION	717-787-7836
WILDLIFE MANAGEMENT	717-787-5529
INFORMATION & EDUCATION	717-787-6286
LAW ENFORCEMENT	717-787-5740
LAND MANAGEMENT	717-787-6818
REAL ESTATE DIVISION	717-787-6568
MANAGEMENT INFORMATION SYSTEMS	717-787-4076

May 25, 1995

RECEIVED
MAY 30 1995
PENNONI ASSOC. INC.

Mr. Dave Fennimore
Pennoni Associates, Inc.
515 Grove Street
Suite 2C
Haddon Heights NJ 08035

Dear Mr. Fennimore:

In response to your request for information services, we are providing the enclosed printouts from the Pennsylvania Fish and Wildlife Data Base. This information was provided for species occurring at or near the Fort Mifflin Project, Philadelphia County, Pennsylvania.

We have record of the **Short-eared Owl, Least Bittern,** and the **King Rail** (PA Threatened) occurring in the Woodbury Quadrangle. A field survey is necessary to determine whether these species occur within your project area. Additional comments concerning this data search are included on the following page.

The bill for this service is as follows:

Staff Time	12.00
Printing	2.30
Mailing Cost	.98
TOTAL	**$15.28**

Please make reimbursement to the Pennsylvania Game Commission, Division of Wildlife Data Base, 2001 Elmerton Avenue, Harrisburg, PA 17110-9797.

If you have any questions or require assistance interpreting this printout, please contact Ms. Bullock at (717) 787-1570.

Very truly yours,

Denver A. McDowell, Chief
Division of Environmental Planning
and Habitat Protection
Bureau of Land Management

Pennsylvania Fish and Wildlife Data Base
LIST A: Endangered and Threatened Species
** Fort Mifflin Project **
11 MAY 1995

Note: The purpose of the following list is to identify endangered or threatened species which occur or are likely to occur on a designated site. We have record of the following species occurring in or near your project area. Their occurrence may depend on season, habitat type, and individual movements or migration patterns. Field surveys may be required to determine whether these species exist on your project area. If an endangered/threatened bird or mammal survey is planned for a project site, please contact the Division of Wildlife Data Base, Pennsylvania Game Commission (717-787-1570).

Quadrangles Included:

Woodbury
Philadelphia

Common Name.....	Scientific Name.....	Status.....
Sturgeon, Shortnose	Acipenser brevirostrum	PA / Fed Endangered
Falcon, Peregrine	Falco peregrinus	PA / Fed Endangered
Owl, Short-eared	Asio flammeus	PA Endangered
Rail, King	Rallus elegans	PA Endangered
Turtle, Redbelly	Chrysemys rubriventris	PA Threatened
Bittern, Least	Ixobrychus exilis	PA Threatened
Egret, Great	Casmerodius albus egretta	PA Threatened

Pennsylvania Fish and Wildlife Data Base
LIST B: Potential Special Concern Species
(Includes Accidental and Migrant Species)
** Fort Mifflin Project **
Philadelphia County
11 MAY 1995

Note: The purpose of the following list is to identify endangered, threatened, and special concern species which may potentially occur within a designated area. This list includes species which may exist on your project area as well as migrating and accidental species. This information is based on records of these animals inhabiting specific habitat types within Philadelphia County.

Status	No. of Species Listed
PA / Fed Endangered	3
PA Endangered	6
Fed Endangered	1
PA Threatened	8
Candidate Species	24
Total Species Listed:	42

Pennsylvania Fish and Wildlife Data Base
LIST B: Potential Special Concern Species
(Includes Accidental and Migrant Species)
** Fort Mifflin Project **
Philadelphia County
11 MAY 1995

Common Name.....	Scientific Name.....	Status.....
Sturgeon, Shortnose	Acipenser brevirostrum	PA / Fed Endangered
Eagle, Bald	Haliaeetus leucocephalus	PA / Fed Endangered
Falcon, Peregrine	Falco peregrinus	PA / Fed Endangered
Frog, New Jersey Chorus	Pseudacris triseriata kalmi	PA Endangered
Turtle, Bog	Clemmys muhlenbergi	PA Endangered
Osprey	Pandion haliaetus	PA Endangered
Owl, Short-eared	Asio flammeus	PA Endangered
Rail, King	Rallus elegans	PA Endangered
Tern, Black	Chlidonias niger	PA Endangered
Tern, Least	Sterna antillarum	Fed Endangered
Sturgeon, Atlantic	Acipenser oxyrhynchus	PA Threatened
Turtle, Redbelly	Chrysemys rubriventris	PA Threatened
Bittern, American	Botaurus lentiginosus	PA Threatened
Bittern, Least	Ixobrychus exilis	PA Threatened
Egret, Great	Casmerodius albus egretta	PA Threatened
Flycatcher, Yellow-bellied	Empidonax flaviventris	PA Threatened
Heron, Yellow-crowned Night	Nycticorax violaceus	PA Threatened
Sandpiper, Upland	Bartramia longicauda	PA Threatened
Harrier, Northern	Circus cyaneus	Candidate - At Risk
Owl, Common Barn	Tyto alba	Candidate - At Risk
Snipe, Common	Gallinago gallinago	Candidate - At Risk
Sparrow, Henslow's	Ammodramus henslowii	Candidate - At Risk
Warbler, Prothonotary	Protonotaria citrea	Candidate - At Risk
Coot, American	Fulica americana	Candidate - Rare
Goshawk, Northern	Accipiter gentilis	Candidate - Rare
Grebe, Pied-billed	Podilymbus podiceps	Candidate - Rare
Grosbeak, Blue	Guiraca caerulea	Candidate - Rare
Tanager, Summer	Piranga rubra	Candidate - Rare
Teal, Green-winged	Anas crecca	Candidate - Rare
Thrush, Swainson's	Catharus ustulatus	Candidate - Rare
Wren, Marsh	Cistothorus palustris	Candidate - Rare
Bat, Silver-haired	Lasionycteris noctivagans	Candidate - Rare

Pennsylvania Fish and Wildlife Data Base
LIST B: Potential Special Concern Species
(Includes Accidental and Migrant Species)
** Fort Mifflin Project **
Philadelphia County
11 MAY 1995

Common Name	Scientific Name	Status
Bobwhite, Northern	Colinus virginianus	Candidate - Undeterm
Crossbill, Red	Loxia curvirostra	Candidate - Undeterm
Dickcissel	Spiza americana	Candidate - Undeterm
Duck, Ruddy	Oxyura jamaicensis	Candidate - Undeterm
Egret, Cattle	Bubulcus ibis ibis	Candidate - Undeterm
Gadwall	Anas strepera	Candidate - Undeterm
Nighthawk, Common	Chordeiles minor	Candidate - Undeterm
Owl, Long-eared	Otus asio	Candidate - Undeterm
Owl, Northern Saw-whet	Aegolius acadicus	Candidate - Undeterm
Wigeon, American	Anas americana	Candidate - Undeterm

Pennsylvania Fish and Wildlife Data Base
LIST C: Potential Special Concern Species Land Use/Cover Type List
** Fort Mifflin Project **
Philadelphia County
11 MAY 1995

Land Use/Cover Type	No. Species
Urban Land	10
Agricultural Land - Cropland/Pasture	25
Agricultural Land - Orchards/Vineyards/Nurseries	7
Agricultural Land - Confined Feeding Operations	3
Rangeland - Herbaceous	18
Rangeland - Shrub/Brush	12
Rangeland - Mixed	12
Forest Land - Deciduous	22
Forest Land - Evergreen	19
Forest Land - Mixed	20
Water - Streams/Rivers/Canals	21
Water - Lakes	19
Water - Reservoirs	19
Water - Estuaries	18
Wetland - Forested	27
Wetland - Nonforested	24
Barren Land	8

Pennsylvania Fish and Wildlife Data Base
LIST C: Potential Special Concern Species Land Use/Cover Type List
** Fort Mifflin Project **
Philadelphia County
11 MAY 1995

Species	Feeding Behavior				Land Use/Cover Type															
Common Name.....	*Stat.	Herb	Omni	Carn..	Urban.. (10's)	Agric Crops (21)	Agric Orchd (22)	Agric.. Feed (23)	Range Herb (31)	Range Shrub (32)	Range.. Mix (33)	Forest Decid (41)	Forest Conif (42)	Forest.. Mix (43)	Water. Stream (51)	Water Lake (52)	Water. Reserv (53)	Water.. Bay (54)	Wetlnd Forest (61)	Wetlnd.. Non-For (62)	Barren. (70's)
Sturgeon, Atlantic	T			X											X			X			
Sturgeon, Shortnose	E			X														X			
Frog, New Jersey Chorus	E			X		X			X	X	X	X		X					X	X	
Turtle, Bog	E	X				X			X	X	X				X				X		X
Turtle, Redbelly	T	X													X	X	X		X		
Bittern, American	T			X											X	X	X	X	X	X	
Bittern, Least	T			X											X	X	X	X	X	X	
Bobwhite, Northern	W	X				X			X	X	X	X	X	X					X		
Coot, American	V	X				X									X	X	X	X	X	X	
Crossbill, Red	W	X					X					X	X	X					X		
Dickcissel	W	X			X	X	X		X	X	X										
Duck, Ruddy	W	X													X	X	X			X	
Eagle, Bald	E			X		X						X	X	X	X	X	X		X	X	
Egret, Cattle	W			X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	
Egret, Great	T			X		X						X	X		X	X	X	X	X	X	
Falcon, Peregrine	E			X	X	X			X	X	X			X					X	X	X
Flycatcher, Yellow-bellied	T	X										X	X	X					X		
Gadwall	W	X				X			X				X		X	X	X	X	X	X	
Goshawk, Northern	V			X		X		X	X			X	X	X					X		
Grebe, Pied-billed	V			X											X	X	X	X		X	
Grosbeak, Blue	V	X							X	X	X	X									

* Status Codes: E = Endangered; T = Threatened. Candidate Classifications: U = At Risk; V = Rare; W = Undetermined Status; Y = Unspecified.

Pennsylvania Fish and Wildlife Data Base
LIST C: Potential Special Concern Species Land Use/Cover Type List
** Fort Mifflin Project **
Philadelphia County
11 MAY 1995

Species	Feeding Behavior				Land Use/Cover Type														
Common Name.....	*Stat.	Herb	Omni	Carn..	Urban.. (10's)	Agric Crops (21)	Agric Orchd (22)	Agric.. Feed (23)	Range Herb (31)	Range Shrub (32)	Range.. Mix (33)	Forest Decid (41)	Forest Conif (42)	Forest.. Mix (43)	Water. Stream (51)	Water Lake (52)	Water. Reserv (53)	Water.. Bay (54)	Wetlnd Forest (61)	Wetlnd.. Non-For (62)	Barren. (70's)
Harrier, Northern	U			X	X	X			X	X	X									X	X
Heron, Yellow-crowned Night	T			X		X						X	X	X	X	X	X	X	X	X	
Nighthawk, Common	W			X	X	X			X												
Osprey	E			X	X							X	X	X	X	X	X	X	X	X	
Owl, Common Barn	U			X	X	X	X	X				X	X	X					X	X	
Owl, Long-eared	W			X	X	X	X		X	X	X	X	X	X					X		
Owl, Northern Saw-whet	W			X		X						X	X	X					X		
Owl, Short-eared	E			X		X			X	X	X							X		X	X
Rail, King	E		X			X									X	X	X	X		X	
Sandpiper, Upland	T		X		X	X			X			X	X	X							
Snipe, Common	U		X			X	X		X	X	X	X	X	X					X	X	X
Sparrow, Henslow's	U		X			X			X											X	
Tanager, Summer	V		X				X					X		X					X		
Teal, Green-winged	V		X			X			X			X	X	X	X	X	X	X	X	X	X
Tern, Black	E			X											X	X	X			X	
Tern, Least	E			X											X	X	X	X			X
Thrush, Swainson's	V		X		X							X	X	X					X		
Warbler, Prothonotary	U			X								X							X		
Wigeon, American	W		X			X						X	X	X	X	X	X	X	X	X	
Wren, Marsh	V			X											X	X	X	X		X	
Bat, Silver-haired	V		X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X

* Status Codes: E = Endangered; T = Threatened. Candidate Classifications: U = At Risk; V = Rare; W = Undetermined Status; Y = Unspecified.

Pennoni Associates Inc.

515 Grove Street, Suite 2C, Haddon Heights, NJ 08035, Tel: 609-547-0505, Fax: 609-547-9174

April 28, 1995

FILE

CLRR-92A7.004.01

Gregory Grabowicz, Director
Bureau of Land Management
Pennsylvania Game Commission
Commonwealth of Pennsylvania
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Re: **Fort Mifflin**
Philadelphia, Pennsylvania

Dear Mr. Grabowicz:

Pennoni Associates Inc., represents CLR Design Inc., in the above referenced matter.

We are requesting the Bureau review your files and provide us with a listing of state threatened or endangered wildlife species occurring in the vicinity of the proposed development.

Enclosed for your use is the project area located on the Philadelphia, PA-NJ U.S.G.S. Topographic Quadrangle (N 0"; W 12.4" from lower right corner). Your response to this request will be incorporated in an Environmental Assessment that our office is preparing.

If you should have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

PENNONI ASSOCIATES INC.

Dave Fennimore
Environmental Scientist

cc: John Scott Rodgers, CLR Design Inc.
DF/pm/92A7004.01\grabowicz.ltr

Pennoni Associates Inc.

515 Grove Street, Suite 2C, Haddon Heights, NJ 08035, Tel: 609-547-0505, Fax: 609-547-9174

April 28, 1995

CLRR 92A7.004.01

Kurt W. Carr, Chief
Pennsylvania Historical & Museum Commission
Bureau for Historic Preservation
Division of Archaeology and Protection
Commonwealth of Pennsylvania
Box 1026
Harrisburg, PA 17108-1026

Re: Fort Mifflin
Philadelphia, Pennsylvania

Dear Mr. Carr:

Pennoni Associates Inc., represents CLR Design, Inc., in the above referenced matter.

While we are aware that Fort Mifflin is a National Historic Landmark, we are requesting the Division review your files and provide us with a listing of other National Register eligible or listed historic or archaeological properties that may be in the vicinity of the proposed development.

Enclosed for your use is the project area located on the Philadelphia, PA-NJ U.S.G.S. Topographic Quadrangle (N 0"; W 12.4" from lower right corner). Your response to this request will be incorporated in an Environmental Assessment that our office is preparing.

If you should have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

PENNONI ASSOCIATES INC.

Dave Fennimore
Environmental Scientist

cc: John Scott Rodgers, CLR Design Inc.
DF/pm/92A7004.01/carr.ltr

Pennoni Associates Inc.

1717-787-3444

515 Grove Street, Suite 2C, Haddon Heights, NJ 08035, Tel: 609-547-0505, Fax: 609-547-9174

File

April 28, 1995

CLRR 92A7.004.01

Pennsylvania Department of Environmental Resources
Bureau of Forestry/FAS
P.O. Box 8552
Harrisburg, PA 17105-8552

Re: Fort Mifflin
Philadelphia, Pennsylvania

Dear Sir/Madam:

Pennoni Associates Inc., represents CLR Design Inc., in the above referenced matter.

Enclosed is a Pennsylvania Natural Diversity Inventory (P.N.D.I.) Search Request Form.

Also, enclosed for your use is the project area located on the Philadelphia, PA-NJ U.S.G.S. Topographic Quadrangle (N 0"; W 12.4" from lower right corner). Your response to this request will be incorporated in an Environmental Assessment that our office is preparing.

If you should have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

PENNONI ASSOCIATES INC.

Dave Fennimore
Environmental Scientist

DF\pm\92A7004.01\pader.ltr

cc: John Scott Rodgers, CLR Design Inc.

1-814-359-5153

Pennoni Associates Inc.

515 Grove Street, Suite 2C, Haddon Heights, NJ 08035, Tel: 609-547-0505, Fax: 609-547-9174

April 28, 1995

CLRR-92A7.004.01

1-814-359-5113

Andrew Shiels, Coordinator
Herpetology & Endangered Species
Pennsylvania Fish and Boat Commission
Commonwealth of Pennsylvania
450 Robinson Lane
Belefonte, PA 16823

Re: Fort Mifflin
Philadelphia, Pennsylvania

Dear Mr. Shiels:

Pennoni Associates Inc., represents CLR Design Inc., in the above referenced matter.

We are requesting the Bureau review your files and provide us with a listing of state threatened or endangered fish, reptiles, amphibians or aquatic organisms occurring in the vicinity of the proposed development.

Enclosed for your use is the project area located on the Philadelphia, PA-NJ U.S.G.S. Topographic Quadrangle (N 0"; W 12.4" from lower right corner). Your response to this request will be incorporated in an Environmental Assessment that our office is preparing.

If you should have any questions or comments, please do not hesitate to contact this office.

Very truly yours,

PENNONI ASSOCIATES INC.

Dave Fennimore
Environmental Scientist

cc: John Scott Rodgers, CLR Design Inc.

DF\pm\92A7004.01\shiels.ltr

Pennoni Associates Inc.
515 Grove Street, Suite 2C, Haddon Heights, NJ 08035, Tel: 609-547-0505, Fax: 609-547-9174

May 24, 1995

CLRR-92A7.004.01

Denver McDowell, Coordinator
Pennsylvania Fish and Wildlife Data Base
Pennsylvania Fish and Boat Commission
Commonwealth of Pennsylvania
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Re: Fort Mifflin
Philadelphia, Pennsylvania

Dear Mr. McDowell:

Pennoni Associates Inc., represents CLR Design Inc., in the above referenced matter.

We are requesting the Commission provide a printout from the Pennsylvania Fish and Wildlife Data Base a listing of species that occurring at or near Historic Fort Mifflin, Philadelphia County, PA. The site is located on Island Avenue southeast of Philadelphia International Airport.

Enclosed for your use is the project area located on the Philadelphia, PA-NJ U.S.G.S. Topographic Quadrangle (N 0"; W 12.4" from lower right corner). Your response to this request will be incorporated in an Environmental Assessment that our office is preparing.

We have identified the following classifications per Anderson Land use/cover type which has been further refined by Cowardin wetland nomenclature.

Anderson

Other Urban or Built-up Land	Code 17
Herbaceous Rangeland	Code 31
Deciduous Forest Land	Codes 412 and 413
Reservoirs	Code 53
Bays and Estuaries	Code 54
Nonforested Wetlands	Code 62

Cowardin Wetland

Palustrine Emergent, Persistent	PEM1
Palustrine Emergent, Nonpersistent	PEM2
Palustrine, open water	POW
Estuarine, Intertidal-Delaware River	E1
Estuarine, Subtidal-Delaware River	E2

If you should have any questions or comments, please do not hesitate to contact this office.

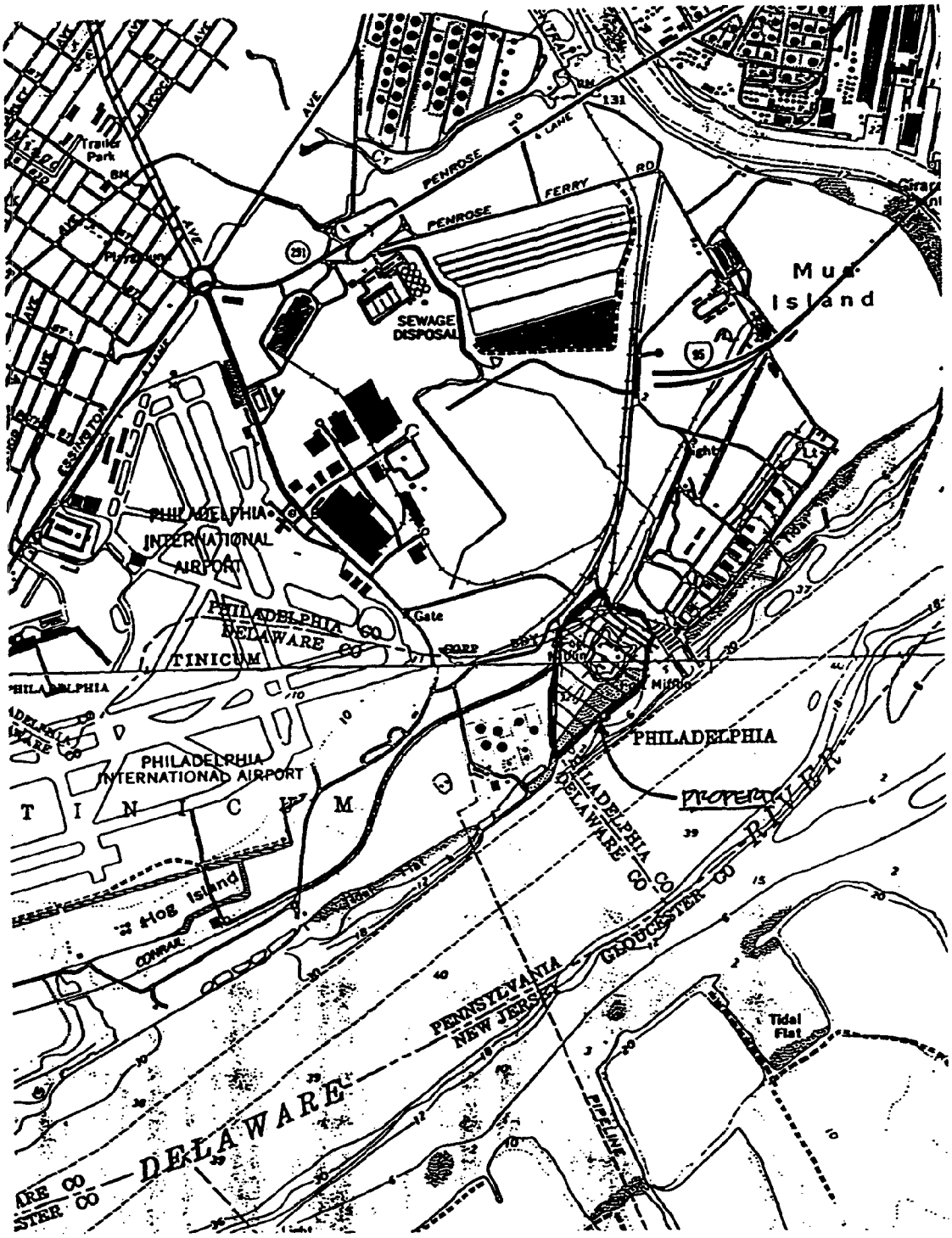
Very truly yours,

PENNONI ASSOCIATES INC.

Daniel J. Martin
Environmental Scientist

cc: John Scott Rodgers, CLR Design Inc.

DJM\tim\92A7004.01\mcdowell.ltr



Pennoni Associates Inc.

FIGURE 1
LOCATION MAP
SCALE 1:24,000

SOURCE:
U.S.G.S.TOPOGRAPHIC QUADS
FOR PHILADELPHIA, PA–NJ &
WOODBURY, NJ–PA

CLRR–92A7.004.01

The Birds of North America

Life Histories for the 21st Century

June 16, 1995

Pennoni Associates Inc.
515 Grove Plaza
Haddon Heights, NJ 08035

To whom it may concern:

On May 18, 1995 I received a phone call from an employee of Pennoni Associates requesting information on the birds of Historic Fort Mifflin in Philadelphia for a project your company is working on. Unfortunately I lost the gentleman's name who called, and it was not listed on a fax he sent me later that day. I hope that this communication will be routed to the right individual.

For the past 9 years I have organized a mid-winter bird census of Philadelphia County. Each year this census has been held during mid January (dates vary somewhat from year to year) and all areas within the Philadelphia County limits are fair game. We have only recently gained access to the Fort Mifflin area, so our data on this area is limited. When we have had access to the Fort we've counted birds seen on the Delaware, around the moat, and along the "nature trail" south of the Fort. Areas without trail access (wetlands) could not be censused. In addition, I have visited the Fort in mid-December several times over the last four years. Based on my own observations (mid-December 1990-1994) and those made by others during our census (mid-January, 1990-1994), I prepared the attached list. This is not an exhaustive list. There are obviously many other species that occur at the Fort during the winter that we have not yet recorded on our brief visits. If you'd like information on the species observed at the Fort during other seasons you should contact Mr. Ed Fingerhood at 637-2741. Also, no attempt has been made to indicate the relative abundance of each species on the attached list. Please let me know if have any questions, or if you need any additional information.

Sincerely

Keith Russell

Keith Russell
Assistant Editor/BNA
215 299-3783 (phone)
215 299-1182 (fax)

Jan 201-523 0204

06/16/95 FRI 16:00 [TX/RX NO 5410]

Published by The American Ornithologists' Union and The Academy of Natural Sciences of Philadelphia
1900 Benjamin Franklin Parkway • Philadelphia PA 19103-1195
Phone: 215/299-1042 • Fax: 215/299-1182

Birds Observed at Historic Fort Mifflin in Philadelphia on the Philadelphia Mid-Winter Bird Census, or by Keith Russell. Dates: Mid December-Mid January 1990-1994.

Great Blue Heron
Canada Goose
American Black Duck
Mallard
Lesser Scaup
Bufflehead
Common Merganser
Ruddy Duck
Red-tailed Hawk
American Kestrel
Ring-billed Gull
Herring Gull
Lesser Black-backed Gull*
Great Black-backed Gull
Rock Dove
Mourning Dove
Downy Woodpecker
Northern Flicker
Eastern Phoebe*
Blue Jay
American Crow
Fish Crow
Carolina Chickadee
Tufted Titmouse
Carolina Wren
American Robin
Gray Catbird*
Northern Mockingbird
European Starling
Northern Cardinal
American Tree Sparrow
Song Sparrow
Swamp Sparrow
White-throated Sparrow
Dark-eyed Junco
Red-winged Blackbird
House Finch
American Goldfinch
House Sparrow

* Rare or very uncommon during winter in Philadelphia.

APPENDIX A

Pennsylvania Fish and Wildlife Data Base
LIST A: Project Area Species List - MASTER LIST
** Philadelphia International Airport **
03 JAN 1991

Category....	Common Name.....	Scientific Name.....
FISH	CARP, COMMON	CYPRINUS CARPIO
AMPHIBIANS	BULLFROG	RANA CATESBEIANA
AMPHIBIANS	FROG, GREEN	RANA CLAMITANS
AMPHIBIANS	FROG, NEW JERSEY CHORUS	PSEUDACRIS TRISERIATA KALMI
AMPHIBIANS	FROG, NORTHERN CRICKET	ACRIS CREPITANS
AMPHIBIANS	FROG, PICKEREL	RANA PALUSTRIS
AMPHIBIANS	FROG, PLAINS LEOPARD	RANA BLAIRI
AMPHIBIANS	FROG, UPLAND CHORUS	PSEUDACRIS TRISERIATA FERIARUM
AMPHIBIANS	FROG, WOOD	RANA SYLVATICA
AMPHIBIANS	NEWT, EASTERN	NOTOPHTHALMUS VIRIDESCENS
AMPHIBIANS	NEWT, RED-SPOTTED	NOTOPHTHALMUS VIRIDESCENS VIRI
AMPHIBIANS	PEEPER, NORTHERN SPRING	HYLA CRUCIFER
AMPHIBIANS	SALAMANDER, FOUR-TOED	HEMIDACTYLIUM SCUTATUM
AMPHIBIANS	SALAMANDER, JEFFERSON	AMBYSTOMA JEFFERSONIANUM
AMPHIBIANS	SALAMANDER, LONGTAIL	EURYCEA LONGICAUDA
AMPHIBIANS	SALAMANDER, MARBLED	AMBYSTOMA OPACUM
AMPHIBIANS	SALAMANDER, NORTHERN DUSKY	DESMOGNATHUS FUSCUS FUSCUS
AMPHIBIANS	SALAMANDER, NORTHERN TWO-LINED	EURYCEA BISLINEATA
AMPHIBIANS	SALAMANDER, REDBACK	PLETHODON CINEREUS
AMPHIBIANS	SALAMANDER, SLIMY	PLETHODON GLUTINOSUS
AMPHIBIANS	SALAMANDER, SPOTTED	AMBYSTOMA MACULATUM
AMPHIBIANS	SPADEFOOT, EASTERN	SCAPHIOPUS HOLBROOKII
AMPHIBIANS	TOAD, AMERICAN	BUFO AMERICANUS
AMPHIBIANS	TOAD, FOWLER'S	BUFO WOODHOUSEI FOWLERI
REPTILES	COPPERHEAD, NORTHERN	AGKISTRODON CONTORTRIX
REPTILES	LIZARD, NORTHERN FENCE	SCELOPORUS UNDULATUS
REPTILES	RACER	COLUBER CONSTRICTOR
REPTILES	SKINK, FIVE-LINED	EUMECES FASCIATUS
REPTILES	SNAKE, BROWN	STORERIA DEKAYI
REPTILES	SNAKE, COMMON GARTER	THAMNOPHIS SIRTALIS
REPTILES	SNAKE, EASTERN HOGNOSE	HETERODON PLATYRHINOS
REPTILES	SNAKE, EASTERN MILK	LAMPROPELTIS TRIANGULUM
REPTILES	SNAKE, EASTERN RIBBON	THAMNOPHIS SAURITUS
REPTILES	SNAKE, NORTHERN RED-BELLIED	STORERIA OCCIPITOMACULATA
REPTILES	SNAKE, NORTHERN WATER	NERODIA SIPEDON SIPEDON
REPTILES	SNAKE, QUEEN	REGINA SEPTEMVITTATA
REPTILES	SNAKE, RING-NECK	DIADOPHIS PUNCTATUS ARNYI
REPTILES	SNAKE, WORM	CARPHOPHIS AMOENUS
REPTILES	STINKPOT	STERNOTHERUS ODORATUS
REPTILES	TURTLE, BOG	CLEMMYS MUHLENBERGI
REPTILES	TURTLE, COMMON SNAPPING	CHELYDRA SERPENTINA
REPTILES	TURTLE, EASTERN BOX	TERRAPENE CAROLINA
REPTILES	TURTLE, EASTERN MUD	KINOSTERNON SUBRUBRUM
REPTILES	TURTLE, PAINTED	CHRYSEMYS PICTA

Pennsylvania Fish and Wildlife Data Base
LIST A: Project Area Species List - MASTER LIST
** Philadelphia International Airport **
03 JAN 1991

:egory....	Common Name.....	Scientific Name.....
PTILES	TURTLE, SPOTTED	CLEMMYS GUTTATA
PTILES	TURTLE, WOOD	CLEMMYS INSCULPTA
RDS	AVOCET, AMERICAN	RECURVIROSTRA AMERICANA
RDS	BITTERN, AMERICAN	BOTAURUS LENTIGINOSUS
RDS	BITTERN, LEAST	IXOBRYCHUS EXILIS
RDS	BLACKBIRD, RED-WINGED	AGELAIUS PHOENICEUS
RDS	BLACKBIRD, RUSTY	EUPHAGUS CAROLINUS
RDS	BLACKBIRD, YELLOW-HEADED	XANTHOCEPHALUS XANTHOCEPHALUS
RDS	BLUEBIRD, EASTERN	SIALIA SIALIS
RDS	BOBOLINK	DOLICHONYX ORYZIVORUS
IRDS	BOBWHITE, NORTHERN	COLINUS VIRGINIANUS
IRDS	BUNTING, INDIGO	PASSERINA CYANEA
IRDS	BUNTING, SNOW	PLECTROPHENAX NIVALIS
IRDS	CANVASBACK	AYTHYA VALISINERIA
IRDS	CARDINAL, NORTHERN	CARDINALIS CARDINALIS
IRDS	CATBIRD, GRAY	DUMETELLA CAROLINENSIS
IRDS	CHAT, YELLOW-BREASTED	ICTERIA VIRENS
IRDS	CHICKADEE, BLACK-CAPPED	PARUS ATRICAPILLUS
IRDS	CHICKADEE, CAROLINA	PARUS CAROLINENSIS
IRDS	COOT, AMERICAN	FULICA AMERICANA
IRDS	CORMORANT, DOUBLE-CRESTED	PHALACROCORAX AURITUS
BIRDS	COWBIRD, BROWN-HEADED	MOLOTHRUS ATER
BIRDS	CRANE, SANDHILL	GRUS CANADENSIS TABIDA
BIRDS	CREEPER, BROWN	CERTHIA AMERICANA
BIRDS	CROSSBILL, RED	LOXIA CURVIROSTRA
BIRDS	CROSSBILL, WHITE-WINGED	LOXIA LEUCOPTERA LEUCOPTERA
BIRDS	CROW, AMERICAN	CORVUS BRACHYRHYNCHOS
BIRDS	CROW, FISH	CORVUS OSSIFRAGUS
BIRDS	CUCKOO, BLACK-BILLED	COCCYZUS ERYTHROPTHALMUS
BIRDS	CUCKOO, YELLOW-BILLED	COCCYZUS AMERICANUS
BIRDS	DICKCISSEL	SPIZA AMERICANA
BIRDS	DOVE, MOURNING	ZENAIDA MACROURA
BIRDS	DOVE, ROCK	COLUMBA LIVIA
BIRDS	DOWITCHER, LONG-BILLED	LIMNODROMUS SCOLOPACEUS
BIRDS	DOWITCHER, SHORT-BILLED	LIMNODROMUS GRISEUS
BIRDS	DUCK, AMERICAN BLACK	ANAS RUBRIPES
BIRDS	DUCK, RING-NECKED	AYTHYA COLLARIS
BIRDS	DUCK, RUDDY	OXYURA JAMAICENSIS
BIRDS	DUCK, WOOD	AIX SPONSA
BIRDS	DUNLIN	CALIDRIS ALPINA
BIRDS	EAGLE, BALD	HALIAEETUS LEUCOCEPHALUS
BIRDS	EAGLE, GOLDEN	AQUILA CHRYSAETOS
BIRDS	EGRET, CATTLE	BUBULCUS IBIS IBIS
BIRDS	EGRET, GREAT	CASMERODIUS ALBUS EGRETTA
BIRDS	FALCON, PEREGRINE	FALCO PEREGRINUS TUNDRIUS
BIRDS	FINCH, HOUSE	CARPODACUS MEXICANUS
BIRDS	FINCH, PURPLE	CARPODACUS PURPUREUS

Pennsylvania Fish and Wildlife Data Base
LIST A: Project Area Species List - MASTER LIST
** Philadelphia International Airport **
03 JAN 1991

Category....	Common Name.....	Scientific Name.....
BIRDS	FLICKER, NORTHERN	COLAPTES AURATUS
BIRDS	FLYCATCHER, ACADIAN	EMPIDONAX VIRESCENS
BIRDS	FLYCATCHER, GREAT CRESTED	MYIARCHUS CRINITUS
BIRDS	FLYCATCHER, OLIVE-SIDED	CONTOPUS BOREALIS
BIRDS	FLYCATCHER, WILLOW	EMPIDONAX TRAILLII
BIRDS	FLYCATCHER, YELLOW-BELLIED	EMPIDONAX FLAVIVENTRIS
BIRDS	GADWALL	ANAS STREPERA
BIRDS	GALLINULE, PURPLE	PORPHYRULA MARTINICA
BIRDS	GNATCATCHER, BLUE-GRAY	POLIOPTILA CAERULEA
BIRDS	GODWIT, HUDSONIAN	LIMOSA HAEMASTICA
BIRDS	GODWIT, MARBLED	LIMOSA FEDOA
BIRDS	GOLDENEYE, COMMON	BUCEPHALA CLANGULA
BIRDS	GOLDFINCH, AMERICAN	CARDUELIS TRISTIS
BIRDS	GOOSE, CANADA	BRANTA CANADENSIS
BIRDS	GOOSE, GREATER SNOW	CHEN CAERULESCENS
BIRDS	GOOSE, LESSER SNOW	CHEN CAERULESCENS CAERULESCENS
BIRDS	GOSHAWK, NORTHERN	ACCIPITER GENTILIS
BIRDS	GRACKLE, COMMON	QUISCALUS QUISCULA
BIRDS	GREBE, PIED-BILLED	PODILYMBUS PODICEPS
BIRDS	GROSBEAK, BLUE	GUIRACA CAERULEA
BIRDS	GROSBEAK, EVENING	COCCOTHRAUSTES VESPERTINUS
BIRDS	GROSBEAK, ROSE-BREASTED	PHEUCTICUS LUDOVICIANUS
BIRDS	GROUSE, RUFFED	BONASA UMBELLUS
BIRDS	GULL, BONAPARTE'S	LARUS PHILADELPHIA
BIRDS	GULL, HERRING	LARUS ARGENTATUS
BIRDS	HARRIER, NORTHERN	CIRCUS CYANEUS
BIRDS	HAWK BROAD-WINGED	BUTEO PLATYPTERUS
BIRDS	HAWK, COOPER'S	ACCIPITER COOPERII
BIRDS	HAWK, RED-SHOULDERED	BUTEO LINEATUS
BIRDS	HAWK, RED-TAILED	BUTEO JAMAICENSIS
BIRDS	HAWK, ROUGH-LEGGED	BUTEO LAGOPUS
BIRDS	HAWK, SHARP-SHINNED	ACCIPITER STRIATUS
BIRDS	HERON, BLACK-CROWNED NIGHT	NYCTICORAX NYCTICORAX
BIRDS	HERON, GREAT BLUE	ARDEA HERODIAS
BIRDS	HERON, GREEN-BACKED	BUTORIDES STRIATUS
BIRDS	HERON, YELLOW-CROWNED NIGHT	NYCTICORAX VIOLACEUS
BIRDS	HUMMINGBIRD, RUBY-THROATED	ARCHILOCHUS COLUBRIS
BIRDS	IBIS, WHITE	EUDOCIMUS ALBUS
BIRDS	JAY, BLUE	CYANOCITTA CRISTATA
BIRDS	JUNCO, DARK-EYED	JUNCO HYEMALIS
BIRDS	KESTREL, AMERICAN	FALCO SPARVERIUS
BIRDS	KILLDEER	CHARADRIUS VOCIFERUS
BIRDS	KINGBIRD, EASTERN	TYRANNUS TYRANNUS
BIRDS	KINGFISHER, BELTED	CERYLE ALCYON
BIRDS	KINGLET, GOLDEN-CROWNED	REGULUS SATRAPA
BIRDS	KINGLET, RUBY-CROWNED	REGULUS CALENDULA
BIRDS	LARK, HORNED	EREMOPHILA ALPESTRIS PRATICOLA
BIRDS	LONGSPUR, LAPLAND	CALCARIUS LAPPONICUS
BIRDS	LOON, COMMON	GAVIA IMMER
BIRDS	LOON, RED-THROATED	GAVIA STELLATA

Pennsylvania Fish and Wildlife Data Base
LIST A: Project Area Species List - MASTER LIST
** Philadelphia International Airport **
03 JAN 1991

Category....	Common Name.....	Scientific Name.....
BIRDS	MALLARD	ANAS PLATYRHYNCHOS
BIRDS	MARTIN, PURPLE	PROGNE SUBIS
BIRDS	MEADOWLARK, EASTERN	STURNELLA MAGNA
BIRDS	MERGANSER, COMMON	MERGUS MERGANSER
BIRDS	MERGANSER, HOODED	LOPHODYTES CUCULLATUS
BIRDS	MERLIN	FALCO COLUMBARIUS
BIRDS	MOCKINGBIRD, NORTHERN	MIMUS POLYGLOTTOS
BIRDS	MOORHEN, COMMON	GALLINULA CHLOROPUS
BIRDS	NIGHTHAWK, COMMON	CHORDEILES MINOR
BIRDS	NUTHATCH, WHITE-BREASTED	SITTA CAROLINENSIS
BIRDS	OLDSQUAW	CLANGULA HYEMALIS
BIRDS	ORIOLE, NORTHERN	ICTERUS GALBULA
BIRDS	ORIOLE, ORCHARD	ICTERUS SPURIUS
BIRDS	OSPREY	PANDION HALIAETUS
BIRDS	OVENBIRD	SEIURUS AUROCAPILLUS
BIRDS	OWL, BARRED	STRIX VARIA
BIRDS	OWL, COMMON BARN	TYTO ALBA
BIRDS	OWL, EASTERN SCREECH	OTUS ASIO
BIRDS	OWL, GREAT HORNED	BUBO VIRGINIANUS
BIRDS	OWL, LONG-EARED	OTUS ASIO
BIRDS	OWL, NORTHERN SAW-WHET	AEGOLIUS ACADICUS
BIRDS	OWL, SHORT-EARED	ASIO FLAMMEUS
BIRDS	OWL, SNOWY	NYCTEA SCANDIACA
BIRDS	PEWEE, EASTERN WOOD	CONTOPUS VIRENS
BIRDS	PHALAROPE, RED-NECKED	PHALAROPUS LOBATUS
BIRDS	PHALAROPE, WILSON'S	PHALAROPUS TRICOLOR
BIRDS	PHEASANT, RING-NECKED	PHASIANUS COLCHICUS
BIRDS	PHOEBE, EASTERN	SAYORNIS PHOEBE
BIRDS	PINTAIL, NORTHERN	ANAS ACUTA
BIRDS	PIPIT, WATER	ANTHUS SPINOLETTA
BIRDS	PLOVER, BLACK-BELLIED	PLUVIALIS SQUATAROLA
BIRDS	PLOVER, LESSER-GOLDEN	PLUVIALIS DOMINICA
BIRDS	PLOVER, SEMIPALMATED	CHARADRIUS SEMIPALMATUS
BIRDS	RAIL, BLACK	LATERALLUS JAMAICENSIS
BIRDS	RAIL, KING	RALLUS ELEGANS
BIRDS	RAIL, VIRGINIA	RALLUS LIMICOLA
BIRDS	REDHEAD	AYTHYA AMERICANA
BIRDS	REDPOLL, COMMON	CARDUELIS FLAMMEA
BIRDS	REDSTART, AMERICAN	SETOPHAGA RUTICILLA
BIRDS	ROBIN, AMERICAN	TURDUS MIGRATORIUS
BIRDS	SANDPIPER, BUFF-BREASTED	TRYNGITES SUBRUFICOLLIS
BIRDS	SANDPIPER, PECTORAL	CALIDRIS MELANOTOS
BIRDS	SANDPIPER, SEMIPALMATED	CALIDRIS PUSILLA
BIRDS	SANDPIPER, SOLITARY	TRINGA SOLITARIA
BIRDS	SANDPIPER, SPOTTED	ACTITIS MACULARIA
BIRDS	SANDPIPER, UPLAND	BATRAMIA LONGICAUDA
BIRDS	SAPSUCKER, YELLOW-BELLIED	SPHYRAPICUS VARIUS
BIRDS	SCAUP, GREATER	AYTHYA MARILA
BIRDS	SCAUP, LESSER	AYTHYA AFFINIS
BIRDS	SCOTER, BLACK	MELANITTA NIGRA

Pennsylvania Fish and Wildlife Data Base
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** Philadelphia International Airport **
03 JAN 1991

Category....	Common Name.....	Scientific Name.....
BIRDS	SHOVELER, NORTHERN	ANAS CLYPEATA
BIRDS	SHRIKE, LOGGERHEAD	LANIUS LUDOVICIANUS
BIRDS	SHRIKE, NORTHERN	LANIUS EXCUBITOR
BIRDS	SNIPE, COMMON	GALLINAGO GALLINAGO
BIRDS	SORA	PORZANA CAROLINA
BIRDS	SPARROW, AMERICAN TREE	SPIZELLA ARBOREA
BIRDS	SPARROW, CHIPPING	SPIZELLA PASSERINA
BIRDS	SPARROW, CLAY-COLORED	SPIZELLA PALLIDA
BIRDS	SPARROW, FIELD	SPIZELLA PUSILLA
BIRDS	SPARROW, FOX	PASSERELLA ILIACA
BIRDS	SPARROW, GRASSHOPPER	AMMODRAMUS SAVANNARUM
BIRDS	SPARROW, HENSLOW'S	AMMODRAMUS HENSLOWII
BIRDS	SPARROW, HOUSE	PASSER DOMESTICUS
BIRDS	SPARROW, LINCOLN'S	MELOSPIZA LINCOLNII
BIRDS	SPARROW, SAVANNAH	PASSERCULUS SANDWICHENSIS
BIRDS	SPARROW, SHARP-TAILED	AMMODRAMUS CAUDACUTUS
BIRDS	SPARROW, SONG	MELOSPIZA MELODIA
BIRDS	SPARROW, SWAMP	MELOSPIZA GEORGIANA
BIRDS	SPARROW, WHITE-THROATED	ZONOTRICHIA ALBICOLLIS
BIRDS	STARLING, EUROPEAN	STURNUS VULGARIS
BIRDS	SWALLOW, BANK	RIPARIA RIPARIA
BIRDS	SWALLOW, BARN	HIRUNDO RUSTICA
BIRDS	SWALLOW, CLIFF	HIRUNDO PYRRHONOTA
BIRDS	SWALLOW, NORTHERN ROUGH-WINGED	STELGIDOPTERYX SERRIPENNIS
BIRDS	SWALLOW, TREE	TACHYCINETA BICOLOR
BIRDS	SWAN, TUNDRA	CYGNUS COLUMBIANUS
BIRDS	TANAGER, SCARLET	PIRANGA OLIVACEA
BIRDS	TANAGER, SUMMER	PIRANGA RUBRA
BIRDS	TEAL, BLUE-WINGED	ANAS DISCORS
BIRDS	TEAL, GREEN-WINGED	ANAS CRECCA
BIRDS	TERN, BLACK	CHLIDONIAS NIGER
BIRDS	TERN, CASPIAN	STERNA CASPIA
BIRDS	TERN, COMMON	STERNA HIRUNDO
BIRDS	TERN, FORSTER'S	STERNA FORSTERI
BIRDS	THRASHER, BROWN	TOXOSTOMA RUFUM
BIRDS	THRUSH, GRAY-CHEEKED	CATHARUS MINIMUS
BIRDS	THRUSH, HERMIT	CATHARUS GUTTATUS
BIRDS	THRUSH, SWAINSON'S	CATHARUS USTULATUS
BIRDS	THRUSH, WOOD	HYLOCICHLA MUSTELINA
BIRDS	TITMOUSE, TUFTED	PARUS BICOLOR
BIRDS	TOWHEE, RUFOUS-SIDED	PIPILO ERYTHROPHTHALMUS
BIRDS	TURKEY, WILD	MELEAGRIS GALLOPAVO
BIRDS	TURNSTONE, RUDDY	ARENARIA INTERPRES
BIRDS	VEERY	CATHARUS FUSCESCENS
BIRDS	VIREO, PHILADELPHIA	VIREO PHILADELPHICUS
BIRDS	VIREO, RED-EYED	VIREO OLIVACEUS
BIRDS	VIREO, SOLITARY	VIREO SOLITARIUS
BIRDS	VIREO, WARBLING	VIREO GILVUS
BIRDS	VIREO, WHITE-EYED	VIREO GRISEUS
BIRDS	VIREO, YELLOW-THROATED	VIREO FLAVIFRONS

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BIRDS	VULTURE, BLACK	CORAGYPS ATRATUS
BIRDS	VULTURE, TURKEY	CATHARTES AURA
BIRDS	WARBLER, BAY-BREASTED	DENDROICA CASTANEA
BIRDS	WARBLER, BLACK-AND-WHITE	MNIOTILTA VARIA
BIRDS	WARBLER, BLACK-THROATED BLUE	DENDROICA CAERULESCENS
BIRDS	WARBLER, BLACK-THROATED GREEN	DENDROICA VIRENS
BIRDS	WARBLER, BLACKBURNIAN	DENDROICA FUSCA
BIRDS	WARBLER, BLACKPOLL	DENDROICA STRIATA
BIRDS	WARBLER, BLUE-WINGED	VERMIVORA PINUS
BIRDS	WARBLER, CANADA	WILSONIA CANADENSIS
BIRDS	WARBLER, CAPE MAY	DENDROICA TIGRINA
BIRDS	WARBLER, CERULEAN	DENDROICA CERULEA
BIRDS	WARBLER, CHESTNUT-SIDED	DENDROICA PENNSYLVANICA
BIRDS	WARBLER, GOLDEN-WINGED	VERMIVORA CHRYSOPTERA
BIRDS	WARBLER, HOODED	WILSONIA CITRINA
BIRDS	WARBLER, KENTUCKY	OPORORNIS FORMOSUS
BIRDS	WARBLER, MAGNOLIA	DENDROICA MAGNOLIA
BIRDS	WARBLER, MOURNING	OPORORNIS PHILADELPHIA
BIRDS	WARBLER, NASHVILLE	VERMIVORA RUFICAPILLA
BIRDS	WARBLER, NORTHERN PARULA	PARULA AMERICANA
BIRDS	WARBLER, PINE	DENDROICA PINUS
BIRDS	WARBLER, PRAIRIE	DENDROICA DISCOLOR
BIRDS	WARBLER, PROTHONOTARY	PROTONOTARIA CITREA
BIRDS	WARBLER, SWAINSON'S	LIMNOTHLYPIS SWAINSONII
BIRDS	WARBLER, TENNESSEE	VERMIVORA PEREGRINA
BIRDS	WARBLER, WILSON'S	WILSONIA PUSILLA
BIRDS	WARBLER, WORM-EATING	HELMITHEROS VERMIVORUS
BIRDS	WARBLER, YELLOW	DENDROICA PETECHIA
BIRDS	WARBLER, YELLOW-RUMPED	DENDROICA CORONATA
BIRDS	WARBLER, YELLOW-THROATED	DENDROICA DOMINICA
BIRDS	WATERTHRUSH, LOUISIANA	SEIURUS MOTACILLA
BIRDS	WATERTHRUSH, NORTHERN	SEIURUS NOVEBORACENSIS
BIRDS	WAXWING, CEDAR	BOMBYCILLA CEDRORUM
BIRDS	WIGEON, AMERICAN	ANAS AMERICANA
BIRDS	WILLET, EASTERN	CATOPTROPHORUS SEMIPALMATUS
BIRDS	WOODCOCK, AMERICAN	SCOLOPAX MINOR
BIRDS	WOODPECKER, DOWNY	PICOIDES PUBESCENS
BIRDS	WOODPECKER, HAIRY	PICOIDES VILLOSUS
BIRDS	WOODPECKER, PILEATED	DRYOCOPUS PILEATUS
BIRDS	WOODPECKER, RED-BELLIED	MELANERPES CAROLINUS
BIRDS	WOODPECKER, RED-HEADED	MELANERPES ERYTHROCEPHALUS
BIRDS	WREN, CAROLINA	THRYOTHORUS LUDOVICIANUS
BIRDS	WREN, HOUSE	TROGLODYTES AEDON
BIRDS	WREN, MARSH	CISTOTHORUS PALUSTRIS
BIRDS	WREN, WINTER	TROGLODYTES TROGLODYTES
BIRDS	YELLOWLEGS, GREATER	TRINGA MELANOLEUCA
BIRDS	YELLOWTHROAT, COMMON	GEOTHLYPIS TRICHAS BRACHIDAC

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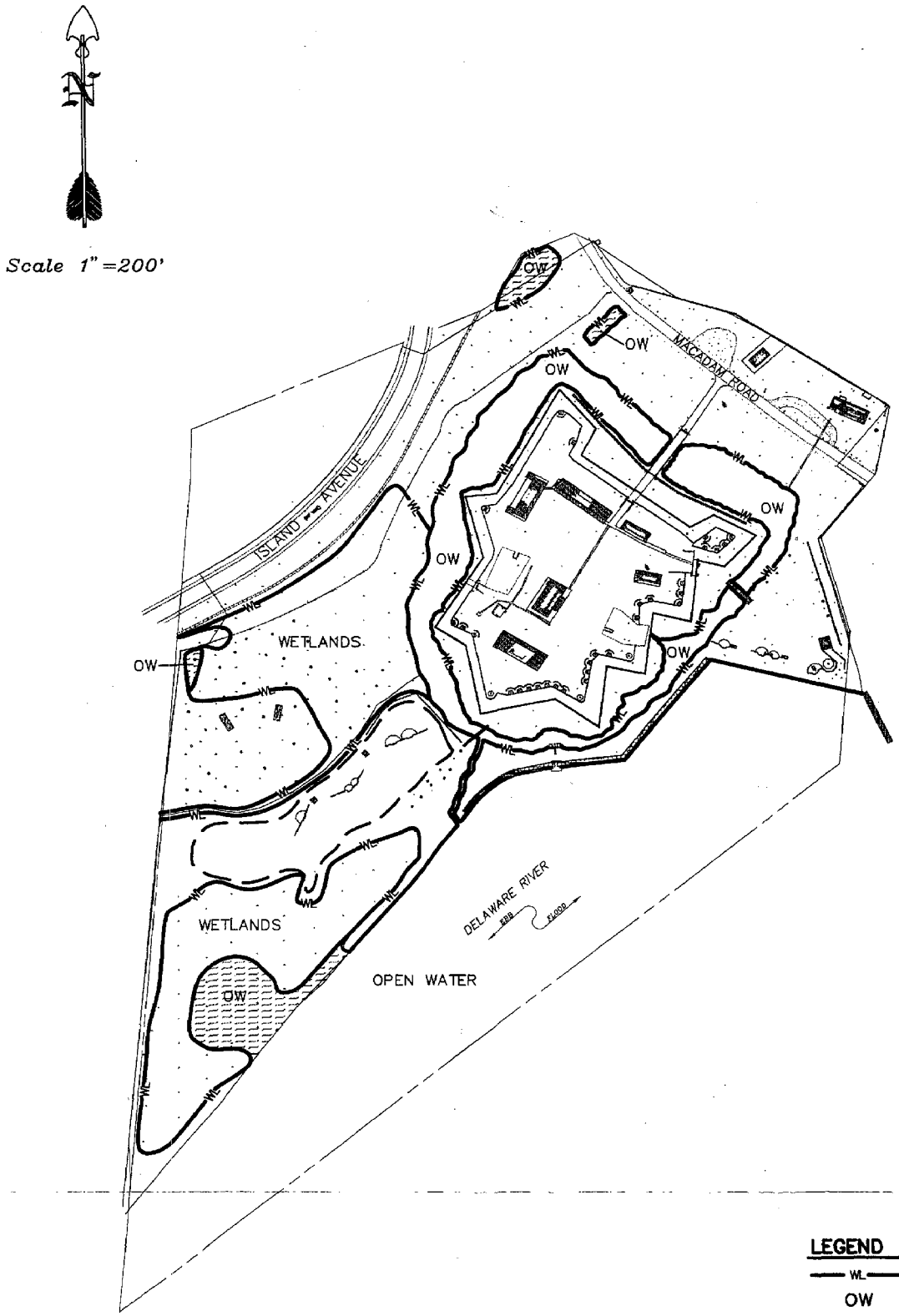
MAMMALS	BAT, BIG BROWN	EPTESICUS FUSCUS
MAMMALS	BAT, HOARY	LASIURUS CINEREUS
MAMMALS	BAT, RED	LASIURUS BOREALIS
MAMMALS	BAT, SILVER-HAIRED	LASIONYCTERIS NOCTIVAGANS
MAMMALS	BEAR, BLACK	URSUS AMERICANUS
MAMMALS	CHIPMUNK, EASTERN	TAMIAS STRIATUS
MAMMALS	COTTONTAIL, EASTERN	SYLVILAGUS FLORIDANUS
MAMMALS	DEER, WHITE-TAILED	ODOCOILEUS VIRGINIANUS
MAMMALS	FOX, GRAY	UROCYON CINEREOARGENTEUS
MAMMALS	FOX, RED	VULPES VULPES
MAMMALS	MINK	MUSTELA VISON
MAMMALS	MOLE, EASTERN	SCALOPUS AQUATICUS
MAMMALS	MOLE, STAR-NOSED	CONDYLURA CRISTATA
MAMMALS	MOUSE, HOUSE	MUS MUSCULUS
MAMMALS	MOUSE, MEADOW JUMPING	ZAPUS HUDSONIUS
MAMMALS	MOUSE, WHITE-FOOTED	PEROMYSCUS LEUCOPUS
MAMMALS	MUSKRAT	ONDATRA ZIBETHICUS
MAMMALS	MYOTIS, KEEN'S	MYOTIS KEENII
MAMMALS	MYOTIS, LITTLE BROWN	MYOTIS LUCIFUGUS
MAMMALS	OPOSSUM, VIRGINIA	DIDELPHIS VIRGINIANA
MAMMALS	RACCOON	PROCYON LOTOR
MAMMALS	RAT, NORWAY	RATTUS NORVEGICUS
MAMMALS	SHREW, NORTHERN SHORT-TAILED	BLARINA BREVICAUDA
MAMMALS	SKUNK, STRIPED	MEPHITIS MEPHITIS
MAMMALS	SQUIRREL, GRAY	SCIURUS CAROLINENSIS
MAMMALS	SQUIRREL, RED	TAMIASCIURUS HUDSONICUS
MAMMALS	SQUIRREL, SOUTHERN FLYING	GLAUCOMYS VOLANS
MAMMALS	VOLE, MEADOW	MICROTUS PENNSYLVANICUS
MAMMALS	VOLE, WOODLAND	MICROTUS PINETORUM
MAMMALS	WEASEL, LONG-TAILED	MUSTELA FRENATA
MAMMALS	WOODCHUCK	MARMOTA MONAX
MAMMALS	WOODRAT, EASTERN	NEOTOMA FLORIDANA



LEGEND

—WL—	WETLANDS LINE
OW	OPEN WATER
— — —	NATURE TRAIL

WETLANDS PLAN
HISTORIC FORT MIFFLIN
40th WARD
CITY OF PHILADELPHIA, PENNSYLVANIA

SCALE: 1" = 200'	DRAWN BY: kas	REVISIONS:
DATE: 5/12/95	APPROVED:	

PENNONI ASSOCIATES INC.
1600 CALLOWHILL STREET
PHILADELPHIA, PENNSYLVANIA 19130

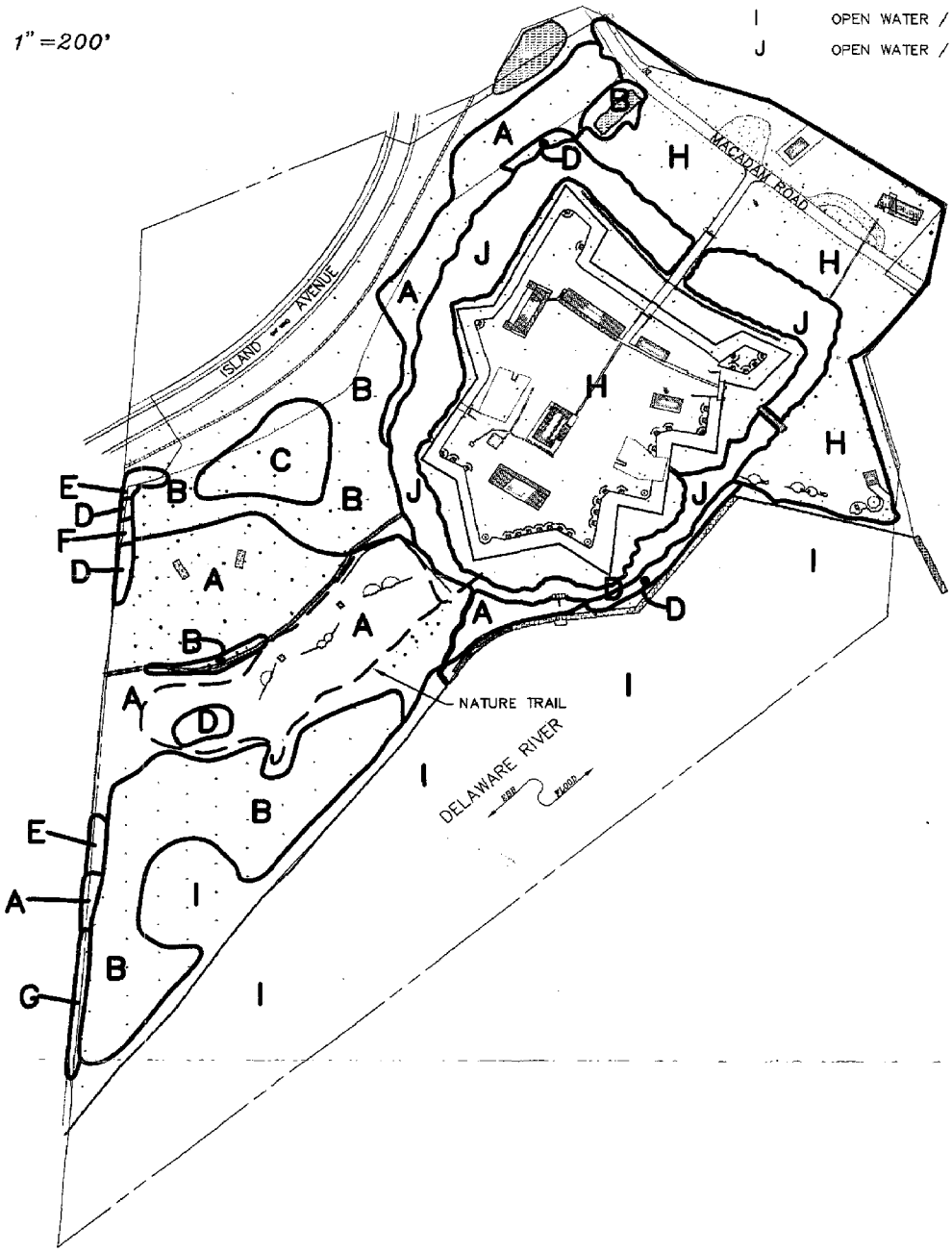
VINCENT R. MARIANI
PROFESSIONAL ENGINEER PA. LICENSE No. 15523-E

CLRR 92A7.004.01/C1701

VEGETATION ASSOCIATION MAP

A	BLACK CHERRY / UPLAND
B	COMMON REED / WETLAND
C	RICE CUTGRASS / WETLAND
D	SUMAC / UPLAND
E	SASSAFRAS / UPLAND
F	WHITE BIRCH / UPLAND
G	LARGE TOOTH POPLAR / UPLAND
H	MAINTAINED OPEN SPACE / ROADWAY
I	OPEN WATER / TIDAL INFLUENCED
J	OPEN WATER / NON TIDAL

Scale 1"=200'



VEGETATION ASSOCIATION PLAN
HISTORIC FORT MIFFLIN
40th WARD
CITY OF PHILADELPHIA, PENNSYLVANIA

SCALE: 1" = 200'	DRAWN BY: kas	REVISIONS:
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VINCENT R. MARIANI
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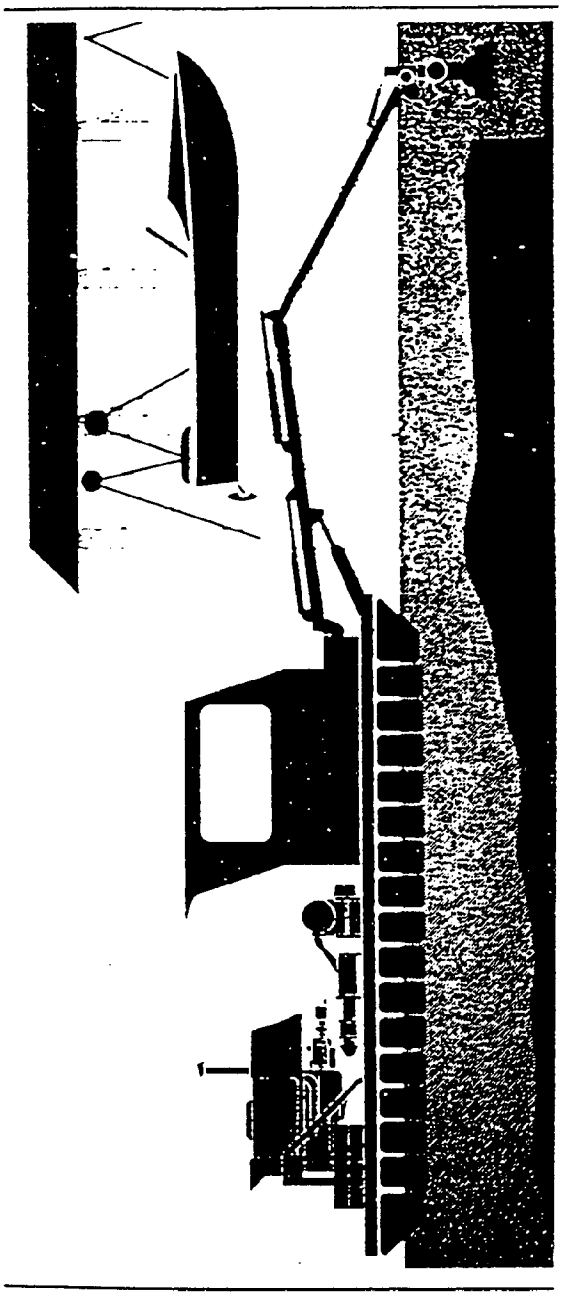
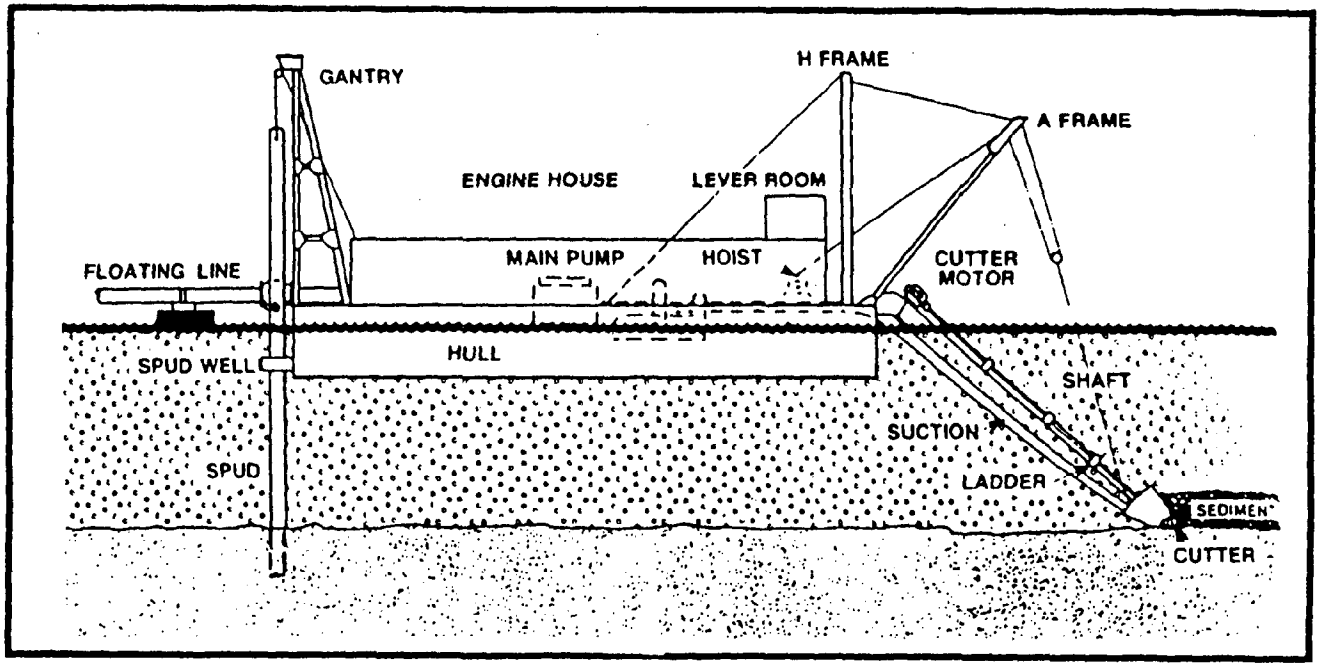
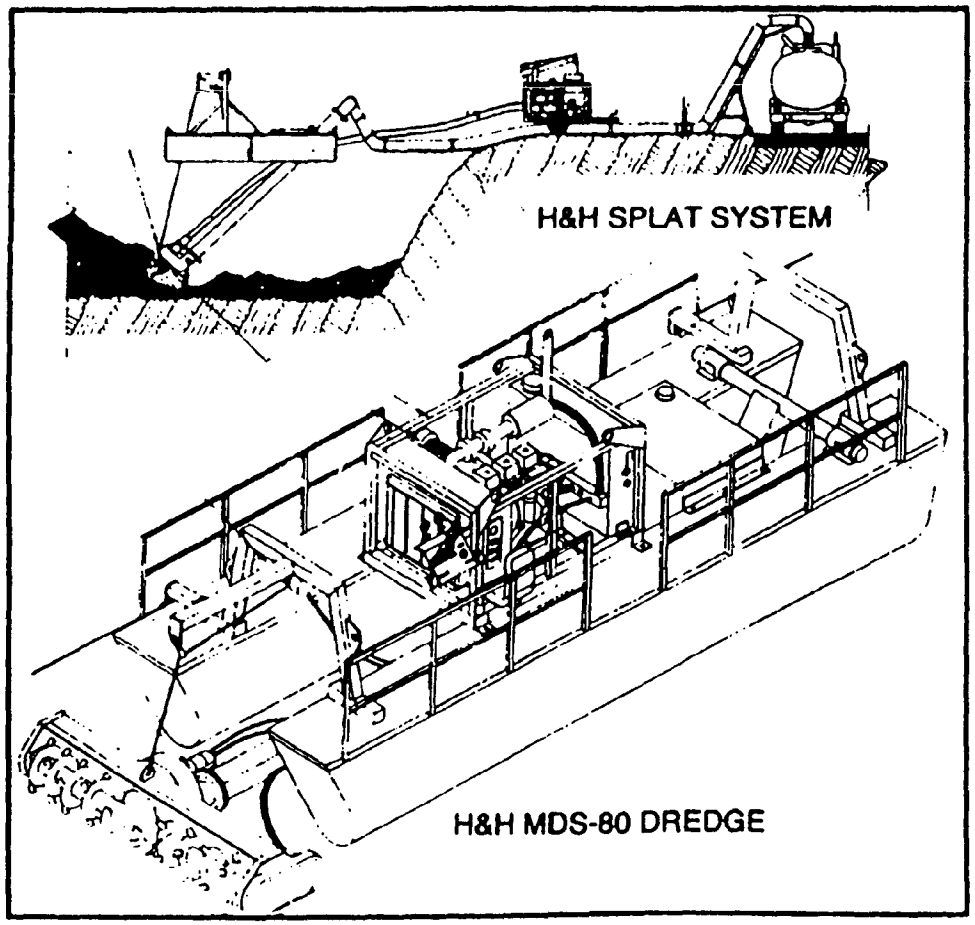


FIGURE 3

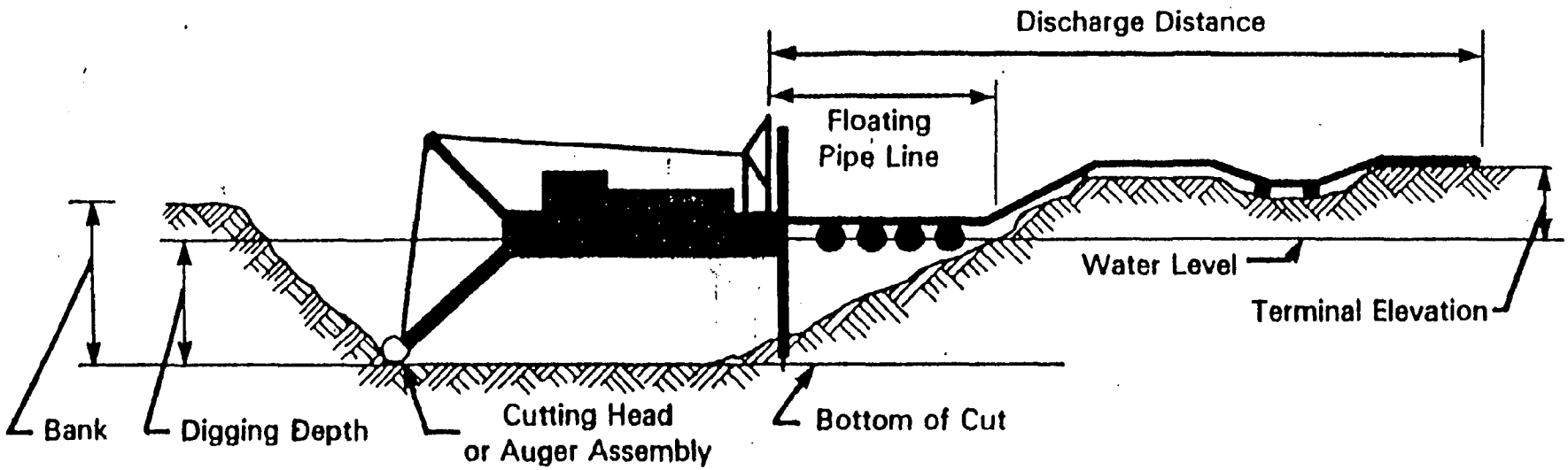


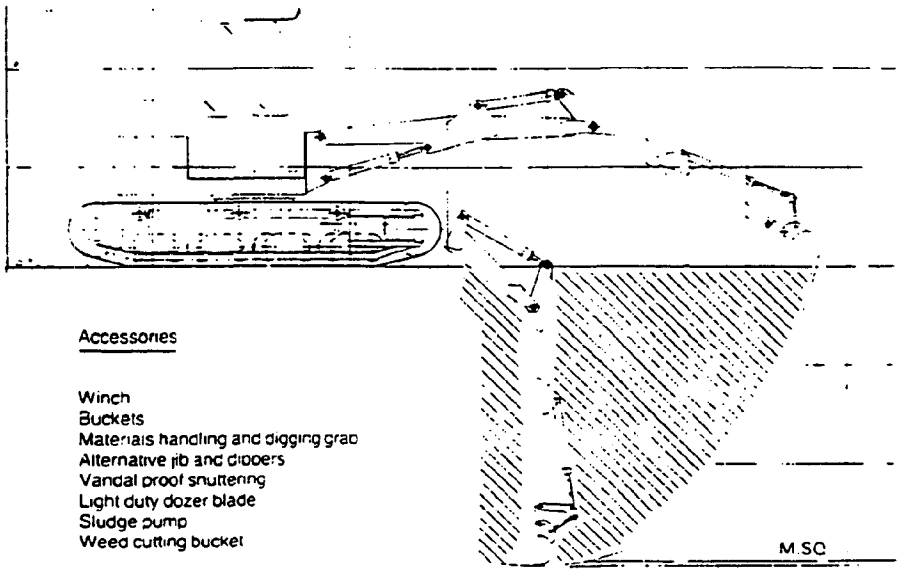
(from Lake and Reservoir Restoration Guidance Manual)


H&H SPLAT SYSTEM
H&H MDS-80 DREDGE

IMPORTANT DISTANCES IN THE SELECTION OF DREDGING SYSTEMS EQUIPMENT

(Source: Ellicott Machine Corp., 1968)



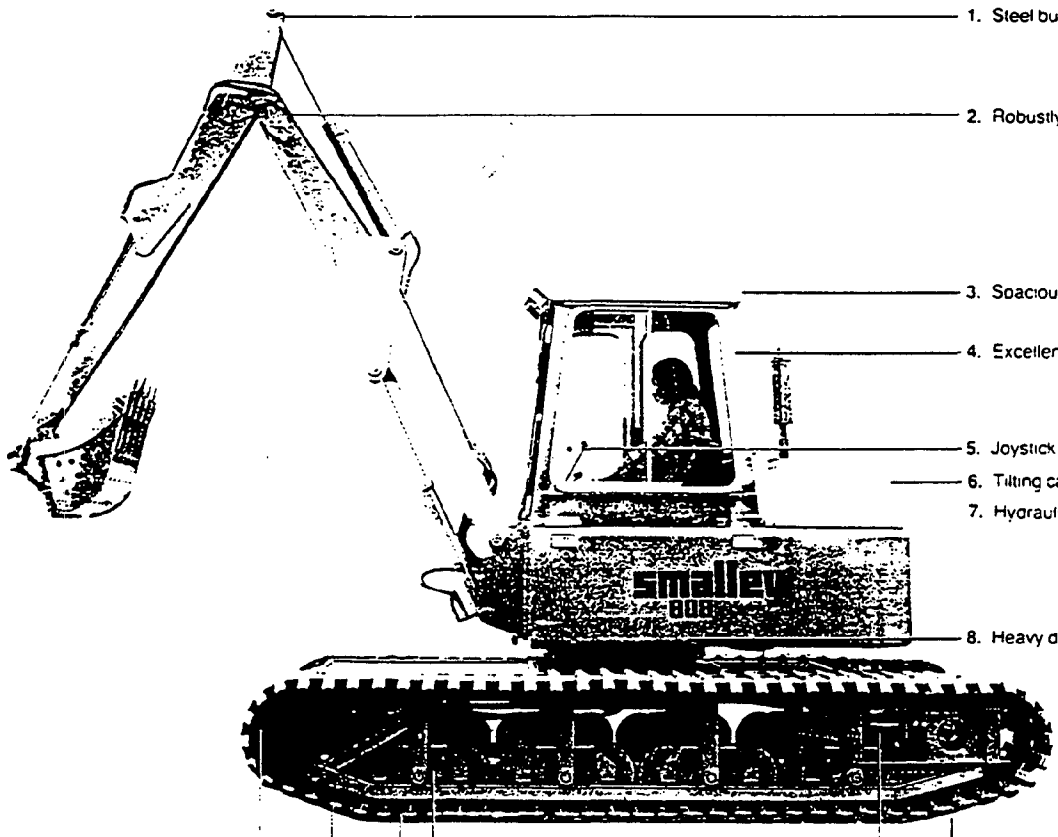


Accessories

Winch
Buckets
Materials handling and digging grab
Alternative jib and dippers
Vandal proof shuttering
Light duty dozer blade
Sludge pump
Weed cutting bucket

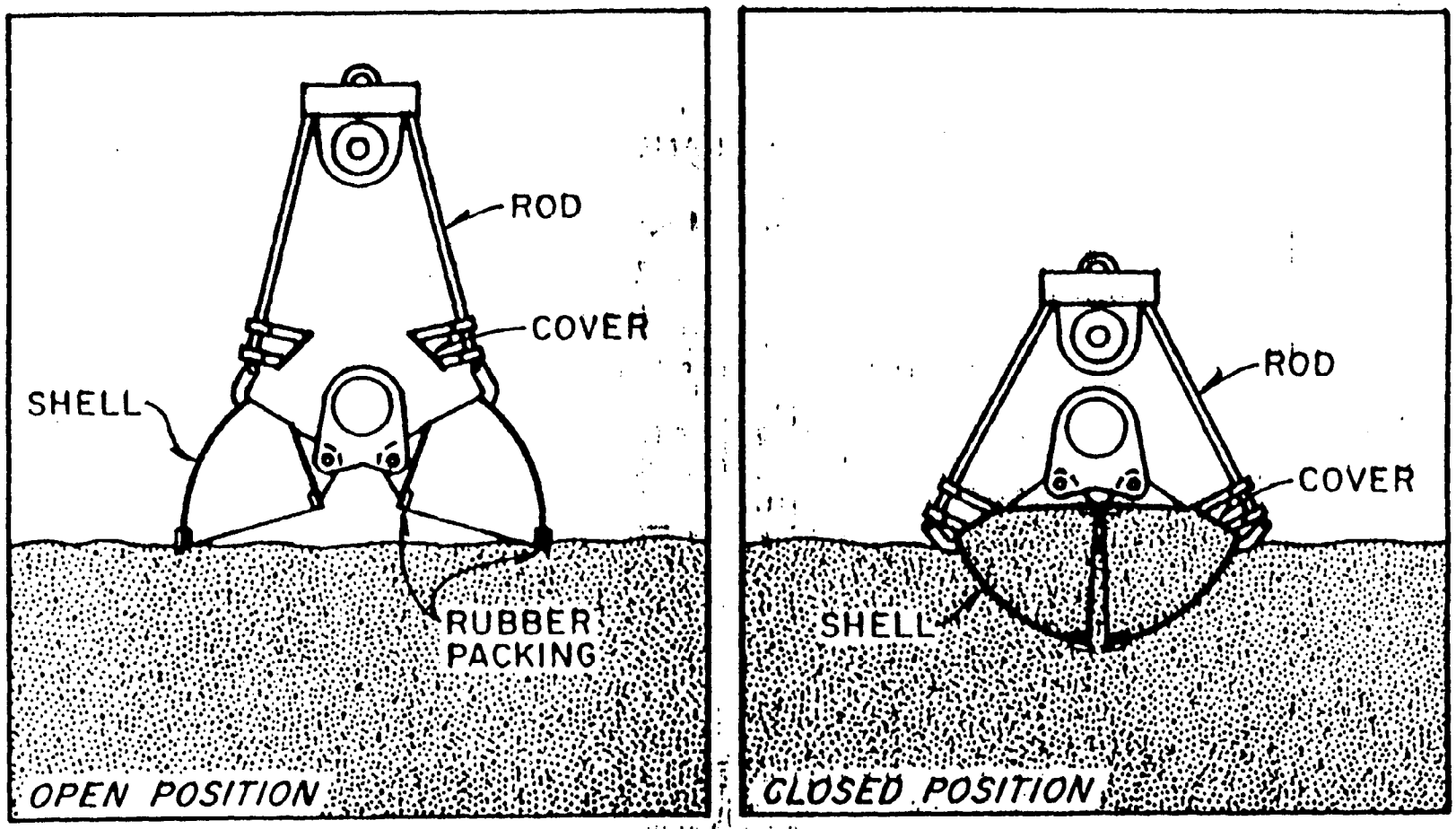
Specifications

Weight: Complete with 152cm (60") ditching bucket 4420kg (9742lb) approx.
Ground pressure: 0.12kg/sq cm (1.6psi)
Electrics: 12v system, twin working lights, cab interior light.
Windscreen wiper and washer.
Engine: Lister TL2 air cooled diesel 30 bhp
Lifting capacity: 500kg (1102lb)
Filtration: Pall return line
Reach: 5.8m (228")
Unload height: bucket pivot point 4.95m (195")
Digging depth: 3.24m (127.5")
Cab height: 2.6m (102") from ground level
Gradeability: 70% 30°
Travel length: 3.8m (149.5")
Width: 2.43m (95.5")
Spare hydraulic spool for grab rotation
Heater.
Sliding Window.
3 pump hydraulic system
Independent two speed track drive



1. Steel bushes and pins
2. Robustly built
3. Spacious, heated, tilting cab
4. Excellent ventilation and visibility
5. Joystick controls for digging and 360° slew
6. Tilting canopy for easy access
7. Hydraulic PTO
8. Heavy duty ball bearing slew ring
9. Good leading angle for crossing ditches
10. Hydraulic track tensioning
11. Oscillating bogie wheels
12. Cleats have angled wings to facilitate turning
13. Long and wide tracks to give good flotation
14. Rear sprockets driven independantly by two hydraulic motors for outstanding manoeuvrability

FIGURE 4



Open and closed positions of the watertight bucket (redrawn from Barnard, 1978).

A DRAGLINE

(Source: EPA, 1978)

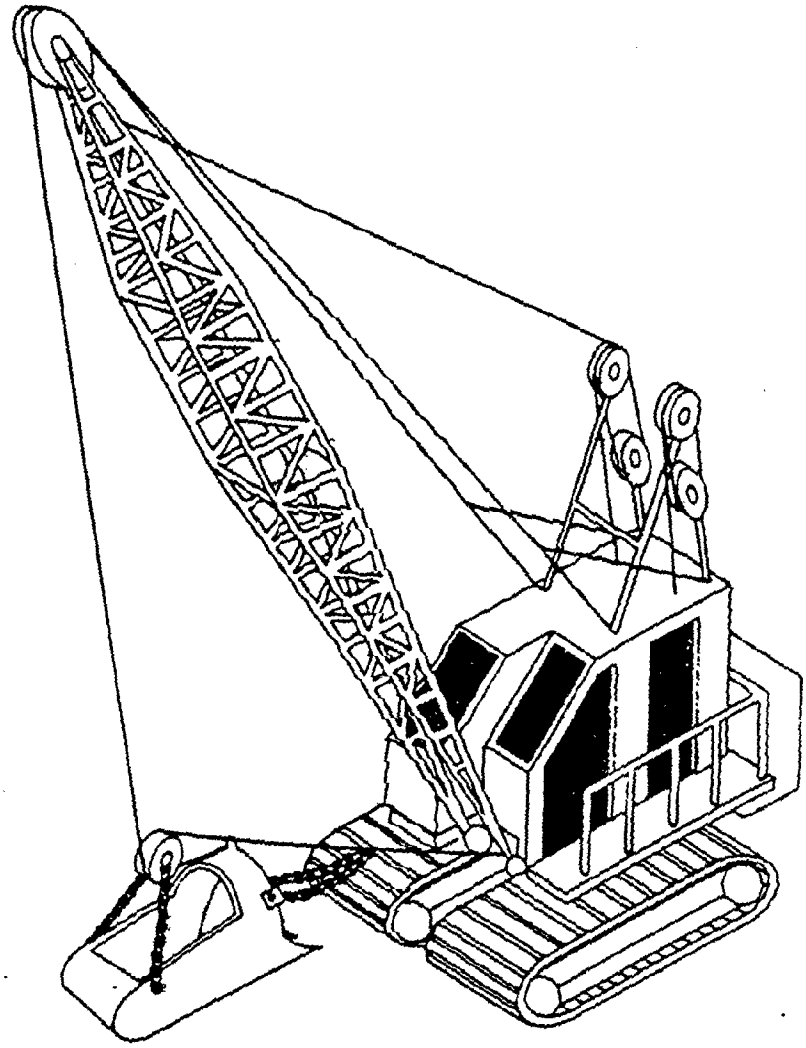


FIGURE 5

AQUAMARINE H650 HARVESTER

WEIGHT - 6604 kgs
OVERALL LENGTH - 11.6 meters
OVERALL WIDTH - 4.9 meters
OVERALL HEIGHT - 3.7 meters

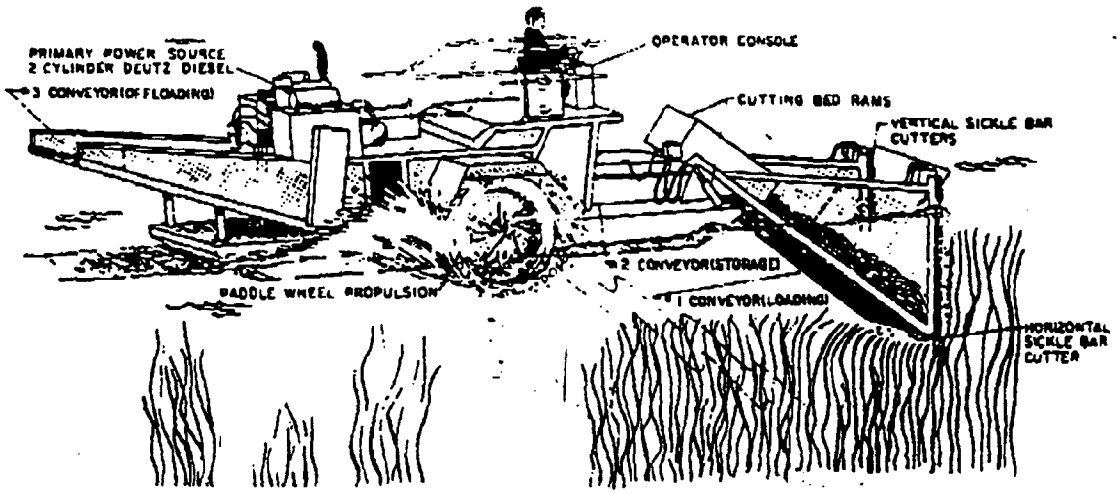


Figure 12-1 The Aquamarine Corporation's (Waukesha, Wisconsin) H650 harvester. Plants are cut with a cutter bar that is 1.6 m (5 feet) long, conveyed into a hold that can contain up to 18 cubic meters (650 ft^3) of plants and offloaded at the shore with another conveyor (Courtesy of the Aquamarine Corporation).

(From Cooke et al., 1986)

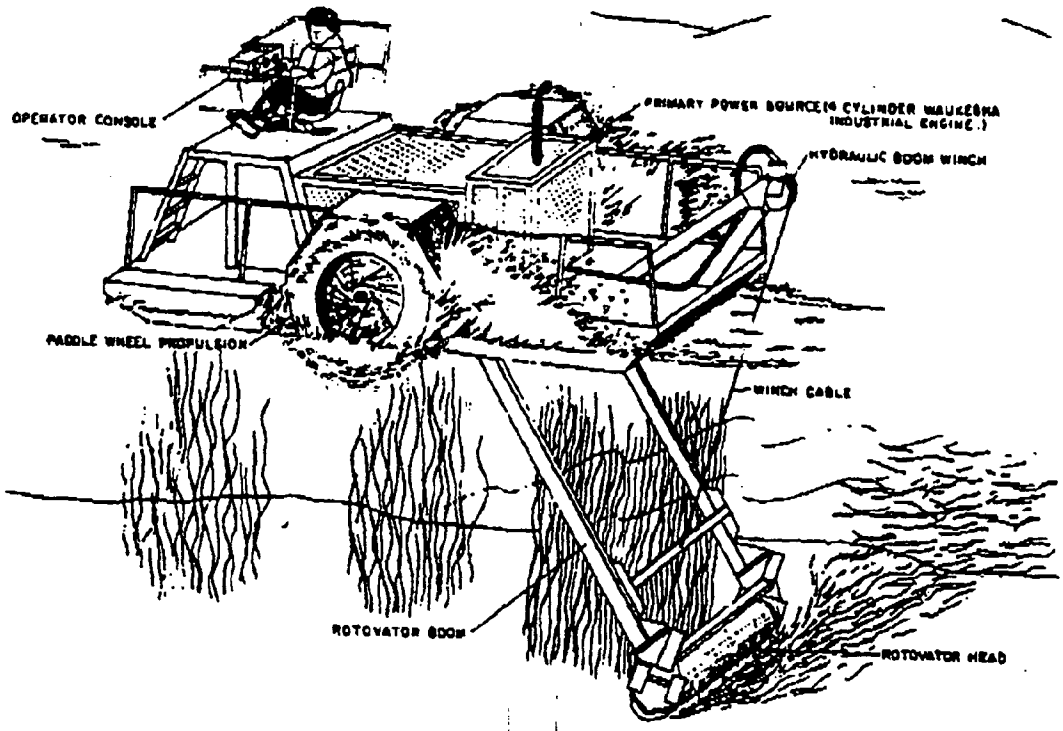


Figure 12-2 The Rotovator, for root tillage.

FIGURE 6

BonTerra America

BioLogs!

Landscaping
Channel Shoulders
Shoreliner
Hiking Trail Development
Channel Edge Liner
Stream Bank Reclamation
Golf Course Wetlands Construction
Revitalize Polluted Water
Wildlife Habitats

BonTerra® BioLogs
Put Nature to Work for You . . .
. . . Nature's Way.

Photo courtesy of HMDC

100% coconut fiber *BioLogs* for channel, stream, and shoreline erosion control and botanic naturalization.

The need for long term stabilization of shorelines, stream banks, and wetlands is an on-going challenge for today's environmentally sensitive planners. To achieve natural riparian regeneration or reclamation, standing and running water has to offer a habitable zone for aquatic plants. Very still, brackish or polluted water can be cleaned by a healthy stand of vegetation. **BonTerra BioLogs** provide a suitable planting medium that will endure for several years, while simultaneously preventing erosion and enhancing natural regeneration.

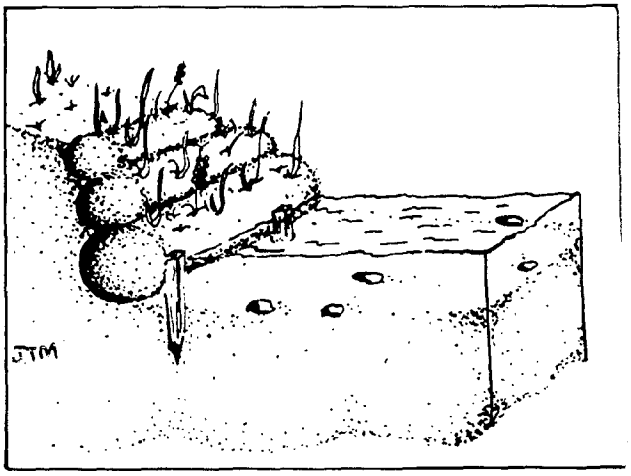


FIGURE 7 Soft Organic Wall

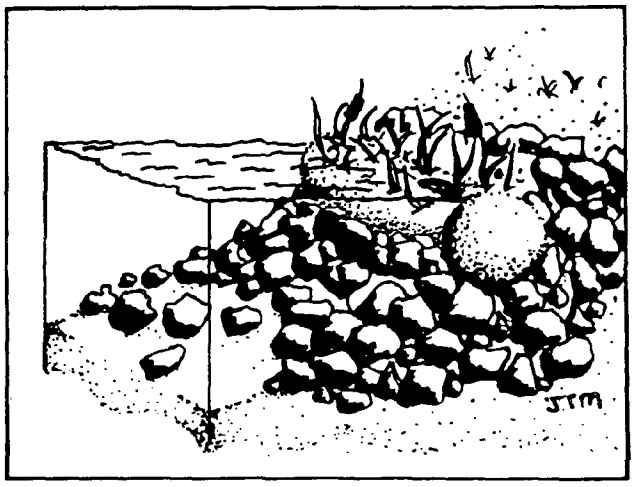
Whatever your challenge: the reconstruction or preservation of a pristine meandering stream, or the creation of hydrophilic plant life at the toe of a rip-rap or concrete structure, **BonTerra BioLogs** offer a long term solution to the establishment and maintenance of a healthy aquatic plant environment.

Dead Shorelines

Concrete walls and rip-rap shorelines are enhanced by the addition of **BonTerra BioLogs**. Installed as a shoreliner, submersed, or as floating logs, **BioLogs** anchor living plants to enhance the natural environment, and create an aesthetically acceptable appearance for an otherwise sterile environment.

Intermittent and Constant Flow Channels

Streams and drainage structures can be reconstructed or enhanced to a natural meandering condition with **BonTerra BioLogs**. **BioLogs** provide erosion protection at the critical juncture of water and shore. Reeds, cattails, willows, and other water loving plants are easily anchored in **BioLog's** flexible matrix of organic fibers, to resist uprooting by the shear effect of running water.



Organic Rip-Rap

Technical Specifications
Flexible matrix of Coir fiber
Encased in Coir fiber net of 2-inch squares
12-inch diameter • 20-foot length • 8-foot length

Installation

BonTerra BioLogs are either anchored with 2" x 2" x 36" wooden stakes, tied together, or both, depending on the application, and are available in eight-foot and 20-foot lengths. Eight-foot **BioLogs** are manufactured with a center rope having loops on both ends. These can be strung together to form a shoreline chain, stacked parallel to form a log wall, weighted and sunk to provide aquatic plant habitat, or tied to floats and used as water surface planters. Twenty-foot **BioLogs** are most commonly used for shore and stream bank stabilization. ***Detailed installation guide available.***

Still Water

Marsh land, swamp, and standing wetlands often stagnate due to rapidly decomposing organic matter and inadequate movement of natural gasses. In these environments **BonTerra BioLogs** act as a stable growing medium for rhizomes and bulbi plant life. **BioLogs** provide an aerated and hydrated micro-environment for a healthy growing zone. As healthy plants are established in the interior of **BioLogs**, rhizome, stolen, and other root developments enter the eco-system and naturally filter impurities and contaminants, returning a healthy balance to an otherwise stagnant environment.

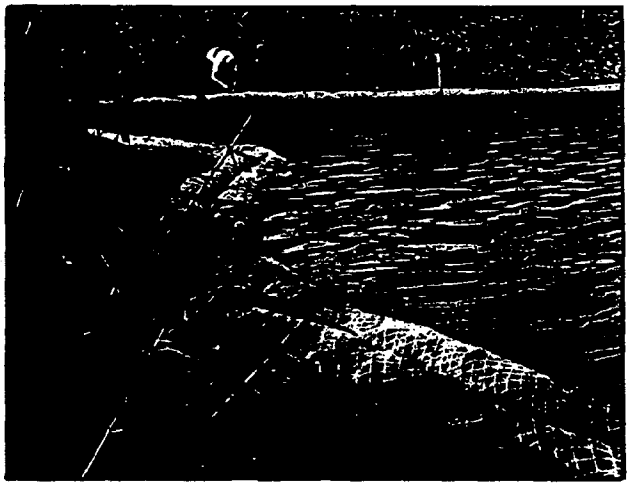


Photo courtesy of HMDC

Shoreline Armor

BonTerra® BioLogs

Effectively manage changes in stream flow velocity.
Provides channel stabalization and beautification.
Stack for moderate to steep streambanks.
Combine with rip-rap to stop wave action erosion.
Blends naturally into aquatic environments.
Secured by biodegradable Coir fiber netting for easy installation and durability.

Distributed by

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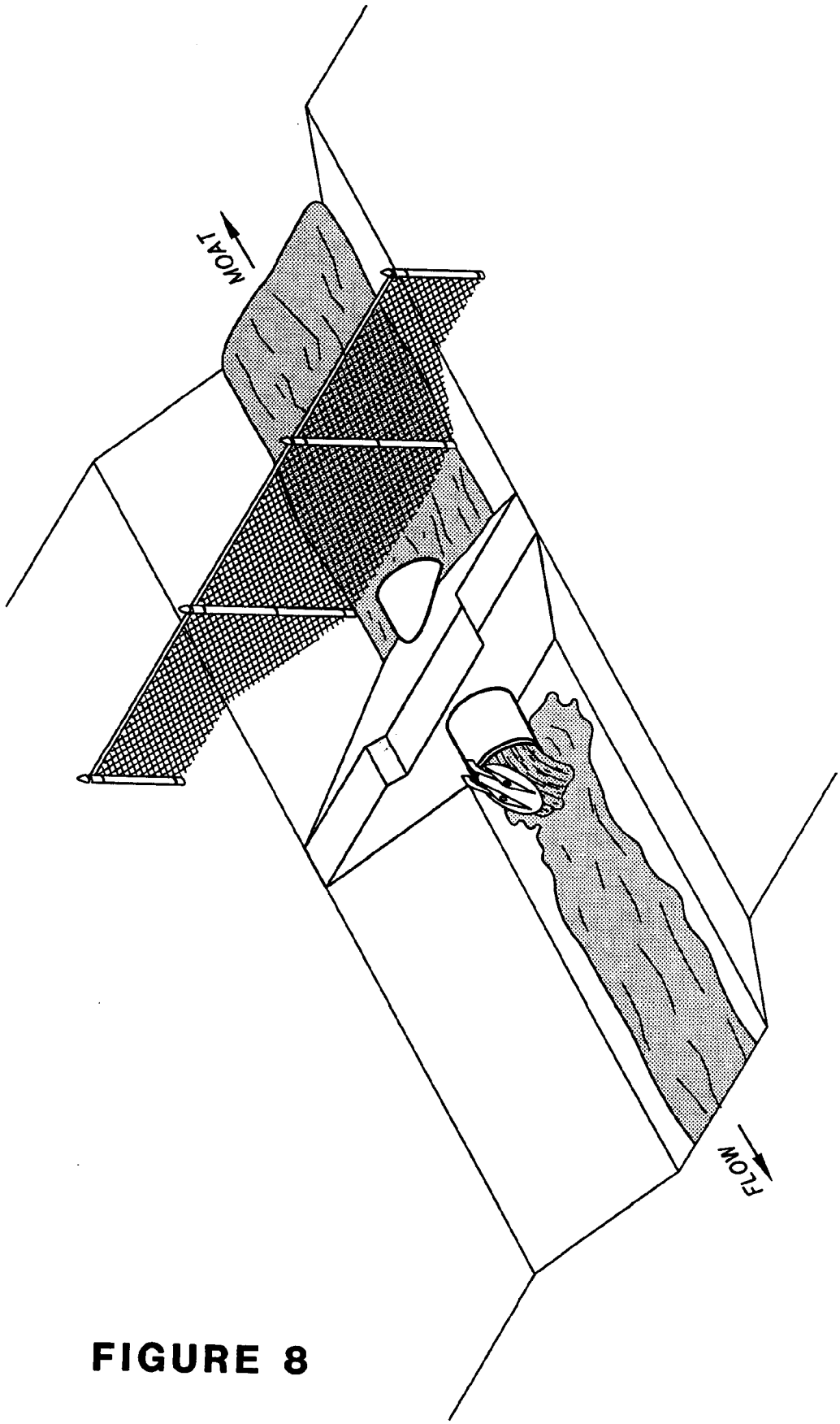

FIGURE 8

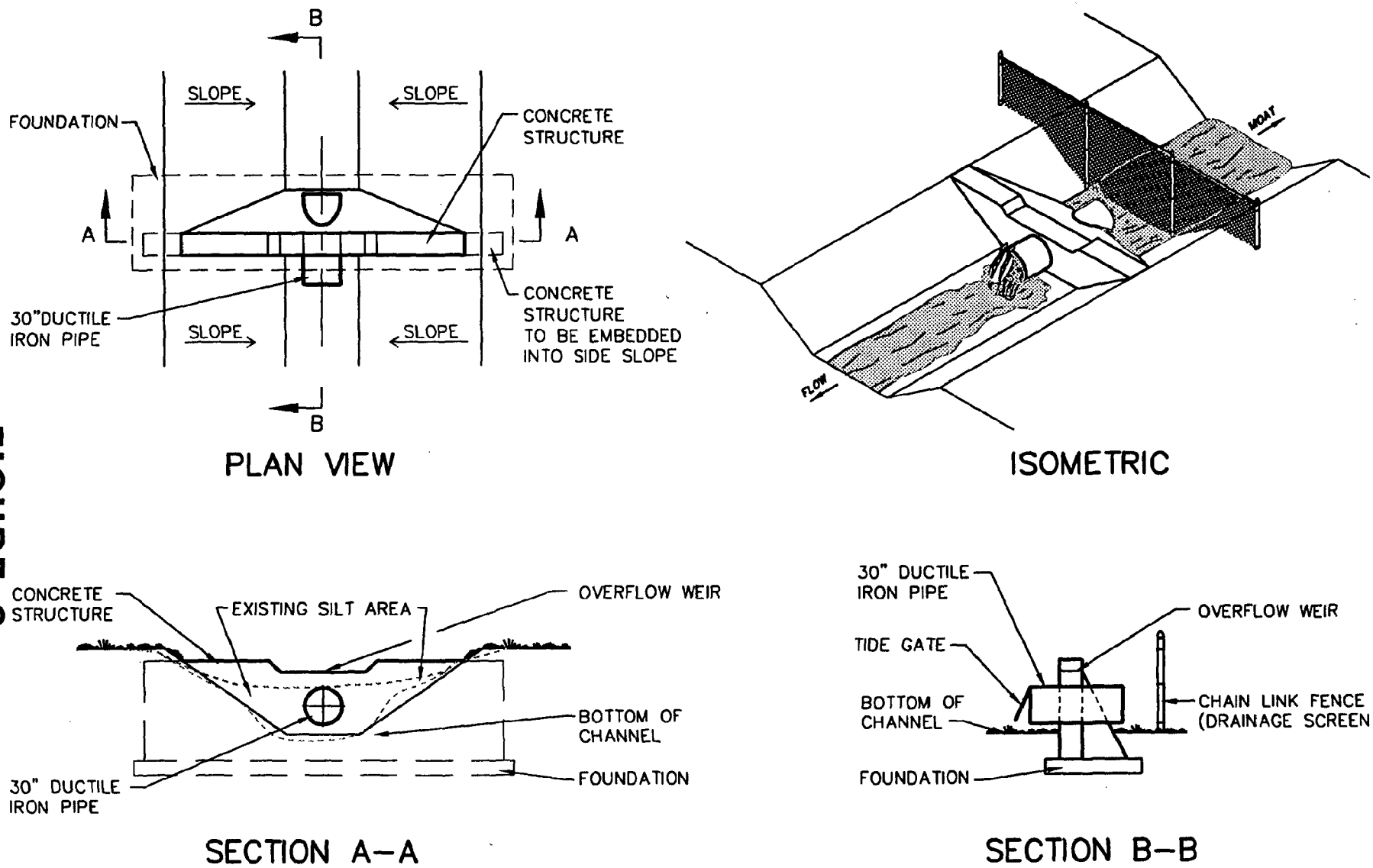

FIGURE 9

MOAT OVERFLOW DRAINAGE SYSTEM

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