385/D-283

VIRGINIUS ISLAND RUINS ASSESSMENT and STABILIZATION PLAN

HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

WILLIAMSPORT PRESERVATION TRAINING CENTER
HARPERS FERRY CENTER
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT of the INTERIOR

SEPTEMBER 1993

Color Scans
4/1/2004

United States Department of the Interior

NATIONAL PARK SERVICE

Harpers Ferry Center

IN REPLY REFER TO:

H30 (HFC-WPTC)

Williamsport Preservation Training Center
205 West Potomac Street
Williamsport, Maryland 21795

September 24, 1993

Memorandum

To: Superintendent, Harpers Ferry National Historical Park

From: Assistant Chief, Williamsport Preservation Training Center

Subject: Transmittal of DRAFT Virginius Island Ruins Assessment and Stabilization Plan

Please take some time to review the enclosed DRAFT for the Virginius Island Ruins Assessment and Stabilization Plan. An assessment of all structures, recommendations for treatment, photographs, and drawings, of extant conditions are included in the plan. Please note that the FINAL Cotton/Flour Mill Ruins Assessment and Stabilization Plan distributed and approved on June 22, 1993 shall be included in the FINAL Virginius Island Ruins Assessment and Stabilization Plan.

Coordinated review comments are due at the Williamsport Preservation Training Center by 15 October 1993.

Should you require further assistance or clarification, feel free to contact Thomas Vitanza, or Paul John Neidinger at (301) 223-7872.

Douglas Hicks

Doug Hicks

cc: all w/enclosures
R. Stevens, Regional Historical Architect, NCR
P. Dessauer, Historical Architect, HAFE
M. Joeseph, Landscape Architect, HAFE
D. Frye, Chief of Interpretation and Cultural Resources, HAFE
P. Shackel, Park Archaeologist, HAFE

DRAFT

VIRGINIUS ISLAND RUINS ASSESSMENT and STABILIZATION PLAN

Harpers Ferry National Historical Park
National Capital Region
September 24, 1993

Recommended:_____Date:
Chief, Williamsport Preservation Training Center

Concurred:_____Date:
Manager, Harpers Ferry Cente

Concurred:_____Date:
Superintendent, Harpers Ferry National Historical Park

Concurred:_____Date:
Regional Historical Architect, National Capital Region

Approved:_____Date:
Regional Director, National Capital Region

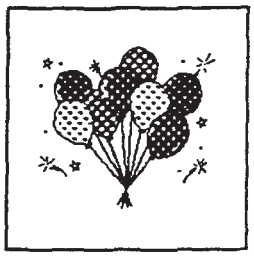
Prepared by:

Paul John Neidinger, Historical Architect
National Park Service
Williamsport Preservation Training Center
205 West Potomac Street
Williamsport, Maryland 21795

FOR YOUR INFORMATION:

PAUL

DRAFT:



Date: Thursday, October 14, 1993

MEMORANDUM

To: **HAFE:** Campbell, Frye, Fox, Joseph
NCR: Stevens, Ziegenfuss
WPTC: Hicks, Vitanza

Pkg.123 Stabilization Plan - HAFE Review

From: Peter F. Dessauer, HAFE Architect

Reference: Package 123; Virginius Island, Stabilization of Ruins; Harpers Ferry National Historical Park/NCR/NPS.

Subject: HAFE Architect Review Comments of Draft Virginius Island Ruins Assessment and Stabilization Plan, composed by Wiliamsport Preservation Training Center.

After review of the DRAFT Virginius Island Ruins Assessment and Stabilization Plan, I have the following comments which WPTC should consider for inclusion in their final publication:

A. **GENERAL COMMENTS:** Applicable for all ruins sites and stabilization campaigns.

1. **FORMAT:** Excellent Presentation, which shows so much dedication by WPTC Architects to complete a very neat and well organized report. WPTC is writing the bible for future HAFE and NCR ruins stabilization plans.

2. **CREDITS:** Be sure to mention all the team players in this extravaganza - HAFE, NCR, and WPTC. Also, give special credits to the WPTC professionals who did the field research, writing, photographs, sketches, and publication.

3. **KEY PLANS:** At the upper right hand corner of sheets, these Key Plans need highlighting. The ruins wall perimeters need darkening to stand out beyond the topographical lines. Show North Arrows.

4. **PHOTOGRAPHS:** Are sharp and clear! Thanks for including some color shots.

5. **SKETCHES:** Someone at WPTC is a good artist. They can stand up and be identified. The tone of these pen and ink sketches adds an impression of value to the historic stones. I recommend that some of these sketches be included on the Virginius Island Wayside Exhibits.

6. **TREE ROOT REMOVALS:** Recommended as necessary for many ruins, tree trunk and root removals pose a challenge for ways and means within the definite site and logistic limitations of Virginius Island. WPTC should be prepared to explain their ways and means to accomplish all work tasks they describe and recommend in this DRAFT report.

7. **ARCH AND QUOIN STONES:** As explained above for tree roots and trunks, WPTC should be prepared with options for ways and means to accomplish all heavy stone reconstruction which they recommend, per each site and logistical situation.

8. **WORK PLANS AND ESTIMATES:** These will be required from WPTC by the Park before each phase of every ruins stabilization. What is important here is the clear and convincing explanation of how the work will be done, with materials and costs included.

9. **REPAIRS BELOW GROUND:** With each stabilization phase, we must reexamine the need to make possible repairs to masonry features below existing infill levels.

10. **PAGES:** Be sure to number these.

11. **MORTAR ANALYSES REPORTS:** As needed per every Work Phase and included with each Completion Report.

12. **COMPLETION REPORTS:** Should be brief but conclusive. Should be due from WPTC to NCR and to HAFE at the completion of each stabilization phase, to describe actual work done, mortar analyses and formulas, successful means and methods, etc.

13. **GENERAL MAP OF VIRGINIUS ISLAND; RUIN SITES LOCATIONS:** This should be included at the front of the report with locations delineated for each of the principal ruins described therein.

B. SPECIFIC COMMENTS: Actually, it is difficult to critique each recommended treatment which WPTC has offered per each feature described without spending a lot of time examining each site in the same manner that WPTC has already done. Thus, there needs to be an understanding that NCR, HAFE, and WPTC will examine in the field and possibly redefine the scope of work at each ruin prior each phase of work.

1. **COTTON MILL - WEST WALL:** Misspelling "fn" at Tunnel Water Supply System at Intake North Retaining Wall.

2. **HEAD GATES - RECOMMENDED TREATMENT:**"Accross" misspelled.

3. **HERR DAM REMNANT - RECOMMENDED TREATMENT:** What is a "structures sting".

4. **HERR DAM REMNANT - EFFECT OPTION 01:** Replace the words "off of" with "from".

5. **LAKE QUIGLEY WALL - GENERAL DESCRIPTION:** Lake Quigley wall extends "westward" upstream, not "eastward".

6. **FLOUR MILL** - Recommendations described amount to large quantities of tree removal, archeological research and monitoring, multiple phases, many work plans, lots of earth removal, and consequently, a large budget. If this site is to achieve the same quality of stabilization and clearance as the other ruins, then the Flour Mill would probably require the most work per square yard of any of the proposed projects.

C. CONCLUSION: HAFE and NCR comments about corrections aside, I feel that WPTC has done a great job with this report. I recommend acceptance based on their inclusion of the comments information and final publication. When this is done, the budget and time can be totally focussed at work plans and actual construction work.

Sincerely:

Peter F. Dessauer

Peter F. Dessauer, HAFE Architect

October 7, 1993

Memorandum

To: Superintendent, Harpers Ferry National Historical Park

From: Paul Shackel
Supervisory Archeologist, Harpers Ferry National Historical Park

Subject: Review of DRAFT Virginius Island Ruins Assessment and Stabilization Plan

Thank you for the opportunity to review Williamsport Preservation Training Center's "Virginius Island Ruins Assessment and Stabilization Plan." It is an impressive document the addresses most of the park's concerns related to stabilization on Virginius Island. I have a few comments to make, although most of them are cosmetic.

1) **HISTORICAL CONTEXT**
The document probably needs some type of background history and address questions like a) why these ruins are significant? and b) why should they be stabilized? While the work is very much justified it needs to be stated.

2) **WERNWAG HOUSE**
The Wernwag House complex was not mentioned in the stabilization plan. This is an important area since one of the island's original inhabitants lived in this structure. It was later occupied by troops and eventually may have been used by one of the Flour Mill owners. Currently there are trees growing out of the ruin's foundation and the cellar in the yard may be in need of stabilization.

3) **ARCHEOLOGICAL MONITORING**
I do not see any need for archeological investigations in most of the areas noted for stabilization. Many of the areas that will be disturbed were created by flood deposits. An archeologist should be present to monitor any excavations since there is always the possibility the excavations may impact undisturbed early deposits.

4) **MAPS and ILLUSTRATIONS**
a) If author uses topographic map of Virginius Island he should reference Ravenhorst, HAFE throughout. Ravenhorst is only credited for the maps in the later part of the proposal.

b) When using topographic maps to show location of feature is would be helpful to

label the feature on the map. Those who are not familiar with the Virginius Island area will have some difficulty in locating the features. Use arrows (like the way the Shenandoah Canal Wall) or use text. Other instances:

1) in the PULP MILL RUINS section it would be helpful to label (alphabetically as in text) each wall on the topographic map that show this complex.
2) label lake Quigly Wall on the Ravenhorst map in LAKE QUIGLY WALL SECTION.
3) locate FLOUR MILL RUINS on map
4) need illustration for BOILER HOUSE RUINS
5) note Herr/Child house in DWELLING AT FLOUR MILL SECTION. Also note that this feature should be call Herr/Child House

5) In **COTTON MILL** section:
a) define SB2 base material. Is this material the same as SB02 "road base material" described in HEADGATE SECTION.

b) need to check with Cultural landscape Report for proper seed for ground cover.

COMMENTS FROM HAFE LANDSCAPE ARCHITECT
MAUREEN JOSEPH.

General:

1. Might want to use spell check for the final document. A lot of spelling errors.

Cotton Mill

General

1. No treatment was recommended for raceway inlet walls where the trail presently transverses. Should these walls be stabilized and capped? Should there be any excavation within the actual raceway inlet? (There will be a plank bridge located here for pedestrian traffic to use).

Cotton Mill : South Wall (Interior)

1. The sentence..."Through this direction of hydraulic..." is confusing. Please rewrite.

2. Vegetation: The trees are silver maples not water maples. Maybe the common name of plant should not be specified other than location, and type (tree, shrub, vine, herbaceous plants). Make these changes throughout the document.

3. Place indicator arrows on the graphic to orient the location of ruin description (used this technique for the cotton/flour mill ruin assessment).

Cotton Mill: East Wall

1. Backfilling: What is SB2 base material?

Tunnel Water Supply System

General:

1. May want to label the site plan of the tunnel water supply system as to what is what. For instance, intake arches, west vaults, east vaults, etc.

Intake North Retaining Wall:

1. Need to include title for second paragraph "Recommended treatment north retaining wall".

2. Why is there a notch where the north and south walls meet the intake arches? Was there a water control gate in this area? Should this feature be retained?

Intake South Retaining Wall:

1. How high should the south side be backfilled? Up to the top course of stone along the wall? A trail will be retained on the

south side of this wall. The trail surface will be improved using a sandy base trail surface material.

Head Gates

Micro-hydrology:

1. Rewrite sentence to read, "Local geology of the river...folded ledges of harpers shale **formed** on a northeast-southwest axis."

Head Gates South Wall and Inner Basin Wall Recommended Treatment:

1. Cannot read the schematic caption very well. The words are to close together.

Recommended Treatment Inner Basin Wall:

1. By reconstructing the blown out wall won't this prevent the water from flowing out? Within the South Wall & Inner Basin Wall Recommended Treatment, it is noted the during high water conditions the water will be allowed to breach the inner basin wall and the south wall. Won't this cause more damage to these walls by not leaving a outlet of least resistance? Should the grade along the north side of the inner basin wall be brought up? This explanation for the treatment is still unclear. May want to provide more schematic drawings of the reconstructed wall for the inner basin and south walls.

Inner Basin Area:

1. Should the grade be increased within the basin area (cover up roots of trees within basin area).

2. Should include schematic drawings of reloading of head gate arches.

Dam Remnant

General:

1. Add to sentence, " The associated head race...following 1870 flood damage **to** the dam."

Recommended Treatment:

1. Change "The structures **siting** within the river..."

Pulp Mill

General:

1. May want to indicated on site plan, the location of the walls (wall B, wall C, etc).

Freestanding Flume Wall (Wall D):

1. Change word to , "The base of this pilaster of the west...that may **have** an impact on the foundation stones ..."

Freestanding Flume Wall (Wall E):

1. Change letter to, "The latest campaign of pointing of the...all elevations of Wall E with..."

Freestanding Flume Wall (Wall F):

1. Should recommend replacing displaced stones at the door or window opening along the east end of Wall F to protect historic feature.

Boiler House

General:

1. Need to include photos of structure and site plan with this section.

2. Does the trail located above the ruins, impact the structure?

Vegetation:

1. The tree is not a water maple. Please indicate as hardwood tree.

Lake Quigley Wall

General:

1. Change to, "Lake Quigley Wall extends...**westward** (upstream)..."

Site Conditions:

1. The grade on the south side of the Lake Quigley Wall was backfilled in the 1890's to accommodate a rail spur to the Pulp Mill from the mainline of the W&P railroad. The level presently represents this use and was not created by siltation deposits.

Flour Mill

Recommended Treatment:

1. Last sentence needs to be rewritten.

Dwelling Ruins

General :

1. Need to indicate location of particular ruins for people that are not familiar with the site.

Dwelling at Flour Mill:

1. There actually are two buildings associated with this structure. To the north of the main structure is another depression that is part of this structure (See Cultural Landscape Report Virginius Island for information regarding this structure).

Shenandoah Canal Wall

General:

1. There is one other wall that is west (upstream) of the reconstructed canal walls near the Randolph Bridge. Is the wall in good shape? Should it be documented also?

CONTENTS:

1 - COTTON/FLOUR MILL (Previously distributed and approved - shall be included in FINAL of Plan)

2 - COTTON MILL RUINS

3 A- WATER INTAKE TUNNELS
3 B- HEAD GATES
3 C- SHENANDOAH DAM REMNANT

5 A- PULP MILL
5 B- BOILER HOUSE RUINS

6 - LAKE QUIGLEY WALL

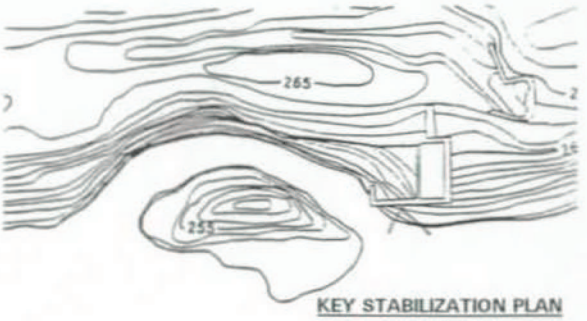
4 - FLOUR MILL RUINS

7 - DWELLING RUINS
- A - Associated with Flour Mil
- B - Dwelling - Wernwag
- C - Dwelling - Wernwag
- D - Dwelling - Wernwag
- E - Cellar Ruin - Wernwag

8 - SHENANDOAH CANAL WALL
- A - South Wall
- B - Bridge Abutment - East end of canal
- C - Section of Stone Wall - East end of canal
- D - Section of Stone Wall - East end of canal

NOTE: NUMBERING OF STRUCTURES CORRESPONDS WITH TASK DIRECTIVE of 03/22/93.
NUMBERING DOES NOT INDICATE PRIORITIZATION OF IMPORTANCE.

COTTON MILL RUINS
Harpers Ferry National Historical Park



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

COTTON MILL: SOUTH WALL (INTERIOR).

MICRO HYDROLOGY:
Severely damaged through impacts of flood water and water-borne debris the coursed rubble masonry of the south wall of the Cotton Mill has deteriorated in response to the direction of the river currents. Prevailing flood water river currents flow across the structure from the northwest to the southeast. Through this direction of hydraulic lateral live loading the south wall has lost upstream stones. The associated west, and north walls have suffered as well responding to the diagonal flow of flood water and debris. Deposition and erosion of silt levels around and in the structure exhibits where the most aggressive hydraulic action occurs. Silt deposited within the structure now serves as buttressing for the upstream west wall and river bank south wall. However, a discharge point at the base of the south wall has allowed the silt to filter out of the interior of the structure increasing the interior surface exposure of the south wall. Lateral live loads combined with aggressive currents has displaced stones from lower courses of the wall.



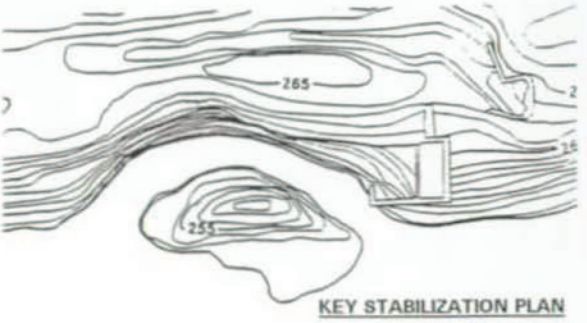
PHOTOGRAPH: COTTON MILL , VIEWING SOUTH AT THE INTERIOR OF THE SOUTH WALL , WPTC-NPS 1993.

VEGETATION:
Root action of water maples along the embankment have detrimentally impacted the foundation of the structure. Stones at the base of the south wall have been displaced, however, the roots of the trees have helped to stabilize the bank, and the trunks have served as breakwaters and partial buttressing.

MASONRY:
The coursed rubble masonry of the cotton mill was laid using Harpers phyllite set in a lime based mortar. Corners of the structure are partially squared and shaped rubble quoins. Three of the southeast quoins have been displaced - now resting at the base of the wall.

TREATMENT

Plug drainage opening at the base of the wall through resetting displaced stones.
Utilize wall fall and stones retained through the removal of the tree root system for repair of masonry replicating the associated historic masonry in type of stone, size, shape, and pattern. Newly placed mortar shall replicate the historic mortar in color, texture, and joint profile.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

COTTON MILL: SOUTH WALL (EXTERIOR)

MASONRY:
Coursed rubble masonry shaped and squared quoins have been displaced through flood water impacts. Three of the quoins now rest along the river bank placed there through the action of extant water maples aiding in damming and producing a floating log jamb that pivoted forcing the quoins off of their bedding. The high volume of water discharged the stones along the bank clearly indicating the direction of current.

VEGETATION:
Roots from existing water maples have grown beneath the foundation displacing stones at the base of the trees.

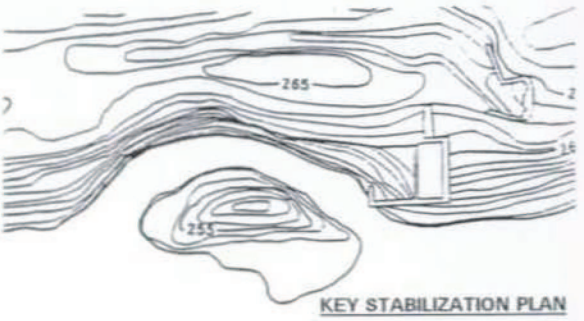
TREATMENT

VEGETATION:
Although the trees at the base of the south wall may provide a breakwater and aid in river bank stabilization - removal is recommended. The root action, detrimental placement, and the possibility of the trees to halt floating logs on top of the stone walls further damaging the structure - are all dominating factors in this case. The tree stumps should be removed along with the canopy to eliminate new growth.



PHOTOGRAPH: VIEWING WEST AT THE SOUTHEAST CORNER OF THE COTTON MILL - WPTC-NPS 1993.

MASONRY:
Reset displaced quoin stones and coursed rubble masonry of the southeast corner. Mark locations and faces for proper placement infilling secondary courses with wall fall in the immediate area.
Repair the base of the wall impacted by the root system of the tree. Utilize an approved and appropriate mortar mix matching the historic mortar in color, texture, joint profile, and level of historic craftsmanship.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

COTTON MILL: EAST WALL

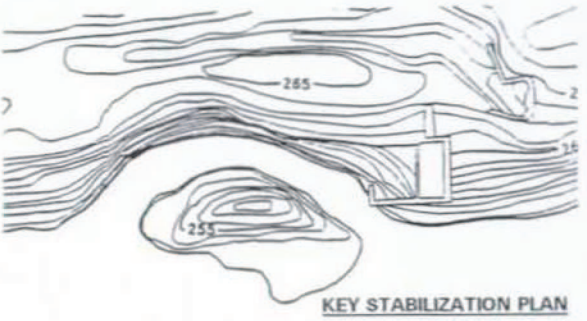
VEGETATION:
The water maple growing from the base of the south wall may have contributed to the displacement of corner quoin stones and upper coursework of the wall through acting as the pivot point for water borne debris. Floating trees and trunks, during times of high water, wrap around extant vegetation creating a lateral dead load held and aggravated by a lateral live load. This action results in the displacement of stones and failure of sections of the wall.
Root activity has impacted the east wall on the interior and exterior lower coursework.

MASONRY:
This view of the southeast corner of the cotton mill exhibits the displacement of major corner quoin stones and associated rubble stone of the field. Displaced stones of the upper courses no longer are existing as recognizable wall fall - discharged downstream beyond the immediate area of the wall.
Later campaigns of pointing utilized a portland based mortar.parged into mortar joints and left undressed.
Note the displaced stone at the base of the wall with a substantial amount of portland based mortar remaining attached to the unit. The excessively hard mortar has contributed to failure of sections of the wall through consolidating the masonry. This creates a condition where the masonry fails in sections rather than individual units.



PHOTOGRAPH: COTTON MILL: VIEWING WEST AT THE EAST FACE O
THE EAST WALL. AT INTERIOR OF THE .NPS-WPTC 1

TREATMENT:
Remove damaging water maple from the base of the south wall including root system impacting the base of the east wall.
Reset displaced corner quoin stones of the southeast corner.
Reset displaced field stones associated with the corner quoin stones to properly integrate the quions with the remaining wall.
Remove only deteriorated mortar from masonry.
Repoint with an approved and appropriate mortar mix matching the existing historic mortar in color, texture, and joint profile.
Reset displaced stones of the east wall that remain as wall fall.
Utilize an approved and appropriate bed and pointing mortar. Replicate the remaining historic mortar in color, texture, and joint profile.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

COTTON MILL: SOUTH WALL, CENTER DIVIDING WALL

VEGETATION:
Extant water maples as shown in the photograph have extensive root systems impacting the stone walls of the ruin. The water maple located left of center on the west side of the cotton mill interior dividing wall has aided in stabilizing the embankment and siltation , however the stone walls of the structure have suffered from detrimental root action.

MASONRY:
Construction detailing of the south stone wall as shown in the foreground of this photograph exhibits the placement of the stones as keyed across the wall with each course of rubble harpers phyllite.
Displaced stones of the south wall rack upward from the southwest corner of the structure to the center dividing wall. Though the south wall measures four feet in thickness with each stone weighing from 140lb/cf the aggressive actions of river currents are clear. The center dividing wall shows an impact from floating debris. This impact may have been associated with the failure of the southeast corner quoin stones.

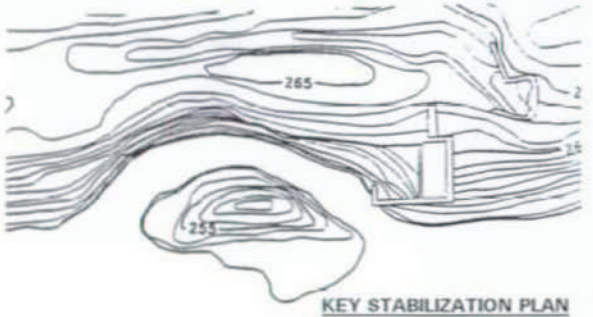
TREATMENT:
VEGETATION:
Remove water maples from the ruin as previously designated - including canopy, trunk, and root system. Retain all wallfall associated with the removal of the root systems.

MASONRY:
Reset displaced stones at the base of the wall from the areas of the tree removal.
Utilize an approved and appropriate mortar mix to set stones retrieved from wallfall in the immediate area of the structure.
Prepare mortar joints to accept new mortar through removing only deteriorated mortar - rake out organic debris and silt from cavities and joints.
Replicate historic mortar in color, texture, joint profile, and level of historic craftsmanship.
Reset stones on the top of the south wall only in areas requiring infill to create a wall cap detail that will eliminate areas where floating debris can wedge or pry top stones off of bedding.



PHOTOGRAPH: COTTON MILL, OBLIQUE, VIEWING EAST ALONG THE TOP OF THE SOUTH WALL, NPS - WPTC 1993.

Reset stones of the center dividing wall where a clear failure and impact was made by floating debris. Utilize wallfall in the immediate area of the ruin. Reset masonry replicating associated historic techniques including keying in each course across the entire width of the wall.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

COTTON MILL: NORTH WALL

MASONRY:

The north wall of the cotton mill functions as a partial retaining wall with a brick inlet arch at the eastern half. Half of the wall has been displaced through impacts from flood waters and water - borne debris. The brick inlet arch, a predominate character defining feature of this ruin, is in a condition that is close to critical. Key structural elements of the arch that are missing or damaged, including the coursed rubble spandrel, masonry units of the springline, and top center, create a condition that threatens the structural stability of the arch. Surface water run-off continues to erode the section of the arch at the meeting with grade just above the eastern springline of the arch. Flood waters impact the remaining elements of the coursed rubble masonry spandrel displacing the stones which in turn relieves the dead load on the arch.

The remaining coursed rubble masonry is in good condition. Continual failure is inevitable in areas where the masonry dead load has been relieved or where individual units no longer are integrated with the wall.



PHOTOGRAPH: COTTON MILL , VIEWING NORTH AT THE INTERIOR OF THE NORTH WALL BRICK INLET ARCH, NPS-WPTC 1993.

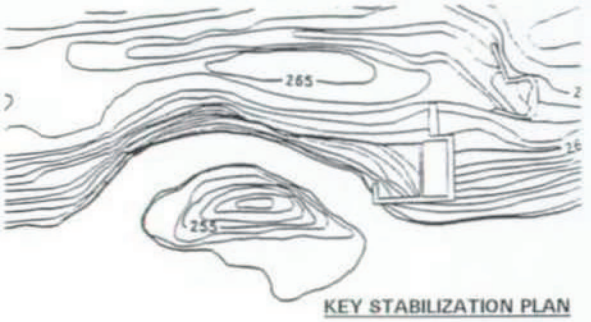
MORTAR:

Mortar used in the construction of the cotton mill is a lime based mix with a possible portion of natural cement. The clean sand derived from mortar analysis matches ,in color, the on site sand of the island. Much of the original mortar has been washed out leaving an inaccurate appearence of dry-laid , or back mortared masonry.

Later campaigns of pointing utilized a portland cement based mix placed at random in shallow depths within the wall. The mortar was not dressed following placement. Much of the mortar has spalled through freeze thaw cycles or remains in-situ consolidating the masonry aiding in sectional failure.

MICRO HYDROLOGY:

The section of the north wall with the brick inlet arch allows surface and flood waters to enter into the ruin from the north through the opening. The eastern half of the brick arch has been subject to more surface water erosion than the western half. Saturated bricks at grade pass through freeze thaw cycles damaging units and associated mortar at critical structural points of the arch. The eastern skewback has been exposed through flood and surface water erosion.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

TREATMENT
Excavate to the base of the east and west skewback stones exposing all faces of brickwork of the inlet arch. Retain all stone and brick wallfall from the excavated area.
Reset displaced masonry units replicating historic bond patterns. Utilize an appropriate and approved mortar mix for bedding and pointing of displaced masonry.

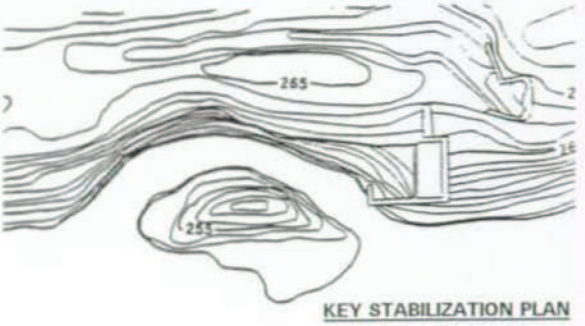
COTTON MILL: NORTH WALL (BRICK INLET ARCH)

MASONRY DETAIL:
The brick inlet arch of the north wall is subject to constant saturation and seasonal freeze thaw cycles. Saturated or frozen soil in contact with the brick units allows for wicking and subsequent deterioration of mortar. Present grade levels contribute to directing surface water into the intrados and north face of the arch. Deterioration of mortar and displacement of individual brick units is the result of this constant erosive action.
Original bedding mortar is a lime based mortar with a possible natural cement additive. Later campaigns of pointing utilized a much harder portland based mortar shown in the photograph as poorly dressed joints. Later campaigns of portland based mortar have consolidated the arch elements making the unit more suseptable to monolithic failure.



PHOTOGRAPH: COTTON MILL, MASONRY DETAIL of the EAST INTRADOS of the NORTH WALL BRICK INLET ARCH, NPS - WPTC 1993.

TREATMENT:
Selective excavation shall expose the skewback stones at the springline of the arch. Retain all masonry units and stone from the excavation for use in resetting of displaced uniits.
Prepare masonry for repointing through removing only deteriorated mortar leaving sound mortar in place. Rake out joints using hand tools removing deteriorated mortar, silt, clay, and organic debris.
Reset displaced brick in an appropriate and approved mortar mix replicating historic mortar in color, texture, joint profile, and level of historic craftsmanship.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

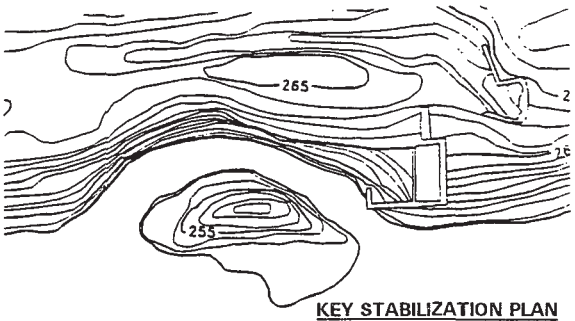


PHOTOGRAPH: COTTON MILL, PANORAMIC VIEW OF INTERIOR OF EAST WALL, NPS - WPTC 1993.

COTTON MILL: EAST WALL

MICRO-HYDROLOGY:
Impacts from floating debris and aggressive actions of flood waters are clearly shown on this wall. Note the level of siltation on the interior of the structure differing from the exterior by as much as six vertical feet. The interior of the east wall has less deposition of silt due to the direction of river currents at flood stage and normal surface water run-off. Water enters into the ruin from the north through the brick inlet arch - ponding at the base of the wall or it discharges through the opening at the bottom of the south wall. The damage to the inlet arch is directly related to the floating debris and erosion from flood and surface water currents. The coursed rubble masonry of the south wall has been severely impacted by flood water and river-borne debris. The interior silt level differs from the exterior level creating a condition where the incoming silt is contained within the walls of the ruin. The east wall serves as a partial retaining wall and an element of a catch basin. Flood waters breaching the interior dividing wall impact the upstream face of the east wall.

VEGETATION:
Extant hardwoods in view, at the base of the south wall have displaced the stones creating the drainage pattern as shown. Erosion of silt has exposed a portion of the extensive root system associated with the water maple of the south wall.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

COTTON MILL: EAST WALL

MASONRY:

Coursed rubble masonry of harpers phyllite has been laid with each course keyed across the entire 3'-10" of the wall laid in a lime based mortar with a possible natural cement additive. Later campaigns of pointing included the use of a portland based mortar that has either spalled or has remained in situ. Most of the historic mortar associated with the construction of the ruin has washed out. River-borne silt has been forced into the mortar joints in its place carrying organic matter, creating an additional task for preparation of stabilization measures (clay and silt must be raked out of joints and off of stones and extant sound mortar). Joint profiles vary with some joints raked back, others undressed, and pointing mortar being nonexistant. Twenty percent of the coursed rubble masonry has been displaced primarily along the top of the wall at the southeast corner associated with the failure of the corner quoin stones.

TREATMENT:

VEGETATION :

Remove exisitng tree root system impacting the base of the east wall.

Remove canopy, trunk, and root system of the water maple located on the south wall, and interior dividing wall.

MASONRY:

Remove only deteriorated mortar, silt, and organic debris from mortar joints in preparation for repointing. Utilize an appropriate and approved pointing mortar matching the historic mortar in color, texture, joint profile, and level of historic craftsmanship.

Reset rubble quoin stones of the southeast corner of the structure. Use the top of the quoin stone and extant masonry at the center of the wall as points to strike a level line. Selective reconstruction of the wall shall be limited to below this line. Approximate cubic feet of coursed rubble masonry to be reset on the east wall is 168 cft. of rubble harpers phyllite @ 140lb/cft = 11.76 tons.

Reset displaced stones where floating debris has impacted the wall. Utilize wallfall from the immediate area of the ruin as a source of material.

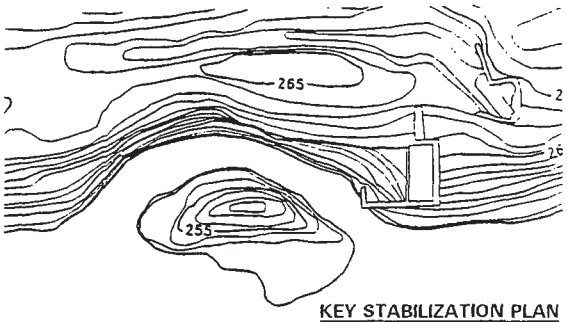
Reset stones utilizing an appropriate and approved mortar mix matching the historic mortar in color, texture, and joint profile.

Replicate coursed rubble masonry using harpers phyllite of same color, shape, dimension, and course pattern. Replicate level of historic craftsmanship, and technique placement, including setting tie stones across the full thickness of the wall and limiting galleting. Maintain historic detailing through setting stones as a full course of the 4ft wall thickness. It is not recommended to create a core within the wall with a rubble or trash infill. Extant masonry has been laid as a full course with each course tying in across the full thickness of the wall.

BACKFILLING:

Following preservation of exposed masonry the interior of the structure shall require regrading. Limited excavation to the skewback stones of the north wall brick inlet arch shall provide the base elevation from which all interior siltation shall be brought up to level. Infill areas within the structure to limit erosion at the base of the east and south walls. Backfill material shall be SB2 base material, hand compacted in six inch lifts. The final eight inches of the backfill shall be local top soil. Seed the area with indigenous herbaceous ground cover.

All stone exposed during interior grading shall be stabilized in the same manner as previously recommended.



KEY STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON MILL

HYDRAULIC FLOW across SITE of RUIN -,SCHEMATIC DIAGRAM:

Mean levels of the Shenandoah River allow the ruin to remain above water for most of the calendar year ,however, seasonal flooding may partially or totally submerse the ruin. The prevailing current of the river is towards the south bank of Virginius Island. A side channel creating a small island upstream from the cotton mill further directs a volume of water towards the now destroyed west wall of the ruin. River bank contours clearly show the areas of erosion along the bank. Further erosion in this area of the island is inevitable. However, the ruin has responded to this site condition - through the deposition of silt, and displacement of certain courses of the wall. Arresting the direction of the flow of water , presently is beyond the scope of stabilizing the ruins. A practical solution as outlined in the treatment recommendations responds to stabilizing a seasonally submersible resource in its present condition. Certain elements require structural stabilization (ie. brick inlet arch - reloading the spandrel of the arch) through limited reconstruction.

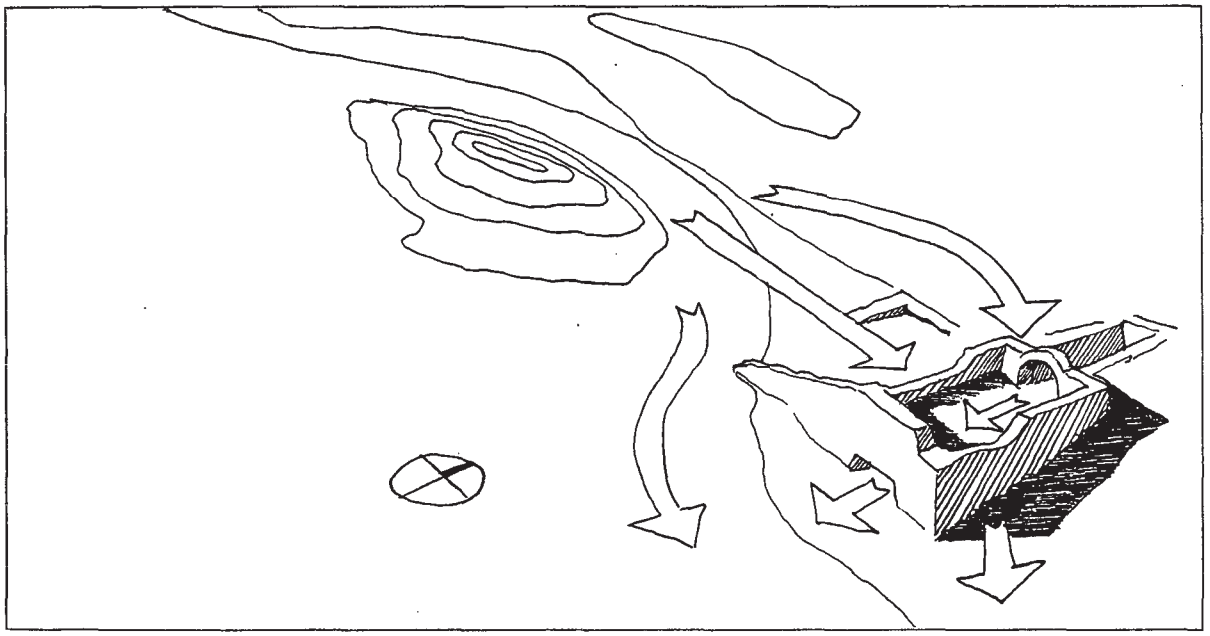
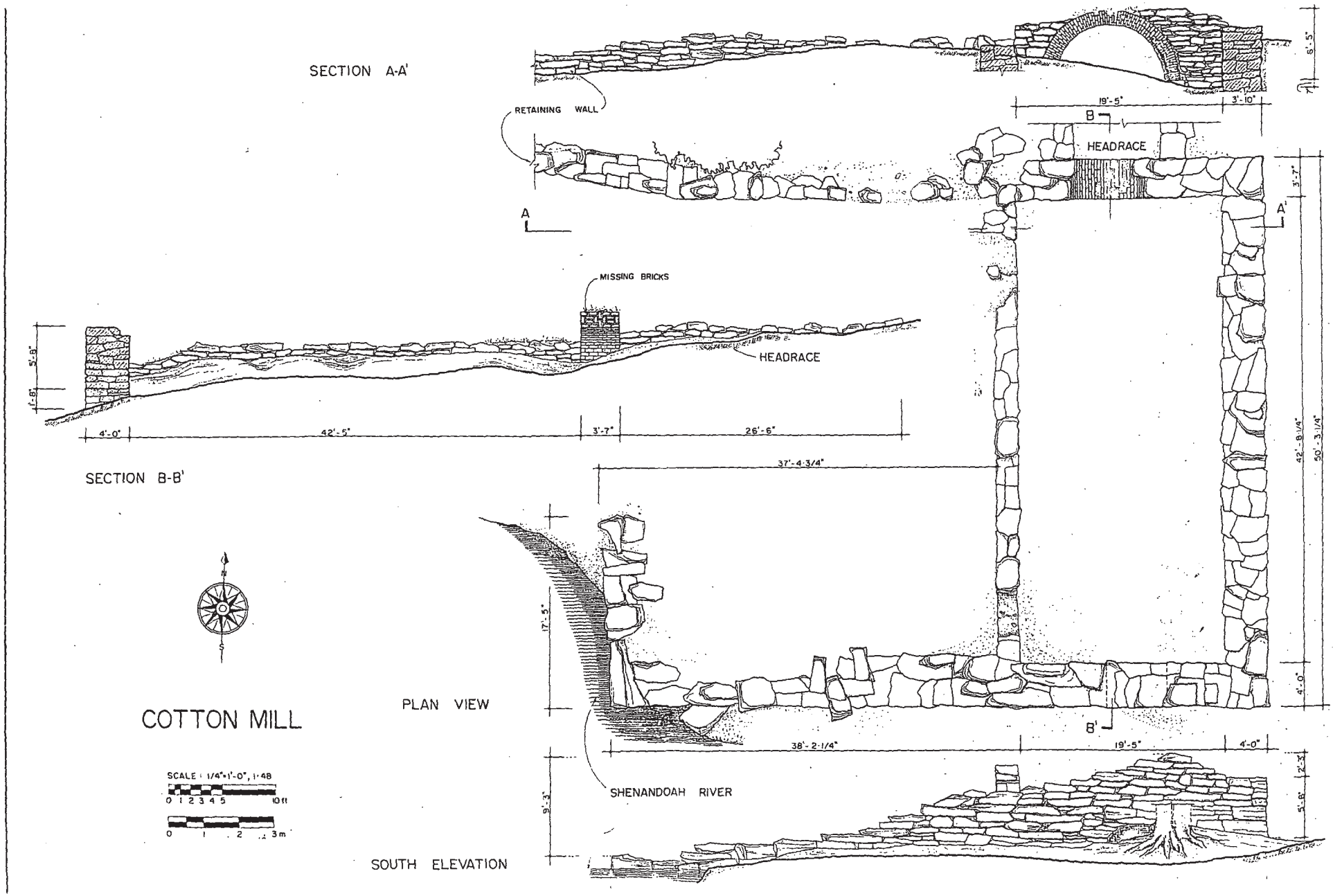


ILLUSTRATION: HYDRAULIC FLOW across SITE of COTTON MILL RUIN - SCHEMATIC DIAGRAM - NPS - WPTC 1993.


SECTION A-A'
RETAINING WALL
19'-5"
3'-10"
B
HEADRACE
A
A'
MISSING BRICKS
HEADRACE
5'-8"
1'-8"
4'-0"
42'-5"
3'-7"
26'-6"
SECTION B-B'
37'-4-3/4"
42'-8-1/4"
50'-3-1/4"
4'-0"
17'-5"
B'
38'-2-1/4"
19'-5"
4'-0"
SHENANDOAH RIVER
9'-3"
2'-3"
5'-8"
PLAN VIEW
SOUTH ELEVATION
COTTON MILL
SCALE : 1/4"=1'-0", 1:48
0 1 2 3 4 5 10ft
0 1 2 3m
THE VIRGINIA ISLAND AND WATERPOWERED MILL COUNTY
1992

WATER INTAKE TUNNELS
Harpers Ferry National Historical Park

TUNNEL WATER SUPPLY SYSTEM

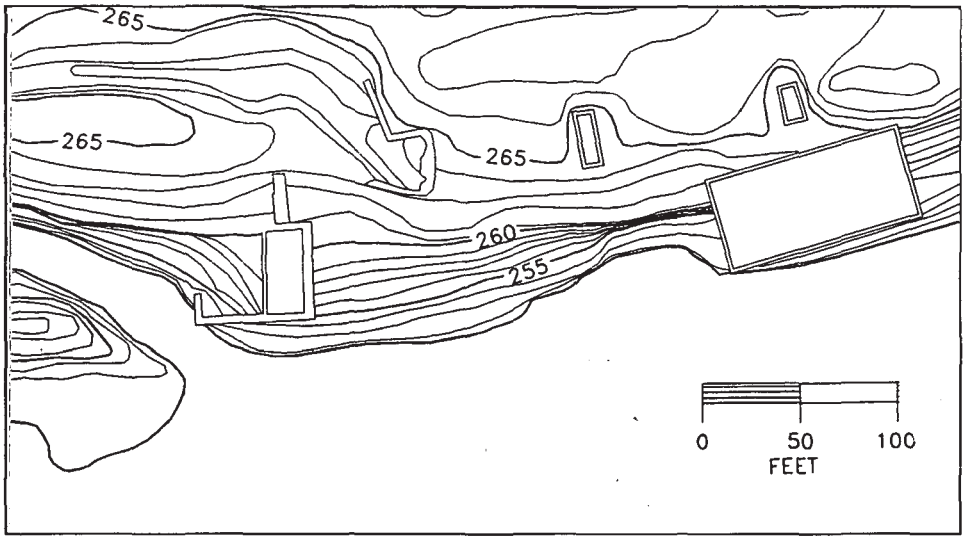
GENERAL DESCRIPTION and SITE CONDITIONS:

Elements included in the water supply system of Virginius Island associated with the Cotton/Flour Mill and the Cotton Mill are two tunnel intake arches, tunnel intake north inlet wall, tunnel intake south inlet wall, west vaults (north vault, paralleling south vault), silt basin, east vaults (north vault, paralleling south vault), silt basin associated with the Cotton/Flour Mill, and the east discharge tunnel.

discharging into the a silt basin, another set of paralling vaults, and a siltation basin associated with the Cotton/Flour Mill Ruins. The vaults with a lineal measurement of over eighty feet have been impacted by flood waters, water-borne debris, and root action from trees. Deposition from flood waters has totally silted in the discharge tunnel. The intake tunnels are partially silted in allowing surface and flood water to make the route from the intake arches to the silt basin.

The vaults parallel the Shenandoah River on the south shore of the eastern end of Virginius Island. This location is within the flood plain. The most impacted area of the vaults is at the west (upstream end) tunnel intake. Seasonal and catastrophic flood waters impact the site of the water system flowing from west to east entering through the Tunnel Intake and through the top of the Siltation Basin. The floor of the vault system is at a 260 foot elevation, while the mean river level runs 255 to 260 feet some forty to fifty feet to the south. The structures proximity to the river and constant impact of water currents and floating debris limited treatment recommendations to deal with the site as a seasonally submersible resource. Limited reconstruction of sections of the system must be implemented in order to limit further deterioration of the masonry.

Vegetation has impacted the entire length of the vaults with hardwoods growing on top of the vaults, within the spandrels of the vaults and at the silt basin openings.



SITE PLAN: TUNNEL WATER SUPPLY SYSTEM , A - TUNNEL INTAKE, B - C SILTATION BASIN from RAVENHORST NPS 1993.

TUNNEL WATER SUPPLY SYSTEM

GENERAL DESCRIPTION VAULT MASONRY:

Located upstream from the Cotton/Flour Mill and downstream from the Cotton Mill are two harpers phyllite rubble vaults at the intake opening faced with pitched faced and margined harpers phyllite ring stones integrated into the rubble masonry. This stone work was set in place at all openings of the vault system to protect the rubble vaults from impacts from floating debris.

Masonry technology used in the construction of the Tunnel Water System utilized a barrel vault of coursed rubble harpers phyllite faced at each opening with ashlar ring stones. Arches and associated barrel vaults utilized coursed rubble harpers phyllite set in a lime mortar. The rubble ring stones were shaped on the intrados or soffit face. Each were set as slabs keyed into each other eliminating concentric rings or independent arches. Soil covers the length of the vault including the spandrels of the vault.

Existing conditions of the intake arches are shown below with the failed voussoirs exposing rubble ring stone slabs. The ring stones continue to be displaced by impacts from floating debris.

Vegetation has impacted the entire length of the strucutre as indicated by the presence of healthy hardwoods above the siltation basin beyond. .



PHOTOGRAPH: WEST ELEVATION OF THE TUNNEL INTAKE, WPTC-NPS 1993.

TUNNEL WATER SUPPLY SYSTEM

NORTH ARCH.

Severly damaged by flood water born debris and errosive action of the water currents fourteen voussoirs of the arch have failed being deposited within the intake tunnel. Attributed to lateral impacts of water born debris infilling and damming the opening subsequent uplift of the bouyant river born debris applied a live load to the intrados of the arch displacing the voussoirs. The damage to the barrel vault behind the displaced voussoirs continues. The slabs of Harpers phyllite fail as the deteriorating mortar is washed away. With the failure of the arch came damage to the associated stem wall to the north. Surface water from the site drains to this area washing out the backfill of the vault and retaining wall.



PHOTOGRAPH: NORTH ARCH OF THE TUNNEL INTAKE. WPTC-NPS 1993.

SPANDRELS.

A shared spandrel of coursed rubble masonry of Harpers phyllite is placed between the north and south arches. Failure of the north arch brought down a section of the spandrel. Subsequent slumping of silt above along with loss of barrel vault stones has occurred.

TUNNEL WATER SUPPLY SYSTEM

SOUTH ARCH:
MASONRY:
Five voussoirs, including the keystone, have failed falling into the intake of the tunnel. The coursed rubble masonry of the barrel vault presently retains the extant voussoirs. Voussoirs are squared and shaped with a bush hammered intrados finish.

RECOMMENDED TREATMENT
SOUTH ARCH
SHORING and FORMWORK

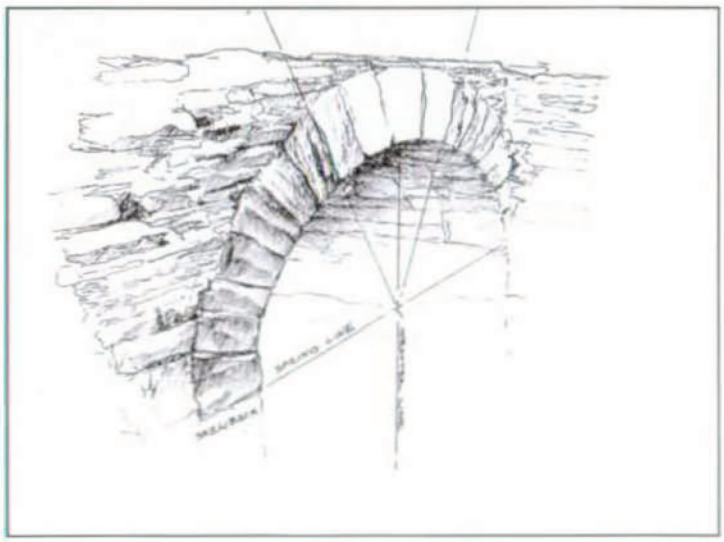


PHOTOGRAPH: VIEWING SOUTH AT THE SOUTH ARCH, WPTC-NPS 1993.

Shoring for the temporary stabilization of extant ring stones of the south arch must be implemented in a manner that will not contribute to the failure of existing ring stones. The ring stones remaining in place on the south skewback must receive shoring that does not create individual upward point loads on the intrados of the arch.
Forms of center shall be used to reset individual arches. Each form shall be designed and constructed to carry the combined dead load of the in situ ring stones and the impact of incremental placement of the retrieved rings stones. Forms of center shall be constructed with new material utilizing timbers that shall carry the combined dead load of extant in situ ring stones and the newly placed ring stones. All elements of the Form of Center including bearers, bearing strips, inclined braces, tie pieces, bearing plates, and fox wedges, shall be of an approved and appropriate dimension to insure the safety of the implementation of the work.

KEYING - IN RING STONES
The pitched faced and margined ring stones that shall be reset must replicate historic detailing keying into the rubble masonry of the vault. A portion of the vault rubble masonry shall be relaid as the ring stones are reset. Each ring stone must key into the rubble masonry vault. Utilize an appropriate and approved mortar mix in the setting of the stones.

SPANDREL and COPING
Upon displacement of the ring stones a section of the spandrel failed. The spandrel and coourse work above the arch must be reset to eliminate erosion of mortar on top of the arch.



CONSTRUCTION DETAIL: RECOMMENDED PLACEMENT OF RING STONES, SOUTH ARCH, WPTC-NPS 1993.

TUNNEL WATER SUPPLY SYSTEM

RECOMMENDED TREATMENT
NORTH ARCH.

Stabilize the barrel vault from further hydraulic impacts through reconstructing the failed arch. Through careful reinforced excavation locate the failed voussoirs, keystone, skewbacks, and vault ring stones. Record and number the placement of the stones in the wallfall to determine placement in resetting of stones.

Field shoring should evenly support the extant arch elements and barrel vault eliminating the possibility of further wallfall. Wood shoring shall not be left in-situ during periods of high water.

Layout voussoirs and rubble vault ring stones prior to implementation taking note of size, shape, face, and placement.

The north arch ring stones must be excavated and inventoried. Rubble masonry within the wallfall shall be retrieved and retained for use in keying in the pitched-faced ring stones. Backfill in the intake area of the arch must be removed in order to access the skewback stones, and the base stones of the north wing wall.



PHOTOGRAPH: TUNNEL INTAKE, VIRGINIUS ISLAND, VIEWING EAST AT THE NORTH ARCH, NPS -WPTC 1993.

TUNNEL WATER SUPPLY SYSTEM

INTAKE NORTH RETAINING WALL

Approximately six feet in height the coursed rubble masonry of Harpers phyllite utilizes large shaped stones up to three feet in length and six inches in height that are racked back into the upstream face of the skewback of the north arch functioning to buttress the barrel vault. These stones were layed after the construction of the north arch. A possible intake on the west face of the west wall fn associated sawmill may be below the soil line. There is a clear separation in the masonry from the face of the arch. From this point the wall runs west approximately fourteen feet before turning to the north where it diminishes. Wallfall has occurred from flood water born debris, errosive action of water currents on the deteriorating mortar, surface water runoff, and root action from a nearby hardwood.

The north wall requires stabilization prior to the resetting of the ring stones of the north arch. This section of rubble masonry abutts the north arch north skewback stone. Lower courses of masonry below the displaced skewback must be stabilized prior to addressing the arch.

Excavation associated with the retrieval of the ring stones may involve exposure of lower courses of the wall. These lower courses shall be stabilized through resetting displaced stones.



PHTOGRAPH: NORTH RETAINING WALL OF THE INTAKE , WPTC-NPS 1993.

TUNNEL WATER SUPPLY SYSTEM

INTAKE SOUTH RETAINING WALL

Coursed rubble masonry wall of Harpers phyllite extends west from the south arch south skewback stone 30 lf . Deposition of silt has created a slope of earth against the north face of the wall. Flood water river currents pass over this wall displacing rubble cap stones. The prevailing flood water current flows north northeast concentrating water born debris impacts and scouring action at the failed north arch.

South retaining wall of the intake tunnel is periodically breached by flood waters from the south. Silt has been deposited against the north elevation of the wall concealing the wall. Top courses of the wall have been displaced by flood waters flowing accross the coping of the wall. Later campaigns of pointing and setting of stones on the top of the wall utilized a high portland based mortar. Incremental failure or displacement was transformed to monolythic failure.

RECOMMENDED TREATMENT SOUTH RETAINING WALL

Displaced coping stones of the south retaining wall shall be reset utilizing wallfall from the immediate area of the wall and an approved and appropriate mortar mix. The stones shall be relayed keying each stone accross the full width of the wall. Backfill on the south face of the stone wall to prevent further surface water erosion. This area of the wall will be subject to further displacement of stone due to localized hydraulic action during times of flooding.



PHOTOGRAPH: SOUTH RETAINING WALL OF THE INTAKE, WPTC-NPS 1993.

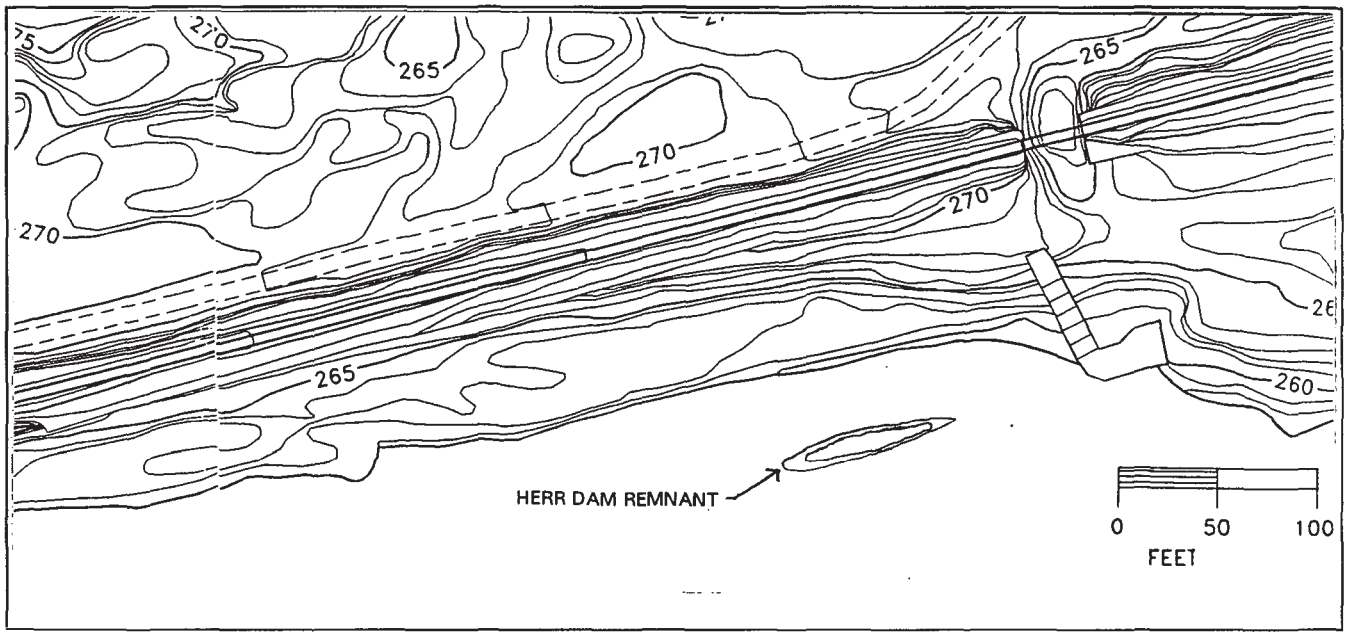
HEAD GATES
Harpers Ferry National Historical Park

HEAD GATES

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

GENERAL DESCRIPTION:

The Headgates of the water power system on Virginius Island are sited on the south bank of the island, upstream from the Cotton Mill. Once located at the downstream end of the now destroyed Herr Dam, the Headgates served as the entrance into the water power system of Virginius Island. Hydraulic impacts from water erosion and water-borne debris have severely damaged the structure leaving stone butresses bridged by three brick arches. Rubble and coursed rubble harpers phyllite with sections of dry laid and mortared in place stones remain in place creating the buttress. The brick arches remain in tact through past stabilization measures, however, the rubble spandrel stones have been displaced. The south section of the structure has been breached by flood waters severely damaging the interior and exterior dry laid walls.



SITE PLAN: HEADGATES of the WATER POWER SYSTEM, WPTC-NPS 1993.

MICRO-HYDROLOGY:

Initial placement of the Headgates of the Virginius Island water power system took advantage of the natural flow of the river and the local geology of the river bottom. The direction of current during mean river levels follows a pattern that draws water from the south bank of the Shenandoah north and down stream towards the south bank of Virginius Island. Local geology of the river bottom upstream from the headgates has folded ledges of harpers shale placed on a northeast-southwest axis. There is a set of rapids within the river upstream from the island sometimes referred to as the staircase that indicates the drop in elevation of the river increasing the speed of the river water in this area.

The headgates of the Virginius Island water power system as sited are seasonally submersible resources. Future hydraulic impacts to the structure are unavoidable. Catastrophic destruction of the structure is possible through impacts from water-borne debris during times of flooding.

Flood waters flow across the site from west to the east entering through the gate arches and discharging through a breach in the south wall of the structure. This pattern results from the silting in of the inner basin that once was located east of the headgates. The southwest corner of the structure remains as sited within the river. This corner is subject to constant erosion from hydraulic action and is suseptible to impacts from water-borne debris..

HEAD GATES

HEADGATE SOUTH WALL

MASONRY

South retaining wall of the Headgate is placed along the south bank of Virginius Island on the Shenandoah River. Constructed of rubble and coursed rubble harpers phyllite, the south wall integrates with the west wall through a gentle arc. The east end of the wall keys into the bank of the river. There is a failure to the east section of the south wall. This section of the wall has been displaced through the impacts of flood waters. Hydraulic lateral live loads from the north elevation of the south wall have displaced stones of the south wall dispersing them into the river. These displaced stones are no longer in close proximity to the south wall, however, bedding stones remain in place.

Agressive water currents flow across the south elevation of the south retaining wall eroding away much of the original placement mortar. Incremental displacement of stones along the top of the wall has deterred monolyhtic failure of the south wall. Backfill on the north side of the wall consists of sand and rubble which has been impacted by flood waters that breach the wall from the west end of the structure.
The failure of the associated inner basin wall permitted flood waters to act upon the north face of the south wall. Erosion of protective backfill exposed the north face of the south wall to lateral live loads. The flood waters followed the natural slope of the south bank of the island displacing a section of the inner basin wall, backfill, and a section of the south wall.

MORTAR:

Historic placement and bedding mortar has been washed out by hydraulic action. A later campaign of portland cement based pointing mortar was placed and not tooled. A portland cement parging has been left in-situ along twelve lineal feet of the western end of the wall.
Mortar is nonexistant on the eastern half of the wall. This section appears as dry laid or extant mortar in joints appear to be cut back deep within the wall.

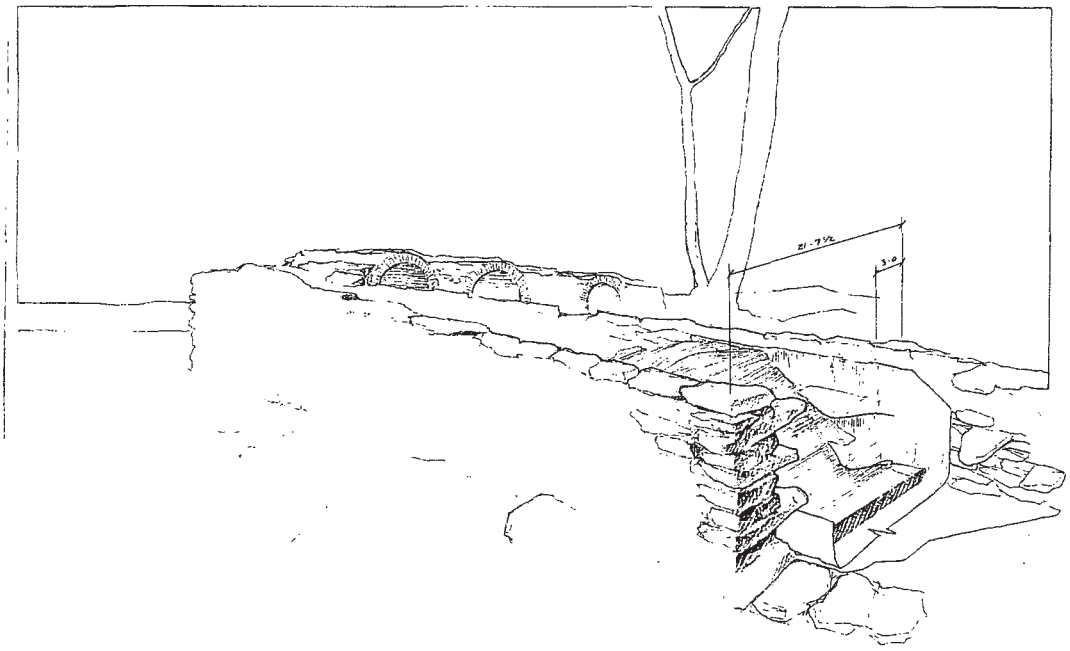


PHOTOGRAPH: SOUTH WALL OF THE HEADGATES, WPTC-NPS 1993.

HEAD GATES

HEAD GATES SOUTH WALL and INNER BASIN WALL
RECOMMENDED TREATMENT:
Stabilization of the south wall shall be accomplished through the reconstruction of the east end of the inner basin wall, the placement of the backfill, and the reconstruction of the east end of the south wall. Displaced stones of the inner basin wall shall be relaid utilizing harpers phyllite rubble. Replacement stone shall replicate associated extant stone in type of stone, shape, general dimension, tool marks, and color. Recommended methodology of placement shall integrate the inner basin wall with the backfill.

Reconstructed sections of the inner basin rubble wall and the south rubble wall shall replicate historic masonry techniques with alterations that allow for placement of stiles or tie-back stones into the backfill. Extant backfill shall remain in-situ on the section of the wall that has not failed. Additional backfill shall be of compacted SB-02 (roadbase material) or similiar approved backfill. Compacting the backfill as the rubble walls are constructed shall tie the new construction in with the backfill.
The site grade conditions must be improved as well through the placement of a protected fill or surcharge on the north face of the inner basin wall. Flood waters entering through the headgates would be allowed to breach over the inner basin wall and the south wall of the structure. The backfill on both faces of the inner basin wall shall bury a section of the resource, however, this will lessen the agressive impacts from flood waters.



SCHEMATIC: RECOMMENDED TREATMENT FOR STABILIZATION OF EXTANT HEADRACE RUINS, WPTC-NPS 1993.

This method of placement shall allow for incremental failure with less loss of historic fabric and new construction as the structure becomes submerged.
Displaced units along the top of the wall should be reset to provide a new coping.

HEAD GATES

RECOMMENDED TREATMENT (cont'd) :

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry).

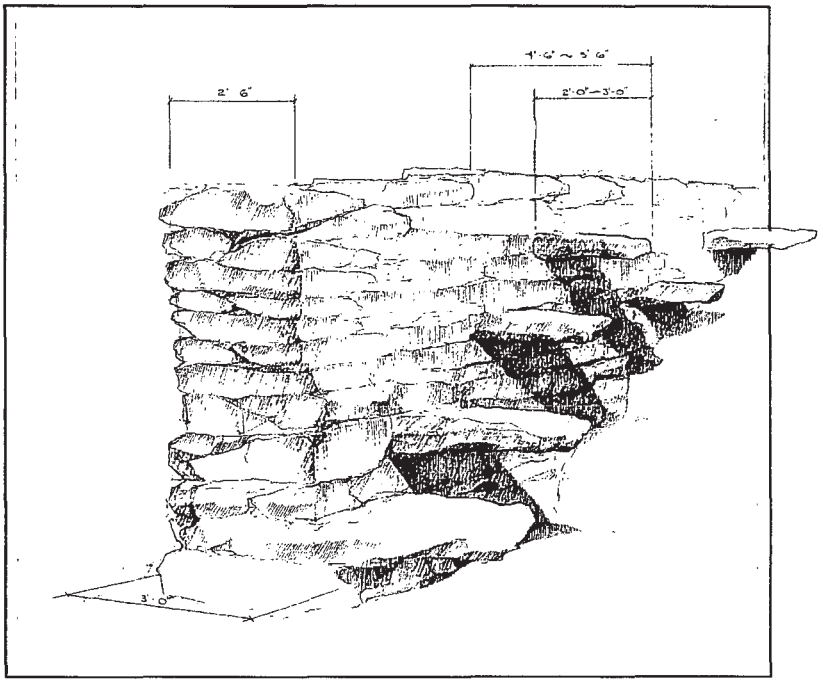
Level base foundation stones prior to implementation of the relaying of the stone wall.

Foundation stones shall be large enough to lay accross entire width of the wall eliminating the potential for wash-out or displacement.

Lay stones replicating associated historic masonry in color, dimension, size, shape, form, and pattern.

Place dry layed masonry so that the new section of wall is level gradually integrating new course work into extant masonry.

All stones shall be keyed on each course the entire width of the wall eliminating technique of rubble infill. Tie the south and inner basin face of the wall in this manner.



SCHEMATIC: RECOMMENDED RECONSTRUCTION DETAIL FOR INNER BASIN AND SOUTH WALLS, WPTC-NPS 1993.

Place stile stones accross the full section of the wall extending in length from the south face of the inner basin wall two to three feet in preparation for the placement of SB - 2 road base material serving as backfill.

REFERENCE: RECOMMENDED CONSTRUCTION DETAIL

Section through wall shows placement of stile stones extending out of the south face of the inner basin wall prior backfilling. This placement of the stone in combination with the backfill material of SB - 2 shall stabilize the newly placed section of the wall in the event of submersion. or erosive action washing away backfill material.

HEAD GATES

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

INNER BASIN WALL
MASONRY:
The associated inner basin wall serves to direct water after entrance through the headgate. Presently a section of the wall has failed in response to the local flood water hydrology. The wall relies on the soil pressure on the south face to buttress against incoming water, however, during flood stage the erosive action of the water attacks both sides of the wall washing away back fill relieving soil pressure on the south face and applying a simultaneous lateral live load to the north face. Displaced units of the failed wall section have washed out of the immediate area. During lower water levels of the river point of deposition of the wallfall may be determined.
Stones of the coping of the wall have been displaced. The lower courses downstream from the bow of the wall have lost some integrity through displacement of stones that are remaining in-situ. The courses are no longer level. Stones remaining on their bedding have shifted in place responding to impacts from lateral live loads and the root action at the base of the wall.

VEGETATION:
The base of the wall has been impacted by root action of associated trees. An uplift of bed stones of the inner basin wall has aided in disrupting the level coursed rubble masonry.

MORTAR:
Historic placement mortar of the inner basin wall has washed out through erosive action leaving a dry laid appearence. Later campaigns of pointing utilizing a portland cement based mortar fully pointed the inside wall of the arch and continued eastward partially pointing the inner basin wall.



PHOTOGRAPH: VIEWING SOUTHWEST AT THE INNER BASIN WALL, HEADGATE, WPTC-NPS 1993

RECOMMENDED TREATMENT INNER BASIN WALL:

Recommended treatment including construction details are referenced under the south wall treatment recommendations.

Reconstruction of the blown-out section of the wall must be implemented in a manner that reduces the possibility of displacement of the wall resulting from impacts from water-borne debris.

Reconstructed sections of the inner basin rubble wall shall replicate historic masonry techniques with alterations that allow for placement of stiles or tie-back stones into the backfill. Extant backfill shall remain in-situ on the section of the wall that has not failed. Additional backfill shall be of compacted SB-02 (roadbase material) or similiar approved backfill. Compacting the backfill as the rubble walls are constructed shall tie the new construction in with the backfill.

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to adepth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry).



PHOTOGRAPH: NORTH FACE OF INNER BASIN WALL, WPTC-NPS 1993

Note the placement of portland based mortar on the upper section of the wall. This mortar shall remain in-situ. Pointing mortar placed in the joints of the wall shall be held back, raked deeply into the joint to maintain the dry laid appearence of the wall. Newly placed mortar shall not replicate extant portland based mortar joints.



PHOTOGRAPH: NORTH FACE OF INNER BASIN WALL, WPTC-NPS 1993.

Note condition of the masonry as being displaced from impacts from water - borne debris, wash out of placement mortar, and root systems at the base of the wall.

The east end of the wall shows where the section of the inner basin wall failed.

HEAD GATES

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

WEST WALL of the HEADGATES:

MASONRY:

Three inlet arches of the west wall functioned as inlets to the inner basin of the water power system on Virginius Island. The arches are separated by buttressing walls constructed of harpers phyllite rubble with a rubble core. Arches are constructed of solid brick placed and pointed with a portland cement based mortar. The north arch appears to have been reconstructed on the west end. The arch has been flattened and displaced somewhat pointed in place with a portland cement based mortar.

Stone has been displaced from the top of the arches relieving the dead load once carried by these three elements. Through this displacement and subsequent consolidation of the masonry with portland cement based mortar the arches are vulnerable. Catastrophic failure of these elements may occur through impacts from floating debris. The submerged or partially submerged arches during times of flooding may retain floating debris that may create stresses and forces on the underside of the arches. A force on the intrados of the brick arch may cause failure and total loss of historic fabric.

MORTAR:

Historic mortar utilized in the pointing of the arches and buttresses of the west wall has been washed out and replaced with a portland cement based mortar. Implementation of the latest campaign of pointing left mortar joints undressed. This parged appearence was left on the top of the arches as a waterproofing measure. Water infiltrates through cracks in the masonry where the portland cement based mortar has shrunk. Subsequent saturation of bricks and mortar joints combined with freeze-thaw cycles has damaged some of the masonry. The arch elements function monolyhtically while going through temperature changes. Cracks in the masonry have appeared as a result of this cycle.



PHOTOGRAPH: WEST ELEVATION OF THE HEADGATES, WPTC-NPS 1993.

HEAD GATES

INNER BASIN AREA
MASONRY:
The east elevation of the west wall exhibits the distribution of the siltation levels on the downstream side of the structure. The north end of the west wall has become integrated with the south bank of Virginius Island. The silt level is kept in place through the aid of hardwood vegetation. Much of the stone that once was set as a dead load on the arches has been displaced through hydraulic impacts. The top of the brick arches have become exposed with only the portland cement based parging remaining to hold the structural element in-situ. Spandrel stones remain in place creating a dead load on the arch, however, lateral live loads and impacts from floating debris against such a small section may result in monolithic failure.

RECOMMENDED TREATMENT:
MASONRY:
The west wall of the Headgates is the most vulnerable element of any of the structures on the island. Originally designed to function as an element of the Herr Dam the slower current against the structure was not as critical as contemporary conditions. Faster more aggressive currents impacting the upstream face of the west wall. These impacts are inevitable and unavoidable.



PHOTOGRAPH: VIEWING WEST AT EAST FACE OF HEADGATES, WPTC-NPS 1993.

Reset displaced stones on top of the brick arches to create a heavier mass against water-borne debris and hydraulic erosion.The stones shall be set in a manner to brace the arches against catastrophic failure and permit incremental failure of the stones.
Increase the wall height by one to two feet on top of the brick arches the full length of the structure. Stone placement shall corbel from the area directly above the skewback of the arches to above the center of the arch. This method of placement allows for distributed loading on the arches without concentrating weight at the center of the arches. Each course shall be keyed into one another during placement integrating an addition to the extant stone spandrel and coping.
Replacement stone shall replicate extant harpers phyllite in type, design, dimension, color, texture, and methodology of placement.

MORTAR:
Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry).

HEAD GATES

RECOMMENDED TREATMENT:
VEGETATION:
Remove extant root systems impacting the base of the wall.
Retain hardwoods upstream from the structure to provide stabilization of the river bank and allow for buttressing against floating debris.
Retain trees within the inner basin to provide bank stabilization controlling erosion.



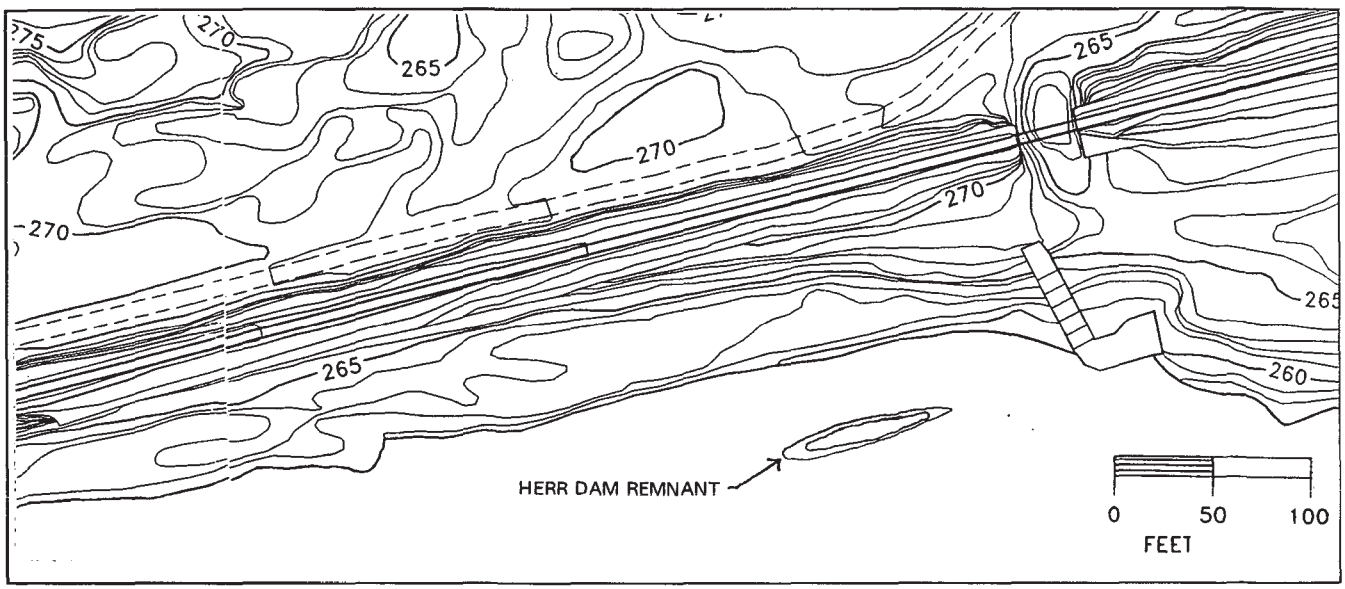
PHOTOGRAPH: VIEWING SOUTH AT THE INNER BASIN WALL, WPTC-NPS 1993.

SHENANDOAH / HERR DAM REMNANT
Harpers Ferry National Historical Park

HERR DAM REMNANT

SHENANDOAH MANUFACTURING COMPANY / HERR DAM REMNANT

GENERAL DESCRIPTION:
The Shenandoah Manufacturing Company built a rubble masonry dam across the Shenandoah river (ca 1850). Following the flood of 1870 the firm of Child and McCreight rebuilt the Cotton Mill waterworks including rehabilitation of the dam so that the structure was 400 feet long and four feet high. This company maintained the structure from 1870 to 1889. The associated head race that was more than 600 feet long was cleaned out and repaired following 1870 flood damaged the dam. The flood of 1889 inflicted extensive damage on the dam and headrace causing closing of the Cotton Mill. Originally the structure swept out from the head gate north against the current before arcing south crossing the river taking the current abreast. This diversionary structure was rebuilt and replaced many times throughout its history. Existing remnants of the dam has been limited to a water-bound eighty lineal foot rubble masonry wall.



SITE PLAN: HERR DAM REMNANT, WPTC-NPS 1993.

MICROHYDROLOGY:
Placed upstream from the head gate of the Virginius Island water power system the Herr Dam remnant remains within the river as a seasonally submersible resource. A length of stone wall not more than eighty feet in length the dam remnant parallels the south bank of Virginius Island. River currents impact the upstream west end of the wall flowing over the entire length of the wall during high water. Lateral impacts from floating debris

HERR DAM REMNANT

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

VEGETATION

Constantly impacted by flood waters and erosive action of the mean river levels the structure remains in place through the assistance of extant vegetation. The tree root systems have become integrated with the masonry of the dam.

The tree root system has a dual impact on the structure. Root systems aid in retaining the stones, however, displacement from the original bedding is possible and inevitable through impacts of water-borne debris. The canopies and trunks of the trees take lateral loads from hydraulic action and floating debris during times of high water.



PHOTOGRAPH: VIEWING SOUTH
(DOWNSTREAM) AT THE WEST END OF THE STRUCTURE,
WPTC-NPS 1993.

MASONRY:

Extant remains of the structure exhibit a masonry construction technique utilizing harpers phyllite placed as vertical slabs. Each stone rests against subsequently placed stones keyed in a domino pattern eliminating possible displacement through hydraulic action uplifting stones off of their bedding.

RECOMMENDED TREATMENT:

Impacts from floating debris and hydraulic erosion are inevitable.

The structures sting within the river limits the possible recommendations for stabilization of the structure.



PHOTOGRAPH: NORTH ELEVATION OF THE WEST END OF THE HERR DAM REMNANT, WPTC-NPS 1993.

OPTION 01

Leave extant vegetation in-situ relying on the root systems of the trees to retain the stones in-situ.

EFFECT of OPTION 01

Unmanaged growth of the tree root systems will detrimentally impact the masonry in-situ. Displacement of stones off of original bedding will occur as wave action and lateral live loads impact the tree trunk and canopy during submersion of the structure. Root systems may displace stones as the individual branches increase in size with growth.

Catastrophic failure is possible through the impacts of floating debris during high flood waters. Total loss of the structure may be possible.

HERR DAM REMNANT

OPTION 02
Remove extant vegetation root systems, trunks, and canopy.
Reset displaced masonry resulting from the removal of root systems.
Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry).
EFFECT of OPTION 02
Removing existing vegetation will expose extant masonry to further hydraulic impacts including floating debris and erosion.
Once exposed the stones must be anchored in place in order to take the hydraulic impacts. Replicating historic masonry techniques while implementing preservation measures will help to maintain the structure, however, these techniques relied upon the structure being much larger than what is in-situ. Placement of the extant masonry was not designed to take the impacts now occurring.
Further anchoring of the stones shall be required in order to maintain the element of the dam in place. The upstream and downstream ends of the dam shall require placement of additional stone. Additional stones must be placed, not dumped, to become an integral part of the wall.
Catastrophic failure and total loss of the structure may result through the impact of lateral live loads. Incremental displacement and failure of sections of the wall will continue after implementation of stabilization measures.

RECOMMENDED TREATMENT:
Maintain the resource through leaving the vegetation in situ.
Periodically remove log jambs and deposited floating debris from the structure to eliminate further strain on the tree roots ion-situ and masonry of the structure.

SHENANDOAH PULP COMPANY MILL RUINS
Harpers Ferry National Historical Park

PULP MILL RUINS

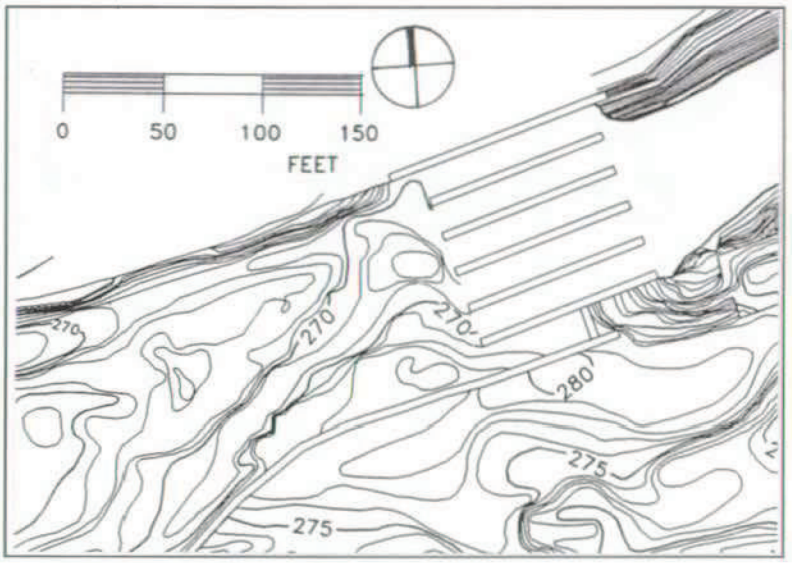
GENERAL DESCRIPTION:

The ruins of the Shenandoah Pulp Company (ca.1887-1890) are located on the site of the lower locks of the old Shenandoah Canal (ca. 1832). Largest of the ruins on Virginius Island the Shenandoah Pulp Company Mill ruins now bridge the location of the old Shenandoah canal locks connecting the north bank of Virginius Island with the mainland. Six flumes now exist with five independent rubble masonry walls each with a length of 93'-8" and a thickness of 3'-9" placed on an east- west axis. The heights of the walls vary from approximately twenty to thirty feet depending upon the base of the flume which drops approximately fifteen feet to the bottom of the canal. The north wall of the pulp mill foundation serves as the retaining wall for the north bank of the canal pond. The south wall is integrated with the Lake Quigley wall retaining a section of the north bank of Virginius Island.

The predominant building material used in the construction of the Pulp Mill foundation is harpers phyllite. Later additions to the foundation wall incorporated the use of molded and regular shaped brick.

Rubble masonry with a placed rubble core makes up the wall section of the freestanding foundation walls of the Pulp Mill. Additional masonry techniques used in the construction of the freestanding foundation walls incorporated large salvage stones for quoining, tie - backs, and flat slabs of stone for points of bearing (plinths) for the now nonexistent superstructure. These plinths were constructed to carry the wide flange steel sill beam of the mill superstructure. Typical features on all the foundation walls include the plinth, and two arc pilasters. These arc pilasters were constructed to accept the plate iron vertical flume gate.

Salvaged stones came from the earlier lock system of the Shenandoah Canal. These salvaged stones were included in the construction of the foundation of the Shenandoah Pulp Company Mill. The older, more highly-crafted ashlar stone of harpers phyllite with a pecked finish was integrated into the rubble masonry of the walls.



PLAN - PULP MILL, NPS-HAFE, RAVENHORST, 1991.



PHOTOGRAPH: VIEWING NORTH AT THE SHENANDOAH PULP MILL, WPTC-NPS 1993.

PULP MILL RUINS

NORTH WALL (WALL A):

MASONRY:

The north retaining wall of the ruin is constructed of harpers phyllite rubble masonry. As a section of the ruin the wall remains in good condition. There are no signs of potential structural failure, wall bulging, or displacement of foundation stones. There is minimal displacement of stones along the top of the wall now serving as the coping.

MORTAR:

The entire wall has been pointed with a cement-lime mortar. Plaster parging associated with the plate iron flume gates remains in-situ. Much of the mortar remains in sound condition with area spalling concentrated at the upper courses of the wall.



PHOTOGRAPH: WEST ELEVATION of FREESTANDING WALL B, ans NORTH RETAINING WALL, WPTC-NPS 1993.

RECOMMENDED TREATMENT (WALL A):

Extensive repointing or replastering of the wall is unnecessary. Selective repointing shall be accomplished where critical stones are subject to wallfall (i - at the coping of the wall, and at the eastern end of the wall at the abacus). Reset displaced stones at the bottom of the arc pilaster to prohibit further loss of historic fabric.

FREE STANDING FLUME WALL (WALL B):

MASONRY:

Character defining features of the free standing rubble masonry flume wall to be retained and stabilized include the stone projections or plinth at the top of the west end of the wall. This feature is constructed of slabs of harpers phyllite that are placed corbeling out from the outside face of the wall. Other features include the arc pilasters at the discharge end of the wall, pockets for floor timbers, and extant cut sections of wide flange steel floor beams.

Freestanding Flume Wall B west elevation (upstream end) is in good condition with minor deterioration of cement-lime mortar. The plinth above shows slight deterioration of mortar. The north and south projecting stones of the plinth show little signs of potential wallfall.

MORTAR:

All elevations of the freestanding wall have been pointed with a cement-lime mortar. The mortar is in sound condition with washout and deterioration limited to areas at the base of the wall at the splash line, and courses of stone along the top of the wall. The mortar joint profiles vary with the projection of the faces of the rubble masonry. The joints were not tooled following the latest campaign of pointing leaving a parged appearance to the masonry joint.. The existing mortar in-situ is sound with slight deterioration in areas of extreme temperature variations or freeze-thaw cycle exposure.

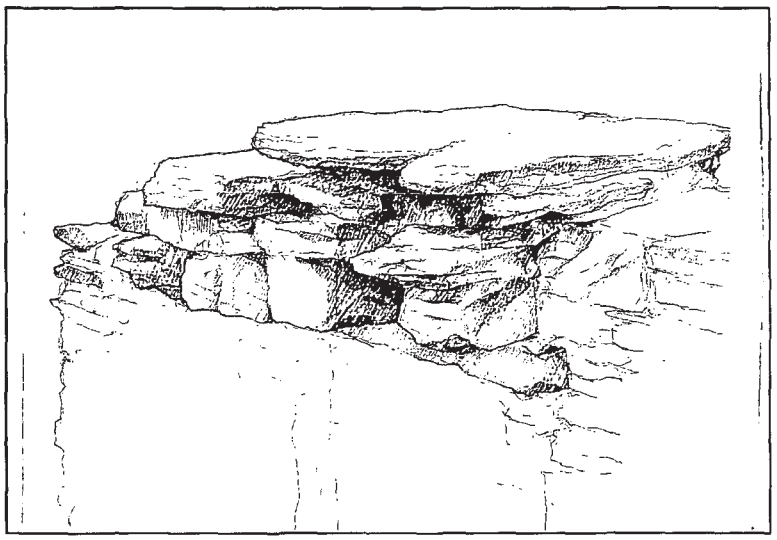
PLASTER:

Cement-lime plaster remains in-situ at the arc pilasters where the iron flume gates were placed. The plaster has been subject to saturation and subsequent freeze-thaw cycles. Spalling and surface erosion of the plaster has occurred. Separation from the substrate is evident in some areas exposing the cantilevered rubble masonry pilaster. The lower coursework of the pilaster has no point of bearing resulting in the loss of masonry units from bottom of the pilaster.

PULP MILL RUINS

RECOMMENDED TREATMENT (WALL B):
Extensive repointing of the wall is unnecessary.
Selective repointing shall be implemented on all masonry joints associated with the plinth at the top of the west end of the wall. Through addressing all bed joints, head joints of the plinth shall eliminate the potential of wallfall (reducing a safety hazard).
Selective repointing shall be implemented on all stones of the coping.

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry.



DETAIL: PLINTH (POINT OF BEARING) OF FREE STANDING WALL ,WPTC-NPS 1993.

FREE STANDING FLUME WALL (WALL C):

The second freestanding wall from the north retaining wall has been constructed in the same manner as that of the other flume walls utilizing harpers phyllite rubble masonry set in a cement-lime based mortar. Character defining feature to be retained and stabilized include the north and south elevation arc pilasters of the east end of the wall, the plinth of the coping of the west elevation of the wall, pockets in the masonry to accept timbers, and sections of the cast iron and steel floor members remaining in-situ.

MASONRY:

Rubble masonry of harpers phyllite remains in good condition. The wall section of two outer faces of rubble masonry with a rubble core shows no sign of bulging or failure. Critical areas to be addressed include the west elevation (upstream) end of the wall where harpers phyllite stones of the plinth overhang the space above. Stones have been displaced from the west elevation exposing sections of the core.

WOOD MEMBERS:

Extant wood members of the remaining floor system shall be retained through careful removal of vegetation, debris, and fill. Further documentation of these elements must take place prior to implementation of preservation measures. Wood elements include sill plates, and nailer plates integrated in the masonry at the flume entry level.



PHOTOGRAPH: WEST ELEVATION of FREESTANDING WALL C, WPTC-NPS 1993.

RECOMMENDED TREATMENT (WALL C):

Extensive repointing of the rubble masonry of the wall is unnecessary.

Selective repointing shall address all masonry joints associated with the stones of the plinth overhead on the west end of the wall. Accomplished repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship.

FREESTANDING FLUME WALL (WALL D)

MASONRY:

The rubble wall is constructed harpers phyllite with a rubble core.

Located at the center of the ruin Freestanding Flume Wall D has the largest abacus of all the freestanding flume walls. The west elevation of the wall retains the historic pilaster in tact - placed to accept flume gates. The base of this pilaster of the west elevation has a change in grade sloping from the north to the south that may has an impact on the foundation stones of the north elevation of the wall.

Above, there is some displacement of stone from the underside of the southwest corner of the abacus. The rubble masonry arc pilasters of the north and south elevations have displaced stones of the lower courses.



PHOTOGRAPH: WEST ELEVATION FREE STANDING FLUME WALL D, WPTC-NPS 1993.

MORTAR:

Mortar used in the placement of the rubble masonry wall was a cement-lime mortar mix. The latest campaign of pointing of the structure included pointing all elevations of Wall D with a portland cement -lime mortar mix. The extant pointing mortar is sound with limited deterioration and washout of mortar at the base of the wall and the top of the wall. There are limited areas within the field of the elevations that indicate deterioration of mortar. The mortar joint profiles vary with the projections of the faces of the rubble masonry. The joints were not tooled during implementation of the latest campaign of pointing leaving a parged appearence to the masonry joint. The existing mortar within the wall is sound with slight deterioration in areas of extreme temperature variations.

RECOMMENDED TREATMENT:

Extensive repointing of the wall is unnecessary.

Selective repointing shall be implemented on all masonry joints associated with the abacus at the top of the west end of the wall. Through addressing all bed joints, head joints of the abacus shall eliminate the potential of wallfall (reducing a safety hazard).

Selective repointing shall be implemented on all stones of the coping.

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry.

FREE STANDING FLUME WALL (WALL E)

MASONRY:

Character defining features of the freestanding rubble masonry flume wall to be retained and stabilized include the remaining elements of the stone abacus, the arc pilasters of the east end of the wall, and the remaining pilaster stones of the west elevation. Rubble masonry of harpers phyllite of the west elevation of Wall E has been heavily impacted by flood waters. The masonry of the west pilaster has been displaced leaving only the lower course of the element and the core of the wall exposed.

The grade of the north elevation of the wall is lower than that of the south elevation exposing the lower courses of the north face of the wall.

A wrought iron hook element protrudes from the west face of the masonry. This element shall be retained and stabilized in-situ along with the plate iron, and remnants of the web and flange floor beams.



PHOTOGRAPH: WEST ELEVATION OF FREESTANDING WALL E, WPTC-NPS 1993

MORTAR:

Mortar used in the placement of the rubble masonry wall was a cement-lime mortar mix. The latest campaign of pointing of the structure included pointing all elevations of Wall D with a portland cement - lime mortar mix. The extant pointing mortar is sound with limited deterioration and washout of mortar at the base of the wall and the top of the wall. There are limited areas within the field of the elevations that indicate deterioration of mortar. The mortar joint profiles vary with the projections of the faces of the rubble masonry. The joints were not tooled during implementation of the latest campaign of pointing leaving a parged appearence to the masonry joint. The existing mortar within the wall is sound with slight deterioration in areas of extreme temperature variations.

RECOMMENDED TREATMENT:

Extensive repointing of the wall is unnecessary.

Selective repointing shall be implemented on all masonry joints associated with the abacus at the top of the west end of the wall. Through addressing all bed joints, head joints of the abacus shall eliminate the potential of wallfall (reducing a safety hazard).

Selective repointing shall be implemented on all stones of the coping and exposed core of the wall on the west elevation.

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry.

PULP MILL RUINS

FREE STANDING FLUME WALL (WALL F)

MASONRY:

Fifth freestanding flume wall from the north retaining wall, Wall F has been constructed utilizing the same masonry techniques as that of the other flume walls. The rubble masonry wall contains a rubble infill that has been exposed on the west elevation of the structure through the loss of the abacus.

Quoins of the west elevation of WALL F have been displaced through combined impacts from deterioration of mortar and flood waters. The core of the wall remains exposed on the west elevation.

Freestanding Flume Wall F has had an addition placed on the east end of the structure utilizing the same masonry techniques as that of the original rubble wall. Character defining features of this addition include a molded brick coping over a rubble wall with remnants of two fenstration. The lintel of the west fenestration has been displaced. The east fenestration was completed with two cast elements used as a lintel. The northern lintel element has been displaced leaving a single half in place to carry the dead load of the masonry above. Associated with the fenstration and addition wall are displaced stones from the eastern end of the wall. Brick masonry units used to finish out the fenestration have been dispaced as well.



PHOTOGRAPH: SOUTH ELEVATION of FREESTANDING FLUME WALL F. WPTC-NPS 1993

MORTAR:

Mortar used in the placement of the rubble masonry wall was a cement-lime mortar mix. The latest campaign of pointing of the structure included pointing all elevations of Wall D with a portland cement -lime mortar mix. The extant pointing mortar is sound with limited deterioration and washout of mortar at the base of the wall and the top of the wall. There are limited areas within the field of the elevations that indicate deterioration of mortar. The mortar joint profiles vary with the projections of the faces of the rubble masonry. The joints were not tooled during implementation of the latest campaign of pointing leaving a parged appearence to the masonry joint. The existing mortar within the wall is sound with slight deterioration in areas of extreme temperature variations.

RECOMMENDED TREATMENT:

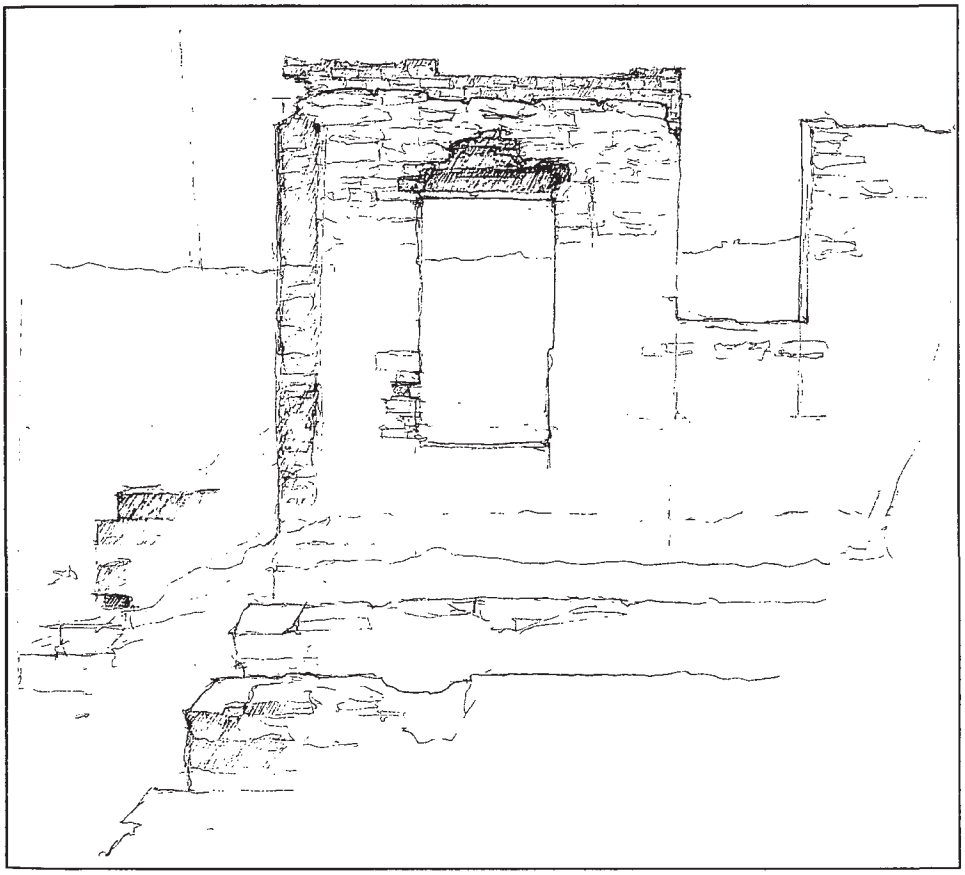
Extensive repointing of the wall is unnecessary.

Selective repointing shall be implemented on all masonry joints associated with the abacus at the top of the west end of the wall.



CONSTRUCTION DETAIL: EXTANT CONDITIONS OF THE SOUTH ELEVATION OF FREESTANDING WALL F. WPTC-NPS 1993.

RECOMMENDED TREAMENT (CONT'D):
Through addressing all bed joints, head joints of the plinth this shall eliminate the potential of wallfall (reducing a safety hazard).
Selective repointing shall be implemented on all stones of the coping.
Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry.



CONSTRUCTION DETAIL: NORTH ELEVATION OF THE FRESTANDING WALL F ADDITION, WPTC-NPS 1993.

BOILER HOUSE RUIN
Harpers Ferry National Historical Park

BOILER HOUSE RUINS

GENERAL DESCRIPTION:
Associated with the Shenandoah Pulp Company Mill Ruins, the Boiler House Foundation Ruins are located east of the of the mill integrated into the north bank of Virginius Island. The extant remains of the structure pallisade down the embankment in two sections.
The south interior wall of the Boiler House Ruins remains at the highest elevation constructed as a rubble retaining wall racked back into the hillside. From the base of the south wall extant lower courses of the west and east wall run north terminating at the lowest north retaining wall. The lower section of the ruin is located at the base of the bank with the north wall in contact with the water of the Shenandoah Canal. Harpers phyllite rubble masonry is used throughout the ruin as drylaid and mortared masonry.
The approach to the stabilization of the Boiler House Ruin involves minimal impact to extant exposed masonry. Preservation recommendations concentrate on the removal of extant vegetation and the drainage patterns of the site. Extensive reconstruction or repointing of the extant masonry will not be necessary.

SOUTH WALL
MASONRY:
The south interior retaining wall of the Boiler House Ruin remains as a dry-laid rubble masonry wall of harpers phyllite. The stones are irregularly shaped cobbles unlike the flat slabs of harpers phyllite used on the west and east walls of the ruin. There is minimal surcharge soil pressure on the the wall, however, basal soil pressure in combination with a 24 inch hardwood projecting from the base of the wall has created a bulge in the center of the north wall. Lower exposed five feet of the wall remains plumb with slight displacement from the root system of the tree.

MORTAR:
No mortar has been used with the placement of the south wall.

VEGETATION:
The hardwood stump remaining in situ is evidence of a tree that had aided in the deformation of the wall. A water maple at the top center of the south wall root system is growing within the backfill of the wall. Herbaceous vegetation remains along the top of the wall.

RECOMMENDED TREATMENT:
Remove herbaceous vegetation and the hardwood stump from the wall by hand.
Remove the extant hardwood root system, trunk, and canopy from the top of the wall.
Retain displaced masonry from the area of vegetation removal resetting the elements in place as dry laid sections of the wall.

EAST WALL
MASONRY:
The remaining elements of this rubble masonry wall are covered with english ivy and herbaceous vegetation. The stones of the rubble wall have been displaced and remain insitu as concentration of stones. Siltation levels are equal on the east and west elevations of the wall.

RECOMMENDED TREATMENT:
Remove herbaceous vegetation by hand. Record the location of the displaced stone and levels of siltation. Reset displaced upper courses of the stone wall on sound foundation stones as a dry laid section of wall.

BOILER HOUSE RUINS

WEST WALL
MASONRY
Placed as rubble masonry utilizing harpers phyllite as building stone the west wall of the structure remains as a section of wall defining the upper and lower west elevation. Much of the masonry has been displaced or buried by levels of siltation. .
The lower section of the west wall helps to define the lower northwest corner of the structure. This section of the west wall is in the direct path of the discharge area of the south flume of the Pulp Mill Ruins.
MORTAR
A later campaign of cement-lime mortar was utilized to point the northwest corner of the structure.
RECOMMENDED TREATMENT
Extensive reconstruction of the walls of the ruins will not be necessary in order to maintain the extant walls of the structure.
Removal of siltation or earth fill from the site unless for archaeological investigation is not recommended.
Backfill areas of ruin that have been impacted by rodents, especially in the floor of the upper level of the ruin.

SOUTH WALL
MASONRY
The harpers phyllite rubble masonry remains in contact with the waters of the Shenandoah Canal.
MORTAR
The wall has been pointed with a cement-lime mortar.
RECOMMENDED TREATMENT
Leave cement-lime based mortar in-situ. Removal of extant mortar and extensive repointing of the masonry will not be necessary.

SITE RECOMMENDATIONS.
The central portion of the south section of the ruins has been impacted by rodents. Extant foundation stones of the structure may be impacted by the displacement of soil.
Remove vegetation from the interior of the structure.

LAKE QUIGLEY WALL RUINS
Harpers Ferry National Historical Park

LAKE QUIGLEY WALL

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION



ILLUSTRATION: SITE PLAN, from RAVENHORST NPS 1993

GENERAL DESCRIPTION:

Lake Quigley Wall extends from the south wall of the Virginius Island Pulp Mill eastward (upstream) approximately six hundred fifty lineal feet. The stone wall is constructed of local harpers phyllite laid as rubble, coursed rubble, pitched face, and pecked finish ashlar masonry. Width of the wall varies from approximately three feet to 5'-6". Typical detail elements of the wall section consists of two rubble faces with a variety of tooled finishes with a rubble core of hand sized stones keying in the outer coursework. The west end of the wall utilizes larger stones that are laid across the entire width of the wall eliminating the core. Though the largest stones are used at the west end of the wall major failures have occurred here - an area heavily impacted by flood waters.

Stones range in dimension from hand sized to large slabs measuring 1' x 2' x 6'. The wall height begins at four feet at the western end of the wall increasing to fifteen feet at the juncture with the pulp mill. Wall height differs on both sides of the wall varying with topographic changes. Throughout the length of the wall there is minimal damage to the existing foundation or upper courses of the wall. An alternate material of concrete was used for later repairs and additions increasing the height of the wall by three feet.



PHOTOGRAPH: LAKE QUIGLEY WALL, VIEWING EAST AT THE WEST END OF THE WALL, WPTC NPS 1993.

LAKE QUIGLEY WALL

GENERAL DESCRIPTION (cont'd) :

The western end of the Lake Quigley Wall exhibits typical construction technique of rubble masonry utilizing harpers phyllite slabs that have been dry-laid, later pointed and galleted. Historically this end of the wall has suffered from catastrophic flood water impacts as indicated through changes in masonry and concrete repairs. The historic concrete repairs of the west end were later blown-out by flood waters. Approximately eighty lineal feet of the west end of the wall has been displaced. Contemporary hydraulic impacts upon the greater length of the wall are not as severe due to the change in topography of the island. The siltation and added vegetation has reduced the impact of water-borne debris on the upstream end of the island.

The wall coping consists of rubble slabs keyed along the top course with stiles overhanging the south face of the wall. This detail makes the coping stones susceptible to displacement with stiles overhanging the south face of the wall (south face and west end of the wall takes the brunt of flood waters).

The core of the wall has been exposed where slabs have been displaced from the top of the wall. The composition of the core includes laid rubble consolidated with a cement- lime paste or slurry.

Individual stones are 4 feet to 5 feet in length and 6 - 10 inches in thickness. Materials used in the construction of the west end of the wall are large slabs of harpers phyllite weighing 350 to 800 lbs.



PHOTOGRAPH: DETAIL OF DISPLACED COPING STONE , WPTC-NPS 1993

SITE CONDITIONS:

Designed to serve as a retaining and containment wall for the industrial operations on Virginius Island the heavy masonry of the wall historically has been subject to impacts from catastrophic flooding of the Shenandoah River. Hydraulic action has had the greatest impact at the western most end of the wall furthest upstream. Displacement of the walls largest stones is attributed to impacts from high water levels and water-borne debris.

Siltation levels deposited on the south side of the wall have aided in stabilizing the wall reducing the impacts from lateral hydraulic live loads. The pattern that the catastrophic flood waters have taken route from west to east across the top of the wall. The greatest point of impact of the flood waters is located at the western most end of the concrete repaired section. The waters must breach the railroad bed prior to severely impacting the wall.



PHOTOGRAPH: VIEWING SOUTHWEST AT THE NORTH FACE CONCRETE REPAIR OF THE WALL, WPTC-NPS 1993.

Site conditions that have aided in the stabilization of the wall include the revegetation of Virginius Island. Hardwoods not impacting the foundation of the wall have stabilized the siltation levels and have aided in buttressing against incoming water-borne debris.

LAKE QUIGLEY WALL

CONCRETE:
Late repairs and additions to the lake wall were accomplished through the use of cast in place concrete. Cast in place concrete was formed and poured directly on top of the extant rubble masonry wall.
Associated with a repair measure to a failed section of the west end of the wall this increased the wall height by three feet. Composition of the concrete appears to be of a high portland based mortar with large aggregate of harpers phyllite and shale, and sand. No steel or reinforcement is recognizable from broken sections or spalled areas, however, there are ferrous stains on the face of the concrete indicating placement of iron or steel within the material.
Exposed reinforcement at the foundation of the concrete repair is a collection of square and round iron and steel rod.
Typical wall section of the western most end of extant wall includes a six to fifteen foot overall wall height with a base varying with levels of siltation.
Concrete repairs to the wall included the placement of a concrete footing that may be formed over extant lower courses of rubble masonry. The footing extends out from the north face of the wall 8" to 10". Cracks have appeared at the cold joint of the concrete and the rubble masonry wall.
Salt and ferrous deposits remain on the exterior surface of the concrete wall. Associated with these deposits are spalled areas where the outer surface of the concrete has reacted to freeze thaw cycles. Note that the south elevation of the concrete repair section has a higher siltation level than that of the north elevation. The concrete wall functions as a retaining wall being exposed to periodic saturation from surface water.
Concrete form work markings indicate the use of rough cut (circular sawn) wood boards measuring 5.5" to 10" in width. Five concrete pours are recognizable as indicated by form work and failure at cold joints in the wall. .



PHOTOGRAPH: VIEWING SOUTHWEST AT THE CONCRETE REPAIR, WPTC-NPS 1993.



PHOTOGRAPH: VIEWING EAST AT THE NORTH FACE OF THE WALL, WPTC-NPS 1993.

PARGING:
Contemporaneous with the concrete repairs to the west end of the wall the portland based parging was used to integrate the concrete with the rubble masonry. Water infiltration and subsequent freeze-thaw cycles have spalled sections of the parging from the face of the rubble wall.

MORTAR:
Larger stones of the wall were dry laid followed by pointing with a cement-lime mortar, or a lime-natural cement amended mortar. Later campaigns of pointing were accomplished with a portland based mortar. The portland cement based mortar was extensively used with a liberal application on the south and north elevations of the wall. The craftsmanship of this application has consolidated much of the masonry. Shrinkage of the portland cement based mortar in limited areas has allowed water to infiltrate with subsequent spalling of the last campaign of pointing.
Bedding mortar was used in some areas depending on the size and shape of the stones. A cement- lime mortar was used for the bedding of stones that were manageable by hand. Larger stones as with the west end of the wall were placed as dry laid sections later pointed with a lime based mortar mix.
Exposed sections of the core of the wall reveals the use of rubble in-fill that has been consolidated in a cement- lime slurry.

LAKE QUIGLEY WALL

VEGETATION:

Root systems from hardwoods on and along the wall have aided in the displacement of coping stones along the top of the wall. Most of the vegetation impacting the wall is located at the western end. An associated trail at the base of the wall has aided in limiting the amount of vegetation impacting the north face of the wall, however the south face of the wall has been impacted significantly by smaller hardwoods and herbaceous vegetation. Tree root systems on the north face of the wall have worked under the bed stones and along the base of the wall aiding in displacement of masonry. The western end of Lake Quigley wall shows the results of the combined impact of catastrophic flooding and the root action of hardwood vegetation. Ashlar coursework of harpers phyllite has been displaced along with rubble coping stones from the top of the wall. Subsequent buildup of organic debris on the exposed core of the wall has aided in the deterioration of extant mortar.



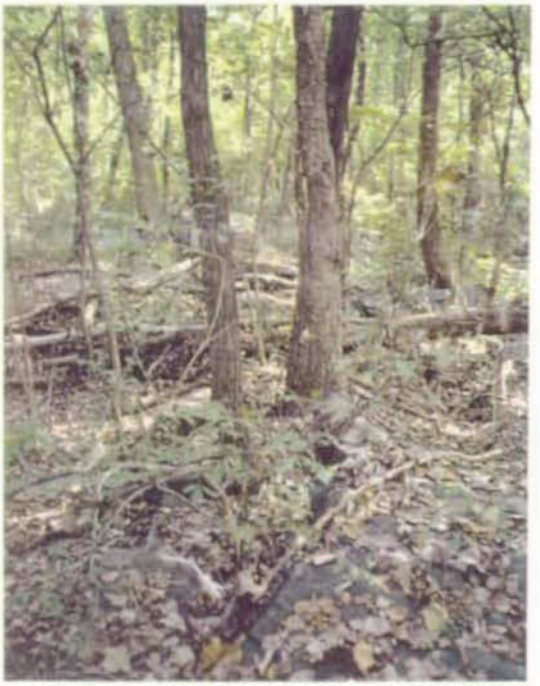
PHOTOGRAPH: VIEWING SOUTHWEST AT THE WEST END OF LAKE QUIGLEY WALL. WPTC-NPS 1993.

RECOMMENDED TREATMENT for VEGETATION:

Remove the canopy, trunk, and root systems of the trees located on the top and the base of the wall.

Retain all elements of the masonry that have been integrated into the tree root systems for use later in the stabilization of extant masonry.

Remove organic debris from the wall in preparation for implementation of stabilization measures.



PHOTOGRAPH: VIEWING EAST ALONG THE TOP OF THE WEST END OF LAKE QUIGLEY WALL. WPTC-NPS 1993.

LAKE QUIGLEY WALL

RECOMMENDED TREATMENT for STABILIZATION:

The approach to preservation of the Lake Quigley wall shall focus on the stabilization of extant masonry through limited reconstruction and management of vegetation.

Further deterioration of the Lake Quigley Wall through the impact of catastrophic flood waters cannot be avoided. Stabilization of the wall shall include replacement of selective stones to arrest further deterioration of the rubble core of the wall or further displacement of coping stones. Massive amounts of repointing will not be necessaryfor the stabilization of the wall. Reconstruction of the west end of the wall will not be required to stabilize the existing length of the wall.

MASONRY:

Stones that have been displaced from the west end of the wall shall remain as they failed. Reconstruction of the masonry on the Lake Quigley wall shall be limited to the resetting of displaced coping stones that have left the central rubble core exposed to the elements. Displaced stones that have the potential of creating additional wallfall shall be reset in a manner that replicates associated historic detailing. Material for stabilization shall be derived from the wallfall in the immediate area of the failed section.



CONSTRUCTION DETAIL: DISPLACED MASONRY COPING STONE EXPOSING THE RUBBLE CORE OF THE WALL, WPTC-NPS 1993.

MORTAR:

Extensive repointing of the wall is unnecessary.

Selective repointing shall be implemented on all masonry joints associated with the resetting of coping stones.

Selective repointing shall be implemented on associated stones of the repaired area to insure proper placement and longevity of repair. .

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry).

FLOUR MILL RUINS
Harpers Ferry National Historical Park

FLOUR MILL

GENERAL DESCRIPTION

The Flour Mill is located near the north bank of Virginius Island at the footbridge crossing the Shenandoah Canal. The structure is in a ruinous state. A large depression in the ground reveals an indication of walls measuring fifty feet by seventy-five feet. Elements of the structure that remain exposed above ground are concentration of rubble masonry defining the northwest, southwest, and southeast corners of the structure. An intermediate rubble masonry wall is placed on an east west axis dividing the structure into two sections. The extant stone work of the foundations are limited to a few feet of exposed wall rising above the berms of the depression in the earth.

The masonry of the structure on the perimeter of the basin appears as dry laid harpers phyllite rubble. The masonry has been impacted by flood waters and water-borne debris and most recently hardwood vegetation. The surcharged soil resulting from the siltation of the ruin has had a detremental impact on extant dry laid masonry.

Herbaceous vegetation has been managed, however, the fertile soil and healthy growing season on the island allows for the rapid return of cut back vegetation - obscuring much of the masonry of the ruin.

NORTH WALL:

MASONRY:

Elements of the rubble masonry of the north wall protrude from the berm of the Flour Mill at the northwest corner of the ruin and at points along top of the wall. There is a concentration of brick at the center of the north wall indicating a possible brick inlet arch. Heavily damaged through surcharge soil pressure, erosion, root systems of a healthy hardwood, and herbaceous vegetation sections of the north wall remains in-situ.



PHOTOGRAPH: OBLIQUE VIEW of the FLOUR MILL, WPTC-NPS 1993

VEGETATION:

There are four healthy hardwood trees impacting the north wall. Root systems have displaced stones and upset bed stones of the stone walls. Leveling of the stone courses has been thrown off as well as out of plumb.



PHOTOGRAPH: WPTC-NPS 1993 DETAIL OF NORTH WALL FLOUR MILL.

FLOUR MILL

SOUTH WALL:
MASONRY:
The south wall of the Flour Mill was placed as coursed and rubble masonry utilizing harpers phyllite as the building stone. There is evidence that the stones were laid in mortar. A portland based pointing mortar was utilized on the southeast corner of the structure.
VEGETATION:
The root systems of two hardwoods are impacting the south wall of the Flour Mill.

WEST WALL
MASONRY:
The west wall of the structure is primarily a berm of the Flour Mill ruin basin. Extant exposed masonry is harpers phyllite rubble located at the southwest and northwest corner of the wall. A central portion of the wall has been exposed as well. The center section of exposed masonry has been displaced through the accumulation of surcharged soil at the top of the wall. The section shows the potential of wallfall.

VEGETATION:
Hardwoods located at the southwest and northwest corners of the ruin have impacted the west wall through root action. The root systems have displaced the bed stones and lower courses of the wall upsetting the upper exposed courses. .

EAST WALL:
MASONRY:
Much of the east wall of the Flour Mill has been covered with silt brought in by flood waters. Rubble masonry of the south section of the east wall remains as a retaining wall. The south section of the east wall has been impacted by hardwood vegetation. Root systems of three large hardwoods have become integrated with the surcharge and backfill soil of the wall.



PHOTOGRAPH: EAST WALL OF THE FLOUR MILL. WPTC-NPS 1993.

VEGETATION
RECOMMENDED TREATMENT:
Remove the root systems, trunk, and canopy of the hardwood trees impacting the foundation ruins.
Retain all masonry elements associated with the removal of the tree root systems.
Reset displaced masonry related to the removal of the root systems of the trees.

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry.

FLOUR MILL

GENERAL APPROACH to PRESERVATION:

RECOMMENDED TREATMENT:



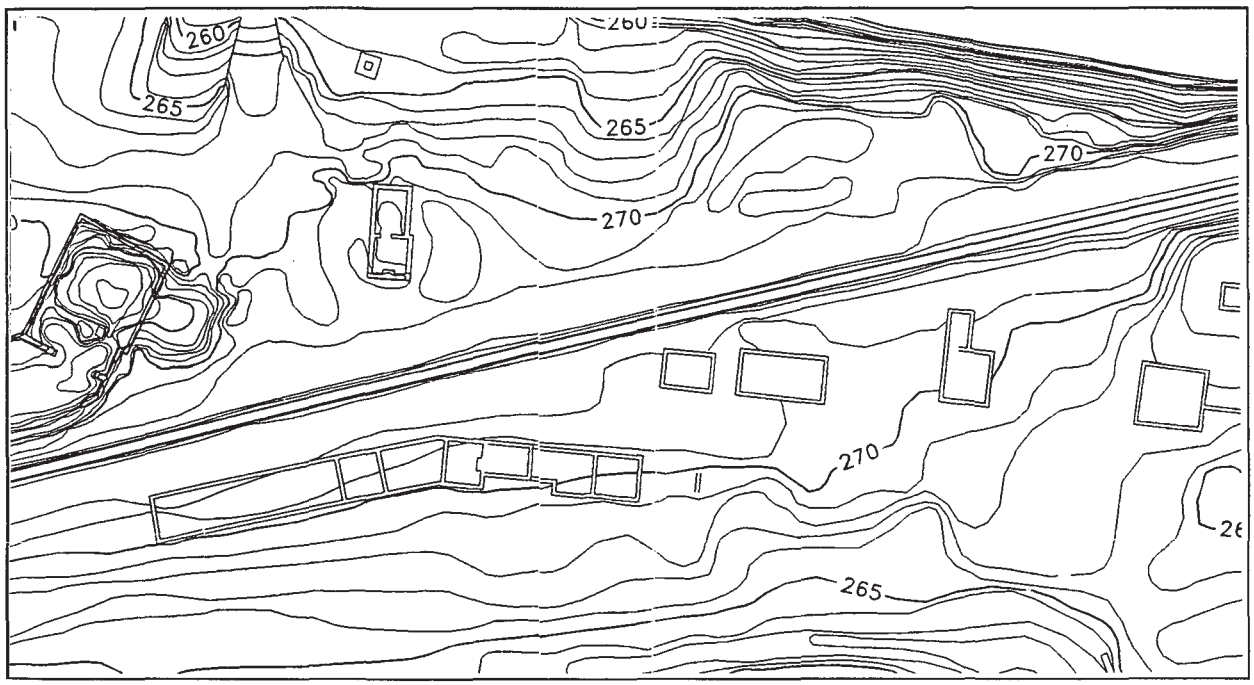
PHOTOGRAPH: DETAIL OF BRICK WALL REMNANTS.
WPTC-NPS 1993.

Distinct features of the ruin to be retained and preserved are the berms of the walls, the internal basin, and the exposed rubble and brick masonry.
All features above grade that are exposed along the tops of the berms shall be left in - situ. Walls within the strucutre shall be retained.
Preservation approach for the structure shall include stabilization of the extant elements through minimal disturbance. Further excavation of the ruins by archaeologists may expose sections wall. These sections must be stabilized prior to backfilling. Post excavation settling and slumping of the ruin may occur unless the extant architectural elements are stabilized prior to backfilling.
Extant rubble masonry above grade shall be reset if in danger of wallfall.
Reset stones replicating historic placement, bonding patterns, and historic masonry techniques.
Limited use of mortar on extant remains will insure less detrimental impact on existing elements.
Remove surcharge soil from the top of the exposed rubble masonry walls. Dismantle sections of rubble wall one course at a time noting original placement of each stone. hat show potential of wallfall removing organic debris and silt.

DWELLING RUINS
Harpers Ferry National Historical Park

DWELLING RUINS

GENERAL DESCRIPTION:
Dwellings on Virginius Island have been impacted by the elements and site conditions to a point where the remains are in a ruinous state. Shallow depressions or basins have been left behind with associated mounds and foundation walls indicating the size and placement of the structure. Archaeological investigations continue around the Wernwag block of rooms located south of the railroad line. Many of the structures exhibit few character defining features. Rubble masonry of harpers phyllite remains as the general type of foundation found on the island.
The dwellings are seasonally obscured from view by the herbaceous vegetation and extant hardwoods growing within the ruins. The ruins of the dwellings have been severely impacted by the root systems of associated hardwoods. Flood waters and surface water erosion has detrimentally impacted the ruins displacing above grade stones and discharging silt.



SITE PLAN: DWELLING RUINS, via RAVENHORST 1993.

The Wernwag and associated ruins are a line of foundations generally obscured by vegetation sited along the south side of the railroad line. There is a dwelling ruin associated with the flour mill on the north side of the railroad line just east of the flour mill.

DWELLING RUINS

DWELLING at FLOUR MILL

GENERAL DESCRIPTION:

Located east of the Flour Mill the extant remains indicate a two room structure measuring fifty feet by sixteen feet. The foundation ruin is a basin with partially exposed masonry piers and foundation walls concentrated on the south, east and west walls. A pile of stone rubble and silt make up the north wall. The basin depression measures approximately five feet in depth with remains of the foundation wall exposed from the berms of the mound not more than four feet in height.

EXTANT MASONRY:

Harpers phyllite rubble masonry was utilized in the construction of piers and walls of the foundation of the dwelling. The most distinct masonry elements defining the structure are the piers of the west wall. This section remains intact without displacement from vegetation or siltation.

RECOMMENDED TREATMENT:

Remove surcharge soil from the top of the southwest corner of the south wall extant masonry. Reset displaced stones of the south wall. Mounds to the north and south wall shall be left undisturbed. Foot traffic during the implementation of preservation measures must not impact the stabile berms of the wall. Leave stones of the east wall undisturbed.



PHOTOGRAPH: EAST WALL of DWELLING RUIN, WPTC-NPS 1993.

Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spalling or displacement of new mortar from the masonry).

SHENANDOAH CANAL WALL
Harpers Ferry National Historical Park

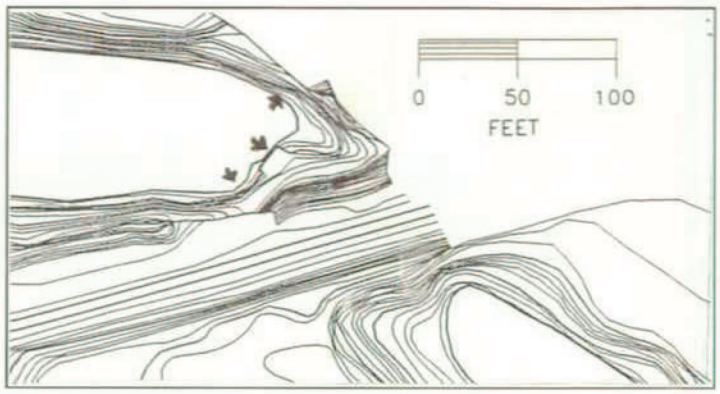
SHENANDOAH CANAL WALL

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

GENERAL DESCRIPTION:
Located at the eastern end of the Shenandoah Canal basin three sections of the old canal walls remain in tact. Walls are functioning to retain the north bank of Virginius Island, north bank of the canal, and the east end of the canal. Critical stone retaining walls, these structural elements protect the associated railroad trestle abutment, blacksmith shop foundation, and the discharge culvert for the canal. The bridge abutment wall and east end section of wall are structurally sound. The retaining wall of the north bank of the canal is in critical condition. Eventually ,if left untreated, the wall will fail along with a large section of the embankment that may impact the area north of the blacksmith shop, and the roadway.



PHOTOGRAPH: SOUTH RETAINING WALL and TRESTLE ABUTMENT, WPTC-NPS 1993.



SITE PLAN - LOCATION OF SHENANDOAH CANAL RETAINING WALLS, WPTC-NPS 1993.

SOUTH WALL
GENERAL DESCRIPTION:
The south wall is located just west of the blacksmith shop. The wall retains a section of the north hillside of Virginius Island and the active B&O Railroad bed of the trestle abutment. All of the stones are of harpers phyllite. Large bolders have been utilized as well as dressed stones (ashlar pitched faced and margined). The dressed stones are placed on the eastern end of the wall integrating into the rubble of the west end of the wall. Approximate vertical height of this section of the wall is fifteen feet. The backfill and surcharge soil of the wall is associated with the railroad bed and the trestle abutment. Though the masonry has been impacted by train movement and vibration the retaining wall appears in sound condition.
Vegetation has taken hold at the base and top of the wall.

CONDITION:
Large squared and shaped harpers phyllite makes up the ashlar section of the wall. Sizes of the stones range from 1'x2'x4'-6'. These substantially sized stones have been pointed with a high portland cement mortar remaining in sound condition. The stones show no signs of stress cracking or displacement from original bedding.
Bolders, or large rubble masonry extends from the ashlar masonry to the west. The embankment exhibits no signs of slumping or failure. Surcharge soil in-situ appears to have a small amount of erosion on the west end of the wall. This erosion may be attributed to foot traffic combined with surface water run-off.

SHENANDOAH CANAL WALL

SOUTH WALL
RECOMMENDED TREATMENT:
Vibrations from passing trains of the active rail system have had some impact to the wall as evident through the concrete repairs. Periodic monitoring of the condition of the wall should be made noting displacement of stones from original bedding, bulging of the rubble masonry, erosion through rodent or vegetation infestation.
Trees located along the top of the wall shall be removed including canopies, trunks, and root systems.



PHOTOGRAPH: SOUTH SHENANDOAH CANAL RETAINING WALL and TRESTLE ABUTMENT, WPTC-NPS 1993.

EAST RETAINING WALL:
Small units of harpers phyllite make up this rubble, and coursed rubble masonry wall. The top section of the wall has been displaced through erosion and soil pressure. The surcharge soil and activity along the top of the wall has displaced some stones, however, the wall is structurally sound with no indication of major displacement of stone, or bulging of sections of the wall.
Herbaceous vegetation has impacted the area. Much of the wall has been obscured through growth of vines. Some stones along the base of the wall have been displaced. There remains an amount of debris at the base of the wall deposited from the higher water levels within the canal.

RECOMMENDED TREATMENT:
Remove the debris and vegetation from the base of the wall to ensure that the stones are not critically displaced. Retrieve the stones at the base of the wall to be reset at the top of the retaining wall. Reset the stones through removing debris and excessive surcharged soil. Reset the stones as dry laid sections increasing the height of the wall to secure the surcharge soil.
Reset displaced stones of the wall through utilizing wallfall in the immediate area of the wall.



PHOTOGRAPH: EAST RETAINING WALL of the SHENANDOAH CANAL, WPTC-NPS 1993.

SHENANDOAH CANAL WALL

VIRGINIUS ISLAND STABILIZATION PLAN
HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION

NORTH RETAINING WALL:
A composite of rubble and coursed rubble masonry the north retaining wall is in CRITICAL CONDITION. The rubble masonry of harpers phyllite has been displaced and rests out of plumb on the southern end of the wall. Precariously overhanging the canal below the retaining wall has been severely impacted by the root system of a healthy hardwood. This combined with erosion on the east end of the canal and extant soil pressure has damaged the retaining wall.



PHOTOGRAPH: NORTH RETAINING WALL VIEWING NORTH, WPTC-NPS 1993

RECOMMENDED TREATMENT:
Stabilizing the retaining wall shall require the removal of the extant hardwood root system, trunk, and canopy.
Dismantling of the stone wall will require careful documentation prior to removal of the stones, backfill and root system of the tree. Reconstruction of the wall will be necessary in order to stabilize the embankment.
Design of the reconstructed section of the wall impacted by the root system must replicate the historic masonry in type of stone, methodology of construction and placement. New design details may be incorporated into the masonry including an increase in width of the wall, foundation of the failing section, stabilizing the backfill, and incorporating a simple drainage system. Incorporating the use of poured in place concrete is not recommended and is unnecessary. The use of the historic methodology of construction must be incorporated into the reconstruction maintaining proven structurally sound masonry techniques.
Accomplish repointing through removing only deteriorated mortar from all bed joints and head joints in preparation for the placement of an approved and appropriate mortar mix. The replacement mortar mix shall match the existing historic mortar in color, texture, joint profile, and historic craftsmanship. All repoint work shall remove extant deteriorated mortar to a depth of at least two inches. Tamp pointing shall be implemented if the masonry joint is deeper than two inches allowing for proper packing of masonry joints (this shall eliminate spelling or displacement of new mortar from the masonry.



PHOTOGRAPH: SOUTH ELEVATION OF THE NORTH RETAINING WALL, WPTC-NPS 1993.

COTTON / FLOUR MILL RUINS STABILIZATION PLAN

VIRGINIUS ISLAND, HARPERS FERRY NATIONAL HISTORICAL PARK
NATIONAL CAPITAL REGION
JUNE 1993

PREPARED BY: Paul John Neidinger
Historical Architect
WILLIAMSPORT PRESERVATION TRAINING CENTER

TABLE OF CONTENTS

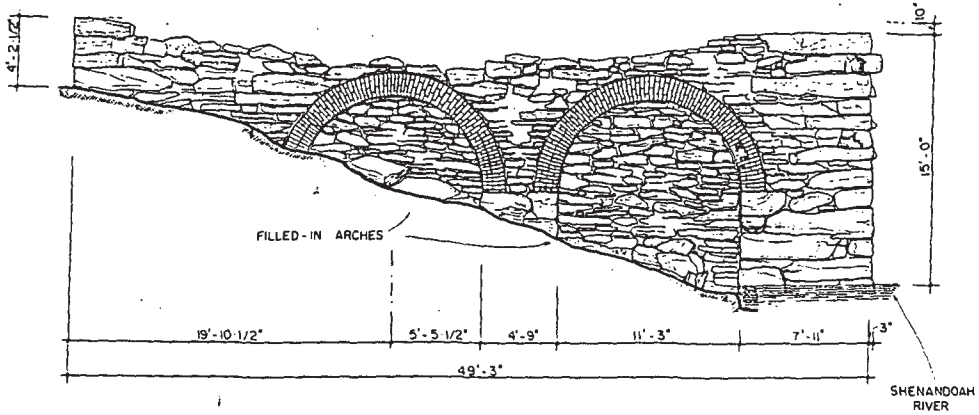
Preservation Approach 01
Site Plan 02
IHTIA Drawings of Existing Conditions 03
North Wall 06
West Wall 09
Brick Turbine Pit 14
South Wall 22
Mortar Specification Appendix A
Phase I and Phase II Stabilization Annotated IHTIA Drawings Appendix B

COTTON / FLOUR MILL

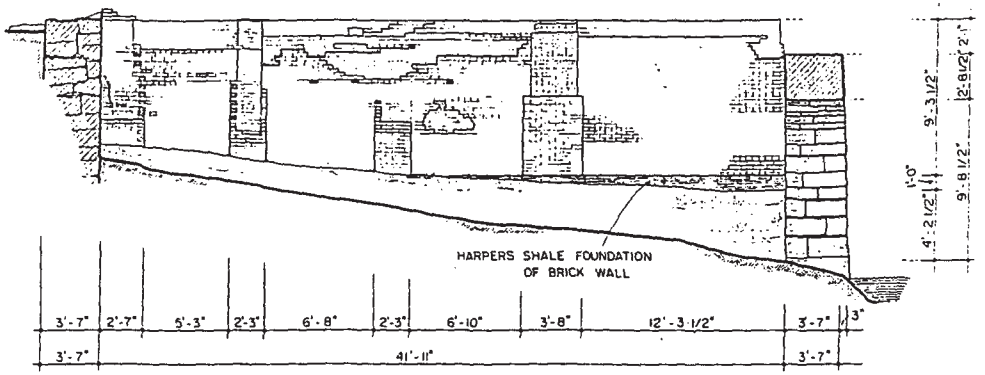
PRESERVATION APPROACH:

Preservation of the Cotton / Flour Mill must involve the reconstruction of character defining features that will function to stabilize the structure during times of high water. The stabilization measures will utilize wall fall material from the immediate area of the structure replicating the historic masonry in material, methodology of construction, detail, mortar color and texture, and historic craftsmanship.

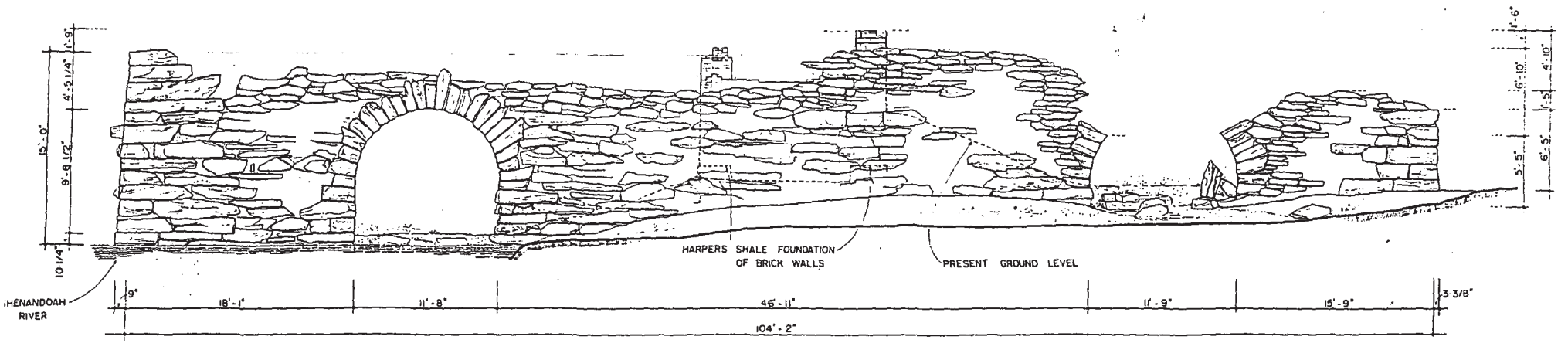
The seasonably submerged stone foundation of the Cotton / Flour Mill will be preserved through structural stabilization of stone masonry. Reloading the stone walls and reconstruction of the failed outlet arch of the south wall shall reduce further detrimental hydraulic action and damage to the extant masonry caused by river currents and water-borne debris.



WEST ELEVATION



SECTION C-C'



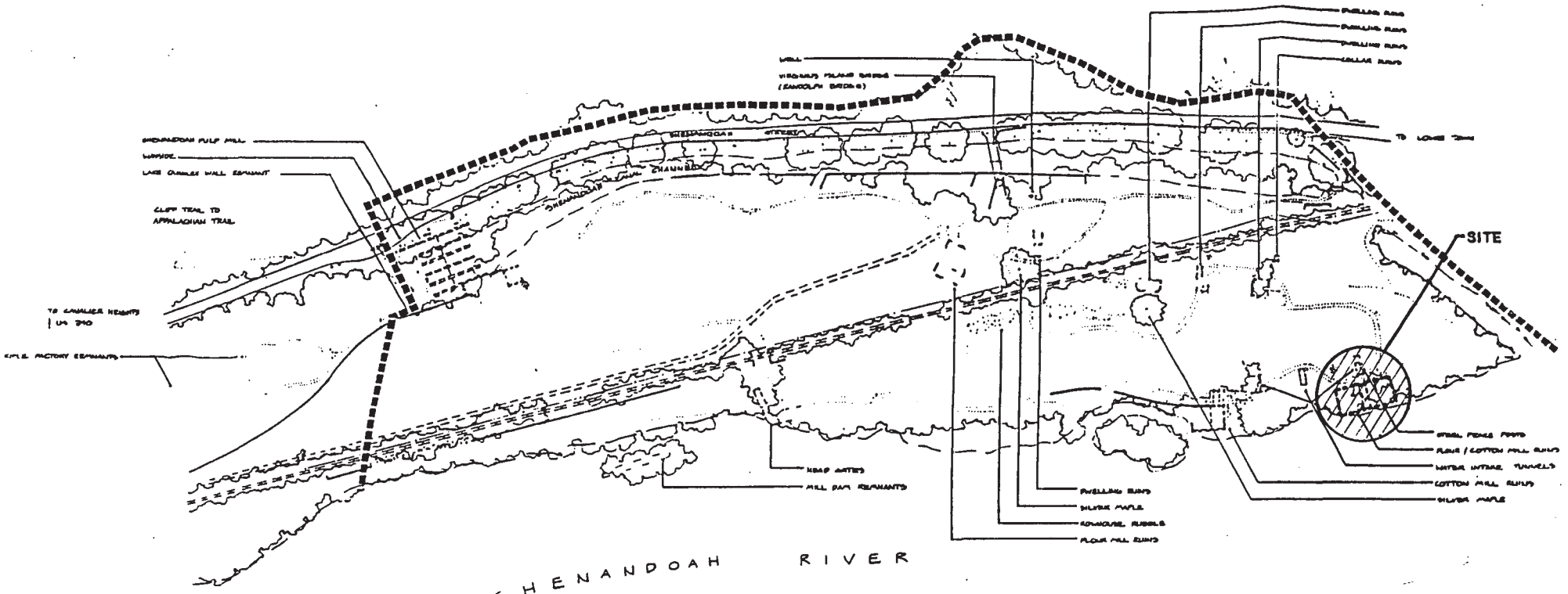
SOUTH ELEVATION

COTTON/FLOUR MILL

SCALE: 1/4"=1'-0", 1:48

0 1 2 3 4 5 10 11

B COFFEY, C SPYRAKOS, 1992



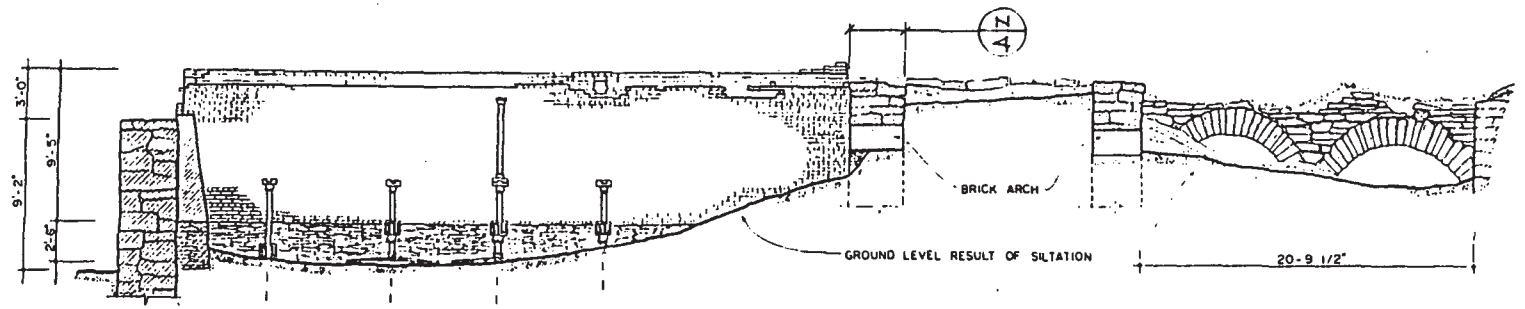
EXISTING CONDITIONS

CULTURAL LANDSCAPE REPORT
VIRGINIUS ISLAND, HARPERS FERRY
NATIONAL HISTORICAL PARK

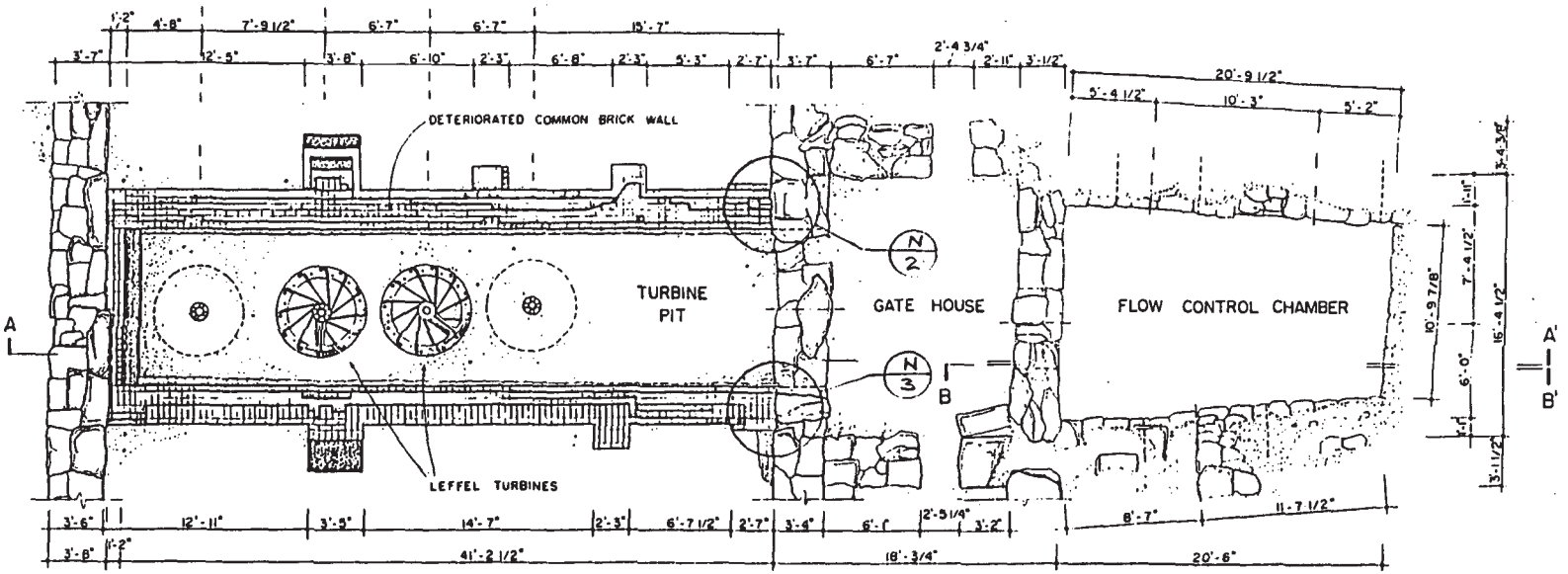
LEGEND

- STRUCTURAL RUINS
- RAILROAD
- ROAD
- SERVICE ROAD
- PEDESTRIAN TRAIL
- PATH
- SHORELINE
- UTILITY LINE
- STRUCTURAL RUBBLE
- STONE WALLS
- TREE
- CANOPY VEGETATION
- TRAIL MARKER
- CULVERT
- SITE BOUNDARY

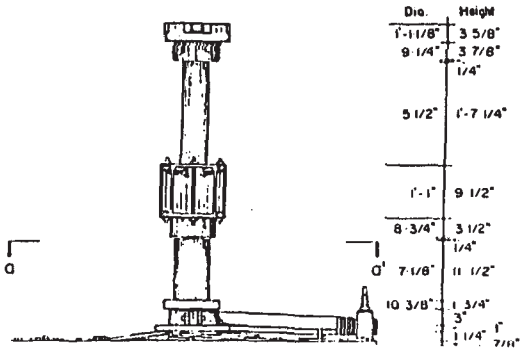
SCALE:



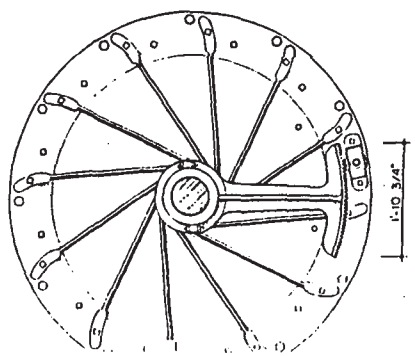
SECTION A-A'

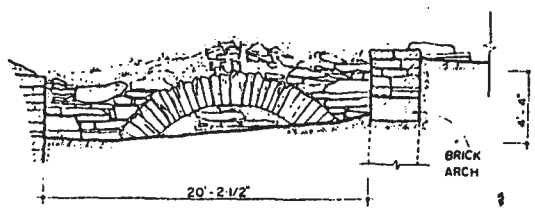


PLAN VIEW



Dia.	Height
1'-11 1/8"	3 5/8"
9 1/4"	3 7/8"
	1/4"
5 1/2"	1'-7 1/4"
1'-1"	9 1/2"
8 3/4"	3 1/2"
	1/4"
7 1/8"	11 1/2"
10 3/8"	1 3/4"
	3"
	1 1/4"



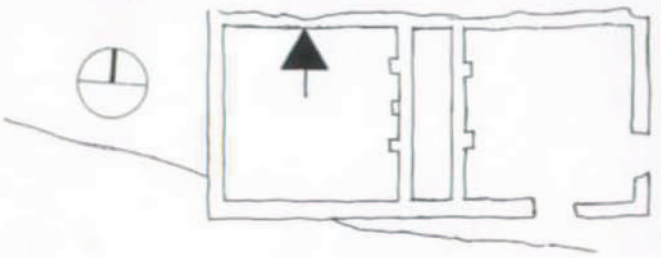


SECTION B-B'

LEFFEL TURBINE

SCALE - 1"=1'-0", 1:12

SCALE 1/4"=1'-0", 1:48



COTTON / FLOUR MILL

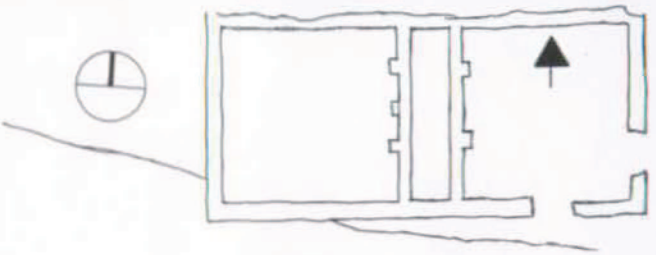
KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: DETAIL N - 1 NORTH WALL WEST of the TURBINE PIT . NPS 1993 .

NORTH WALL of the Cotton/Flour Mill.
Serving as a retaining wall the west half of the north wall shows no sign of bulging or potential failure. Stones along the top of the wall have been displaced due to high water levels. Note that some cap stones remain in-situ providing a datum for original wall height.

Treatment:
Remove or rake out only deteriorated mortar in preparation for placement appropriate and approved mortar mix. A new campaign of pointing shall be implemented matching historic mortar in color, texture, and joint profile. Note that extant vegetation at the top of the wall shall be removed with associated displaced stones being reset. Make certain that at the juncture of the stone wall and the interior brick turbine pit wall is capped properly in order to deter further moisture penetration.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: N - 2 NORTH WALL EAST of the TURBINE PIT , NPS 1993.

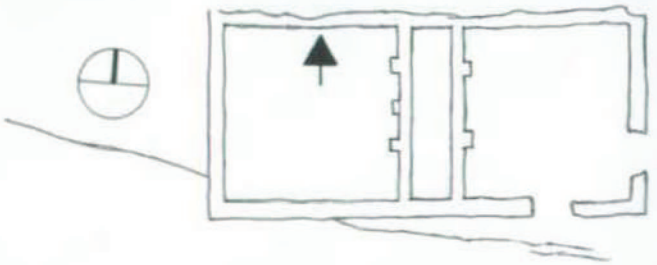
ELEVATION.

NORTH WALL of the Cotton/Flour Mill.

Coursed rubble masonry continues with this section of the north wall east of the brick turbine pit. Capped with large partially shaped slabs of Harpers phyllite this portion of the wall differs from the west half through the use of larger stones. Flood impacts include the displacement of cap stones and the deposit of silt against the south face at the base of the wall.

Treatment:

The course rubble masonry requires the placement of displaced units including the cap stones. Wall-fall in the immediate area of the wall shall be utilized as a source of material. Limited herbaceous vegetation removal will be necessary in order to implement the new campaign of pointing. Mortar shall match historic in color, texture, and joint profile.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

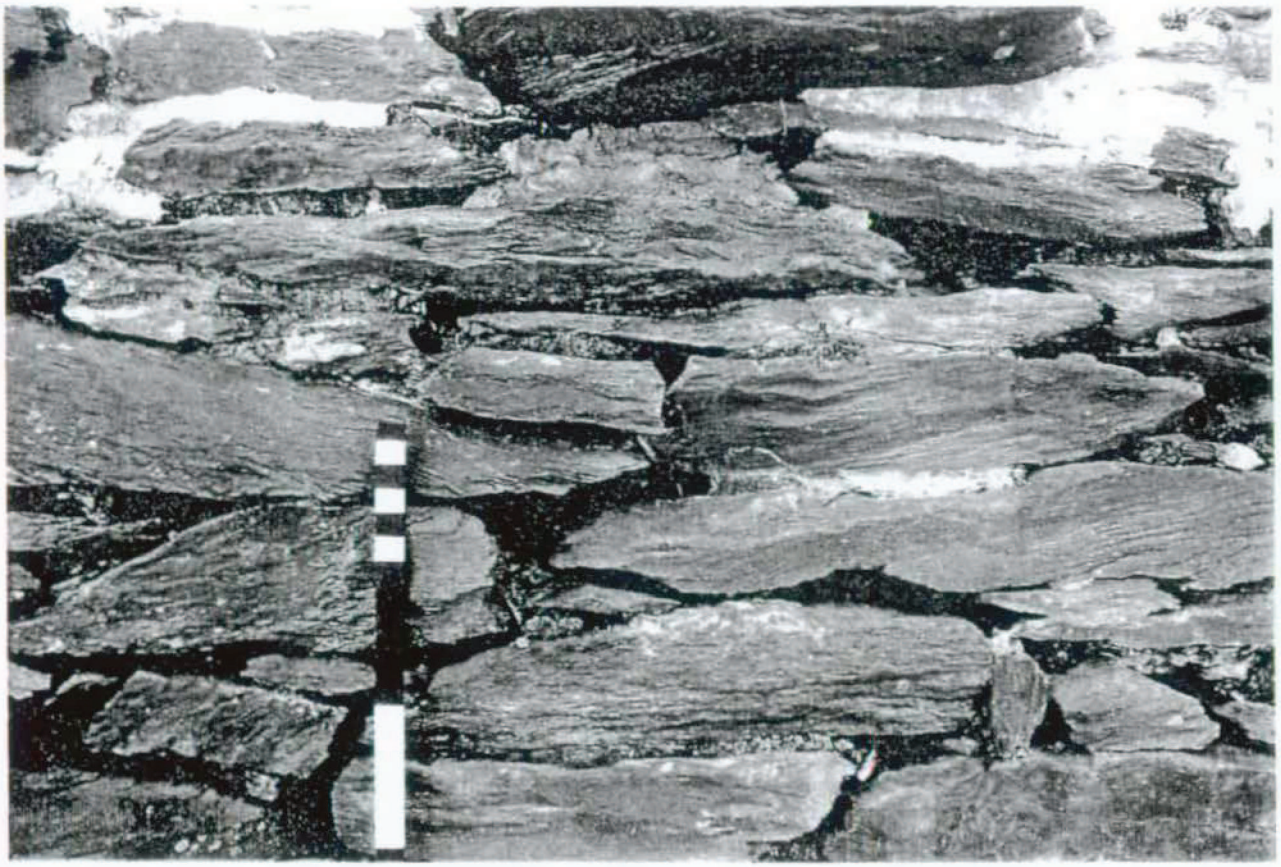
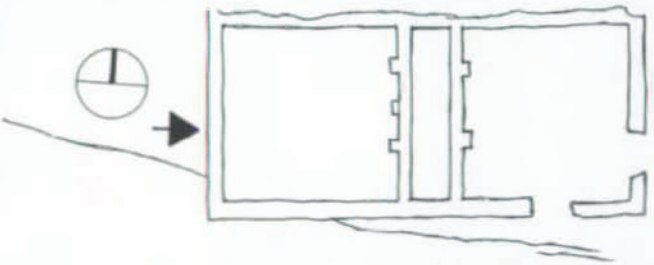


PHOTO: DETAIL N - 3 NORTH WALL . NPS 1993.

NORTH WALL of the Cotton /Flour Mill.
Detail of the Harpers shale coursed rubble wall exhibits the condition of the masonry joints. Historic pointing mortar is nonexistent with later campaigns of portland based mortar left in-situ. Note placement of stones, with direction of grain, pattern, and size.

Treatment:
Remove only deteriorated mortar raking out mortar joints in preparation for pointing with an appropriate and approved mortar mix. Replicate level of historic craftsmanship and historic mortar in color, texture, and joint profile.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island

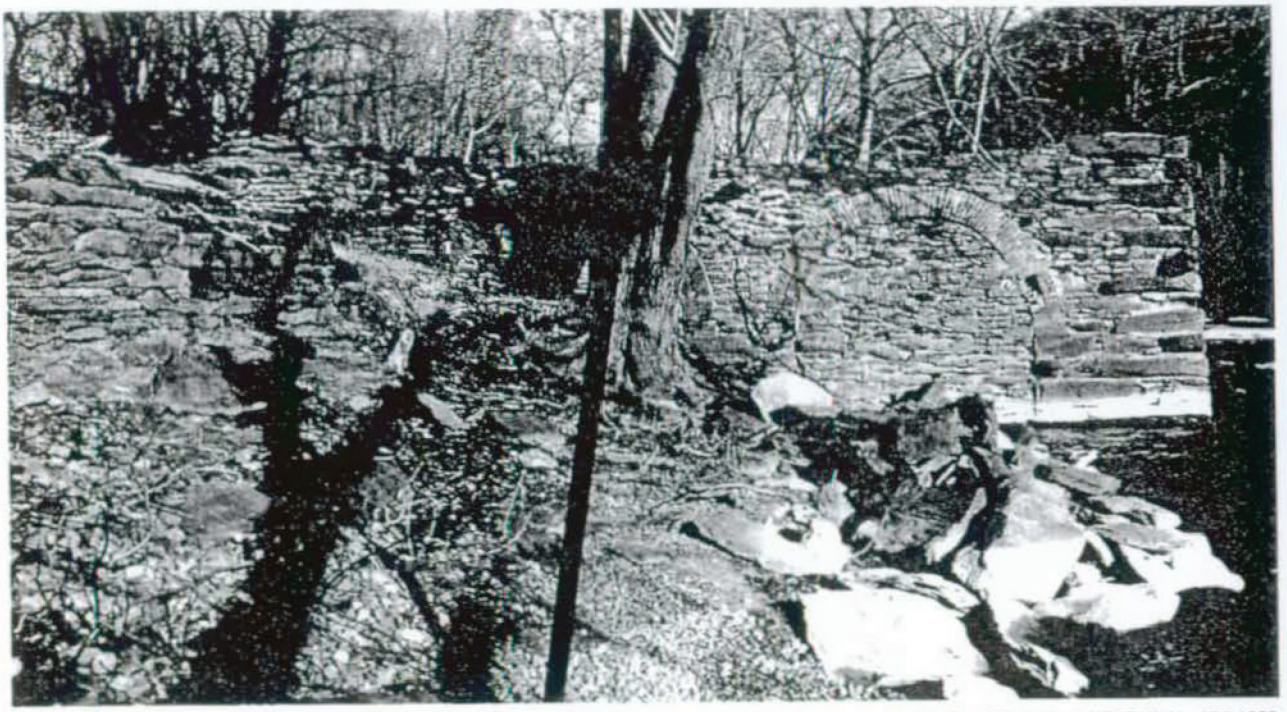


PHOTO: DETAIL W - 1 WEST WALL . NPS 1993.

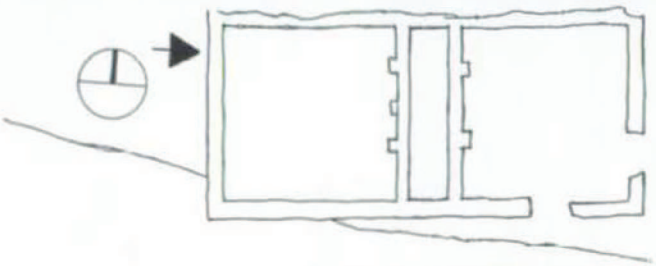
WEST WALL of the Cotton/Flour Mill.

The west wall of the structure is subject to the constant erosion from the river currents as well as seasonal flood waters. The top of the wall between the rubble masonry quoins has been displaced as a result of high water and water born debris. The large rubble quoins in-situ have saved the extant masonry through acting as a dead load anchoring the corners and providing lateral bracing. Siltation on the east face of the west wall also provides lateral bracing when flood waters apply a live load to the structure. Note the integrated brick arches that once served as inlets for the earlier power train. The infill stones are laid in a different manner than that of the gambrel and corner stones.

The large rubble quoins anchor the wall yet intermediate smaller stones along the top of the wall have been displaced.

Treatment:

Stabilization of the length of the wall will involve resetting approximately
260 cf. of coursed rubble masonry - Harpers phyllite - along 36 lf. of wall. Appropriate approved mortar mixes shall be used for the laying and pointing of wall-fall in the immediate area of the wall.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: W - 1 WEST WALL , NPS 1993.

WEST WALL of the Cotton/Flour Mill.

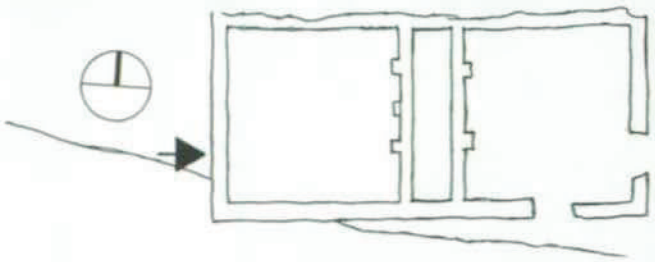
Northwest rubble quoins are well integrated with the extant coursed rubble masonry of the west and north walls. Portland based mortar utilized to repoint the west face of the wall remains in place. Approximately 260 cf of Harpers phyllite has been displaced from 36 lf of the wall relieving the dead load on the spandrel of the infilled brick arches. Rubble infill of the brick arches is Harpers shale pointed with a portland based mortar. Arches of this section of the wall originally were utilized as intake ports prior to the placement of the Leffel turbine system.

The wall has been subject to soil pressure from siltation and constant wave action of river currents. Vegetation in the immediate area of the wall retains the river bank and protects the masonry from water-borne debris. .

Treatment:

A hardwood located at the northwest corner of the structure having a split trunk shall be removed prior to preservation of the structure. The tree's canopy, trunk, and root system shall be removed to to eliminate the hazardous condition and detrimental impact on the quoining stones of the wall.

NOTE: Located near the center of the west wall on the upstream side of the structure a large hardwood cantilevers over the west wall. The tree has aided in stabilizing the river bank and serves as a breakwater against floating debris during times of highwater. One large branch of the tree poses a potential threat to the west wall of the structure , however, if the tree were removed the structure would take the full force of water-borne debris. Leaving the tree in place will require monitoring by the park.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: DETAIL W - 2 SOUTH ARCH of WEST WALL.

DETAIL: South Arch of the WEST WALL.

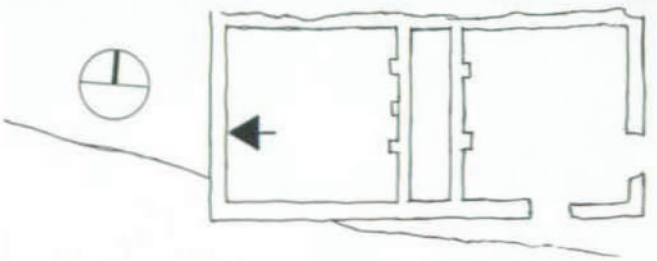
The south infilled brick arch remaining in-situ show signs of displacement or failure prior to infilling of the opening. Repointing of the top segment of the south arch of the wall indicates that mortar may have been severely eroded by flooding. Resetting of individual units of the upstream face and downstream face of the arch is evident. The bricks were relayed utilizing the original alternating pattern of header/stretcher/header on stretcher/stretcher. The common bricks were not gauged or shaped in any way in the original placement or later repairs. Present conditions of the upstream face of the south arch includes a dozen displaced bricks with 20% of the mortar missing or deteriorated.

Treatment:

A - Reset displaced bricks utilizing brick wall-fall of the immediate area as a source. Make certain that broken headers are removed and replaced with a full brick. Note the pattern of the arch bricks beginning with common bond followed by two concentric rings of alternating headers and stretchers, followed by common bond. Replicate bonds when resetting displaced units.

B - Rake out joints removing only deteriorated mortar repointing with an approved mortar mix matching the historic in color, texture. Tool joints to be slightly recessed.

C - Structural stabilization that may assist in prevention of further flood damage shall include the resetting of 260 cf. of Harpers phyllite rubble along 34 lf. of wall. An approved mortar appropriate for the condition and masonry material shall be used when resetting displaced stones. Wall-fall of the immediate area shall be utilized as a source of material. Material shall be placed in a manner replicating historic craftsmanship, patterns, size, shape, and course work.



COTTON / FLOUR MILL

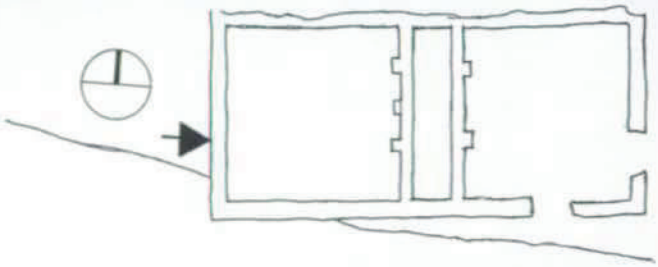
KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: DETAIL W - 3 EAST FACE OF WEST WALL

DETAIL: Downstream East Face of West Wall.
Soil has been deposited on the east face of the wall due to high water resulting in an increased soil pressure. The soil pressure serves as a stabilizer during flooding of the structure through providing buttressing along the entire length of the wall. This natural backfill has retained the wall in-situ. Wall-fall above the soil line on the top of the wall has been displaced and deposited on the eastern side as shown. This wall-fall aids in stabilizing natural backfill. Care should be taken when resetting wall-fall not to create a condition that may lose naturally deposited silt, or decrease the buttressing effect of the backfill. Note the large rubble quoins displaced from the and resting at the base of the south wall.

Treatment:
A - Reset stones of the southwest corner of the structure utilizing the wall-fall in the immediate area as a source of material. Take note of placement of stones in-situ of the southwest and northwest corners of the structure to help determine the placement referencing size, shape, form, of the infill stones and the rubble quoins.
B - Maintain the coursed rubble masonry range of the wall when resetting stones along the top 34 lf. of wall.
C - Prepare infilled brick masonry arches for repointing through removal of only deteriorated mortar. Rake out joints for placement of an appropriate and approved mortar mix replicating sound historic mortar in color, texture, and joint profile.
D - Portland based repointing of the infill rubble masonry where spalling and separation has occurred should be carefully removed as not to damage the face of the stones. The majority of the portland based mortar may be left in-situ if field test verify that removal is in appropriate or damaging.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

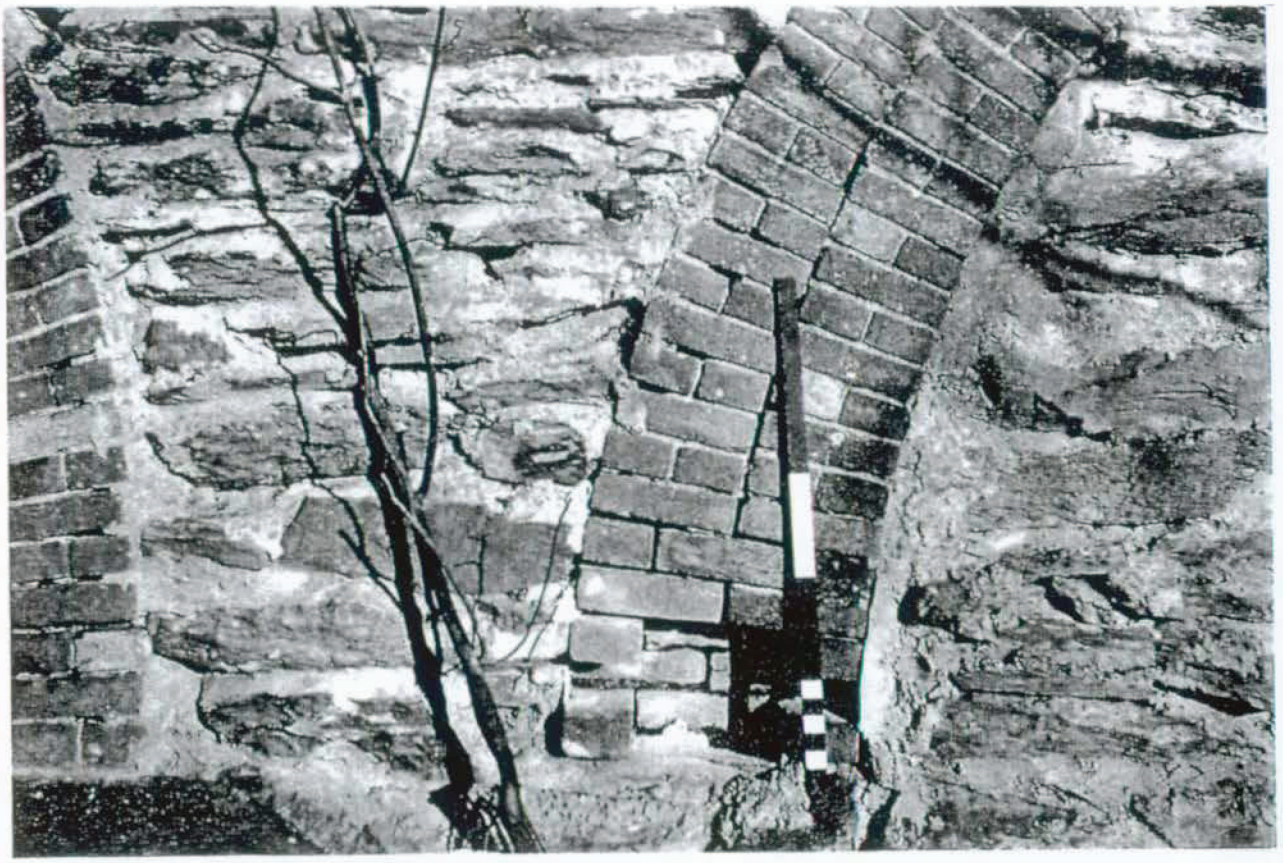


PHOTO: DETAIL W - 4 , ARCH of WEST WALL, NPS 1993.

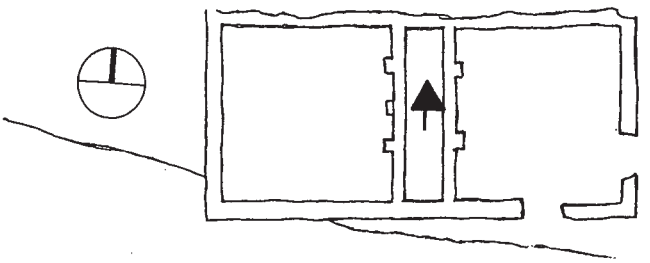
DETAIL: W - 4 West Wall , upstream face of spring of the south infilled arch.

The upstream face of the wall has been repointed utilizing a portland based mortar roughly tooled into rubble masonry joints and around the brick arch elements. Historic mortar of the infilled brick arch remains in place. Solid brick units have been displaced at the spring of the arch exposing inner wythes of brick. A high moisture within the wall content is visually apparent. Note the detail the placement of individual units.

Treatment:

A - Reset displaced solid brick units utilizing wall-fall from the immediate area of the structure and an appropriate approved mortar mix. Replicate historic mortar in color, texture, profile, and craftsmanship.

B - Extant portland based mortar of the coursed rubble masonry shall be left in-situ where further damage to stones would occur. Remove only deteriorated mortar that has spalled or is separating from the masonry. Repoint areas with replicating associated mortar in color, texture, and joint profile.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

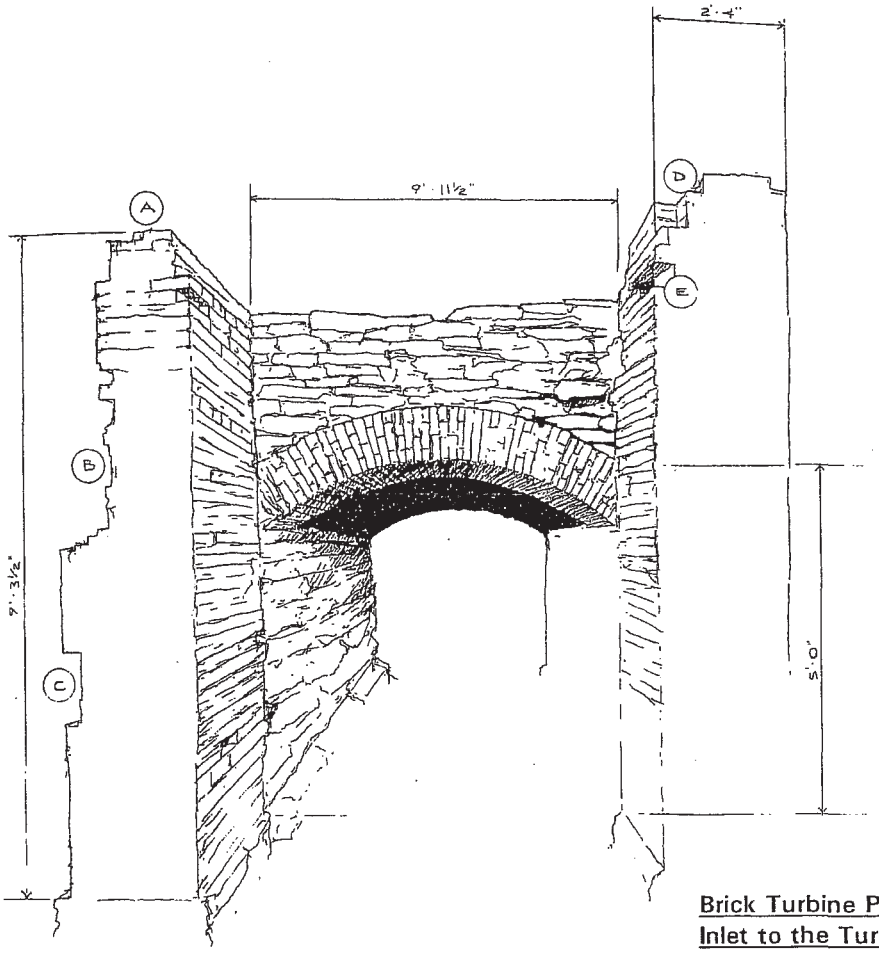
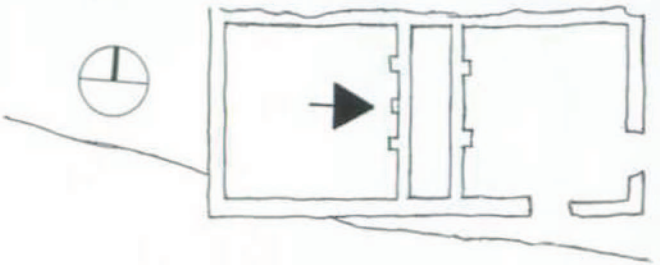


ILLUSTRATION: DETAIL TP W-S Section Turbine Pit.

Brick Turbine Pit of the Cotton/Flour Mill:
Inlet to the Turbine Pit.

This sectional drawing through the turbine pit exhibits common problems with the brick masonry of the structure.

A - Displaced bricks from top of the wall allows moisture penetration.
B - Brick wythes of the west/upstream face of the wall have been broken and displaced through moisture penetration, freeze thaw, and flood water impacting and abrading the mortar joints.
C - Outter wythes of brick have spalled away from the wall through subflorescence, freeze thaw cycles, and flood born debris.
E - Stretchers of the outter wythe of the wall have been displaced through deterioration of mortar of the bed and head joints.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

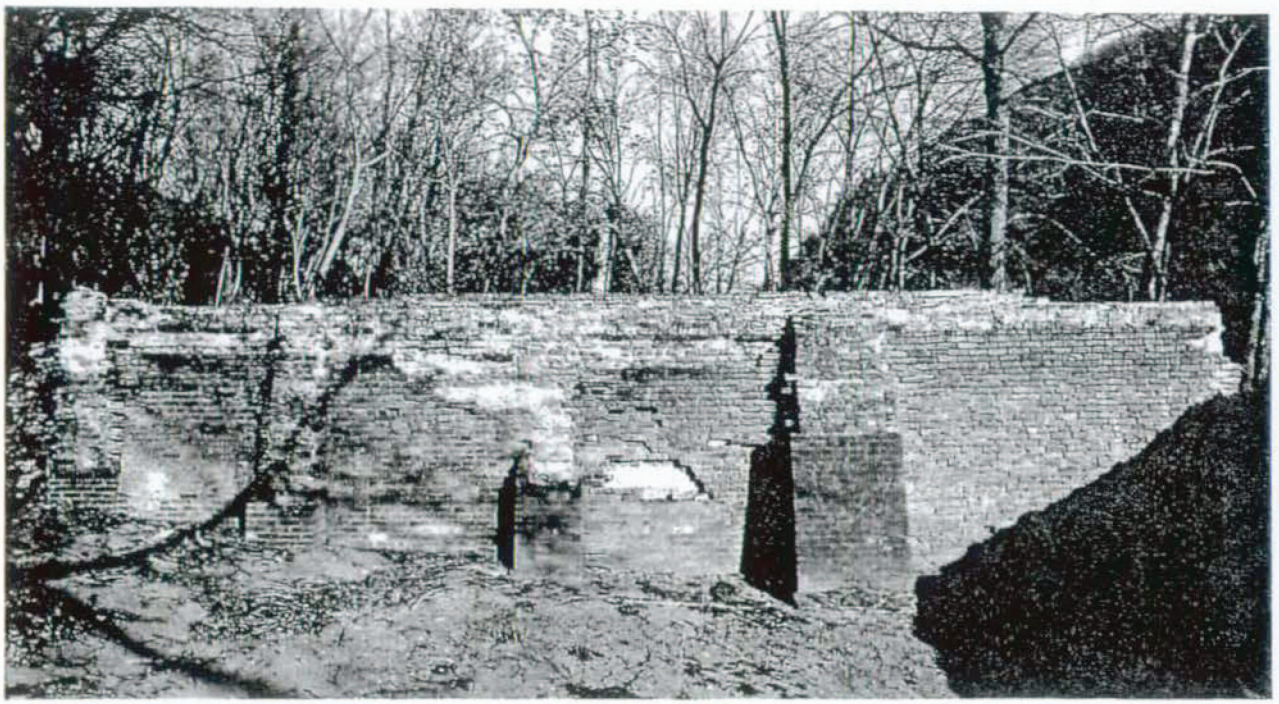


PHOTO: BRICK TURBINE PIT WEST WALL , NPS 1993.

BRICK TURBINE PIT: West Wall -

North Pilaster A:

Placed at the juncture of the north rubble masonry wall and the west wall of the turbine pit the pilaster has severely deteriorated. The base of the pilaster remains in tact offering a footprint to base placement of stabilizing units. Headers have been displaced leaving voids within the outer wythe of the wall, while the core of the pilaster remains as deteriorate and missing units.

Treatment:

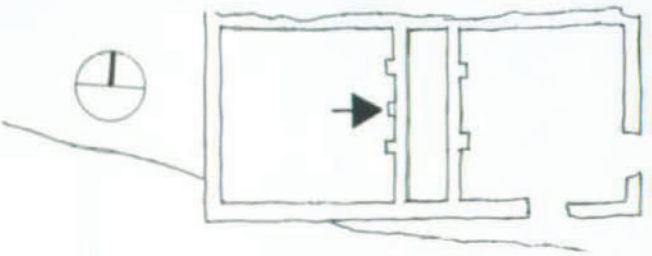
Stabilize the pilaster through infilling displaced masonry units with wall-fall from the immediate area of the wall. Utilize an appropriate and approved mortar mix for placement and repointing of masonry. Remove mortar that has deteriorated leaving sound mortar in place. Match historic mortar in color, texture, and joint profile.

Pilaster B:

Racked back and integrated with the wall this pilaster has been severely damaged with 28 courses of brick displaced or deteriorated. The core of the pilaster remains in-situ with an indication of the outer wythe through remaining headers integrated in the wall.

Treatment:

Stabilization of this pilaster shall involve raking out of deteriorated mortar in preparation of repointing. Broken or deteriorated units should be left in place or reset if necessary. Utilize an approved appropriate mortar mix matching historical mortar in color, texture, joint profile and craftsmanship.



COTTON / FLOUR MILL

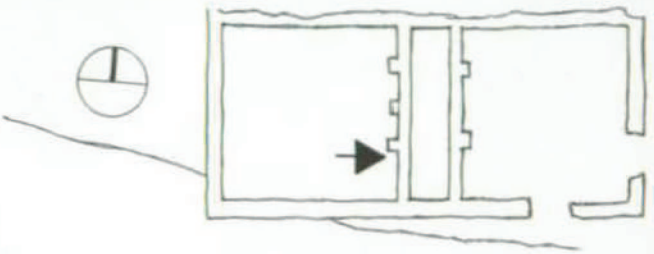
KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: DETAIL TP W - 1 WEST WALL , NPS 1983.

DETAIL: TP W - 1
BRICK TURBINE PIT: West Wall Pilaster C:
More than half of this pilaster is missing as a result of subflourescence, spalling of units, and damage from flood waters. Mortar of the extant section is sound except for what is now the top of the pilaster which is exposed. Moisture penetration through the top of the core has begun to deteriorate courses of masonry.
A ghost of the integrated core remains on the surface of the wall where headers have broken off and stretchers have fallen away. The face of the wall in this area is a collection deteriorated batters and damaged stretchers.

Treatment:
Prepare the top of the extant pilaster for repointing through removal of deteriorated bed mortar. Reset displaced units in an appropriate approved mortar matching the historic in color, texture, and joint profile. Provide a sound and water repellent cap of masonry to eliminate moisture penetration.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

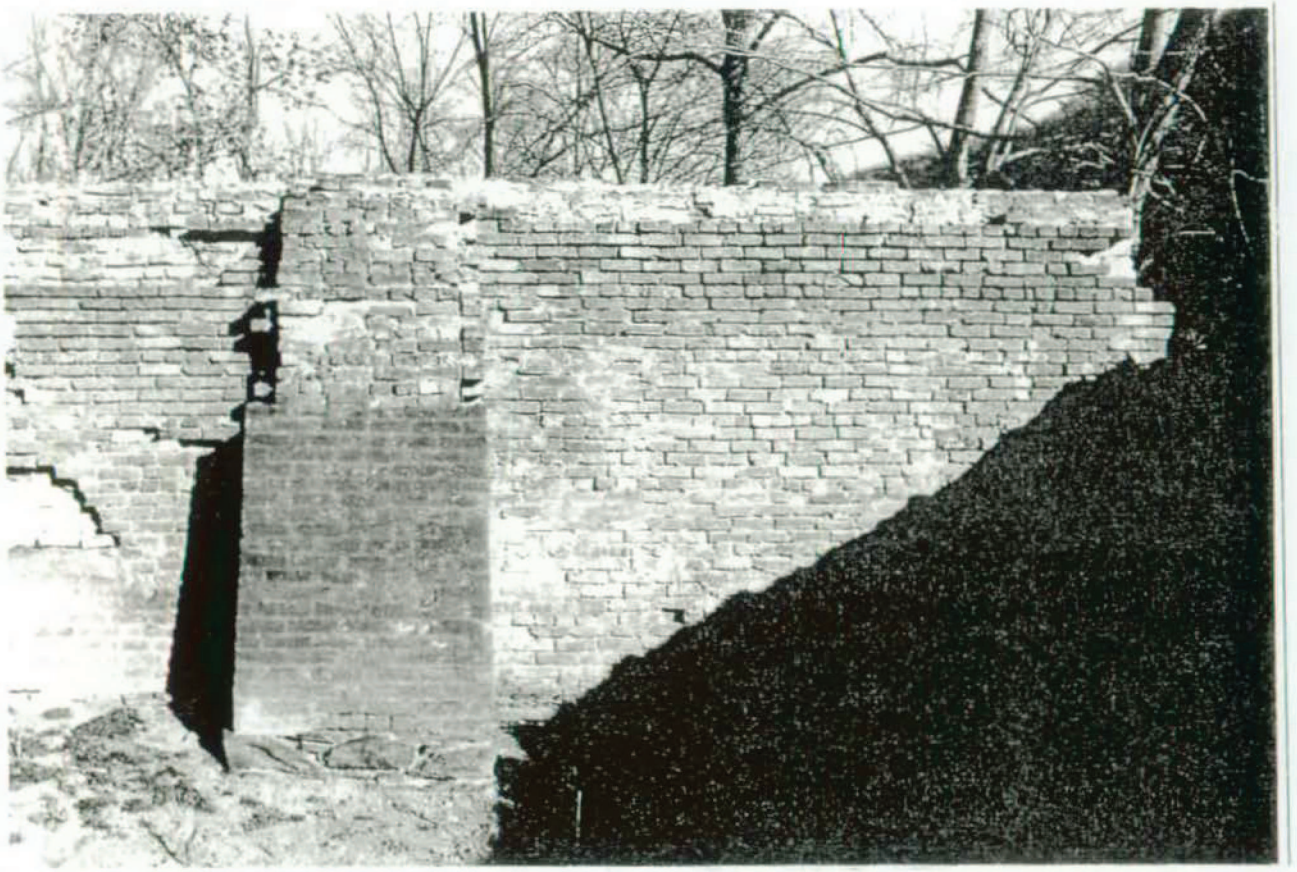


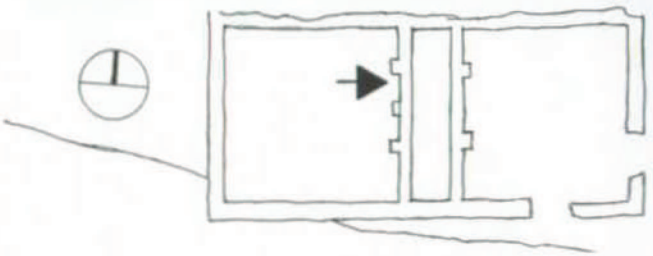
PHOTO: DETAIL TPW - 2 WEST WALL of the TURBINE PIT , NPS 1993.

DETAIL: TP W - 2 BRICK TURBINE PIT:
West Wall Pilaster D:

Largest of the four pilasters the racked buttress shows signs of deterioration primarily with the outer wythe of brick. Headers of the masonry have been broken or have lost associated tieing wythes leaving individual units in place suggesting the original outer finished surface of the pilaster. The Harpers phyllite foundation remains in good condition without displacement of units or signs of compressive failure.

Treatment:

Prepare exposed surface of the masonry to accept a replacement wythe of brick above the twenty-first brick course. Remove excess mortar and batters of headers. Rake out only deteriorated mortar leaving sound mortar in place. Reset displaced and damaged bricks utilizing undamaged wall-fall from the immediate area o the wall. Make certain that preservation work replicates historic brick bonds, placement of headers, slope of racking, and historic mortar in color, texture, and joint profile.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

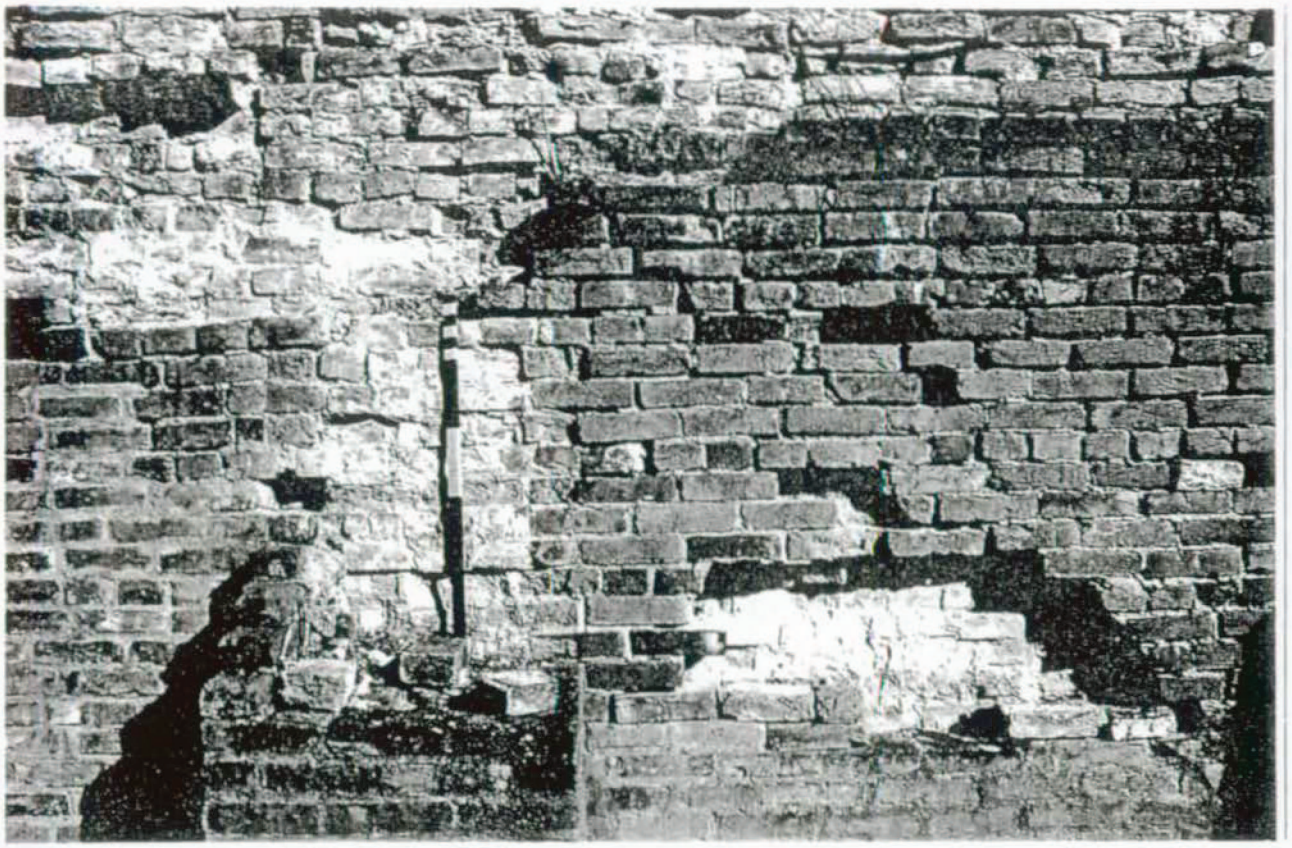
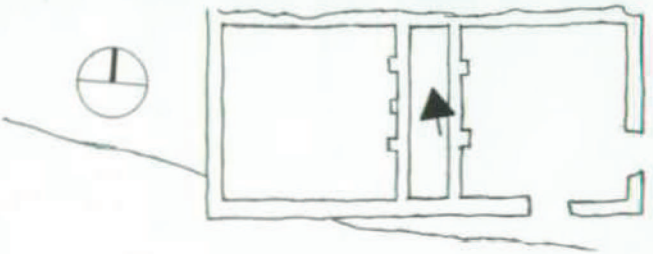


PHOTO: DETAIL TP W - 3 TURBINE PIT WEST WALL , NPS 1993.

BRICK TURBINE PIT: Detail of West Wall.
Typical condition of the brick masonry at the cotton/flour mill.
A - Displacement of outer wythe of brick.
B - Broken headers and displaced stretcher courses.
C - Lime mortar has deteriorated and washed out contributing to displacement of masonry units.
D - Subflorescence has added in the displacement of the outer wythe and spalling of the face of individual units.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

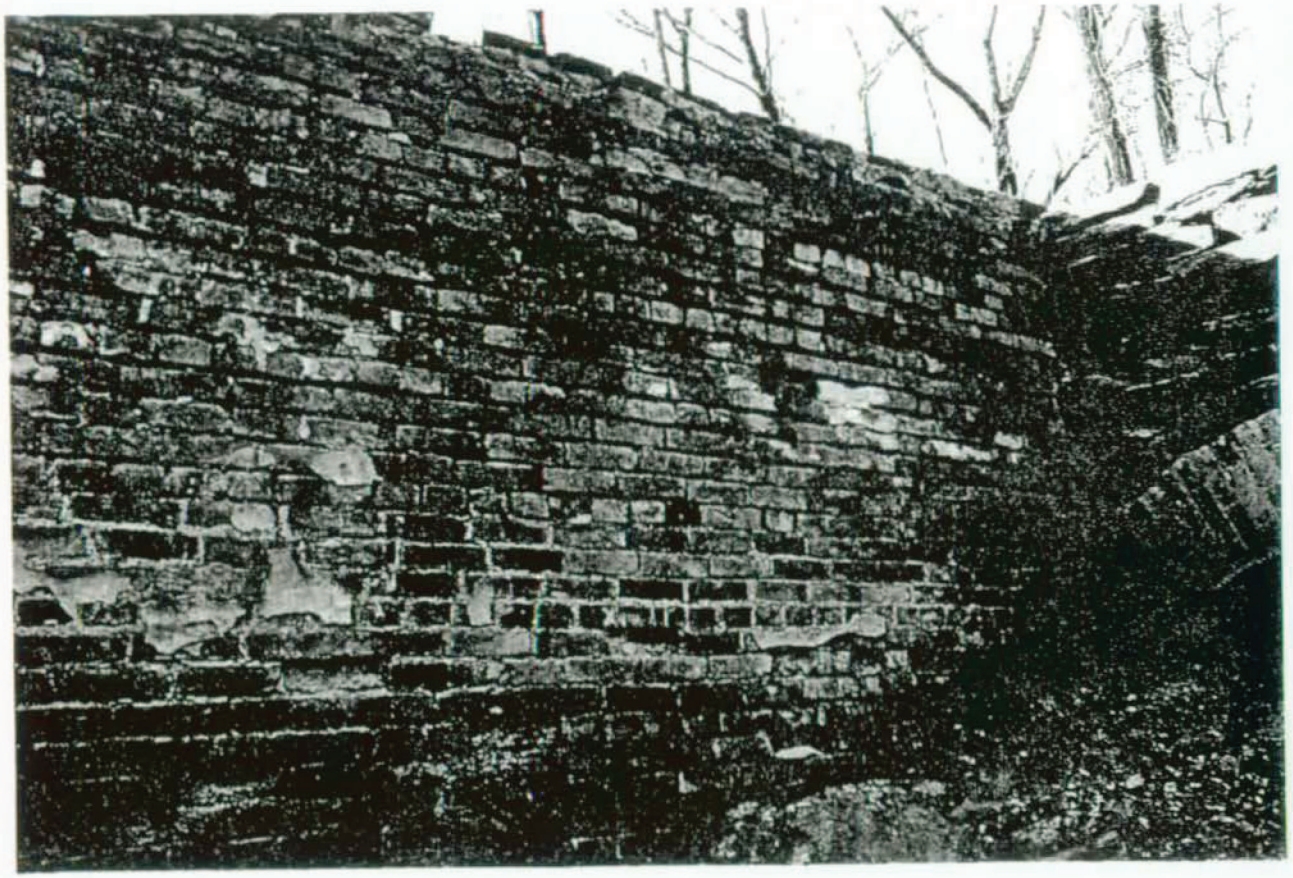
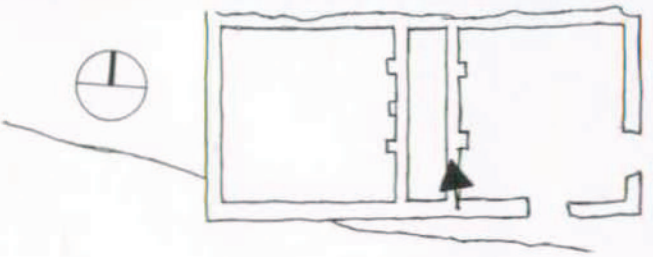


PHOTO: OBLIQUE TURBINE PIT . NPS 1993.

BRICK TURBINE PIT: East Face of the West Wall.
Viewing north northwest at the interior of the east face of the turbine pit the wall is notably in better condition than that of the western exposure. Within the turbine pit the wall has been protected from the impacts of water born debris, direction of dehydration through exposure to the sun, and abrasive action of river currents.
Lime mortar has deteriorated washing out of masonry joints contributing to the displacement of individual units of the outer wythe.

Treatment:
A - Reset displaced units at the top of the wall providing a proper wall cap to reduce further deterioration through moisture penetration.
B - Rake out and remove only deteriorated mortar leaving sound mortar in place. Repoint the face of the wall utilizing an approved and appropriate mortar mix replicating the level of historic craftsmanship, and historic mortar in color, texture, and joint profile.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

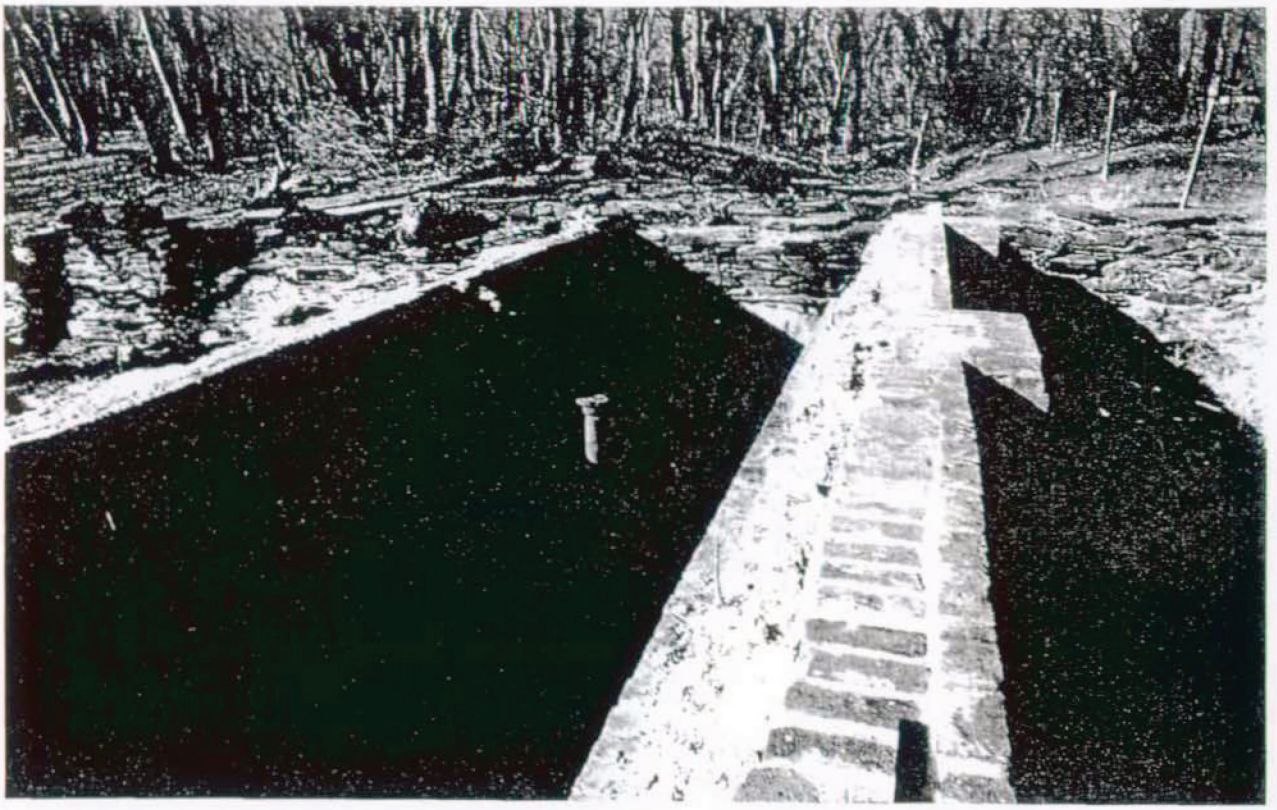
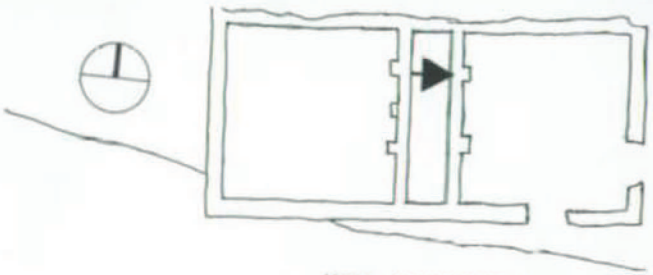


PHOTO: OBLIQUE of TURBINE PIT VIEWING NORTH . NPS 1993.

BRICK TURBINE PIT: Viewing North.
Note the displacement of brick courses on the western edge of the caps of both walls of the turbine pit. Flood waters carrying debris have had an impact on the caps of the walls reducing their ability to
properly shed moisture. Repeated lateral impacts and saturation of the wall followed by freeze thaw or rapid drying has contributed to the deterioration of mortar and displacement of units.

Treatment:
Remove deteriorated mortar for proper bedding of a new wall cap.
Reset displaced units along the top of the wall laying in historic bond patterns, removing batters replacing with full headers or stretchers. The mortar shall replicate historic mortar in color, texture, joint profile, and level of historic craftsmanship. Make certain that the new wall cap eliminates standing water along the top of the wall and corrects for weathertight meeting at the juncture of the brick wall and rubble masonry.



KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON / FLOUR MILL

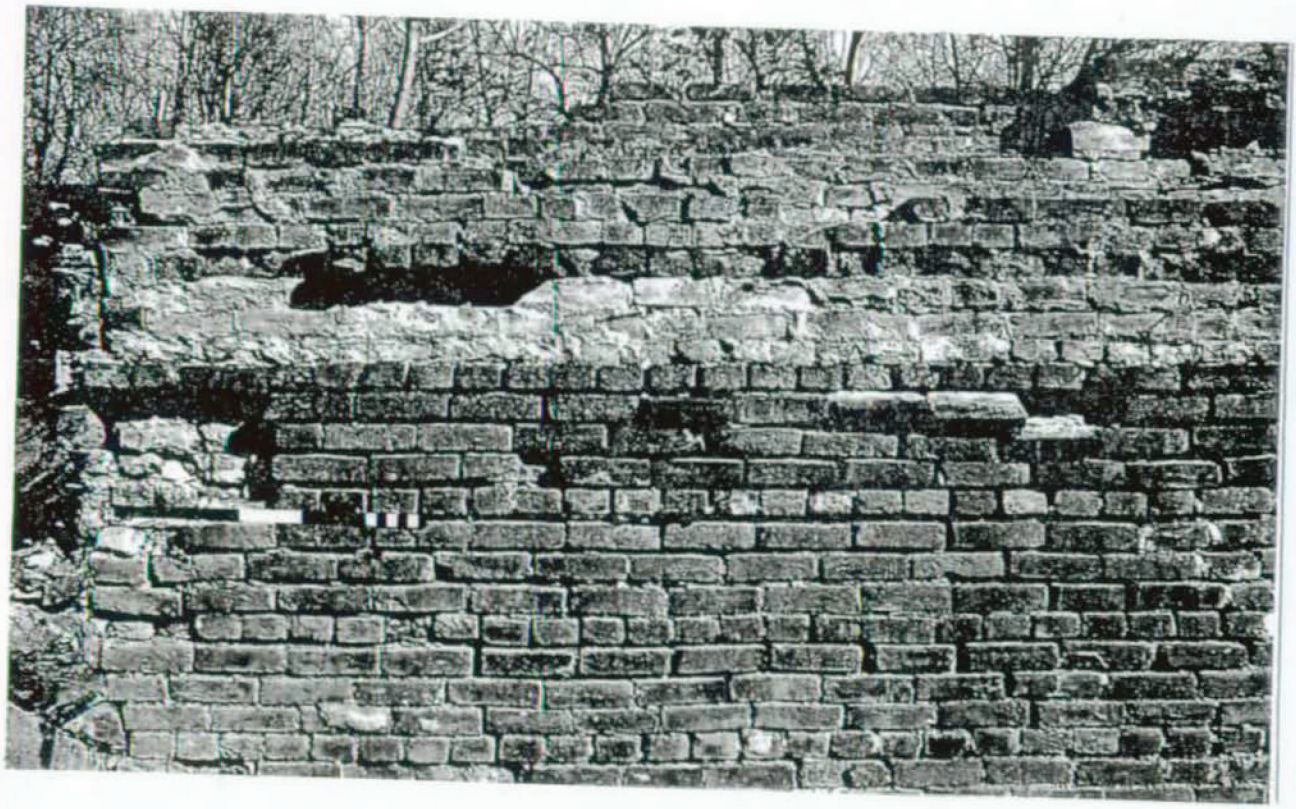


PHOTO: DETAIL TP E - 1 TURBINE PIT EAST WALL . NPS 1993.

DETAIL TP E - 1 BRICK TURBINE PIT:
West face of East Wall.

Typical conditions of the masonry of the entire wall are shown in this view with displacement of stretcher courses, broken headers, and wash out of masonry joints. The top of the wall has been subject to the impacts of water born debris, saturation, freeze-thaw, and rapid dehydration during high temperatures.

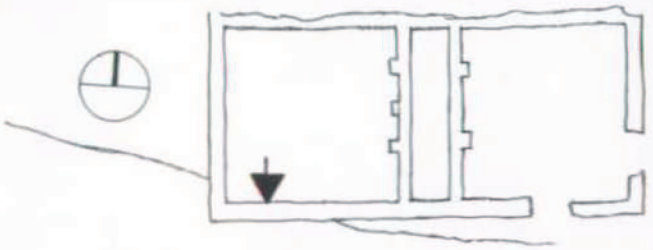
Treatment:

Critical:

Rake out and remove deteriorated mortar from bed and head joints at the cap of the wall in preparation of placement of a new coping utilizing wall-fall from the immediate area and an appropriate and approved mortar mix.

Desirable:

Prepare the entire wall surface for repointing through removal of the deteriorated mortar. Repoint the entire face of the wall utilizing an appropriate and approved mortar mix matching historic in color, texture, and joint profile (slightly recessed).



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: DETAIL 6 - 1 SOUTHWEST CORNER of SOUTH WALL NPS 1993.

SOUTH WALL of the Cotton/Flour Mill.

Viewing south at the southwest corner of the structure the coursed rubble masonry of Harpers phyllite has been displaced through impacts of flood water, and water born debris. Associated stones remaining in place have been pointed with a portland/lime mortar indicating an inconsistent repointing campaign or a past level of siltation. Masonry has fallen away as individual units of coursework. This type of failure is less damaging and more acceptable than a monolithic failure that may result from laying of stone in a portland based mortar.

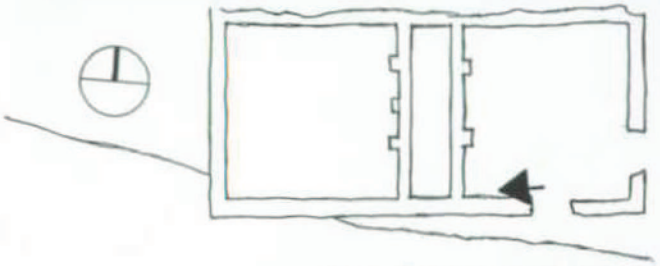
Treatment:

Priority:

Reset coursed rubble masonry of Harpers phyllite utilizing associated wall-fall at the base of the wall to reinforce the corner from further wall failure or loss of rubble masonry quoining.

Second Priority:

Reset 54 lf of coursed rubble masonry along the top of the wall reloading the spandrels of the arch.



KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region

COTTON / FLOUR MILL

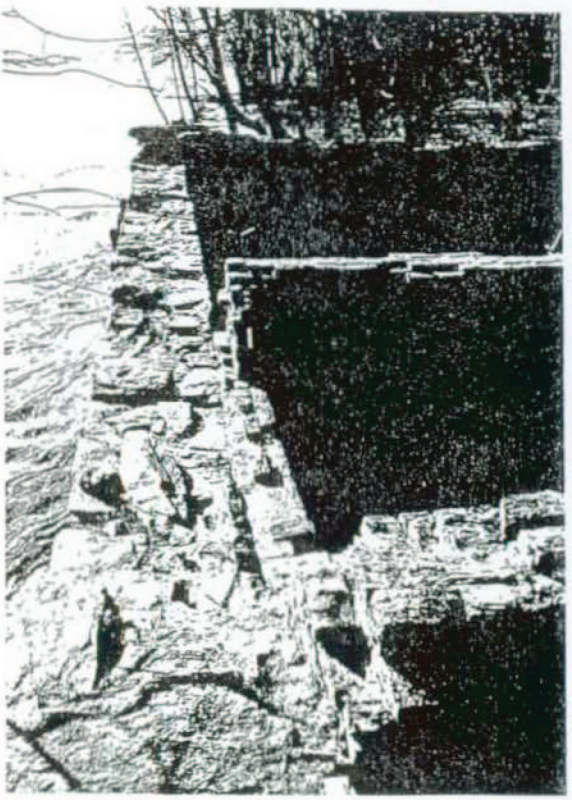


PHOTO: S - 3 OBLIQUE VIEW OF SOUTH WALL , NPS 1993.

SOUTH WALL of Cotton / Flour Mill.

Viewing west along the top of the South Wall displacement of stones is evident above the spandrel of the arch and at the juncture of the brick turbine pit walls. River currents at flood stage running the length of the wall have removed approximately 25 tons of stone from 54 lf. of wall relieving the dead load on the spandrel of the arch and allowing river currents to act upon the south ends of the brick turbine pit walls. Fifteen lineal feet of a three foot high triple wythe brick wall has been displaced with further action of flood waters on the south end of the east brick wall of the turbine pit.

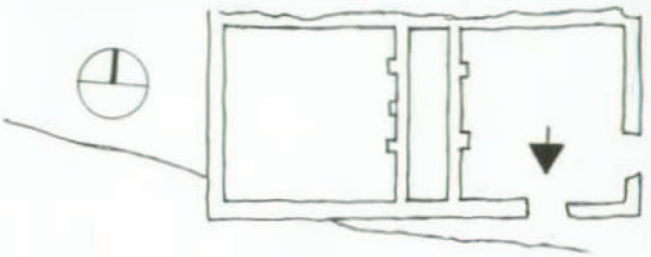
Treatment:

Critical:

Reset section of wall-fall at the southwest corner of the structure to reinforce existing rubble quoin at the top of the wall.

Desirable:

Relay 430 cubic feet of Harpers phyllite coursed rubble masonry wall utilizing wall-fall in the immediate area as a source. Stabilization through placement of coursed rubble masonry shall replicate historic craftsmanship in appearance and technique. Note placement of stones, size of individual units, and an approved mortar mix matching historic in color, texture, and joint profile.



COTTON / FLOUR MILL

KEY: STABILIZATION PLAN
Virginius Island
Harpers Ferry National Historical Park
National Capital Region



PHOTO: NORTH FACE of SOUTH WALL at the FAILED ARCH , NPS 1993.

SOUTH WALL of the Cotton/Flour Mill.

Viewing south at the north face of the south wall displaying the condition of the failed arch. Arch failure may have been due to monolithic failure and nonexistent dead load on the spandrel of the arch. Intrados had been pointed with a portland based mortar as evident with residual mortar on failed stones that may have contributed to the displacement of the arch elements when under hydraulic lateral loads. Early stabilization measures utilizing timber posts as shoring may have disrupted the distribution of weight of the arch elements applying an upward and lateral force during times of flooding resulting in structural failure. Displace units of the arch have been deposited at the foot of the arch and downriver along the bank.

Treatment:

Priority:

Reset displaced coursed rubble masonry on the east and west side of the arch to stabilize extant arch elements in place. Utilize wall-fall in the immediate area of the wall set in an approve and appropriate mortar mix matching the associated historic mortar in color, texture, and joint profile.

Second Priority:

Curate displaced elements of the arch subject to total loss that have been deposited downstream from the structure.

Rake out deteriorate mortar in preparation for repointing the entire face of the wall. The south face of the wall subject to past campaigns of portland based mortar may not require repointing.

APPENDIX A : Mortar Specification

COTTON / FLOUR MILL

Virginius Island Stabilization Plan
Harpers Ferry National Historic Park
National Capital Region
Proportion Specification Requirements: MORTAR

POINTING MORTAR PROPORTIONS for Structural Solid Fired Brick Masonry

Mortar	Portland Cement	Hydrated Lime	Aggregate Ratio
Cement-Lime	01	03	Not less than 2.25 and not more than 3 times the sum of the separate sum of the volumes of cementitious materials.

CONDTION NOTES:
The brick turbine pit walls are seasonably submerged and are subject to subsequent freeze-thaw cycles that may damage the extant separate campaigns of pointing mortar and masonry units. Subflorescence in the masonry is related to the brick turbine pit walls constant saturation and wicking of moisture from mean river levels. Lime based historic mortar of the outer wythes has deteriorated due to physical impacts, freeze-thaw cycles, subflorescence, and efflorescence. Proportion Specifications as designated allow for a range in proportion of sand for matching historic mortar in color and texture without significantly changing the physical properties of the mortar composition. Proportion Specification Requirements noted above shall be utilized for the bed mortar of displaced units.

POINTING MORTAR for Coursed Rubble Masonry of Harpers Ferry Phyllite

Mortar	Portland Cement	Hydrated Lime	Aggregate Ratio
Cement-Lime	01	02	Not less than 2.25 and not more than 3 times the sum of the separate volumes of the cementitious materials.

CONDITION NOTES:
Coursed rubble masonry of Harpers Phyllite of the Cotton / Flour Mill has a high compressive strength ranging from 35000 psi to 55000 psi. There is no evidence of damage to individual stones within the wall. Displacement of stones from flood water and water-borne debris is the primary means of deterioration of the stone walls.

BEDDING MORTAR for Structural Coursed Rubble Masonry of Harpers Phyllite

Mortar	Portland Cement	Hydrated Lime	Aggregate Ratio
Cement-Lime	.75 to 01	02	Not less than 1.75 and not more than 2.25 times the sum of the separate sum of the volumes of cementitious materials.

CONDTION NOTES:

The coarsed rubble masonry of Harpers Phyllite of the Cotton / Flour Mill has a high compressive strength ranging from 35,000 psi to 55,000 psi. There is no evidence of damage attributed to the strength of later campaigns of pointing. Flood water and water-borne debris have been factors contributing to the displacement of individual stones.

MORTAR MATERIALS

WHITE PORTLAND	ASTM C150
HYDRATED LIME	ASTM C207
SAND	ASTM C144

MATERIAL NOTES

Either natural or manufactured sands may be used and should be clean, sound, and well graded with all sizes and particles ranging in size from very fine to coarse material not larger than that in the sand sample provided or from additional field sample tests.

APPROVAL

Sand samples, and test patches of mortar shall be approved by WPTC, Park architect and NCR notified.

GENERAL

Drape all masonry with dampened burlap following implementation of new campaign of pointing.
Transport water for mortar in rust-free containers.
Masonry units and stone shall be cleaned prior setting or relaying.

APPENDIX B : Phase I and Phase II Stabilization Annotated Drawings

IX. Project Cost Estimate: Please note that this cost estimate is based on the amount of funding available in FY'93. The day labor work element below represents the maximum commitment of WPTC personnel and resources available under the FY'93 WPTC construction program.

PHASE I Cost Estimate: Stabilization of the Cotton/Flour Mill.

MASON CREW.			
MASON W-10	200hours	$15.67/h	$3134.00
MASON W-10	200hours	$15.67/h	$3134.00
Maint. Helper W-5	200hours	$13.10/h	$2620.00
Maint. Helper W-5	200hours	$13.10/h	$2620.00
Maint. Helper W-5	200hours	$15.52/h	$3104.00
PROJECT LEADER GS-7	240hours	$24.43/h	$5863.20
PROJECT SUPERVISOR 01	100hours	$30.28/h	$3028.00
Per Diem		Not applicable	$0000.00
SUBTOTAL:			$23503.20
MATERIAL COST.			
Mortar.			
150 cf mortar @ $3.00/cf			$ 450.00
Masonry.			
Stone	1ton(wallfall)		$ 00.00
Brick	200 units(wallfall)		$ 00.00
Equipment Rental.			
Truck 1.25 months @ $400.00/month			$ 500.00
Truck 1.25 months @ $400.00/month			$ 500.00
Portable Toilet 1.25months @ $100.00/month			$ 150.00
Subtotal:			$ 25103.00
Project Completion Report.			$1500.0
Subtotal:			$26351.20
WPTC overhead			$ 8778.00
PHASE I Stabilization Cotton/Flour Mill TOTAL			**$35,382.00**

PHASE II Cost Estimate: Stabilization of the Cotton/Flour Mill.

MASON CREW.			
MASON W-10	560 hours	$15.67/h	$8775.00
MASON W-10	560 hours	$15.67/h	$8775.00
Maint. Helper	560 hours	$13.10/h	$7336.00
Maint. Helper	560 hours	$13.10/h	$7336.00
Maint. Helper	560 hours	$13.10/h	$7336.00
PROJECT LEADER	600 hours	$23.55/h	$14130.00
PROJECT SUPERVISOR	280 hours	$29.20/h	$8176.00
Subtotal:			$61864.00

Material Cost.

Masonry:

Stone 890 cf @ 140#/cf = 62.30 tons @ $160.00/ton $9968.00

(Cost per ton references availability and site retrieval of wallfall)

Mortar:

300 cf @ $3.00 cf $ 900.00

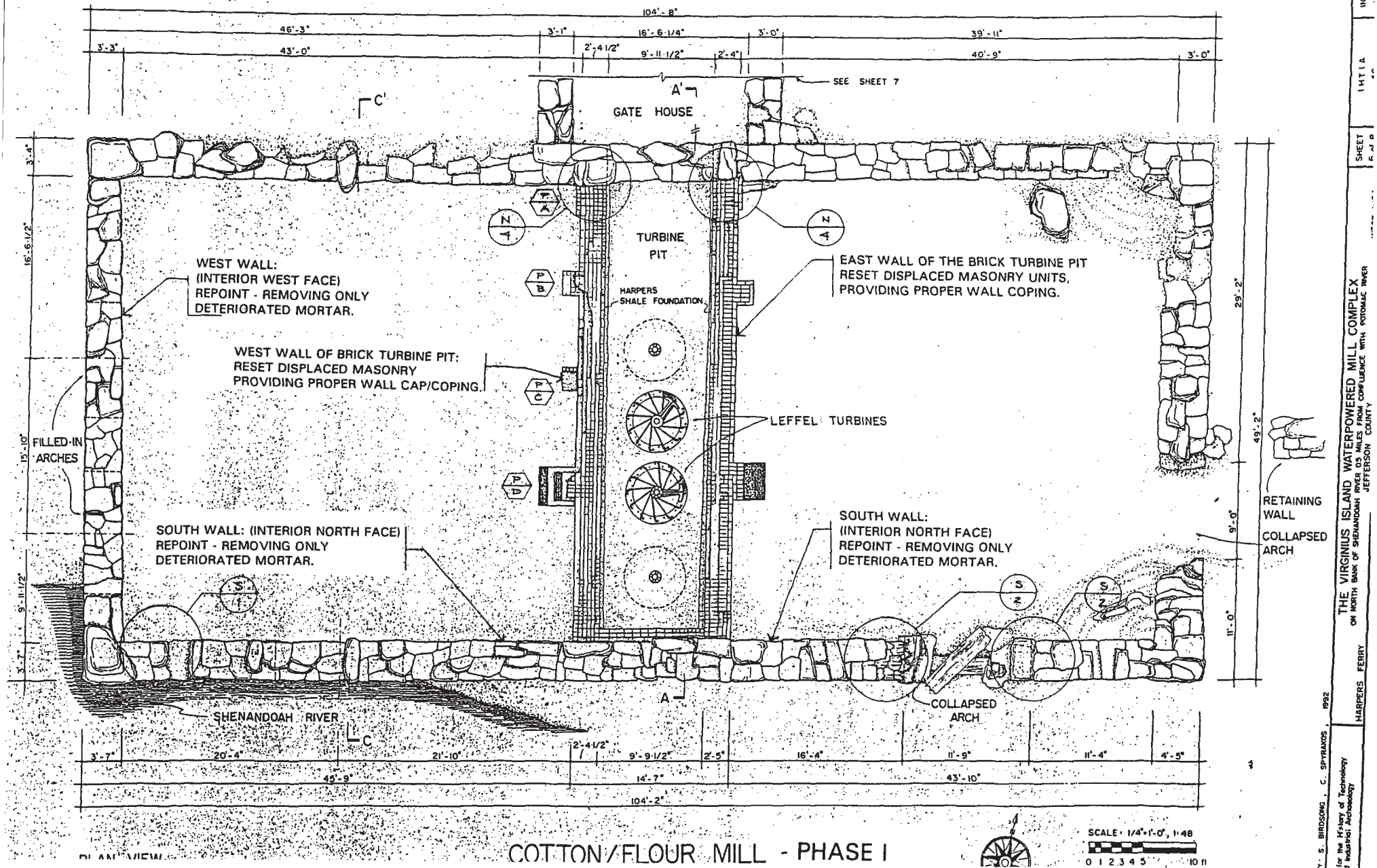
Equipment Rental.

Truck 3.5 months @ $400.00/month	$1400.00
Truck 3.5 months @ $400.00/month	$1400.00
Portable Toilet 3.5 months @ $100.00/month	$ 350.00
All Terrain Crane Rental 3.5 months @ $5750.00/month	$20125.00
Subtotal:	$96,007.00

Project Completion Report. $1500.00

WPTC Overhead $32,177.00

PHASE II Stabilization Cotton/Flour Mill TOTAL: $129,684.00



COTTON/FLOUR MILL - PHASE I

PLAN VIEW

SCALE: 1/4"=1'-0", 1:48

0 1 2 3 4 5 10 ft

THE VIRGINIUS ISLAND WATERPOWERED MILL COMPLEX
ON NORTH BANK OF SHENANDOAH RIVER 0.5 MILES FROM CONFLUENCE WITH POTOMAC RIVER
JEFFERSON COUNTY

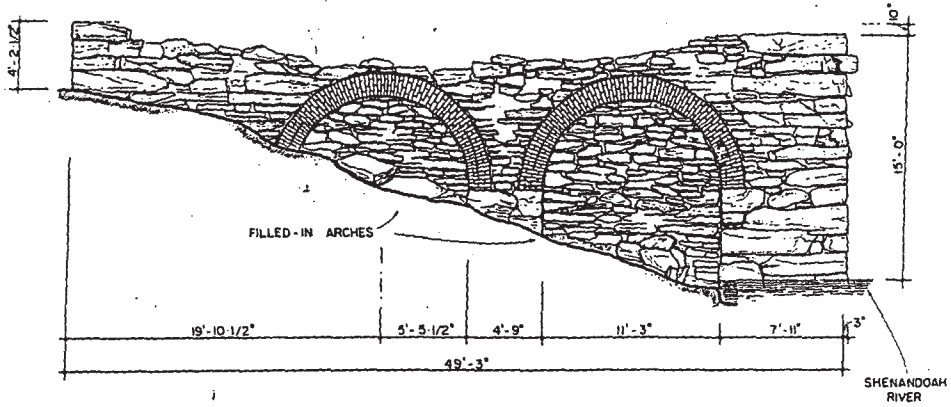
HARPERS FERRY

INT

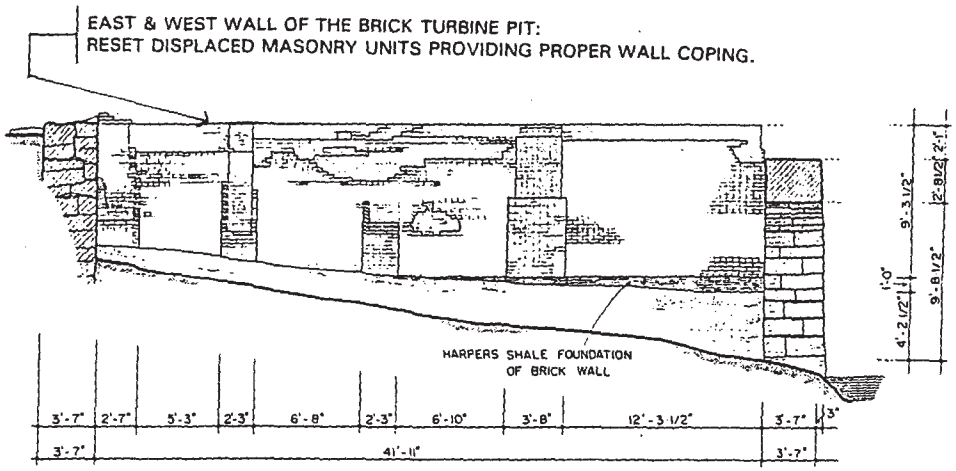
SHEET

1992

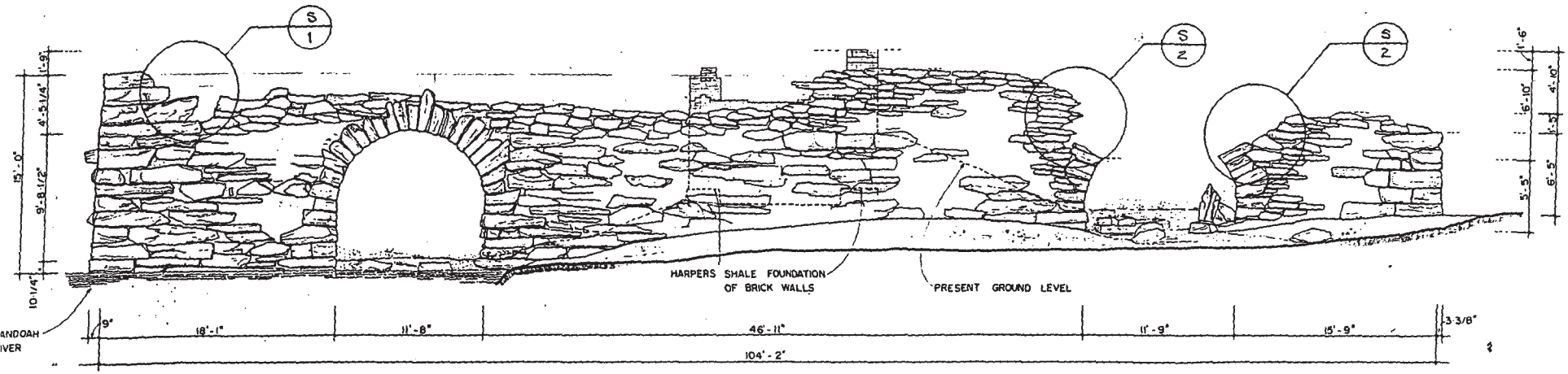
for the History of Technology
d Industrial Archaeology



WEST ELEVATION



SECTION C-C'



SOUTH ELEVATION

COTTON / FLOUR MILL - PHASE I

SCALE · 1/4"=1'-0", 1:48

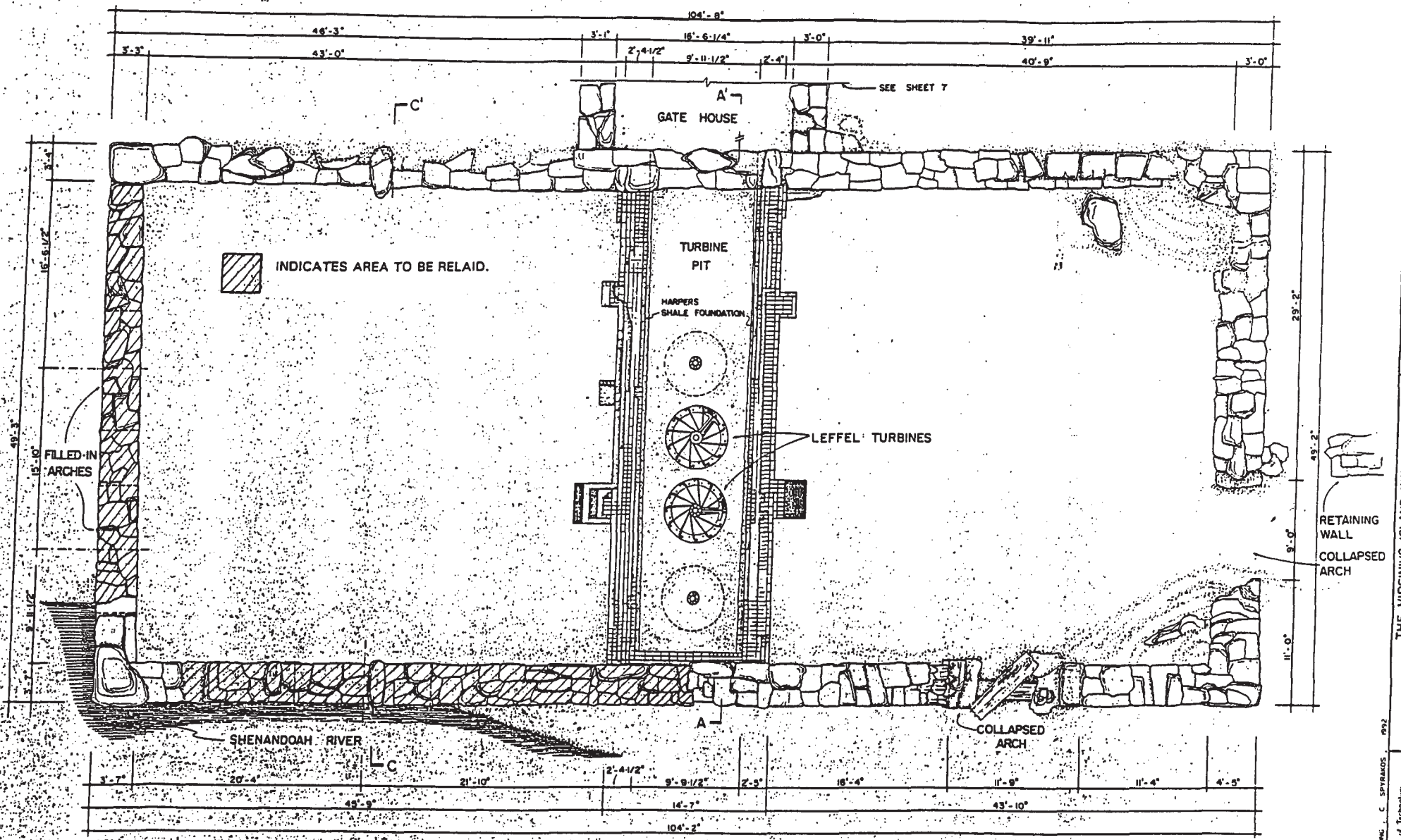
0 1 2 3 4 5 10 11

THE VIRGINIUS ISLAND WATERPOWERED MILL COMPLEX

INIT | HTIA | SHEET

ED BY B. COFFEY, C. SPYRAKOS, 1932

ute for the History of Technology



PLAN VIEW

NOTES: DASHED LINES INDICATE VISIBLE GROUND INTERSECTION OF ARCHES.
BATTER OF WALLS NOT ILLUSTRATED SEE SHEET 8

COTTON/FLOUR MILL - PHASE II

SCALE: 1/4"=1'-0", 1:48

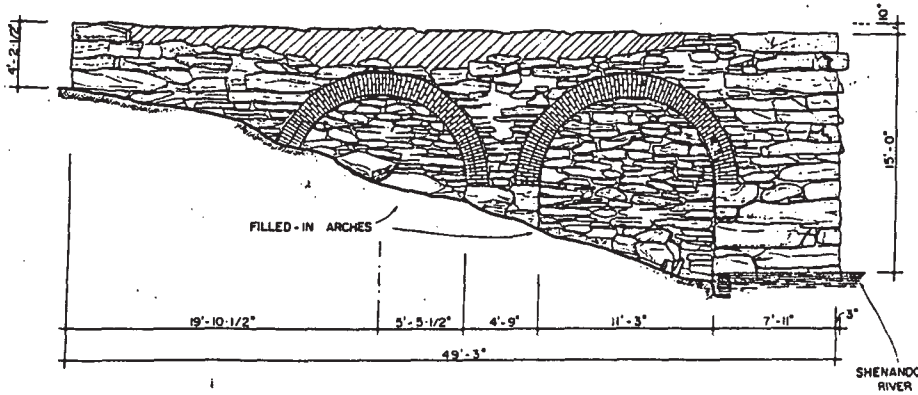
0 1 2 3 4 5 10 ft

THE VIRGINIUS ISLAND WATERPOWERED MILL COMPLEX

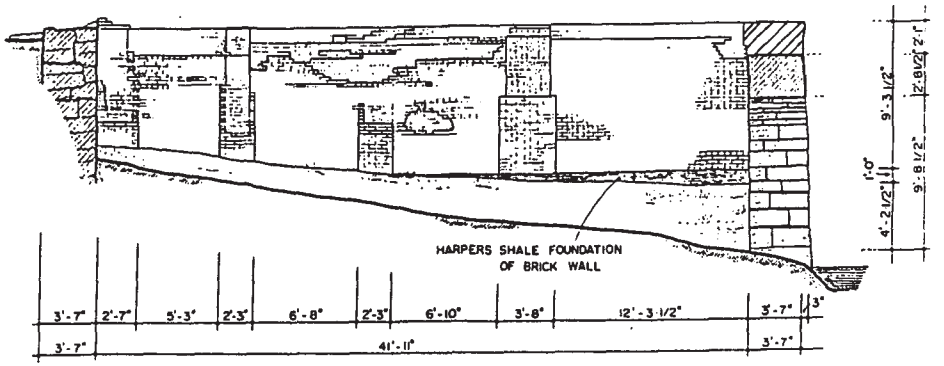
J. H. S. BHODSENG, C. SPYRAKOS, 1982

for the History of Technology

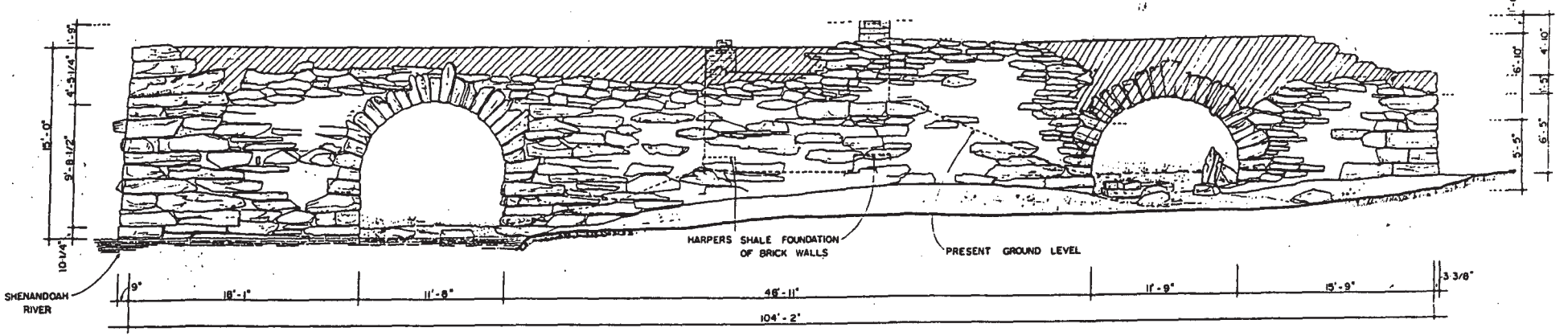
INDICATES AREA OF COURSED RUBBLE MASONRY TO BE RELAID.



WEST ELEVATION



SECTION C-C'



SOUTH ELEVATION

COTTON/FLOUR MILL - PHASE II

SCALE - 1/4"=1'-0", 1:48

0 1 2 3 4 5 10 ft

0 1 2 3 m

THE VIRGINIUS ISLAND WATERPOWERED MILL COMPLEX

On North Bank of Shenandoah River 10 miles South of Harpers Ferry, West Virginia

SHEET

DRAWN BY B. COFFEY, C. SPYRAKOS, 1992

Institute for the History of Technology and Industrial Archaeology

ARCHEOLOGICAL CLEARANCE
AT THE
VALLEY COTTON MILL (1849-1852)
ON
VIRGINIUS ISLAND-HARPERS FERRY, WEST VIRGINIA



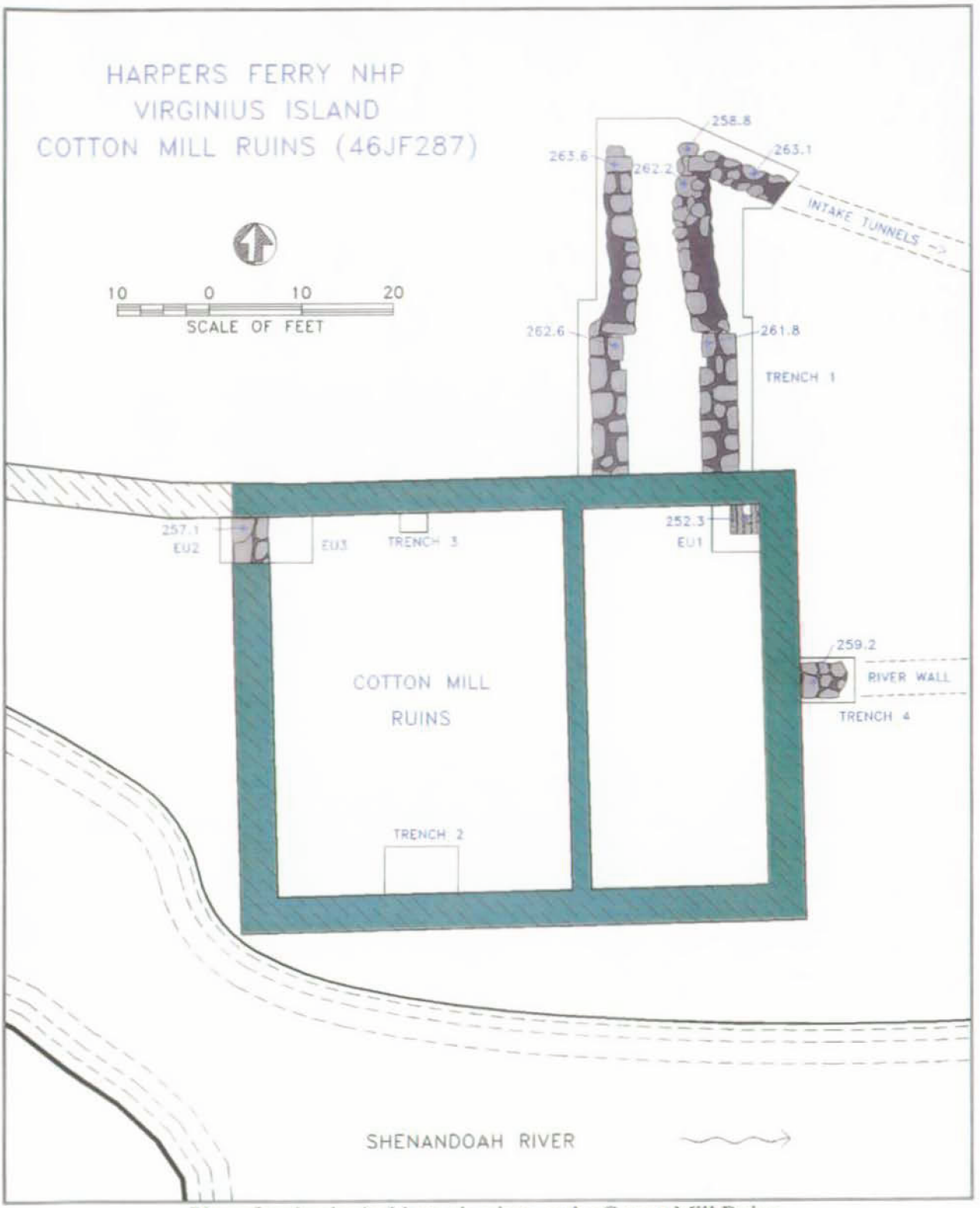
Archeology Program
Harpers Ferry National Historical Park
January 2002

ARCHEOLOGICAL CLEARANCE AT THE VALLEY COTTON MILL (1849-1852) ON VIRGINIUS ISLAND-HARPERS FERRY, WEST VIRGINIA

The Harpers Ferry National Historical Park Archeology Program performed excavations and monitored heavy equipment excavations at the Cotton Mill ruins on Virginius Island from December 3-20, 2001 in order to provide clearance for stabilization work performed by the Historic Preservation Training Center (HPTC). Initially, tree stumps and vegetation was removed from the interior and exterior of the Cotton Mill ruins. Archeological excavations were concentrated in several areas within and surrounding the Cotton Mill ruins. Upper levels of flood deposits were mechanically removed from the interior of the structure and along portions of the exterior walls. HPTC concentrated efforts on recovering and stockpiling shale to use for the stabilization work that will be completed in the coming months.

Trench 1 was excavated north of the foundations from the brick arch to uncover and record any remains of the headrace that supplied water to the mill from the main raceway running across Virginius Island. Archeologists excavated Trench 4 adjacent to the east exterior wall of the Cotton Mill to try to locate the river wall. Excavation Unit 1 was placed in the northeast corner of the interior of the east chamber in order to examine the stratigraphic record and determine the depth of the original floor. Excavation Units 2 and 3 were placed at the northwest corner of the western chamber in order to locate the west foundation wall and examine the stratigraphy and artifact deposits on this part of the site. Trench 3 was placed at the center of the north interior wall of the western chamber to determine if any additional interior walls may be present. Trench 2 was excavated along the south interior wall of the western chamber to uncover and record the condition of the foundations and look for evidence of interior dividing rooms in the west chamber.

The archeology work performed at the Cotton Mill ruins supplied the clearance necessary for HPTC to remove the overburden deposits and continue with stabilization of the masonry features. Features located and documented during this excavation include: the river wall to the east of the Cotton Mill, the head race, a section of wood flooring in the east chamber that housed the water power mechanism, and the northwest corner of the Cotton Mill. More detailed descriptions of the fieldwork are presented below in the form of excavation unit summaries.



Plan of archeological investigations at the Cotton Mill Ruins.

HARPERS FERRY NATIONAL HISTORICAL PARK
EXCAVATION UNIT SUMMARIES FOR THE
COTTON MILL (VALLEY MILLS), VIRGINIUS ISLAND
SITE # 46JF287

EXCAVATION UNIT 1

Excavation Unit 1 measured 5 x 5 ft. It was opened at the interior northeast corner of the eastern chamber of the cotton mill ruins. The purpose of this excavation was to examine the stratigraphy, determine depositional history and recover any remaining artifacts associated with the historic use of the structure. A stone near that supports the brick arch feature was used as a datum for elevation in this unit.

Stratum A was the uppermost level of flood deposit that settled within the interior chamber. The deposit is characterized by 10YR 5/6 yellowish brown sand containing various sizes of river cobbles. The deposit has an average thickness of 1.3 ft. Five large shale stones were noted on top of the next level, Stratum B. No artifacts were collected from this non-historic flood episode.

Stratum B consists of 10YR 3/3 dark brown sandy clay with increased amounts of sand at lower depths. A lense of freshwater bivalve shells were prevalent at the top of this stratum. The average thickness of this stratum is 1.68 ft. Modern artifacts were noted but not collected from this flood-deposited stratum.

Stratum C was reduced to a 1.5 ft. EW x 3 ft. NS recovery unit in the northeast corner of Excavation Unit 1. This decision was based on the need to step the unit for safety/access purposes. The soil matrix is 7.5YR 5/6 strong brown sand with some clay at the base of the level. No artifacts were discovered within this stratum. A series of wooden planks were uncovered after 2 ft. of Stratum C was removed. The elevation of these planks is approximately the same as the elevation of the southwest corner of the foundation and the bottom of excavations in Unit 3. The planks are very well preserved and are laid with a north/south orientation. Hardware identified as nails or bolts remains in the planks. No signs of burning were evident on the plank feature or within the soil deposits. This feature is identified as the original floor for the turbine room of the factory. The choice of wood for flooring may be due to its flexible nature that would provide natural shock absorption for the weight of the waterpower machinery. The lack of burning on the timbers is expected since the flooring was under water (lies below the water table under average conditions and water was regularly introduced to the chamber from the raceway in order to power the turbines). The lack of destruction debris in this area may be a sign that the valuable, unburned turbines were unburied and salvaged and the chamber was not refilled with the architectural debris from the buildings destruction. The stratigraphy in Excavation Unit 1 indicated that the deposits are entirely alluvial in nature.



Excavation Unit 1 showing wooden floor.

EXCAVATION UNIT 2

Excavation Unit 2 was 5ft. x 5 ft. and placed adjacent to the river wall in order to locate the northwest corner of the cotton mill. Recent flood deposits were removed to reveal a shale stone wall extending from the river wall. The wall covers a width of 4 ft. in this excavation but obviously extends to the east. The foundation stones are tied into the river wall stones. This stone feature combined with the river wall make up the northwest corner of the Cotton Mill. Excavations ceased once the wall feature was exposed. Excavation Unit 3 was placed adjacent to and directly east of Excavation Unit 2 in order to fully expose the foundation wall and examine the interior deposits of the structure.

EXCAVATION UNIT 3

Excavation Unit 3 covered a 5 ft. x 5 ft. area immediately east of Excavation Unit 2. The purpose of this excavation was to fully expose the west wall feature and examine the depositional history of the interior of the cotton mill.

Stratum A consists of 10YR 4/6 dark yellowish brown sand with inclusions of river cobble and pebbles. This stratum is the same as the ground surface level of flood deposits found across the site. Stratum A has an average thickness of 0.92 ft. No artifacts were collected from this stratum.

Stratum B consists of 10YR 3/3 dark brown sandy clay with inclusions of river cobbles and pebbles. Brick and shale stones fragments were recorded at this level. Stratum B has an average thickness of 0.88 ft. This stratum is interpreted as a flood or high water deposit.

Stratum C is described as 10YR 4/4 dark yellowish brown sandy clay with inclusions of river cobbles and pebbles. Artifacts recorded at this level include a spike, brick and brick fragments, charcoal and charred wood. Inclusions of mortar are found throughout the deposit and bricks become more prevalent at the lower depths. The average thickness of this deposit is 0.6 ft. Stratum C is identified as a flood/high water deposit mixed with the upper levels of debris from the cotton mill destruction.

Stratum D consists of 10YR 5/4 yellowish brown sand mixed with a high concentration of mortar. A few river cobbles and pebbles make up the inclusions in this deposit that averages 0.96 ft. thick. Artifacts include three 6-in. spikes attached to charred wood. The concentration of brick and mortar has increased. This deposit is interpreted as a destruction level mixed with settlement or high water deposits.

Stratum E consists of 10YR 5/8 yellowish brown sand with a high concentration of mortar inclusions. The average thickness of this deposit is 0.33 ft. A large quantity of brick and mortar chunks along with a fragment of window glass, several iron spikes, and unidentified metal objects

were recovered. This stratum is similar to Stratum D with the exception of slightly different color sand and more bricks and brick fragments. Stratum E is an earlier stage of the same destruction process as noted in Stratum D.

Stratum F is made up of 10YR 3/6 dark yellowish brown clayey sand with mortar mixed throughout. Stratum F had an average thickness of 0.83 ft. and contained a high concentration of charred wood, charcoal, unidentified iron and spikes. This deposit contains materials directly related to the burning of the building in November of 1852.

Stratum G is another burn layer located directly below Stratum F. The soil is 10YR yellowish brown sand containing bricks, brick fragments, and small fragments of charred wood and metal. Excavation of Stratum G was not completed due to time conflict with the heavy machinery work. A shovel test pit was excavated in the center of the unit and the bottom of the stratum was reached. It would be misleading to take an average depth of this stratum since the soil is much thicker along the north wall and dramatically slopes towards the east. The thickness of the deposit in the center of the excavation unit is 0.6 ft.

During the excavation of the shovel test pit, Stratum H was discovered below Stratum G. Stratum H consists of 10YR 5/2 gray clay and is approximately 0.4 ft. thick. Historical documentation reveals that a major flood swept across Virginius Island in April 1852. Stratum H may be a gley or puddling effect sometimes left behind by major flooding or high water episodes.

Stratum I consists of 10YR 5/8 yellowish brown clay with dense brick rubble. It was only possible to excavate 0.4 ft. of this stratum due to the small workspace and density of the rubble. Stratum I may be architectural destruction caused by the April 1852 flood.



EU 3 showing the west Cotton Mill wall on the left, the north Cotton Mill/river wall at the top and a charred timber at base of the excavations.

Trench 1

A goal of this project was to investigate the extent, condition and configuration of the headrace walls north of the Cotton Mill Ruins. Although portions of the walls were previously exposed, the condition and extent of the walls was not known. Investigation of the walls was required prior to the start of stabilization activities on the mill to determine what effect the activities might have on the walls. Trench 1 comprised an area 40 ft N/S by 19 ft E/W.

Investigation of the headrace began with removal of modern flood deposits and surface stones scattered over the area. The intersection of the headrace and the mill was previously exposed so the initial width and alignment of the walls was known. Removal of the overburden continued northward along the west wall exposing the existing upper level of the wall. The depth of the overburden covering the west wall was a foot or less. Approximately 37 ft of the west wall was exposed. At this the point the stones ended at the shallow depth. The east wall was similarly covered for a distance of 33 ft at which point the stones dropped in elevation and an intersecting wall was discovered coming from the southwest. This intersecting wall lines up with the riverside wall of the intake tunnels and is assumed to be the continuation of that wall.

Starting at the mill and for 11.5 ft the walls are 4 ft wide and 8 ft apart. At 11.5 ft north of the mill, there is a 1 ft N/S by 0.75 ft E/W vertical recess on the interior face of walls. The recess probably functioned to hold a gate or other water control device. The walls then reduce to 3.5 ft in width with an 8.5 ft separation and continue to 15 ft north of the mill. At this point there is a butt joint and the walls are offset 1 ft inward reducing the separation to 6 ft. The construction of the walls also changes here. Larger stones are used and the 'craftsmanship' of the construction seems to diminish. The walls from this point northward appear to be impacted by flooding or other actions.



Overview of Trench 1 looking south toward the Cotton Mill ruins.



Intersection of the east wall of the headrace and the intake tunnel wall.



Water control feature located on west wall of headrace.

Trench 2 and 3

Trench 2 covering an area approximately 8 ft. EW x 5 ft. NW was excavated along the interior of the south wall of the west chamber of the Cotton Mill. This area was explored to determine if the larger west chamber may have been bisected by an interior wall and to examine the deposits in this portion of the structure. Numerous large shale stones were uncovered in this excavation trench. The shale stones contain remnants of mortar at first were thought to be portion of a wall. After further excavation, brick rubble was found that undercut the shale stones. The stones are identified as wall fall from the Cotton Mill foundations. A great deal of burned wood, brick and iron was excavated below the brick level. This level shows evidence of the intensity of heat when the structured burned. Bricks and iron objects were found fused together. Below the burned level light gray sand was found and the water table was reached. Wood fragments were noted in the water but were not collected. The results of excavation Trench 2 indicate that there was not an interior wall dividing the western chamber of the Cotton Mill at the lower foundation level. Evidence of the fire that destroyed the structure was documented in this area.

Trench 3 covered approximately 3 ft. EW x 2.5 ft. NS along the interior of the river wall/north wall of the Cotton Mill. This unit was placed at this location to determine if an interior wall may have divided the lower level of the Cotton Mill. The recent flood deposits were excavated revealing the same soil deposits as the previously excavated units and trench. No masonry features were found to indicate the large western chamber was divided into smaller rooms.

Trench 4

One of the goals of this project was to determine the location of the historic river wall on the east side of the Cotton Mill. Just downstream, near the Cotton/Flour Mill the river wall is clearly defined. A park maintenance project involves locating, accessing condition and stabilizing the river wall feature between the Cotton Mill and the Cotton/Flour Mill.

Archeologists cleared the uppermost level of modern flood deposits from an area adjacent to the east elevation of the Cotton Mill. The river wall was found just below the ground surface. Located 21.2 ft. from the NE corner of the structure, the river wall measured 4 ft. wide. The wall is constructed of dry-laid blue shale and the upper course that is exposed appears to be in good condition. Excavation ceased at this point since the goal, to locate the feature, was met.



Plan view photo of the river wall feature taken from the east wall of the Cotton Mill ruins.