



# Blackstone River Valley National Heritage Corridor Commission Blackstone Canal Alternative Transportation Feasibility Study Uxbridge and Northbridge, MA

NPS Contract No. GS-10F-0281R; VHB Project No. 33281.02  
Document No.





# CONTENTS

<b>Introduction .....</b>	<b>1</b>
<b>Study Area Description.....</b>	<b>1</b>
<b>Purpose Of The Feasibility Study .....</b>	<b>1</b>
<b>Canal Trench, Towpath &amp; Related Features.....</b>	<b>3</b>
Canal Trench and Towpath from Stanley Woolen Mill to Visitor's Center/Hartford Avenue.....	3
Existing Conditions.....	3
Recommendations .....	4
Canal Trench and Towpath from Hartford Avenue to Goat Hill Lock .....	4
Existing Conditions.....	4
Recommendations .....	5
Canal Trench and Towpath from Goat Hill Lock to Plummer's Landing .....	6
Existing Conditions.....	6
Recommendations .....	7
<b>Goat Hill Lock .....</b>	<b>10</b>
Existing Conditions .....	10
Recommendations.....	10
<b>Recreational Access to the Canal.....</b>	<b>12</b>
Existing Conditions for Parking.....	12
Existing Conditions for Walking and Biking.....	12
Existing Conditions for Canoes & Kayaks.....	13
Existing Conditions for Interpretive Opportunities.....	14
Recommendations .....	14
Parking.....	14
Walking and Biking.....	15
Canoes and Kayaks.....	15
Interpretive Opportunities .....	16
<b>Canal Boat Replica and/or Tour Boat Operations.....</b>	<b>17</b>
Canal Boat Replica and/or Tour Boat Operations.....	17
Existing Conditions for Canal Boat Replica and Tour Boat Operations .....	17
Tour Boat Operations.....	17
Canal Boat Replica Operations.....	18
Existing Canal Conditions Relative to Tour and Canal Boat Operations .....	18
Recommendations for Boat Operations North of Hartford Avenue.....	19
Recommendations for Boat Operations South of Hartford Avenue .....	21
<b>Appendix A: Conceptual cost estimate.....</b>	<b>A-1</b>
<b>Appendix B: FEMA Flood map .....</b>	<b>B-1</b>
<b>Appendix C: Public Comments.....</b>	<b>C-1</b>

# 1

## **INTRODUCTION**

The Blackstone Canal was constructed between 1824 and 1828, stretching approximately 45 miles from Worcester, Massachusetts to Providence, Rhode Island. It provided a means of transporting crops and manufactured goods from the interior sections of Massachusetts and Rhode Island to the shipping port of Providence and was the last major transportation canal to be constructed in New England. As designed, the canal trench was generally 34 feet wide and 4 to 6 feet deep with a 10 foot wide towpath. As built, the dimensions varied somewhat depending on the existing terrain and surrounding conditions. Forty-eight locks allowed boats to navigate the 450 foot descent of the Blackstone Canal. The canal was utilized until approximately 1847 when the Providence & Worcester Railroad Company began operations and railroad transportation became quicker, less expensive and a more reliable mode of transportation. Although many historic canal features have disappeared or been altered over time, significant stretches of the canal remain largely intact. In recognition of its significance, the Blackstone Canal is listed in the National Register of Historic Places.

## **STUDY AREA DESCRIPTION**

This report focuses on an approximately 3.5-mile segment of the Blackstone Canal located within the Blackstone River & Canal Heritage State Park in the Towns of Uxbridge and Northbridge, Massachusetts. A key resource within the Blackstone River Valley National Heritage Corridor, the park is operated by the Massachusetts Department of Conservation & Recreation (DCR). The study area extends from the Stanley Woolen Mill north to Plummer's Landing (see Figure 1). (Note that the study area does not include the Millville Lock and Trail, a separate, discontinuous part of the state park located approximately 6 miles to the south.) In addition to the canal and towpath, the study area includes hiking trails, access points for recreational boats, the remnants of Goat Hill Lock and the archaeological remains of a canal landing basin and trading house at Plummer's Landing. The route of the Blackstone River Bikeway, still in the planning stages, may go through the study area.

## **PURPOSE OF THE FEASIBILITY STUDY**

The intent of this study, as stated in the Scope of Work (SOW), is to:

- Evaluate the condition of the canal trench, towpath and related features.
- Evaluate the feasibility of restoring and/or stabilizing the canal trench and towpath by addressing breaches in the towpath embankment.
- Evaluate the feasibility of restoring Goat Hill Lock.

- Evaluate the need for improved recreational access to the canal by canoes, kayaks, and tour boats from the River Bend Farm Visitor Center
- Identify opportunities for improved connections between the canal and the bikeway and hiking trails.
- Evaluate the feasibility of operating a canal boat replica in this segment of the Canal based on the physical condition of canal, bridge clearances, docking access and other conditions.
- Develop Class C cost estimates for the restoration of breaches in the towpath embankment and, if feasible and desired, the restoration of Goat Hill Lock.

## **SPECIAL CONSIDERATIONS**

The Blackstone Canal is a significant historic resource, and the entire length of the canal, from Worcester, Massachusetts to Providence, Rhode Island, is listed in the National Register of Historic Places. In addition, the segment of the Canal that is the subject of this study is located within the Blackstone River and Canal Heritage State Park and implementation of the recommendations presented in this report will likely involve state and/or federal funding. Such work may also involve complex environmental permitting, with potential impacts on wildlife, the possibility of contaminated soils, and the potential for underwater archaeological resources. Therefore, a number of special considerations apply to any projects undertaken as a result of this study:

- All work must meet the *Secretary of the Interior's Standards for the Treatment of Historic Properties*.
- Projects must include, in the planning stages, an assessment of the potential for archaeological sensitivity as well as research regarding known archaeological sites in the vicinity of the project. Before any design or construction work is undertaken, a Project Notification Form (PNF) and supporting documentation should be filed with the Massachusetts Historical Commission to determine the need and scope of an archaeological survey for the repair/rehabilitation/restoration of different features and segments of the Canal.
- Any activities that could remove, damage, displace or destroy submerged cultural resources in state waters are subject to the review and consent of the Board of Underwater Archaeological Resources.
- Wildlife breeding, nesting and migration seasons must be taken into consideration in the scheduling and sequencing of construction activities, particularly if work involves de-watering the canal.



# 2

## **CANAL TRENCH, TOWPATH & RELATED FEATURES**

Although a sizable portion of the original Canal infrastructure remains, the surrounding area has seen significant changes since the Canal was constructed over 180 years ago. Remnants of the Canal trench, towpath, quarry sites, stone locks and bridges can be found in this segment, but land uses, development patterns, naturally occurring events such as floods and storms, and intentional, man-made alterations have combined to impact these Canal features. This section will examine the condition of the Canal infrastructure remnants and provide recommendations for their stabilization, restoration and preservation.

### **CANAL TRENCH AND TOWPATH FROM STANLEY WOOLEN MILL TO VISITOR’S CENTER/HARTFORD AVENUE**

#### **Existing Conditions**

The segment of the Blackstone Canal that stretches approximately 1.5 miles from the Stanley Woolen Mill on Mendon Street (Route 16) north to Hartford Avenue is substantially intact, with a stable Canal trench and towpath and three functioning sluice gates (see Photo 1): one located near Hartford Avenue (the head gate or inlet control, hereafter referred to as Gate #1), one at the Stanley Woolen Mill (outlet from the Canal into the Mill, referred to as Gate #3) and one approximately 1,300 feet north of the Woolen Mill (outlet from the Canal into the River, referred to as Gate #2). Originally constructed in the early 1900’s to direct waterpower to the mill, the gates were restored to operating condition in 2007. Water levels in this section of the Canal can be manipulated by DCR staff via the opening/closing of the three gates; the gate at the Stanley Woolen Mill, though operable, remains closed, thus water in the Canal currently drains toward the middle outlet control structure (Gate #2).

DCR maintenance operations for the Canal and towpath include regular mowing, minor vegetation control, and removal of trash, debris and fallen trees from the Canal trench. A continuing item of concern is the large trees that are growing along the Canal side of the towpath embankment. While the trees provide a scenic shaded walkway along the towpath and Canal, they were not present historically. (The Blackstone Canal Company did plant trees in some locations on the River side of the towpath, for shade and erosion control.) In addition, a blow-down of a large tree on the Canal side would most likely result in significant damage to the towpath embankment from the tree’s root ball. It is highly likely that a catastrophic breach of the embankment could result. DCR staff has considered selective removal of the trees most likely to be blown down but public reaction was overwhelmingly against the removal. Additionally, funding to complete the tree removal is lacking.

**Photo 1 – Canal Tow Path Looking South Towards Visitor Center Foot Bridge**



**Photo 2 – Remains of Canal Trench and Towpath at Rice City Pond/Goat Hill, Looking South**



## **Recommendations**

This section of the Canal trench and towpath is generally in good condition. The recently restored water control structures allow DCR staff, who is headquartered close by, to manipulate water levels in the Canal, decreasing the likelihood of water overtopping the towpath embankment during a flood event, which could result in a breach.

Consideration should be given to selective tree cutting along the embankment to prevent a catastrophic breach in the event of a blow down. Given that the suspect trees will only grow larger, the likelihood of a blow down and breach will only increase in the years to come. So while great progress has been made in providing provisions to prevent damage to the Canal and towpath, it seems counterproductive to not address a potentially significant hazard to the integrity of the Canal. A possible solution to address the public concern over the visual impact of tree removal and loss of shade could be the planting of new trees on the River side of the slope, which is generally separated from erosive forces of flood flows. Tree planting on the River side of the towpath is also consistent with the original Canal Company planting and erosion control program. When larger trees are removed care should be taken not to damage Canal features where trees are cut particularly in areas of Canal structures. Stump grinding, rather than stump removal, should be sufficient in historic earthwork areas like the Canal towpath and berms. Tree stumps should be ground to existing ground grade with the roots generally left in-place. Roots should only be removed when they are visible and such removal would be part of a larger reconstruction project such as rebuilding of the stone locks, bridge abutments or other structures. Prior to any tree removal or reconstruction of the Canal prism, field verification of the design and as-built characteristics of the Canal prism should be undertaken.

Provided that the current level of maintenance is continued and the tree hazard is resolved, it is reasonable to anticipate that current conditions along this segment of the Canal can be maintained for the foreseeable future.

## **CANAL TRENCH AND TOWPATH FROM HARTFORD AVENUE TO GOAT HILL LOCK**

### **Existing Conditions**

The segment of the Canal that stretches from Hartford Avenue north to Goat Hill Lock includes an approximately 0.7-mile long Canal trench and towpath, as well as a 1955 dam and spillway at Hartford Avenue, the remains of a Canal-era stone bridge abutment just north of the Hartford Avenue Bridge, and Goat Hill Lock (discussed separately; see below).

Rising water levels have resulted in significant erosion in this section of the Canal trench and towpath, especially at Rice City Pond along the base of Goat Hill. A dam was built near Hartford Avenue ca. 1850, raising the water level significantly compared to when the Canal was operational and completely submerging the Canal trench and towpath. The ca. 1850 dam was damaged during a flood in 1955 and the dam was rebuilt soon after with a lower crest elevation. It seems likely that the Canal and towpath incurred significant damage during the 1850-1955 period from River flood flows and moving ice floes during the spring thaws.

While the existing dam has a crest elevation several feet lower than the ca. 1850 dam, water levels remain higher than during the Canal era and water inundates the towpath and Canal during most of the year (see Photo 2). Indeed, during high water seasons, most of this segment of the Canal trench and towpath is barely distinguishable from the surrounding River and pond wetland areas as wetland vegetation has overgrown the original Canal infrastructure. Although it appears that the construction of the 1955 dam, which lowered the water level, has slowed the erosion of the Canal trench and towpath, it is possible that significant River flood events result in further erosion and widening of the existing towpath embankment breaches. The southern portion of this segment of the Canal and towpath are especially vulnerable to the brunt of River flood flows. Just downstream from Goat Hill Lock, there is a short section of reasonably intact Canal trench which is shielded from direct exposure to River flood flows and serves as a backwater flood storage area. This section of Canal is periodically exposed to flood flows that discharge through the lock because of towpath breaches upstream from the lock.

Maintenance in this section of the Canal trench and towpath is limited to removal of trees that have fallen across the hiking trail on Goat Hill. DCR does not currently have the resources to address erosion or breaches in this area.

### **Recommendations**

Extensive work would be required to restore this segment of the Canal trench and towpath to original condition, including vegetation removal, dredging of the Canal trench, and filling of open water and wetland areas to replace eroded sections of towpath embankment. Rebuilding the Canal and towpath to original configuration and elevations may not preclude repetitive flooding and erosion, however, since the current River hydraulics/flood routing and water levels in Rice City Pond have been significantly altered by the dam and spillway at Hartford Avenue. A complete reconstruction of the dam at Hartford Avenue would be necessary to restore the River/Canal hydraulics and water level in Rice City Pond to those elevations dating from the original Canal construction. This reconstruction would significantly alter sensitive wildlife habitat and obtaining the required federal and state environmental permitting approvals for this work is doubtful. Also, as per discussion with Heritage Corridor staff, studies by the US Environmental Protection Agency have shown that sediments in Rice City Pond are contaminated. Other projects in the Blackstone Valley involving removal of river sediment have required soil testing, handling and disposal of these soils as contaminated material and/or hazardous waste. Given the anticipated permitting difficulties and cost of design, permitting, construction and contaminated soils disposal, restoration of this section of the Canal and towpath is not recommended.

It is recommended that the intact section of Canal trench just downstream from Goat Hill Lock be kept clear of downed trees to prevent collection of debris and possible scour during River flood events. Additionally, repairing the towpath breaches upstream from the lock (as outlined in other sections of this report) will eliminate the periodic flood flows through the lock and prevent damage to this intact section of Canal trench.

## **CANAL TRENCH AND TOWPATH FROM GOAT HILL LOCK TO PLUMMER’S LANDING**

### **Existing Conditions**

The section of the Canal that stretches from Goat Hill Lock north to Plummer’s Landing is in varying condition. In the approximately 1,800 foot-long section from the lock north to the site of a former stone farm bridge crossing, the Canal trench remains mostly intact but is dry most of the year (see Photo 3 and Figure 2). The towpath and embankment are overgrown with large trees although a stable earth surface footpath remains (see Photo 4). Some filling in the Canal trench has occurred due to operations of a former gravel pit owned by the town of Northbridge. The former stone farm bridge was constructed c. 1828 as part of the Canal construction, most likely to provide access to the fields between the Canal and the River. The bridge is a contributing property to the Blackstone Canal National Register District. The bridge has collapsed and the remnants (mostly cut stone blocks) snag debris and obstruct flow in the Canal trench. These obstructions cause the water to breach through the towpath embankment back toward the River. Flood waters also occasionally enter the Canal trench through this breach, as well as at a low point/eroded section of towpath just north of Goat Hill Lock.

The section of Canal that stretches from the farm bridge site north to a point 2,100 feet south of Plummer’s Landing is currently subjected to significant erosive forces. At the north point of this section, the River has breached over and through the towpath embankment (see Photo 5). A substantial amount of River flow fills the Canal trench and flows south at elevated velocity for approximately 2,700 feet. At this point the Canal trench is blocked by a stone culvert crossing which is clogged by debris, silt and vegetation. The flow in the Canal breaches back through the towpath embankment toward the River channel (see Photo 6). Flows at both breaches are eroding the towpath embankment. Once the flow leaves the Canal trench, it continues south, eroding a new channel along the outside base of the towpath embankment. The volume and velocity of the flow has caused significant erosion of the towpath embankment in a direction back towards the Canal trench (see Photo 7). Additionally, a stone culvert dating from the original Canal construction that carried a stream under the Canal is clogged. The stream has breached the west side Canal embankment and is eroding the Towpath embankment from the inside of the Canal trench. These flows will eventually cause another breach through the embankment into the Canal trench. Most likely the flow will continue south along the dry section of Canal trench directly into Goat Hill Lock. It is highly likely that this volume and velocity of flow will cause further significant deterioration of the Lock. A review of the FEMA Flood Insurance Rate Map (FIRM) shows that the area between the River channel and the towpath embankment is in the River 100 year storm floodway (see Appendix C). The area is subject to flood velocity flows which bear directly on the towpath embankment. The area of the Canal trench westward is within the 100 year floodplain which means this area is inundated by the 100 year flood. The end result is that the towpath berm is overtopped by the 100 year flood.

The approximately 2,100-foot long section of the Canal that stretches from the River breach into the Canal north to Plummer’s Landing is in fair condition. The Canal trench is stable but watered for most of the year with stagnant water, most likely the remains of occasional flood flows and

**Photo 3 – Dry Canal Trench North of Lock, Looking North**



**Photo 4 – Towpath Embankment and Dry Canal Trench North of Goat Hill Lock, Looking North**



**Photo 5 – River Breach Into Canal Trench, Looking North**



**Photo 6 – Canal Breach Into River at Old Stone Culvert Crossing, Looking North**



**Photo 7 – Channel on Eroding Outside of Towpath Berm, Looking North**



**Photo 8 – Canal Trench and Towpath (on right) Looking North Gravel Crossing in Foreground**



**Photo 9 – Sewer Access Road, Canal Trench on Right, Looking North**



**Photo 10 – South Side of Church Street Bridge Founded on Canal Lock, Looking North**



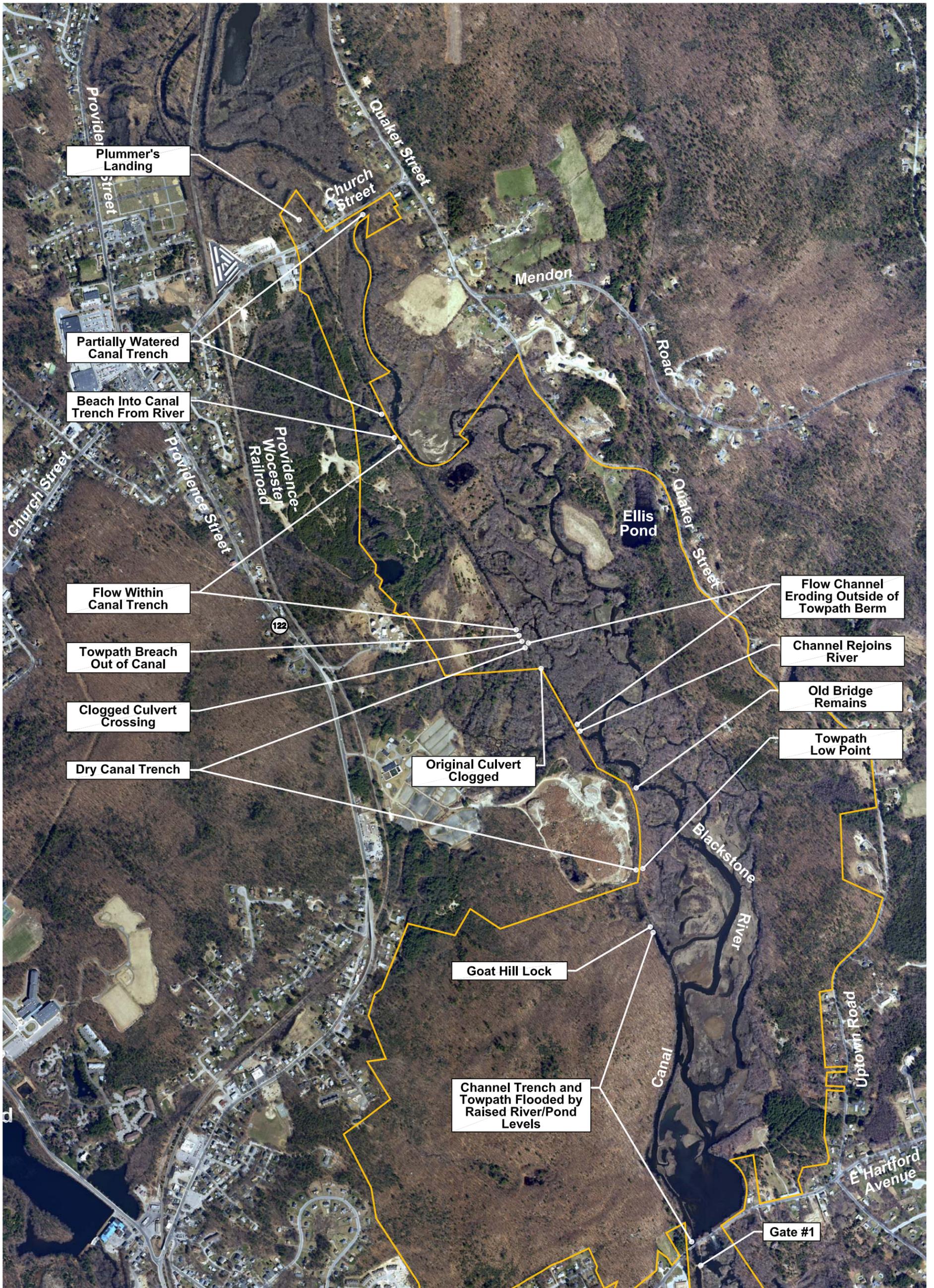


Figure 2

**Blackstone Canal Alternative Transportation Feasibility Study**

Uxbridge/Northbridge Existing Canal Condition Site Map

Goat Hill Lock to Plummer's Landing



National Park Service  
U.S. Department of the Interior

rainfall runoff (see Photo 8). The Canal trench has become filled with some debris, vegetation and leaf litter. This section is bordered on the west side by a gravel surfaced access road over a sanitary sewer interceptor (see Photo 9). A gravel crossing and small corrugated metal pipe provide access from the sewer access road to the towpath. It appears that this gravel crossing is frequently overtopped by flow in the Canal trench. The pipe is heavily damaged and significantly clogged with silt and debris (see Photo 8). The towpath itself has become overgrown with brush making walking along the towpath difficult.

Just south of Plummer’s Landing, a bridge constructed on the remains of a Canal lock carries Church Street over the Canal trench. The lock remnant is most visible on the downstream side of the bridge where an approximately twenty foot section of lock is visible.

## **Recommendations**

### ***General recommendations***

Recent major flood events along the Blackstone River and Canal in Rhode Island have provided an opportunity to observe the sequence of events that can lead to a Canal towpath breach. The erosion begins with the River flood rising to an elevation that overtops the towpath embankment. Flow down the backside or Canal trench side of the embankment begins the erosion of the berm, which increases in depth and width as the flood works a “gully” back towards the River. The “gully” size and depth continues to increase until finally the River flood waters burst through the towpath embankment in a catastrophic failure. The width and depth of the breach rapidly increases in size as the River flood is diverted into the Canal trench. The construction of the Blackstone River Bikeway along the Canal and River in Rhode Island has utilized designs to prevent these failures. It is generally not feasible to construct berms above the elevations of major flood events as this would require substantial fill in flood storage areas, involve significant wetland impacts, and would not be an accurate replication of the original Canal infrastructure. A more reasonable and realistic approach is to accept the notion that the Canal towpath and embankment will occasionally be subjected to major flood events and thus design rehabilitation and repair solutions to withstand these events. A practical solution used successfully in Rhode Island is to armor both sides of the Canal embankment at locations most exposed to River flood flows and susceptible to overtopping.

**It is recommended that the following repairs be given the highest priority and should be completed as soon as possible. Further delay will only result in additional erosion of the Canal towpath embankment to a point where the Goat Hill Lock will be subjected to sustained, direct and significant velocity flows of the Blackstone River. Complete destruction of the Lock is highly likely.**

**For the Canal section from Goat Hill Lock north to the former farm bridge site –** It is recommended that the Canal trench be cleared of vegetation, debris and fill that has been deposited over the years. The low point in the towpath embankment just north of Goat Hill Lock should be restored to its original shape and elevation to shield the Lock from occasional River floods. The work shall meet the *Secretary of Interior’s Standards for the Treatment of Historic Properties*.

The towpath embankment should be restored and armored with rip-rap on both sides as this area is located adjacent to the River channel. In order to meet the *Secretary's Standards*, the rip rap size and placement should replicate that of the rip rap used in the original Canal construction. (Refer to the photos of the original rip rap construction at Skull Rock Lock.) Even with this protection, however, breaching and erosion of the towpath berm will continue unless the remnants of the stone farm bridge that have fallen into the Canal trench are removed, which would permit free flow of flood waters. There is no practical need for the former stone farm bridge but because the bridge is a contributing property in the Blackstone Canal National Register Historic District, complete removal of the bridge would be considered an adverse effect in a Section 106 review and is not recommended. Restoring the bridge to its historical appearance would provide an outstanding interpretive feature of the park. It would seem reasonable to expect, however, that many of the cut stone blocks are lost and would need to be replaced which would significantly increase the cost. As an alternative to complete removal or expensive reconstruction, it is recommended that the side base/abutment stones of the bridge be left intact and visible and that only the remnants of the bridge that have fallen into the Canal trench – and which block water flow – be removed. The removed stone blocks could be used for seating around an interpretive panel explaining the history and former activities at the site.

**For the Existing Breaches in the Towpath Embankment North of the Farm Bridge Site –**

The restorations/repairs for this section are recommended in the following order:

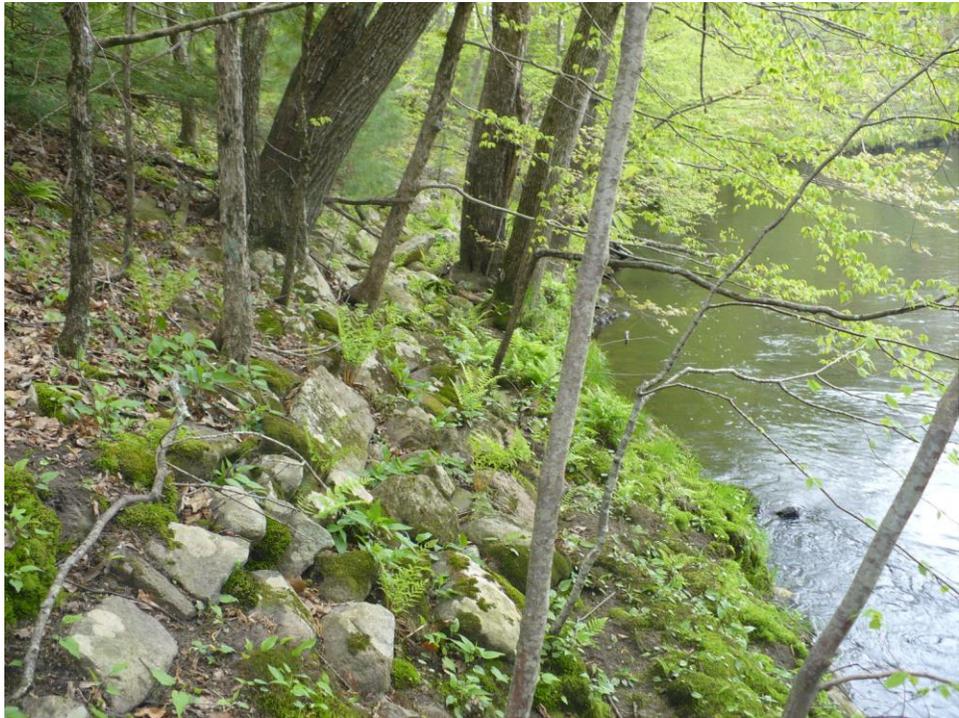
- Repair the northern breach of the River into the Canal trench by rebuilding the Canal towpath embankment to the original dimensions and elevation. The River side and Canal side of the embankment should be armored with rip-rap to prevent future breaches (see Figures 3 and 4). The rip-rap should sized and laid in courses to replicate the rip rap used in the original Canal construction. (Refer to the photos of original rip rap construction at Skull Rock Lock.) All work would meet the Secretary's Standards. Any interpretation should explain the use of historic erosion control techniques.
- Remove the old stone culvert Canal crossing and associated debris/silt and repair the southern breach of Canal into the River in a similar fashion. This should effectively “shut off” the flow of water in this section of the Canal trench and the subsequent flow in the new channel that is eroding the towpath berm. Note that the old stone culvert crossing, though not from the Canal era, is a historic resource and its removal would constitute an adverse effect in a Section 106 review. Documentation of the structure could serve to mitigate the adverse effect.
- Repair the eroded sections of the towpath embankment by rebuilding the Canal towpath embankment to the original dimensions and elevations and restore the channel to a wetland section. The reconstruction of the towpath embankment would need to meet the Secretary's Standards.

**For the Section of Canal and Towpath from the Breach North to Plummer's Landing –** It is recommended that debris, vegetation and leaf litter be removed from the Canal trench. The

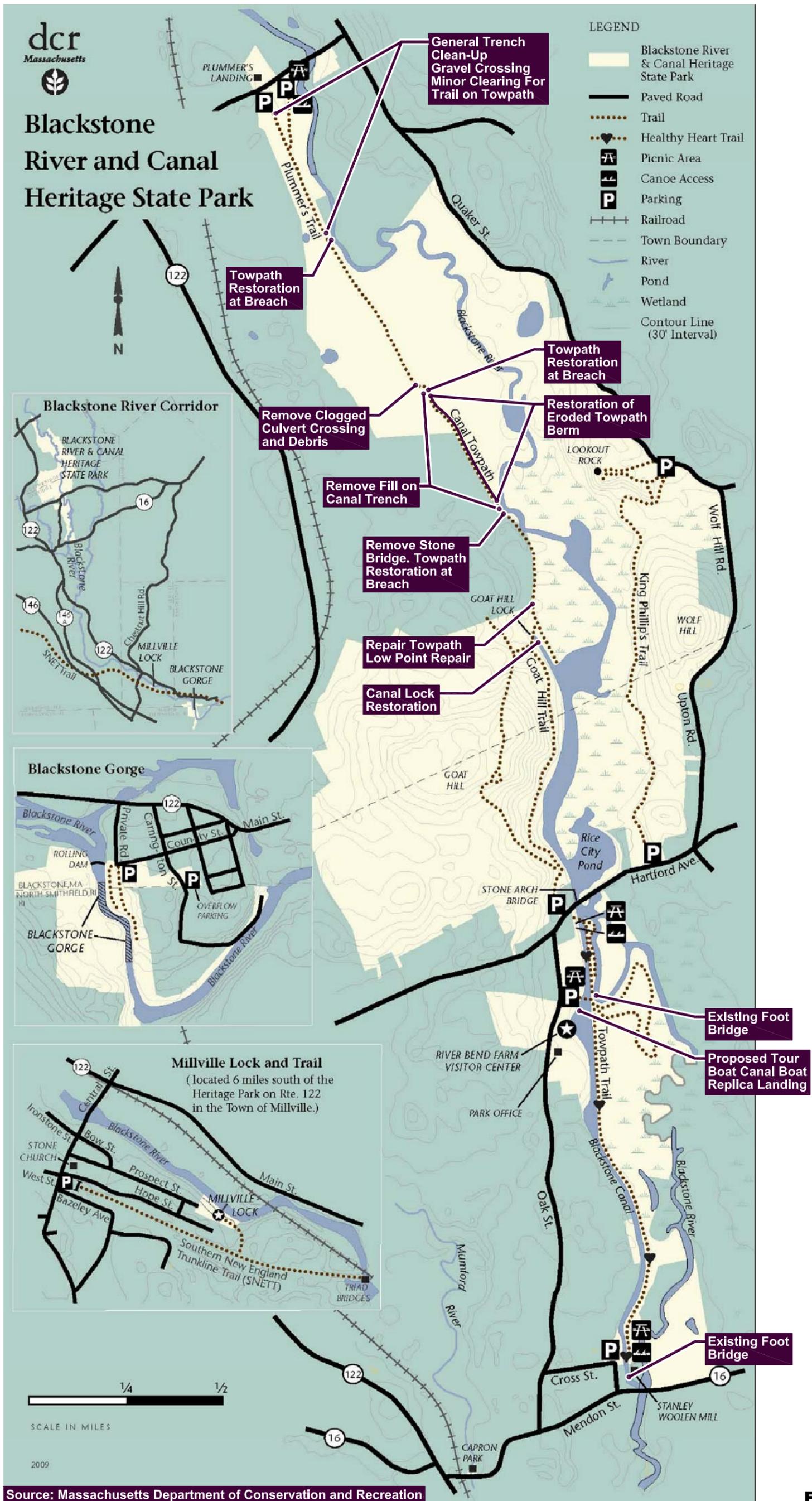
corrugated pipe should be removed and the crossing rebuilt as a “watered crossing” consisting of crushed stone. This crossing would allow access to the towpath while allowing water in the trench to flow through. Minor clearing on the towpath for a hiking trail would provide an opportunity for interpretation and views of the River.



Original Rip Rap at Skull Lock



Original Rip Rap at Skull Lock

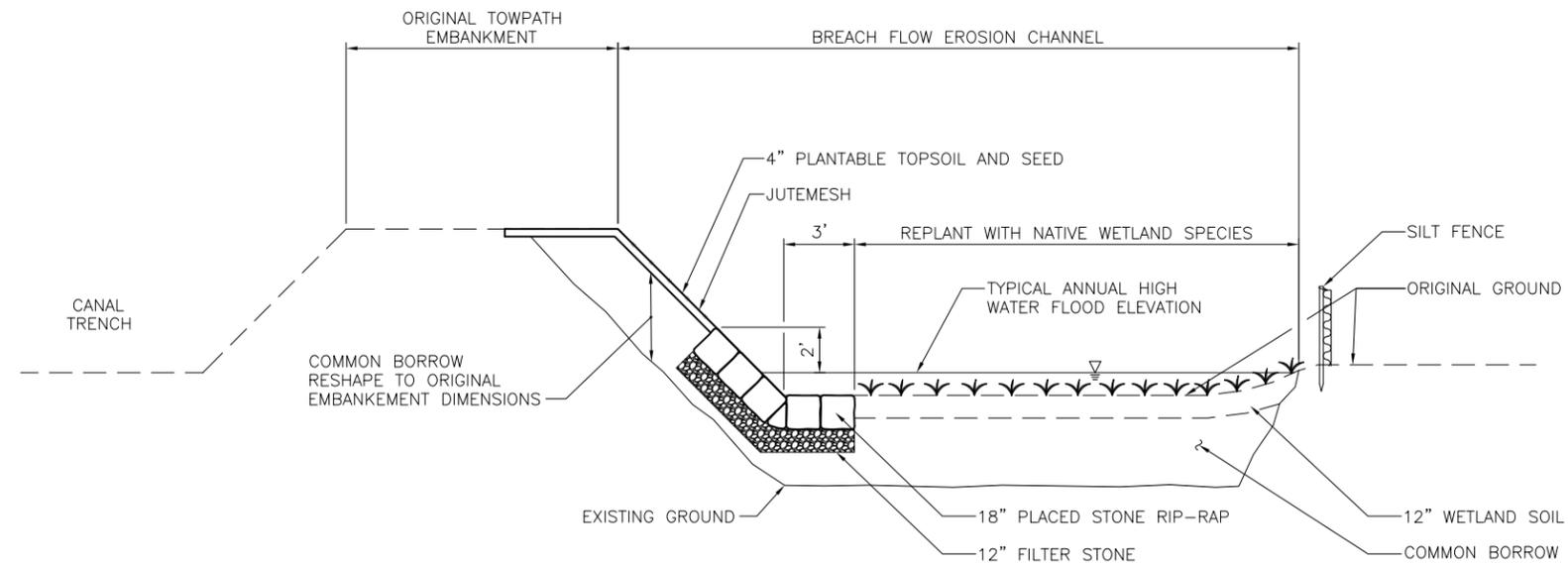


**Figure 3**

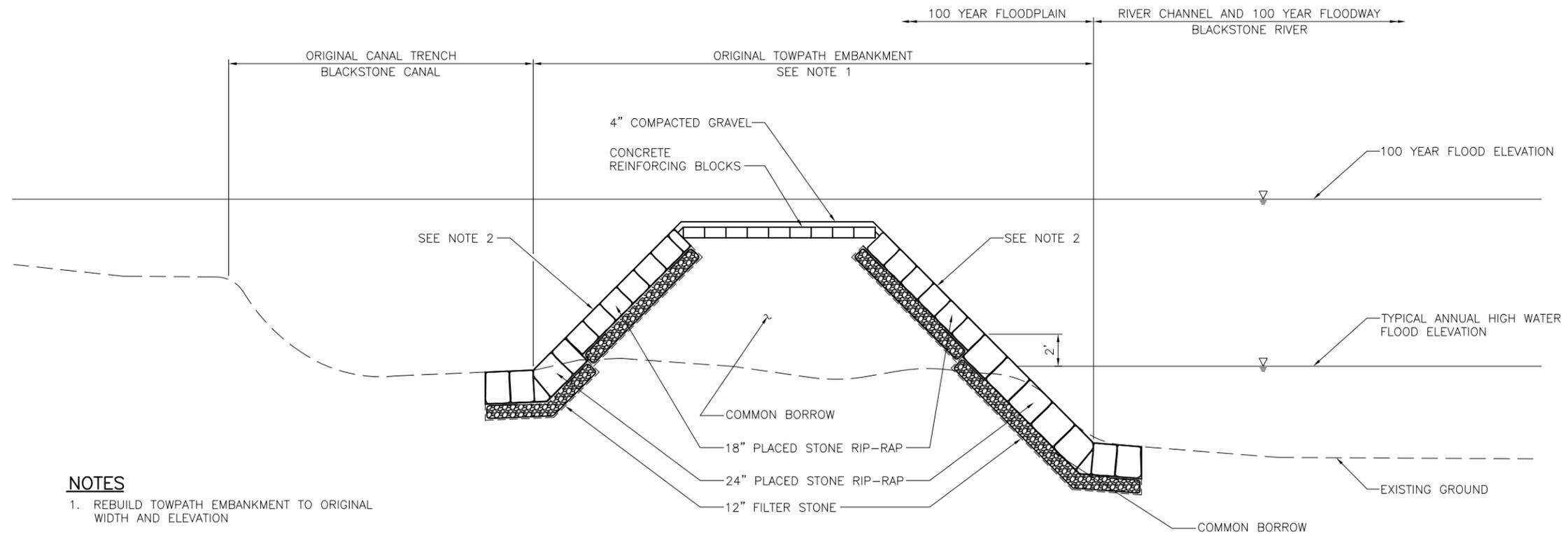
**Blackstone Canal Alternative Transportation Feasibility Study**

**Uxbridge/Northbridge Canal Proposed Restorations/Improvements**





**RESTORATION OF ERODED TOWPATH BERM  
LOOKING NORTH**  
SCALE: 1"=8'



**NOTES**

1. REBUILD TOWPATH EMBANKMENT TO ORIGINAL WIDTH AND ELEVATION
2. ARMOUR BOTH SIDES TO PROTECT AGAINST RIVER SCOUR AND OVERTOPPING

**CANAL TOWPATH RESTORATION AT BREACHES  
LOOKING NORTH**  
SCALE: 1"=8'

**Figure 4**

DESIGNED: <b>ADD</b>	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
TECH. REVIEW:		TOWPATH RESTORATION TYPICAL SECTION	PMIS/PKG NO.
DATE:			SHEET OF

# 3

## **GOAT HILL LOCK**

The Goat Hill Lock was one of the 48 original Canal lock and is one of the few remaining locks along the entire Canal corridor. Constructed of cut granite with timber gates at each end, the lock is 92 feet long by 10 feet wide and served Canal barges and packet boats. Besides the Millville Lock, it is the best preserved lock on the Blackstone Canal. The lock is accessed via a hiking trail from Hartford Avenue. This section will examine the condition of the Lock and provide recommendations for its stabilization and restoration.

### **EXISTING CONDITIONS**

Goat Hill Lock remains largely intact although the top courses of stone along the lock walls and wingwalls have dislodged and fallen into the canal. It appears the causes are a combination of frost heaving and disruption from the roots of nearby large trees (see Photo 11). In addition, the lock is regularly inundated during river floods as water passes over the eroded low point of the towpath embankment north of the lock. This most likely also contributes to the deterioration of the lock; several stones were dislodged after flooding in the spring of 2010.

The hiking trail from Goat Hill down to the lock has significant erosion as the trail alignment is straight down the hillside, allowing runoff to erode the trail surface. A wood plank walkway is constructed over the north end of the lock but lacks railings and ADA accommodation. Immediately north (upstream) of the lock is the remains of a layby pond which has become filled with silt to the point it is now most likely a regulated wetland resource.

### **RECOMMENDATIONS**

Goat Hill Lock is an outstanding historic resource and, if restored, it could become an important interpretive amenity for park visitors. Since the lower portion of the lock has been submerged for over 100 years, it seems reasonable to assume that the lower portions of the lock including the timber miter sills that sealed the lower edges of the gates and the timber floor are intact. Thus the rebuilding of the lock itself to an operable condition is possible; a functioning lock would require dredging and restoration of the layby pond. Since the layby pond upstream of the lock is now a regulated wetland it is unlikely that the required environmental permits can be obtained to restore the canal as a functioning navigational feature. Rebuilding the lock as a static feature is possible without dredging the layby pond therefore a static lock restoration is recommended, due to the high interpretive impact.

Restoration of the lock would involve the removal of trees and brush from the lock walls. The area behind the top courses of stone should be excavated to remove tree roots and backfilled with

a granular material and filter fabric to promote free-flowing drainage of the subgrade behind the lock walls. The cut granite stones which have fallen into the lock should be retrieved and reset into the lock walls and wingwalls. Replica timber leaf gates could then be fabricated and installed. This would require temporary dewatering of the Canal and lock. A historically sensitive timber walkway with railings could be constructed to replace the substandard existing structure (see Figure 5).

Tree removal and excavations in the immediate area of the lock could damage or destroy construction features for the lock as well as artifacts and features associated with the operation and maintenance of the Canal. Remains of the timber leaf gates may be buried or submerged in the area of the lock and could help reconstruct the new gates. As previously noted, a PNF should be filed with the MHC which then provide technical advice and may recommend a reconnaissance or intensive study.

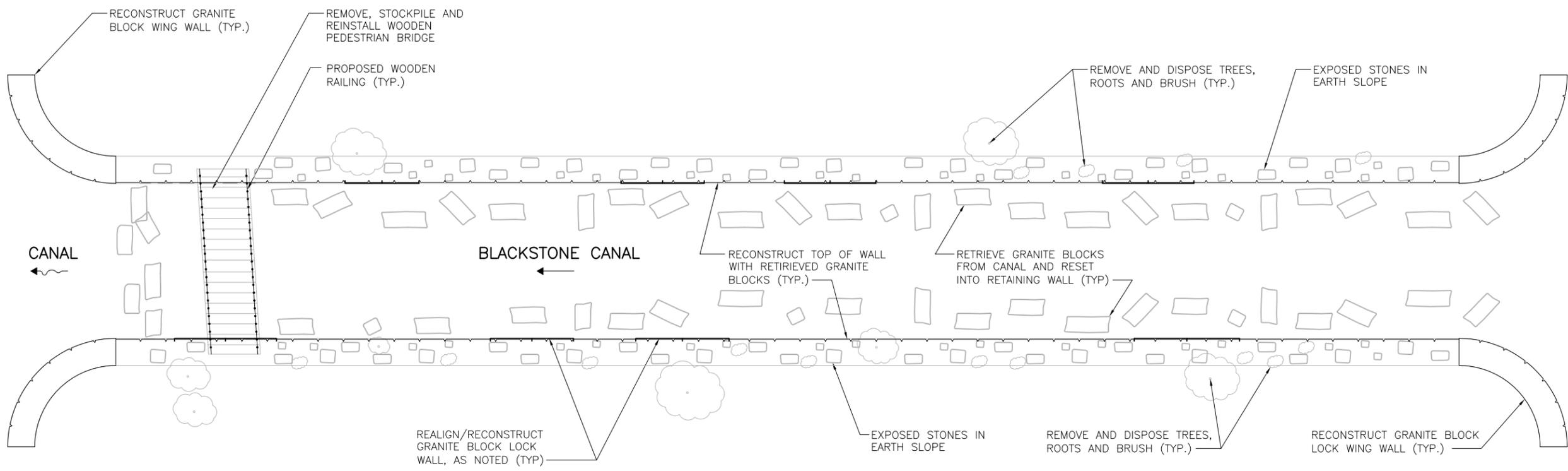
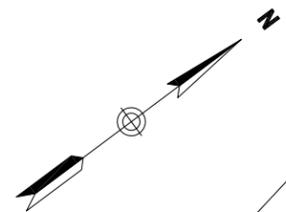
All work would need to meet the *Secretary's Standards*.

**Photo 11 – Goat Hill Lock Remains, Looking North**

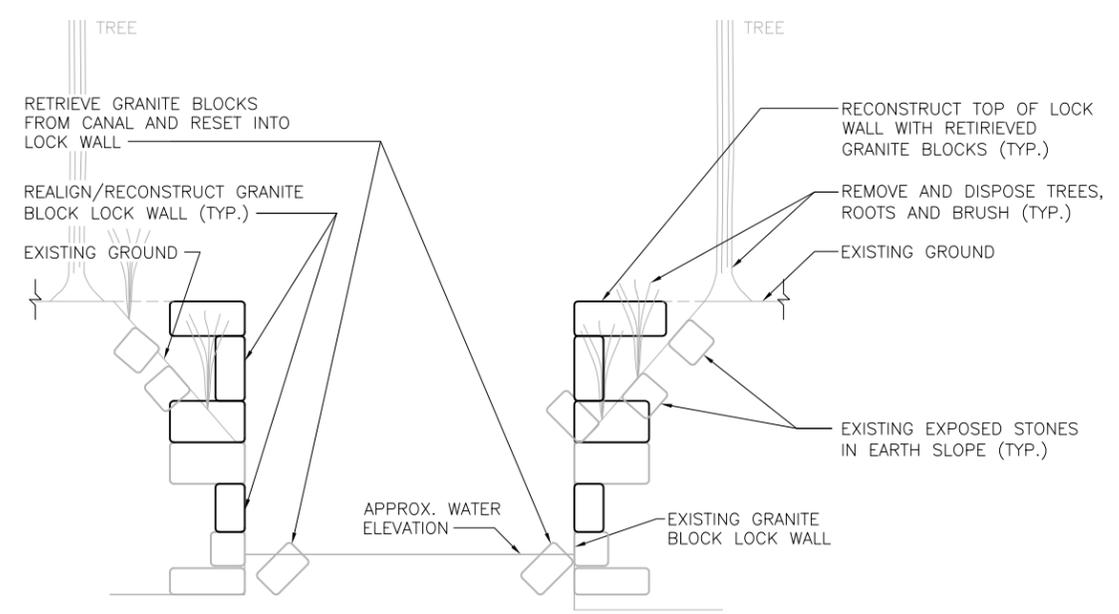


**Photo 12 – Towpath and Footbridge at Visitor Center, Looking South**





**PLAN**  
NOT TO SCALE



**SECTION**  
NOT TO SCALE

**Figure 5**

DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
<b>ADD</b>		<b>GOAT HILL LOCK PLAN AND SECTION</b>	_____
TECH. REVIEW:			PMIS/PKG NO.
DATE:			SHEET
			___ OF ___

# 4

## **RECREATIONAL ACCESS TO THE CANAL**

The Blackstone River and Canal Heritage State Park offers visitors opportunities to experience the canal on foot, by walking along the Canal towpath, and by boat, by canoeing or kayaking in the River and Canal. A Visitor Center is located on Oak Street in Uxbridge, in an area of the park known as River Bend Farm. The Visitor Center provides public rest rooms and meeting space as well as park maps and interpretive and educational brochures. An exhibit explores the history of agriculture in the Blackstone Valley and the construction of the Blackstone Canal. This section will examine existing access conditions and list recommendations for improvements.

### **EXISTING CONDITIONS FOR PARKING**

The park contains several parking areas for visitors. The primary vehicle parking facility is at the River Bend Farm Visitor's Center, which has 16 spaces in a paved parking area. Overflow parking for special events is available on the grassed areas near the Visitor Center and across the street, near the maintenance building. Other facilities include a 20-space paved parking area off Cross Street behind the Stanley Woolen Mill, at the southern end of the study area; a small unpaved gravel parking area at the corner of Oak Street and Hartford Avenue, in a lot that is shared with the Tri-River Family Health Center; an unpaved gravel parking area off Church Street at Plummer's Landing, at the northern end of the study area; and an informal unpaved overflow parking area in the field near Rice City Pond on the north side of Hartford Avenue adjacent to the trail to Goat Hill Lock.

### **EXISTING CONDITIONS FOR WALKING AND BIKING**

The park includes several miles of trails that provide hikers and mountain bicyclists access to the Canal and Towpath. The most heavily used trail is the Towpath Trail, a level, gravel-surface trail that runs from the Stanley Woolen Mill to Rice City Pond. There are several access points to the Towpath Trail:

- From River Bend Farm Visitor Center via a small footbridge over the Canal (see Photo 12).
- At the head of the Canal via the embankment and Gate #1 head gate control structure just south of Hartford Avenue.
- Via a small bridge over the Canal at the end of the towpath just north of Stanley Woolen Mill located on Mendon Street (Route 16). Access onto the bridge near Stanley Woolen Mill is via steps which do not meet ADA requirements.

**Photo 13 – Visitor Center Parking and Pond Dock/Canoe Landing, Looking East**



**Photo 14 – View of Explorer Boat Ramp and Docks at Central Falls Landing, Blackstone River, Central Falls, RI/Cumberland, RI**



The Canal Towpath continues north of Rice City Pond, where it becomes less formalized and more of a hiking/mountain biking trail. Access to this portion of the towpath is as follows:

- North from Hartford Avenue via a hiking and single track biking trail along the side of Goat Hill. (This is part of a loop trail on Goat Hill.)
- From Church Street/Plummer’s Landing via the gravel surface road over the sanitary sewer interceptor.

Portions of the trail on the towpath embankment between Goat Hill Lock and Plummer’s Landing are being eroded by the Canal breach flow. The trail is undercut by the breach flow and could result in hikers falling into the fast flowing water in flood channel. Otherwise, except for isolated sections of steep downgrades where runoff is eroding the trail surface, the trails are for the most part stable and in good condition.

The Massachusetts Department of Transportation (MDOT) had been developing plans to construct the Blackstone River Bikeway through the Heritage State Park. The MDOT bikeway design was intended to comply with the AASHTO Bicycle Design Guidelines for a shared-use bicycle/pedestrian facility. These Guidelines call for a paved surface 10 feet wide with 2 foot wide graded shoulders, 3:1 maximum side slopes and a maximum profile grade of 5% for ADA accommodation. Construction of such a facility would have resulted in significant clearing of an alignment along the side of Goat Hill, substantial earthwork cuts and fills and/or retaining walls to provide the shoulders, side slopes and ADA compliant grades. This work would have obliterated the remains of the historic stone quarry sites on the east side of Goat Hill above the Canal. Design of the bikeway has recently been transferred to the Massachusetts Department of Conservation and Recreation. The agency envisions developing a “greenway” type facility (see recommendations, below, for more information).

## **EXISTING CONDITIONS FOR CANOES & KAYAKS**

In addition to bicycling and walking, the park offers visitors the opportunity to canoe and kayak in the Canal and River. The BRVNHCC produces maps for River and Canal canoe/kayak tours, including a river tour from Plummer’s Landing to the Visitor’s Center; a Canal tour that begins at the Visitor’s Center and heads north to the Goat Hill Lock; a Canal tour that begins at the Visitor’s Center and heads south to the Stanley Woolen Mill; and a loop tour that includes a leg from the Visitor’s Center to Stanley Woolen Mill in the River. There are several put-in locations in the park: one in the River at Plummer’s Landing on the south side of Church Street; one in the River, near Gate #1 just south of Hartford Avenue (the Canal can be accessed from this location by portaging over the Gate #1 head gate embankment); one in the Canal, at the pond adjacent to the Visitor’s Center (see Photo 13); and one in the Canal, at the south end of the towpath just north of the Stanley Woolen Mill.

Existing conditions prevent boats from navigating this length of the canal unimpeded, without portaging. Vertical clearance under the Church Street bridge over the River is very limited even for canoes (see Photo 10). Boat/canoe/kayak passage through Gate #1 is not possible as the inlet is blocked by a metal trash rack and is submerged for most of the year. In any case, passage

through Gate #1 is not recommended as a canoeist could become entangled in debris or get wedged sideways between the gate walls and capsize. Several accidents have occurred at other water control gates in the lower Blackstone including one drowning victim. Canoe passage through Gate #2 and Gate #3 is not recommended as the inlets are submerged. The existing vertical clearance under the Canal footbridge at the Visitor's Center is approximately 6 feet to 8 feet which allows ample clearance for canoes and kayaks. The vertical clearance under the bridge at the south end of the towpath at Stanley Woolen Mill is insufficient to provide adequate canoe or kayak clearance.

Significant areas of the pond by the Visitor Center, especially towards the west bank, have accumulated a layer of muck and silt resulting in a shallow water depth making passage even by canoe difficult, especially during periods of low water. This is a result of the Canal current expanding out of the Canal trench and into the pond and being slowed by the original Canal trench embankment which stills exists submerged under the current pond. These conditions reduce the velocity of the Canal current, and the slack water deposits the silt and debris in the Pond.

## **EXISTING CONDITIONS FOR INTERPRETIVE OPPORTUNITIES**

The Visitor's Center provides tourism and interpretive information (i.e. pamphlets in racks) as well as an exhibit regarding the natural, agricultural and industrial heritage of the area. The Visitor Center also serves as a focal point for special events and activities such as the annual spring maple sugaring festival.

The Park also includes a self-guided interpretive trail, with numbered wooden post trail markers coordinated with a printed map/handout. There are kiosks at several access points which display the map and have a card rack for visitors to take a copy with them. It seems this system does provide interpretive information at minimal cost, though the kiosk racks are sometimes empty. Park staff and Corridor Commission Rangers also offer guided tours of the Canal and towpath on an occasional basis.

## **RECOMMENDATIONS**

### **Parking**

Existing parking facilities appear adequate with the exception of the informal parking at Rice City Pond on the north side of Hartford Avenue, which is not clearly defined. Some vehicles park on grassed areas which during wet periods results in rutting and disturbance of grassed areas. It is recommended that a gravel surface area be constructed with attention to providing sight distances along Hartford Avenue for vehicles exiting the parking lot.

If tour boat and/or canal boat facilities are constructed, additional parking will need to be provided as described in Chapter 5.

## **Walking and Biking**

Trail improvements at the following specific locations are recommended:

- Along the Goat Hill Lock trail, removal of briars and underbrush to permit access to former stone quarry sites (see Recommendations for Interpretive Opportunities, below, for additional information).
- Along the Goat Hill Lock trail on the eroded downhill approach to the Lock, realign the trail to a switchback to eliminate the erosion hazard.
- The trail on the towpath embankment north of the farm bridge site that is undercut by the Canal breach would be restored as part of the breach repairs as outlined in previous chapters of this report.

Recently DCR has assumed overall responsibility for design of the Blackstone River Bikeway and envisions developing a “greenway” type facility. For sensitive areas like the Heritage State Park and Goat Hill, DCR sees a combination of on-road and off-road bikeway facilities. This vision includes construction of a stabilized hiking/single track mountain biking trail through sensitive areas complimented by a signed and marked parallel on-road bike route to accommodate road cyclists.

The USDA Forest Service *Trail Construction and Maintenance Notebook, 2007 Edition* and the International Mountain Biking Association’s *Trail Solutions, Guide to Building Sweet Singletracks* are two resources which outline sustainable trail design and construction techniques. To this end, it is recommended for walking & biking accommodation in the Park, that the eroded unstable sections of the existing hiking trails be restored and reconstructed in accordance with current state-of-the-art trail building for sustainable hiking and single-track mountain bike trails. These efforts should be complimented by DCR’s continuing efforts to develop on-road sections of the bikeway.

## **Canoes and Kayaks**

The current access points for canoes and kayaks appear to be adequate for the stretch of River and Canal between Plummer’s Landing and Route 16. Providing additional portage points between Hartford Avenue and Route 16 would most likely require acquisition of private property since the west bank of the Canal is bounded by privately owned residential properties. Implementing additional canoe access points is not recommended.

Increasing the vertical clearance at the Church Street Bridge to provide passage of watercraft would require significant rise in the profile of Church Street. This would most likely require filling or wall construction which would impact the Landing site, adjacent wetlands and private properties. The work would need to meet the *Secretary’s Standards* due to the likely impacts to the Plummer’s Landing site. Raising the Church Street profile is therefore not recommended.

Consideration should be given to removing the silt and muck that has accumulated along the west bank of the pond at the Visitors Center. The removal would be a dredging operation and would require appropriate environmental permits. Testing of the dredge material should be

performed prior to dredge to determine the appropriate handling and disposal requirements. Given that this material most likely originates from the Blackstone River, it is highly likely that the material is contaminated. The removal of the pond sediments would need to meet the *Massachusetts Contingency Plan* requirements for handling and disposal of contaminated material. Additionally, the dredging operation would require review and approval of the Massachusetts Board of Underwater Archaeological Resources given the proximity of the Blackstone Canal.

## **INTERPRETIVE OPPORTUNITIES**

The Visitor Center at River Bend Farm does a good job of providing visitors with interpretive information, including a permanent exhibit about the history of the Blackstone Valley, with a particular emphasis on agricultural history and the Canal.

A long term goal for additional interpretive opportunities would be to include a Visitor Center facility in redevelopment plans for the Stanley Woolen Mill. Since the Mill is located on a state highway (Route 16), the Mill site is along a roadway with higher traffic volumes and more direct/easier access. This additional Center could serve as a southern anchor of the Heritage State Park.

The self-guided canal tour, with numbered wooden posts keyed to a map, is an effective way to provide visitors with information on historic resources within the Park. The system also minimizes maintenance costs and requirements, since if a sign is vandalized all that is required is the replacement of a numbered wooden post. (At many other locations in the Heritage Corridor, there are interpretive waysides, which are expensive to fabricate and install and can be prone to vandalism.) However, the wood-post-and-map system breaks down when maps are not available at the entry points. It is recommended that the current system remain, provided that DCR provides sufficient funds to insure that the self-guided tour maps are available on-site. It is also recommended that the maps be on-line and made readily available for viewing on a smart phone. The website address or a QR code could be displayed on the kiosks at the entry points.

The loop trail located to the west of the canal on Goat Hill provides excellent opportunities to interpret 19<sup>th</sup>-century construction techniques. Former quarry sites are evident along the trail closest to the Canal, including remnants of steel stone cutting “feathers and wedges” imbedded in granite boulders and large cut granite slabs that were left just as they fell from the quarry face.

The addition of a canal boat replica operation to the State Park would offer visitors a significant interpretive experience. Tours along the Canal from the Visitor’s Center to the Stanley Woolen Mill would offer passengers an up-close perspective on the history and operations of the Canal. Additional information is contained in Chapter 5.

# 5

## CANAL BOAT REPLICA AND/OR TOUR BOAT OPERATIONS

### CANAL BOAT REPLICA AND/OR TOUR BOAT OPERATIONS

The addition of a canal boat replica operation in the Canal in Uxbridge would offer significant interpretive experiences and tourism opportunities. Boat tours have been offered in the Rhode Island sections of the Canal for over a decade, operated by the Blackstone Valley Tourism Council. This organization has conducted boat tours in the Canal in Uxbridge on several occasions in the past, but it is unlikely they will do so again in the near future. The Uxbridge Canal conditions are similar to the Rhode Island sections, however, so the Rhode Island tour boat operations were used as examples and points of reference for the evaluation of boat operations in Uxbridge. This section will examine existing conditions related to boat operations and provide recommendations for improvements needed for their implementation.

### EXISTING CONDITIONS FOR CANAL BOAT REPLICA AND TOUR BOAT OPERATIONS

#### Tour Boat Operations

The Blackstone Valley Tourism Council (BVTC) has operated several tour boats in various sections of the Canal and the Blackstone River in Rhode Island. The *Explorer* is a flat bottomed boat that can carry 40 passengers, which the BVTC has indicated is the minimum capacity required to make the operation economically feasible. The BVTC provided the following dimensions for the *Explorer*:

Length: 33'-6"  
Width: 11'-11 3/4"  
Height: 10'-6"  
Draft: 18" (loaded)

In the past, the *Explorer* was moved to various locations via a trailer; however, it currently operates from a permanent dock facility on the River at a landing in Central Falls, RI. Conversations with BVTC officials indicated the following operating/transporting factors:

- Due to its size, the Council has encountered difficulties in launching the *Explorer*. On numerous occasions, the transport trailer has gotten stuck in the River mud and was damaged because the launch ramp was not of sufficient length. For these reasons, the *Explorer* is no longer transported by trailer and is currently launched via crane only. It operates from the Central Falls Landing, a facility that includes a paved boat ramp, pile-supported dock, floating docks and a gang plank (see Photo 14). The BVTC, through funding from the RI

Department of Transportation Enhancement Program, is constructing landing sites for the *Explorer* that will again allow trailer transport.

- BVTC staff has found that tours are most successful if the launch site is directly visible from public activity centers where the passengers can visually see the *Explorer* and boarding facility. On several occasions, the BVTC has conducted tours where passengers are directed to a parking or assembly area and transported by bus to the boarding facility. The ridership on those occasions was substantially less than when the boat was directly visible from the assembly areas. For this reason, the BVTC feels very strongly that the boat boarding area must be visible from the parking area and easily accessible by a short walk.

### **Canal Boat Replica Operations**

The BVTC also operates a replica British canal boat during the summer and fall. Built in England and named the *Samuel Slater*, the boat is 40 feet long, motor driven and provides a floating bed & breakfast, “British tea tour” and chartered cruises for business functions or family events (weddings, reunions, etc.) on a stretch of the Blackstone River from Central Falls north to Cumberland, RI, in an area known as the Lonsdale Marsh. During the summer and fall, the boat is usually moored at the Central Falls Landing. The boat is removed during the late fall, to avoid the annual Blackstone River winter and early spring flooding events.

The *Samuel Slater* is not a replica of a Blackstone Canal boat. According to the Worcester Historical Museum, the dimensions of the boats that operated on the Blackstone Canal were as follows:

Length:	45’ to 70’
Width:	9’-3”
Height:	unknown
Draft:	2’ to 2’-6” (loaded)

Each boat had a crew of 3 including the captain, deck hand and one man to drive the horses that pulled the boat from the towpath.

### **EXISTING CANAL CONDITIONS RELATIVE TO TOUR AND CANAL BOAT OPERATIONS**

The Canal is generally 34 feet wide at the waterline with an 18 foot wide bottom. The original depth of the Canal was 4 to 6 feet, although current depths in some sections may be less due to the accumulation of debris and silt.

In 1994 the BVTC launched the *Explorer* for a tour in the Canal from the Hartford Avenue Bridge north towards the Goat Hill Lock, a distance of approximately 0.7 miles. The *Explorer* was launched into the Canal by lifting the boat from the trailer with a crane; however, this was an expensive and somewhat risky operation. Corridor Commission staff that were present report that, for the most part, the *Explorer* was able to navigate the Canal up to Goat Hill Lock; however, crew members had to get out and push the boat in some areas, due to shallow water. A

smaller pontoon boat, the *Spirit of the Blackstone*, did operate in this stretch of the Canal for a couple of years around this time, but the BVTC no longer utilizes this watercraft.

Existing conditions in the Canal south of Hartford Avenue present several challenges for tour and Canal boat operations. Neither a tour boat the size of the *Explorer* nor a canal boat replica can fit through Gate #1 at Hartford Avenue or under the existing bridge over the Canal at River Bend Farm, the clearance of which is approximately 6 feet. Similarly, the vertical clearance under the bridge just north of the Stanley Woolen Mill is approximately 6 feet, too low to allow passage of canal or tour boats. A boat would therefore be limited to operating from River Bend Farm south to the bridge just north of the Stanley Woolen Mill, a distance of approximately 1 mile.

The Canal is generally wide enough to accommodate a tour boat or canal boat replica, but there is a narrow “pinch point” at the Widow Willard Bridge located halfway between the Visitor Center and Gate #2. The stone abutments remain at the Canal edges and several stones have fallen into the Canal trench. The width between the abutments is 18 feet-6 inches; however, the displaced stones reduce the effective width to approximately 16 feet. The Canal’s relatively narrow width at the Widow Willard Bridge abutments would permit passage of a Blackstone Canal boat replica and/or a tour boat the size of the *Explorer*, however, removal and resetting of the stones that have fallen into the Canal would improve the clearance.

The only location where the Canal is wide enough to turn a canal boat replica or a boat the size of the *Explorer* around and reverse direction is in a wide canal “layby” section north of Gate #2, which is approximately 1/2 mile south of the Visitor Center. In order to reach the bridge just north of the Stanley Woolen Mill, the boat would need to be able to operate in both directions without being turned around.

Finally, the sediment deposits and shallow water in the pond at River Bend Farm make it impossible to get the boat close enough to the shoreline to load and unload passengers.

## **RECOMMENDATIONS FOR BOAT OPERATIONS NORTH OF HARTFORD AVENUE**

Operating a canal boat replica or tour boat in the Canal north of Hartford Avenue to Goat Hill Lock presents several challenges but is possible, provided the following improvements are implemented:

- The vessel should be self-propelled, of shallow draft and designed to fit the dimensions of the Canal trench.
- Rather than using a crane to launch and/or remove boats from the pond, a stable ramp facility should be constructed that will allow boats to be launched and removed via towed trailer. The ramp surface should be firm, stable, slip resistant, erosion resistant and of materials compatible with the historic context of the site.

- A suitable dock and landing facility would need to be constructed to moor the boat during the boating season and for passenger loading/unloading. This may be possible by utilizing in part the remains of the original Hartford Avenue Bridge stone abutments, located approximately 50 feet north of the present bridge. The dock design should be such that any ramps/floating platforms can be removed and stored for the winter months to prevent damage by seasonal flooding. Overnight storage of the boat during the boating season could be accommodated at the dock, provided a means of securing the craft is implemented to prevent unauthorized use.
- It is recommended that the canal boat replica be removed annually for the winter season to prevent damage and to facilitate regular maintenance. Provisions to store the vessel at the Visitor's Center are recommended, such as a stable granular surface.
- The existing unpaved parking area off of Hartford Avenue would need to be resurfaced with a granular surface material more suitable to parking and foot traffic than the existing natural soil, as recommended in the Parking section of this report.
- Additional parking should be provided at the Visitor's Center to accommodate anticipated boat passengers. Rather than construct permanent paved or surface parking areas, temporary parking on grassed areas could be utilized only for the days of the boat operations. Parking in these temporary areas could be prohibited at other times. (Note, however, that off-site parking and busing of tour/canal boat customers may not attract adequate ridership.)
- Additional rights-of-entry across the private properties along the Canal bank may be needed for public access from the parking area to the dock and ramp.
- Dredging of the Canal trench will be needed to remove the silt and debris and provide adequate depth for the boat passage without fear of running aground. As previously mentioned, it is highly likely that the silt would be considered as contaminated soil and would have to be handled and disposed of in accordance with solid waste regulations. The Massachusetts Board of Underwater Archaeological Resources would need to review and approve any proposed dredging.
- Another consideration for operating these boats within the Canal is the presence of large trees on both banks. It is not uncommon for large trees to fall across the Canal blocking transit by watercraft. As previously discussed, the issues of these large trees in the Canal towpath embankment is a sensitive issue that should be addressed as part of the discussion regarding regular boat operations in this section of the Canal.
- Adequate funding is appropriated for regular maintenance of the boat and landing facilities.

Consideration could be given to replace the “flashboards” on the crest of the Rice City dam at Hartford Avenue to increase the water depth of the Canal north of Hartford Avenue. This modification would increase the typical depth of Rice City Pond and may require significant evaluation of the impact of (?) increased water depth on wildlife habitat.

These improvements for replica and/or tour boat operations could also be used for improved canoe and kayak access.

## **RECOMMENDATIONS FOR BOAT OPERATIONS SOUTH OF HARTFORD AVENUE**

The approximately one mile length of watered Canal trench from the footbridge at the Visitor’s Center to the bridge at Stanley Woolen Mill would provide an interesting length of Canal features. Operating a canal boat replica or tour boat in this section of Canal is possible, provided the following improvements are implemented:

- The vessel should be self-propelled, of shallow draft and designed to fit the dimensions of the Canal trench.
- A canal boat replica or modern tour boat would need to be sized to clear the constrained width at the Widow Willard Bridge site. Since the present Canal width narrows near the Stanley Woolen Mill, the boat should also be designed to operate in either direction without the need to turn around so that tours can continue south past the layby.
- The pond at the Visitor’s Center needs to be dredged to remove the silt and debris to provide access to the western edge of the pond shoreline. The dredging operation would require review and approval of the Massachusetts Board of Underwater Archaeological Resources. In addition, it is highly likely that the silt is contaminated and would need to be handled and disposed of in accordance with solid waste regulations.
- A suitable dock and landing facility would need to be provided at the Visitor’s Center to moor the boat during the summer season and for passenger loading. Overnight storage during the season could be accommodated at the Visitor’s Center provided a means of securing the craft is implemented to prevent unauthorized use.
- Rather than using a crane to launch and/or remove boats from the pond, a stable ramp facility should be constructed that will allow boats to be launched/removed via towed trailer. The ramp surface should be firm, stable, slip resistant, erosion resistant and of materials compatible with the historic context of the site. The ramp would also improve landing/access conditions for canoes and kayaks.
- It is recommended that the replica boat be removed from the Canal and “dry-docked” over the winter to avoid damage from seasonal flooding and to allow annual maintenance. The easiest method would be removal/launch by trailer rather than lifting by crane. Thus heavy vehicle access to the dock is needed to remove the boat for the winter season and store it on-site at the Visitor’s Center. This ramp could serve as a launch ramp for trail mobile tour boats and canoes/kayaks.
- Another consideration for operating these boats within the Canal is the presence of large trees on both banks. It is not uncommon for large trees to fall across the Canal blocking transit by watercraft. As previously discussed, the issues of these large trees in the Canal towpath

embankment is a sensitive issue that should be addressed as part of the discussion regarding regular boat operations in this section of the Canal.

- Additional parking should be provided at the Visitor’s Center to accommodate anticipated boat passengers. Rather than construct permanent paved or surface parking areas, temporary parking on grassed areas could be utilized only for the days of the boat operations. Parking in these temporary areas could be prohibited at other times. As previously mentioned, off-site parking and busing of tour/canal boat customers does not seem to attract adequate ridership.
- Adequate funding is appropriated for regular maintenance of the boat and landing facilities.

To access the half mile section of Canal trench north of the Visitor’s Center, replacement of the existing footbridge over the canal to provide 12 foot vertical clearance would be required. Provision of these clearances may not be feasible since it would require an elevated/ramped approach from the towpath up to the bridge. It is anticipated that this would not fit within the context of the original Canal towpath construction and therefore is not recommended.

If the craft were to be pulled by draft animals rather than self/motor propelled, additional provisions to care for and feed the animals on-site would need to be provided. Although River Bend Farm was originally a dairy farm, the barn has been converted to Park administrative office space, public restrooms, a meeting room and public assembly/interpretive display areas. The remaining farm buildings are devoted to Park maintenance needs. These buildings would have to be reconverted back to animal stable or new draft animal stable facilities built. Park staff would need to be trained in the handling and care of the animals. Additionally, the canal side towpath bank would need to be cleared of trees to permit the passage of the draft animals and tow ropes. Given the staff and budget constraints faced by MaDCR, the option of using draft animals to tow replica boats is not feasible, nor recommended.

# **APPENDIX A: CONCEPTUAL COST ESTIMATES**

## **CONSTRUCTION COST ESTIMATE SUMMARY**

Construction cost estimates were prepared for the repairs to the Canal, the Goat Hill Lock and improvements to establish tour boat operations. The estimates included approximate quantities and unit costs derived from bids on recent projects in the Canal area of the Blackstone Valley. Standard NPS contingency, indirect and direct costs, design and permitting costs as a percentage of construction cost and inflation escalation factors were included. The costs do not include acquisition of any property or easements over private property.

## **CONSTRUCTION PRIORITIES**

The existing condition of the Canal between Goat Hill Lock and Plummers Landing is of extreme concern. Based on recent observations and discussions with DCR staff, the erosion of the Canal towpath embankment due to the breaches is accelerating. It is apparent that another breach of River flow back into the Canal prism will occur perhaps within the next year or two. As described in the text, this new breach will allow flow directly onto the Goat Hill Lock which in its current condition would not be able to withstand the erosive forces. Therefore, repair of the Towpath embankment to eliminate the breaches and stabilize the Canal features from future flood damage is of the highest priority. The overall repair consists of five elements as detailed in the cost estimate spreadsheets and described in the text-entrance breach repair, exit breach repair, Canal embankment repair, towpath low point repair, and northern Canal repairs.

Failure to complete these repairs in a timely manner will most likely result in loss of the Goat Hill Lock and significant sections of the Canal prism and towpath between the Lock and Plummers Landing.

Improvements to accommodate a Canal Boat operation, although desirable, should be considered secondary to the Canal repairs.

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 1 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
 10 Dorrance Street  
 Providence, RI 02903

Date: 12-Dec-11

**Canal and Towpath Repairs Estimate Summary  
 Northbridge, MA**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	EA	Entrance Breach Repair		\$84,000.00
1	EA	Exit Breach Repair		\$86,000.00
1	EA	Canal Embankment Repair - Reinforcement		\$829,000.00
1	EA	Tow Path Low Point Repair		\$48,000.00
1	EA	Northern Canal Repairs		\$33,000.00
		<b>Subtotal Direct Construction Costs</b>		<b>\$1,080,000.00</b>
		Remoteness Factor (2%)		\$21,600.00
		State and Local taxes (6.25%)		\$67,500.00
		Construction Contingency (30%)		\$324,000.00
		<b>Total Direct Construction Costs</b>		<b>\$1,493,100.00</b>
		Standard General Conditions (15%)		\$223,965.00
		Government General Conditions (5%)		\$74,655.00
		Historic Preseervation Factor (5%)		\$74,655.00
		<b>Total Indirect Construction Costs</b>		<b>\$373,275.00</b>
		<b>Subtotal NET Construction Costs</b>		<b>\$1,866,375.00</b>
		Bonds and Permits (2%)		\$37,327.50
		Contracting Method Adjustment (10%)		\$186,637.50
		Inflation Escalation (24 months @ 4% per year)		\$149,310.00
		<b>Total Estimated NET Cost of Construction</b>		<b>\$2,239,650.00</b>
		Construction Contingency (10%)		\$223,965.00
		Construction Mangement (8%)		\$179,172.00
		<b>Estimated Total Gross Cost of Construction</b>		<b>\$2,642,787.00</b>
		Design Costs (17%)		\$449,273.79
		Archeological Survey, Site Mapping and Permitting (8%)		\$211,422.96
		<b>Total Estimated Project Cost</b>		<b>\$3,303,483.75</b>
		<b>Say</b>		<b>\$3,310,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 2 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 13-Dec-11

**Entrance Breach Repair**

	QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
	400	SF	Sheeting (50' x 8')	\$80	\$32,000.00
	400	SF	Dewatering	\$15	\$6,000.00
	0.5	Acre	Clearing & Grubbing	\$5,000	\$2,500.00
	660	LF	Erosion Control Hay bales & silt fence both sides	\$8	\$5,280.00
	230	CY	New Towpath Embankment	\$30	\$6,900.00
	100	CY	Rip Rap Armor	\$100	\$10,000.00
	2420	SY	Loam and Seed	\$6	\$14,520.00
			<b>Subtotal</b>		\$77,200.00
			<b>Mobilization</b>	8%	\$6,176.00
			<b>Total</b>		\$83,376.00
			<b>Say</b>		<b>\$84,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 3 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 13-Dec-11

**Exit Breach Repair**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
300	SF	Sheeting (50' x 6') cut off River	\$80	\$24,000.00
400	SF	Dewatering	\$15	\$6,000.00
0.5	Acre	Clearing & Grubbing	\$5,000	\$2,500.00
660	LF	Erosion Control	\$8	\$5,280.00
230	CY	New Towpath Embankment	\$30	\$6,900.00
100	CY	Rip Rap Armor	\$100	\$10,000.00
2400	CY	Loam and Seed	\$6	\$14,400.00
1	Each	Remove and Stockpile Culvert/Bridge Structure	\$10,000	\$10,000.00
		<b>Subtotal</b>		\$79,080.00
		<b>Mobilization</b>	8%	\$6,326.40
		<b>Total</b>		\$85,406.40
		<b>Say</b>		<b>\$86,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 4 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 13-Dec-11

**Canal Embankment Repair - Reinforcement**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
450	CY	Install and Remove Sand Bag Dams,As needed	\$75	\$33,750.00
650	SF	Dewatering	\$15	\$9,750.00
1	Acre	Clearing & Grubbing	\$5,000	\$5,000.00
11,600	LF	Erosion Control Hay bale & silt fence both sides	\$6	\$69,600.00
6,700	CY	New Towpath Embankment	\$30	\$201,000.00
2500	CY	Rip Rap Armor	\$100	\$250,000.00
5800	SY	Loam and Seed	\$5	\$29,000.00
2150	CY	Wetland Soil (to backfill eroded area)	\$35	\$75,250.00
58,000	EA	Wetland Plantings	\$2	\$116,000.00
		<b>Subtotal</b>		<b>\$789,350.00</b>
		<b>Mobilization</b>	5%	<b>\$39,467.50</b>
		<b>Total</b>		<b>\$828,817.50</b>
		<b>Say</b>		<b>\$829,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 5 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 13-Dec-11

**Towpath Low Point Repair**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
0.6	Acre	<b>Clearing &amp; Grubbing</b>	\$5,000	\$3,000.00
1,800	LF	<b>Erosion Control Hay bale &amp; silt fence both sides</b>	\$8	\$14,400.00
280	CY	<b>New Towpath Embankment</b>	\$30	\$8,400.00
33	CY	<b>Rip Rap Armor</b>	\$100	\$3,300.00
2,400	SY	<b>Loam and Seed</b>	\$6	\$14,400.00
		<b>Subtotal</b>		\$43,500.00
		<b>Mobilization</b>	10%	\$4,350.00
		<b>Total</b>		\$47,850.00
		<b>Say</b>		<b>\$48,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 6 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date 12-Dec-11

**Northern Canal Repairs**

	QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
	1	Acre	Clearing & Grubbing	\$5,000	\$5,000.00
	1800	LF	Erosion Control (Baled hay/silt fence 1 side)	\$6.00	\$10,800.00
	50	LF	Remove and Dispose Pipe	\$20.00	\$1,000.00
	125	Ton	Remove & Dispose misc fill and trash	\$75	\$9,375.00
	100	CY	Towpath Embankment Spot Repairs approximately 100 CY	\$30	\$3,000.00
			<b>Subtotal</b>		\$29,175.00
			<b>Mobilization</b>	10%	\$2,917.50
			<b>Total</b>		\$32,092.50
			<b>Say</b>		<b>\$33,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 7 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 12-Dec-11

**Goat Hill Lock Rehabilitation Estimated Summary  
Uxbridge, MA**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
40	EACH	<b>Clearing Vegetation/Stump Removal</b>	\$120	\$4,800.00
330	CY	<b>Install and Remove Water Diversion Dams</b>	\$75	\$24,750.00
400	SF	<b>Dewatering</b>	\$15	\$6,000.00
1	EACH	<b>New double Leaf gate installation (1 end only)</b>	\$65,000	\$65,000.00
		Fabricate and assemble the timber and steel components of Leaf Gate.		
10	CY	<b>Concrete Substructure (Leaf Gate Hinge)</b>	\$900	\$9,000.00
30	CY	<b>Retrieve Stones from Canal and Reconstruct Top of Wall</b>	\$1,200	\$36,000.00
15	CY	<b>Realign/Reconstruct Existing Granite Wall</b>	\$1,200	\$18,000.00
240	SF	<b>Remove and Replace Wooden Footbridge</b>	\$22	\$5,280.00
50	LF	<b>Footbridge Railings</b>	\$80	\$4,000.00
400	SY	<b>Loam and Seed</b>	\$5	\$2,000.00
		<b>Subtotal Direct Construction Costs</b>		<b>\$174,830.00</b>
		Remoteness Factor (2%)		\$3,496.60
		State and Local taxes (6.25%)		\$10,926.88
		Construction Contingency (30%)		\$52,449.00
		<b>Total Direct Construction Costs</b>		<b>\$241,702.48</b>
		Standard General Conditions (15%)		\$36,255.37
		Government General Conditions (5%)		\$12,085.12
		Historic Preseervation Factor (5%)		\$12,085.12
		<b>Total Indirect Construction Costs</b>		<b>\$60,425.62</b>
		<b>Subtotal NET Construction Costs</b>		<b>\$302,128.09</b>
		Bonds and Permits (2%)		\$6,042.56
		Contracting Method Adjustment (10%)		\$30,212.81
		Inflation Escalation (24 months @ 4% per year)		\$24,170.25
		<b>Total Estimated NET Cost of Construction</b>		<b>\$362,553.71</b>
		Construction Contingency (10%)		\$36,255.37
		Construction Mangement (8%)		\$29,004.30
		<b>Estimated Total Gross Cost of Construction</b>		<b>\$427,813.38</b>
		Design Costs (17%)		\$72,728.27
		Archeological Survey, Site Mapping and Permitting (8%)		\$34,225.07
		<b>Total Estimated Project Cost</b>		<b>\$534,766.73</b>
		<b>Say</b>		<b>\$540,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 8 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 13-Dec-11

**Canal Boat Replica Cost  
Uxbridge, MA**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	EA	Canal Boat Replica (withheld from contingency total and added at bottom line as a purchase)	\$200,000	
1	EA	Boat Launching Ramp 20 feet long x 20 feet wide crushed stone, paver block surface		\$30,000.00
1	EA	Dock/Passenger loading/unloading structure including 200 SF floating dock, 150 SF gangway, wood bulkhead/dock and timber piles		\$55,000.00
1	EA	Off-season storage facility 1000 SF wood frame building		\$10,000.00
1	EA	Dredging of Boat launch area		\$60,000.00
<b>Subtotal Direct Construction Costs</b>				<b>\$155,000.00</b>
Remoteness Factor (2%)				\$3,100.00
State and Local taxes (6.25%)				\$9,687.50
Construction Contingency (30%)				\$46,500.00
<b>Total Direct Construction Costs</b>				<b>\$214,287.50</b>
Standard General Conditions (15%)				\$32,143.13
Government General Conditions (5%)				\$10,714.38
Historic Preseervation Factor (5%)				\$10,714.38
<b>Total Indirect Construction Costs</b>				<b>\$53,571.88</b>
<b>Subtotal NET Construction Costs</b>				<b>\$267,859.38</b>
Bonds and Permits (2%)				\$5,357.19
Contracting Method Adjustment (10%)				\$26,785.94
Inflation Escalation (24 months @ 4% per year)				\$21,428.75
<b>Total Estimated NET Cost of Construction</b>				<b>\$321,431.25</b>
Construction Contingency (10%)				\$32,143.13
Construction Mangement (8%)				\$25,714.50
<b>Estimated Total Gross Cost of Construction</b>				<b>\$379,288.88</b>
Design Costs (17%)				\$64,479.11
Archeological Survey, Site Mapping and Permitting (8%)				\$30,343.11
				\$474,111.09
Canal Boat Replica				\$200,000.00
<b>Total Estimated Project Cost</b>				<b>\$674,111.09</b>
<b>Say</b>				<b>\$680,000.00</b>

\*\*Annual operation costs estimated \$50,000 to \$75,000

# **Conceptual Cost Estimate 'Economic Impact'**

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 1 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
 10 Dorrance Street  
 Providence, RI 02903

Date: 12-Dec-11

**Canal and Towpath Repairs Estimate Summary  
 Northbridge, MA**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	EA	Entrance Breach Repair		\$84,000.00
1	EA	Exit Breach Repair		\$86,000.00
1	EA	Canal Embankment Repair - Reinforcement		\$829,000.00
1	EA	Tow Path Low Point Repair		\$48,000.00
1	EA	Northern Canal Repairs		\$33,000.00
		<b>Subtotal Direct Construction Costs</b>		<b>\$1,080,000.00</b>
		Remoteness Factor (2%)		\$21,600.00
		State and Local taxes (6.25%)		\$67,500.00
		Construction Contingency (30%)		\$324,000.00
		<b>Total Direct Construction Costs</b>		<b>\$1,493,100.00</b>
		Standard General Conditions (15%)		\$223,965.00
		Government General Conditions (5%)		\$74,655.00
		Historic Preseervation Factor (5%)		\$74,655.00
		<b>Total Indirect Construction Costs</b>		<b>\$373,275.00</b>
		<b>Subtotal NET Construction Costs</b>		<b>\$1,866,375.00</b>
		Bonds and Permits (2%)		\$37,327.50
		Contracting Method Adjustment (10%)		\$186,637.50
		Inflation Escalation (24 months @ 4% per year)		\$149,310.00
		<b>Total Estimated NET Cost of Construction</b>		<b>\$2,239,650.00</b>
		Construction Contingency (10%)		\$223,965.00
		Construction Mangement (8%)		\$179,172.00
		<b>Estimated Total Gross Cost of Construction</b>		<b>\$2,642,787.00</b>
		Design Costs (17%)		\$449,273.79
		Archeological Survey, Site Mapping and Permitting (8%)		\$211,422.96
		<b>Total Estimated Project Cost</b>		<b>\$3,303,483.75</b>
		<b>Say</b>		<b>\$3,310,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 2 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
 10 Dorrance Street  
 Providence, RI 02903

Date: 13-Dec-11

**Entrance Breach Repair**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
400	SF	Sheeting (50' x 8')	\$80	\$32,000.00
400	SF	Dewatering	\$15	\$6,000.00
0.5	Acre	Clearing & Grubbing	\$5,000	\$2,500.00
660	LF	Erosion Control Hay bales & silt fence both sides	\$8	\$5,280.00
230	CY	New Towpath Embankment	\$30	\$6,900.00
100	CY	Rip Rap Armor	\$100	\$10,000.00
2420	SY	Loam and Seed	\$6	\$14,520.00
		<b>Subtotal</b>		\$77,200.00
		<b>Mobilization</b>	8%	\$6,176.00
		<b>Total</b>		\$83,376.00
		<b>Say</b>		<b>\$84,000.00</b>

20' X 20' RIDOT Item 208.0100

80' x 275'/43560 RIDOT Item 201.0320

work area 330' long, ec on both sides RIDOT Items 206.0201 & 206.0202

12' top, 1.5: 1 slope, 7' height, 40' length RIDOT Item 302.0100

(14'x2'x50') x two sides X 1/27 RIDOT Items 920.055 & 920.0130

Same area as clear & grub RIDOT Items L01.0102 & L02.0102

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 3 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
 10 Dorrance Street  
 Providence, RI 02903

Date: 13-Dec-11

**Exit Breach Repair**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL	
300	SF	Sheeting (50' x 6') cut off River	\$80	\$24,000.00	
400	SF	Dewatering	\$15	\$6,000.00	20' X 20' RIDOT Item 208.0100
0.5	Acre	Clearing & Grubbing	\$5,000	\$2,500.00	80' x 275'/43560 RIDOT Item 201.0320
660	LF	Erosion Control	\$8	\$5,280.00	work area 330' long, ec on both sides RIDOT Items 206.0201 & 206.0202
230	CY	New Towpath Embankment	\$30	\$6,900.00	12' top, 1.5: 1 slope, 7' height, 40' length RIDOT Item 302.0100
100	CY	Rip Rap Armor	\$100	\$10,000.00	(14'x2'x50') x two sides X 1/27 RIDOT Items 920.055 & 920.0130
2400	CY	Loam and Seed	\$6	\$14,400.00	Same area as clear & grub RIDOT Items L01.0102 & L02.0102
1	Each	Remove and Stockpile Culvert/Bridge Structure	\$10,000	\$10,000.00	selective demolition and removal of stone blocks
		<b>Subtotal</b>		\$79,080.00	
		<b>Mobilization</b>	8%	\$6,326.40	
		<b>Total</b>		\$85,406.40	
		<b>Say</b>		<b>\$86,000.00</b>	

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 4 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
 10 Dorrance Street  
 Providence, RI 02903

Date: 13-Dec-11

**Canal Embankment Repair - Reinforcement**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL	
450	CY	<b>Install and Remove Sand Bag Dams,As needed</b>	\$75	\$33,750.00	(5' top x 25' base x 8' depth x 50') x 2 dams - 1 at each end Blackstone bikeway segment 5
650	SF	<b>Dewatering</b>	\$15	\$9,750.00	2 siites 20' x 20' & 15' x 15' RIDOT Items 208.0100
1	Acre	<b>Clearing &amp; Grubbing</b>	\$5,000	\$5,000.00	Loam & seed 5800 x 9 /43560 RIDOT Item 201.0320
11,600	LF	<b>Erosion Control Hay bale &amp; silt fence both sides</b>	\$6	\$69,600.00	5800 x 2 x \$1.75 RIDOT Items 206.0201 & 206.0202
6,700	CY	<b>New Towpath Embankment</b>	\$30	\$201,000.00	6' top, 8' depth, 10' wide base, 2900 lf RIDOT Item 302.0100
2500	CY	<b>Rip Rap Armor</b>	\$100	\$250,000.00	(12'x2'x2900')/27=2577CY RIDOT Items 920.0055 & 920.0130
5800	SY	<b>Loam and Seed</b>	\$5	\$29,000.00	18' x 2900/9=5800sy RIDOT Items L01.0102 & L02.0102
2150	CY	<b>Wetland Soil (to backfill eroded area)</b>	\$35	\$75,250.00	1' depth x 20' wide x2900x 1/27 = 2148CY RIDOT AWUP
58,000	EA	<b>Wetland Plantings</b>	\$2	\$116,000.00	1 plant per foot, 20'x2900' RIDOT AUWP
		<b>Subtotal</b>		\$789,350.00	
		<b>Mobilization</b>	5%	\$39,467.50	
		<b>Total</b>		\$828,817.50	
		<b>Say</b>		<b>\$829,000.00</b>	

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 5 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
 10 Dorrance Street  
 Providence, RI 02903

Date: 13-Dec-11

**Towpath Low Point Repair**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
0.6	Acre	<b>Clearing &amp; Grubbing</b>	\$5,000	\$3,000.00
				1,000' x24' / 43560 RIDOT Item 201.032C
1,800	LF	<b>Erosion Control Hay bale &amp; silt fence both sides</b>	\$8	\$14,400.00
				900' X 2 for both sides RIDOT Items 206.0201 & 206.0202
280	CY	<b>New Towpath Embankment</b>	\$30	\$8,400.00
				6' top, 10' base, 6.5 ' depth x150' length RIDOT Item 302.0100
33	CY	<b>Rip Rap Armor</b>	\$100	\$3,300.00
				3'x2'x150'/27=33CY RIDOT Items 920.0055 & 920.013C
2,400	SY	<b>Loam and Seed</b>	\$6	\$14,400.00
				same as clearing and grubbing 0.5 ac x 43560 /9 RIDOT Items L01.0102 & L02.0102
		<b>Subtotal</b>		\$43,500.00
		<b>Mobilization</b>	10%	\$4,350.00
		<b>Total</b>		\$47,850.00
		<b>Say</b>		<b>\$48,000.00</b>

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 6 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date 12-Dec-11

**Northern Canal Repairs**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	Acre	Clearing & Grubbing	\$5,000	\$5,000.00
1800	LF	Erosion Control (Baled hay/silt fence 1 side)	\$6.00	\$10,800.00
50	LF	Remove and Dispose Pipe	\$20.00	\$1,000.00
125	Ton	Remove & Disopose misc fill and trash	\$75	\$9,375.00
100	CY	Towpath Embankment Spot Repairs approximately 100 CY	\$30	\$3,000.00
		<b>Subtotal</b>		\$29,175.00
		<b>Mobilization</b>	10%	\$2,917.50
		<b>Total</b>		\$32,092.50
		<b>Say</b>		<b>\$33,000.00</b>

1800' x24'=43,200 RIDOT 201.0301 adjusted

RIDOT 206.0201 & 206.0208

50' X \$20/ LF Manville Landing Cumberland RIDOT TE project and SEG 5 Blackstone bikeway contract PLH-F005 (005)

Trash removal (5'+10')/2 x 6' high x 50' long x 1/27=83 CY X 1.5 TONS/cy x \$75/ton=\$9,375 Manville Landing RIDOT TE Project

100 CY estimated from field review RIDOT Item 302.0100

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 7 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 12-Dec-11

**Goat Hill Lock Rehabilitation Estimated Summary  
Uxbridge, MA**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
40	EACH	Clearing Vegetation/Stump Removal	\$120	\$4,800.00
330	CY	Install and Remove Water Diversion Dams	\$75	\$24,750.00
400	SF	Dewatering	\$15	\$6,000.00
1	EACH	New double Leaf gate installation (1 end only)	\$65,000	\$65,000.00
		Fabricate and assemble the timber and steel components of Leaf Gate.		
10	CY	Concrete Substructure (Leaf Gate Hinge)	\$900	\$9,000.00
30	CY	Retrieve Stones from Canal and Reconstruct Top of Wall	\$1,200	\$36,000.00
15	CY	Realign/Reconstruct Existing Granite Wall	\$1,200	\$18,000.00
240	SF	Remove and Replace Wooden Footbridge	\$22	\$5,280.00
50	LF	Footbridge Railings	\$80	\$4,000.00
400	SY	Loam and Seed	\$5	\$2,000.00
		<b>Subtotal Direct Construction Costs</b>		<b>\$174,830.00</b>
		Remoteness Factor (2%)		\$3,496.60
		State and Local taxes (6.25%)		\$10,926.88
		Construction Contingency (30%)		\$52,449.00
		<b>Total Direct Construction Costs</b>		<b>\$241,702.48</b>
		Standard General Conditions (15%)		\$36,255.37
		Government General Conditions (5%)		\$12,085.12
		Historic Preservation Factor (5%)		\$12,085.12
		<b>Total Indirect Construction Costs</b>		<b>\$60,425.62</b>
		<b>Subtotal NET Construction Costs</b>		<b>\$302,128.09</b>
		Bonds and Permits (2%)		\$6,042.56
		Contracting Method Adjustment (10%)		\$30,212.81
		Inflation Escalation (24 months @ 4% per year)		\$24,170.25
		<b>Total Estimated NET Cost of Construction</b>		<b>\$362,553.71</b>
		Construction Contingency (10%)		\$36,255.37
		Construction Mangement (8%)		\$29,004.30
		<b>Estimated Total Gross Cost of Construction</b>		<b>\$427,813.38</b>
		Design Costs (17%)		\$72,728.27
		Archeological Survey, Site Mapping and Permitting (8%)		\$34,225.07
		<b>Total Estimated Project Cost</b>		<b>\$534,766.73</b>
		<b>Say</b>		<b>\$540,000.00</b>

(100+100) x 12'w/9=267 sy

RIDOT 203.0530 20' x 20'

from Ashton gate estimate

metal work from previous Blackstone Canal structure control mechanism restoration projects. Fabricate and install hinge and gate opening hardware.

2 sides x 100' x 4'high x 1/27+ =30 CY

2 sides x 100' x 2' high x 1/27=15 CY

2" dimensional lumber, ped loading, 10' wide x 24' long labor \$2,000 materials \$3,000

2" dimensional lumber pedestrain loading Labor \$3,000 matls \$1,000

(100+100) x 18'w/9=400 sy RIDOT Items L01.0102 & L02.0102

Project: Blackstone Canal Alternative transportation Feasibility Study

Page 8 of 8

Park: Blackstone State Park

NPS Contract: GS-10F-0281R

Estimate By: Vanasse Hangen Brustlin, Inc  
10 Dorrance Street  
Providence, RI 02903

Date: 13-Dec-11

**Canal Boat Replica Cost  
Uxbridge, MA**

QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	EA	Canal Boat Replica (withheld from contingency total and added at bottom line as a purchase)	\$200,000	
1	EA	Boat Launching Ramp 20 feet long x 20 feet wide crushed stone, paver block surface		\$30,000.00
1	EA	Dock/Passenger loading/unloading structure including 200 SF floating dock, 150 SF gangway, wood bulkhead/dock and timber piles		\$55,000.00
1	EA	Off-season storage facility 1000 SF wood frame building		\$10,000.00
1	EA	Dredging of Boat launch area		\$60,000.00
<b>Subtotal Direct Construction Costs</b>				<b>\$155,000.00</b>
Remoteness Factor (2%)				\$3,100.00
State and Local taxes (6.25%)				\$9,687.50
Construction Contingency (30%)				\$46,500.00
<b>Total Direct Construction Costs</b>				<b>\$214,287.50</b>
Standard General Conditions (15%)				\$32,143.13
Government General Conditions (5%)				\$10,714.38
Historic Preservation Factor (5%)				\$10,714.38
<b>Total Indirect Construction Costs</b>				<b>\$53,571.88</b>
<b>Subtotal NET Construction Costs</b>				<b>\$267,859.38</b>
Bonds and Permits (2%)				\$5,357.19
Contracting Method Adjustment (10%)				\$26,785.94
Inflation Escalation (24 months @ 4% per year)				\$21,428.75
<b>Total Estimated NET Cost of Construction</b>				<b>\$321,431.25</b>
Construction Contingency (10%)				\$32,143.13
Construction Management (8%)				\$25,714.50
<b>Estimated Total Gross Cost of Construction</b>				<b>\$379,288.88</b>
Design Costs (17%)				\$64,479.11
Archeological Survey, Site Mapping and Permitting (8%)				\$30,343.11
Canal Boat Replica				\$200,000.00
<b>Total Estimated Project Cost</b>				<b>\$674,111.09</b>
<b>Say</b>				<b>\$680,000.00</b>

from BVTC costs for replica boats.

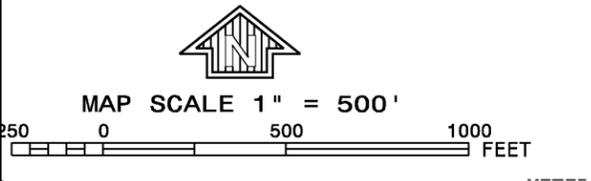
ramp 40' x 40 x 1/9=180 SY X\$50 = \$9000 + stone dust drive 100' x 15' x 6" x 1/27 x \$160/CY=\$9,000 + misc grading and fill \$12,000

from Manville Landing RIDOT TE project

from BRBW Segment 5 wood frame concrete slab electric service only.

from Manville Landing project

# **APPENDIX B: FEMA FLOOD MAP**



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0010 C

**FIRM  
FLOOD INSURANCE RATE MAP**

TOWN OF  
NORTHBIDGE,  
MASSACHUSETTS  
WORCESTER COUNTY

PANEL 10 OF 12  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
NORTHBIDGE, TOWN OF	250322	0010	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



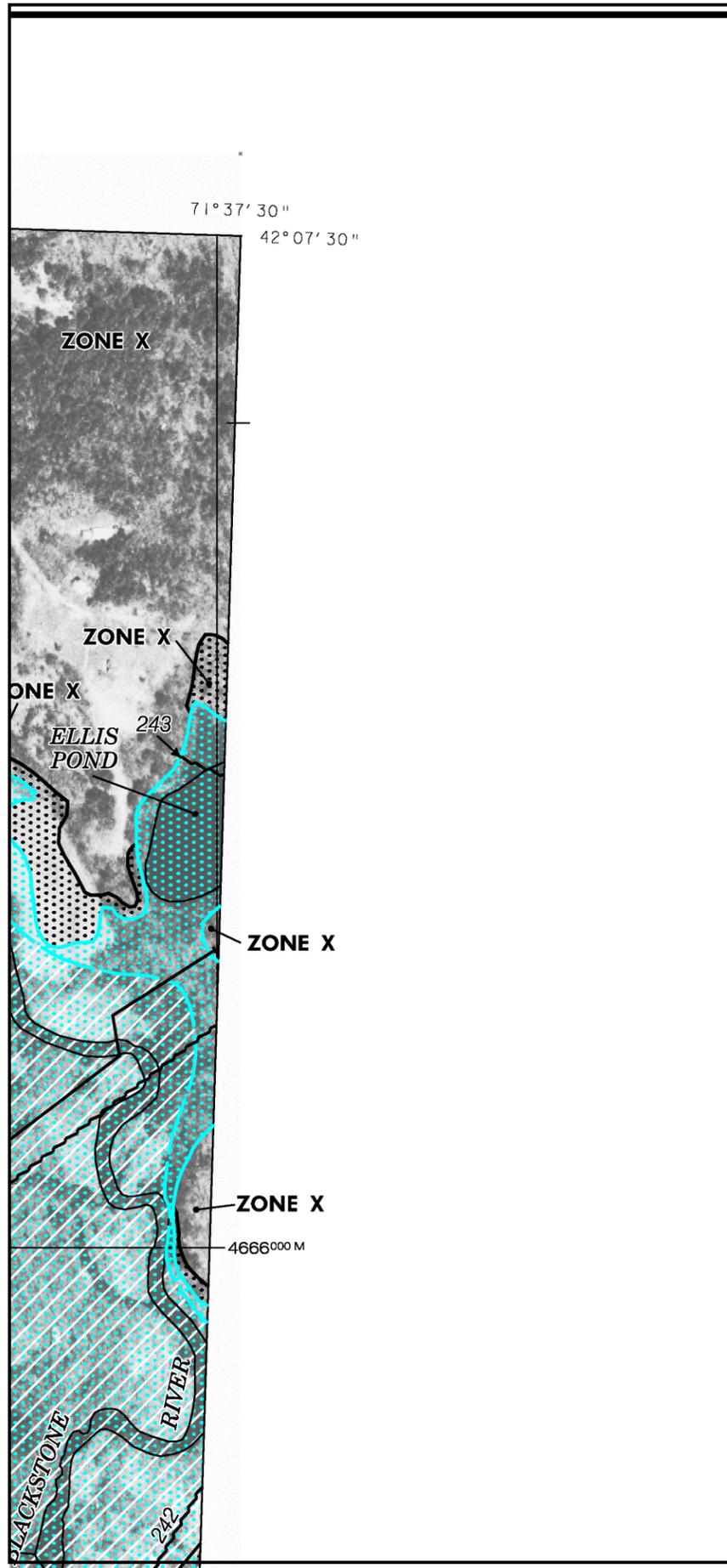
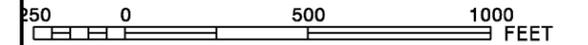
**MAP NUMBER  
2503220010 C**  
**MAP REVISED  
FEBRUARY 2, 2002**

Federal Emergency Management Agency

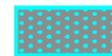
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



MAP SCALE 1" = 500'



# LEGEND



**SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.



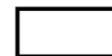
**FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.



**OTHER FLOOD AREAS**

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.



**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D** Areas in which flood hazards are undetermined, but possible.



**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**



**OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.



1% annual chance floodplain boundary



0.2% annual chance floodplain boundary



Floodway boundary



Zone D boundary



CBRS and OPA boundary



Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.



Base Flood Elevation line and value; elevation in feet\*

NFP PANEL 0010 C

**FIRM**  
FLOOD INSURANCE RATE MAP

TOWN OF  
NORTHBRIDGE,  
MASSACHUSETTS  
WORCESTER COUNTY

**PANEL 10 OF 12**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

<small>COMMUNITY</small>	<small>NUMBER</small>	<small>PANEL</small>	<small>SUFFIX</small>
NORTHBRIDGE, TOWN OF	250322	0010	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

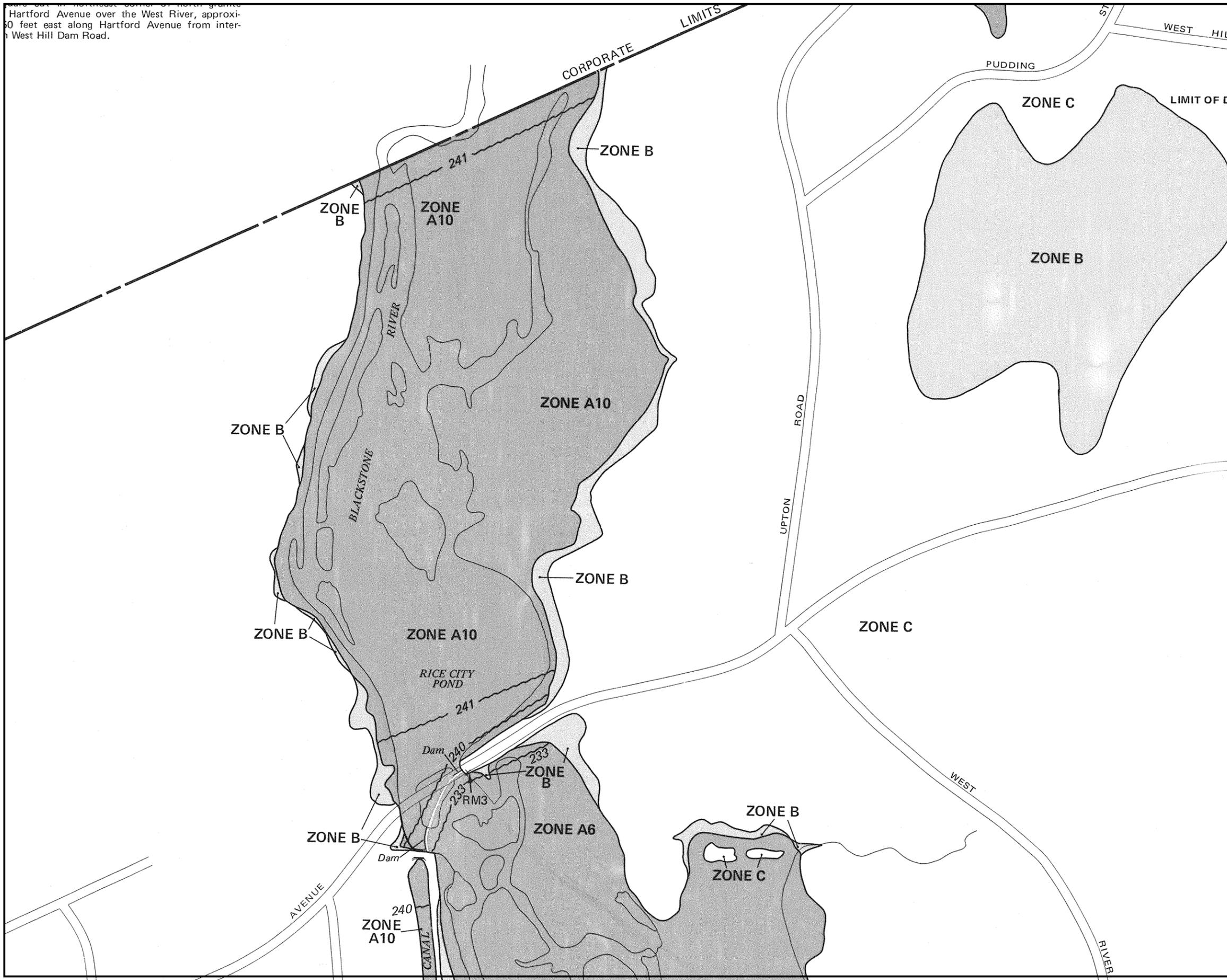
**MAP NUMBER**  
2503220010 C

**MAP REVISED**  
FEBRUARY 2, 2002

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

...cut in the road...  
Hartford Avenue over the West River, approxi-  
60 feet east along Hartford Avenue from inter-  
West Hill Dam Road.



APPROXIMATE SCALE  
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

TOWN OF  
UXBRIDGE,  
MASSACHUSETTS  
WORCESTER COUNTY

PANEL 2 OF 9  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

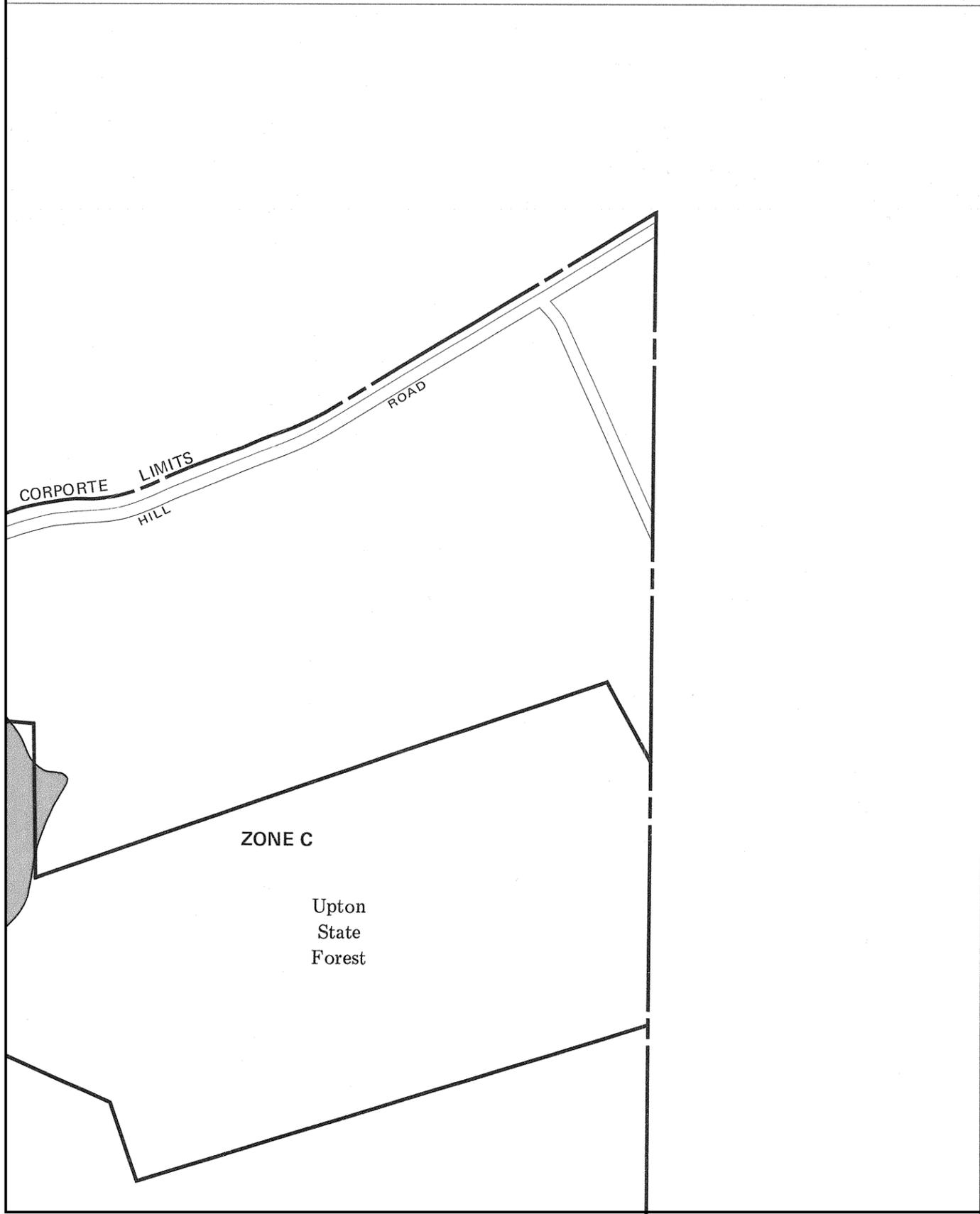
COMMUNITY-PANEL NUMBER  
250341 0002 B

EFFECTIVE DATE:  
JUNE 1, 1983



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



**KEY TO MAP**

500-Year Flood Boundary	→	—————
100-Year Flood Boundary	→	—————
Zone Designations*		
100-Year Flood Boundary	→	—————
500-Year Flood Boundary	→	—————
Base Flood Elevation Line With Elevation In Feet**		~~~~~513~~~~~
Base Flood Elevation in Feet Where Uniform Within Zone**		(EL 987)
Elevation Reference Mark		RM7x
Zone D Boundary	→	—————
River Mile		•M1.5

\*\*Referenced to the National Geodetic Vertical Datum of 1929

**\*EXPLANATION OF ZONE DESIGNATIONS**

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

**NOTES TO USER**

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.



APPROXIMATE SCALE  
400 0 400 FEET

**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM  
FLOOD INSURANCE RATE MAP**

**TOWN OF  
UXBRIDGE,  
MASSACHUSETTS  
WORCESTER COUNTY**

**PANEL 2 OF 9**  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

**COMMUNITY-PANEL NUMBER  
250341 0002 B**

**EFFECTIVE DATE:  
JUNE 1, 1983**



**Federal Emergency Management Agency**

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

# **APPENDIX C: PUBLIC COMMENTS**

## D'Amelio, Scott

---

**From:** Chuck\_Arning@nps.gov  
**Sent:** Friday, June 17, 2011 1:37 PM  
**To:** Desantis, William; D'Amelio, Scott  
**Cc:** Joanna\_Doherty@nps.gov  
**Subject:** Fw: Blackstone Canal Restoration, River Bend Farm area  
**Attachments:** RiverBendFarm.sm.jpg

June 17, 2011

Bill & Scott:

Some additional comments from the MASS mtg at River Bend.  
Chuck

Ranger Chuck Arning  
National Park Service  
The John H. Chafee  
Blackstone River Valley National Heritage Corridor One Depot Square Woonsocket, RI 02895  
(401) 762-0440  
"Experience Your America"

----- Forwarded by Chuck Arning/BLAC/NPS on 06/17/2011 01:35 PM -----

[veery@charter.net](mailto:veery@charter.net)

06/16/2011 09:11  
PM

To  
Stegemoen Val  
<[Val.Stegemoen@state.ma.us](mailto:Val.Stegemoen@state.ma.us)>, Chuck  
Arning <[chuck\\_arning@nps.gov](mailto:chuck_arning@nps.gov)>  
cc

Subject  
Blackstone Canal Restoration, River  
Bend Farm area

Val and Chuck,

That was an interesting meeting Tuesday night--I need some time for all the information to percolate through the layers of gravel in my brain before I can come up with some reasonable suggestions.

But I'm anxious to say I cringe at the idea of changing the character and view of the pond and bridge area at the Farm. This is heaven writ small, and I think at least some of us would hate to see that change.

I realize the Canal is an important element in the history of the Valley. I know there has to be a reason to restore the Canal and that a tourist boat to Stanley Mill would be at least part of that reason.

Is there any way at all that the tourist boat and its accessories (dock, shed, etc.) could be placed somewhere along the southern end of the pond, maybe in that small cove area, where it wouldn't loom so large in the landscape?

Beth Milke

Uxbridge(See attached file: RiverBendFarm.sm.jpg)

**D'Amelio, Scott**

---

**From:** Chuck\_Arning@nps.gov  
**Sent:** Wednesday, July 13, 2011 3:29 PM  
**To:** Desantis, William; D'Amelio, Scott  
**Cc:** Joanna\_Doherty@nps.gov  
**Subject:** Fw: Northbridge canal breach

More comments...

Ranger Chuck Arning  
National Park Service  
The John H. Chafee  
Blackstone River Valley National Heritage Corridor One Depot Square Woonsocket, RI 02895  
(401) 762-0440  
"Experience Your America"

----- Forwarded by Chuck Arning/BLAC/NPS on 07/13/2011 03:16 PM -----

[DGBarber@cs.com](mailto:DGBarber@cs.com)

07/12/2011 10:01  
AM

To  
[vals@aol.com](mailto:vals@aol.com), [Chuck\\_Arning@nps.gov](mailto:Chuck_Arning@nps.gov)  
cc

Subject  
Northbridge canal breach

Val & Chuck

I've been thinking further about the northern most canal breach in Northbridge where the river first enters the canal south of Church Street. Stopping the flow down the canal which has been producing increasing damage over the 20+ years I have been observing it seems to be a top priority. Replacement of the towpath requires first stopping the water.

That initial step might be accomplished at a relatively small cost by dumping two large dump truck loads of a high clay content fill material in the canal itself just south of where the water is entering. The material should then be spread all the way across evenly and compacted by a small bulldozer. For best effect, that should be followed by hydroseeding. Such a plug would dry up the canal to the south, eliminating scour there. It would also reduce the flow along the outside of the towpath in the area of the two towpath bridges. It would also back up water through the breach itself eliminating scour at the breach and creating the conditions needed for towpath rebuilding. The plug itself should be considered temporary and to be removed when other repairs are completed. The material could then be reused at some other site.

The resultant dike would also provide access across the canal to the towpath for planning and beginning other work.

Since roadway access is available, this initial effort would require two 4 axle dump trucks of material delivered through the Church St. access, a days use of a small bulldozer and operator, and the hydroseeding. Of course, state park permission and maybe a Corps of Engineers permit would be needed. I'm sure that the consultants could provide a cost estimate. I would think that a designation of the dike as temporary to stop further damage would help with the Corps permit.

Dave

**From:** [Joanna\\_Doherty@nps.gov](mailto:Joanna_Doherty@nps.gov)  
**To:** [Steinitz, Michael \(SEC\)](mailto:Steinitz, Michael (SEC))  
**Cc:** [Loparto, Leonard W. \(SEC\)](mailto:Loparto, Leonard W. (SEC)); [Desantis, William](mailto:Desantis, William); [D'Amelio, Scott](mailto:D'Amelio, Scott); [Chuck Arning@nps.gov](mailto:Chuck_Arning@nps.gov)  
**Subject:** Re: Comments on Blackstone Canal Study  
**Date:** Tuesday, May 31, 2011 3:22:52 PM

---

Dear Michael and Lenny:

Thanks very much for your thoughtful review of the Canal Study and for getting your comments to me in advance of tomorrow's meeting. I'm copying VHB on this message thinking that they might be able to review it before the meeting, which should make tomorrow's discussion more productive.

Thanks again for these very helpful comments. See you tomorrow --

Joanna

-----  
Joanna M. Doherty, Community Planner  
John H. Chafee Blackstone River Valley  
National Heritage Corridor  
One Depot Square  
Woonsocket, RI 02895  
(401) 762-0250 x14  
(401) 762-0530 fax  
[joanna\\_doherty@nps.gov](mailto:joanna_doherty@nps.gov)

"Steinitz,  
Michael (SEC)"  
<michael.steinitz@state.ma.us>  
05/31/2011 12:56 PM  
To  
<Joanna\_Doherty@nps.gov>  
cc  
"Loparto, Leonard W. (SEC)"  
<leonard.w.loparto@state.ma.us>  
Subject  
Comments on Blackstone Canal Study

May 31, 2011

Joanna M. Doherty  
Community Planner  
John H. Chafee Blackstone River Valley  
National Heritage Corridor  
One Depot Square  
Woonsocket, RI 02895

RE: Draft Blackstone Canal Alternative Transportation Feasibility Study

Dear Joanna,

Staff of the Massachusetts Historical Commission has reviewed the above-referenced draft document related to treatment recommendations for segments of the Blackstone Canal in Northbridge and Uxbridge, Massachusetts. In relation to the project meeting scheduled for June 1, Preservation Planner/Archaeologist Leonard Loparto and I have both reviewed and discussed the findings and recommendations of this study and have the following comments:

This study certainly ranks among the better canal feasibility studies we have seen. Our main concern however, is that little has been done to predict the archaeological sensitivity of the specific areas under study. Particularly given the permitting and related regulatory review that would be required to complete the proposed work components, issues of archaeological sensitivity will need to be taken into consideration. An archaeological survey should have preceded this feasibility study so that the results of that study could have informed the description of and assessment of the potential significance of the canal features in each area under study and the restoration effort planned for those areas. At this planning stage it would have been helpful to include a statement about the known or expected archaeological potential for each area under study in the report. For example, since the Public Archaeology Laboratory has previously undertaken archaeological research in the Plummer's Landing area, it would be appropriate to reference that work and any implications it may have related to work proposed for this segment.

In relation to tree removal, when larger trees are removed care should be taken not to damage canal features when trees are cut, particularly in the areas of the canal locks, bridge abutments, culverts and other structures. Recommended practice would be to specify that all tree stumps be ground to ground level with the roots left in the ground. Roots should only be removed when they are visible and such removal would be part of a larger reconstruction project such as the rebuilding of stone locks, bridge abutments, and other stonework structures where the roots are a major cause of damage to the stonework and need to be removed. Stump grinding should be sufficient in historic earthwork areas like the tow path and berms. Prior to any tree removal or reconstruction of parts of the canal prism, some prior field verification of the design and as-built characteristics of the canal prism in the work area should be undertaken.

The study recommends armoring of the canal embankments with rip-rap, citing the survival of such historic armoring at Skull Lock [sic], presumably Skull Rock Lock in Uxbridge. Such armoring does not appear to have been discussed in any detail in the National Register documentation for the Blackstone Canal in Massachusetts or the more recent National Register documentation for the Middlesex Canal. Is anything more known about historic erosion control used along the canal? Was stone the only type of armor used to prevent erosion?

MHC concurs that preservation of the contributing abutment stones or reconstruction of the Stone Farm Bridge would be an appropriate treatment. Very few of these bridges or their abutments survive. Relative to the recommendations for relocating stones, such an option would apply only to stones that are presently disturbed and not now actually part of the structure.

On page 8 of the draft, there is no explanation for why the old stone

culvert "Canal" crossing, presumably a historic contributing canal feature (?), would need to be removed.

Also on page 8 of the draft, the last paragraph references potential impacts to Plummer's Landing area. Has archaeological testing been performed in this area?

Figure 5, Goat Hill Lock . Leonard Loparto notes that he was under the impression that the lock walls were flared on the downstream side of the locks.

Page 10, Paved (bicycle) surfaces seem to be an inappropriate treatment recommendation for an early nineteenth century canal. Are there alternative surfacing options?

Page 10. Why do the noted historic stone quarry sites need to be obliterated? Aren't they contributing features of the Canal? Are there alternative locations for the bicycle facility or could the quarry sites be incorporated into the facility design?

Page 16. The use of concrete pads and other materials not appropriate for the period of significance and design features of the canal should be avoided in the canal area.

Appendix A: Cost Estimates – Budgets should be revised to include cost items for archaeology that will need to be performed prior to any reconstructions (see below).

Dredging of canal sediments from the canal trench, locks, river, and landing areas. There is some concern that there could be significant structures or objects in the canal that could be damaged or destroyed by any dredging operations. For example, in 1997 the Massachusetts Board of Underwater Archaeology issued a reconnaissance permit to the Blackstone River & Canal Commission and DCR to investigate a potential canal barge in the area of the Millville Lock. The canal barge was mentioned in historical studies of the area and several potential targets were indicated during remote sensing of the area. A reconnaissance study under permit to the Board of Underwater Archaeology might be warranted if dredging is to occur.

Appendix A: Conceptual Cost Estimates

All work specifications and cost estimates should note the requirement that all work must meet Secretary of the Interior's Standards for the Treatment of Historic Properties.

Page 1 of 7, Goat Hill Lock Rehabilitation

Page 2 of 7, Goat Hill Lock Rehabilitation

Both of these budgets may require funds for archaeological testing. Tree removal and excavations in the immediate area of the lock could damage or destroy construction features for the lock as well as artifacts and features associated with the operation and maintenance of the canal. It's also possible that fragments of the timber leaf gates survive buried or submerged in the area of the lock. If they exist, these fragments may help reconstruct the new gates planned for the lock. Once a Project Notification Form (PNF) and its supporting documents have been filed with MHC, the Technical Services Division staff will give technical advice on the proposed project. It is possible that staff may recommend a reconnaissance or intensive study for the entire feasibility study to

identify potential cultural resources and potential impacts to those resources in the different canal areas identified in the feasibility study. It's also possible that no impacts will be identified to the canal and no survey recommended. In any event, this determination cannot be made until a PNF is submitted.

Page 3 of 7, Entrance Breach Repair  
Page 4 of 7, Exit Breach Repair

Several aspects of the restoration plans for these areas indicate some level of archaeological research should be incorporated into these budgets and precede any restoration work. Historical research combined with archaeological survey and testing may identify construction features of the towpath and embankment that could aid in the restoration of these canal features. Undocumented, as-built changes to construction specifications may exist. If the old stone culvert canal crossing is removed, it should be documented prior to its removal. Restoration of the channel to a wetland may also imply some level of excavation of the channel or other areas. Many of these items might be clarified through submittal of the PNF and supporting documents.

Page 5 of 7, Canal Embankment Repair – Reinforcement  
Page 6 of 7, Tow Path Low Point Repair  
Page 7 of 7, Northern Canal Repairs

MHC's comments for these budgets echo those detailed in the section immediately above. A PNF and supporting documents should be filed with the MHC to determine the need and scope of an archaeological survey for the repair/rehabilitation/restoration of different features and segments of the canal.

Please feel free to contact Leonard Loparto or me at the Massachusetts Historical Commission with any questions regarding the comments included in this communication.

Best regards,

Michael Steinitz  
Director  
Preservation Planning Division  
Massachusetts Historical Commission

Michael Steinitz  
Director  
Preservation Planning Division  
Massachusetts Historical Commission  
220 Morrissey Blvd  
Boston MA 02125  
617-727-8470  
617-727-5128 (fax)  
michael.steinitz@state.ma.us

**From:** [Joanna\\_Doherty@nps.gov](mailto:Joanna_Doherty@nps.gov)  
**To:** [Mastone\\_Victor \(ENV\)](mailto:Mastone_Victor_(ENV))  
**Cc:** [D'Amelio\\_Scott](mailto:D'Amelio_Scott); [Desantis\\_William](mailto:Desantis_William)  
**Subject:** Re: Draft Feasibility Study  
**Date:** Tuesday, May 31, 2011 11:50:40 AM

---

Dear Vic:

Thanks very much for your e-mail, and apologies for not responding sooner (I'm catching up on messages after having been out of the office Friday and Monday). I was not aware of the investigations conducted in the 1990s -- very interesting! And thanks, too, for alerting us to the need for BUAR review and consent if the proposed dredging were to go forward.

I will put a copy of the report in the mail to you today. Please note that it is a draft and we are actively seeking comments from those, like MHC and MADCR, with an interest in the project. I am copying the project consultants on this message, so they can incorporate the information you provided in the final draft. If you have additional comments after reviewing the report, please let me know. Also please note that there is a meeting on this project tomorrow, June 1 at 10:00 a.m. at River Bend Farm in Uxbridge. MADCR, MHC and other project stakeholders will be attending, along with the consultants. You are welcome to join us. There will also be a public meeting on this project on Tuesday, June 14 at 7:00 p.m. at River Bend Farm.

Thanks again for getting in touch --

Joanna

---

Joanna M. Doherty, Community Planner  
John H. Chafee Blackstone River Valley  
National Heritage Corridor  
One Depot Square  
Woonsocket, RI 02895  
(401) 762-0250 x14  
(401) 762-0530 fax  
[joanna\\_doherty@nps.gov](mailto:joanna_doherty@nps.gov)

"Mastone, Victor  
(ENV)"  
<[victor.mastone@state.ma.us](mailto:victor.mastone@state.ma.us)> To  
"Joanna\_doherty@nps.gov"  
<[Joanna\\_doherty@nps.gov](mailto:Joanna_doherty@nps.gov)>  
05/27/2011 09:15 AM cc  
Subject  
Draft Feasibility Study

Dear Ms. Doherty,

My name is Victor Mastone and I serve as the Director and Chief Archaeologist for the Massachusetts Board of Underwater Archaeological Resources (BUAR). Established in 1973, BUAR is the trustee of the Commonwealth's underwater heritage, promoting and protecting the public's interest in these resources for recreational, economic, environmental and historical purposes. Under Massachusetts General Laws Chapter 6, sections 179-180, and Chapter 91, section 63, BUAR is charged with the responsibility of encouraging the discovery and reporting, as well as the preservation and protection, of underwater archaeological resources. Title to these resources that lie under the waters of the Commonwealth are held by the state through BUAR.

In conversation with staff at the Massachusetts SHPO, I recently learned NPS conducted a study of the Blackstone River Valley National Heritage Corridor. BUAR is very interested in that area. In the late 1990s, BUAR had issued a permit (now expired) to the State's Blackstone River and Canal Commission as part their search for a sunken historic canal boat. As they are a sister state agency, BUAR staff and volunteers conducted a very preliminary diver field investigation of the river in the vicinity of the Millville Lock. In addition, we arranged for a pro-bono side scan sonar survey of the area conducted by American Underwater Search and Survey. A suspicious target was identified in the factory pond, but it was not visually inspected. Both the remote sensing and diver preliminary field research of this very small section of the river was inconclusive.

Based on information from other historic canal projects, lock gates have often been disposed of within the lock area after abandonment. However, work was not undertaken within the lock area during our investigation. Due to time constraints, our efforts were confined to relocating the canal boat.

I was wondering if it was possible to obtain a copy of this draft report currently being reviewed by SHPO staff. The study is entitled:

Blackstone River Valley National Heritage Corridor Commission  
Blackstone Canal Alternative Transportation Feasibility Study  
Blackstone River Canal  
Draft Feasibility Study (Uxbridge, MA)  
NPS Contract No. GS-10F-0281R; VHB Project No. 33281.02

SHPO staff observed that possible dredging was mentioned in the report. Any activities that could "remove, damage, displace, or destroy" submerged cultural resources in state waters (inland or coastal) are subject to BUAR review and consent under state law.

Thank you for your consideration of my request. If you should have any questions, I can be reached at 617-626-1141 or at victor.mastone@state.ma.us. I look forward to hearing from you.

Best regards,

Vic

Victor T. Mastone

Director and Chief Archaeologist  
Board of Underwater Archaeological Resources  
251 Causeway Street, Suite 800  
Boston, MA 02114  
Direct Line: 617-626-1141  
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## D'Amelio, Scott

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**From:** Chuck\_Arning@nps.gov  
**Sent:** Thursday, June 16, 2011 11:36 AM  
**To:** DGBarber@cs.com  
**Cc:** Joanna\_Doherty@nps.gov; Desantis, William; D'Amelio, Scott  
**Subject:** Re: Blackstone Canal in Northbridge

June 16, 2011

Dave:

Thanks for all the info and taking the time to take a hike out to double check the locations for the breaches.

Appreciate your thoughts very much.

Chuck

Ranger Chuck Arning  
National Park Service  
The John H. Chafee  
Blackstone River Valley National Heritage Corridor One Depot Square Woonsocket, RI 02895  
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06/15/2011 02:22  
PM

[Chuck\\_Arning@nps.gov](mailto:Chuck_Arning@nps.gov)

To

cc

Subject

Blackstone Canal in Northbridge

Chuck

Since today is a nice day, I decided after lunch to walk the canal from Church Street to Goat Hill Lock & return. It's been a year or so since I last walked north from Hartford Ave. but at that time the river was in flood and high water stopped me at the roadway down from the gravel pit.

As a result of this walk, I agree that the top priority is to stop the water flowing into the canal from the river at the north most breach.

Fortunately, access is easy as the road along the sewer line is close by.

Today, there were two close together breaches separated by a small island.

To close them (the first step) might be done by sheet pile cells or by setting rock filled gabions by crane. I think that a proposed method and a cost estimate for just this item is needed promptly (even before fall) and then a source of funding can be sought.

Dave

## D'Amelio, Scott

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**From:** Chuck\_Arning@nps.gov  
**Sent:** Thursday, June 16, 2011 11:40 AM  
**To:** Desantis, William; D'Amelio, Scott  
**Cc:** Joanna\_Doherty@nps.gov  
**Subject:** Fw: Blackstone Canal in MA

June 16, 2011

Bill & Scott:

Here are some additional comments from Dave Barber. I would be happy to join you for another walk of the area in question if that would help at and I could recruit Val Stegemoen to join us. Let me know if you think that would be necessary.  
Chuck

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----- Forwarded by Chuck Arning/BLAC/NPS on 06/16/2011 11:37 AM -----

DGBarber@cs.com

06/15/2011 09:25  
AM

Chuck\_Arning@nps.gov

To

cc

Subject

Blackstone Canal in MA

Chuck

Thank you for hosting the meeting last night. I found it most interesting and plan to also attend Thursday's meeting in Woonsocket.

After reflecting on what was said, but without a copy of the draft report to read, I'm going to take advantage of your invitation to send you comments. I'm particularly concerned with the section of canal from the sewer line crossing south of Church St., Northbridge to and including Goat Hill Lock.

1) South of the sewer line crossing, the canal and towpath are intact to a breach where the river flows into the canal. At one time, a sewer line was located in the towpath at this area and there is evidence of the pipe in the embankment. Last night, the

consultants were saying that the towpath and breach should be plugged at this point and armored to protect it from the river.

I agree with most of that, but I think the site is an opportunity to get water from the river to water the canal to and including Goat Hill Lock. A control structure to regulate water into the canal is also needed at this point. Failure to do so soon will result in more cost later and dewater the canal south of here which will rapidly lead to it becoming overgrown.

2) A couple of hundred feet south of this breach, there is a concrete pier in the middle of the canal where the sewer line used to cross the canal. I heard no mention of this, but it should be removed as part of clearing the canal. Perhaps the consultants haven't seen it.

3) I believe there is another breach further south, but before we get to the point where water again flows out of the canal. This needs to be filled in.

4) Just north of what I refer to as the "farm causeway" the water exists the canal through a breach in the towpath and then flows south along the left edge of the towpath eroding it. I can remember when this breach didn't exist and I later once took a wild canoe trip through it and down the flow next to the towpath. I agree that this breach should be filled in soon and will require temporary dewatering of the canal to do so.

5) Just south of the above breach is what I refer to as the "farm causeway" (where the towpath trail now crosses the prism) . The consultants referred to this as a plugged, two bay, post canal culvert. This may be the site of a farm bridge over the canal with the a culvert made from stone from the abutments. I think the culvert and the crossing should be completely removed from the canal. If this is a historic crossing, then the stone should be used to rebuild the abutments. In the short term, a wooden foot bridge could be built across the canal while the culvert is removed.

6) Further south, are two short breaches now spanned by towpath bridges where water flows into and out of the canal. These should be plugged and the prism waterproofed.

7) Next, we come to what was referred to as a plugged culvert where the flow from the marsh to the west and the Northbridge treatment plant crosses the canal. I'm not sure how plugged the culvert is as I have seen considerable flow through it surfacing at the river end and there is no overtopping of the berm in normal conditions. I do know that at times of high flow, the culvert is inadequate to the flow and the water spills over the berm into the canal. Since this is a submerged culvert, it could be built of wood, but may be stone. If it is partially plugged, it should be cleaned. But, an evaluation is needed as to the modern flow, including the waste treatment plant output, during high flow events. Repair of the berm and the floor of the prism should be done, but it may be necessary to add more tubes for additional capacity.

8) Then we get down to where a roadway comes down from the gravel pit and cross the canal to the close by river. I believe that this is where the consultants were saying were collapsed abutments and sounded like they were saying it was an arch bridge. Later it was said that these were abutments for a wooden bridge. In any event, if water is flowing down the canal, there is a need for a place for it to exit in a controlled manner other than through the chamber of Goat Hill Lock. I have seen no sign of a bypass at the lock or through the dike that connects the lock to Goat Hill. This roadway site would seem to be the ideal site to construct a controlled flow discharge structure including a towpath bridge. I can show photos of overflow structures on the Delaware & Raritan Canal Feeder that work very well with no human intervention.

9) I agree that the canal through this area should be cleaned out of trees and fill to its historic dimensions.

10) Finally, we come to Goat Hill Lock. I believe this is where you began this effort. I think that the restoration of Goat Hill Lock is a primary opportunity and that you and I and maybe a few others need to sit down and brainstorm as to how we can get that done.

The lock is basically intact with several of the upper courses fallen into the chamber. I think all of the stone missing is still there under water. I also believe that the lower parts of the upper gates (which contained the valves) are still there and the lower gates could well be on the floor.

The important thing is that the floor, foundation and most of the walls are intact and have been underwater for over 100 years. On the floor are the miter sills that sealed the lower edge of the gates. These too are probably intact. Say these are 8" high. On top of that was the 4-1/2 feet of water that the boats floated in. On top of that is another 8 feet of water that is the surcharge of the Hartford Avenue dam after the 1954 flood. That's about 13 feet of water. An indication of this depth is the lower wing walls that should be above water to guide boats into the chamber. A visit to the site shows that they are a couple of feet below water. This 13 or so feet of water can cover a lot of stone.

What I think is needed is a project to build a cofferdam below the lock and pump the level down to near floor level (but keeping the floor wet). Then the fallen stone can be removed by crane for resetting. Any gate remains can also be removed and measured. The gate remains should probably be immediately resubmerged to preserve them. Then the lock should be rebuilt to operating condition.

I am concerned with the recommendation to reassemble the lock to a cosmetic state. An operating lock is far more valuable and probably not much more work or cost. I do not think that any of the stone currently intact needs to be reset. I think that they were laid dry and then grouted. Of course, the grout has disappeared, but it can be replaced and any voids behind the walls filled. I'm not a stone mason and definitely not one of 1828 masonry construction. But maybe consulting with a stone masonry contractor and the NPS folks at the C&O Canal would provide insight. Another possible source is Dennis McMullan at McMullan & Associates, Inc. 8321 Old Courthouse Road, Suite 350, Vienna, VA 22182 [www.mcmse.com](http://www.mcmse.com) who has worked for the C&O Canal and others on such structures.

Dave



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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