National Park Service
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Valley Forge National Historical Park
Valley Forge, Pennsylvania

Valley Forge
Alternative Transportation Feasibility Study

Final Report
PMIS No. 91449
June 2004

John A. Volpe National Transportation Systems Center
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14. ABSTRACT

NPS, as part of their General Management Plan (GMP) realignment, worked with Volpe to develop a series of alternative transportation methods in Valley Forge National Historical Park. Automobiles are the predominant means of transportation in the park, posing a threat to the preservation of park resources and pristine quality. Suggested alternatives to automobile transport include shuttle buses and similar efforts that reduce the need for automobile travel within the park. Beyond relieving congestion, alternative modes of transportation allow the visitor more options in terms of guided tours. This report presents an overview of the current transportation system at Valley Forge. Alternative solutions and an analysis of the impacts on ridership are presented. A cost analysis is done with regards to implementing the shuttle bus. Finally, an implementation strategy is set forth.

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Report Notes

This report was prepared by the U.S. Department of Transportation John A. Volpe National Transportation Systems Center, located in Cambridge, Massachusetts. The project team was led by Dr. Jeffrey Bryan of the Planning and Policy Analysis Division and included Katherine S. Fichter, also of the Planning and Policy Analysis Division, and Frances Switkes of the Service and Operations Assessment Division. David Spiller and Eric Plosky of the Service and Operations Assessment Division provided technical assistance to the project team.

This effort was undertaken in fulfillment of PMIS No. 91449, Alternative Transportation Feasibility Study for Valley Forge National Historical Park.

Contents

Introduction

This document, developed by the John A. Volpe National Transportation Systems Center (the Volpe Center), assesses the feasibility of introducing an alternative transportation system at Valley Forge National Historical Park (Valley Forge NHP).

Document Purpose: To Assess the Feasibility of Alternative Transportation

As part of an on- going process to prepare a General Management Plan/Environmental Impact Statement (GMP/EIS), Valley Forge National Historical Park (Valley Forge NHP) is currently considering different means of enhancing the experience of visiting the park, with particular emphasis on preserving the atmosphere of tranquility and reflection currently found there. Among other ways of achieving these goals, park staff are evaluating the possibility of (1) restricting the use by private automobiles of several roads within the boundaries of the park and (2) introducing an alternative transportation system to convey visitors around the park. Although the majority of this study is devoted to the feasibility of different types of transit service, *alternative transportation* is broadly taken here to mean any network of transportation facilities and services that provides viable substitutes to the private automobile as a means for viewing and exploring the park.

The feasibility of an alternative transportation system needs to be assessed prior to the continued refinement of the GMP concepts, as such a system will have both benefits and costs. This document provides the foundation for a final assessment of feasibility, an assessment which can be made using the benchmark data provided here in combination with park priorities articulated through the GMP process. Three questions are at the core of the issue of feasibility, and should help guide any judgment about the feasibility of alternative transportation.

- What are the transportation priorities of Valley Forge NHP?
- What set of transportation services best meets those priorities?
- How would the success of an alternative transportation system be evaluated at Valley Forge NHP?

At Valley Forge NHP, alternative transportation could provide both transportation and a means of offering interpretation to the approximately 350,000 annual historical visitors, those who come primarily for the historical resources of the park, and to the approximately 900,000 annual recreational visitors, those who come primarily for recreational purposes.[1] An alternative transportation system also has the potential to ease automobile congestion within the park—both present and future—while reducing opportunities for conflict between visitor and commuter traffic and automobile and non- automobile traffic. Alternative transportation is a costly undertaking, however, requiring a significant investment of funds and staff time. For this reason, it must be carefully analyzed prior to implementation.

The alternative transportation options discussed here are compatible with any program of road closures that may ultimately be implemented at Valley Forge NHP. The future decision to close roads within Valley Forge NHP is dependent upon the feasibility and ultimate success of alternative transportation within the park. To clarify and simplify the issues involved, however, the options for alternative transportation have all been considered here in the context of the current transportation conditions at the park—that is, with all roads within Valley Forge NHP open to private automobiles and all current traffic regulations in place. Some preliminary, qualitative conclusions have then been drawn about the relationship between road closures and alternative transportation; however, the primary focus here is the feasibility of alternative

[1] Data from Valley Forge NHP.

transportation exclusive of any future program of road closures. (A map of the proposed alternatives for road closures is presented in Appendix 1.)

It is also important to note that Valley Forge NHP is working in partnership with The National Center for the American Revolution (NCAR), a non- profit institution, to develop a facility for use by scholars and the general public for the display and storage of many of the known artifacts associated with the Revolutionary period. NCAR, when opened, is anticipated to attract additional visitors to Valley Forge NHP. Although the analysis that follows does present findings on projected post- NCAR transportation demand and ridership, this document emphasizes transportation options given current visitation levels.

Options for Alternative Transportation

Three alternative transportations options for Valley Forge NHP are considered in this document:

- No Action—No or minimal modifications would be made to the existing transportation network. No program of road closures would be executed and no new transportation service would be introduced. Instead, limited improvements to park bicycle and pedestrian facilities could be implemented, along with the better provision of transportation- related information.

- Shuttle Service—A new transportation service would be introduced at Valley Forge NHP, one that would run continuously, make a combination of designated stops and "flagged" stops,[2] charge a small fee, if any,[3] and emphasize the provision of transportation services without the active provision of interpretive information (passive provision could be considered). Depending on demand, a shuttle service would run during select seasons of the year and/or certain days of the week.

- Interpretive Tour—Valley Forge NHP offered a pilot interpretive bus tour during the summer of 2003 and, for the purposes of this document, any future interpretive tour is assumed to be similar in character to the summer 2003 service. Such a tour would run on a set schedule, make designated stops, charge a fee, and emphasize the provision of interpretive information. An interpretive tour is assumed here to be a special, extra- cost service offered during certain seasons of the year and certain days of the week, either on a regular basis or by special arrangement for groups with specific interests.

Based on the outcome of the GMP process, elements from the different options could be selected as makes sense at a given time. Furthermore, alternative transportation could be introduced at Valley Forge NHP in phases, beginning with pilot efforts and expanding as resources and demand determine.

Assessing the Options for Alternative Transportation

In order to evaluate and compare these three options, the staff of Valley Forge NHP should weigh the benefits and costs of each and determine which best serves the interests of the park and its users. Most important to this evaluation are three central issues:

- Changes to the visitor experience
- Transportation demand and ridership
- Vehicle operations and costs

Thus, to assess each alternative transportation option in turn, the park must determine (1) how alternative transportation will affect the user experience, (2) how many people will use it, and

[2] For a description of flagged stops, see Section 5.
[3] In general, fare- free transportation service can be assumed to have the largest pool of potential riders.

(3) how much it will cost to operate. These criteria necessarily inter- relate and depend both on data analysis and on policy priorities (for example, the minimum number of riders per day necessary to make alternative transportation a meaningful enhancement to the visitor experience) that will be set by decisions of the Valley Forge NHP management.

Scope and Structure of the Document

Following this Introduction, Sections 1 and 2 of this document describe the current transportation environment at Valley Forge NHP—including the history and regional setting of the park—and then use that information to develop a preliminary list of potential transportation nodes within the park. Section 3 presents three options for alternative transportation at Valley Forge NHP, along with a qualitative analysis of the changes to the visitor experience that could be expected with each one. Section 4 analyzes current visitor data at Valley Forge NHP, which are then used to develop working hypotheses about the potential demand for an alternative transportation system. This section also includes two demand analyses, one for historical visitors and one for recreational visitors, and presents ridership estimates that take both groups of visitors into consideration. Section 5 addresses operational considerations for alternative transportation at Valley Forge NHP, particularly issues of routes, headways, vehicle types, passenger fees, and overall costs. Section 6 presents an implementation scenario for one hypothetical alternative transportation option. The final section offers preliminary conclusions and recommendations for next steps.

The analyses presented in this document draw upon sets of data provided to the Volpe Center Study Team by Valley Forge NHP. These include:

- Park visitation data gathered at the Valley Forge NHP Welcome Center, August 2002–August 2003
- Data on parking lot usage recorded by Boles Smyth Associates, Inc., Summer 2002
- Survey responses collected from users of the pilot interpretive tour, Summer 2003
- Traffic counts collected by Boles Smyth Associates, Inc.
- Cost information provided by the Greater Valley Forge Transportation Management Association and the General Services Administration

The data listed above have been taken to be reasonably representative of current conditions at Valley Forge NHP. Necessarily, they cannot perfectly predict any single day or isolated experience. Nonetheless, in aggregate they provide the building blocks necessary to create a set of reasonable assumptions and ranges within which alternative transportation at Valley Forge NHP can be assessed. To further this assessment, this document includes analyses of only those transportation scenarios that are realistic, scenarios that the management of Valley Forge NHP could reasonably adopt, having weighed all relevant benefits, costs, and effects.

In particular, this study focuses on the feasibility of the *shuttle service* option as described in Section 3. Since Valley Forge NHP has some experience in managing an interpretive tour service—most recently offered during the summer of 2003—park managers already have some data on the demand for such a service, including survey responses indicating passenger preferences for the particulars of the service. Furthermore, any program of road closures would need to be coupled with the provision of a transportation service more like a shuttle than like an interpretive tour, as a shuttle would provide greater and more flexible access to the park. A shuttle service would have certain disadvantages, however, and therefore is considered here alongside the other two options.

Not available for this study are additional data related to the central issues described above, particularly survey data indicating the transportation patterns and preferences of current Valley Forge NHP visitors. Any further planning for alternative transportation will require

supplementary data in order to more fully estimate the demand for alternative transportation. Such data could be gleaned either through additional studies or through the implementation of a pilot transportation service.

1 The Park: Transportation Facilities and Use

Valley Forge National Historical Park—History and Current Usage

Valley Forge NHP, located approximately 25 miles northwest of Philadelphia, was the site of the encampment and headquarters of General George Washington and the Continental Army during the winter of 1777–1778, and commemorates that history and the history of Washington's leadership during the Revolutionary War. The Valley Forge encampment served the Continental Army during a crucial period of the American Revolution, a period during which the British Army occupied Philadelphia and General Washington struggled to forge a cohesive, effective army from the 20,000 men who were encamped at Valley Forge. Through Washington's leadership and the determination and skill of his officers, the soldiers of the Continental Army were able to overcome the harsh conditions of the Valley Forge winter to create a military force that would fight for five more years, eventually compelling the British to surrender at Yorktown in October of 1781.

Map 1
Valley Forge National Historical Park
Source: National Park Service

During the months of the encampment, Valley Forge was populated with soldiers and civilians, men and women, and the area is now rich with archaeological and historical artifacts from the encampment and post- encampment periods. Visitors to Valley Forge NHP are able to learn about the history of the encampment through resources offered at the Welcome Center and embedded in the landscape of the park, including replicated huts of the type used to house encamped soldiers, established earthen defenses used to protect the encampment from British invasion, and the house and outbuildings inhabited by General Washington and his staff and family. Additionally, the National Park Service has identified particular areas of the park for further archaeological research.

In addition to its importance as an historical site, Valley Forge NHP is a significant regional recreational resource. With over 3,500 acres of outdoor space, Valley Forge NHP offers visitors a variety of natural landscapes suitable for walking, running, and cycling, as well as for picnicking, sunbathing, and quiet contemplation. As a large open space in a region that is experiencing rapid residential and commercial development, Valley Forge NHP offers important opportunities for outdoor experiences.

Regional Setting

Valley Forge NHP sits at the border of Montgomery and Chester Counties in southeastern Pennsylvania, within the commuter- shed of metropolitan Philadelphia. The region around Valley Forge NHP is home to more than 1.2 million residents. Urbanized areas surrounding Valley Forge NHP include King of Prussia, Chesterbrook, Paoli and other Main Line towns, as well as Norristown and Phoenixville, with most of the communities linked together by a network of highways. The region is also connected to central Philadelphia by public transit, with several transit services—both public and private—serving the commercial and corporate centers of the greater Valley Forge area.

Park Traffic—Current Conditions[4]

As the staff of Valley Forge NHP considers ways to enhance the experience of park visitors, it is important to analyze the current use of park roadways in order to determine the number and type of trips being made through the park. Although it is generally difficult to distinguish Valley Forge NHP visitors from non- visitors when analyzing traffic conditions within the park, some conclusions can be drawn using knowledge of the area and available traffic- volume data. Additional detailed information, beyond that which is provided in this overview section, can be found in Appendix 2.

Those roads within the park that are neither owned or controlled by the National Park Service include Route 23, Route 252 (Valley Creek Road/Baptist Road), and Gulph Road. These roads carry the highest numbers of vehicles of any roads within the park and are used primarily by commuters and others traveling through the park to destinations beyond. These roads have shown an increase in traffic since 1994, when previous traffic counts were taken. Since the National Park Service neither own nor controls these roads, opportunities to manage the traffic along them must be implemented through cooperation with the Pennsylvania Department of Transportation.

Compared to the increasing traffic on non- NPS roads, NPS- owned roads have shown a decrease in use of approximately 25% since 1994. The data for non- NPS roads, combined with the traffic-volume data for Routes 23 and 252, suggest that the level of traffic congestion on the National Park Service- owned roads within Valley Forge NHP is, from the perspective of traffic operations, minor and decreasing. The question of whether the existing and potential traffic flows are detrimental to the cultural landscape of the park and the experience of its visitors, however, can only be determined by park staff.

Parking Lot Usage and Fees—Current Conditions[5]

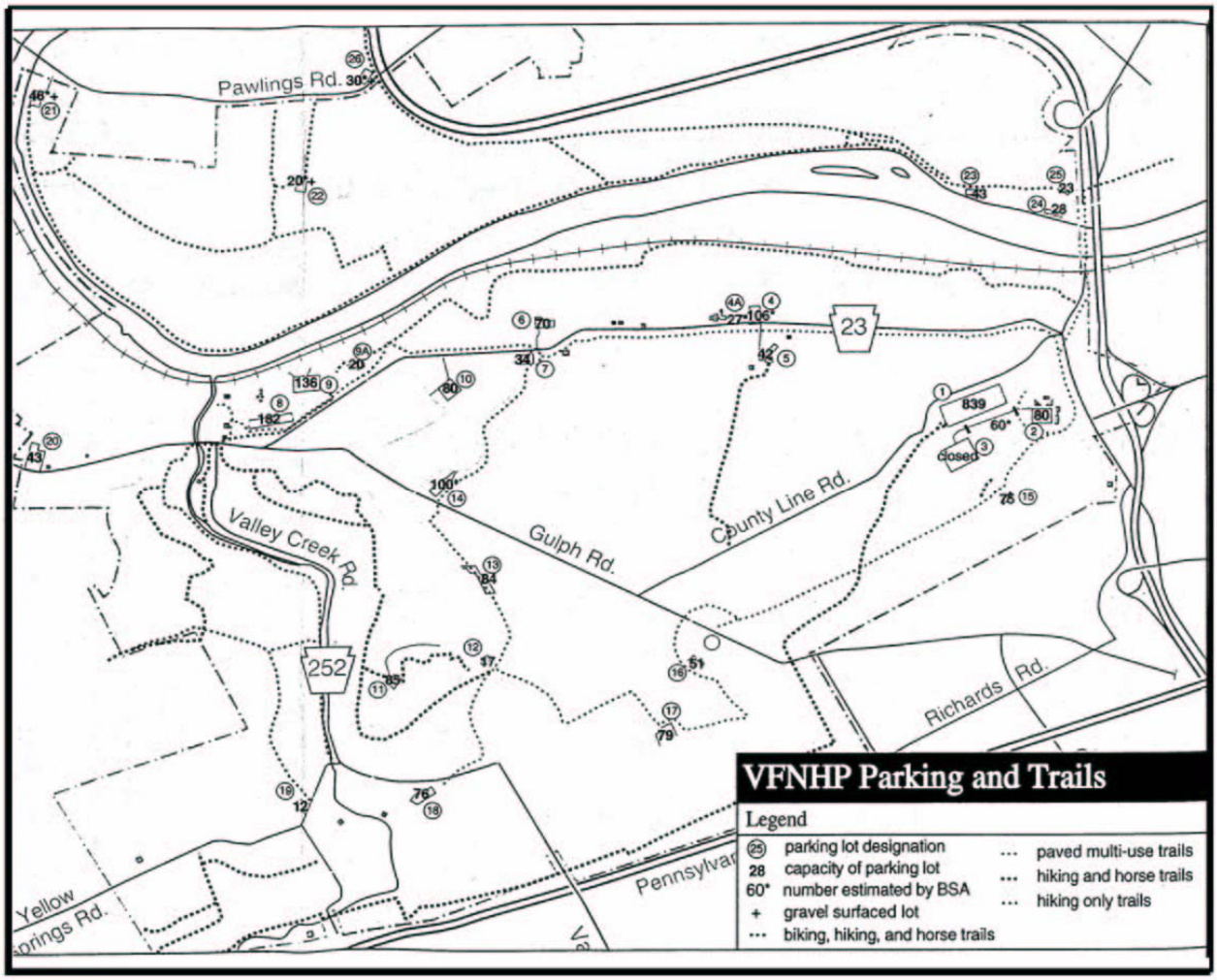
Valley Forge NHP offers its visitors the use of 26 different parking lots. The lots are distributed throughout the park, with many located near such high- visitation sites as the Welcome Center, Wayne's Woods Picnic Area, and Washington's Headquarters. Some of the parking lots are quite small, holding no more than 50 cars, while others—particularly the lots at the Welcome Center

[4] The data used to develop this analysis were provided to the Volpe Center by Boles Smyth Associates, Inc. No new data were collected for this study.

[5] The parking lot data and numbering system used here is taken from *Trail and Parking Lot Report*, prepared in June of 2002 by Boles Smyth Associates. Further information about parking usage is available in Appendix 3 of this report.

and those serving the complex of buildings at Washington's Headquarters—hold hundreds of cars. At present, none of the parking lots within Valley Forge NHP charge usage fees. The only parking lot that is restricted in any way is the one reserved for NPS staff members.

Map 2
Parking Lots Within Valley Forge NHP
Source: Valley Forge NHP



An analysis of parking lot usage is interesting for a number of reasons. Not only can it offer a rough sense of the levels of visitation at the park—equating numbers of vehicles with numbers of visitors—but it can also offer a mechanism for interpreting patterns of usage. As different parking lots are associated with different areas of the park and, concurrently, with different types of activities within the park, the usage of the parking lots provides a window into the ways in which visitors are using Valley Forge NHP as a whole.

The most used parking areas are those located adjacent to:[6]

- Welcome Center (Lots 1 and 2)—106/919 spaces filled

[6] Representing average usage during all site visits of the data collection team.

- Von Steuben Statue (Lot 7)—17/34 spaces filled
- Washington's Headquarters (Lot 8)—16/182 spaces filled
- National Memorial Arch (Lot 16)—11/51 spaces filled
- Wayne's Woods Picnic Area (Lot 17)—11/79 spaces filled
- Yellow Springs Road at the covered bridge (Lot 19)—10/12 spaces[7]
- Betzwood Picnic Area (Lots 23 and 25)—39/66 spaces filled

Of these seven parking lots, the first four sites have high value for cultural visitors, while the rest of the sites are predominantly used for picnicking and other recreational uses. The very large lot at the Welcome Center is used by both historical visitors and recreational visitors.

Of these lots, the following were noted to have usage that exceeded 100% during one or more of the site checks:

- Yellow Springs Road at the covered bridge (Lot 19)
- Betzwood Picnic Area (Lots 23 and 25)

In addition, the von Steuben Statue lot (Lot 7) came close to capacity use (i.e., 78% filled) on occasion.

Those parking lots with the lowest usage include:

- The secondary lots at Washington's Headquarters (Lots 9 and 9A)—2/156 spaces used on average
- Lots along Inner Line Drive (Lots 10, 11, 12, and 14)—8/282 spaces used on average[8]
- Lots outside of the main park loop that are not adjacent to recreational trails (Lots 20 and 22)—2/63 spaces used on average

The parking areas listed below are accessed by roads that may be closed under the proposed alternatives for road closures.

Table 1
Parking Lots Impacted by the Proposed Alternatives for Road Closures
Source: Valley Forge NHP

Parking Lot	Capacity	Average Usage
10	80	3
11	85	1
12	17	1
13	84	8
14	100	3
15	75	6
15/16 (on-street)	0	4
16	51	11
17	79	11
17/18 (on-street)	0	1

Two high- use parking areas, those at the National Memorial Arch and Wayne's Woods Picnic Area, could potentially be closed to use by private automobiles under the proposed alternatives for road closures. While the National Arch attracts a variety of park users, Wayne's Woods primarily serves recreationalists and picnickers.

[7] Based on data from park staff, this lot is believed to fill to overflowing every weekend day.
[8] Excluding the parking areas at Artillery Park.

The Role of Transportation in Interpretation

Under current conditions, transportation is used in a variety of ways as a mechanism for providing interpretative information at Valley Forge NHP. Visitors interested in learning about the history of the encampment are currently able to do so from a private vehicle, from an interpretive tour (operated on a pilot basis during the summer of 2003), or on foot or bicycle.

Visitors to the park are able to purchase a recorded, self- guided tour at the shop in the Welcome Center. The route for the tour is included on the official National Park Service map and guide to Valley Forge NHP. The tour, which is available on both tape and compact disc, allows visitors to explore Valley Forge NHP at their own pace and in their own vehicle, with suggested stops along the route. Both the tape and the CD versions of the tour can be purchased for less than $20, and the total running time for the recorded narration is approximately 35 minutes.

As mentioned, the summer of 2003 saw the experimental commencement of an interpretive tour bus service, offered by the National Park Service in partnership with NCAR. The shuttle, which ran at 10:00 a.m., 12:00 p.m., and 2:00 p.m. on Thursday, Friday, Saturday, Sunday, and Monday, offered a 90- minute tour of Valley Forge NHP in a minibus contracted from Werner Coach, a local transportation company. The tour service was funded with support from the Valley Forge Convention and Visitors Bureau and Ford Motor Company through the National Park Foundation. The tour included three stops—at the Muhlenberg Brigade, Washington's Headquarters, and Washington Memorial Chapel—and cost $15.50 for adult riders and $10.50 for children. Survey data collected from tour participants indicated strong support both for the service and the price of the tour.

Valley Forge NHP visitors are also able to explore the park on foot or by bicycle, either independently or as part of a guided tour. Walking tours to Muhlenberg Brigade from the Welcome Center are offered regularly, with interpretive information provided both along the way and at the Brigade.

Facilities for Non-Automotive Transportation

In addition to the walking tours described above, Valley Forge NHP offers facilities for non-automotive transportation in the park. The park includes a six- mile multi- use trail, which follows Outer Line Drive, Route 252, and Route 23 and offers a way for pedestrians, cyclists, and others to traverse the park away from automotive traffic. In addition, many of the most popular sites within Valley Forge NHP, including Washington's Headquarters and Betzwood Picnic Area, offer bicycle racks. These facilities and others make it possible for individuals—both historical visitors and recreationalists—to explore Valley Forge NHP without the use of an automobile.

Transportation Expectations

It is instructive to offer a few thoughts on the expectations of visitors to Valley Forge NHP for the provision of transportation infrastructure and services. Without conclusive survey data these points are by their nature suggestive, but they can help to frame future considerations of alternative transportation at Valley Forge NHP.

As discussed above, Valley Forge NHP is oriented to automobile visitors and has provided ample parking and roadways to accommodate the wishes of visitors to view the landscape and resources of the park from a private vehicle. The usage indicated by the parking lot data makes it clear that several of the primary sites visited by historical visitors—Washington's Headquarters, the National Memorial Arch, and the area of the von Steuben statue—receive significant visitation from motorists, conforming to expected patterns.

At the same time, Valley Forge NHP is also heavily used by recreational visitors, many of whom drive to favored parking lots within the park in order to begin their activity of choice. Again, the

parking lot patterns reflect this: Wayne's Woods Picnic Area, Betzwood Picnic Area, and the parking area at the Covered Bridge (Yellow Springs Road)—all of which are located adjacent to popular trails—are among some of the most heavily used within the park, with Yellow Spring Road and Betzwood Picnic Area often exceeding their allotted capacity.

Of particular note are the parking lots at the National Memorial Arch and Wayne's Woods Picnic Area, both of which could potentially be closed to private automobiles under the alternatives for road closures. The identified patterns of usage indicate that alternative access to those sites would need to be provided in order to meet the established expectations of visitors for easy access to these areas, particularly the recreational visitors who use the picnic area at Wayne's Woods. While an interpretive tour could meet the needs of historical visitors, it could not easily also serve recreational visitors, particularly if a fee were to be charged. These questions, and others, will be explored in later sections of this document.

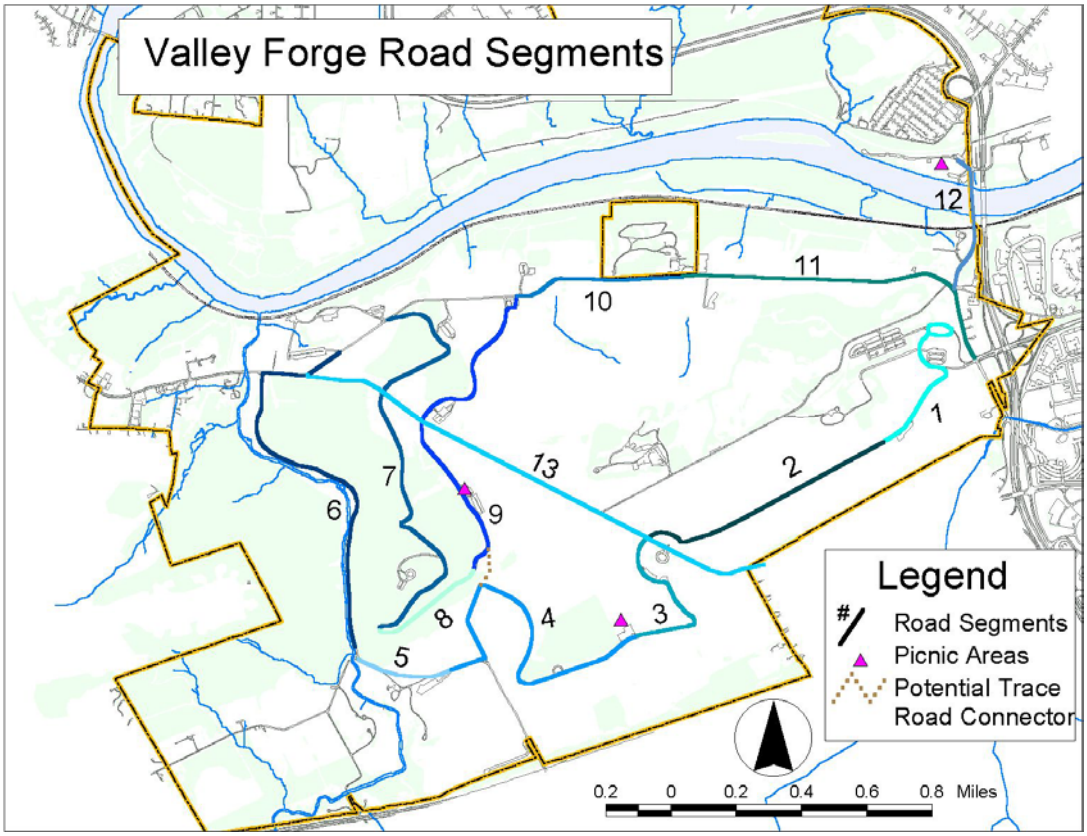
2 Nodes of Activity—Detailed Inventory

Overview

From the visitation analysis presented here, site visits, and discussions with park staff, the Volpe Center Study Team has developed the following list of *nodes of activity* within the park—sites of concentrated interest and visitation—that should be considered for inclusion in any routes established for a potential system of alternative transportation. The process of selecting from among these possibilities will be a process of articulating and defining the purpose of an alternative transportation service, its intended audience, and its salient characteristics. Once made, the selections should then be checked against survey and other types of data that reveal information about visitor transportation preferences.

The following section subdivides Valley Forge NHP into a series of thirteen segments—each a possible leg in the route of an alternative transportation service—and discusses the transportation and interpretive attributes of each segment. Both of these elements would be key to the success of a future transportation service, and the data presented here could be used to plan, develop, and implement such a service.[9]

Map 3
Road Segments
Source: Volpe Center Study Team



[9] County Line Road was closed to traffic during the Volpe Center site visit to Valley Forge NHP, and so no County Line Road segment is included in this analysis. It the understanding of the Volpe Center Study Team that its proposed closure to private automobiles would have little impact on any user group.

Segment 1: Welcome Center Parking Lot to Muhlenberg Brigade, along Outer Line Drive

- Approximate Length: 0.45 miles
- Road Direction: One- way westbound
- Approximate Road Speed: 25 mph
- Resources and Attributes: Due to the elevation of this section of Outer Line Drive, visitors are afforded an attractive view to the southeast of open, rolling fields and, in the same direction, can see the approximate location of the beginning of the outer line defenses. The Brigade area itself, set in a field, consists of several reproductions of the hundreds of huts in which the members of the Continental Army spent the winter of 1777–1778. The huts are accompanied by a bake oven and by an example of period fencing. This is a site of daily interpretive programs. The multi- use trail runs parallel to Outer Line Drive at this point.
- Audience: Primarily historical visitors, although recreational visitors frequently pass nearby on the multi- use trail (the historic zone of the Brigade is off- limits to recreational visitors).
- Interpretive Opportunities: Information about living conditions in the encampment, building materials and technologies, cooking and rations, weaponry, and the role of the outer line defenses.
- Available Pull- Over Areas: Along the right- hand shoulder of Outer Line Drive or in the parking lot located on the left- hand side of Outer Line Drive (a pull- over in the later area would require passengers to cross Outer Line Drive in order to visit the Brigade).
- Available Parking: Lot 15 (75 spaces)
- Proposed Road Closure: Outer Line Drive
- Other Notes: Recreational activity is heavy in this area, and the closure of Outer Line Drive to private vehicles would reduce the possibility of conflict. It also would encourage bicyclists to use Outer Line Drive, rather than the multi- use trail, reducing conflicts with pedestrians.

Segment 2: Muhlenberg Brigade to National Memorial Arch, along Outer Line Drive

- Approximate Length: 0.85 miles
- Road Direction: One- way westbound
- Approximate Road Speed: 25 mph
- Resources and Attributes: Due to the elevation of this section of Outer Line Drive, visitors are afforded an attractive view to both the south and north of open, rolling fields and, in the same direction, can see the approximate location of the outer line defenses. The Arch itself, set on a rise, was constructed in 1917 to honor the soldiers encamped at Valley Forge. There is limited interpretive signage at the Arch. The multi- use trail runs parallel to Outer Line Drive at this point.
- Audience: Primarily historical visitors, although recreational visitors frequently pass nearby, both on and off the multi- use trail.
- Interpretive Opportunities: The Arch is visually appealing but does not directly contribute to the stories of the encampment or the Revolution.
- Available Pull- Over Areas: In the parking areas to the west of the Memorial Arch.
- Available Parking: Lot 16 (51 spaces) and some unofficial parking along Outer Line Drive.
- Proposed Road Closure: Outer Line Drive
- Other Notes: In the existing circulation pattern, the segment immediately around the Memorial Arch is two- way, while the rest of Outer Line Drive is one- way.

Segment 3: Memorial Arch to Wayne's Woods, along Outer Line Drive

- Approximate Length: 0.3 miles
- Road Direction: One- way westbound, except at Memorial Arch
- Approximate Road Speed: 25 mph, slower at Memorial Arch
- Resources and Attributes: Wayne's Woods is an established picnic area, with tables, parking, vending machines, and restrooms. The area offers both a wooded space currently closed to visitor use and an open field. The Pennsylvania Columns, memorializing the Pennsylvania soldiers encamped at Valley Forge, flank Outer Line Drive directly in front of the entrance to

the Wayne's Woods parking lot. The multi- use trail runs along Outer Line Drive at this point, leaving the road at the Wayne's Woods parking lot.

- Audience: Primarily recreational visitors, although the Pennsylvania Columns may attract historical visitors.
- Interpretive Opportunities: The Pennsylvania Columns and the site of the Poor Brigade are the primary interpretive elements in this area.
- Available Pull- Over Areas: In the Wayne's Woods parking lot (Lot 17).
- Available Parking: Lot 17 (79 spaces)
- Proposed Road Closure: Outer Line Drive
- Other Notes: Recreational activity is heavy in this area, and the closure of Outer Line Drive to private vehicles could reduce the possibility of conflict.

Segment 4: Wayne's Woods to Parking Lot at Knox's Quarters, along Outer Line Drive and Route 252

- Approximate Length: 1.15 miles
- Road Direction: One- way westbound until Route 252, then two- way traffic
- Approximate Road Speed: 30 mph
- Resources and Attributes: The route between Wayne's Woods and the parking lot at Knox's Quarters passes by several brigade encampment sites and the Wayne Statue. While Knox's Quarters itself is closed to the public, the parking lot immediately to the east of the Quarters is used by recreationalists, including walkers, cyclists, and sunbathers. One spur of the multi-use trail terminates in the Knox's Quarter's parking lot.
- Audience: Primarily recreational visitors, although historical visitors might park here in order to view Knox's Quarters or to walk to the covered bridge.
- Interpretive Opportunities: The history of the brigade sites and the Wayne Statue are of the most interest.
- Available Pull- Over Areas: In the Knox's Quarters parking lot (Lot 18).
- Available Parking: Lot 18 (76 spaces)
- Proposed Road Closure: Outer Line Drive
- Other Notes: Outer Line Drive joins Route 252 in this segment.

Segment 5: Parking Lot at Knox's Quarters to Covered Bridge, along Route 252

- Approximate Length: 0.22 miles
- Road Direction: Two- way traffic
- Approximate Road Speed: 30 mph
- Resources and Attributes: The primary resource of interest is the covered bridge itself, which connects Route 252 to Yellow Springs Road and dates from 1865. Although not associated with the encampment story, the bridge is picturesque and of interest to visitors. With no sidewalk and little shoulder, however, the immediate area is not particularly safe for pedestrians.
- Audience: Both historical and recreational visitors.
- Interpretive Opportunities: The history of the bridge itself and of Valley Forge Farms. The sites of the iron forges burned by the British in 1777 are found in this valley.
- Available Pull- Over Areas: None at the moment.
- Available Parking: Lot 19 (12 spaces). It is important to note that Lot 19 is located beyond the covered bridge, on Yellow Springs Road, and is not immediately adjacent to the bridge. The configuration of Route 252 and the speed and volume of traffic at the bridge make it a difficult place to either slow down or pull over in order to observe the bridge.
- Proposed Road Closure: None
- Other Notes: Yellow Springs Road leads into and out of the park. The usage of Lot 19 frequently exceeds its designated capacity. A foot path that runs along the Valley Creek is accessible from Lot 19.

Segment 6: Covered Bridge to Washington's Headquarters, along Route 252

- Approximate Length: 1.40 miles
- Road Direction: Two- way traffic
- Approximate Road Speed: 30–35 mph
- Resources and Attributes: Route 252 between the covered bridge and Washington's Headquarters follows the Valley Creek ravine. The drive is narrow, wooded, and attractive, particularly the Valley Creek and the site of the historic Upper Forge. Washington's Headquarters includes not only the Headquarters itself but also a number of other buildings, including Potts' Barn. The Headquarters site also features large parking areas, restroom facilities, water fountains, picnic tables, benches, bike racks, and open space. There is some interpretive signage in the immediate area, and interpretive staff are available to present information and answer questions. One spur of the multi- use trail begins at the Headquarters.
- Audience: Both historical and recreational visitors.
- Interpretive Opportunities: The history not only of the structures themselves but also of Washington's leadership at Valley Forge and beyond.
- Available Pull- Over Areas: In the parking lots surrounding the buildings.
- Available Parking: Lots 8, 9 and 9A (182 spaces, 136 spaces, and 20 spaces, respectively)
- Proposed Road Closure: None
- Other Notes: There is no parking along Route 252. A seasonal fee is charged to visit the Headquarters building.

Segment 7: Washington's Headquarters to the Bottom of Inner Line Drive

- Approximate Length: 1.4 miles
- Road Direction: Inner Line Drive one way southbound (counter- clockwise)
- Approximate Road Speed: 25 mph
- Resources and Attributes: This section of Inner Line Drive is steep and heavily wooded, providing an attractive and secluded trip. The high elevation of the road provides views of the earthen defenses along the eastern side of Mount Joy.
- Audience: Both historical and recreational visitors.
- Interpretive Opportunities: The inner line defenses.
- Available Pull- Over Areas: There are no areas officially designated as pull- over spots along this segment of Inner Line Drive, but a number of vehicles were observed to be parked on the shoulder of the road. Given the width of the road and the relatively low traffic speeds and volumes, shoulder parking here is feasible in certain areas.
- Available Parking: Lot 11 (85 spaces)
- Proposed Road Closure: Inner Line Drive
- Other Notes: None

Segment 8: Bottom of Inner Line Drive to Redoubt 3 and Knox's Artillery

- Approximate Length: 0.5 miles
- Road Direction: One- way northbound (counter- clockwise)
- Approximate Road Speed: 25 mph
- Resources and Attributes: As in Segment 7, this portion of Inner Line Drive is wooded, although the views are more open in this area. There is a viewing platform to oversee Redoubt 3 and Knox's Artillery, the later of which also includes restroom facilities. The multi- use trail runs along Inner Line Drive at this point, and there are a series of reconstructed huts on both sides of the Drive.
- Audience: Both historical and recreational visitors.
- Interpretive Opportunities: The history of Redoubt 3, of Knox's Artillery, and of the Baptist Trace Road.
- Available Pull- Over Areas: In the small parking area at Redoubt 3 or the larger parking lot at Knox's Artillery.

- Available Parking: Lot 12 (17 spaces) and Lot 13 (84 spaces)
- Proposed Road Closure: Inner Line Drive
- Other Notes: The Baptist Trace Road runs between Outer Line and Inner Line Drives at this point, offering the possibility for a connection.

Segment 9: Knox's Artillery to von Steuben Statute

- Approximate Length: 1.0 miles
- Road Direction: One- way northbound
- Approximate Road Speed: 35 mph
- Resources and Attributes: This segment of Inner Line Drive offers an excellent view of the Grand Parade and of the Conway Huts. More generally, the views are open and sweeping, making for an attractive ride.
- Audience: Both historical and recreational visitors.
- Interpretive Opportunities: The Grand Parade and the von Steuben statue together offer an opportunity for interpretation on the training of the Continental Army. The huts and the brigade encampment sites are also of interest.
- Available Pull- Over Areas: In Lot 14, at the Conway Brigade, and in Lot 7 at the von Steuben statue.
- Available Parking: Lot 7 (34 spaces) and Lot 14 (100 spaces)
- Proposed Road Closure: Inner Line Drive
- Other Notes: Observation indicates that this area is used by school groups as well as other visitors.

Segment 10: Von Steuben Statute to Washington Memorial Chapel

- Approximate Length: 0.40 miles
- Road Direction: Two- way
- Approximate Road Speed: 40 mph and higher
- Resources and Attributes: This segment offers a number of resources that are of interest to both recreationalists and historical visitors, including Varnum's Headquarters, Redoubt 1, and Varnum's Picnic Area (which includes a parking lot). The views from both Inner Line Drive and Route 23 are of the Grand Parade, with open, rolling fields to the southeast. Washington Memorial Chapel, built in the early 20th century and still an active church, houses important artifacts associated with General Washington, the Revolution, and later American presidents.
- Audience: Both historical and recreational visitors.
- Interpretive Opportunities: Varnum's Headquarters offers opportunities for a discussion of 18th- century architecture and of the role of General Varnum at Valley Forge. Washington Memorial Chapel, although not directly associated with the history of the encampment, is of interest to historical visitors. In addition, interpretive information can be offered about Redoubt 1 and the huts clustered to its east.
- Available Pull- Over Areas: None
- Available Parking: Lot 6 (70 spaces) Lot 4 (106 spaces), Lot 4A (27 spaces), Lot 5 (42 spaces)
- Proposed Road Closure: None
- Other Notes: Washington Memorial Chapel requests a donation of $3 from adult visitors.

Segment 11: Washington Memorial Chapel to Welcome Center Parking Lot

- Approximate Length: 1.1 miles
- Road Direction: Two- way
- Approximate Road Speed: 35 mph and greater
- Resources and Attributes: This segment includes the Patriots of African- American Descent Monument, which is located on the east side of Route 23.
- Audience: Historical and recreational visitors.
- Interpretive Opportunities: The monument offers opportunities for a discussion of the role of different racial and ethnic groups in the Continental Army.

- Available Pull- Over Areas: None
- Available Parking: Lot 1 (839 spaces)
- Proposed Road Closure: None
- Other Notes: Route 23 has heavy traffic in this segment, including truck traffic. The multi- use trail parallels this segment.

Segment 12: Welcome Center Parking Lot to Betzwood Picnic Area

- Approximate Length: 0.8 miles, assuming reconstruction of the Betzwood Bridge
- Road Direction: Will be two- way
- Approximate Road Speed: Projected to be 35 mph. The intersections of Routes 363 and 23 and Route 363 and the Betzwood picnic area will be signalized.
- Resources and Attributes: Betzwood Picnic Area is located on the north side of Valley Forge NHP and offers significant recreational opportunities. The picnic area is a trailhead for both the Schuylkill River Trail and the River Trail and is heavily used by cyclists, walkers, and runners. There is also a shaded, mowed area that includes picnic tables, grills, vending machines, and restrooms. There is also a boat launch with access to the Schuylkill River.
- Audience: Recreational visitors.
- Interpretive Opportunities: The extensive natural resources of the north side as well as remnants of the historic Schuylkill Canal.
- Available Pull- Over Areas: Lot 25
- Available Parking: Lot 23 (43 spaces), Lot 24 (28 spaces), and Lot 25 (23 spaces)
- Proposed Road Closure: None
- Other Notes: This area is currently not directly accessible from Valley Forge NHP, due to the closure of the Betzwood Bridge. The bridge will be replaced within the next few years. In good weather, hundreds of cars are routinely turned away from the area due to lack of parking capacity.

Segment 13: Gulph Road, from Route 23 to Richards Road

- Approximate Length: 1.4 miles
- Road Direction: Two- way
- Approximate Road Speed: 30 mph
- Resources and Attributes: Gulph Road travels in a northwest/southeast direction across the center of Valley Forge NHP, continuing outside the park into a residential neighborhood. The portion of Gulph Road within Valley Forge NHP passes through the Grand Parade area and by Artillery Park and the National Memorial Arch.
- Audience: Historical and recreational visitors.
- Interpretive Opportunities: The Grand Parade and Artillery Park offer opportunities to discuss the training of the Continental Army.
- Available Pull- Over Areas: Possibly on the shoulder of Gulph Road.
- Available Parking: Four spaces adjacent to the Arch.
- Proposed Road Closure: Gulph Road within Valley Forge NHP
- Other Notes: None

Other: The Baptist Trace Road

It is important to note the presence of the historic Baptist Trace Road, which runs north- south through the center of Valley Forge NHP. The Trace Road is the remnant of a historic road through the Valley Forge area. Due to its location, the Trace Road offers the possibility for a physical connection between Outer Line Drive and Inner Line Drive, a connection that could significantly shorten the route necessary to travel the interior of the park. Such a connection could decrease the drive- time required of a future shuttle service. The park is actively pursuing the restoration of the connector.

3 Alternative Transportation for Valley Forge: Options

The transportation options listed below are described in general terms as a way to capture the essence of three types of transportation programs that could be appropriate for Valley Forge NHP. The options described here do not directly address the question of particular routes or stops—those issues are covered in Section 5—but rather lay out the primary characteristics of (1) a no action scenario, (2) a shuttle service scenario, and (3) an interpretive tour scenario. Of the three, the shuttle scenario and the tour scenario could be provided in conjunction with a program of road closures, although a shuttle service would be more able to provide public access comparable to what is currently available.

In- depth descriptions of some of the issues touched upon in this section – transportation demand, operational arrangements, and estimated costs – are included in Sections 4 and 5.

No Action

Characteristics

In the no action option, Valley Forge NHP introduces no new transportation service and does not execute the proposed alternatives for road closures. In order to encourage the use of alternative transportation, however, the park could improve the facilities available for non- motorized visitors beyond what is already provided—including additional bicycle racks, better way- finding materials, shaded benches, and drinking fountains throughout the park—and promote the availability of such facilities and the benefits of traversing the park without use of an automobile.

Valley Forge NHP could also improve the transportation- related information offered to visitors, including the development of specialized maps—with routes and distances for walking and cycling—aimed at non- motorized visitors. The Valley Forge NHP website could also be used to emphasize information about alternative transportation options to and in the park. Lastly, a set of guided activities specifically designed for non- motorized visitors could be developed, including walking and biking tours, some with special themes and days dedicated only to pedestrians and/or bicyclists.[10]

Interpretation

The development of new informational materials offers opportunities to present interpretation in new and different ways. This is particularly true if the new materials are aimed at pedestrians and cyclists, who are able to explore the resources of Valley Forge NHP in a more intimate way than are motorists. Providing maps and other printed materials would reduce the need to install additional signage and other similar items in the park landscape. Furthermore, the development of materials aimed specifically at visitors who come primarily for recreation could promote a greater understanding of the historical story of Valley Forge NHP by those who use it for leisure and recreation.

Audience

This alternative has relevance for both historical visitors and recreational visitors. The development of informational materials could benefit from tailoring for the two different audiences, however, as could the guided activities.

Impact

The no action option would produce no negative impacts on the park. It could encourage some

[10] A walking tour from the Welcome Center to the Muhlenberg Brigade is currently offered at Valley Forge NHP, and new walking tours could be modeled on it.

park visitors both to arrive and also to walk or bicycle through Valley Forge NHP rather than to drive. The availability of additional interpretive information could also increase visitor understanding of the story of Valley Forge NHP.

Shuttle Service

Characteristics

A shuttle service would run continuously through the south side of the park and would not include active visitor information. As shuttle could be offered daily during the high seasons and on a reduced schedule during the "shoulder" seasons of spring and autumn. Shuttles would run on a set schedule, perhaps beginning at 10:00 a.m. and ending at 6:00 p.m. A shuttle would have an established headway, most likely once every 15 or 20 minutes (see Section 5 for a discussion of headways). Other scenarios could also be appropriate for a shuttle service, including different seasons and a different daily schedule, depending on demand and on park priorities.

The shuttle would stop at the primary sites of historical interest and at areas popular with recreationalists. In addition to boarding and exiting at designated stops, passengers could potentially hail the shuttle vehicle at non- designated stops. A continuously running service gives visitors the freedom to spend as much time as they like at any given stop.

Interpretation

As a shuttle service would aim to provide transportation for both historical and recreational visitors—and as recreational visitors are assumed to have limited tolerance for a guided interpretive program—a shuttle would likely not include interpretation provided by a tour guide or other audible means. Interpretive information could instead be provided through printed information or personal audio devices. Printed material, stationary interpreters, and audio devices could also be used to provide interpretation at various stops throughout the park, as suggested in the current GMP alternatives.

Audience

A shuttle service would be of most interest to historical visitors. Some recreationalists may also be attracted to the shuttle service, although they are likely to be very sensitive to cost and convenience. This dynamic would shift if a program of road closures were to be introduced.

Impact

The introduction of a shuttle service at Valley Forge NHP could have a number of impacts, particularly if the introduction of the service were coupled with a program of road closures.[11] Positive impacts could include a reduction in opportunities for on- road conflicts and the creation of a quieter park environment. Interpretive opportunities could be tailored to specific shuttle stops and shuttle headways.

Conversely, the cost of operating a shuttle service would require Valley Forge NHP to make an investment of funds and staff time, both for the planning and implementation of the service and for its long- term operation. Stops, headways, and vehicle type and size are some of the considerations that need to be made in developing a shuttle service.

Interpretive Tour

Characteristics

Valley Forge NHP experimented with the provision of an interpretive bus tour during the summer of 2003. The tour was offered three times a day, Thursday–Monday, at a cost of $15.50 per adult passenger. This summer service—developed in concert with NCAR—consisted of a 90-

[11] The potential impacts of alternatives for road closures are discussed in the GMP/EIS.

minute tour of the park with three designated stops. Vehicles and drivers were provided through a contract with a private operator. Passengers remained with the tour guide and vehicle throughout the tour. Survey data collected from tour participants indicated strong support both for the concept and the price of the tour.

It is anticipated that any interpretive tour offered in the future at Valley Forge NHP would be similar to that offered during the summer of 2003. The service could be offered multiple times per day, every day, May–October, with a reduced schedule during the "shoulder" seasons in the spring and autumn. Interpretive tours could also be offered as special services to groups interested in certain aspects of Valley Forge NHP. An interpretive tour could also be designed so that passengers would not leave the vehicle, but would instead see the sites of the park from their seats. Although this is considered an inferior way to share the park's history, it could be attractive for people with mobility issues and those interested in a shorter tour time.

Interpretation

The summer 2003 service provided on- vehicle interpretation by a member of the Student Conservation Association (SCA), under the direction of the NPS, with additional interpretation by park rangers at two of the three stops. In the future, interpretive information could also be provided by alternate media, allowing for presentations to be tailored to different interests. Both live or audio tours could allow visitors to understand the history and significance of various park attributes without requiring additional interpretive infrastructure to be developed within the park landscape, as described in the GMP/EIS.

Audience

An interpretive tour would be of interest to historical visitors.

Impact

As in the case of the shuttle service, the introduction of a permanent interpretive tour at Valley Forge NHP would have a number of impacts, particularly if the introduction of the service were coupled with a program of road closures.[12]

The cost of operating such a tour service would require Valley Forge NHP to make an investment of funds and staff time, both for the planning and implementation of the service and for its long-term operation. The current tour service can serve as a model for the amount of effort required to provide such a service. As a tour takes longer to complete a single circuit than does a shuttle and may include on- board interpretive staff, additional vehicles and personnel may be needed.

A permanent interpretive tour could prompt a re- thinking of the provision of interpretive information at Valley Forge NHP, as it would offer new opportunities to reach park visitors and could require very few changes to the physical resources and landscape of the park. On- board interpretive opportunities would be limited to tour patrons, however, and would not benefit recreationalists or historical visitors using other means to access the park. Activities at each site, however, would be available to non- tour visitors.

[12] The potential impacts of alternatives for road closures are discussed in the GMP/EIS.

4 Transportation Demand and Ridership

A key step in determining the feasibility of any transportation service is to estimate the future demand and ridership for the service. In order to perform these analyses for Valley Forge NHP, two broad questions are posed: (1) how many people visit the park and when, and (2) what proportion of those people would use alternative transportation. Multiplying these answers together produces an estimate of the hourly, daily, and monthly numbers of people who would use the alternative transportation provided. This section combines available data with calculated estimates to address each of these points in turn.

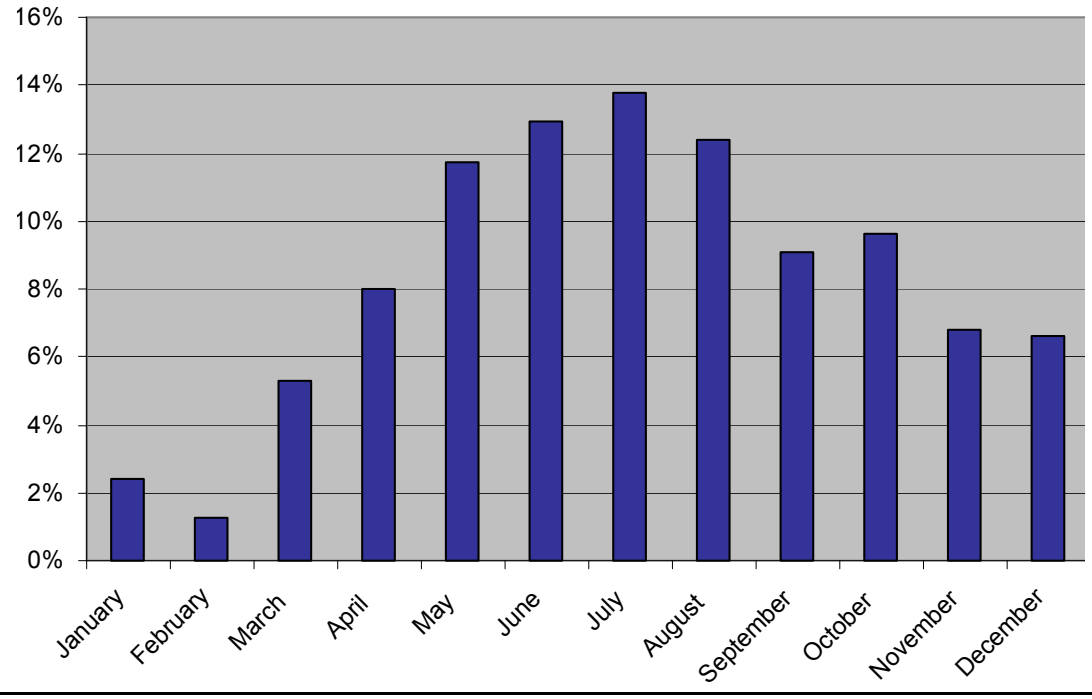
Current Patterns of Visitation

Available data and calculated estimates on current visitation—by month, day, and hour—make it possible to project the potential periods of peak ridership demand, off- peak demand, and demand during the "shoulder" periods. These projections provide not only an initial understanding of patterns of demand, but also a framework for developing preliminary concepts for routes and scheduling.

Monthly and Daily Visitation

As mentioned above, Valley Forge NHP currently receives approximately 350,000 historical visits per year and approximately 900,000 recreational visits per year. Charts 1 and 2 illustrate visitor trends based on daily visitor counts taken at the Valley Forge NHP Welcome Center between August 2002 and August 2003. The data show that the park receives its heaviest visitation during the summer months, when visitors can most enjoy its outdoor resources, with heavy visitation also occurring in the early autumn.

Chart 1
Monthly Visitation at Valley Forge NHP, Based on Data Collected at the Welcome Center
August 2002–2003
Source: Valley Forge NHP

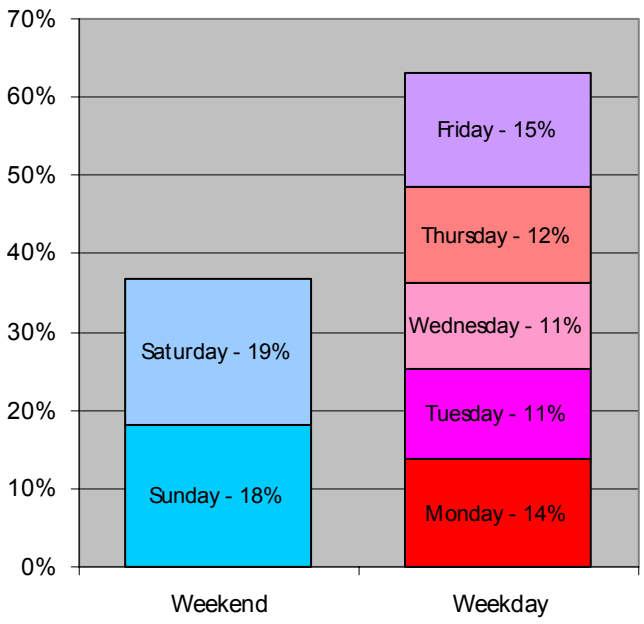


It is assumed that the visitation data collected at the Welcome Center reflect visitation primarily by historical visitors, as recreational visitors are assumed not to use the resources of the Welcome Center in significant numbers. Since no quantitative data on the annual patterns of recreational visitation are available, this study assumes that recreational visitors follow the same basic patterns as do historical visitors. This assumption is reasonable seeing that both groups spend a significant portion of their visits outside and are similarly affected by seasonal variations.

In addition, calculations done by the Volpe Center Study Team reveal that the Welcome Center receives more visitors on weekends than on any one weekday: 37% of visitation occurs on Saturdays and Sundays, and 63% Monday–Friday. Although these data are again assumed to reflect historical visitation, analysis of the parking lot data collected by Boles Smyth Associates, Inc. during the summer of 2002 reflects a similar weekday and weekend pattern for all park visitors.

After further analysis, it was found that December 2002, March 2003, and June 2003 had particularly high percentages of weekend visitation compared to other months. This indicates that those periods might warrant additional weekend service beyond that called for in the annual estimates developed by the Volpe Center Study Team. It should also be noted that weekday visitation is slightly higher on Mondays and Fridays than it is mid- week, suggesting that service could be provided successfully on Mondays and Fridays during the shoulder season.

Chart 2
Weekly Visitation at Valley Forge NHP, Based on Data Collected at the Welcome Center August 2002–2003
Source: Valley Forge NHP

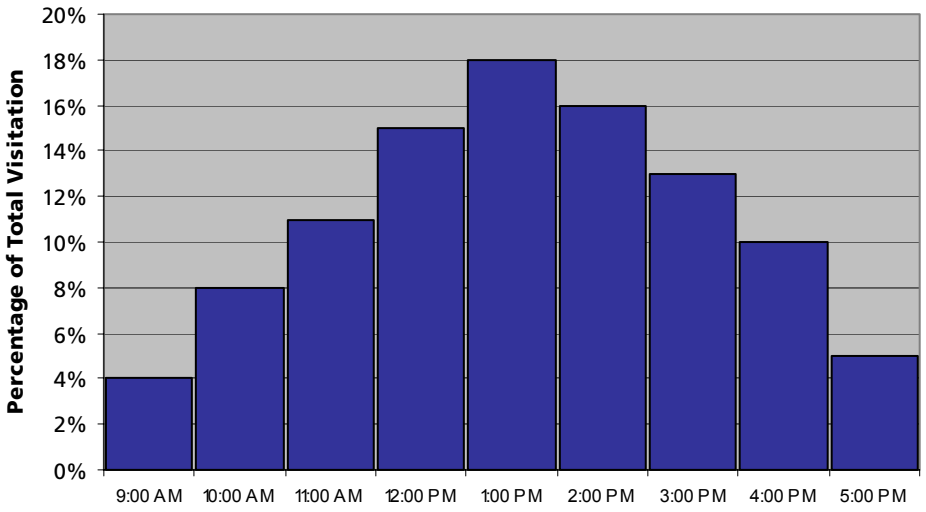


Hourly Visitation

Limited data were available to assist in determining the distribution of visitation throughout the day. Chart 3 illustrates a calculated estimate of daily peak- period visitation based on the limited parking lot data collected by Boles Smyth Associates, Inc. and input from Valley Forge NHP staff. This curve follows the standard visitation pattern of many NPS units, in which visitation peaks in the early afternoon. A more detailed program of data collection, including visitor surveys, would

be required in order to determine whether and in what ways per- hour visitation differs based on (1) time of the year, (2) day of the week, and (3) visit purpose.

Chart 3
Daily Visitation at Valley Forge NHP, Based on Data Collected September 2002
Source: Boles Smyth Associates, Inc., Valley Forge NHP, and Volpe Center Study Team



Estimating Transportation Demand for Historical and Recreational Visitors

Having determined approximate patterns of visitation, it is possible to estimate the proportions of visitors who would use an alternative transportation service. Given that there are two distinct groups of visitors at Valley Forge NHP—historical and recreational—this document presents two different demand analyses.

The Challenges and Assumptions of Estimating Transportation Demand

As it is unlikely that all possible riders will actually be interested in using a transportation service, it is vital to determine the most likely "capture rate" from within the pool of possible riders. Estimating use of a future transportation service—particularly one in an environment that has previously had only limited alternative transportation—is a challenging and inexact process, as there are many potential variables that can influence the capture rate. Service attributes—such as route, headway, convenience, and cost—compared to available transportation alternatives all play a large role in determining whether a given individual will use alternative transportation.

In the case of Valley Forge NHP, the development of such a forecast faces several challenges: (1) a lack of visitor survey data, particularly from recreational visitors, to indicate transportation preferences, (2) a lack of data, beyond the parking lot data, to indicate patterns of movement within Valley Forge NHP, (3) a lack of established techniques for understanding the demand for transportation services in recreational settings, and (4) the general inapplicability of standard home- to- work commuting models to National Park Service sites. As a result, the development of a demand forecast relies on available data and, when necessary, reasonable assumptions.

For the purposes of these calculations, the transportation service considered here is assumed to be a shuttle service as it is described in Section 3, one that runs continuously throughout the day and makes a combination of flagged and designated stops. Due to its flexibility, a shuttle service could appeal to both historical and recreational visitors, whether or not the proposed alternatives for road closures were implemented, as a way to enjoy the resources of Valley Forge NHP without the use of a private automobile. As delineated below, however, the Volpe Center Study

Team has hypothesized that most recreationalists would only use a shuttle service if it provided optimum convenience. It can be further hypothesized that instead of using the shuttle, recreationalists would focus their activities on areas close to accessible parking lots, whether or not a program of road closures was implemented. These hypotheses, and others about transportation demand among historical visitors, are tested in the following sub- sections.

Transportation Demand Estimates—Historical Visitors

Reasoning and Methodology

Since many historical visitors to Valley Forge NHP come to the park with a limited period of time to spend there, it seems reasonable to assume that they would, as a group, be interested in a transportation service that would allow them to visit the sites of interest in a convenient way that combines transportation with the opportunity for interpretation. In general, historical visitors may be accustomed to museums and other cultural sites that encourage or require the use of a guided tour or other structured experience, and so would not be inherently averse to using a transportation service as a way to visit the park.

In light of these characteristics, the simplest and most useful approach to estimating ridership demand among historical visitors is to use the transportation experiences of other National Park Service units that have characteristics, mission, interpretive requirements, and transportation needs similar to those of Valley Forge NHP. Using data from other parks makes for a more robust estimation than does a purely abstract demand model. Although Valley Forge NHP has certain unique characteristics, including a high rate of recreational visitation and a road network that would remain partially accessible to the public even in the case of a program of tour road closures, two National Park Service units do provide reasonable models for estimating ridership demand among historical visitors: Adams National Historical Park in Quincy, Massachusetts, and Kennesaw Mountain National Battlefield Park in Kennesaw, Georgia.

Analysis

Adams National Historical Park (Adams NHP), located within easy driving and public transit distance of downtown Boston, consists of a Visitor Center and two historic structures associated with Colonial and Revolutionary America. Visitation at Adams NHP is exclusively historical (i.e., non- recreational). Each of the sites of the park is geographically separated from the others, and street parking in Quincy is scarce. To assist its visitors and improve their experience of the park, Adams NHP introduced a shuttle service in 1994 to transport visitors between park sites every thirty minutes. Visitors are able to access the historic structures of the park without traveling on the shuttle, but Adams NHP strongly encourages the use of the shuttle and provides it to visitors without cost.[13] Free parking is provided at the Visitor Center. For the past two years, 44% of visitors touring the historic resources have, on average, used the shuttle to traverse the park.[14]

Kennesaw Mountain National Battlefield Park (Kennesaw Mountain NBP), located 35 miles from Atlanta, attracts both recreational and historical visitors. As in the case of Valley Forge NHP, approximately 75%–80% of the approximately 1.36 million annual visits to Kennesaw Mountain NBP are for recreational purposes. On weekends,[15] 2.5 miles of Kennesaw Mountain Drive are closed to private vehicles and a free shuttle service is offered to transport visitors from the Visitor Center to the top of Kennesaw Mountain, an area popular with historical visitors. Annually, 75,000 riders use the shuttle.[16] Assuming visitor distribution is similar to that at Valley Forge NHP,

[13] Entrance to the sites of Adams NHP does cost $3, however, and many visitors may assume that the fee covers the cost of the shuttle.
[14] From interviews with Adams NHP.
[15] Prior to 2002, the weekend shuttle service ran February–November only. In 2002, Kennesaw Mountain NBP introduced year- round shuttle service.
[16] From interviews with Kennesaw Mountain NBP.

these 75,000 passengers represent approximately 32% of all Kennesaw Mountain NHB historical visitors during the period that the shuttle is available. Interviews with park employees indicate that recreationalists are not generally interested in the shuttle service.

Results of the Analysis for Valley Forge NHP

Drawing upon the Kennesaw Mountain NBP and Adams NHP examples, the Volpe Center Study Team adjusted the capture rates taken from the two parks to 30% and 45%. This makes it possible to calculate a range of high (45%) and low (30%) transportation demand estimates for historical visitors at Valley Forge NHP. This estimate can then be bolstered by survey data collected during the summer of 2003 from riders of the Valley Forge NHP interpretive tour. Although the interpretive tour was a highly structured experience and different from a flexible shuttle service, the data collected from the summer 2003 passengers are a valuable source of information about transportation preferences among historical visitors to Valley Forge NHP. The data available do not allow for accurate calculations of the proportion of park visitors who used the tour during the period in which it was available, but do make it possible to draw qualitative conclusions about the effect of the tour on visitor experience.

Qualitatively, the survey data support the hypothesis that historical visitors are receptive to structured tours and that the experience of a transportation service at Valley Forge NHP can be a positive one, sometimes significantly more positive than the experience of driving.[17] The comments and scores provided by the riders are generally complimentary and supportive. 91% of the 778 returned surveys gave a "4" or "5"—the two highest marks—to the question of whether the tour was enjoyable. Likewise, 88% of the returned surveys gave a "4" or "5" to the question of whether the respondent would recommend the tour to a friend.

Several participants cited the convenience of the tour as a preferable alternative to driving, particularly on hot days, with one commenting that the large size of Valley Forge NHP makes it a natural fit for a transportation service. One rider wrote that he or she had just come from Gettysburg National Military Park and had "assumed there would be" a bus tour at Valley Forge NHP just as there is at Gettysburg. Many riders requested that the tour be extended beyond its 1.5- hour length and include more stops and more flexibility for passengers to disembark at will and pick up later buses as appropriate. Another indicated that his or her family wouldn't have stopped to visit the park without the tour service, and a third asked that private automobiles be restricted from Valley Forge NHP.

Although the survey responses were collected from a self- selected group—those who elected to take the interpretive tour—and cannot necessarily be understood to represent the views of the rest of the historical visitors to Valley Forge NHP, the feedback provided by the respondents can be taken to indicate a general level of satisfaction and support for a transportation service that combines interpretation with mobility.

Transportation Demand Estimates—Recreational Visitors

Reasoning and Methodology

Recreational visitors follow very different and more individualized use patterns than do historical visitors, making their transportation preferences and prospective transportation behavior more challenging to estimate. Many large parks provide shuttles for hikers, taking them from parking lots or campgrounds to trailheads and mountaintops, but the idiosyncratic recreational visitor seen at Valley Forge NHP is more difficult to serve. For that reason, it makes the most sense here to use an estimation approach different from that described for historical visitors (that of using another National Park Service unit as a model).

[17] Survey data from Valley Forge NHP.

The approach chosen by the Volpe Center Study Team for estimating demand among recreational visitors has two steps:

- Determine the number of recreational visitors who currently use parking lots located along likely shuttle routes (see Section 5 for a discussion of suggested shuttle routes) and who would, thus, be potential shuttle riders.

- Develop a model of transportation behavior for these recreationalists to identify those who would be potentially attracted to a shuttle service.

Although Valley Forge NHP receives an estimated 900,000 annual recreational visits, no two recreational visitors are equally likely to use a shuttle service. As the currently available data are limited, the parking lot counts taken by Boles Smyth Associates, Inc. were used to estimate visitor distribution throughout the park.[18] Further calculations involved in developing the model for transportation demand among recreational visitors can be found in Appendix 3.

Analysis

To address Step 1—calculating the number of recreationalists a shuttle *could* serve—the following assumptions have been made.

- The introduction of a shuttle service will not affect the location of recreationalist activity, assuming that park roads and parking areas remain open to private automobiles.
- Park visitors using parking lots located outside of the main park loop (Outer Line Drive, Inner Line Drive, Route 252, and Route 23) are unlikely to be captured by any of the routes proposed for a shuttle (see Section 5 for more information on proposed routes). This includes visitors using the parking lots at Betzwood Picnic Area and Yellow Springs Road.[19]
- Visitors using parking lots located near to sites of primary historical interest and sited on roads not owned by the National Park Service, such as those lots located at Washington Memorial Chapel and Washington's Headquarters, are assumed to be using park resources in the immediate area of the parking lots and were thus also excluded from analysis.
- Those visitors using parking lots located at areas believed to be used by both recreational and historical users are assumed to be split evenly between recreationalists and historical visitors.[20] For areas for which use was unknown, all users were included.[21]

Based on these assumptions, 40% of recreationalists have been automatically excluded from the analysis of potential recreational shuttle users, making the base recreational audience for a shuttle service approximately 540,000 visitors annually. This base audience is premised on current patterns of usage and is presumed to be sensitive to any significant changes in the current transportation environment of the park, including the closure of any of the park roads.

For Step 2—determining the proportion of recreationalists who would be both served by *and*

[18] It was assumed that people parked as close as possible to their desired destination.
[19] The following parking lots were excluded from the analysis: Muhlenberg Encampment (Lot 3); Washington Memorial Chapel (Lot 4); Huntington's Quarters / Nature Center (Lot 5); Washington's Headquarters (Lots 8, 9, and 9A); Yellow Springs Road at covered bridge (Lot 19); von Steuben Memorial / Post Office (Lot 20); Pawling's Parking Area (Lot 21); Walnut Hill (Lot 21); Betzwood Picnic Area (Lots 23, 24, and 25); Pawlings Road at Route 422 (Lot 26). Parking lots 3, 4, 5, 8, 9, and 9A are accessible by all shuttle routes, but are on roads that will continue to be open to private automobiles under any of the proposed alternatives for road closures. Assuming that users of the excluded parking lots are, in fact, potential shuttle riders, shuttle ridership increases by only 0.1% (i.e., a maximum of one person per shuttle).
[20] Includes lots: Lower Lot Welcome Center (Lot 1); Welcome Center/Employees (lot 2); von Steuben Statue (Lot 7); Artillery Park (Lot 13); National Memorial Arch (Lot 16).
[21] Additional data on the exact usage of these parking lots would be required in order to calculate this component of the model more exactly.

attracted to a shuttle service—the Volpe Center Study Team has created a simple transportation demand model. The model attempts to hypothesize the likely transportation behavior of recreationalists by comparing the overall convenience and cost of an alternative transportation service—in this case, a flexible shuttle service serving the proposed Route 1 (see Section 5)—to the convenience and cost of using a private automobile.[22] As noted before, this model also assumes that the roads within Valley Forge NHP are open to private automobiles. Additional calculations made to support the model can be found in Appendix 4.

This model further assumes that there is no initial bias between transportation modes—i.e., shuttle service and private automobile—and that equivalent convenience and cost would cause users to split evenly between the two modes. The model also assumes that there is a disproportionate response in mode choice to changes in the cost and convenience of either mode, so that small variations can have large effects on mode choice. One of the simplest functional forms of this second assumption is the transportation concept known as *exponential decay*, which is represented as follows:

$$\delta = Ae^{-\lambda}$$

In this form, generalized costs (GC) between a shuttle service and a private automobile (GC_{ATS}/GC_{Auto}) are compared.[23] For the purposes of this model, GC is represented by time, so that the time it would take a rider to reach the desired destination by alternative transportation is compared to the time it would take to reach the same destination by private vehicle. For this model, λ has been simplified to a ratio of round- trip travel- times. The equation has been applied to each of the parking lots in which there are potential recreational shuttle riders. The final percentage is weighted based on the estimated use of a shuttle service by recreationalists in each of the lots.

GC_{ATS} is the same for all locations, since a rider would have to take the shuttle around the entire circuit to get back to their starting point, regardless of where the rider starts or where they are going. The expected wait- time (½ headway) for the shuttle is included in travel time. A person will have to wait this amount of time on both the inbound and outbound trips.

$$GC_{ATS} = \text{shuttle loop time} + 2^{*}(\tfrac{1}{2}\ \text{headway})$$

GC_{Auto} represents only the travel- time to and from various areas of Valley Forge NHP. It is assumed that the road configuration and traffic regulations will remain as they currently are, and that visitors will continue to use the same access points to enter and exit the park as they currently do. Lacking precise data, it is assumed that recreationalists use each of three entrances equally: the main Valley Forge NHP entrance, the entrance at Route 23 from the west, and the entrance at Baptist Road in the south.

$$GC_{Auto} = \text{average round- trip travel- time from the three entrances}$$

From the calculations and model above, we estimate that 0.75% of all recreationalists would use the shuttle if it were running, assuming a 15- minute headway. A 20- minute headway would reduce the percentage of recreationalists interested in the shuttle to 0.54%. Although recreational users make up the majority of Valley Forge NHP visitors, the 0.75% that they would add to the

[22] The use of a route other than the proposed Route 1 could have marginal impact on demand among recreational visitors, but it is believed to be insufficient to significantly alter the analysis presented here.

[23] Using the first assumption described above as a boundary condition, the constant "A" can be calibrated such that δ is 0.50 and λ is 1. The resultant mode split model is $\delta = 1.359e^{-\lambda}$

ridership by historical visitors calculated above would make recreationalists only 4%- 6% of total shuttle ridership, or approximately two riders per vehicle, which is within the expected level of error of the model. (Further calculations involved in developing this model are provided in Appendix 4.)

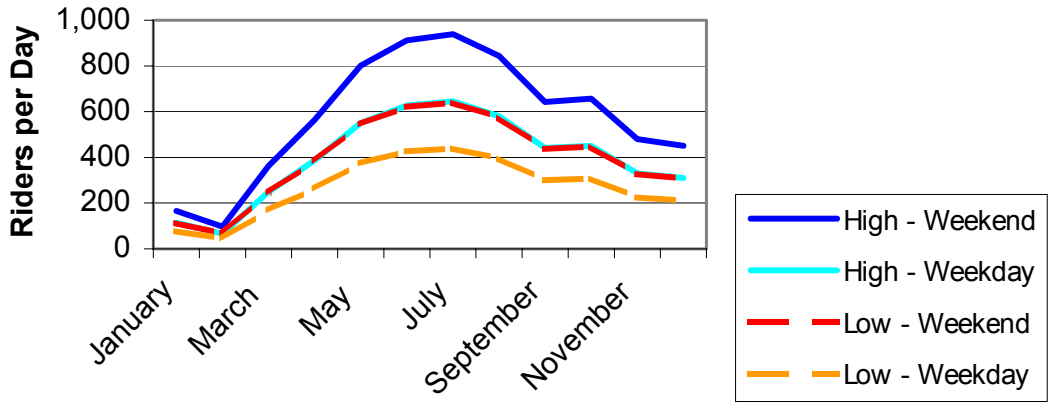
Intuitively, this estimate seems to make sense. For reasons described elsewhere in this document, a shuttle service is most likely to appeal to historical visitors, and it can be assumed that the majority of passengers using the shuttle at any given time would be historical visitors. Nevertheless, it seems probable that there would be recreationalists who would also enjoy the services of a shuttle. As a way to quickly move from one location within the park to another, as a way to transport recreational equipment, or as a way to catch a lift back to a parking area after a long jog or day in the sun, a shuttle service could be attractive to recreationalists. For these reasons, the estimate of two recreationalists per vehicle per shuttle trip appears reasonable.

Estimated Ridership

Estimated Ridership at Valley Forge NHP—Current Conditions

Based on the analyses above, the number of visitors at Valley Forge NHP can now be multiplied by the potential transportation demand to yield ridership estimates. (Sample calculations are included in Appendix 5.) These estimates, presented in Chart 4, indicate that daily demand for a shuttle service is likely to vary from fewer than 100 passengers in February to close to 1,000 passengers on a peak weekend day in July. This range from low to high estimates is based on the experiences of Kennesaw NHP and Adams NHP and is used here as a bound for potential shuttle use among historical visitors at Valley Forge NHP. The estimates presented here also include the assumption that 0.75% of recreationalists will use the shuttle, as presented in the preceding section

Chart 4
Estimated Potential Daily Shuttle Ridership
Source: Valley Forge NHP and Volpe Center Study Team



An hourly distribution of potential riders was also calculated to get a better understanding of peak- period demand. Based on this analysis, the peak- period demand is estimated to be 115–170 riders at 1:00 p.m. on July weekends, when 639–939 riders per day are anticipated. This spectrum of potential ridership accounts for the inherent uncertainty in estimating transportation ridership, but provides a range within which future planning can be done for a transportation service.

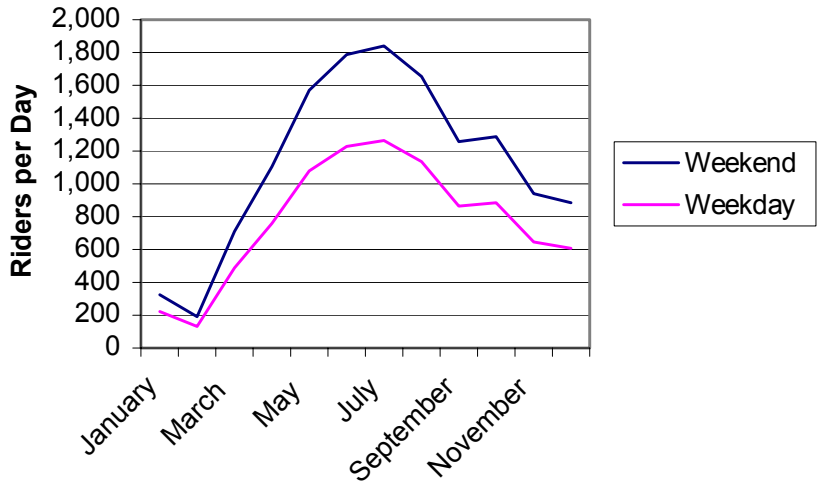
Table 2
Shuttle Ridership Based on "High" Estimates
Source: Volpe Center Study Team

Time of Day	Percent of Daily Ridership	Headway 60	30	20	15
9:00 a.m.	4%	38 riders	19 riders	13 riders	9 riders
10:00 a.m.	8%	75 riders	38 riders	25 riders	19 riders
11:00 a.m.	11%	103 riders	52 riders	34 riders	26 riders
12:00 p.m.	15%	141 riders	70 riders	47 riders	35 riders
1:00 p.m.	18%	169 riders	85 riders	56 riders	42 riders
2:00 p.m.	16%	150 riders	75 riders	50 riders	38 riders
3:00 p.m.	13%	122 riders	61 riders	41 riders	31 riders
4:00 p.m.	10%	94 riders	47 riders	31 riders	23 riders
5:00 p.m.	5%	47 riders	23 riders	16 riders	12 riders

Estimated Ridership at Valley Forge NHP—Effect of the Opening of the National Center for the American Revolution (NCAR)

The opening of the National Center for the American Revolution is currently anticipated to increase to as many as 700,000 the number of historical visitors at Valley Forge NHP. This increase, should it be realized, would have a significant effect on the demand for alternative transportation. The effect would be one of scale, requiring additional vehicles and, potentially, more frequent headways and adjustments to the routes served. The estimates presented in Chart 5 represent "high" ridership following the opening of NCAR. The current *status quo* estimates are assumed to represent "low" ridership following the opening of NCAR. It is believed that a shuttle service will begin before NCAR opens, in which case improved estimates can be derived from the data collected from the operations of the shuttle service.

Chart 5
High Estimated Ridership Following Opening of NCAR
Source: Economic Research Associates and Volpe Center Study Team



Based on this analysis, the peak- hour demand after the opening of NCAR is estimated to be 331 riders at 1:00 p.m. on July weekends, when 1,840 riders per day are anticipated.

Effect of Road Closures on Projected Ridership

At this time, the Volpe Center Study Team believes there are no comparable examples of National Park Service units that serve high proportions of recreational visitors, are crossed by public roadways outside the control of the National Park Service, and have closed all park- owned roads to private automobiles in concert with the introduction of an alternative transportation service. Furthermore, a comprehensive analysis of the effect of road closures on demand for alternative transportation at Valley Forge NHP would require additional data not currently available, including qualitative and quantitative data about transportation preferences among current and prospective park visitors.

Nevertheless, it can be assumed that a program of road closures would increase the pool of potential users of alternative transportation. Lacking access to park roads, anyone wishing to visit the central area of the south side of the park would need either to use the alternative transportation provided or to travel by foot, bicycle, or horseback. Several broad, qualitative scenarios can be hypothesized for the relationship between road closures and transportation demand, in a park environment without NCAR, including the following three:

- The remaining parking lots are sufficient to hold all historical and recreational visitors. Historical visitors take advantage of the alternative transportation service if they want to explore the park beyond the Welcome Center. Recreational visitors either shift their patterns of use to match the available parking or use alternative transportation to reach those areas that are now otherwise inaccessible. Overall visitation remains level or increases due to positive response to the new transportation program.

- The combination of publicly accessible parking and convenient alternative transportation satisfies the needs of historical visitors. Recreational visitors, however, find the road closures and alternative transportation system inconvenient and are deterred from using the park resources closest to the closed parking lots. Instead, visitors move their activities to other areas of the park or elect to go outside the park for recreation. Overall visitation decreases slightly, due to a loss of recreational visitors, but the use of the alternative transportation system remains constant or increases slightly due to use by historical visitors.

- Some potential historical visitors, unwilling to leave their vehicles, choose not to come to the park. At the same time, recreational visitors perceive the same inconveniences cited above. Overall visitation decreases.

These scenarios are provided here only to give a sense of how the demand for alternative transportation relates to the potential closure of roads within Valley Forge NHP. These scenarios would require survey data and real- world experience in order to be confirmed or reconsidered.

Summary of Findings

Based on the data available and the analyses presented here, the Volpe Center Study Team has concluded that the shuttle service will attract 30%–45% of current historical visitors to Valley Forge NHP and 0.75% of current recreational visitors (approximately 112,000–164,000 potential riders annually) under conditions in which all park roads remain open. These estimates, which are presented in Table 3, do not account for any future increases in visitation generated by the opening of NCAR. An interpretive tour, which offers similar advantages to the shuttle service but with more structure and heavy emphasis on education, is assumed to have approximately similar

ridership patters—i.e., number or riders, types of riders, and peak ridership hours and days— to that experienced during the summer 2003 pilot effort.[24]

The ridership estimates presented here should be understood as initial, baseline estimates, from which the staff and management of Valley Forge NHP can begin to decide whether to pursue alternative transportation within the park. Moreover, the figures presented here are for Valley Forge NHP as it currently is: with all *roads open* and *without NCAR*. Any program of road closures would, by its very nature, increase the demand for alternative transportation services, as visitors would be required to seek new ways of accessing the park. Likewise, the opening of NCAR would also increase the demand for alternative transportation—whether or not park roads were available to private automobiles—by significantly increasing park historical visitation.

A no- action scenario will maintain the current transportation environment at Valley Forge NHP, and thus has not been compared in the table below.

Table 3
Summary Comparison of Shuttle Service and Interpretive Tour Options by Central Issue
Source: Volpe Center Study Team

	Shuttle Service	Interpretive Tour
Estimated Daily Ridership	♦ Peak Weekend (July): 639-940 ♦ Peak Weekday (July): 439-645 ♦ Off-Peak Weekend (February): 66-97 ♦ Off-Peak Weekday (February): 45-67	♦ Assumed to be similar to ridership during summer of 2003, but could be increased as a result of promotional campaigns and the opening of NCAR.
Expected Changes to Visitor Experience	♦ Provides a way to visit the park without having to drive. ♦ Offers flexibility to see park at own pace. ♦ By reducing traffic volumes, reduces opportunities for on-road conflicts. ♦ By reducing traffic volumes, contributes to a quieter park environment. ♦ Reduces autonomy of visitor experience. ♦ Raises cost of visit (potential).	♦ Provides a way to visit the park without having to drive. ♦ Offers a structured way to visit park on set schedule. ♦ By reducing traffic volumes, reduces opportunities for on-road conflicts. ♦ By reducing traffic volumes, contributes to a quieter park environment. ♦ Reduces autonomy of visitor experience. ♦ Raises cost of visit (potential). ♦ Provides a new way to learn park history.

[24] More exact calculations of projected ridership on a future tour service could be done through a detailed analysis of the proportion of overall Valley Forge visitors—particularly historical visitors—who elected to use the tour during the period that it was available.

5 Vehicle Operations and Costs

The preceding sections of this document have laid out (1) current transportation conditions at Valley Forge NHP, (2) expected changes to the park visitor experience following the introduction of alternative transportation and (3) estimated transportation demand and ridership among both recreational and historical visitors. From these analyses, Valley Forge NHP may decide to pursue further planning and implementation studies for alternative transportation. Those studies will include certain operational and financial issues, which are addressed here for preliminary thought and discussion.

If the decision to operate an alternative transportation service is made, three categories of issues then arise. First, the staff of Valley Forge NHP must decide where and when the vehicles should run (i.e., routes, stops, and headways). Second, they must set user fees—if any—for ridership and/or parking. Third, they must select the most appropriate vehicles, decide whether to purchase or lease them, and decide whether to contract for operations and maintenance or perform one or both with National Park Service staff members. Resulting from these decisions are cost estimates that will need to be weighed against funding availability and other park priorities.

Routes, Stops, and Headways[25]

Routes

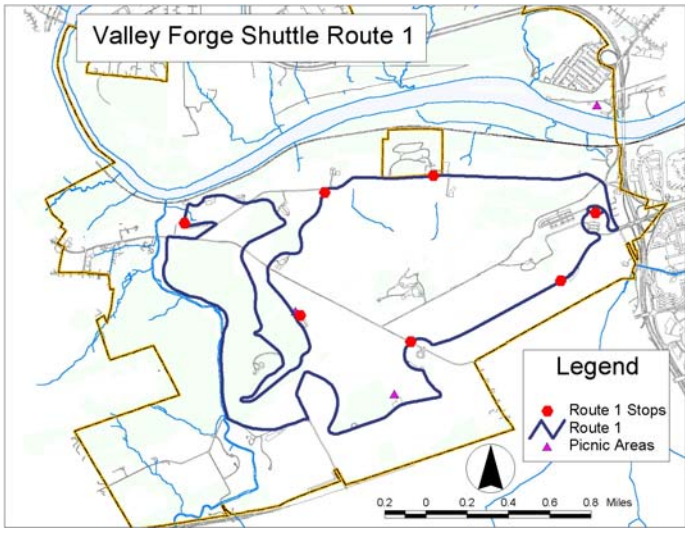
The development of appropriate routes is vital to the success of any transportation service. At Valley Forge NHP, routes should be chosen in such a way that they will efficiently transport visitors around the park, following a logical path that suits the needs of the identified audience, whether they be historical visitors or recreationalists or both. A route that emphasizes the interests of historical visitors would include the primary sites of historical and cultural interest and would travel to them in a manner and order that allowed a coherent historical story to be told. A route that emphasizes the interests of recreational visitors would include the primary sites of recreational and leisure interest, including picnic grounds and trailheads. A hybrid route would combine elements of both.

The three routes described below could be applied either to an interpretive tour service or a shuttle service. Each of these routes covers the primary sites of historical interest in the park and most of the significant recreational areas, but each offers a slightly different itinerary in order to provide different alternatives for coverage and drive- time.

Proposed Route 1 —The longest of the proposed routes, Route 1 would traverse almost the entirety of the south side of the park, including the full lengths of both Outer Line Drive and Inner Line Drive. Route 1 would include stops at the Welcome Center, Muhlenberg Brigade, the National Memorial Arch, Washington's Headquarters, the von Steuben Statue, and Washington Memorial Chapel. It would also provide access to the recreation areas of Wayne's Woods, Artillery Park, and the Conway Huts, as well as to Maxwell's parking lot. Route 1 parallels the route of the interpretive shuttle offered during the summer of 2003. Route 1, with a total length of 9.5 miles, is estimated to take approximately 45 minutes to drive, allowing 1:00–3:00 minutes at each stop.

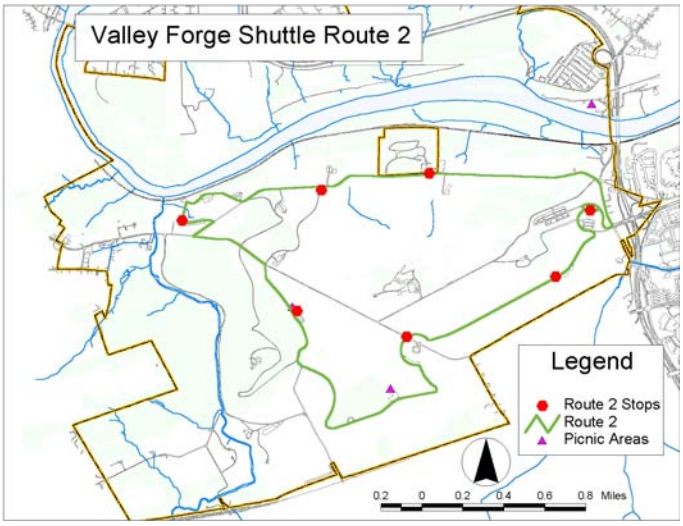
[25] Complete tables of routes and stops, as well as travel times for each route segment and dwell times at proposed stops, may be found in Appendix 6.

Map 4
Proposed Shuttle Route 1
Source: Volpe Center Study Team



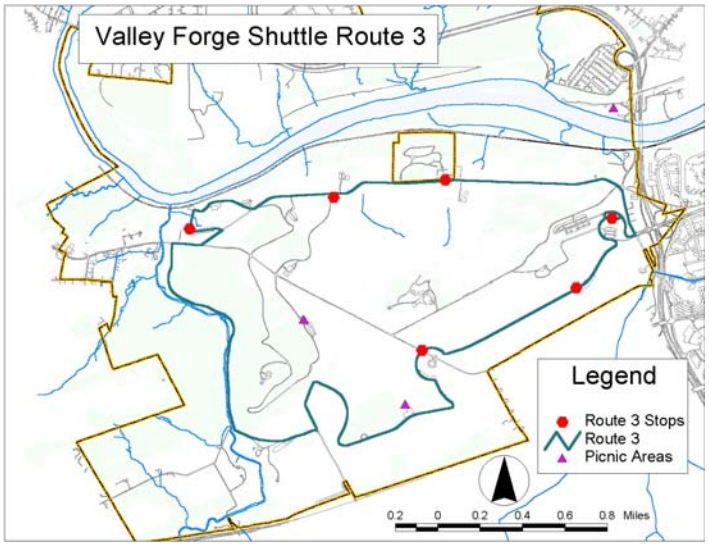
Proposed Route 2—Route 2, with a total length of 6.1 miles, is an abbreviated version of Route 1, eliminating a large portion of Inner Line Drive in order to reduce the time needed to drive the route. Route 2 relies upon the construction of a short connector road between Outer Line Drive and the eastern portion of Inner Line Drive at the site of the Baptist Trace Road. The construction required for a connector road is currently part of the Federal Lands Highways program of Valley Forge NHP. Route 2 makes the same stops as Route 1, but misses the historic resources of Mount Joy and the Inner Line Defenses, as well as Maxwell's parking lot, a parking lot well- used by recreational visitors. Route 2 is estimated to take approximately 31 minutes to drive, allowing 1:00–3:00 minutes at each stop.

Map 5
Proposed Shuttle Route 2
Source: Volpe Center Study Team



Proposed Route 3—Route 3 eliminates Inner Line Drive all together, producing a route that is a large loop around the perimeter of the south side of the park. Route 3 includes stops at the sites accessed by Routes 1 and 2 and at Wayne's Woods and Maxwell's parking lot, but eliminates access to the Artillery Park and Conway Huts recreation areas and the historical resources of Mount Joy and the Inner Line Defenses. Route 3, with a total length of 7.0 miles, is estimated to take approximately 34 minutes to drive, allowing 1:00–3:00 minutes at each stop.

Map 6
Proposed Shuttle Route 3
Source: Volpe Center Study Team



Types of Stops

Stops help to define several important characteristics of a transportation service, including the length of the ride, and are vital to the overall experience of the service. In addition to selecting the location of stops, it is also important to consider the type of stops:

- Designated Stops—Stops can be designated much as they are in an urban environment, in which the stopping area is signed and riders know that the service can always be accessed at that spot. Designated stops might also include benches and covered waiting areas, as well as interpretive information and other passenger amenities.

- Identified Stops—An interpretive tour would almost certainly include a system of identified stops, in which passengers would all leave the vehicle together at a particular spot, but the stops would not need to be signed or otherwise identified. The stops included in the suggested routes here would most likely be identified stops.

- Flagged Stops—A shuttle vehicle could stop upon the signaled request of a visitor along the side of the road. Flagging should only be used at secondary stops, particularly in less frequented areas that may be popular primarily with recreationalists.

Headways

Headway, the frequency with which a transportation service runs, is one of the most important elements in the design of an alternative transportation system. Decisions about headway frequencies not only influence the number of vehicles required to meet ridership demand but also profoundly affect the desirability and convenience of using alternative transportation.

Appropriate headway is determined, in large part, by the environment in which a transportation service operates and the tolerance of its passengers for waiting. Transit systems that operate in metropolitan areas and primarily serve commuters focus on providing as frequent service as is feasible in order to make their systems attractive to individuals who might otherwise use private automobiles. As commuters often rely upon buses as their primary means of transportation, and as they are sometimes made to wait for buses or other transit vehicles in the elements or other inhospitable settings, wait- time tolerance among commuters is typically low.

The need is much the same in recreational settings, although some research has demonstrated that leisure travelers have a somewhat higher tolerance for waiting than do commuters, particularly if they are provided with interpretation, entertainment, or shelter during the waiting period. Studies performed by the Walt Disney Company have clearly indicated that the wait- time perceived by passengers increases exponentially over actual wait- time as soon as the average wait- time exceeds ten minutes.[26] As wait- time is calculated as one- half the actual headway, Walt Disney World has mandated headways of no greater than twenty minutes. Based on these findings—some of the most comprehensive to date for headways in recreational settings—the Volpe Center Study Team has based the calculations included in this document on the possibilities of 15- and 20- minute headways.

Some recreational settings, including Adams NHP, do maintain transportation schedules in which vehicles run every 30 minutes. As the Adams NHP trolley is timed to meet each tour group as it completes its visit of the park sites, however, there is no passenger waiting at a tour site even with the 30- minute schedule. Given that the shuttle service contemplated here for Valley Forge NHP is a more flexible service, in which passengers could anticipate waiting for the vehicle at multiple stops, a headway shorter than 30 minutes would be desirable in order to keep wait- times reasonable.

Vehicle Considerations

Vehicle Types

The choice of vehicle is significant not only for cost and efficiency but also for aesthetic and environmental reasons. A well- chosen vehicle will be in relative harmony with its surroundings and will not impose upon the landscape any more than is necessary. Anticipated ridership also helps to determine the appropriate size of vehicle and number of vehicles, which in turn dictate cost and fuel usage. For this reason, accurate estimates of future ridership are crucial to vehicle selection.

In order to accommodate the maximum number of estimated peak- period riders (see Section 4) with a shuttle service offering 15- minute headways, 29–42- seat vehicles would be needed. A vehicle accommodating 29 passengers would be appropriate for the "low" ridership estimate, and a 42- seat vehicle would be appropriate to meet the "high" ridership estimate. In general, however, it is not recommended that a new transportation service be designed to meet maximum potential demand. To do so would be to provide excess capacity during the majority of the period during which service is offered, producing inefficiencies and unnecessary cost. Instead, a vehicle seating 21–31 passengers would accommodate average estimated ridership during the peak hours of 12:00 p.m. – 4:00 p.m. on 85% of the days proposed for service, a more reasonable goal. Based on the headways used during that period, passengers might have to wait for a second shuttle because of overcrowding, but any backlog of passengers would resolve itself by 4:00 p.m. on those days.

The following table compares four common types of vehicles—one large bus, two smaller shuttle

[26] Based on Volpe Center Study Team analysis of transportation policies and standards of Walt Disney World.

vans, and one replica trolley—that are used in recreational, entertainment, and similar settings. These options are provided here to give a sense of the types of vehicles that might be appropriate for use at Valley Forge NHP, not to imply a comprehensive review of all potential vehicles.

Table 4
Suggested Vehicle Types[27]
Source: Volpe Center Study Team

	Model	Concorde	300 Aero Elite	Ultra LF	American Heritage Streetcar
	Manufacturer	Glaval	Eldorado National	Blue Bird	Chance Coach
	Base Price	$80,000	$85,000-$95,000	$80,000	$255,000
	Type	High Floor	High Floor	Low Floor	High Floor
	Seating Capacity	28-37	25, 29, 33	19-35	28
	Length (ft)	30, 32, 34, 38	27, 29, 32	30, 35	29
	Configuration	Forward Facing, Perimeter	Forward Facing, Perimeter	Various	Forward Facing, Perimeter
	Wheel Chair Accessible	Yes	Yes	Yes	Yes
Fuel Options	Gasoline		X		
	Diesel	X	X	X	X
	CNG			X	X
	Propane				
	Hybrid				
	Altoona Tested (Years)	7	7	10	12

These vehicles also allow passengers to stand while in transit, thereby increasing capacity.

Fuel Types
Vehicles of the kind appropriate for use at Valley Forge NHP can use a myriad of types of fuel, each with its own characteristics, cost, and convenience. In particular, the park should weigh the following fuel- related issues in selecting a vehicle:

- Vehicle performance
- Maintenance needs
- Fuel efficiency
- Fuel costs
- Emissions

Some National Park Service units have opted to use alternative- fuel vehicles in their transportation fleets, and it is likely that Valley Forge NHP would want to consider alternative fuels as a possible source of power for any new vehicles.[28] Listed below are the primary types of fuel—including alternative fuels—used by bus- and trolley- type vehicles:

- Gasoline and Diesel—Available within Valley Forge NHP

[27] Altoona testing is used to ensure compliance with Federal laws and standards.
[28] Alternative- fuel vehicles are often significantly more expensive to purchase and maintain than are standard diesel-powered vehicles.

- Propane—Available in Norristown, Pennsylvania at U- Haul (approximately 8 miles away)
- Compressed Natural Gas (CNG) —Available in King of Prussia, Pennsylvania at PECO Energy (approximately 4 miles away). The cost of constructing a CNG facility at Valley Forge NHP has been estimated at $100,000.
- Liquefied Natural Gas (LNG) —Not available within 70 miles
- Ethanol and other biodiesels—Not available within 70 miles

Given the fuel availability described above, the most appropriate fuel choices for Valley Forge NHP would be gasoline, diesel, compressed natural gas, and propane.

Vehicle Procurement and Operations—Options

Valley Forge NHP could use a variety of options for vehicle procurement, maintenance, and operations. The main vehicle procurement options include purchasing vehicles outright, leasing vehicles, or paying a contractor for use of vehicles. At present, Valley Forge NHP owns all of its own vehicles, and employs two mechanics to maintain those vehicles.

For the pilot interpretive tour of 2003, Valley Forge NHP and NCAR entered into a contract with a local transportation provider in which the contractor handled all vehicles, operations, and maintenance. Valley Forge NHP received $3.10 of each passenger fare of$15.50, NCAR received $0.90 of each fare, and the remainder was retained by the contractor to cover the expenses of the service and obtain some profit. This was a low- risk undertaking for Valley Forge NHP, as it allowed the park to experiment with an alternative transportation service without investing in new vehicles, employees, infrastructure, or expertise. A larger transportation effort would likely require additional vehicles and drivers, and so might prompt consideration of other methods of providing transportation.

In general, leasing vehicles would be a preferable option for Valley Forge NHP if (1) the vehicles were expected to receive a significant amount of wear and tear, (2) the park wanted to replace them on a regular basis, (3) the selected vehicles were known to have shorter than average lifespans, and (4) Valley Forge NHP was unsure whether the transportation service would continue over the long term. Since the vehicles at the park are expected to be used lightly—both seasonally and in miles per day—it may make more sense to purchase strong, sturdy, and well-tested vehicles and plan to keep them for an extended period, provided that the transportation service is expected be an on- going program. A pilot service would be well- served by a leased or contracted vehicle.

Vehicle operations could be run by the park, which could hire drivers and a program manager as National Park Service employees, or by a contractor, who could manage all aspects of vehicle operations. Vehicles could also be maintained by National Park Service employees or by a contractor. It is likely that a decision about the provision of maintenance will be the same as the decision about the operation of the vehicles: either a contractor or Valley Forge NHP would provide both services. The park may also decide to own or lease the vehicles and then place the responsibility for operations and maintenance with a contractor.

It is important to note that choices about procurement and operations should be made late in the planning process, after many other decisions have been finalized.

Fees

This section raises some issues about the types of passenger fees that could be considered for an alternative transportation service and the experiences of transportation fees at other National Park Service units. The decision to charge fees for any transportation service or facility is as much a policy decision as a financial one, and the information provided here is intended to guide the staff and management of Valley Forge NHP in that consideration.

At present, there are no fees levied for the use of any of the facilities or resources of Valley Forge NHP, including the parking lots, except for admission to Washington's Headquarters. The introduction of a transportation service—with or without the closure of any of the park roads—could require the imposition of a fee in order to help fund the operating costs of the service. In order to promote equity and reduce any loss of visitation, different fees could be charged for different services and different groups of individuals could be charged in different ways. In all cases, market research would need to be performed to determine the appropriate price for each service.

The imposition of fees requires a mechanism for the collection of the fees. This can be performed in a number of ways: (1) by paying the driver or tour guide on the transit vehicle, (2) by pre- paying at the Welcome Center,[29] and (3) through parking fees for the park parking areas. Should Valley Forge NHP elect to offer any discounts to local residents or other frequent users, decals, badges, or other identifying documentation could be distributed to indicate the eligibility of those users for a discount.

Several specific fee scenarios are described below:

- Interpretive Tour—An extended tour, with a tour guide or sophisticated audio track, could garner a significant fee. The interpretive tour piloted at Valley Forge NHP during the summer of 2003 charged a fee of $15.50 for adult riders, with a discount for children and students. 71% of 746 survey respondents answered the question "I feel the tour was priced fairly" with a "4" or "5" grade, indicating support for the pricing structure.[30] Similar tour services in urban areas charge upwards of $20.

- Shuttle Service—A shuttle service can likely support a small fee. The acceptable fee for a shuttle service would depend in part on the exact parameters of the service, including the frequency of service, the number and placement of stops, the type of vehicle, and whether any interpretive services are offered. If a shuttle service were to include optional interpretive services—through personal audio devices, for instance—a separate, additional fee could be charged for the use of the equipment. A fee could reasonably range between $1 and $5, with transportation demand subject to fluctuation based on the exact fee charged.

- Parking Fees—As an alternative to charging fees for the use of a transportation service, parking fees offer some advantages. Due to the fact that the vast majority of visitors to Valley Forge NHP arrive by automobile, a parking fee would impact historical and recreational users equally. Thus, the fee charged could be less per capita than it could be for a transportation service. The parking fees could be used to help subsidize the cost of providing transportation service, and could obviate the need to collect fees specifically for the use of the service. Parking fees could be in the range of $1–$5.

- Discounts—The introduction of fees at Valley Forge NHP could prompt consideration of programs to offer discounts for particular types of users. Valley Forge NHP would likely want to consider offering discounts, whether for parking or for transportation services, to local residents, school groups, and other frequent users, including holders of National Park Service entrance passes (e.g., the National Parks Pass and the Golden Eagle Pass). A program of discounts could be particularly important if Valley Forge NHP were to introduce parking fees, as parking fees would capture many park users—particularly recreationalists—who are likely to not use the transportation service.

[29] As was done for the interpretive tour offered during the summer of 2003.
[30] Survey data from Valley Forge NHP.

The Volpe Center Study Team is not aware of any comprehensive studies performed by or for the National Park Service to analyze the effect of fees on transportation demand within National Park Service units. Nevertheless, the two case studies provided earlier—Adams NHP and Kennesaw Mountain NBP—offer some insight into the types of policy decisions made by park staff on the issue of transportation fees.

Neither Adams NHP nor Kennesaw Mountain NBP charges a fee to use its alternative transportation service. Adams NHP charges $3 for each adult to tour the sites of the park, and the ride on the shuttle service requires no additional charge. Likewise, Adams NHP makes free parking available to all visitors at the Visitor Center, a further inducement for visitors to leave their cars and use the shuttle. Kennesaw Mountain charges no fee for admission to the park, and the shuttle service is also free.

A third case, that of Acadia National park (Acadia NP) provides a particularly interesting study in fees. Acadia NP charges $20/vehicle for a seven- day pass to the park, but the cost of using the Island Explorer shuttle bus system is free. The Island Explorer serves both park visitors and local residents, and both groups are able to ride the shuttle in and around Acadia NP without any charge. When alternative transportation was first offered at Acadia NP, a charge of $2 was required of riders. Since the fee was eliminated, ridership is estimated to have increased by 600%, although that increase is likely due to a combination of factors of which fare- free service is only one. Acadia NP requires that park visitors using the Island Explorer to travel into the park purchase a visitor pass before boarding the bus, but have found it difficult to enforce this requirement.[31]

The experiences of three other, larger units of the National Park Service, while not as directly comparable to Valley Forge NHP, also point to a trend toward fare- free shuttle services coupled with admissions fees. Grand Canyon National Park operates a free shuttle service on the South Rim of the Canyon, but charges $10/individual for a seven- day park pass. During the months of April- October, Zion National Park requires that visitors use a free shuttle to tour Zion Canyon Scenic Drive—the Drive is closed to private automobiles—and charges $20/vehicle for a seven-day pass into the parking areas of the park. Lastly, Yosemite National Park provides a free, year-round shuttle service in Yosemite Valley and seasonal service in Wawona/Mariposa Grove and Tuolumne Meadows, while charging $10/individual for a seven- day park pass.

Specific decisions about funding alternative transportation at Valley Forge NHP should come as part of a later implementation study, and the information here is intended only to offer some ideas and examples from other National Park Service units. The lessons taken from those parks, all of which have succeeded in providing alternative transportation to their visitors, are that fare-free service seems to be preferable to fee service. Unlike Valley Forge NHP, however, the parks cited here all charge either entrance fees or tour fees, or have alternate sources of funding, which make it possible for the parks to subsidize the cost of alternative transportation.

Operations and Maintenance Costs

Estimating the costs of the operations and maintenance of a transportation service is a complex process, particularly at an early stage in the planning process. Nevertheless, the Volpe Center Study Team has developed a series of approximate cost breakdowns—one for each of the three proposed routes described above—based on the ridership estimates presented in Section 4 as well as the operational parameters for a shuttle service described earlier in Section 5.

Given that Valley Forge NHP, in conjunction with the National Center for the American Revolution, has already piloted an interpretive tour service, this analysis does not include cost

[31] From interviews with staff members at Acadia National Park

estimates for a future interpretive service. It is assumed that those costs have already been established by Valley Forge NHP and would not change dramatically in the future unless the scope of the service or the method of providing it—a switch from contractor- provided service to National Park Service- provided service, for instance—were significantly altered. Instead, this analysis focuses on the cost of operating a shuttle service.

Table 5
Cost Estimates - Operation and Maintenance of a Shuttle Service[32]
Source: Volpe Center Study Team

Route 1: 9.5 Miles, 45:30-Minute Route		
Headway (minutes)	**15**	**20**
Number of vehicles needed	4	3
Daily miles per vehicle	98	99
Total daily operating cost	$2,500	$1,900
Total annual mileage for fleet	65,000	49,000
Annual operating cost	$405,000	$306,000
Route 2: 6.1 Miles, 31:00-Minute Route		
Headway (minutes)	**15**	**20**
Number of vehicles needed	3	2
Daily miles per vehicle	87	96
Total daily operating cost	$1,600	$1,200
Total annual mileage for fleet	43,000	32,000
Annual operating cost	$269,000	$198,000
Route 3: 7.0 Miles, 34:15-Minute Route		
Headway (minutes)	**15**	**20**
Number of vehicles needed	3	2
Daily miles per vehicle	97	108
Total daily operating cost	$1,800	$1,300
Total annual mileage for fleet	48,000	36,000
Annual operating cost	$301,000	$222,000

Based on the proposed shuttle service schedule, operating costs are estimated to range between $198,000 and $405,000 annually (see Table 5). Daily operating costs—estimated here to range from $1,200 to $2,500—can be used to determine appropriate fares schedules (e.g., the periods of the week or year during which transportation service is financially feasible) for an alternative transportation service. Accounting for fluctuations in visitation throughout the year, an average transportation fare of $1.90–$5.75 would be needed from each passenger in order to recoup the operating costs. This range represents the spectrum from highest ridership/lowest cost service to lowest ridership/highest cost service. Requiring user fees of some form—parking, admissions,

[32] Based on $6.25 per mile, the average operating expense per vehicle revenue mile in 2000. From *National Transit Summaries and Trends* (Federal Transit Administration), 2000. In addition to service miles, 20 miles per day is included in daily miles per vehicle to account for travel to and from fueling and storage facilities.

etc.—from every park visitor would reduce the necessary per capita costs to a range of $0.16-$0.32 or a per vehicle range of $0.40- $0.81, assuming 2.5 passengers per vehicle.[33]

The operating costs for an interpretive tour differ somewhat from those for a shuttle service, based on the different ways in which vehicles would be used. A shuttle service travels more miles per hour (generating more costs for maintenance and fuel), while the cost of an interpretive tour would be more heavily weighed to the salary of the driver and any interpretive staff. Nevertheless, assuming an interpretive tour route of 9.5 miles that requires 90 minutes for one vehicle to complete, and a schedule of three tours per day (producing a total of 48.5 daily miles traveled), the total daily operating cost per vehicle would be $300. The annual operating cost for a fleet of three vehicles would be $50,000.

It should be noted that the estimated costs presented here would differ somewhat based on the mechanism used by Valley Forge NHP—contract, lease, or purchase—for the use, operations, and maintenance of vehicles. As Valley Forge NHP progresses in its GMP and transportation planning processes, these estimates will need to be updated to fit the transportation scenarios that are ultimately selected for implementation.

[33] The least expensive estimate for the cost of providing annual shuttle service is $198,000, while $405,000 is the most expensive. To calculate per- visitor costs, the operating costs are simply divided by the number of annual visitors (i.e., $198,000/1.25 million and $405,000/1.25 million).

6 Implementation Scenario

The following is a hypothetical description of one type of alternative transportation service that could be implemented at Valley Forge NHP. The service description provided here, including suggested schedules, hours, headways, and routes, is given as an example of what might be done, not as a recommendation for the on- going GMP/EIS.

Service Scenario—Operational Characteristics

Route

The proposed route (elsewhere described as Route 1) begins at the Welcome Center and travels west along Outer Line Drive, making stops at the Muhlenberg Brigade and National Memorial Arch. The route continues on Outer Line Drive to Valley Creek Road (Route 232), where it travels north to Valley Forge Road (Route 23). At Valley Forge Road, the route turns south and quickly turns into the service road for Washington's Headquarters in order to provide access to the site. The route continues along the service road, crossing Route 23 onto Inner Line Drive south. The route follows Inner Line Drive back to Route 23, stopping at Knox's Artillery and the von Steuben Statue. The vehicle would then continue on Route 23 east, stopping at Washington Memorial Chapel before returning along North Gulph Road to the Welcome Center. The route is approximately 9.5 miles and is believed to take 45 minutes to complete, including stops.

Schedule

Based on previous visitation statistics provided in Section 4, the proposed service includes weekends during the period March–December (10 months) and daily service from April to October (7 months). This season provides service for the 240 days when expected daily ridership will be above 250 –360 people.

Service begins at 10:00 a.m. and runs until 5:00 p.m., with 15- minute headways and with the last shuttle leaving the Welcome Center at 4:15 p.m. This provides seven hours of service, allowing the vehicle to be refueled and stored within an 8- hour shift. Provisions have not been made here to account for driver breaks, which would need to be arranged.

The proposed service uses three 25–30- passenger ADA compliant vehicles. This particular size of vehicle, which is relatively small, has been chosen based on expected ridership and sensitivity to the Valley Forge NHP landscape. 15- minute headways make it possible to balance visitor dislike of waiting, expected ridership, and the cost of additional vehicles.

The following table provides information on the number of days that demand will not be met, using the high and low ridership estimates described in Section 4 to provide a range of number of days.

Table 6
Unmet Shuttle Demand
Source: Volpe Center Study Team

Service Demand Period	25 – Passenger Vehicle		30 – Passenger Vehicle	
	Days exceeding available capacity	Percent of Service Days	Days exceeding available capacity	Percent of Service Days
Daily	0-26	0-11%	0	0%
Peak Hour	26-126	11-53%	0-35	0-15%
4-Hour Peak	0-44	0-18%	0-35	0-15%

Service Scenario—Operational Options

Two models for operating the service have been developed. In the first model, Valley Forge NHP would contract with a local transportation company to provide vehicles and drivers and to maintain and store the vehicles. The second option places these responsibilities on the park itself, requiring park staff to lease vehicles and perform all tasks associated with the operation and maintenance of the vehicle.

Contracted Service

The Greater Valley Forge Transportation Management Association (GVFTMA) is an important transportation stakeholder in the Valley Forge region. Through contacts with local transportation companies, the staff of GVFTMA was able to estimate that the service described here would cost approximately $57 per hour per vehicle if it were provided by a privately operated service. With a service running three vehicles for 240 days per year, 7 hours per day, the total estimated cost of contracting the service is $287,280 per year.

Some benefits of contracting out the service include:

- The transportation service provider manages all of the details of service.
- No overtime penalty for working more than 8 hours.

Some drawbacks of contracting the service include:

- The costs can be more expensive than performing the service with in- house staff members.
- Valley Forge NHP management would have less control over driver and maintenance quality than it would with in- house staff members.

In-House Service

Valley Forge NHP has the option of leasing a vehicle and running the service with its own staff. As a federal agency, Valley Forge NHP is able to use the General Services Administration (GSA) Automotive Fleet Services in order to lease a vehicle. A representative of the Philadelphia GSA Fleet Service Office provided some basic cost information for leasing a vehicle from GSA. The rate provided covers the cost of the vehicle, maintenance, and fuel. The contact person noted that the majority of vehicle requests are for sedans, and that wider research would be required to locate an appropriate vehicle type for Valley Forge NHP.

Table 7
General Services Administration Leasing Rates[34]
Source: General Services Administration

Capacity (seats)	Monthly Rate ($/month)	Yearly Flat Rate ($/year)	Mileage Rate (¢/mile)
24	453	5,436	29.5
28	572	6,864	36
44	616	7,392	39

If Valley Forge NHP were to run its own service, park staff would be responsible for administration, driver wages, and storage. Valley Forge NHP has space for vehicle storage and the ability to fuel its own vehicles, including both gasoline and diesel vehicles. As GSA lease agreements include the cost of fuel, arrangements would have to be made for any fuel used in the leased vehicle.

[34] Please note that most vehicle leases are offered on an annual basis.

Driver wages are estimated to be $11–$15/hour in the Valley Forge region. Other units of the National Park Service, however, have estimated that a driver would cost $19/hour, including benefits.

The following table estimates the annual cost for Valley Forge to run its own shuttle service.

Table 8
The Costs for Valley Forge NHP to Provide Shuttle Service[35]
Source: Volpe Center Study Team

Element	Cost	Multiplier	Cost per Day	Annual Cost per Vehicle (240 days of service)	Total Cost
Yearly Flat Rate	$6,964 per year			$6,964	$20,892
Vehicle Lease per Mile	$0.36 per mile	83 miles per day	$29.88	$7,171	$21,514
Fuel Costs	$1.30 per mile	83 miles per day	$107.90	$25,896	$77,688
Driver Costs	$15 per hour	7 hours	$105	$25,200	$75,600
Administration	$1,500 per year				$1,500
				Total Cost	**$197,194**

Providing a shuttle service using in- house staff and resources has many advantages, including greater flexibility to run greater or fewer vehicles in keeping with demand, ability to use staff members who also have other duties, and more control over the quality and character of the experience. In- house service is also less expensive than contracted service. In- house service does have some disadvantages, however, including:

- Not having a replacement vehicle while maintenance is performed.
- Increased difficulty in managing drivers' schedules (e.g., lunch breaks, extended service hours) because the staff is smaller and work rules may be more stringent.
- Increased burden on existing employees.

[35] Assumes 1.5 hours of administration per week when service is seven days per week and 0.4 administrative hours during weekend- only service. Administrative costs are estimated at $30/hour.

Conclusions and Next Steps

Although the existing transportation network at Valley Forge NHP is relatively simple, the issues surrounding the decisions to close certain of the park roads to use by private automobiles and/or to introduce an alternative transportation system are complex and interconnected. Both decisions, whether made separately or in concert, have significant implications for the users of Valley Forge NHP and for the ways in which the park is visited, experienced, and remembered. Decisions about the provision of transportation services are decisions not only about the size and style of vehicle, type of fuel, mapping of routes, and management of maintenance—although those elements are vitally important and require careful planning—but also about the fundamental uses, present and future, of a public resource.

This document has analyzed three options for alternative transportation. Through transportation, the park has an opportunity to significantly affect its visitors' experiences, but each option requires certain trade- offs between flexibility and guided learning, between accessibility and cost, and between the convenience of the individual visitor and the needs of the greater park environment. As Valley Forge NHP evaluates these priorities, its decisions among the options should grow clearer.

As articulated in the introduction, this study has focused on three central issues: (1) expected changes to the visitor experience following the introduction of alternative transportation, (2) transportation demand and ridership estimates, and (3) vehicle operational issues and costs. The calculations and analyses developed for each of these issues are estimates, based on available data, reasonable assumptions, and proven methodologies. The calculations establish a minimum baseline which, when coupled with the basic program of transportation options presented here, can be used as parameters within which the staff and management of Valley Forge NHP can begin to decide whether alternative transportation is a viable way to help reach the long- term goals of the park.

Using the central issues described in the introduction and the data analysis provided here, the management of Valley Forge NHP will be able to judge the feasibility of alternative transportation under current conditions. That judgment will be based on an internal weighing of the costs and benefits of an alternative transportation system, both as they have been described here and as might be observed from future pilot transportation programs at the park. From that evaluation, and as part of the overall GMP process, the alternatives program of road closures could also be pursued as appropriate.

While the questions of feasibility are, ultimately, those that only the staff and management of Valley Forge NHP can make, the results presented in this document make it clear that an alternative transportation service, should it be introduced at the park with the transportation environment *as it exists today*, would likely attract a significant number of riders, particularly during the months of peak park visitation. A decision to implement any of the proposed GMP/EIS alternatives for road closures would only increase the potential ridership, as the opening of NCAR would almost certainly also add passengers to the system. Either of these scenarios would also require an increase in the number of vehicles and, potentially, in the frequency of service. Both are matters to consider as part of implementation planning.

Following the completion of this study, Valley Forge NHP can pursue the decision to implement alternative transportation in a number of ways. A first scenario would be to collect additional data on current conditions in the park, in order to develop a fuller picture of transportation patterns and preferences among existing visitors. Suggested sets of data to collect for both historical and recreational visitors include:

- Qualitative data about use patterns within the park—what visitors are doing during their time at Valley Forge NHP
- Qualitative data about the willingness of visitors to alter their use and transportation patterns
- Qualitative and quantitative data about sensitivity to the price and routing of an alternative transportation service

This information can be collected prior to the implementation of alternative transportation or can be done in concert with an expanded pilot program. Such a program, which would optimally include both an interpretive tour and a shuttle service, could be done through a concession or other arrangement that required a minimal investment from the park. It could also be done in concert with a pilot program of road closures, in order to gain a more accurate picture of visitor behavior in an environment of closed roads.

Valley Forge National Historical Park offers both historic appreciation and recreation. Some visitors seek one and some the other, and their particular patterns of use determine their transportation and other needs – for information, for interpretation, for mobility, and for convenience. How visitors travel within the park affects how the see and use it. For that reason, decisions about transportation today are also crucial decisions about visitor experience tomorrow.

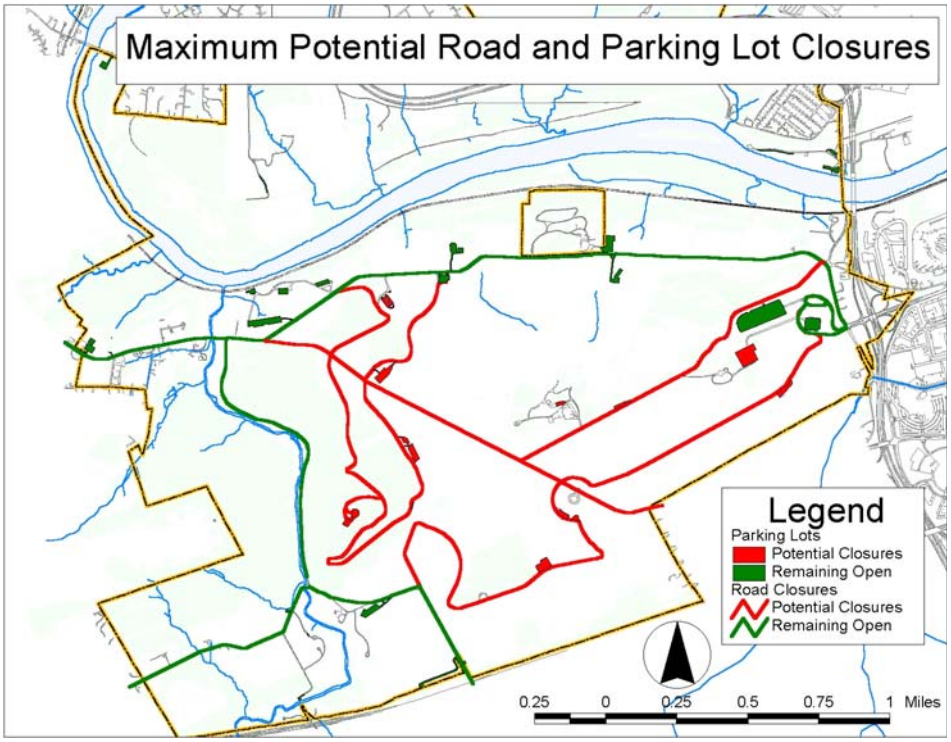
Appendix 1 Road Closure Alternatives

As part of the GMP/EIS process, Valley Forge NHP is considering the closure of some or all of the roads within the boundaries of the park. Once closed, the roads would no longer be available for use by private automobiles. The road closure alternatives currently include the closure of Inner Line Drive, Outer Line Drive, and Gulph Road (unrelated to the GMP/EIS alternatives, County Line Road will be vacated by the Pennsylvania Department of Transportation and closed to public use as mitigation for the reconstruction of the Betzwood Bridge). These alternatives will receive review, analysis, and public comment in the GMP/EIS process, and are included in this document only as context for the consideration of alternative transportation at the park.

While the closure of Inner Line Drive, Outer Line Drive, Gulph Road, and County Line Road would help to remove some traffic from within the park, it would increase traffic volumes on Routes 252 and 23, which are currently the primary commuter travel routes within Valley Forge NHP and the roads on which visitor traffic mixes most with commuter traffic. Therefore, the proposed road closures would positively impact the visitor experience primarily within the central area of the park.

For the purposes of this study, it has furthermore been assumed that only parking lots along the roads proposed for closure would themselves be closed, although this decision has not yet been finalized through the GMP/EIS process. Decisions about parking lot closures, as well as decisions about road closures, will alter the visitor experience in ways that have been mentioned elsewhere in this document.

Map 7
Maximum Potential Road and Parking Lot Closures
Source: Valley Forge NHP and Volpe Center Study Team



Appendix 2 Traffic Volumes

Map 8
2003 Annual Average Daily Traffic Counts at Valley Forge NHP, by Road
Source: Federal Highway Administration—Eastern Federal Lands Highway Division

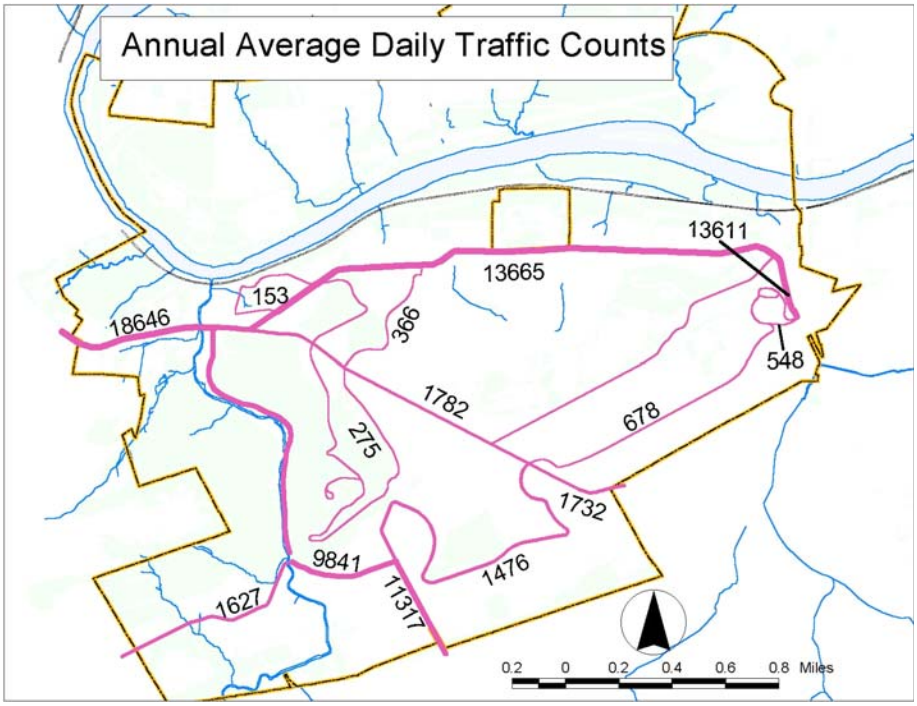


Table 9
2003 Traffic Volumes at Valley Forge NHP, by Roadway Segment[36]
Source: Federal Highway Administration—Eastern Federal Lands Highway Division
Note: Roads marked * are owned by the National Park Service

Roadway Segment	Travel Direction	Annual Average Daily Traffic
Route 23 west of Valley Creek Road	Two-Way	18,646
Route 23 from Gulph Road to northbound Inner Line Drive	Two-Way	9,008
Route 23 from northbound Inner Line Drive to County Line Road	Two-Way	13,665
Route 23 from County Line Road to Park Entrance	Two-Way	13,611
Washington Headquarters	Two-Way	153
Inner Line Drive Northbound, north of Gulph Road*	One-Way	366
Inner Line Drive south of Gulph Road*	One-Way	275
Gulph Road between Outer Line Drive and Inner Line Drive*	Two-Way	1,782
Gulph Road south of Outer Line Drive*	Two-Way	1,732
Baptist Road	Two-Way	11,317
Outer Line Drive west of Visitor Center*	One-Way	678
Valley Creek Road from Baptist Road to Yellow Springs Road	Two-Way	9,841
Yellow Springs Road west of Valley Creek Road	Two-Way	1,627
Visitor Center Drive to Route 23	One-Way	548

[36] All traffic counts were taken beginning July 30, 2003 except for the segment of Inner Line Drive northbound, north of Gulph Road, which was taken beginning August 2, 2003, due to equipment failure.

Appendix 3 Transportation Demand Calculations Recreational Visitors—Supplemental Data on Parking Patterns and User Groups

The Volpe Center Study Team estimated demand for alternative transportation among recreational visitors by studying known activity patterns within the park. The Study Team associated each parking lot with a dominant user group—either recreational visitors or historical visitors—as is noted in the table below (see next page) in the column labeled *Visitor Groups*. Those assumptions made by the Study Team are indicated with a black X. For those parking lots for which the Study Team could not make a determination about its dominant user group, the entry is left blank. For areas that have both recreational and historical visitors, one- half of users were estimated to be recreationalists. After the initial analysis was completed, park staff provided additional information about park activities, which are noted with a red X.

The visitor distribution information was developed using data collected from parking lot counts completed by Boles Smyth Associates, Inc during a week of June 2002. The number of vehicles in each parking lot was counted three times each day during the data collection period. These data were aggregated to determine an average number of vehicles for each parking lot, which was used to represent visitation to the adjacent region of the park. The percentages in the table represent the amount of use a single parking lot received compared to the overall level of use by the stated user group.

Table 10
Distribution of Visitors to Valley Forge NHP, by Parking Lot, July 2002
Source: Boles Smyth Associates, Inc. and Volpe Center Study Team

			All Park Visitors		Visitor Groups		Recreational Visitors	
Lot #	Name	Lot Capacity (vehicles)	Avg. Number of Vehicles	Percent of Total Visitation	Recreational	Historical	Avg. Number of Vehicles	Percent of Recreational Visitation
1	Lower Lot Visitors Center	839	57	18%	x	x	29	13%
2	Employee / Visitor Center	80	49	16%	x	x	25	11%
23	Betzwood Picnic Area - Nearest Trailhead	43	21	7%	x		21	10%
25	Betzwood Picnic Area - First Lot	23	18	6%	x		18	8%
7	von Steuben Statue	34	17	5%	x	x	9	4%
8	Washington's Headquarters - Main	182	16	5%		x	0	0%
18	Knox's Quarters	76	16	5%	x		16	7%
24	Betzwood Picnic Area - Boat Launch	28	16	5%	x		16	7%
17	Wayne's Woods	79	11	4%	x		11	5%
16	National Memorial Arch	51	11	3%	x	x	5	2%
19	Yellow Springs Road at Bridge	12	10	3%	x		10	5%
21	Pawling's Parking Area	46	9	3%	x		9	4%
4	Washington Memorial Chapel	106	9	3%		x	0	0%
6	Varnum's Picnic Area	70	8	3%	x		8	4%
13	Artillery Park	84	8	2%	x	x	4	2%
26	Pawling Road at Rt 422	30	7	2%	x		7	3%
15	Outer Line Drive across from reconstructed huts	75	6	2%	x	X	6	3%
SRC	Schuylkill River Crossing dead end		5	2%	x		5	2%
15/16	Outer Line Drive	0	4	1%	x	x	4	2%
5	Huntington's Quarters / Nature Center	42	4	1%	x		4	2%
14	Conway Encampment	100	3	1%	x	x	3	1%
10	Redoubt 4	80	3	1%	x	x	3	1%
22	Walnut Hill	20	2	1%	x		2	1%
11	Mount Joy	85	1	0%	x		1	1%
17/18	Loop at Wayne Statue	0	1	0%		x	1	1%
12	Redoubt 3	17	1	0%	x	x	1	0%
9	Washington's Headquarters - Map	136	1	0%	x		0	0%
9A	Washington's Headquarters - Third	20	1	0%	x		0	0%
20	von Steuben Memorial / Post Office	43	0	0%	x		0	0%
3	Muhlenberg Encampment (Closed at time of parking study)	60	0	0%	x	x	0	0%
	TOTAL		315	100%			218	100%

Appendix 4 Transportation Demand Calculations for Recreational Visitors—Supplemental Data on Estimated Shuttle Use

The calculations presented here (see next page) make the following assumptions:

- This analysis does not include parking lots adjacent to Route 23. At most, these lots account for 14% of recreational users within the shuttle service area. Assuming that these users are as likely as recreationalists in other areas of the park to use the shuttle, the percent of recreationalists using the shuttle increases to 0.855%, adding at most six additional riders per day (fewer than one passenger per shuttle trip).
- Use of parking lots by recreational visitors was determined by averaging the number of vehicles counted from each time period during the data collection period and then estimating the level of use by recreationalists for each lot.
- Shuttle travel time estimates the round trip travel time to a single site in the park and includes the expected wait time to pick up the shuttle for the initial and return trip, in addition to the total travel time for the route.
- The *Entrance* column represents a start from the Welcome Center.
- The *252* column represents a start from Knox's Quarter's parking lot.
- The *23* column represents a start from the intersection of Route 23 and Route 252.
- The *Average* column assumes an even distribution of visitors entering from each of the three entrances.

Table 11
Estimation of Shuttle Use by Recreational Visitors, Based on 15-Minute Headways and Proposed Route 1
Source: Volpe Center Study Team

Lot #	Name	Recreational Use	Percent of Recreational Visitation	Shuttle Travel Time (in minutes)	Private Vehicle Travel Time				Travel Time Ratio (Shuttle/Private Vehicle)	Percent of Recreational Visitors Using the Shuttle	
					Entrance	252	23	Average		At This Location	All Recreational Visitors
1	Lower Lot Visitors Center	29	13%	**60.5**	0	17.5	14.5	**10.7**	5.7	0.47%	0.06%
2	Employee / Visitor Center	25	11%	**60.5**	0	17.5	14.5	**10.7**	5.7	0.47%	0.05%
7	von Steuben Statue	9	4%	**60.5**	10.5	12	4	**8.8**	6.8	0.14%	0.01%
18	Knox's Quarters	16	7%	**60.5**	22.5	0	10	**10.8**	5.6	0.51%	0.04%
17	Wayne's Woods	11	5%	**60.5**	20	15	15.5	**16.8**	3.6	3.74%	0.20%
16	National Memorial Arch	59	2%	**60.5**	10	15	15.5	**13.5**	4.5	1.54%	0.04%
6	Varnum's Picnic Area	8	4%	**60.5**	11.5	13	5	**9.8**	6.2	0.29%	0.01%
13	Artillery Park	4	2%	**60.5**	21.75	22	11.5	**18.4**	3.3	5.09%	0.09%
15	Outer Line Drive across from reconstructed huts	6	3%	**60.5**	16	15.5	17.75	**16.4**	3.7	3.41%	0.10%
SRC	Schuylkill River Crossing dead end	5	2%	**60.5**	3.75	13.75	10.75	**9.4**	6.4	0.22%	0.01%
15/16	Outer Line Drive	4	2%	**60.5**	16	15.5	17.75	**16.4**	3.7	3.41%	0.07%
14	Conway Encampment	3	1%	**60.5**	14.75	16.25	7.25	**12.8**	4.7	1.18%	0.02%
10	Redoubt 4	3	1%	**60.5**	11.5	11	3	**8.5**	7.1	0.11%	0.00%
11	Mount Joy	1	1%	**60.5**	21.75	22	11.5	**18.4**	3.3	5.09%	0.03%
17/18	Loop at Wayne Statue	1	1%	**60.5**	18.25	15	15.5	**16.3**	3.7	3.28%	0.02%
12	Redoubt 3	1	0%	**60.5**	21.75	22	11.5	**18.4**	3.3	5.09%	0.02%
	TOTAL	**131**	**60% all recreational visitation**								**0.75%**

Table 11A
Effect of Headway on Recreational Shuttle Use for Route 1
Source: Volpe Center Study Team

Headway	Percent of all Recreational Visitors Using the Shuttle
0	2.15%
15	0.75%
20	0.54%
30	0.28%

Appendix 5 Shuttle Ridership Estimates

Table 12
Calculations for "High" Estimate of Shuttle Ridership, Based on Current Visitation and Proposed Shuttle Service[37]
Source: Volpe Center Study Team

Month	Days	Weekend Days	Percentage of Visitation	Monthly Visitation	Season	Days of Service		Average Weekend Visitation			Average Weekday Visitation			Daily Potential Ridership		Monthly Shuttle Ridership
						Weekend	Weekdays	All Visitors	Recreational	Historical	All Visitors	Recreational	Historical	Weekend	Weekday	
January	31	9	2%	30,276	Off	0	0	1,258	906	352	864	622	242	165	114	-
February	28	8	1%	16,094	Off	0	0	740	533	207	509	366	142	97	67	-
March	31	9	5%	66,429	Shoulder	9	0	2,760	1,987	773	1,896	1,365	531	363	249	3,264
April	30	8	8%	99,989	Shoulder	8	0	4,293	3,091	1,202	2,949	2,123	826	564	388	4,513
May	31	9	12%	146,828	Shoulder	9	0	6,101	4,393	1,708	4,191	3,017	1,173	802	551	7,215
June	30	8	13%	161,780	Peak	8	22	6,946	5,001	1,945	4,771	3,435	1,336	913	627	21,096
July	31	9	14%	172,040	Peak	9	22	7,149	5,147	2,002	4,910	3,535	1,375	939	645	22,649
August	31	9	12%	154,660	Peak	9	22	6,426	4,627	1,799	4,414	3,178	1,236	844	580	20,361
September	30	8	9%	113,780	Peak	8	22	4,885	3,517	1,368	3,356	2,416	940	642	441	14,837
October	31	9	10%	120,328	Shoulder	9	0	5,000	3,600	1,400	3,434	2,473	962	657	451	5,913
November	30	8	7%	85,144	Shoulder	8	0	3,656	2,632	1,024	2,511	1,808	703	480	330	3,843
December	31	9	7%	82,651	Off	0	0	3,434	2,473	962	2,359	1,698	661	451	310	-

[37] The "high" ridership estimate includes 45% of historical visitors and 0.75% of recreational visitors.

Appendix 6 Routes, Stops, and Dwell Times

Table 13
Route Segments
Source: Volpe Center Study Team

ID	Travel Time in Minutes	Segment Start	Segment End
1	02:15	Welcome Center	Muhlenberg Brigade
2	02:45	Muhlenberg Brigade	National Memorial Arch
3	02:00	National Memorial Arch	Wayne's Woods
4a	01:45	Wayne's Woods	Trace Road Cutoff
4b	01:45	Trace Road Cutoff	Knox's Quarters
5	00:30	Knox's Quarters	Covered Bridge
6	04:30	Covered Bridge	Washington's HQ
7a	02:00	Washington's HQ	Inner Line Drive @ Gulph Road (NW)
7b	03:45	Inner Line Drive @ Gulph Rd. (NW)	Tip of Inner Line Drive
8	01:45	Tip of Inner Line Drive	Redoubt 3
9a	01:00	Redoubt 3	Inner Line Drive @ Gulph Road (SE)
9b	02:45	Inner Line Drive @ Gulph Road (SE)	Von Steuben Statue
10	01:30	Von Steuben Statue	Washington Memorial Chapel
11	03:45	Washington Memorial Chapel	Welcome Center
13a	03:00	National Memorial Arch	Gulph Road @ Inner Line Drive (SE)
13b	00:30	Gulph Road @ Inner Line Drive (SE)	Gulph Road @ Inner Line Drive (NW)
13c	01:00	Gulph Road @ Inner Line Drive (NW)	Washington's HQ Entrance
14	01:00	Washington's HQ Entrance	Von Steuben Statue via Route 23

Table 14
Dwell Times Allotted for Each Stop
Source: Volpe Center Study Team

ID	Dwell Time in Minutes	Name
A	01:15	Muhlenberg Brigade
B	01:15	National Memorial Arch
C	01:00	Wayne's Woods
D	00:30	Wayne Statue
E	03:00	Washington's HQ
F	01:00	Redoubt 4
G	00:30	Redoubt 3
H	01:00	Artillery Park
I	01:00	Conway Encampment
J	01:00	Von Steuben Statue
K	02:00	Varnum's Picnic Area
L	02:00	Washington Memorial Chapel
M	02:00	Welcome Center
N	02:00	Auxiliary Stops

Table 15
Route 1—Route Segments and Stops[38]
Source: Volpe Center Study Team

ID	Time in Minutes	Segment Start	Segment End
1	02:15	Visitor Center	Muhlenberg Brigade
A	**01:15**	**Muhlenberg Brigade**	
2	02:45	Muhlenberg Brigade	National Memorial Arch
B	**01:15**	**National Memorial Arch**	
3	02:00	National Memorial Arch	Wayne's Woods
4a	01:45	Wayne's Woods	Trace Road Cutoff
4b	01:45	Trace Road Cutoff	Knox's Quarters
5	00:30	Knox's Quarters	Covered Bridge
6	04:30	Covered Bridge	Washington's HQ
E	**03:00**	**Washington's HQ**	
7a	02:00	Washington's HQ	Inner Line Dr. @ Gulph Rd. (NW)
7b	03:45	Inner Line Dr. @ Gulph Rd. (NW)	Tip of Inner Line Dr.
8	01:45	Tip of Inner Line Dr.	Redoubt 3
9a	01:00	Redoubt 3	Inner Line Dr. @ Gulph Rd. (SE)
H	**01:00**	**Artillery Park**	
9b	02:45	Inner Line Dr. @ Gulph Rd. (SE)	Von Steuben Statue
J	**01:00**	**von Steuben Statue**	
10	01:30	von Steuben Statue	Washington Memorial Chapel
L	**02:00**	**Washington Memorial Chapel**	
11	03:45	Washington Memorial Chapel	Visitor Center
M	**02:00**	**Visitor Center**	
N	**02:00**	**Auxiliary Stops**	
Total Time	45:30		

[38] Route segments are identified with numbers and stops with letters.

Table 16
Route 2—Segments and Stops[39]
Source: Volpe Center Study Team

ID	Time in Minutes	Segment Start	Segment End
1	02:15	Visitor Center	Muhlenberg Brigade
A	**01:15**	**Muhlenberg Brigade**	
2	02:45	Muhlenberg Brigade	National Memorial Arch
B	**01:15**	**National Memorial Arch**	
3	02:00	National Memorial Arch	Wayne's Woods
4a	01:45	Wayne's Woods	Trace Road Cutoff
9a	01:00	Redoubt 3	Inner Line Dr. @ Gulph Rd. (SE)
H	**01:00**	**Artillery Park**	
13b	00:30	Gulph Rd. @ Inner Line Dr. (SE)	Gulph Rd. @ Inner Line Dr. (NW)
13c	01:00	Gulph Rd. @ Inner Line Dr. (NW)	Washington's HQ Entrance
E	**03:00**	**Washington's HQ**	
14	01:00	Washington's HQ Entrance	Von Steuben Statue via 23
J	**01:00**	**von Steuben Statue**	
10	01:30	von Steuben Statue	Washington Memorial Chapel
L	**02:00**	**Washington Memorial Chapel**	
11	03:45	Washington Memorial Chapel	Visitor Center
M	**02:00**	**Visitor Center**	
N	**02:00**	**Auxiliary Stops**	
Total Time	31:00		

[39] Route segments are identified with numbers and stops with letters.

Table 17
Route 3—Route Segments and Stops[40]
Source: Volpe Center Study Team

ID	Times in Minutes	Segment Start	Segment End
1	02:15	Visitor Center	Muhlenberg Brigade
A	**01:15**	**Muhlenberg Brigade**	
2	02:45	Muhlenberg Brigade	National Memorial Arch
B	**01:15**	**National Memorial Arch**	
3	02:00	National Memorial Arch	Wayne's Woods
4a	01:45	Wayne's Woods	Trace Road Cutoff
4b	01:45	Trace Road Cutoff	Knox's Quarters
5	00:30	Knox's Quarters	Covered Bridge
6	04:30	Covered Bridge	Washington's HQ
E	**03:00**	**Washington's HQ**	
14	01:00	Washington's HQ Entrance	Von Steuben Statue via 23
J	**01:00**	**von Steuben Statue**	
10	01:30	von Steuben Statue	Washington Memorial Chapel
L	**02:00**	**Washington Memorial Chapel**	
11	03:45	Washington Memorial Chapel	Visitor Center
M	**02:00**	**Visitor Center**	
N	**02:00**	**Auxiliary Stops**	
Total Time	34:15.0		

[40] Route segments are identified with numbers and stops with letters.

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As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our parks and historic 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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