National Park Service
U.S. Department of the Interior

**Lake Chelan National Recreation Area • Washington**
**North Cascades National Park Service Complex**

# Draft Stehekin River Corridor Implementation Plan Draft Environmental Impact Statement

## North Cascades National Park Service Complex: Lake Chelan National Recreation Area

**August 2010**

**Draft Stehekin River Corridor Implementation Plan**
**Draft Environmental Impact Statement**
**Lake Chelan National Recreation Area**
Prepared by
North Cascades National Park Service Complex
Pacific West Region
National Park Service, U.S. Department of the Interior

***Lead Agency*: National Park Service, U.S. Department of the Interior**
***Cooperating Agency*: Federal Highway Administration, U.S. Department of Transportation**


# ABSTRACT

## Description

Recent major floods on the lower Stehekin River are threatening National Park Service (NPS) facilities and natural resources within Lake Chelan National Recreation Area (NRA). Because of the current impacts and future risks associated with these unprecedented conditions, the purpose of this implementation plan is to enable the NPS to meet the goals and direction provided in the 1995 Lake Chelan NRA General Management Plan (GMP).

The NPS and FHWA have identified a need to evaluate comprehensive and sustainable management strategies and linked public-private actions to address the consequences of flooding. This implementation plan is needed to address several interrelated issues, including to (1) respond to the increased magnitude and frequency of flooding, (2) implement and clarify 1995 GMP guidance, (3) sustain public facilities while protecting natural resources, (4) manage limited funding, and to (5) respond to private land-related concerns.

## Summary of Alternatives

*Alternative 1*: No Action (Continue Current Management Practices and Existing Plan Implementation). This alternative would maintain the Stehekin Valley Road in its current alignment, including raising it through McGregor Meadows. Administrative facilities in the floodplain would be relocated near the airstrip as called for by the GMP. Priorities from the 1995 Land Protection Plan would continue to be followed. Erosion protection measures would be implemented at one site but could eventually be implemented at many sites.

*Alternative 2*: At-Risk Public Facilities Removed from Channel Migration Zone Where Possible; More High-Priority Land Acquisition in Channel Migration Zone (Preferred). This alternative would reroute the Stehekin Valley Road out of the floodplain / channel migration zone around McGregor Meadows and the Lower Field. Administrative facilities in the floodplain would be relocated near the airstrip. New land protection priorities would be identified through the revised Land Protection Plan. New campgrounds and a new raft takeout would be designated. The shooting range would be closed. Erosion protection measures would be implemented at three erosion protection sites.

*Alternative 3*: At-Risk Public Facilities Removed from Channel Migration Zone in Most Areas; Same Land Acquisition as in Alternative 2. This alternative would reroute the Stehekin Valley Road out of the floodplain / channel migration zone around McGregor Meadows. Administrative facilities in the floodplain would be relocated near the airstrip. New land protection priorities would be identified through the revised Land Protection Plan. New campgrounds would be designated. Erosion protection measures would be implemented at five erosion protection sites.

*Alternative 4*: At-Risk Public Facilities Removed from Channel Migration Zone in Some Areas; Less High-Priority Land Acquisition in Channel Migration Zone. This alternative would maintain the alignment of the Stehekin Valley Road, including raising it through McGregor Meadows. Administrative facilities in the floodplain would be relocated near the airstrip. New land protection priorities would be identified through the revised Land Protection Plan. New campgrounds and a new raft takeout would be designated. Erosion protection measures would be implemented at seven erosion protection sites.

Public comments on this DEIS will be accepted for 90 days and must be postmarked no later than December 11, 2010. For further information, please write to Palmer L. Jenkins, Superintendent, Attn: Stehekin River Corridor Implementation Plan DEIS, North Cascades National Park Service Complex, 810 State Route 20, Sedro-Woolley, Washington 98284-1239 or call the superintendent‟s assistant at (360) 854-7201.

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# ii. Executive Summary

This Draft Environmental Impact Statement (DEIS) analyzes a range of alternatives (management actions) to respond to the increased magnitude and frequency of flooding in the Stehekin River corridor within Lake Chelan National Recreation Area (Lake Chelan NRA or recreation area). The differences among the alternatives are primarily related to the way different management strategies are applied. These strategies are focused on the floodplain / channel migration zone, land use, and land acquisition and exchange.

The Alternatives (1 - 4) are based on the purpose and need for the project and conform to existing laws, policies, and planning documents, including the National Park Service (NPS) Omnibus Management Act (Public Law 105-392) and the Lake Chelan National Recreation Area General Management Plan / Environmental Impact Statement (GMP/EIS) (NPS 1995a).

The DEIS analyzes the potential environmental impacts that could result from the alternatives considered, including:

- Alternative 1: No Action (Continue Current Management Practices and Existing Plan Implementation)
- Alternative 2: At-Risk Public Facilities Removed from Channel Migration Zone Where Possible; More High-Priority Land Acquisition in Channel Migration Zone (Preferred)
- Alternative 3: At-Risk Public Facilities Removed from Channel Migration Zone in Most Areas; Same Land Acquisition as in Alternative 2
- Alternative 4: At-Risk Public Facilities Removed from Channel Migration Zone in Some Areas; Less High-Priority Land Acquisition in Channel Migration Zone.

This DEIS has been prepared to satisfy the requirements of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190, 42 U.S. C. 4321 - 4347, as amended), including the Council on Environmental Quality (CEQ) regulations found at 40 CFR 1500 - 1508 and other applicable laws; NPS *Management Policies 2006* (NPS 2006a); the NPS NEPA *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (Director's Order 12) and handbook (NPS 2001a); and other management directives. This DEIS facilitates compliance with Section 106 of the National Historic Preservation Act and its implementing regulations (36 CFR Part 800), Section 7 of the Endangered Species Act, and other applicable laws and executive orders enacted for the protection of the environment.

This DEIS together with public and agency comments will be used to prepare a final environmental impact statement, which will then be used to support a Record of Decision for the proposed action (whichever alternative [or parts thereof] is selected).

## Project Area Location

The project area includes the lower Stehekin Valley, from High Bridge to the head of Lake Chelan, including Weaver Point. No actions are considered in adjacent wilderness which begins above about 1,640 feet elevation in the lower valley (Figure ii-1: *Project Area—Lower Stehekin Valley* and Figure ii-2: *Existing Conditions*).

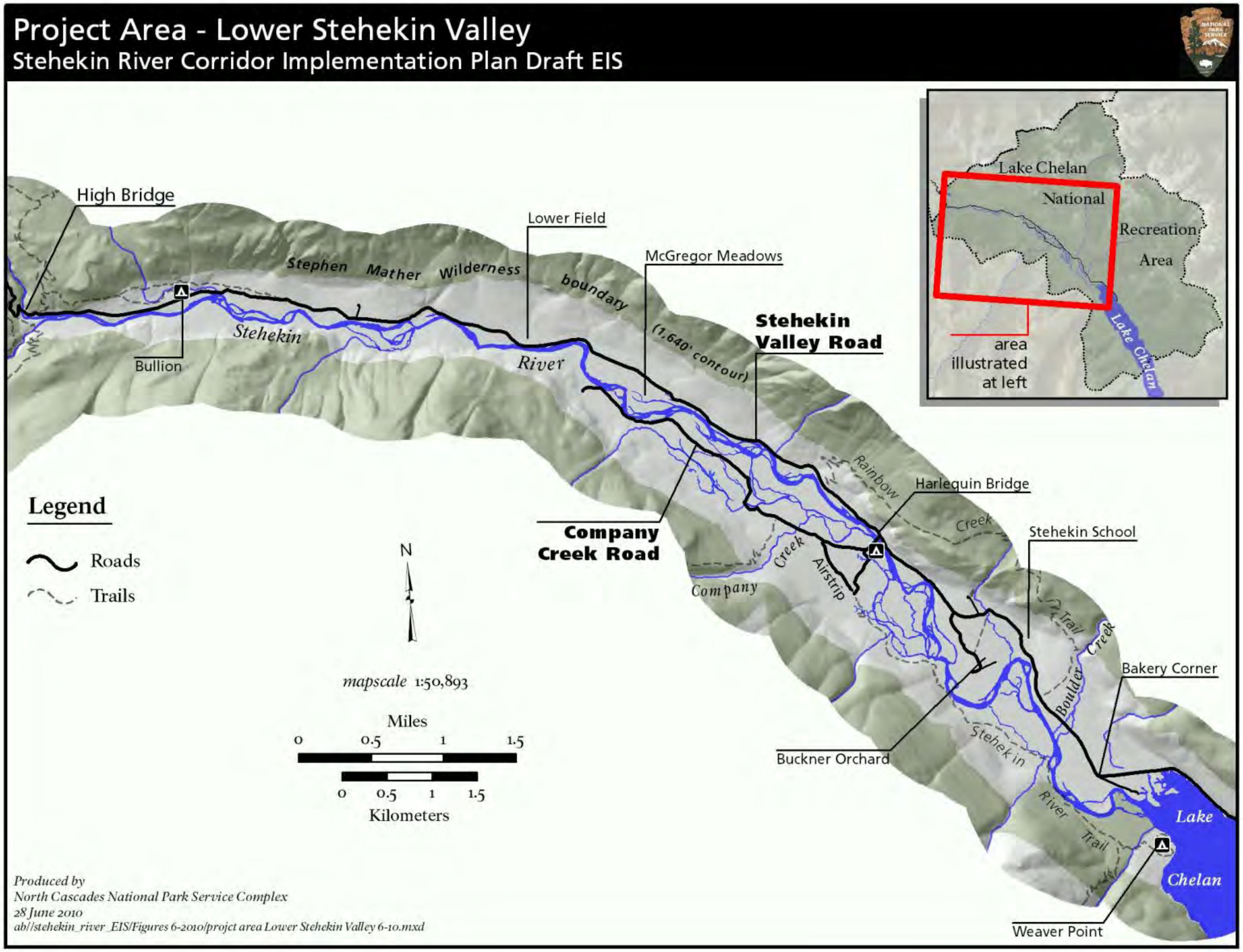


**Figure ii-1: Project Area – Lower Stehekin Valley**

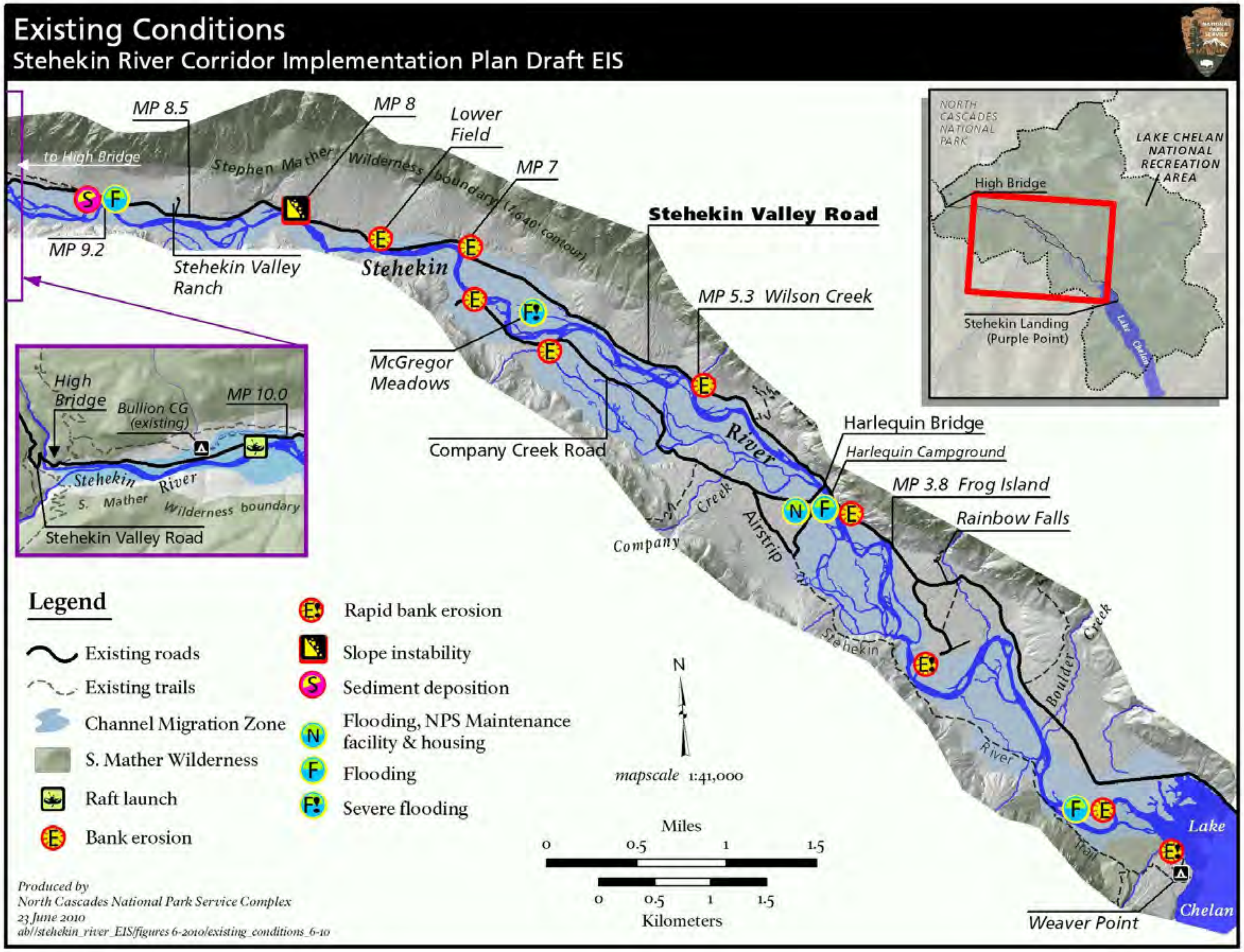


**Figure ii-2: Existing Conditions**

## SUMMARY: PURPOSE OF AND NEED FOR MANAGEMENT ACTION

Recent major floods and resultant channel changes on the lower Stehekin River have intensified flood and erosion threats to NPS facilities and are impacting natural resources within Lake Chelan NRA. The three largest recorded floods on the Stehekin River since 1911 have occurred within the past 15 years, and in response, the NPS has spent more than $3 million to protect public roads and facilities and to repair flood damage. Roads, visitor facilities, and private development once thought to be safe from the river are now threatened. Because of the current impacts and future risks associated with these unprecedented conditions, the primary purpose of this implementation plan is to enable the NPS to meet goals and direction provided in the 1995 Lake Chelan NRA GMP (NPS 1995a). Goals for this plan include the following:

- Sustainably operate and maintain NPS administrative facilities, public access (roads and trails), and campgrounds;
- Protect water quality, scenic values, habitat, and natural processes of the Stehekin River; and
- Continue visitor services provided by the Stehekin Community, including those services and facilities found on private lands.

**Photo 1 – Private Cabin, Well, and Septic System Incorporated into Logjam at McGregor Meadows (2003)**

The NPS, the lead agency in the development of this DEIS, and the Federal Highway Administration (FHWA), the cooperating agency, have identified a need to evaluate comprehensive and sustainable management strategies and linked public-private actions to address the consequences of flooding. Floodplain utilization is embraced in this plan as the best approach for managing a flood-prone mountain river. This concept allows floodwaters to occupy the floodplain to achieve the benefits of slower, shallower flood water for all areas and is viewed as a sustainable approach over the long term. Consistent with past public-private partnerships on both sides of the river at McGregor Meadows and elsewhere in the valley, this plan seeks to develop new management strategies in partnership with private landowners where public and private concerns overlap. This implementation plan is needed to address several interrelated issues, which are to (1) respond to the increased magnitude and frequency of flooding, (2) implement and clarify 1995 GMP guidance, (3) sustain public facilities while protecting natural resources, (4) manage limited funding, and to (5) respond to private land-related concerns.

## Primary Issues

**(1) Respond to the Increased Magnitude and Frequency of Flooding**. Prior to the late 20th century, the Stehekin River was prone primarily to spring snowmelt flooding (Figure ii-3*: Magnitude and Timing of the Annual Peak Flood on the Stehekin River*). Since the 1970s, however, the Stehekin River has become prone to large fall rain-on-snow floods, which rise quickly and occur from mid-October through December. Hydrologic data collected on the river since 1911 confirm the significance of this shift, as analyzed by the U.S. Geological Survey. The passage of severe floods in 1995, 2003, and 2006 has led to significant changes in the Stehekin River channel, and redefined the boundaries for the 100-year flood. The NPS has defined the channel migration zone, where the Stehekin River historically migrated in the valley over the past 1,000 years, as the effective floodplain regarding park management actions. As a result of this new flood regime, recreational and administrative facilities and developments once thought to be safe from the river are now threatened by flooding and bank erosion, while other sites in the floodplain have been compromised by larger, more frequent floods. Until now, the NPS has addressed problems on a case-by-case basis throughout the valley with the passage of each of these large floods.

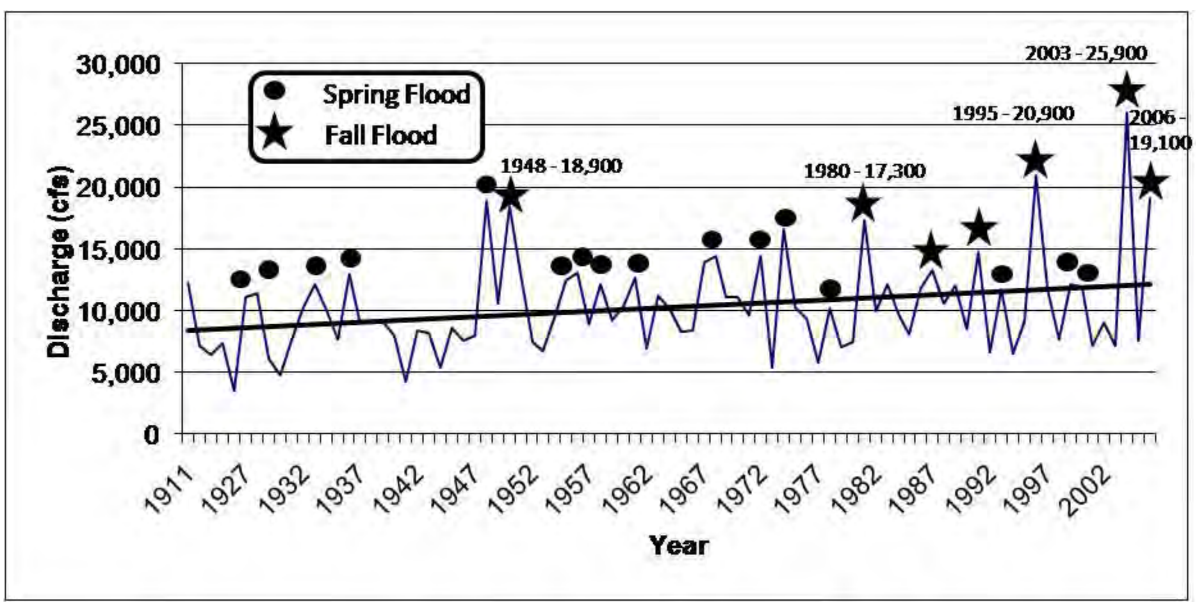


**Figure ii-3: Magnitude and Timing of the Annual Peak Flood on the Stehekin River**

**(2) Implement and Clarify 1995 Lake Chelan NRA GMP Guidance**. The GMP provides broad management guidance for Lake Chelan NRA, as well as some specific prescriptions to mitigate the risks and consequences of flooding (NPS 1995a). As a programmatic document, the GMP lacks the specific management direction needed to respond to the current circumstances imposed by the recent floods. Specific actions called for in the GMP that would be implemented in this plan include replacement and relocation of the maintenance facility and NPS housing out of the floodplain (NPS Tracts 06-118, 06-104, 06-121, and 06-122), construction of the Lower Valley Trail and continued maintenance of vehicle access on the Stehekin Valley and Company Creek roads. This implementation plan is needed to inform the location, design, construction, and implementation of these actions. Guidance provided by the GMP needs to be updated and clarified to reflect the dramatic increase in woody debris since 1995 and recognition of the influence of Chelan County Public Utility District (Chelan PUD) operations on the level of Lake Chelan and the lower Stehekin River. This implementation plan is also needed to evaluate and publicly disclose the direct, indirect, and cumulative impacts of proposed actions on the resources and values of Lake Chelan NRA.

**(3) Sustain Public Facilities While Protecting Natural Resources.** Management action is needed to provide long-term use and access to administrative and recreation facilities. Despite erosion protection and flood protection efforts by the NPS and private landowners, bank erosion continues to threaten public and private property. Channel changes have increased the rate of erosion and frequency of flooding at some sites, while decreasing erosion rates at others. Integrated management actions such as facility replacement and relocation, site-specific bank hardening, and limited manipulation of woody debris in the Lake Chelan backwater zone now need to be considered to ensure the long-term sustainability of infrastructure and protection of resources. Management of large wood and proliferation of bank-protection measures have the potential to impact federally- and state-listed species and to increase the spread of nonnative plants. These conditions underscore the need for updated assessment of erosion and flood protection measures in the lower Stehekin Valley.

**(4) Manage Limited Funding**. The NPS has spent more than $3 million to react to recent flood damage and new threats on an event-by-event basis to maintain vehicle access on the Stehekin Valley and Company Creek roads. A comprehensive and integrated set of strategies and tactics to meet the goals of the GMP and to mitigate the risk and impacts from flooding is urgently needed to enable the NPS to use limited funds for the maximum benefit of Lake Chelan NRA. Without this comprehensive approach, the NPS would continue to respond on a case-by-case basis, which costs more and could threaten natural resources and public safety.

**(5) Respond to Private Land-Related Concerns**. Lake Chelan NRA includes approximately 417 acres of private land, much of which lies within the floodplain and channel migration zone of the Stehekin River. Developments at McGregor Meadows and near the river mouth are particularly vulnerable because of their density and their location in more active river reaches. These sections of the river have extensive new gravel deposits and rapidly growing logjams as a result of recent floods. The high monetary and environmental costs of bank-protection and flood-mitigation measures continue to threaten long-term sustainability of recreation area resources and private property. At the river mouth, the accumulation of logs in the backwater zone of Lake Chelan has led to deeper floodwater in parts of the floodplain. The recent flooding has hastened channel migration, damaged or destroyed several cabins, incorporated debris and effluent from septic systems into the river, and increased the flood risk to private lands previously not threatened by flooding. The NPS is concerned that these circumstances will continue to adversely affect Lake Chelan NRA and Stehekin River natural resources and values. The primary means by which the NPS can address this concern is through a land exchange/acquisition program (Land Protection Plan (LPP)). The *Lake Chelan National Recreation Area Land Protection Plan* (NPS 1995b) identifies and prioritizes private lands for acquisition or exchange from willing sellers. Last updated in 1995, this plan is being revised through this DEIS to address new river-channel and floodplain conditions and to create new funding opportunities to help protect Lake Chelan NRA and the Stehekin Community. In conjunction with this implementation plan, the Land Protection Plan has been revised to reflect the new river channel and flood conditions along the Stehekin River and new criteria for prioritizing land acquisition have been developed in response to these conditions. The revised Land Protection Plan is incorporated into Alternatives 2 - 4 in this DEIS and can be found in Appendix 13 (detached).

**Photo 2 – Rafters on the Stehekin River**

## DECISION TO BE MADE

NEPA requires the documentation and evaluation of potential impacts resulting from federal actions on lands under federal jurisdiction. An EIS discloses the potential environmental consequences of implementing the proposed action and other reasonable and feasible alternatives. NEPA is intended to provide decision makers with sound knowledge of the environmental consequences of the alternatives (or parts thereof) available to them. In this case, the superintendent of Lake Chelan NRA (North Cascades National Park Service Complex) and the Pacific West Regional Director are faced with deciding which alternative to implement from the SRCIP to most effectively implement the 1995 GMP, to sustainably operate and maintain Lake Chelan NRA administrative and visitor facilities, and the private Stehekin Community and the visitor services it provides.

## Background

This SRCIP is a response to the effects of the increased frequency and magnitude of flooding on the Stehekin River and the adverse effects this flooding has had on NPS infrastructure and private lands in the lower Stehekin Valley.

The following key characteristics of the Stehekin Valley require careful planning to avoid the effects of repeated flood damage:

- The flood prone nature of the Stehekin River, which is due to its geography, watershed shape, and steep slopes (includes the potential for the formation and sudden failure of debris dams in the narrow canyons above High Bridge)
- Channel instability from the transport of large amounts of gravel, water, and large wood
- A shift in the last 30 years from spring floods to larger, more frequent, fall floods
- A history of river manipulation, including the Lake Chelan Dam, and the addition of erosion protection measures to the river over the last 20 years—riparian resources and water quality have been adversely affected as destroyed cabins, effluent from septic systems, and other debris are incorporated into the river during floods

### SUMMARY: MANAGEMENT ALTERNATIVES

The following description summarizes the differences among the management alternatives. A detailed comparison of the alternatives is found in Chapter II: Management Alternatives and in Table II-1: *Alternative Comparison Chart*. Illustrations of the alternatives are found in Figures ii-4 through ii-10.

- Alternative 1: No Action (Continue Current Management Practices and Existing Plan Implementation)
- Alternative 2: At-Risk Public Facilities Removed from Channel Migration Zone Where Possible; More High-Priority Land Acquisition in the Channel Migration Zone (Preferred)
- Alternative 3: At-Risk Public Facilities Removed from Channel Migration Zone in Most Areas; Same Land Acquisition as in Alternative 2
- Alternative 4: At-Risk Public Facilities Removed from Channel Migration Zone in Some Areas; Less High-Priority Land Acquisition in Channel Migration Zone.

## Introduction

Alternatives 2 - 4 embrace the concept of floodplain utilization to varying degrees. In this concept, floodwaters would be allowed to spread out across the floodplain, rather than being constrained by dikes or levees. Floodplain utilization is proposed to reduce flood damage in any one area during the largest events.

All of the action alternatives also identify integrated actions that are sustainable. Past integrated actions undertaken by the NPS include private-public partnerships to maintain floodplain utilization in McGregor Meadows (1998), the ―1948" channel (2007), and upper Company Creek Road (2007). In this plan, integrated solutions to erosion and floodplain utilization include the proposed actions at Boulder Creek, the Stehekin River Mouth, and using the Land Protection Plan revision to ease threats to private property and the integrity of the Stehekin River.

On public land, Alternatives 2 - 4 attempt to avoid the channel migration zone, rather than just the 100-year floodplain. This more conservative approach is used because of the observed rapid changes in Stehekin floodplain boundaries during large floods; the high cost of computer models to determine flood elevations to map accurate floodplain boundaries; and the inaccuracy of these models.

The alternatives conform to recreation area policies in the Lake Chelan GMP, which call for removing public and administrative facilities from the floodplain. Options for private development in the floodplain include exchange of land with the NPS, purchase of private property out of the floodplain, elevating cabins, or construction of a variety of physical features to reduce the impacts of flooding (see Appendix 7: Army Corps of Engineers (ACOE) Advanced Flood Protection Measures). Other alternatives, such as construction of additional levees or dikes or dredging, were considered but were dismissed because they would have unacceptable impacts on the Stehekin River floodplain, would result in more ecological damage, or would require repeated, costly management actions (see ―Alternatives and Actions Considered but Dismissed" below and in Chapter II).

Because all alternatives involve various treatments of the Stehekin Valley Road, for which the FHWA would provide the necessary funding, design, and construction expertise, the FHWA is participating as a cooperating agency in the development of this DEIS.

## Summary of Actions Common to All Alternatives (1 - 4)

Several actions in this plan are common to all Alternatives (1 - 4) because they were identified in the GMP. These actions would also protect public facilities or support the concept of floodplain utilization (Figure ii-4: *Actions Common to All Alternatives*).

Actions called for by the 1995 Lake Chelan NRA GMP that would be implemented by all alternatives include replacement and relocation/construction of the NPS maintenance compound to the north end of the airstrip; replacement and relocation/construction of administrative housing in the same area; creation of a Lower Valley Trail that connects Stehekin Landing (Landing) to High Bridge and which is also connected to the Stehekin River Trail via a footbridge; and the ongoing use of willing seller-willing buyer land acquisition and exchange to remove development from the Stehekin River floodplain. Actions involving administrative and maintenance facilities will require additional site-specific environmental review and are not analyzed in detail in this document.

The Company Creek Road would be maintained in its existing alignment and existing erosion protection measures along the Stehekin Valley and Company Creek roads would be maintained, including the 400-foot-long levee constructed in the 1980s. The levee has virtually no effect on floodplain utilization because of its short length and location and is necessary to maintain the Company Creek Road in place as called for by the GMP.

The Stehekin Valley Road at Wilson Creek, Milepost 8.0, and Frog Island would be protected in place in all alternatives because these locations have severe erosion problems and no viable reroutes. Actions to protect these areas, however, would vary among the alternatives. Grade-control structures designed to maintain sheet flow in floodplains during large floods at Milepost 7.0 and 9.2 on the Stehekin Valley Road and along the upper Company Creek Road would also be maintained. These structures were installed by private-public partnerships in 1998 and 2008 and are consistent with the concept of floodplain utilization because they protect the road from being occupied by the river. Consistent with the current GMP, logjams could be manipulated on the Stehekin River to protect Harlequin Bridge and the roads.

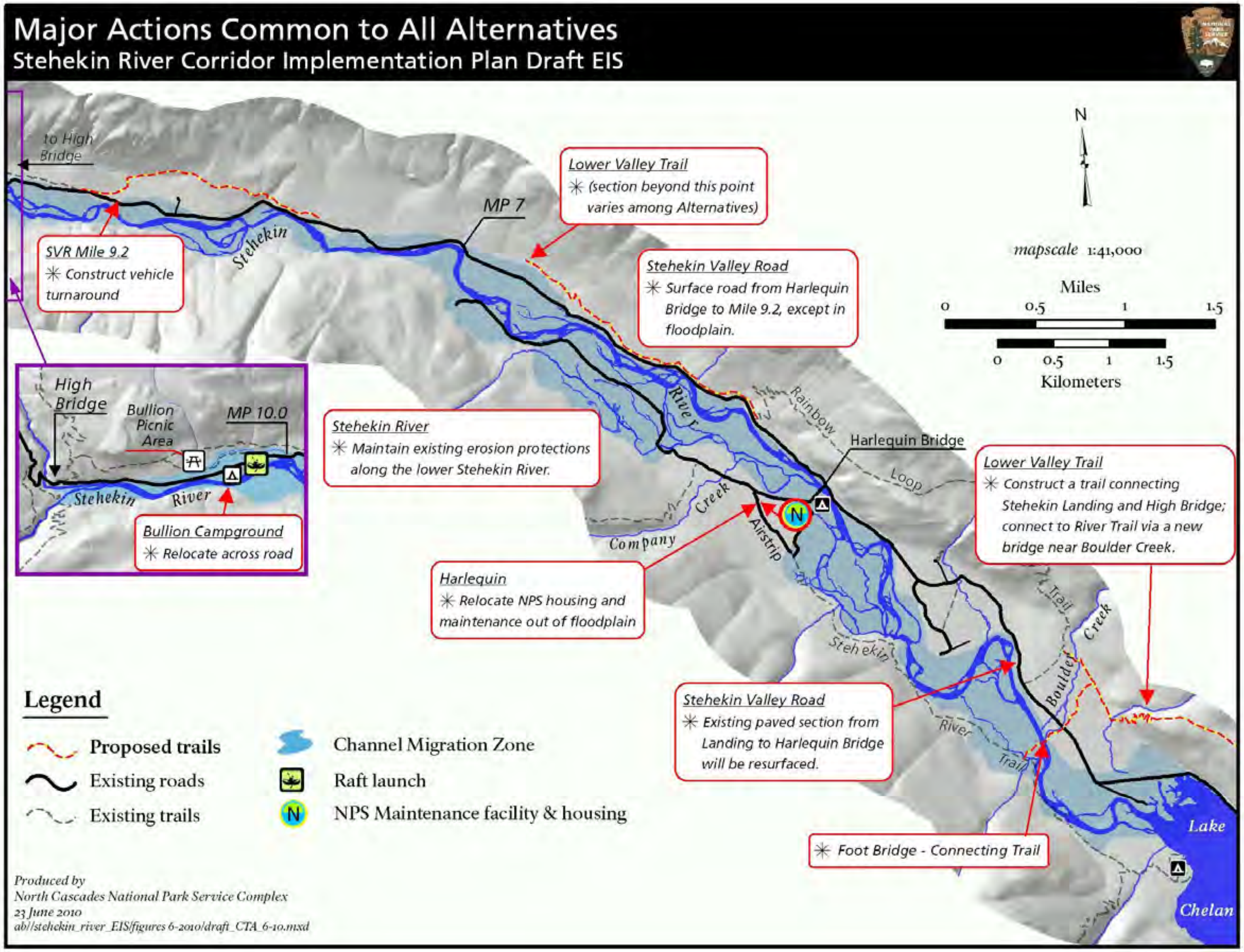


**Figure ii-4: Actions Common to All Alternatives**

**Recreational Facilities**: Bullion Camp would be relocated downstream and across the road to mitigate safety concerns associated with hazard trees in the current camp. Day use, however, would be retained at the former Bullion Camp.

### Alternative 1: No Action (Continue Current Management Practices and Existing Plan Implementation)

This alternative would continue existing management practices and improvements called for by existing plans (Figure ii-5: *Major Actions Proposed in Alternative 1*). Foremost among these would be continuing implementation of the GMP, as described previously under ―Actions Common to All Alternatives (1 - 4)" and the 1995 Land Protection Plan.

**Photo 3 – Stehekin Valley Road in McGregor Meadows during the 2006 Flood**

Implementation of the 1995 LPP would continue using existing criteria and potential exchange lands. Decisions regarding land acquisition priorities would continue to be based on properties identified based on currently out-of-date floodplain boundaries and protection of scenic resources (areas of high visual sensitivity) along the Stehekin Valley Road. Both the Stehekin Valley Road and the Company Creek Road would be retained in their existing alignments.

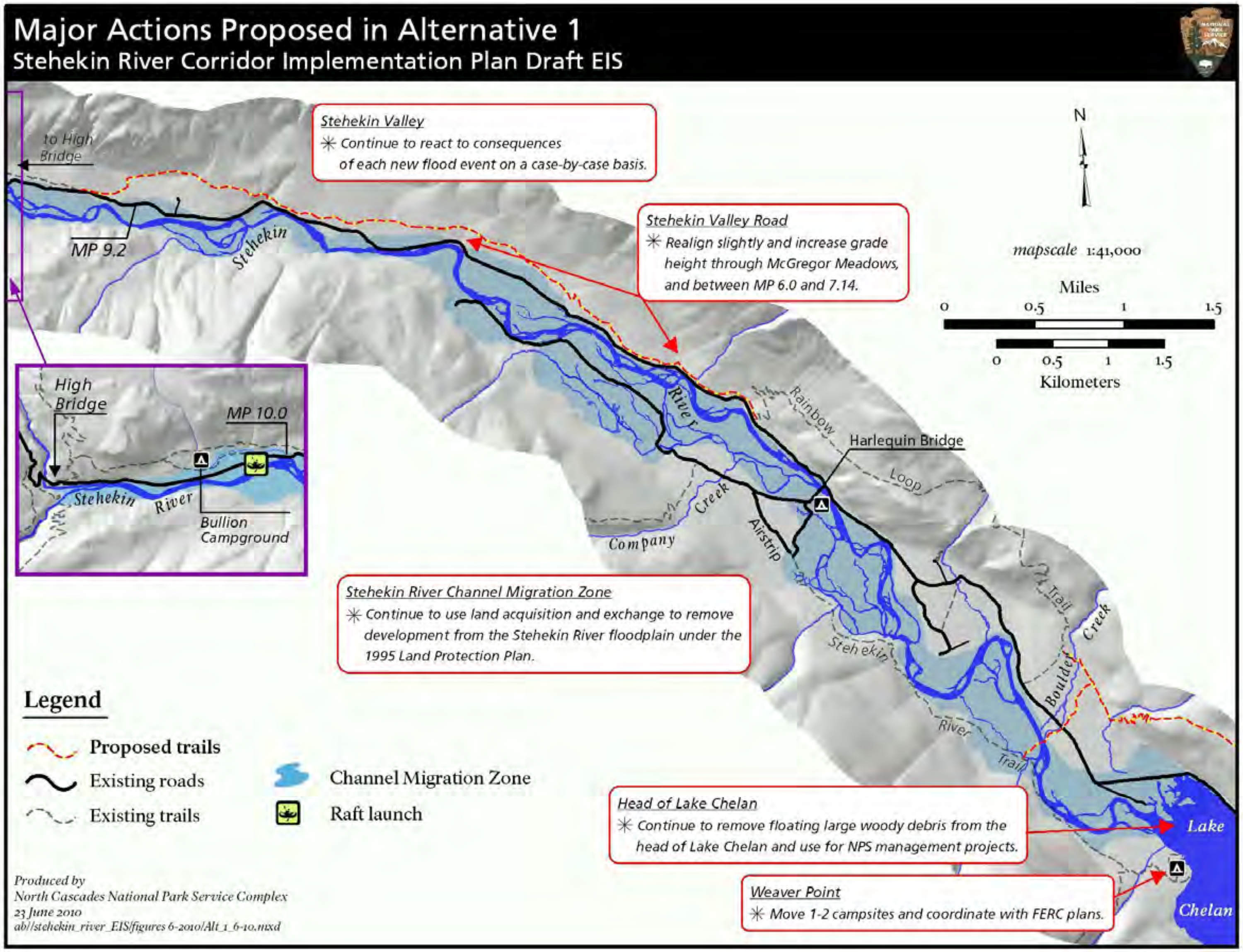


**Figure ii-5: Major Actions Proposed in Alternative 1**

Stehekin Valley Road Improvement Project actions for the Stehekin Valley Road would include rehabilitation and surfacing of the road with an asphalt chip seal for 4.9 miles from Harlequin Bridge to the winter turnaround (Milepost 9.2), except for areas within the floodplain. There would be slight realignment (between Mileposts 6.0 and 6.5) and two grade increases (from Milepost 6.25 to 6.53 and from Milepost 6.95 to 7.14) using nearly 5,600 cubic yards of fill through McGregor Meadows, as well as implementation of erosion protection measures at Wilson Creek (NPS 2005). To retain the road, Alternative 1 would also include maintenance of, but not major improvements to, existing erosion protection measures along the lower Stehekin River. Routine maintenance actions, including snow removal; spring opening; unpaved road grading, shaping, and repair; paved road asphalt patching; ditch clearing; culvert cleaning; vegetation maintenance; and sign replacement would also continue as needed. It is anticipated that existing pavement would be resurfaced during or shortly after road projects above Harlequin Bridge.

**Photo 4 – Floor of NPS Maintenance Shop after 2003 Flood**

In Alternative 1, unlike the other alternatives, the NPS would continue to react to the consequences of each new flood event on a case-by-case basis, producing individual environmental assessments as needed to implement management actions.

Floating large woody debris could continue to be removed from the head of Lake Chelan and used for NPS management projects. Individual pieces could also be turned or trimmed (subject to NPS approval) to maintain safe rafting in the Stehekin River, while logjams could only be removed to protect Harlequin Bridge and public roads.

Parts of the Stehekin Valley Road and Company Creek Road would continue to lie adjacent to and within the floodplain / channel migration zone of the Stehekin River. Over time, it is anticipated that this would continue to require the NPS to install additional erosion protection measures in the river (e.g., rock barbs) to protect roads and public facilities. There would continue to be limited improvements to visitor and administrative facilities within the lower Stehekin Valley to implement the GMP. In Alternative 1, rehabilitation of the Stehekin Valley Road would be implemented upon approval of this DEIS. Replacement and relocation of the maintenance facility and NPS housing (NPS Tracts 06-118, 06-104, 06-121, and 06-122) would be implemented following site specific environmental analysis and approval of a tiered environmental assessment.

In Alternative 1 as in other alternatives, private landowners could continue to implement the U.S. Army Corps of Engineers ―Advanced Flood Protection Measures" (Appendix 7), including elevating cabins or constructing measures to protect private structures from the largest floods.

Recreational opportunities associated with the Stehekin River would continue, including camping, rafting, and hiking. As noted above, the Lower Valley Trail would be constructed to link the Landing with High Bridge, including connecting it to the Stehekin River Trail with a bridge near the mouth of Boulder Creek. In this alternative the trail would use 6.1 miles of existing trail and would require 6.3 miles of new trail to be constructed.

## Elements Common to All Action Alternatives (2 - 4)

In addition to the actions that would be common to Alternatives 1 - 4, there are a variety of elements common to Alternatives 2 - 4, including proactive measures to protect administrative and public facilities from the future consequences of flooding.

**Erosion Protection Measures**: A logjam and new grade-control structure would be installed near Milepost 2.0 (Boulder Creek) to maintain sheet flow in the floodplain. Erosion protection measures would also be undertaken near the river mouth, Milepost 3.8 (Frog Island), Weaver Point, and Milepost 5.3 (Wilson Creek), though specific actions would vary by alternative.

The raveling slope at Milepost 8.0 would also be stabilized by laying back the uppermost part of the slope brow, which produces most of the large rocks that fall onto the road. A rock wall (100 - 150 feet long and 3 - 8 feet high) would also be added at the base of the slope.

Large woody debris could be manipulated within the Lake Chelan backwater zone (0.25 mile from the head of the lake up the Stehekin River) if it posed a threat to the Stehekin Valley Road or water quality. Under certain conditions, it could also be used for agency-permitted erosion protection measures.

In addition, because there is a large volume of wood now in the river system and because of the backwater influences of Lake Chelan, there is the potential for a large logjam to cause flooding of the densely developed area near the Bakery or to preclude access on the Stehekin Valley Road. Under these emergency conditions, large logjams in this area could be manipulated to remove the threat consistent with the GMP. As with other use of large woody debris, the wood taken from this area could only be used in the channel migration zone for erosion protection and/or restoration projects.

**Restoration**: Restoration of a 300-foot-long riparian strip along the Stehekin River at Buckner Homestead lower hayfield and pasture and along the Lower Field would occur, as would bioengineering (layered planting of native shrubs) associated with erosion protection measures.

**Private Property Access**: If access to private property was compromised by river encroachment, the NPS would work with private landowners on a case-by-case basis to evaluate alternative access.

**Land Protection Plan**: The NPS would make new exchange lands available through the revised Land Protection Plan (Figure ii-6: *Potential Exchange Lands in the 1995 and Revised Draft Land Protection Plan*).

**Recreational Facilities**: New individual camping would occur near Rainbow Falls and group camping would occur at the Purple Point Horse Camp.

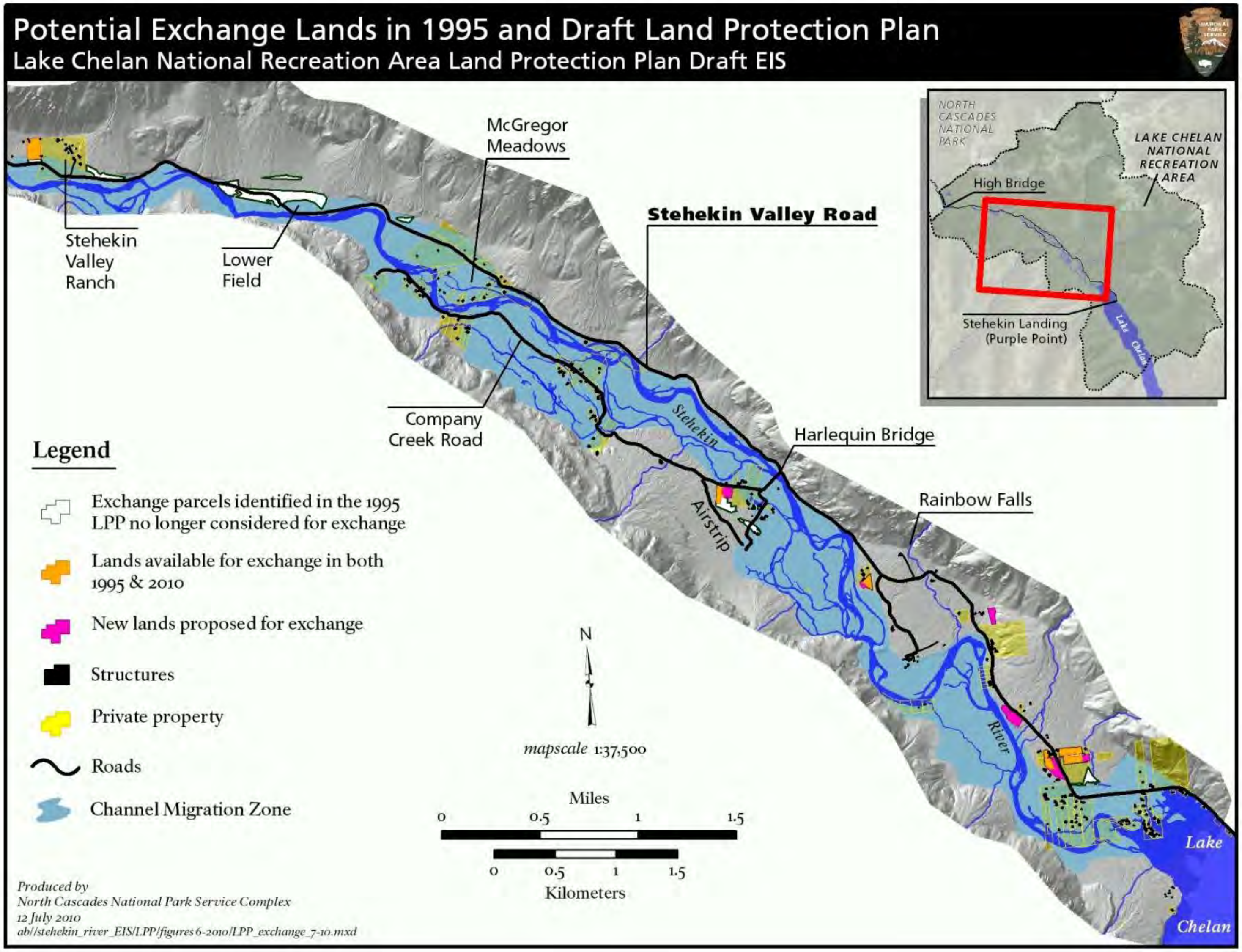


**Figure ii-6: Potential Exchange Lands in the 1995 and Revised Draft Land Protection Plan**

## Alternative 2: At-Risk Public Facilities Removed from the Channel Migration Zone Where Possible; More High-Priority Land Acquisition/Exchange in the Channel Migration Zone (Preferred)

Compared to other alternatives, Alternative 2 would allow the Stehekin River the most space to utilize its floodplain and move within its natural channel migration zone over time (Figure ii-7: *Major Actions Proposed in Alternative 2*). Proposed new bank stabilization on the left bank would be installed at three new sites to protect the road, including the Stehekin River mouth, Milepost 3.8 (Frog Island), and Milepost 5.3 (Wilson Creek). At Mileposts 3.8 and 5.3 the river is at the edge of the channel migration zone, and relocation into steep cliffs is not feasible. As in other alternatives, Alternative 2 would also implement GMP provisions (including maintenance facility and housing relocation and construction of the Lower Valley Trail); however, there would be a change in the use of large woody debris to implement erosion protection measures. Alternative 2 would include limited use of wood from logjams in the river mouth area, where it is influenced by backwater from Lake Chelan. Such use would only be from the tops of prescreened jams, and only if the jam would not be destabilized.

The revised LPP would be used to encourage relocation of private property from within the floodplain / channel migration zone to outside the channel migration zone, using management actions such as land exchange or land acquisition from willing sellers. Land protection priorities would identify specific properties that are most threatened by the Stehekin River as it migrates across its channel migration zone. Where if development at these sites were claimed by the river, debris from cabins, wells, and septic systems, including effluent, would be incorporated into the river. The criteria in the LPP used to identify NPS lands for potential exchange has been weighted more toward removing private development from the floodplain in Alternatives 2 and 3 than in Alternative 4 (see Appendix 11 for the priority ranking of private lands in Alternatives 2 and 3). New exchange parcels outside the channel migration zone would be made available, while some lands available for exchange in the 1995 GMP would no longer be available due to new or changed conditions.

The Stehekin Valley Road would be rerouted from Milepost 5.7 to 7.5 (Figure ii-8). An access road would be maintained into McGregor Meadows from Milepost 5.7 to 6.5, to the last parcel of private property (07-157), until it is no longer needed. A turnaround at Milepost 6.5 to Milepost 6.8, would continue to provide administrative access to the grade-control structures. From Milepost 6.8 to 7.5, the road would be rehabilitated as part of the Lower Valley Trail. The portions of the Stehekin Valley Road before and after the reroute would also be rehabilitated and surfaced with an asphalt chip seal. Under Alternative 2, there would also be a series of erosion protection measures to stabilize those sections of the Stehekin Valley Road that are at the edge of the channel migration zone and cannot be relocated without major slope removal or extensive new road construction. Woody debris from the tops of some logjams and from floating logs in Lake Chelan could also be made available to landowners (for agency-permitted erosion protection) under a permit system. The wood could only be used in the channel migration zone for erosion protection and/or restoration projects. This action would limit importation of large rock and acknowledges the large amount of wood currently on the river. Rock barbs would be constructed at Wilson Creek (two to three barbs) and Frog Island (one to two barbs). Three more barbs and a small logjam would be located at a key point on the left bank above the river mouth. One or two of the barbs would replace 100 feet of rip-rap, and the bank would be revegetated with native shrubs. Another logjam would be constructed near Boulder Creek atop a grade-control structure (avulsion sill) away from the bank of the river and back into the forest. At Weaver Point, bank stabilization would be coordinated with plans under development by Chelan PUD for recreation, erosion, and cultural resource management. Riparian restoration and/or bioengineering would enhance riparian vegetation along the bank, at the Lower Field, Buckner Homestead hayfield and pasture, Wilson Creek, Frog Island, and the river mouth.

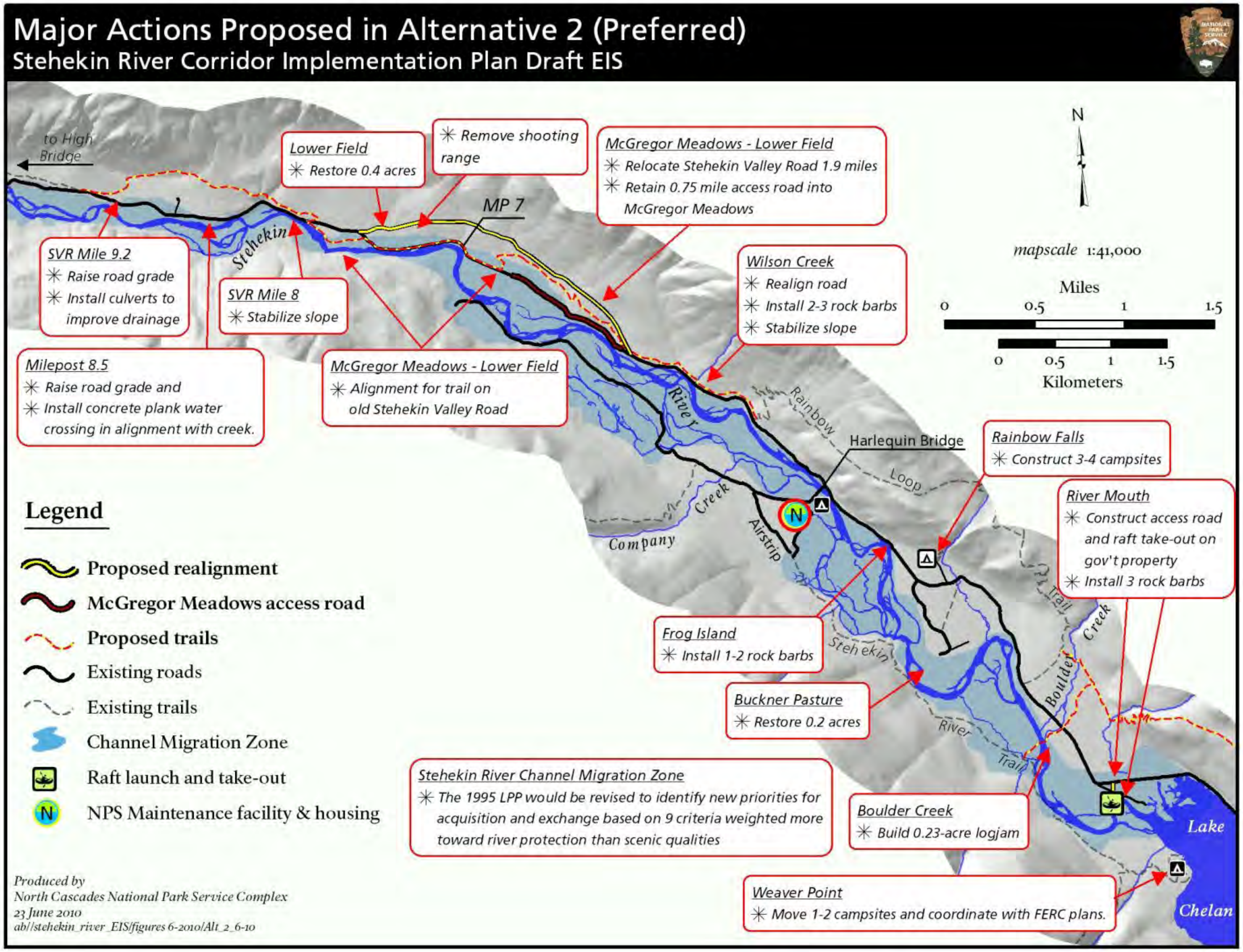


**Figure ii-7: Major Actions Proposed in Alternative 2**

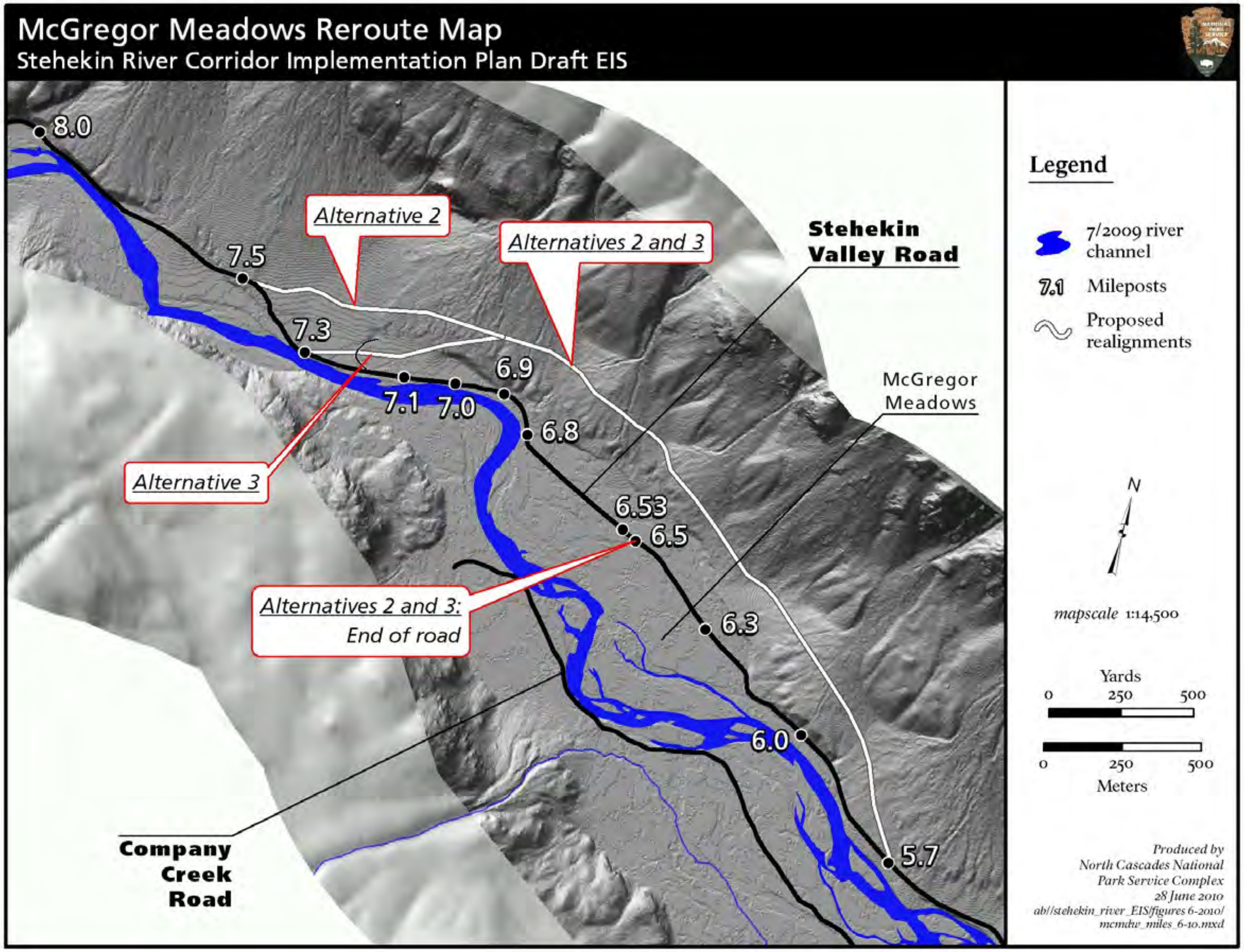


**Figure ii-8: McGregor Meadows Reroute Map**

Compared to Alternative 1, Alternatives 2 - 4 would involve some manipulation of woody debris within the Lake Chelan backwater zone (extending 0.25 mile from the head of the lake up the Stehekin River). In this area of the lower Stehekin River and Harlequin Bridge, large logjams that threatened public roads, water quality, public safety, and regular access to private property could be altered to relieve threats.

Recreational opportunities, including camping, rafting, and hiking associated with the Stehekin River would be enhanced. As in Alternative 1, the Lower Valley Trail would be constructed to link the Landing with High Bridge, including connecting it to the Stehekin River Trail. In this alternative (as in Alternative 3), fewer miles of new trail (4.6 miles) would be needed since the trail would use some former roadway (1.7 miles) and existing trail (6.2 miles). New group camping opportunities would be located at Purple Point Horse Camp to replace the group campsite at Harlequin when it is seasonally flooded. Three or four new individual sites would also be located near Rainbow Falls. In addition, a new raft takeout would be provided near the Stehekin River mouth, which would require a small new parking area and a 300-foot-long access road off of the Stehekin Valley Road. Because the shooting range is located along the proposed Lower Field reroute, it would be closed and restored. No replacement shooting range would be constructed.

### Alternative 3: At-Risk Public Facilities Removed from Channel Migration Zone in Most Areas; Same Land Acquisition/Exchange as in Alternative 2.

Alternative 3 would allow the Stehekin River slightly less room to move within its natural channel migration zone and therefore would include the use of different erosion protection measures than in Alternative 2 (with four barbs and five logjams, instead of six to eight barbs and two logjams) (Figure ii-9: *Major Actions Proposed in Alternative 3*). As in other alternatives, Alternative 3 would implement the GMP replacement and relocation of the maintenance facility and housing areas and construction of the Lower Valley Trail. Different erosion protection approaches were developed since the rock barbs and logjams have different benefits and installation impacts. The erosion protection measures increase from Alternative 2 through Alternatives 3 and 4, consistent with the overall degree to which each alternative constrains the river. As in Alternative 2, there would be a minor change regarding the use of woody debris, and the revised LPP would be used.

The reroute of the Stehekin Valley Road in Alternative 3 would be slightly shorter than the one proposed in Alternative 2. The reroute would begin at Milepost 5.7 and would end at Milepost 7.3 (Figure ii-8). With the shortening of the reroute, the portion of the existing road that borders Lower Field would be stabilized with riparian vegetation and rock barbs. As in Alternative 2, an access road from Milepost 5.7 to Milepost 6.5 would be retained up to the last private parcel in McGregor Meadows until it is no longer needed; and administrative access would also be maintained to Milepost 6.8 for maintenance of grade-control structures. From Milepost 6.8 to Milepost 7.3, the road would be rehabilitated as part of the Lower Valley Trail.

Four rock barbs would be constructed along the bank at Weaver Point (two barbs) and Lower Field (two barbs), while large logjams would be constructed at Weaver Point, near the Stehekin River mouth, at Boulder Creek (and avulsion sill), at Frog Island, and at Wilson Creek. Restoration and/or bioengineering (layered planting using native shrubs) would also occur in the same locations as in Alternative 2.

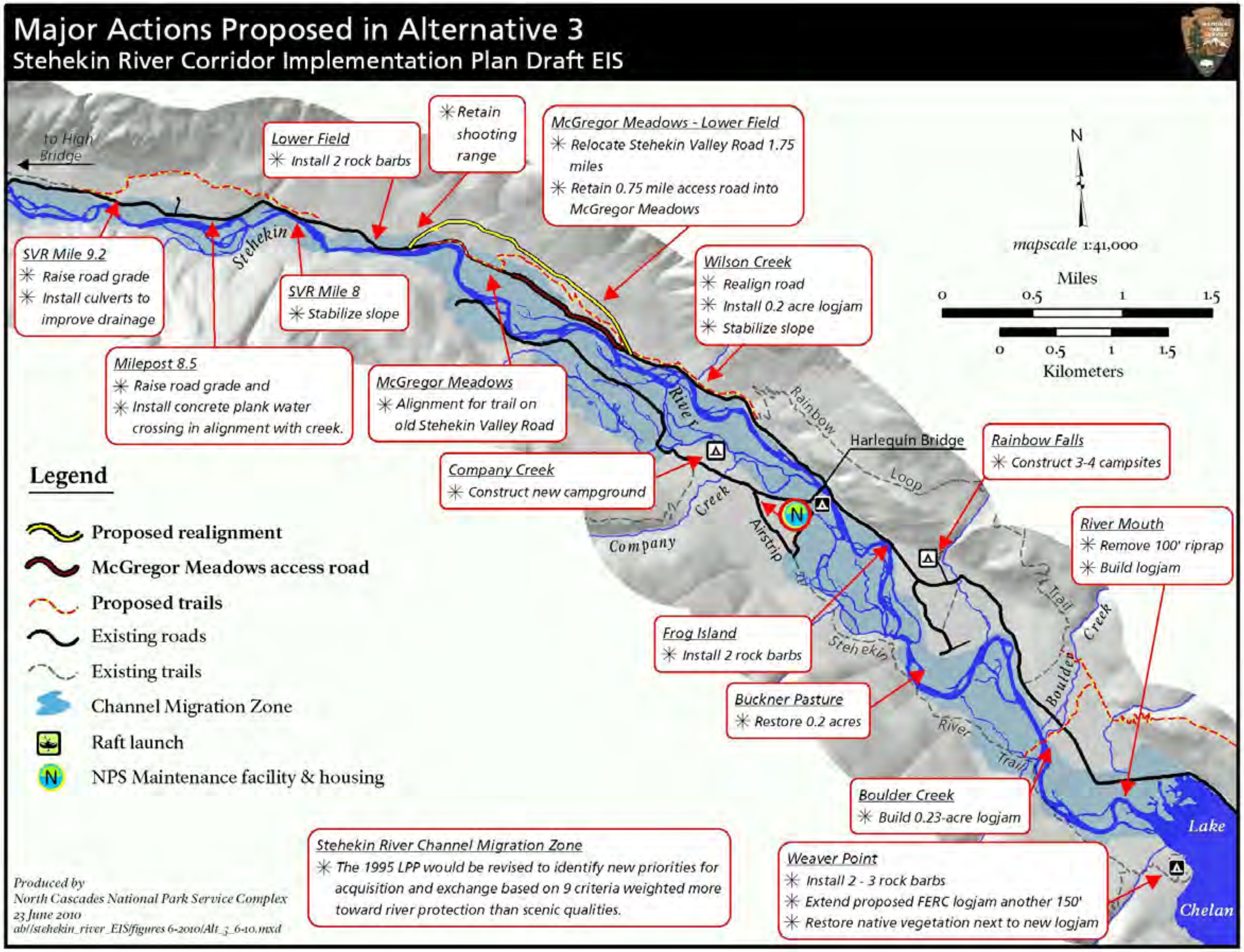


**Figure ii-9: Major Actions Proposed in Alternative 3**

Management of woody debris would be the same as in Alternative 2. Recreational improvements would be similar to Alternative 2; however, additional camping opportunities would also be provided at Company Creek at a previously disturbed site outside the Stehekin River channel migration zone, and no new raft takeout would be constructed near the Stehekin River mouth.

## Alternative 4: At-Risk Public Facilities Removed from Channel Migration Zone in Some Areas; Less High-Priority Land Acquisition in Channel Migration Zone

Compared to Alternative 1, Alternative 4 would allow for some additional movement of the Stehekin River within its channel migration zone, if private property was purchased or exchanged. If Alternative 4 was selected, the draft LPP (Appendix 13) would be revised to rank high priority lands per the criteria shown in Table II-15. Alternative 4 would constrain the movement of the Stehekin River from a large part of its floodplain through McGregor Meadows and at Lower Field (Figure ii-10: *Major Actions Proposed in Alternative 4*). Appendix 11 lists the priority ranking of private lands for Alternatives 2 and 3; Appendix 12 lists the priority ranking of private lands for Alternative 4. The LPP revision is different than in Alternatives 2 and 3. Land exchanges would be focused less on properties along the river, and more on sustaining the current development pattern. Because of this, there would be fewer parcels with a high priority for acquisition that would allow for their removal from the channel migration zone. Some private development in flood-prone areas near the river channel, however, would be considered for exchange or purchase. Actions associated with GMP implementation (including replacement and relocation of the maintenance facility and NPS housing and construction of the Lower Valley Trail) would be the same as in ―Actions Common to All Alternatives (1 - 4).”

As in Alternatives 2 and 3, there would be stabilization and riparian restoration of the bank along the Lower Field. As in Alternative 1, instead of a reroute around McGregor Meadows, Stehekin Valley Road would be raised in some locations to minimize flood damage, and 4.9 miles of the road would be rehabilitated and paved between Harlequin Bridge and the winter turnaround.

There would be additional placement of barbs and bioengineering for erosion protection measures implemented along the Stehekin River, not only at the Lower Field, but also near Milepost 7.0 and Milepost 9.2. To maintain the Stehekin Valley Road in its existing alignment, Alternative 4 would have the greatest number of locations where erosion protection measures would be undertaken. Rock barbs would be constructed at Weaver Point (two barbs), Stehekin River mouth (three barbs), Frog Island (two barbs), Wilson Creek (two to three barbs), Lower Field (two barbs), Milepost 7.0 (two barbs), and Milepost 9.2 (three barbs), and a large logjam/avulsion sill would be constructed at Boulder Creek along the bank extending into the forest. Riparian restoration and/or bioengineering (layered planting associated with rock barbs or logjams) would also occur in the same locations as in Alternatives 2 and 3.

Use of woody debris would be the same as in Alternatives 2 and 3 (with both NPS and private, permitted use), except that woody debris could be used from the tops of prescreened logjams from areas below the Bullion raft launch, including at McGregor Meadows. (This is in contrast to Alternatives 2 and 3, which restrict taking logs from the river to below Boulder Creek in the Lake Chelan backwater zone.)

Recreational improvements would be the same as in Alternative 3 except there would be a raft launch in this alternative, as in Alternative 2. Construction of the Lower Valley Trail would be similar to that proposed in Alternative 1, with 6.1 miles of existing trail and 6.3 miles of new trail, but it would follow more sections of the existing road under this alternative.

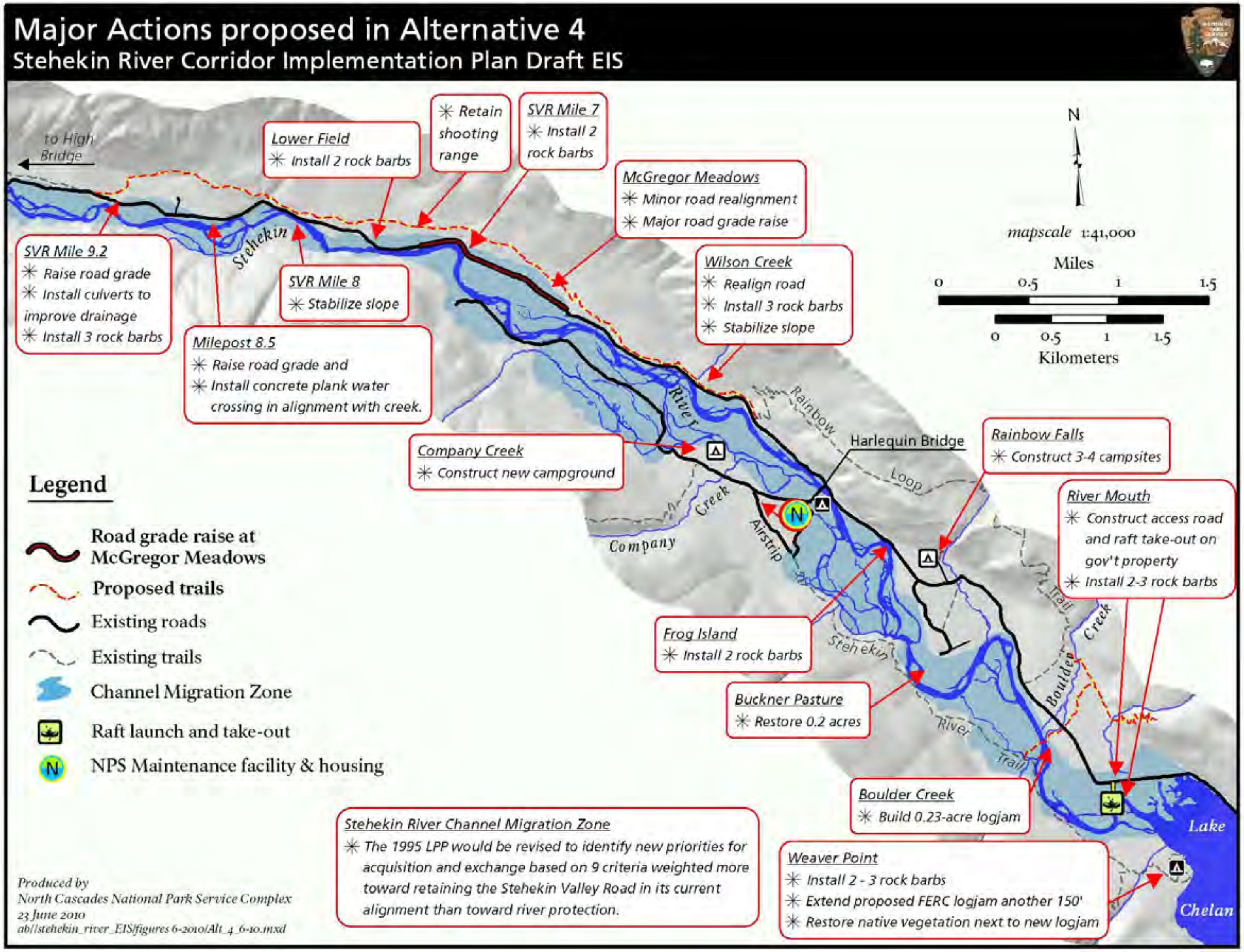


**Figure ii-10: Major Actions Proposed in Alternative 4**

## LIST OF ALTERNATIVES AND ACTIONS CONSIDERED BUT DISMISSED

Under NEPA,(40 CFR 1504.14 (a)) alternatives may be eliminated from detailed study based on the following reasons:

- Technical or economic infeasibility;
- Inability to meet project objectives or resolve need for the project;
- Duplication of other less environmentally damaging alternatives;
- Conflicts with an up-to-date valid plan, statement of purpose and significance, or other policy; and therefore, would require a major change in that plan or policy to implement; and
- Environmental impacts too great, in either a cumulative or site-specific sense.

The following alternatives or variations were considered during the design phase of the project, but because they met one or more of the above criteria, they were rejected. Information about why these alternatives or actions were rejected is included in Chapter II (D: Alternatives and Actions Considered but Dismissed) of this document:

- Allow use of the airstrip for exchange to relocate private property outside of the floodplain.
- Implement additional flood protection (bank hardening) measures, such as rip-rap or levees along the banks of the Stehekin River to prevent flooding.
- Implement additional erosion protection measures at Buckner Homestead hayfield and pasture
- Exchange lands to allow private landowners to establish or maintain flood/erosion protection.
- Take action as part of the plan to solely protect private property.
- Reroute the Road at Milepost 8.0.
- Reestablish the south side Stehekin Valley Road along the Company Creek Road alignment, including constructing a new bridge.
- The scope of the plan should include the entire Stehekin River Watershed, including the area above High Bridge.
- Sediment and large woody debris sources above High Bridge and/or in the whole Stehekin watershed should be evaluated for treatment.
- The Stehekin River should be contained within a channel to reduce flooding of private property and public facilities.
- The plan should include actions that would resolve issues in the whole lower valley.
- The goal of the plan should be to allow natural processes to occur unimpeded so that natural flooding and erosion can continue to occur without regard to its effect on facilities and private property.
- Plan alternatives should include consideration of rerouting the Company Creek Road.
- Excess materials, including large woody debris and excavated gravel generated by the plan should be used for other public and private projects in Stehekin.
- Use suitable gravel from Stehekin for projects in the valley instead of importing materials at high cost.

- Pile burning or consumptive use of large woody debris generated by the plan should be considered.
- The plan should consider changes to the *Sand, Rock and Gravel Plan* to allow use of gravel generated by plan actions.
- Gravel removal should be used instead of land exchanges.
- Dredging should be part of the plan as long as it is done in a way that minimizes impacts.
- Reroute the Road at Milepost 9.2.
- Relocate the shooting range in Alternative 2.

## Interdisciplinary Analysis / Technical Committee

Analysis of impacts to wildlife, plants, and cultural resources was conducted primarily by NPS staff. The U.S. Fish and Wildlife Service was consulted on impacts to threatened and endangered species, including the northern spotted owl. In addition, because of the large amount of hydrologic and geologic data on the Stehekin River; the complexity of the Stehekin River system; and the number of issues, sites, and actions considered in this plan, the NPS established a technical committee for this planning effort. The committee included representatives from Chelan County, Chelan PUD, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Washington Departments of Ecology and Fish and Wildlife, and Geomax PC, a private consulting engineer familiar with Stehekin. The technical committee provided scientific and regulatory information related to long-term river and floodplain management in the lower Stehekin Valley.

**Photo 5 – Harlequin Bridge**

To comply with the Federal Advisory Committee Act (1972), the purpose of the technical committee was not to advise the NPS on plan development, but rather to assess technical information and the applicability of regulations regarding proposed management alternatives and actions. Meetings of the technical committee were held to identify issues and to review alternative development in spring 2008; to conduct a field review of potential actions and sites in summer 2008; and to analyze impacts associated with specific alternative actions.

## SUMMARY OF ISSUES AND IMPACT TOPICS CONSIDERED

Impacts of each alternative have been analyzed. The impact topics focus the discussion of impacts on the comparison of affected resources.

The following impact topics have been retained because measurable impacts would occur from implementation of the alternatives and because concerns about impacts were expressed by the public and/or the interdisciplinary team. A detailed analysis of their inclusion is given in Chapter I*:* Purpose of and Need for Management Action.

- Land use
- Air quality
- Soils and vegetation
- Water resources (including hydraulics and streamflow characteristics, water quality, wetlands, and floodplains)
- Geologic hazards
- Wildlife
- Special status wildlife
- Prehistoric and historic archeological resources
- Historic structures
- Visitor experience (including access and transportation, visitor use opportunities, interpretation and education, scenic resources, and safety)
- Wild and scenic rivers
- Park operations
- Socioeconomics
- Hazardous materials
- Unavoidable adverse impacts
- Relationship between short-term use of the environment and maintenance and enhancement of long-term productivity
- Irreversible and irretrievable commitments of resources

The topics listed below either would not be affected or would be affected only negligibly by the alternatives evaluated in this DEIS. Therefore, these topics have been dismissed from further analysis. A detailed rationale for dismissing these and other impact topics is given in Chapter I: Purpose of and Need for Management Action.

- Water quantity
- Special status plants
- Traditional cultural (ethnographic) resources
- Museum collections
- American Indian Religious Freedom Act
- Lightscapes
- Wilderness
- Soundscapes
- Prime and unique farmlands
- Energy consumption (carbon footprint of alternatives is discussed in Air Quality)
- Environmental justice.

## IMPACT ASSUMPTIONS

Acreage impacts and other quantified impacts provided within the analysis are preliminary. This information is provided to convey the relative differences in impacts among alternatives and is from multiple sources, including the 30 percent road designs provided by Federal Highway Administration (FHWA) to the North Cascades National Park Service Complex. Final impact numbers would likely be within 10 percent of the numbers provided in Table ii-1: Impact Assumptions and throughout this document. Estimated road impacts have been rounded to the nearest half or whole acre, although some specific differences are given within, depending on the impact being discussed. Impacts associated with erosion protection measures and recreational features have been derived from designs based on the anticipated area that would be affected. Implementation of these measures would have similar impacts but could be slightly more or less than the approximate impact figures identified.

## SUMMARY OF ENVIRONMENTAL CONSEQUENCES

NEPA requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided should the proposed action be implemented. These analyses provide the basis for comparing the effects of the alternatives. NEPA requires consideration of context, intensity and duration of impacts, indirect impacts, cumulative impacts, and measures to mitigate impacts. In addition to determining the environmental consequences of the preferred and other alternatives, NPS *Management Policies 2006* (NPS 2006a) and Director's Order 12 (NPS 2001a) require analysis of potential effects to determine if actions would impair park resources.

Below is a summary of major adverse and beneficial impacts that would occur under the alternatives (Table ii-1: *Impact Assumptions*). These impacts are further defined in Chapter IV of the DEIS. In Table IV-16: *Impact Comparison Chart*, in addition to major impacts, negligible, minor, and moderate impacts are described. For each impact topic, effects of the alternatives are assessed by context, type, duration, area, and intensity, and include a discussion of cumulative impacts.

**Table ii-1: Impact Assumptions**

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| **Overall road mileage** | 4.9 mi | Same as Alt 1 | Same as Alt 1 | Same as Alt 1 |
| **Actual area** (road length × 16 ft) | 9.4 ac | Same as Alt 1 | Same as Alt 1 | Same as Alt 1 |
| **Estimated lands available for exchange** | 37 ac | 24 ac | Same as Alt 2 | Same as Alt 2 |
| **Site-specific road improvements** (pullouts, winter turnaround) | 0.8 ac | 0.9 ac | 0.9 ac | Same as Alt 1 |
| **McGregor Meadows Access Road** | N/A | 1.3 ac (0.8 mi) | Same as alt 2 | N/A |
| **Number of barbs** (acres) | 0 | 6 - 8 (0.5) | 4 (0.3) | 16 - 17 (1.1) |
| **Number of logjams (acres)** | 0 | 2 (0.1) | 5 (0.3) | 3 (0.1) |
| **Maintenance / housing relocation** | 5 - 8 ac | Same as Alt 1 | Same as Alt 1 | Same as Alt 1 |
| **Recreational improvements** | 3.1 ac | 3.6 ac | 3.4 ac | 3.5 ac |
| **Restoration** | | | | |
| a. Riparian<br>b. Upland<br>c. Bioengineering (barbs and logjams) | 1.5 ac<br>3.6 ac<br>n/a | 4.1 ac<br>4.4 ac<br>0.6 ac | 3.9 ac<br>3.7 ac<br>0.6 ac | 2.9 ac<br>3.7 ac<br>1.2 ac |
| **Total restoration** (a+b+c) | 5.1 ac | 9.1 ac | 8.2 ac | 7.8 ac |
| **Total disturbance** | 10 ac (new)<br>37 ac (LPP)<br>12 ac (existing) | 28 ac (new)<br>24 ac (LPP)<br>8 ac (existing) | 28 ac (new)<br>24 ac (LPP)<br>9 ac (existing) | 11 ac (new)<br>24 ac (LPP)<br>12 ac (existing) |

Alternatives 2 and 3 have major benefits in eight impact categories, while major negative impacts occur in five categories. Benefits in Alternative 2 would occur in land use, soils and vegetation, hydraulics and streamflow, water quality, wetlands, floodplains, NPS operations, and hazardous materials impact categories. Most of these beneficial impacts are from removal of the NPS maintenance facility and housing and 1.9 miles of road from the floodplain in McGregor Meadows and the Lower Field. An updated Land Protection Plan in Alternatives 2 and 3 would create opportunities for private landowners and the NPS to remove some of the most threatened floodplain development. As shown in Figure ii-11, Alternatives 1 and 4 have fewer major beneficial effects than Alternatives 2 and 3.

Most of the major negative impacts in Alternatives 2 and 3 are associated with short- and long-term disturbances to land use, vegetation and soils, water quality, and wildlife during construction of the new road around McGregor Meadows and NPS facilities. The reroute includes the possibility of disturbing a nesting site for northern spotted owls. Alternatives 1 and 4 avoid immediate encroachment on the owl activity area, but over the long term, anticipated channel avulsion in the valley near the nesting site would require additional activity to protect the road and could disturb the owls.

All of the action alternatives would add to cumulative effects on the Stehekin River by installation of new erosion protection structures. Alternative 2 would add six to eight rock barbs at three sites, an increase in the total number of barbs on the river from the current 30, and an increase in affected streambank from 6.5 to 8.3%. At Frog Island and Wilson Creek, the road is currently at the edge of its channel migration zone, and the added barbs would be viewed as a moderate impact. Proposed barbs at the Stehekin River mouth are along a terrace in the middle of the channel migration zone, and therefore have a larger impact than at the other two sites. At Frog Island and the Stehekin River mouth, impacts are mitigated to some degree because rock barbs and bioengineering would replace existing rip-rap.

Alternatives 2 and 3 would have similar cumulative impacts on river processes, but in Alternative 3 large engineered log jams would be installed instead of some rock barbs. By focusing on maintaining the Stehekin Valley Road in place, Alternative 4 would add to cumulative impacts to the river by adding 16 - 17 new rock barbs, increasing the amount of affected streambank from 6.5 to 9.5%. While Alternative 1 proposes the fewest new erosion protection structures, it would add more fill to the floodplain at McGregor Meadows to elevate the road, and would restrict the river from more of its floodplain, similar to Alternative 4.

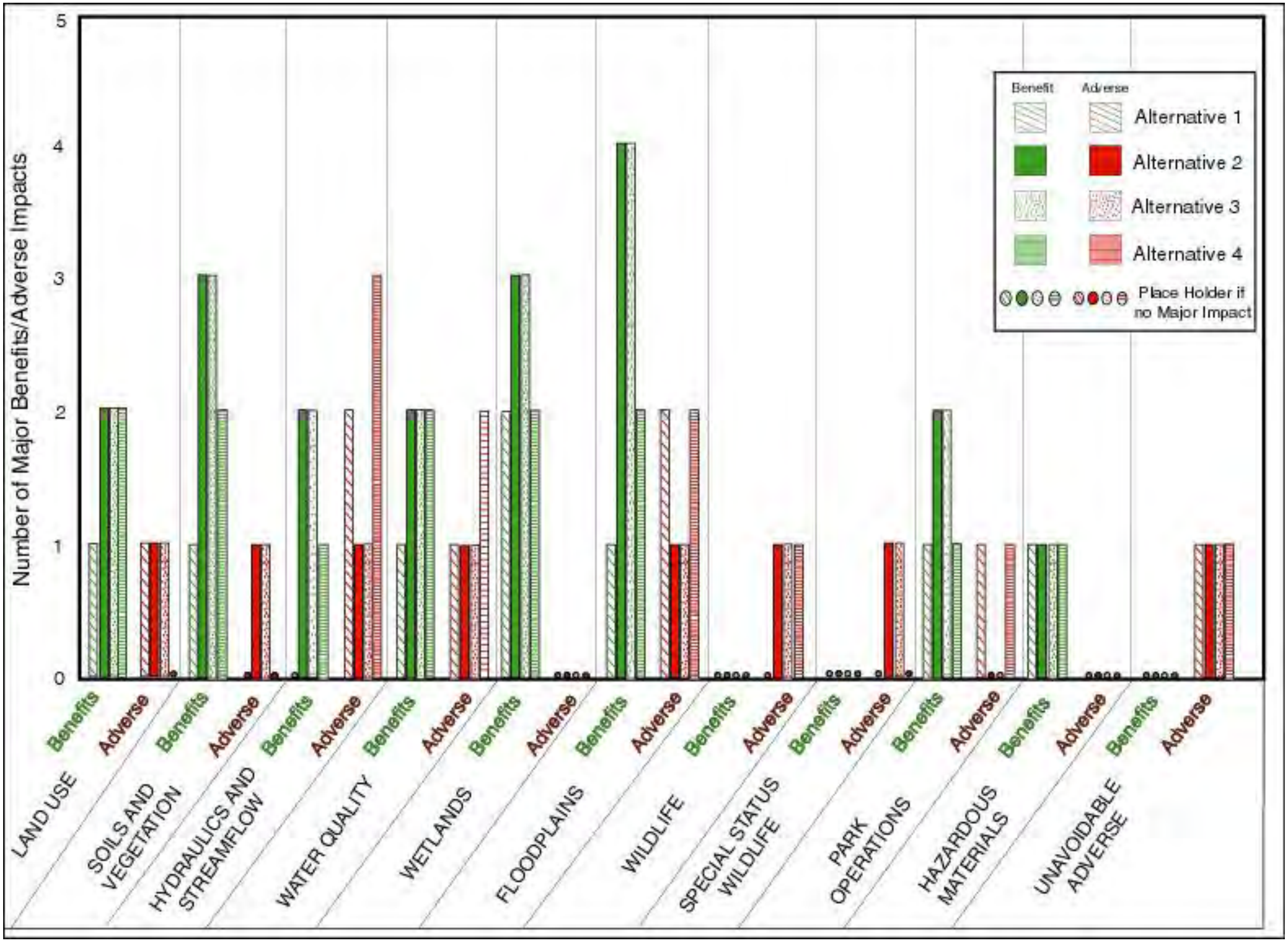


**Figure ii-11: Impact Categories that Contain Major Benefits or Major Adverse Impacts**

## iii. How this Draft Environmental Impact Statement (DEIS) is Organized

**i. Table of Contents**. This lists the chapters and primary subsections of each and where they may be found within the document.

**ii. Executive Summary**. This section contains a summary of the main sections of this DEIS.

**iii. How this Draft Environmental Impact Statement is Organized**. This section (the current section) describes what is contained in each section of the document.

**iv. Public Review of this Draft Environmental Impact Statement**. This is a guide to how to comment on the DEIS.

**Chapter I: Purpose of and Need for Management Action**. This chapter identifies the purpose and need for the proposed actions. It also introduces Lake Chelan NRA, the project area, and the planning background for the project, including the purpose and significance of Lake Chelan NRA. It identifies related laws, policy, and park and other agency plans and summarizes public participation to date. ―Impact Topics” describes the potentially affected resources and laws or policy relating to their inclusion in this DEIS. This section also identifies those resources that have been dismissed from further analysis due to their having no or negligible identified potential environmental consequences.

**Chapter II: Management Alternatives**. This chapter describes the proposed alternative courses of action, including the reasons for dismissing options that do not meet project objectives or other defined criteria. It also identifies and provides analysis related to the selection of the environmentally preferable alternative. The alternative comparison chart (Table ii-1) highlights the major impacts among the alternatives.

**Chapter III: Affected Environment**. ―Affected Environment” provides information about the existing environment, focusing on those resources that could be affected by the decisions in the alternatives.

**Chapter IV: Environmental Consequences**. This chapter describes the impacts of each alternative on Lake Chelan NRA resources, including cumulative impacts. ―Methodology” introduces key background material for the analysis presented in the ―Environmental Consequences” section. Similar to Chapter II: Management Alternatives, the ―Environmental Consequences” section contains an impact comparison chart (Table IV-16) to compare the differences in projected impacts among the alternatives.

**Chapter V: Consultation and Coordination.** This chapter summarizes information about internal and public scoping and preparation and review of the DEIS and includes a list of preparers, identifying agencies, and individuals consulted during the planning process.

**Chapter VI: References.** This chapter provides bibliographical information for sources cited in this DEIS.

**Chapter VII: Glossary**. This chapter provides definitions for acronyms and technical terms used in this DEIS.

**Appendices**. These sections support the analysis and information within the Draft SRCIP/EIS, and include the following:

Appendix 1: Lake Chelan National Recreation Area Enabling Legislation (Public Law 90-544)
Appendix 2: Management Objectives and Actions in the Lake Chelan NRA GMP Applicable to the SRCIP
Appendix 3: Land Protection Plan Management Goals / Objectives and Guidelines
Appendix 4: Stehekin River Reach Analysis
Appendix 5: Cumulative Impacts Project List
Appendix 6: Summary of Mitigation Measures
Appendix 7: Army Corps of Engineers Advanced Flood Protection Measures
Appendix 8: Vascular Plants Observed within Proposed Project Areas
Appendix 9: Proposed Conditions, Covenants, and Deed Restrictions
Appendix 10: 1995 Land Protection Plan Ranking of Private Lands
Appendix 11: Alternatives 2 and 3 Proposed Ranking of Private Lands
Appendix 12: Alternative 4 Proposed Ranking of Private Lands
Appendix 13: Revised Land Protection Plan (Detached)
Appendix 14: Carbon Emissions Estimates and Calculations
Appendix 15: Laws, Policies, and Regulations Whitepaper
Appendix 16: Current Knowledge Base Whitepaper (Detached)
Appendix 17: Draft Floodplains Statement of Findings
Appendix 18: Estimates of Gravel Accumulation in Two Reaches of the Stehekin River

## iv. Public Review of this Draft Environmental Impact Statement

The public comment period for this draft SRCIP/DEIS will extend no later than 90 days after the Environmental Protection Agency files the notice of availability of the DEIS in the Federal Register.

The SRCIP/DEIS is being made available to the public, federal, state, and local agencies and organizations through a wide variety of news media, direct mailing, placement on the park's website, and announcements in the SRCIP newsletter. Copies may also be found at the following public libraries: Chelan, Wenatchee, and Seattle and Golden West Visitor Center in Stehekin.

During the comment period, comments may be submitted through any one of several methods.

Mail: North Cascades National Park Service Complex<br>
Attn: SRCIP/DEIS<br>
810 State Route 20<br>
Sedro-Woolley, Washington 98284

Phone: Project Leader Jon Riedel (360) 854-7330<br>
NOCA Headquarters (360) 854-7200

E-mail: *noca_planning@nps.gov*

Park Website: NOCA homepage: *www.nps.gov/noca/srcip*<br>
At the PEPC website, select the –Stehekin River Corridor Implementation Plan." The full text document, an online comment form, and instructions for submitting online comments are under the –Documents and Links" tab. Please use the online comment form to submit your ideas, questions, or comments.

Please include –Stehekin River Corridor Implementation Plan" in the subject header.

For the ease of record keeping, the park would prefer that comments be made on PEPC or the park website as opposed to emails and phone calls.

Comments may also be made in person at one of the upcoming public workshops. The specific dates and times for these meetings will be announced in local newspapers, in the SRCIP newsletter, and online at the above website. A limited number of additional copies of this document are available from the above mailing address.

Public comments and contributions are an invaluable part of this planning process and the NPS looks forward to comments on this draft SRCIP/DEIS.

### Freedom of Information Act Notice

Before including your address, phone number, e-mail address, or other personally identifiable information in your comment, please be aware that due to recent litigation, NPS practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents may request that we withhold their names and/or home addresses from the rulemaking record, which we will honor to the extent allowable by law. There also may be circumstances in which we would withhold from the rulemaking record a respondent's identity, as allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. Anonymous comments, however, may not be considered. We will always make all submissions from organizations or businesses, and from individuals identifying themselves as representatives of officials of organizations or businesses, available for public inspection in their entirety.

Responses to comments on the SRCIP/DEIS will be addressed in the final EIS. (For more information about specific agency and staff consultation, see the section in this document entitled ―List of Preparers / Persons and Agencies Consulted" in Chapter V: Consultation and Coordination.)

# CHAPTER I:

## Purpose of and Need for Management Action

# CHAPTER I: PURPOSE OF AND NEED FOR MANAGEMENT ACTION

## A. PURPOSE AND NEED

Recent major floods and resultant channel changes on the lower Stehekin River have intensified flood and erosion threats to National Park Service (NPS) facilities and are impacting natural resources within Lake Chelan National Recreation Area (NRA). The three largest recorded floods on the Stehekin River since 1911 have occurred within the past 15 years, and in response to this increased frequency of major floods, the NPS has spent more than $3 million to protect public roads and facilities and to repair flood damage. Roads, visitor facilities, and private development once thought to be safe from the river are now threatened. Because of the current impacts and future risks associated with these unprecedented conditions, the primary purpose of this draft Stehekin River Corridor Implementation Plan / environmental impact statement (SRCIP/EIS) is to enable the NPS to meet the goals and direction provided in the 1995 *Lake Chelan National Recreation Area Final General Management Plan / Environmental Impact Statement* (GMP) (NPS 1995a). Goals for this plan include the following:

- Sustainably operate and maintain NPS administrative facilities, public access (roads and trails), and campgrounds
- Protect water quality, scenic values, habitat, and natural processes of the Stehekin River
- Continue visitor services provided by the Stehekin Community, including those services and facilities found on private lands.

The NPS, the lead agency in the development of this Draft Environmental Impact Statement (DEIS), and the Federal Highway Administration (FHWA), the cooperating agency, have identified a need to evaluate comprehensive and sustainable management strategies and linked public-private actions to address the consequences of flooding. This implementation plan is needed to address several interrelated issues, including to (1) respond to the increased magnitude and frequency of flooding, (2) implement and clarify 1995 GMP guidance, (3) sustain public facilities while protecting natural resources, (4) manage limited funding, and to (5) respond to private land-related concerns.

### 1. PRIMARY ISSUES

**(1) Respond to the Increased Magnitude and Frequency of Flooding**. Prior to the late 20th century, the Stehekin River was prone primarily to spring snowmelt flooding. Since the 1970s, however, the Stehekin River has become prone to large fall rain-on-snow floods, which rise quickly and occur from mid-October through December. Hydrologic data collected on the river since 1911 confirm the statistical significance of this shift, as analyzed by the U.S. Geological Survey (USGS). The severe floods in 1995, 2003, and 2006 have led to significant changes in the Stehekin River channel and redefined the boundaries for the 100-year flood. As a result, recreational and administrative facilities and developments once thought to be safe from the river are now threatened by flooding and bank erosion, while other sites in the floodplain have been compromised by larger, more frequent floods. Until now, the NPS has addressed problems on a case-by-case basis throughout the valley with the passage of each of these large floods.

**(2) Implement and Clarify 1995 GMP Guidance**. The GMP provides broad management guidance for Lake Chelan NRA, as well as some specific prescriptions to mitigate the risks and consequences of flooding (NPS 1995a). As a programmatic document, the GMP lacks the specific management direction needed to respond to the current circumstances imposed by the recent floods. Specific actions called for in the GMP that would be implemented in this plan include replacement and relocation of the maintenance facility and NPS housing out of the floodplain (NPS Tracts 06-118, 06-104, 06-121, and 06-122), construction of the Lower Valley Trail, and continued maintenance of vehicle access on the Stehekin Valley and Company Creek roads. This implementation plan is needed to inform the location, design, construction, and implementation of these actions. Guidance provided by the GMP needs to be updated and clarified to reflect the dramatic increase in woody debris since 1995 and recognition of the influence of Chelan County Public Utility District (Chelan PUD) operations for power generation on the level of Lake Chelan and the lower Stehekin River. This plan is also needed to evaluate and publicly disclose the direct, indirect, and cumulative impacts of these actions on the resources and values of Lake Chelan NRA.

**Photo 6 – Flooding of NPS Maintenance Area in 2006 Flood**

**(3) Sustain Public Facilities While Protecting Natural Resources**. Management action is needed to provide long-term use and access to administrative and recreation facilities. Despite erosion protection and flood protection efforts by the NPS and private landowners, bank erosion continues to threaten public and private property. Channel changes have increased the rate of erosion and frequency of flooding at some sites, while decreasing erosion rates at others. Integrated management actions such as facility replacement and relocation, site-specific bank hardening, and limited manipulation of woody debris in the Lake Chelan backwater zone now need to be considered to ensure the long-term sustainability of infrastructure and protection of resources. Management of large wood and proliferation of bank-protection measures have the potential to impact federally and state-listed species and to increase the spread of nonnative plants. These conditions underscore the need for updated assessment of erosion and flood protection measures in the lower Stehekin Valley.

**(4) Manage Limited Funding**. The NPS has spent more than $3 million to react to recent flood damage to maintain vehicle access on the Stehekin Valley and Company Creek roads and to respond to new threats on an event-by-event basis. A comprehensive and integrated set of strategies and tactics to meet the goals of the GMP and to mitigate the risk and impacts from flooding is urgently needed to enable the NPS to use limited funds for the maximum benefit of Lake Chelan NRA. Without this comprehensive approach, the NPS would continue to respond on a case-by-case basis, which costs more and could threaten natural resources and public safety.

**(5) Respond to Private Land-Related Concerns**. Lake Chelan NRA includes approximately 417 acres of private land, much of which lies within the floodplain and channel migration zone of the Stehekin River. (The channel migration zone is defined as where the river has historically migrated in the valley over the past 1,000 years.) Developments at McGregor Meadows and near the river mouth are particularly vulnerable because of their density and their location in more active river reaches. These reaches, or sections of the river, have extensive new gravel deposits and rapidly growing logjams as a result of recent floods. The high monetary and environmental costs of bank-protection and flood-mitigation measures continue to threaten the long-term sustainability of recreation area resources and private property. At the river mouth, accumulation of logs in the backwater zone of Lake Chelan has led to deeper floodwater in parts of the floodplain. The recent flooding has hastened channel migration, damaged or destroyed several cabins, incorporated debris and sanitary systems into the river, and increased the flood risk to private lands previously not threatened by flooding. The NPS is concerned that these circumstances will continue to adversely affect Lake Chelan NRA and Stehekin River natural resources and values. The primary means by which the NPS can address this concern is via the *Lake Chelan National Recreation Area Land Protection Plan* (LPP) (NPS 1995b). The LPP (NPS 1995c) identifies and prioritizes private lands for acquisition or exchange from willing sellers. Last updated in 1995, this plan is being revised through this DEIS to address new river channel and floodplain conditions, and to create new funding opportunities to help protect Lake Chelan NRA and the Stehekin Community.

**Photo 7 – Destruction of Private Cabin and Damage to Upper Company Creek Road during the 2003 Flood**

## 2. DECISION TO BE MADE

This DEIS has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and its implementing regulations (40 CFR Parts 1500 - 1508); NPS *Management Policies 2006* (NPS

2006a); NPS *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (Director's Order 12) (NPS 2000a) and handbook; Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended, and its implementing regulations (36 CFR Part 800); related guidance; and applicable executive orders.

NEPA requires the documentation and evaluation of potential impacts resulting from federal actions on lands under federal jurisdiction. An EIS discloses the potential environmental consequences of implementing the proposed action and other reasonable and feasible alternatives. NEPA is intended to provide decision makers with sound knowledge of the environmental consequences of the alternatives available to them. In this case, the superintendent of Lake Chelan NRA (North Cascades National Park Service Complex) and the Pacific West Regional Director are faced with deciding which alternative to implement from the SRCIP to most effectively implement the 1995 GMP, to sustainably operate and maintain administrative and visitor facilities, and the private Stehekin Community and the visitor services it provides.

### Interdisciplinary Analysis / Technical Committee

Analysis of impacts to wildlife, plants, and cultural resources was conducted primarily by NPS staff. The U.S. Fish and Wildlife Service (USFWS) was consulted on impacts to threatened and endangered species, including the northern spotted owl. In addition, because of the large amount of hydrologic and geologic data on the Stehekin River, the complexity of the Stehekin River system, and the number of issues, sites, and actions considered in this plan, the NPS established a technical committee for this planning effort. The committee included representatives from Chelan County, Chelan PUD, U.S. Army Corps of Engineers, USFWS, Washington Departments of Ecology and Fish and Wildlife, and Geomax PC, a private consulting engineer familiar with Stehekin. The technical committee provided scientific and regulatory information related to long-term river and floodplain management in the lower Stehekin Valley.

To comply with the Federal Advisory Committee Act (1972), the purpose of the technical committee was not to advise the NPS on plan development, but rather to assess technical information and the applicability of regulations regarding proposed management alternatives and actions. Meetings of the technical committee were held to identify issues and to review alternative development in spring 2008; to conduct a field review of potential actions and sites in summer 2008; and to analyze impacts associated with specific alternative actions.

## 3. Project Area

The project area includes the lower Stehekin Valley from High Bridge to the head of Lake Chelan, including Weaver Point. No actions are considered in adjacent wilderness, which is located above about 1,640 feet in elevation in the lower valley.

Lake Chelan NRA is located in north central Washington State and is bordered on the north by North Cascades National Park, on the east by the Lake Chelan / Sawtooth Wilderness area (Okanogan-Wenatchee National Forest), on the south by the Wenatchee National Forest, and on the west by the Glacier Peak Wilderness Area (Okanogan-Wenatchee National Forest) (Figure I-1: *Project Area* and Figure I-2: *Lower Stehekin Valley*). Approximately 90 percent of Lake Chelan NRA (56,000 acres) is included within the Stephen Mather Wilderness Area (NPS 2000b). Lake Chelan NRA is one of three NPS units managed as part of the North Cascades National Park Service Complex.

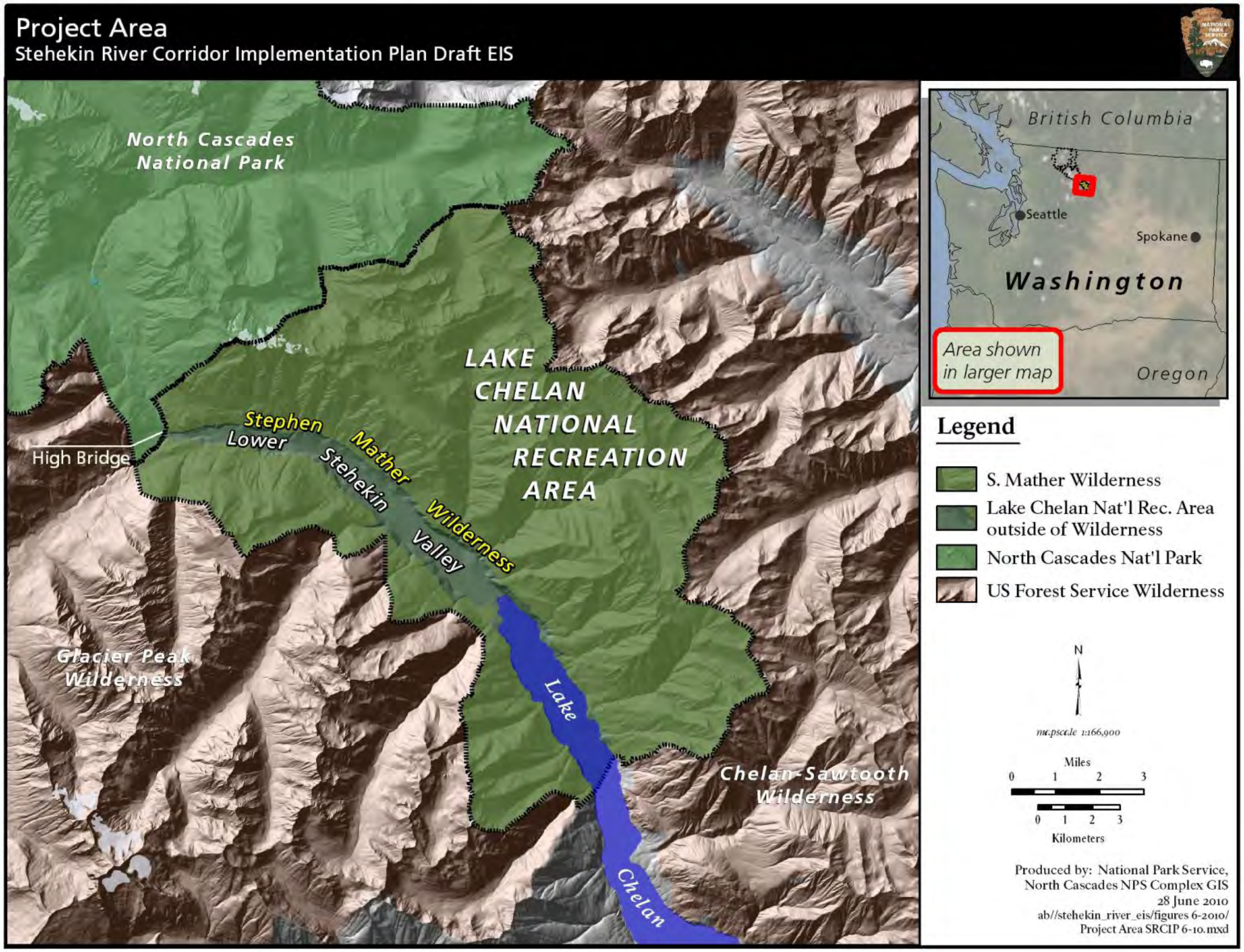


**Figure I-1: Project Area**

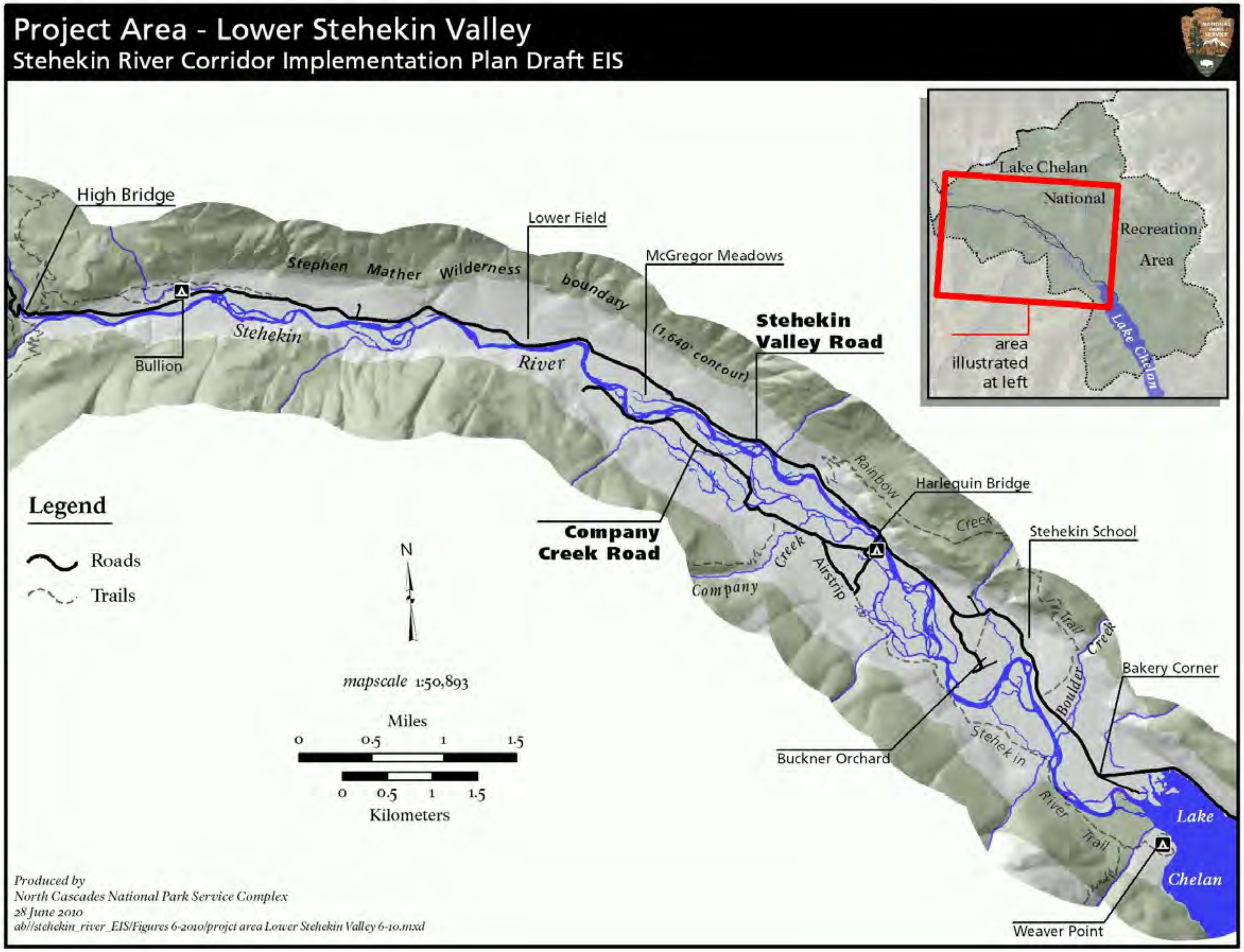


**Figure I-2: Lower Stehekin Valley**

The Stehekin Valley was originally considered for national status as early as 1906. A much later Senate report (Senate Report 700, October 31, 1967) recommended that the area become a national recreation area (rather than a national park) and to include within it the private lands of the Stehekin Valley, because it was believed that the properties were principally owned by descendants of the early homesteaders and because services could be provided to visitors by the remote Stehekin Community. The hunting lobby, however, pushed hardest for the national recreation area classification (Louter 1998:50 - 52). Senate Report 700 states:

> Designate the lower Stehekin River Valley and upper Lake Chelan areas the Lake Chelan National Recreation Area instead of a part of the national park. Many of the year long residents of the Stehekin Valley are descendants of the original homesteaders. Some 1,700 acres, mostly on the valley floor, are in private ownership, and in the past several decades a number of summer homes have been built. The only access to the community is by foot, horseback, boat, or plane, even though there is in existence a road of some 25 miles extending from the village up the valley. The lake, likened by most to the spectacular fjords of Norway, will serve as the primary access for park and recreation area visitors approaching from the southeast. The village and lower valley, therefore, will have considerable use, and development to accommodate these visitors will be necessary. The Stehekin Valley, the Rainbow Creek Valley, and Rainbow Ridge traditionally have been used by high country big game hunters.

The Stehekin Valley is a glacial valley that begins at the crest of the Cascade Range near Cascade Pass (North Cascades National Park) and ends at the mouth of the Stehekin River where the river flows into Lake Chelan, the third-deepest natural lake in the United States. The developed lower valley is remarkable for the rapid change in river pattern, from boulder-strewn gravel bars at McGregor Meadows to sandbars at the lake edge, within 7 miles. Tributaries enter the lower Stehekin Valley as hanging valleys, with deep gorges containing thundering waterfalls. Lake Chelan is a 55-mile-long, 1,500-foot-deep lake whose level was raised 21 feet by a hydroelectric/flood-control dam in the 1920s. Approximately the upper 5 miles of Lake Chelan and the lower 9 miles of the Stehekin River are included in Lake Chelan NRA.

## 4. Purpose and Significance of Lake Chelan National Recreation Area

### Significance

The following statements from the recently completed North Cascades National Park Service Complex Foundation Statement (NPS 2006b) are those that apply specifically to Lake Chelan NRA:

- Within Lake Chelan NRA, Stehekin is a private-land based community that provides visitors with an opportunity to see and experience life in a remote setting that is not accessible by roads and is surrounded by wilderness.
- Set in a glacier-carved trough between steep valley walls, Lake Chelan is the nation's third deepest lake. Fed by glacial melt and the Stehekin River, it is known for its exceptionally cold and clear water.
- Lake Chelan National Recreation Area provides a spectrum of recreational opportunities that transition from highly mechanized to primitive as one moves from the lake, up the Stehekin Valley, and into the wilderness.

## Purpose

The purpose of Lake Chelan NRA is to ―. provide for public outdoor recreational use and enjoyment …and for conservation of the scenic, scientific, historic and other values" (Enabling Legislation for Lake Chelan NRA, Public Law 90-544, October 2, 1968). Today Lake Chelan NRA functions as a gateway to more than 2 million acres of roadless wilderness. Management is dedicated to conserve the scenery for outdoor recreation and education, the natural and cultural values of the lower Stehekin Valley, Lake Chelan and surrounding wilderness, while respecting the remote Stehekin Community (NPS 2006b).

Management Objectives for Lake Chelan NRA include:

- **Natural Resource Management**: Manage Lake Chelan NRA as an integral part of a larger regional ecosystem, and protect and restore the components and processes of naturally evolving park ecosystems, including the natural abundance, biodiversity, and ecological integrity of plants, animals, water and soil to the extent public safety considerations permit (NPS 1995a:19).
- **Cultural Resource Management**: Protect and interpret the park's archeological, historic and ethnographic resources. Treatment of historic properties would be undertaken in accordance with NPS policies and the park's cultural resource management plan in consultation with the Washington State Historic Preservation Officer, the Advisory Council on Historic Preservation, and other interested persons as appropriate under 36 CFR 800… (NPS 1995a: 28).
- **Visitor Experience**: Emphasize selected opportunities that focus on natural, cultural, and recreational values, through both structured and unstructured ways and both solitary and social means. Visitors encounter facilities and services in a rural Stehekin Community context where needs are balanced with preservation of a nearly pristine natural environment (NPS 1995a: 29).

# B. BACKGROUND

This plan is a response to the effects of the increased frequency and magnitude of flooding on the Stehekin River and the adverse effects this flooding has had on NPS infrastructure and private lands in the lower Stehekin Valley (Figure I-3: *Existing Conditions*).

The following key characteristics of the Stehekin Valley require careful planning to avoid the effects of repeated flood damage:

1. The flood prone nature of the Stehekin River, which is due to its geography, watershed shape, and steep slopes (includes the potential for the formation and sudden failure of debris dams in the narrow canyons above High Bridge)
2. Channel instability from the transport of large amounts of water, gravel, and large wood
3. A shift in the last 30 years from spring floods to larger, more frequent fall floods
4. A history of river manipulation, including the Lake Chelan Dam, and the addition of erosion protection measures to the river over the last 20 years—riparian resources and water quality have been adversely affected as destroyed cabins, effluent from septic systems, and other debris are incorporated into the river during floods.

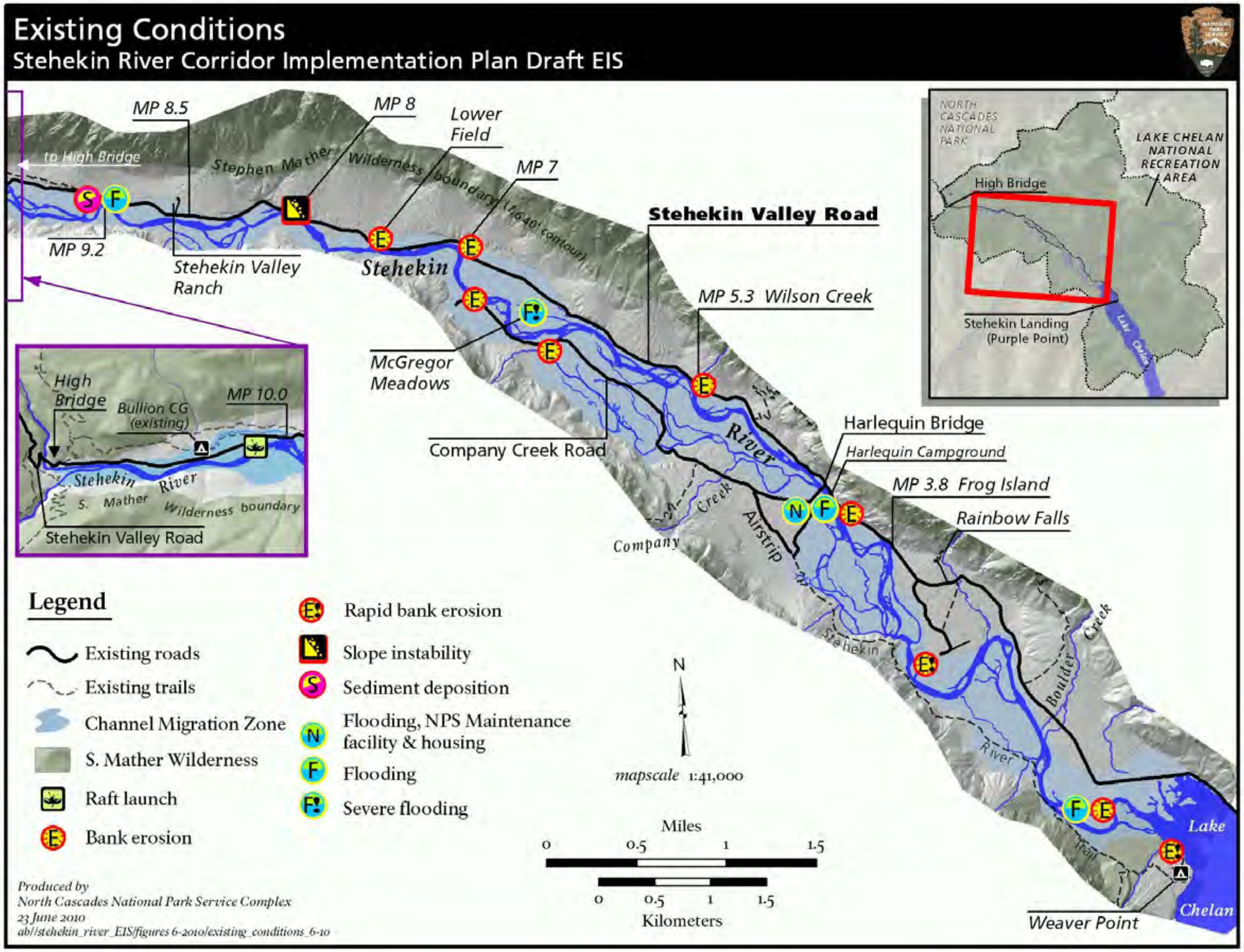


**Figure I-3: Existing Conditions**

**Photo 8 – Stehekin River Mouth after the 2003 Flood**

## 1. History of Stehekin River Flooding

Inventorying, monitoring, and research have been conducted primarily on the lower 10 miles of the river above Lake Chelan. The USGS flow gauge near Boulder Creek was installed in 1911 and is the basis for understanding flood magnitude and frequency in the watershed.

The Stehekin River watershed encompasses approximately 220,000 acres (344 square miles). Public lands comprise 99 percent of the watershed and includes the Glacier Peak and Stephen Mather wilderness areas. Steep slopes, a dense network of tributary streams, and the location of the river's headwaters along the wet Pacific Crest have led to the frequent and rapid rise of floodwaters on the river, perhaps more so than any other river in eastern Washington (Figure 1-4: *Timing and Magnitude of Peak Discharge for the 2003 Flood on Six North-Central Washington Rivers*).

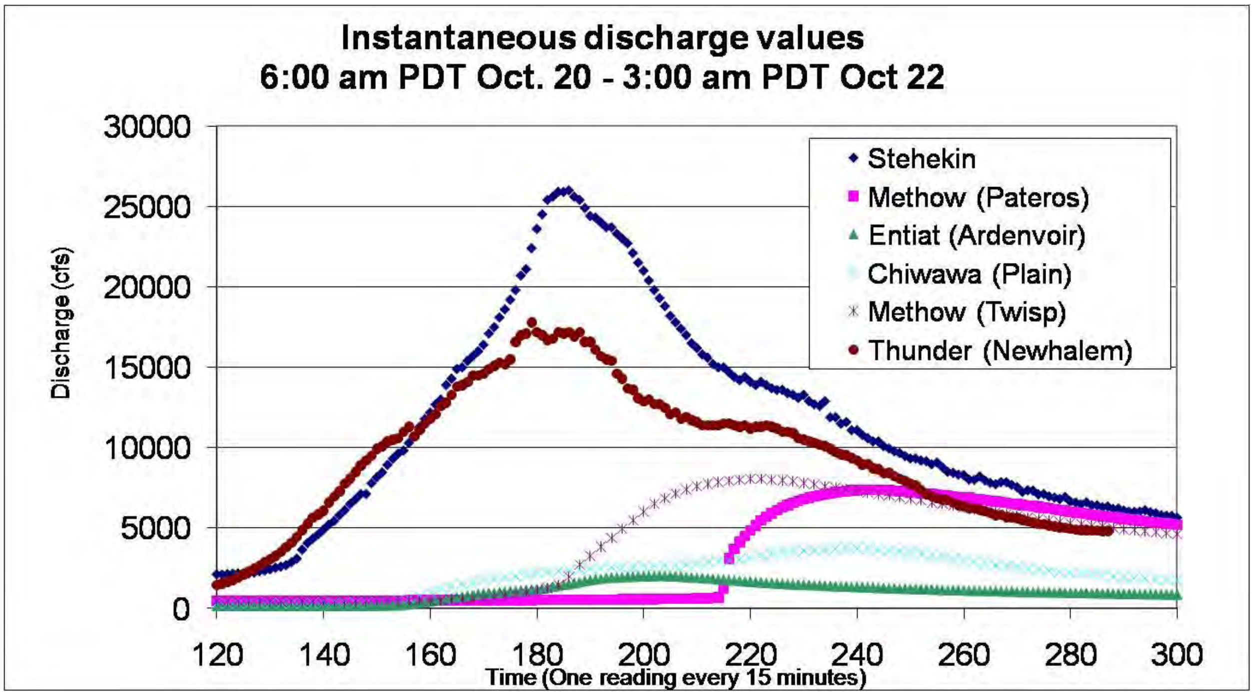


**Figure I-4: Timing and Magnitude of Peak Discharge for the 2003 Flood on Six North-Central Washington Rivers**

Just above the developed lower valley, the Stehekin River is joined by three major tributaries within 5 miles. Deep bedrock canyons within this zone deliver water, sediment, and large wood quickly to the wide lower valley below High Bridge. These narrow box canyons are potential sites for the formation and failure of temporary debris dams, which add an unpredictable element to flooding on the Stehekin River. Some anecdotal and observed evidence indicates that the temporary formation and rapid failure of a debris dam on the Stehekin River above High Bridge led to the record peak flow of 25,600 cubic feet/second (cfs) in October 2003 (Table I-1: *Chronology and Features of the 10 Largest Floods on the Stehekin River*).

**Table I-1: Chronology and Features of the 10 Largest Floods on the Stehekin River**

| Date | Flood Type | Discharge (cfs) | Recurrence Interval[a] |
|---|---|---|---|
| October 20, 2003 | Intense rainfall | 25,600[b] | 100 - 500 years |
| November 29, 1995 | Rain on snow | 20,900 | 100 years |
| November 07, 2006 | Rain on snow | 19,100 | 100 years |
| May 29, 1948 | Snowmelt | 18,900 | 100 years |
| November 07, 1948 | Rain on snow | 18,400 | 50 - 100 years |
| December 26, 1980 | Rain on snow | 17,300 | 50 years |
| June 16, 1974 | Snowmelt | 16,600 | 25 years |
| November 24, 1990 | Rain on snow | 14,700 | 10 years |
| June 02, 1968 | Snowmelt | 14,400 | 10 years |
| June 10, 1972 | Snowmelt | 14,400 | 10 years |
| June 21, 1967 | Snowmelt | 13,900 | 10 years |

[a]Flood recurrence interval based on approach discussed below.

[b]Flood discharge estimated due to gauge malfunction.

## 2. Channel Instability Associated with the Transport and Deposition of Gravel

The gradient of the Stehekin River at its confluence with Agnes Creek is about 80 feet per mile. This decreases to 50 feet per mile above McGregor Meadows, and to 25 feet per mile just above Lake Chelan. Within this zone, decreases in channel steepness cause the river to deposit coarse gravel during big floods and to erode banks. Four distinct areas of net gravel deposition have been identified in the lower Stehekin Valley (Figure I-5: *Gravel Transport and Deposition and Channel Instability Zones on the Lower Stehekin River*).

The McGregor Meadows area is the site of massive gravel deposition during floods because the valley widens threefold in this reach, which results in a drop in gradient, gravel deposition, and channel instability (i.e., river creates multiple channels). The next two gravel deposition and channel instability zones occur above and between the Company, Rainbow, and Boulder Creek alluvial fans. These fans constrict the river and cause an increase in channel gradient and stability. River kilometers 2 - 3, 6 - 7, and 11 - 12, where relatively straight, steep sections of the river are net transport zones for sediment and large wood (where large woody debris and sediment move freely down river), are also areas of relative channel stability. In contrast, the wood and sediment storage zones between these fairly stable reaches are characterized by the existence of massive logjams, multiple side channels, and channel instability. The fourth major zone of deposition and channel instability in the lower Stehekin Valley is where the river meets the backwater of Lake Chelan. A 2000 Chelan PUD study showed that at full pool the lake influence on the river extended about a quarter mile upstream during a 100-year flood (Chelan PUD 2000).

Bank erosion and storage of gravel on the lower Stehekin River have been dramatic in the past 50 years. Annual total sediment load on the Stehekin River is estimated at 32,000 cubic yards per year, with about 17 percent, or 5,440 cubic yards per year, transported along the bed of the river as gravel (Riedel pers. comm. 2008). Bank erosion measured since 1962 at 16 sites averaged about 25 feet, with some sites stable and others with as much as 110 feet of erosion. Bank erosion at all sites yielded an estimated 500,000 cubic yards of gravel to the channel over 47 years. While large amounts of gravel are stored in the lower valley, it appears some gravel has moved through the river and into Lake Chelan.

The massive movement and deposition of gravel makes consideration of periodic dredging as a tool for addressing the flood threat highly problematic, expensive, and unsustainable (Riedel 2009). Based on estimates of gravel deposition since 1995 at two important, half-mile-long sections of the river (McGregor Meadows and near the Stehekin River Mouth), the U.S. Army Corps of Engineers estimated an cost over time of about $12 million for channel deepening and for removal and transport of gravel to Company Creek Pit (Riedel 2009) (see ―D. Alternatives and Actions Considered but Dismissed" and Appendix 18).

Gravel deposited along the channel causes large logs to accumulate during floods. Due to the rapid increases in wood on the river, the NPS conducted three comprehensive surveys of large wood accumulations (1984, 2000, and 2007), which have documented a major increase in large woody debris accumulation on the lower Stehekin River (Figure I-6: *Stehekin River Large Wood Monitoring*). This would need to be repeated to remove gravel continuously washed down by the river.

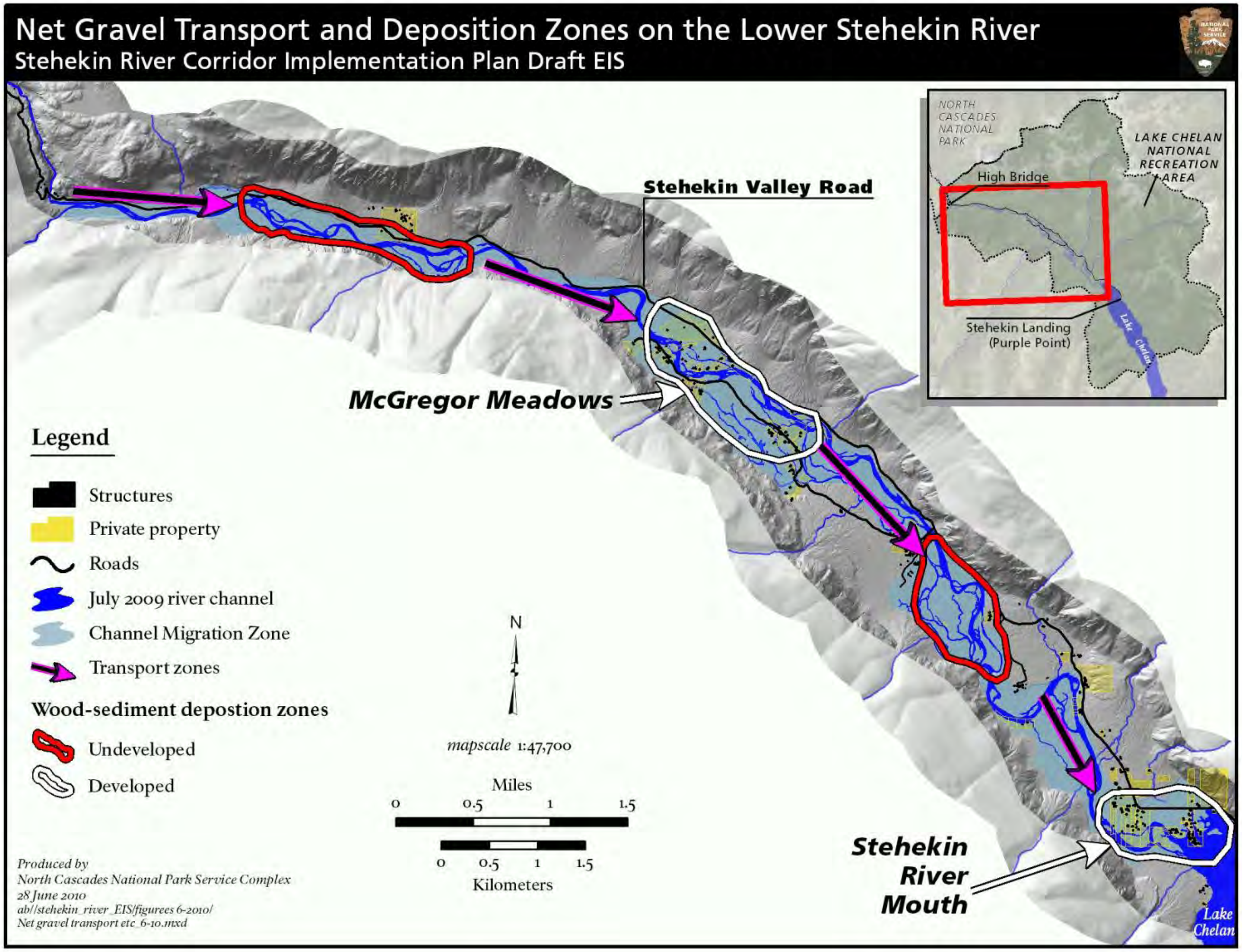


**Figure I-5: Net Gravel Transport and Deposition Zones on the Lower Stehekin River**

Note development in two of these zones (McGregor Meadows and Stehekin River Mouth), shown in white.

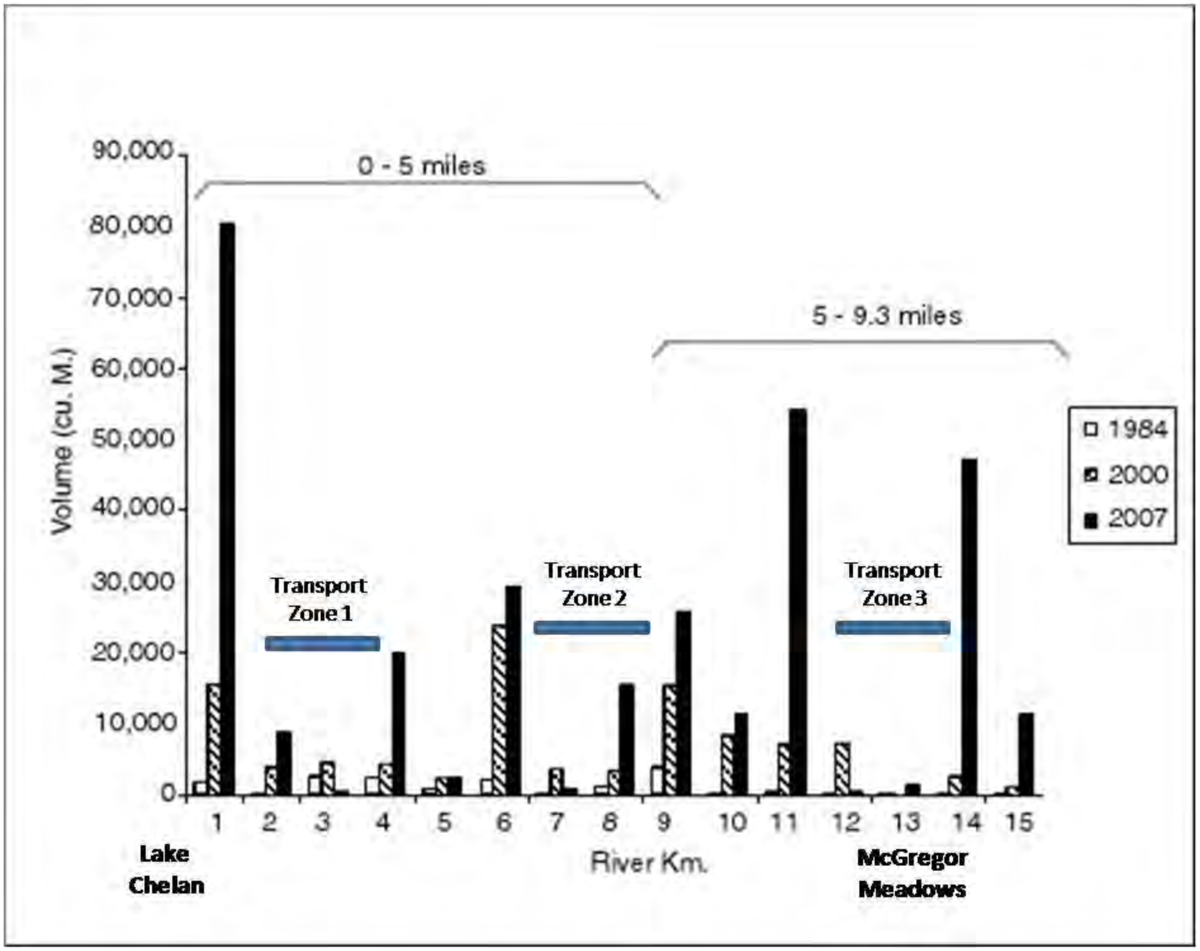


**Figure I-6: Stehekin River Large Wood Monitoring 1984 - 2007**

In 2007, there were 166 logjams consisting of 10 or more pieces on the lower river that contained a total volume of 400,000 cubic yards. In the 2000 survey, there were 101 logjams with a total volume of about 130,000 cubic yards. In 1984, about 10 years after the last large-scale logjam removal, there were 128 logjams with a total volume of about 22,000 cubic yards (Riedel 2007). The substantial increase in large woody debris is attributed primarily to the passage of the three major floods in 1995, 2003, and 2006. The accumulated wood is now viewed as a benefit because it creates pools (habitat for aquatic life) and slows the spread of water during big floods and provides other wildlife habitat.

To some extent, the increase in wood below Harlequin Bridge in the last 40 years may appear unusually large because up to the early 1970s, the large woody debris was occasionally removed. In 1972, the U.S. Army Corps of Engineers, under contract with the Federal Disaster Assistance Administration (FDAA), the precursor to the Federal Emergency Management Administration (FEMA), removed most large logjams on the Stehekin River below Harlequin Bridge. Removal of large woody debris was funded in an attempt to reduce the flood and erosion risk to private property within Stehekin. Federal and state regulations have changed to generally discourage large scale manipulation like this because it is recognized as not financially, or ecologically, sustainable.

### 3. Shift from Spring Peak Flooding to Fall Peak Flooding

Analysis of nearly 100 years of flow records indicates that in about 1975 the Stehekin River switched from a system dominated by spring snowmelt floods to one dominated by larger, more frequent, fall rain-on-snow floods. Illustrating this shift, the three largest floods on record have occurred within the past 15 years and were fall events (Figure I-7: *Magnitude and Timing of the Annual Peak Flood on the Stehekin River*).

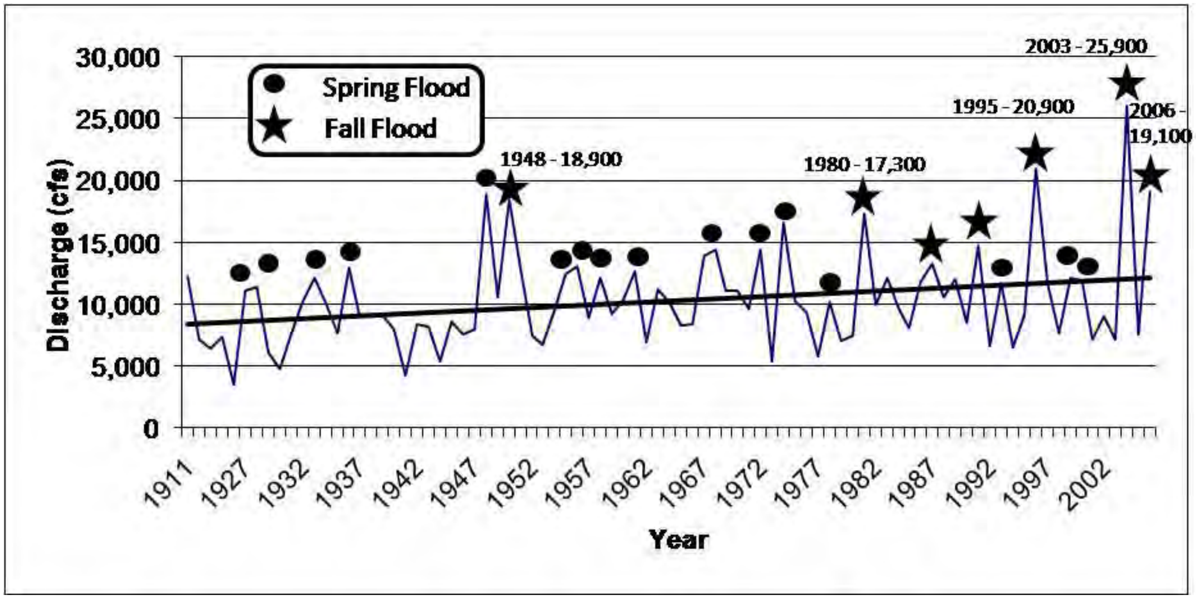


**Figure I-7: Magnitude and Timing of the Annual Peak Flood on the Stehekin River**

The importance of this shift and the two-season nature of flooding on the river is that floods have become larger and more frequent. Analysis of the flood record by the USGS Water Resources Division showed that analyzing the frequency and size of fall floods separately from spring floods—instead of together, as is typically done—gave a more realistic view of how often major floods like those in 1995, 2003, and 2006 might be expected to occur on the Stehekin River (Riedel pers. comm. 2008). Although the length of the record is somewhat limited, floods comparable to these recent large floods might be expected to occur once every 20 years, not once every 100 years, as previously believed (Riedel pers. comm. 2008). When spring and fall flood peaks are looked at separately, it is clear that the high peaks of the fall floods are being obscured by the combination of the spring and fall data, leading to an overall lower prediction of the maximum flood discharge (Table I-2: *Comparison of Two Methods for Estimating Flood Frequency and Magnitude on the Stehekin River*).

Based on analysis of recent flood-related seasonal changes on the Stehekin and other Pacific Northwest rivers, it is likely that the Pacific Northwest will continue to see an increase in the frequency and magnitude of fall flooding related to an increase in winter temperature and increase in eastern Washington rain-on-snow events.

**Table I-2: Comparison of Two Methods for Estimating Flood Frequency and Magnitude on the Stehekin River**

| Recurrence interval (probability in given year) | Discharge (cfs) for combined fall and spring floods (85 events) | Discharge (cfs) for spring floods alone (70 events) | Discharge (cfs) for fall floods alone (16 events) |
|---|---|---|---|
| 10 - year (0.1) | 14,950 | 13,740 | 21,360 |
| 20 - year (0.04) | 17,560 | 15,100 | 26,220 |
| 50 - year (0.02) | 19,490 | 16,190 | 29,850 |
| 100 - year (0.01) | 21,400 | 17,910 | 33,490 |

Note: This approach is used to analyze flood records with mixed fall and spring floods.

## 4. Human Manipulation of Lake Chelan and the Stehekin River

With the construction of the Lake Chelan Dam in the 1920s, flooding in the lower Stehekin Valley began to be influenced by the level of Lake Chelan. The Chelan PUD showed that the backwater effect of Lake Chelan at full pool extends nearly 0.25 mile upstream from the river mouth, effectively raising the 100-year flood event elevation 0.5 foot (Chelan PUD 2000). Within this zone, the backwater effect also likely influences gravel deposition and formation of logjams.

In the years following establishment of Lake Chelan NRA, in response to ongoing bank erosion and threats to private lands and NPS facilities, the NPS and private landowners have reacted to erosion and flooding on the Stehekin River on a case-by-case basis by installing numerous structures. Extensive bank treatments were first placed in the 1960s by the filling of Lake Chelan at Silver Bay and placement of rip-rap at the Stehekin River Resort, as well as the construction of the 400-foot-long crib and levee at upper Company Creek Road in the 1980s. In response to gravel deposition at McGregor Meadows during large floods, the NPS has placed 10 rock barbs since 1995 to protect the upper Company Creek Road.

A recent inventory identified 46 sites with bank stabilization measures, including 15 locations with rip-rap, 14 sites with cabled logs (two of these also have rip-rap), and four locations with log-cribbing or logjams. Bank barbs have become the favored approach to bank-erosion problems in the past 15 years due to their effectiveness and relatively low cost. There are now 8 sites on the river with a total of 30 bank barbs installed, primarily to protect public roads (Riedel pers. comm. 2008). Most are concentrated in the unstable gravel deposition zone near the McGregor Meadows / Company Creek Road area (13 structures on both sides of the river). Because gravel deposition raises the elevation of the riverbed, bank barbs can become buried and ineffective. Five of the bank barbs installed since 1995 on the Stehekin are hydraulically ineffective less than 15 years after installation. The burial of these bank barbs is not unusual on mountain rivers that carry massive amounts of gravel.

Together, all of the erosion structures affect approximately 8,211feet (1.56 miles) of Stehekin River shoreline, or approximately 6.5 percent of the river within Lake Chelan NRA.

**Photo 9 – Stehekin Valley Road at Milepost 10 after the 2003 Flood**

## C. RELATIONSHIP TO OTHER PLANS

This section includes laws, regulations, executive orders, National Park Service Policy, and North Cascades NPS Complex planning documents and studies applicable to the SRCIP.

### 1. LAWS: LAKE CHELAN

**Lake Chelan National Recreation Area Enabling Legislation (Public Law 90-544) (selected sections) (see Appendix 1**: Lake Chelan Enabling Legislation for the legislation in its entirety). This legislation established the Lake Chelan NRA, identified its key purposes, and provided the basis for land exchanges.

> Title III, section 301:
> Within the boundaries of …the recreation areas, the Secretary of the Interior…may acquire lands, waters, and interests therein by donation, purchase with donated or appropriated funds, or exchange, except that he may not acquire any such areas within the recreation areas without the consent of the owner, so long as the lands are devoted to uses compatible with the purposes of this Act. Lands owned by the State of Washington or any political subdivision thereof may be acquired only by donation.

> In exercising his authority to acquire property by exchange, the Secretary may accept title to any non-Federal property within the boundaries of the park and recreation areas and in exchange there for he may convey to the grantor of such property any federally owned property under his jurisdiction in the State of Washington which he classifies as suitable for exchange or other disposal. The values of the properties so exchanged either shall be approximately equal, or if they are not approximately equal the values shall be equalized by the payment of cash to the grantor or to the Secretary as the circumstances require.
>
> Title IV, section 402 (a):
> The Secretary shall administer the recreation areas in a manner which in his judgment will best provide for (1) public outdoor recreation benefits; (2) conservation of scenic, scientific, historic and other values contributing to public enjoyment; and (3) such management, utilization, and disposal of renewable natural resources and the continuation of such existing uses and developments as will promote or are compatible with, or do not significantly impair, public recreation and conservation of the scenic, scientific, historic or other values contributing to public enjoyment.

Appropriations Bill for the Department of the Interior, H.R. 1977, Title I, Section 117 (1996)

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

## 2. Laws: National Park Service

### National Park Service Organic Act (1916) (16 USC 1)

The Organic Act (NPS Organic Act, 16 USC 1) established the NPS and the purpose of national parks. Unless their enabling legislation states otherwise, the Organic Act applies to all units of the national park system, including Lake Chelan NRA.

> The National Park Service shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified…by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

See also Appendix 15: Laws, Regulations, and Policies Whitepaper.

### 1970 National Park Service General Authorities Act (as amended) (Public Laws 91-368, 94-458, and 95-250—the Redwood Act) (16 USC 1a et seq.)

This act prohibits the NPS from allowing any activities that would cause derogation of the values and purposes for which the parks have been established (except as directly and specifically provided for by Congress in the enabling legislation for the parks). Therefore, all units are to be managed as national parks, based on their enabling legislation and without regard for their individual titles. Parks also adhere to other applicable federal laws and regulations, such as the Endangered Species Act (ESA), the Clean Water Act (CWA), the NHPA, the Wilderness Act, and the Wild and Scenic Rivers Act. To articulate its responsibilities under these laws and regulations, the NPS has established management policies for all units under its stewardship (see ―7National Park Service Policies" and Appendix 15: Laws, Regulations, and Policies Whitepaper).

## 3. OTHER FEDERAL LAWS

### National Environmental Policy Act (Public Law 91-190) (42 USC 4341 et seq.)

NEPA requires the identification, documentation, and public disclosure of the environmental consequences of federal actions. Section 102 of the act requires that “in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment, there be a detailed statement concerning the environmental impact of a proposed action.” Regulations implementing NEPA are set for by the President’s Council on Environmental Quality (CEQ) (40 CFR Parts 1500 - 1508). CEQ regulations establish the requirements and process for agencies to fulfill their obligations under the act.

NEPA sets up a procedural requirement for the preparation of environmental impact statements. An EIS requires public involvement throughout the decision-making process. In an EIS, the impacts of the proposed action and the alternatives to the proposed action are clearly presented to enable a clear basis for choice from among the options by the decision maker and the public.

The NPS has adopted specific procedures for analyzing environmental impacts and complying with NEPA (*Director’s Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* [NPS 2001a]). See also Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Clean Water Act (Public Laws 92-500 and 95-217) (33 USC 1241 et seq.)

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Clean Air Act (as amended) (Public Law 88-206) (42 USC 7401 et seq.)

The Clean Air Act (CAA) states that park managers have an affirmative responsibility to protect park air quality and air quality-related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse air pollution impacts. Special visibility-protection provisions of the CAA also apply to Class I areas, including new national rules to prevent and remedy regional haze affecting these areas. Under existing visibility-protection regulations, the NPS has identified “integral vistas” that are important to the visitor’s visual experience in many NPS class I areas, and it is NPS policy to protect these scenic views. North Cascades National Park is a class I area and Lake Chelan NRA is a class II area under the CAA.

### Endangered Species Act (Public Law 93-205) (16 USC 1531 et seq.)

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### National Historic Preservation Act (1966 as amended) (Public Laws 89-665 and 95-515) (16 USC 470)

The purpose of the NHPA is to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of American heritage. The act directs federal agencies to inventory historic properties (Section 110) and to take into account the effect of any undertaking (a federally funded or assisted project) on historic properties (Section 106). Historic property is any district, building, structure, site, or object that is eligible for listing in the National Register of Historic Places because the property is significant at the national, state, or local level in American history, architecture, archeology, engineering, or culture. Requirements for implementing Section 106 are found in the Code of Federal Regulations (36 CFR Part 800).

### Archaeological Resources Protection Act of 1979 (ARPA) (Public Law 96-95) (16 USC 470aa)

This act provides a means for additional protection of archeological resources and for prosecuting the collecting of resources on federal lands. Its purpose is to secure, for the present and future benefit of the American people, the protection of archeological resources and sites that are on public lands and Indian lands (NPS 2006: 5.3.5.3).

### Wild and Scenic Rivers Act (1968) (Public Law 90-542) (16 USC 1271 - 1287)

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (as amended) (Public Law 91-646) (42 USC 4601 et seq.)

This law mandates offering “just compensation” for real property based on a Fair Market Value appraisal, and sets criteria for appraisals. The law also mandates certain land acquisition and relocation benefits, like moving reimbursement, to eligible parties involved with a federal realty acquisition.

#### Federal Land Exchange Facilitation Act of 1988 (Public Law 100-409) (43 USC 1701)

This act sets up a process to “facilitate and expedite land exchanges pursuant to the Federal Land Policy and Management Act of 1976 and other applicable laws for the Departments of the Interior and Agriculture by (a) providing more uniform rules and regulations pertaining to land appraisals which reflect nationally recognized appraisal standards; and (b) establishing procedures and guidelines for the resolution of appraisal disputes.” It also sets up the means “to provide sufficient resources to the Secretaries of the Interior and Agriculture to ensure that land exchange activities can proceed consistent with the public interest” and requires a “study and report concerning improvements in the handling of certain information related to federal and other lands.”

### Land and Water Conservation Fund Act of 1965, as amended (Public Law 88-578) (16 USC 460l et seq.)

This act provides funds for and authorizes federal assistance to the states in planning, acquisition, and development of needed land and water areas and facilities and provides funds for the federal acquisition and development of certain lands and other areas. The amendments (July 15, 1968) provide that the values of the properties shall be approximately equal or may be equalized in part by cash.

## 4. Federal Regulations

Federal regulations applicable to land use and development in Lake Chelan NRA include but are not limited to the following: Minerals Management (36 CFR 9) and Rights-of-Way (36 CFR 14).

### 36 CFR Part 17

This regulation provides the means to identify lands “suitable for disposal” and determines the range of acceptable uses (typically for single-family residential and related outbuildings), with associated deed restrictions and/or protective easement criteria that can be applied to lands in the identified special-use zones. Similar to the Part 18 requirement for a “high-bid” auction, Part 17 requires a similar Fair Market Value appraisal and competitive bidding process. In Part 17, however, the landowner has a right of preference to match the high bidder if the lands are offered for disposal within two years following acquisition. To use this authority in Stehekin, the seller (exchange proponent) is offered the preference via the exchange to take other park land (not public domain lands) in lieu of a cash payment from the NPS for their –offered” lands.

### 36 CFR Part 18: Leasing of Properties in Park Areas

This regulation contains the how-to, step-by-step process for doing NPS land exchanges as generally alluded to in *Director's Order 25: Land Acquisition* (NPS 2001b). It only applies specifically, however, to exchange of historic properties under the NHPA.

When combined with the North Cascades National Park, Lake Chelan NRA, and Ross Lake NRA legislation (Section 302), these regulations provide the practical authority to use 36 CFR Parts 17 and 18 and other applicable authorities for the Secretary to acquire lands within the complex and to exchange lands within Lake Chelan NRA (Stehekin). This legislation is applicable and provides a unique authority outside the more generic references in the Land and Water Conservation Fund Act and in NPS *Director's Order 25* (NPS 2001b).

### 36 CFR Part 800: Advisory Council Regulations

This regulation implements Section 106 of the National Historic Preservation Act.

### 40 CFR Part 1500 - 1508: NEPA Regulations

This regulation implements the National Environmental Policy Act.

## 5. Legal Actions

### United States v. Chelan County CS-92-331-AMM (E.D. Wash.)

This ruling quieted title to Stehekin Valley Road in the name of the United States against Chelan County, and permanently enjoins Chelan County from interfering with the NPS's administration and management of Stehekin Valley Road (NPS 1993a).

## 6. Executive Orders

The following executive orders are among those applicable to land management in the Stehekin Valley.

### Floodplain Management Executive Order 11988 (1977, 42 CFR 26951, PL 93-234 Section I) (as amended by Executive Order 12148, 1979, 44 FR 43239, 42 USC 4321)

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Protection of Wetlands Executive Order 11990 (1977, 42 FR 26961) (as amended by Executive Order 12608, 1987, 52 FR 34617, 42 USC 4321)

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Invasive Species Executive Order 13112 (1999, 64 FR 6183) (as amended by Executive Order 13286, 2003, 68 FR 10619, 42 USC 4321)

This executive order was crafted to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.” It requires federal agencies whose actions may affect invasive species to identify their actions, and to use relevant programs and authorities to:

- prevent the introduction of invasive species;
- detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
- monitor invasive species populations accurately and reliably;
- provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
- conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control … ; and
- promote public education on invasive species and the means to address them.

It also states that federal agencies may not authorize, fund, or carry out actions that will cause or promote the introduction and spread of species unless the agency believes that the benefits of such actions clearly outweigh the harm and has taken all feasible and prudent measures to minimize the risk of harm in conjunction with such actions.

### Facilitation of Cooperative Conservation Executive Order 13352 (2004, 69 FR 52989, 42 USC 4332)

This purpose of this executive order is to ensure that the Departments of the Interior, Agriculture, Commerce, and Defense and the Environmental Protection Agency implement laws relating to the environment and natural resources in a manner that promotes cooperative conservation, with an emphasis on appropriate inclusion of local participation in federal decision making, in accordance with their respective agency missions, policies, and regulations.” In doing so, federal agencies are directed to carry out the programs, projects, and activities of the agency that they respectively head that implement laws relating to the environment and natural resources in a manner that: facilitates cooperative conservation; takes appropriate account of and respects the interests of persons with ownership or other legally recognized interests in land and other natural resources; properly accommodates local participation in federal decision-making; and provides that the programs, projects, and activities are consistent with protecting public health and safety.”

## 7. National Park Service Policies

### NPS Management Policies 2006

*Management Policies 2006* (NPS 2006a) governs the way park managers make decisions on a wide range of issues that come before them. Excerpts from several sections applicable to this plan are highlighted below.

**Photo 10 – Stehekin River near Buckner Homestead Hayfield and Pasture during a Fall Flood**

## Section 3.3, Land Protection Plans

> …Land Protection Plans (LPPs) should be prepared to determine and publicly document what lands or interests in land need to be in public ownership and what means of protection area available to achieve the purposes for which the unit was created…
>
> Land acquisition priorities will be guided by a park unit's land protection plan. Superintendents will ensure that land protection plans are developed, and periodically reviewed and updated to identify what land or interests in land would facilitate achieving desired park purposes…

## Section 4.3.4, National Wild and Scenic Rivers System

> …No management actions may be taken that could adversely affect the values that qualify a river for inclusion in the National Wild and Scenic Rivers System.

## Section 4.6.4, Floodplains

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Section 4.6.6, Watershed and Stream Processes

See Appendix 15: Laws, Regulations, and Policies Whitepaper.

### Section 9.2.1.1, Park Roads

> Park roads will be well constructed, sensitive to natural and cultural resources, reflect the highest principles of park design, and enhance the visitor experience. Park roads are generally not intended to provide fast and convenient transportation; rather, they are intended to enhance the quality of a visit while providing for safe and efficient travel with minimal or no impacts on natural and cultural resources. For most parks, a road system is already in place. When plans for meeting the transportation needs of these parks are updated, a determination must be made as to whether the road system should be maintained as is, reduced, expanded, reoriented, eliminated, or supplemented by other means of travel. Before roads are chronically at or near capacity the use of alternative designation points or transportation systems or limitations on use will be considered as alternatives to road expansion.
>
> Park road designs are subject to NPS Park Road Standards, which are adaptable to each park's unique character and resource limitations. Although some existing roads do not meet current engineering standards, they may be important cultural resources whose values can and should be preserved with attention to visitor safety.

### Section 9.4.4, Maintenance Structures

> Maintenance structures will be consistent in design, scale, texture, and details with other park facilities. Optimally, they will be screened or located in areas remote from public use…

### Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making

This order identifies the standards to which NPS environmental analysis documents, including categorical exclusions, environmental assessments (EAs), and EISs, must comply. It contains a list of applicable Departmental (Interior) and agency (NPS) categorical exclusions.

### Director's Order 25: Land Protection

This order articulates the framework for land protection and the process for the acquisition of land and interests in land within the authorized boundaries of units of the NPS. It summarizes applicable information from *Management Policies 2006* (NPS 2006a) and sets forth other requirements and responsibilities as they relate to the NPS's land protection program.

### Director's Order 87A: Park Roads and Parkways

> The fundamental purpose of national parks …dictates that the quality of the park experience must be our primary concern. Full enjoyment of a national park visit depends on its being a safe and leisurely experience. The distinctive character of park roads plays a basic role in setting this essential unhurried pace. Consequently, park roads are designed with extreme care and sensitivity with respect to the terrain and environment through which they pass—they are laid lightly onto the land (p. 7).

> Each segment of every park road should relate to the resource it traverses in a meaningful way and should constitute an enjoyable and informative experience in itself while providing the visitor the utmost in visual quality…The horizontal and vertical alignment and cross-section should respect the terrain, blending into the environs…The purpose of park roads remains in sharp contrast to that of the federal and state highway systems. Park roads are not intended to provide fast and convenient transportation; they are intended to enhance visitor experience while providing safe and efficient accommodation of park visitors and to serve essential management access needs (p. 7).
>
> Park roads are constructed only where necessary, and only as necessary to provide access for the protection, use and enjoyment of the natural, historical, cultural and recreational resources which constitute our National Park System. National park roadways, where they exist, are planned for leisurely sightseeing and are located with sensitive care for the environment and designed with extreme care. They are often narrow, winding, and hilly—but therein may lie their appeal… (p. 13).
>
> Thus park roads are often an end in themselves, rather than just a means to an end, in contrast to more conventional highway systems. For some, such as the handicapped, roads may provide the only means of park use, thereby reinforcing the case for their being intimately blended with the resource. Where terrain and safety conditions permit and where such uses are advocated by the general management plan, opportunities should be provided for random stopping to enable park visitors to more completely experience the park resources (p. 13).

## 8. North Cascades National Park Service Complex Plans

### Lake Chelan National Recreation Area Executive Summary, Final General Management Plan / Environmental Impact Statement

The final GMP executive summary (NPS 1995c) identifies the key features and actions associated with the selected alternative in the GMP. Because it is derived from the GMP, it contains the vision for Lake Chelan NRA:

> The rustic setting of Lake Chelan (LACH) would be part of a transition from the down lake recreational, residential, agricultural, and industrial setting to the very wild and natural North Cascades National Park. The use of LACH resources by visitors and residents would be limited to preserve the natural, scenic, and cultural values of the area. (NPS 1995c: 5).

### Lake Chelan National Recreation Area Final General Management Plan / Environmental Impact Statement

The final GMP (NPS 1995a) provides some additional detail about the management objectives and corresponding actions that would be undertaken in Stehekin. This plan identifies the following management objectives associated with the management of Lake Chelan that would be implemented or clarified by the SRCIP.

**Natural Resource Management**: The NPS would

- manage Lake Chelan NRA as an integral part of a larger regional ecosystem and protect and restore the components and processes of naturally evolving park ecosystems, including the natural abundance, biodiversity, and ecological integrity of plants, animals, water, and soil to the extent public safety considerations permit (NPS 1995a:19).

- not manipulate the Stehekin River to protect federal property except that it would protect roads in erosion / river conflict zones [if certain criteria were met] (NPS 1995a:20).
- not manipulate the river to protect private property [but would also not take action] to prevent private owners from manipulating the river on their land to protect their property unless [they] would significantly harm recreation area resources or were in violation of local, state, or federal ordinances, regulations, or laws (NPS 1995a:20).
- manipulate woody debris in the Stehekin River or its tributaries only to protect public roads and bridges according to the criteria above (NPS 1995a:21).
- work with the county to encourage private property owners to protect natural river processes…. The highest priority would be placed on acquiring lands through exchange or purchase, that are threatened by or where development threatened natural river processes (NPS 1995a:21).
- [encourage property owners] to minimize impacts on wetland, floodplain, shoreline or riparian areas (NPS 1995a:21).
- [relocate] NPS structures that could be threatened by river processes (NPS 1995a:23).
- [bring campgrounds in regulatory floodplains] into compliance with floodplain guidelines (NPS 1995a:23).
- [encourage property owners] to minimize impacts on wetland, floodplain, shoreline, or riparian areas. The NPS would take appropriate measures where actions threatened to cause significant impacts on wetland, floodplain, shoreline, or riparian areas (NPS 1995a:23).
- restrict mining to the Company Creek borrow pit for NPS maintenance and public use and minor reconstruction only; [and] allow for importing of material from outside the valley for new construction (NPS 1995a:23).
- [conserve and recycle sand, rock, and gravel] whenever possible (e.g., consider conservation through maintenance and road system design. No sand, rock, or gravel would be removed from the 100-year floodplain of the Stehekin River or its tributaries (NPS 1995a:24).
- [restore the] natural character of the lake and river edge on public lands, [including] areas within 200 feet of the lake and river shoreline (NPS 1995a:27).

**Visitor Experience**: The NPS would

- [pave the Stehekin Valley Road] from the Landing to 9-mile (NPS 1995a:30).
- [manage the Stehekin River] as a dynamic natural system…. Opportunities for visitors to appreciate the power and intricacy of the river as a natural system would be enhanced (NPS 1995a:30).

**Land Use and Development**: The NPS would

- Provide transportation and access to, from, and within the NRA to accomplish a quality visitor experience, fulfill resource management objectives, and meet local Stehekin Community needs (NPS 1995a:32 - 33).
- [maintain] the current character (slow leisurely pace) and surface (chip seal) of the main valley road from [the] Landing to Harlequin Bridge (NPS 1995a:33).

- [pave and reduce] to a single-lane (12 - 14 feet wide) with pullouts that would be visible from both directions (18 feet wide; 30 - 35 feet long) [the road between Harlequin Bridge and 9-mile] (NPS 1995a:33).
- [maintain] Company Creek Road … in its current alignment and condition (NPS 1995a:34).
- [develop] an 11-mile pedestrian and horseback trail … from the Landing to High Bridge; sensitive areas would be avoided to minimize impacts. It would be marked and maintained as a cross-country ski route as well. A pedestrian and horseback riding trail system that connects key lower valley features to the Stehekin Valley Road would also be developed (NPS 1995a:34).
- [improve Weaver Point dock facilities] to accommodate the Purple Point dock and allow seasonal moving of the dock between Purple Point and Weaver Point (NPS 1995a:34).
- [retain all NPS campgrounds] (NPS 1995a:39).
- [consolidate some NPS and concession housing] in clustered sites beside the airstrip, based on environmental parameters and in compliance with compatibility criteria (NPS 1995a:39).
- [relocate NPS vehicle fuel storage / dispensing to the airstrip] (NPS 1995a:39).
- [locate maintenance facilities near the airstrip] (NPS 1995a:40).

**Park Operations**: The NPS would

- provide road maintenance for all designated public roads including the Stehekin Valley Road … (including snow removal 9 miles upvalley) (NPS 1995a:48).
- strengthen working relationships with others, defining shared objectives and developing strategies that lead to cooperative agreements for the management of natural, scenic, cultural, and recreational resources (NPS 1995a:48).

See also Appendix 2: Management Objectives and Actions in the Lake Chelan NRA GMP Applicable to the SRCIP and Appendix 15: Laws, Regulations, and Policies Whitepaper for more information on the GMP.

## Lake Chelan National Recreation Area Land Protection Plan

This plan (NPS 1995b) has been revised as part of Alternatives 2, 3, and 4 in this DEIS.

The LPP's purpose is to:

- Determine what land or interests in land need to be in public ownership, and what means of protection other than fee acquisition are available to achieve unit purposes as established by Congress.
- Inform landowners about NPS intentions for buying or protecting land through other means within the unit.
- Help managers identify priorities for making budget requests and allocating available funds to protect land and unit resources.
- Find opportunities to help protect the unit by cooperating with state or local governments, landowners, and the private sector.

The Lake Chelan LPP includes six management objectives to meet the overall goal to ensure that land uses on public and private lands are compatible with the purpose of the park, and 13 guidelines that form the basis for implementing the plan (Appendix 2: Management Objectives and Actions in the Lake Chelan NRA GMP Applicable to the SRCIP).

The LPP also identified compatibility criteria that assist in determining how uses contribute to or detract from the purposes of Lake Chelan NRA. The compatibility criteria were first identified in 1988, and then updated in 1992 and in 1995. Four purposes guide the application of the compatibility criteria:

- To identify uses that would harm, degrade, or adversely affect resource values of Lake Chelan NRA.
- To identify proposed types and levels of land uses that would harm resources when cumulative effects are considered in the context of previously established uses.
- To encourage uses that would enhance resource values and the general character of the valley.
- To encourage conversion from a higher-impact land use to a lower-impact land use (NPS 1995b:12 - 13).

Residents may ask the Complex superintendent for a compatibility determination and should receive a letter within 45 days, subject to a 30-day extension for more information, if needed.

Land use protection techniques detailed in the LPP include agreements (cooperative and overlay district), regulations, and various methods of acquisition (fee, easement, donation, exchange, purchase, purchase and sellback, reservation of life or term estates, and condemnation). Priorities (high, medium, and low) are also established.

### Lake Chelan National Recreation Area Stehekin Landing and Valley Development Concept Plan

These combined plans (NPS 1995d) prescribe NPS development plans for the Stehekin Landing, Stehekin Valley (roads, trails, and transportation services), and the Airstrip area.

### Sand, Rock, and Gravel Plan

This plan (NPS 1995e) stipulated that no sand, rock, or gravel would be removed from the 100-year floodplain of the Stehekin River or its tributaries and that material needed for construction would be barged in. Guidelines include the following:

> Allow mining of sand, rock and gravel in Stehekin Valley but restrict mining to the Company Creek borrow pit for NPS maintenance and public use and minor reconstruction only; allow for importing of material from outside the valley for new construction. (NPS 1995a:23)
>
> Sand, rock and gravel will be conserved and recycled whenever possible (e.g., consider conservation through maintenance and road system design). (NPS 1995a:24)
>
> To ensure conservation of sand, rock and gravel, the National Park Service proposes to limit the use of in-park material to 1,400 cubic yards per year: 1,200 cubic yards for NPS use and 200 cubic yards per year for private use over a proposed 10-year excavation cycle—i.e., in the event of a large flood, the remaining 10-year stockpile could be used in one year… The superintendent will have the option to exceed the established limit in the event of an emergency such as a major flood. (NPS 1995e:10 - 11).

The plan projected that the paving of the Stehekin Road from Harlequin Bridge to Milepost 9.0 would reduce gravel use, but anticipated that road repairs would continue to be required following flood events. It did not address specific projects, such as relocating the road farther away from the river. It does specify when and for what purposes material from the local Company Creek Pit in Stehekin may be used (NPS 2005a:7).

The Sand, Rock, and Gravel Plan is related to the current proposed project because some material from the local Company Creek Pit would be used for certain aspects of the project. Because the proposal would need to comply with the plan, material from this source could only be used in certain instances, such as to repair flood-damaged road sections. In this plan, material that has been determined to be excess to Lake Chelan NRA needs (oversize material and some screened material) could also be used. Much of the earth-related material needed for the current project, however, would come from road reroutes or would be barged in from an outside source (NPS 2005a:7).

## Lake Chelan National Recreation Area Transportation Plan

**Campgrounds**: All campgrounds will be retained. Weaver Point Campground will be expanded and some sites will be moved back from the shoreline. Campsites will be low density, unobtrusive and safe, with ample screening. Water will be provided and all sites will have access to pit or composting toilets. will be removed from hazardous areas as necessary. (NPS 1995f:2)

**Stehekin Valley Road**: The transportation plan repeats the language in the GMP regarding the Stehekin Valley Road (see ―Land Use and Development” section above).

**Company Creek Road**: Company Creek Road will be maintained in its current alignment and condition. Erosion control systems along the upper Company Creek Road will be removed and replaced, designed to keep the road from eroding during frequently recurring flood events (i.e., 10- to 25-year recurrence interval), and will be made from rock, soil, and native vegetation …

Public roads below Cottonwood will be protected in active river erosion zones only if (1) there are no feasible alternatives, (2) funds are available, (3) the actions will have less impacts than other alternatives, and (4) the actions are permitted by county, state, and other federal agencies. No new road construction will be permitted in active river conflict zones. (NPS 1995f:9)

**Trails**: The Transportation Plan repeats the GMP language (see above) and adds the following:

Some old and abandoned road alignments may be converted to new trail loops in the lower valley. (NPS 1995f:9 - 10)

One new trail system, from the Castle area to the river trail, will be developed, including a suspension bridge just below the confluence of Boulder Creek. (The existing river trail connects the Weaver Point and Harlequin Bridge areas). (NPS 1995f:10)

The use of bicycles on roads will be encouraged, but bicycles will not be allowed on pedestrian trails except on connections to features and in some campgrounds. (NPS 1995f:10)

**Maintenance Facility**: A new maintenance facility will be constructed near the airstrip, including shuttle bus storage and maintenance, equipment, a repair building, a search and rescue fire cache, and a helicopter pad. Hazardous material, propane, and gasoline storage and NPS vehicle fuel storage and dispensing will also be relocated to the airstrip area in a safe area outside the 500-year floodplain. The future use or removal of the existing maintenance facility has yet to be determined; however, any use would be compatible with floodplain management guidelines. (NPS 1995f:13)

### Lake Chelan National Recreation Area Forest Fuel Reduction Plan / Firewood Management Plan

The Forest Fuel Reduction Plan (NPS 1995g) was developed and implemented to reduce forest fuel accumulation in selected coniferous stands in the Stehekin Valley. The goals are to protect the safety of human life and property in the valley, to protect natural and cultural resources, to restore the forest to a late successional stage, and to protect old growth forest, particularly ponderosa pine. The plan provides for selective thinning and use of management-ignited controlled fires to reduce the fuel supply and risk of wildfires. It specifies the disposition of firewood obtained from tree thinning and also provides for long-term monitoring of the program to evaluate management actions (NPS 2005e:7).

The Stehekin Valley Road is the main route that would be used by visitors or residents to exit the Lake Chelan NRA in the event of a wildfire. Maintenance of the road is an important part of the strategy to protect Lake Chelan NRA users and local citizens from wildfire and structural fires. This is also the route that would be used to bring in equipment and personnel to fight wildfires in this area. Thus, protection of the road from wildfire is an important part of the strategy to protect resources and personal property in this area. As part of the fuel management program, management-prescribed and controlled fires are set and thinning of the forest are methods used to reduce fuels in the valley and to maintain a healthy late successional forest. NPS also conducts wildfire-suppression activities through its forest fuel reduction program (NPS 1995a).

## 9. Company Creek Road Environmental Assessments 1989 - 2007

See Appendix 5: Cumulative Impacts Project List.

## 10. Stehekin Valley Road Environmental Assessments 1993 - 2007

See Appendix 5: Cumulative Impacts Project List.

### Stehekin Valley Road Improvement Project Environmental Assessment

This EA included actions on 5 miles of the road from Harlequin Bridge to below High Bridge, including paving, reroutes (1,100 feet and 2,200 feet in length), raising of the road surface, and drainage improvements at specific locations, including repair of culverts, installation of bank protection, and installation of new barbs.

There are some measures that have not yet been implemented from the selected action in the *Stehekin Valley Road Implementation Project Environmental Assessment* (NPS 2005a) that would be included in all alternatives in the SRCIP. Implementation of some portions of the Road Improvement Project EA were put on hold because immediately following the preparation of the Road Improvement Project EA, a second 100-year flood occurred on the Stehekin River in 2006 and it became clear to NPS and FHWA staff that surfacing, rehabilitation and raising sections of the Stehekin Valley Road were not going to be enough to prevent future damage to the roadway. As a result, the NPS began implementation of some actions from the EA but postponed implementation of others to undertake a more comprehensive analysis of the Stehekin River corridor to determine what actions would best protect public facilities and allow continued access to private property with respect to the apparent flood regime changes on the Stehekin River.

Those measures that have not yet been implemented from the selected action in the Stehekin Valley Road Improvement Project Environmental Assessment and FONSI (NPS 2005a) would either be included in all alternatives or have been modified in the action alternatives based on new information and are explained below. Impacts of these modified actions are the same as were described in that EA/FONSI.

These measures include rehabilitation of the road from Harlequin Bridge to Milepost 9.2, surfacing of the road, installing erosion protection measures at Milepost 5.3 (Wilson Creek), and construction of new pullouts and a winter turnaround / parking area. Because of the proposed reroutes, other measures from that EA, such as the grade raise in McGregor Meadows, would only be implemented as part of Alternative 1 or 4 (see ―Description of Alternatives 1 - 4” for each alternative discussed in Chapter II: Management Alternatives).

The following actions were implemented as noted:

- (2006) Milepost 7.0: permanent reroute of approximately 1,000 feet (0.19 mile) following emergency reroute (constructed after October 2003) moved farther away from river. Revegetation also completed from Milepost 7.0 to 7.5.
- (2006) Milepost 7.5: reroute road farther from Stehekin River (2,300 feet, or 0.44 mile).
- (2007) Milepost 8.0: repair and reinforce existing stream bank revetment; install four new barbs downstream of two existing barbs.
- (2005) WeavTel
- (2003) Courtney-Kellers Park Land Exchange
- (2003) Griffith Cabin Housing Replacement

## 11. Other Related Environmental Assessments

### Finding of No Significant Impact: Acquisition of Interest in Private Land in the Stehekin Valley Environmental Assessment

Under this EA/ Finding of No Significant Impact (FONSI) (NPS 2003a), the NPS acquired 5.0 acres of private land (Tract 04-103) near the head of Lake Chelan to protect high resource values and exchanged 7.15 acres of federal land (Little Boulder/Boulder creeks) (Tract 05-131) previously identified in the 1995 LPP (NPS 1995b) as potentially available for exchange. This action was undertaken to provide protection of river dynamics and natural processes within the floodplain of the Stehekin River.

## 12. North Cascades National Park Service Complex Studies

**Stehekin River Floodplain Mapping**: In 1993, the NPS updated and corrected the 1981 FEMA floodplain map by adding 14 cross sections upstream, recalculating Manning’s roughness values, and by using a more accurate base map (NPS 1993b). This map was not adopted by Chelan County/FEMA, but was used in development of the 1995 GMP (NPS 1995a) and other actions.

**Large Woody Debris**: In the 1980s, the NPS commissioned a study of large wood accumulations that resulted in a report by Mason and Koon (1985). Following up on this study, NPS repeated large wood inventories in 2000 and 2007.

**Stehekin River Inventory Report**: In 2004, NPS published a technical report on the results of several inventory and monitoring programs on the Stehekin River (NPS 2004b).

**Sediment Yield**: A study by NPS and Chelan PUD in 2001 compared 1978 and 2000 Chelan PUD surveys at the river mouth to assess vertical changes in the Stehekin River bed (Chelan PUD 2001a). The NPS estimated annual sediment yield at 25,000 cubic yards per year, with about 17 percent, or 5,600 cubic yards, of that contained in bed load.

**Backwater Effect of Lake Chelan**: Chelan PUD studied the effect of the manipulated level of Lake Chelan on flooding and backwater in the lower Stehekin River (Chelan PUD 2001b). The study was based on a one-dimensional hydraulic model, and indicated that a backwater effect extends at least 0.25 mile up the river from the lake and increases the 100-year flood elevation by approximately 0.5 feet.

**Flood Frequency Analysis**: In 2008, the USGS reanalyzed the flood data for the Stehekin River to update analyses used in the 1997 Company Creek EA. The analysis was revisited using the flood data from large events in 2003 and 2006, and a new approach that separated spring and fall flood events for statistical analysis of magnitude and frequency. As a result, this analysis provided a return interval of 20 years for the 200,000 cfs flood, in contrast to the 100-year return interval used in the 1981 FEMA study.

**Information Summaries**: In addition to these studies, there were two ―white papers" prepared to summarize the status of information on various resources for the SRCIP: *Laws, Regulations, and Policies* (Zipp 2008; see Appendix 15) and *Current Knowledge Base* (Riedel 2009; see Appendix 16).

## 13. OTHER APPLICABLE ORDINANCES AND PLANS

## STATE OF WASHINGTON

### Washington State Department of Fish and Wildlife

Washington State Hydraulic Code: see Appendix 15: Laws, Regulations, and Policies Whitepaper.

## CHELAN COUNTY

### Chelan County Comprehensive Plan

Under Chelan County zoning regulations, the Stehekin Valley is in a general-use zone, where single-family residential is the primary use. Property owners, however, can petition the county for a conditional-use permit to use land for other than residential purposes. These petitions are considered on a case-by-case basis. Consideration involves public hearings before the board of adjustment (NPS 1995c:8).

### Chelan County Code, Flood Hazard Development

Development in flood hazard zones is limited by Chelan County.

#### *Section 3.20.040 Purpose*

It is the purpose of this chapter to promote the general public health, safety, and welfare, and to minimize public and private losses due to flood conditions in specific areas, by providing standards designed to

- Protect human life and health;
- Minimize expenditure of public moneys and reduce the need for uneconomical flood-control projects;
- Minimize the need for rescue and relief efforts associated with flooding and usually undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities, such as water and gas mains and electric, telephone, and sewer lines, and streets and bridges located in flood hazard areas;

- Help maintain a stable tax base by providing for the sound use and development of flood hazard areas so as to minimize future flood loss;
- Ensure that potential buyers are aware that the property is located in a flood hazard area;
- Ensure that those who occupy the flood hazard areas assume responsibility for their own actions; and
- Satisfy the requirements established by the Federal Emergency Management Agency, as failure to do so would jeopardize federal financial support to the county and its citizens. (Res. 99-91 (part), July 6, 1999; Res. 89-56 Section 106, May 30, 1989).

#### Chelan County Emergency Resolution #2007-42

On March 12, 2007, Chelan County issued an Emergency Resolution (#2007-42) declaring an “imminent danger at several locations in the Stehekin River and upper Lake Chelan due to increased flooding risk.” The purpose of the Resolution was to “request that the Washington State Department of Fish and Wildlife issue an expedited written permit to perform work to reduce the flooding risk in the Stehekin Community.” The Resolution identified several specific locations for flood protection measures, including upper Company Creek Road, based on concerns voiced by landowners and recommendations provided by the Corps of Engineers, Emergency Management Division (NPS 2007:10 - 11).

## D. SUMMARY OF PUBLIC SCOPING

### 1. OVERVIEW

Public involvement is a key component of the NEPA process. In this part of the process, the general public, federal, state, and local agencies and organizations are provided an opportunity to identify concerns and issues regarding the potential effects of proposed federal actions. The opportunity to provide input is called “scoping.”

Internal scoping engaged professional staff of Lake Chelan National Recreation Area and the North Cascades National Park Complex and other NPS offices (Pacific West Region and Denver Service Center) to provide information regarding proposed actions that could affect Lake Chelan NRA resources. Internal scoping by NPS staff began in fall 2007. A variety of concerns were identified regarding vegetation, wildlife, maintenance, water resources, cultural resources and planning through participation in a formal internal scoping meeting held from October 28 -31, 2007. Comments were also solicited formally and informally from park and federal highway planning team members, from other agency staff, and from the technical committee. Internal scoping continued throughout the development of this DEIS.

As a key step in the overall conservation planning and environmental impact analysis process necessary for achieving the goal of partnering to achieve coordinated Stehekin River management, the NPS sought public comments and relevant information to guide the preparation of the DEIS. Among the objectives of this public scoping were to:

- Invite participation from federal, tribal, state, local governments and other interested parties;
- Inform all interested parties about the scope of the problem and the need to find solutions;
- Identify a preliminary range of management alternatives (in addition to a no-action alternative that would be used as a baseline of existing conditions from which to evaluate proposed changes in management);

- Identify substantive environmental (including natural, cultural, recreational and socioeconomic) issues which warrant detailed environmental impact analysis, and eliminate issues or topics which do not require analysis; and
- Identify potential environmental consequences and suitable mitigation strategies.

Public scoping was conducted through the following means: a press release describing the intent to begin the public involvement process through comments on the proposed project was issued on January 7, 2008; a newsletter was distributed to approximately 350 people on the park's mailing list and was available in park visitor centers; and it was announced via the park's website in January. In addition the formal Notice of Intent to prepare an EIS was published in the Federal Register on February 27, 2008.

The public outreach called for by Section 106 of the NHPA has been integrated into the NEPA process in accordance with the NPS *Programmatic Agreement* and *Management Policies* (2006a).

Informal preliminary scoping for the Stehekin River Corridor Implementation Management Plan Environmental Impact Statement began on January 22, 2008. During scoping, the NPS held three open house public meetings in Stehekin (January 22, 2008), Wenatchee (January 23, 2008) and Seattle (January 24, 2008). All parties wishing to express concerns or provide information about management issues which should be addressed in the forthcoming conservation planning and environmental impact analysis process were strongly encouraged to submit written comments.

Professional staff, including some members of the technical committee, was available to introduce the project, give presentations on scientific data, answer questions, and to accept comments. The public was encouraged to provide comments during the meetings and/or to submit written comments. The meetings were attended by approximately 73 people. There were 84 comments made at the Stehekin Public Meeting by 23 people who signed in, 73 comments made at the Wenatchee Public Meeting by 26 people who signed in, and 69 comments made at the Seattle Public meeting by 24 people who signed in.

Twenty-one public comment letters were also received: 16 from individuals, 3 from nonprofit organizations (The Wilderness Society, National Parks Conservation Association, North Cascades Conservation Council), 1 from the Environmental Protection Agency, and one from a business (Stehekin River Resort). These were received via PEPC (3 letters), U.S. mail (12), and/or email (6) and fax. Several were received both via email and U.S. mail and one was received via U.S. mail and fax. These public comment letters included approximately 216 comments. One letter was mailed from California, all of the others listed Washington State addresses. Eight letters/emails identified a Stehekin address, two other individuals submitting letters/emails identified themselves as Stehekin property owners.

Comments were submitted directly to the park at the following address:

> North Cascades National Park Service Complex, Attn: SRCIP-EIS, 810 State Route 20, Sedro-Woolley, WA 98284. Comments were also submitted via the NPS Planning Environment and Public Comment (PEPC) website at *http://parkplanning.nps.gov/noca* or sent via e-mail to the superintendent, project manager or *NOCA_planning@nps.gov*. Information about the planning process was regularly updated and posted on the park's website: *www.nps.gov/noca* and on PEPC.

## 2. Summary of Concern Statements

### Public Scoping

The public comments from both the meetings and the letters (456) were sorted into 26 different categories, three of which were further split to reflect the diversity of comments received. These ultimately resulted (from additional sorting and combining) in the 128 concern statements listed below plus the ones listed in the lower section that were considered but dismissed, or were outside the scope of the proposed plan. The comments have become part of the public record.

#### Purpose and Need (3 comments)

- The purpose and need should conform to NEPA and its implementing regulations.

#### Alternatives (6 comments)

- The alternatives should conform to NEPA and its implementing regulations.
- Alternatives that include heavy-handed manipulation of the Stehekin River are probably not within the scope of the plan.

#### Vision/Philosophy (37 comments)

- The plan should be holistic in its approach and should articulate clear goals and objectives that result in sustainable long-term management strategies.
- The SRCIP should identify and justify its area of potential effects.
- The alternatives should identify a wide range of management strategies to accomplish the purpose and need. Implementation of the alternatives will necessarily include tradeoffs.
- The plan should balance the need for resources with effective management strategies that generate them. In doing so, it should involve the Stehekin Community.
- Scientific understanding of the effects of climate change should be applied to determining the vision for management.
- The plan should be comprehensive.
- The plan should identify criteria for valley development and have as its goal allowing for appropriate development while maintaining natural processes.
- The Stehekin Valley and Community were included in the national park system as part of Lake Chelan NRA because they are of national significance. Notwithstanding development, the protection of Stehekin resources should be a high priority to preserve for future generations.
- The Stehekin Community is a unique resource recognized by the enabling legislation for Lake Chelan NRA.
- The Stehekin River should not be modified to preserve or limit flooding effects on private property.
- There is an inherent conflict between preserving the Stehekin Community and allowing natural flooding to occur on the Stehekin River.

- The goal of the plan should reflect a long-term balance between allowing natural processes to continue unimpeded and allowing for appropriate sustainable (flood-protected) development, including safe public recreation, facilities, and private lands.
- There appears to be a conflict between the erosion control and flood protection actions NPS has taken in the Stehekin Valley and its assertion that it cannot act or expend funding to protect private property.
- Although NPS asserts that the original goal to remove private development from the main valley corridor is no longer valid, actions taken by NPS to protect Company Creek Road appear to be implementing that goal.
- The plan should include actions that would resolve issues in the whole lower valley.
- The plan should balance private property protection and fish habitat with respect to the accumulation of large woody debris.

## Alternative Focus (4 comments)

- One alternative should focus on minimal disturbance to natural systems.

## Impact Topics (44 comments)

### *Socioeconomic / Cumulative Impacts*

- Land exchanges may affect the value of land in Stehekin or encourage speculation.
- A cumulative effects analysis of previous efforts by NPS and private landowners to install erosion and flood protection measures should be included. These measures have exacerbated the consequences of flooding on private property.
- A comprehensive analysis of the costs of the alternatives, encompassing the cost of purchasing remaining private lands, in comparison to continuing to install erosion and flood protection measures, should be included.

### *Impairment*

- The plan should include analysis of impairment and how it is applied.

### *Land Use*

- Development in Stehekin should be clustered to minimize impacts.
- Public and private land use in each alternative should be evaluated to determine its ecological and visitor use consequences.

### *Environmental (Natural, Cultural, and Social) Impacts*

- A socioeconomic analysis of the impacts of land exchanges and other actions should be conducted.
- Among the impacts that should be included in the environmental impact analysis are the following: terrestrial and/or aquatic habitat loss, alteration, degradation, and fragmentation; indirect effects, particularly stimulated development, human activities, and impacts to wilderness values; cumulative effects to specific resources of concern; impacts to plant and animal species, particularly state- and federally listed (e.g., northern spotted owl, bull trout), candidate, and other sensitive species; impacts to water quality and/or drinking water; introduction and/or spread of

invasive species; cultural, historical impacts, including those pertaining to tribes; hydrological alterations; stream bank hardening; loss and/or restoration of riparian areas; recreation and access; safety concerns; and costs.

- The plan should identify the consequences of changing the large woody debris management policy in Stehekin.

### *Visitor Experience*

- Analysis of the effects of the alternatives on visitor experience should be included.
- Analysis of the effects of the alternatives on recreational use should be included.
- Analysis of the effects of the alternatives on the Stehekin Community should be included.

### *Natural Resources*

- Analysis of the effects of the alternatives on natural resources (fish, vegetation, wildlife, soils, river hydrology, etc.) should be included.
- The Lower Field should not be considered for exchange due to its adjacency to northern spotted owl habitat.
- There is an apparent conflict between identifying the ecological sensitivity of the Lower Field with respect to northern spotted owls and identifying a proposed Stehekin Valley Road reroute above it. Other existing and potential ecological and human factors, such as fire and noise, also have effects on northern spotted owls.
- The use of pesticides should be carefully considered/should not occur near the Stehekin River.

## Large Woody Debris / Sediment (30 comments)

- Selective removal of gravel and large woody debris from the Stehekin River should occur to minimize impacts from flooding. There is an overabundance of these materials in the Stehekin River.
- The plan should determine the origin and need for large woody debris, including its role in the river system, and whether the number of logjams is appropriate.
- The plan should determine whether management changes are needed for large woody debris.
- Large woody debris could be used in engineered logjams.
- Logjams should be retained to minimize disruption to the ecosystem.
- Logjams should be removed (in some/all instances) to minimize flooding impacts.
- If large woody debris /gravel is not removed, it will continue to increase and contribute to the formation of logjams and increased impacts from flooding.
- There is a need to understand the origin of the wood in the logjams.
- The plan should determine how large woody debris manipulation could be used to enhance fish and wildlife habitat. Analysis of the need for large woody debris within the river system should occur.
- The amount of large woody debris now in the river is a natural phenomenon and was historically altered so that it is perceived now to be an overabundance.
- Removal of logjams will not fix problems related to flooding.

- The plan should determine the relationship of wood to gravel, especially the consequences of the accumulation of these at the Stehekin River mouth.
- Excess materials, including large woody debris and excavated gravel, generated by the plan should be used for other public and private projects in Stehekin.

### Sediment (11 comments)

- Sediment and large woody debris sources above High Bridge/in the whole Stehekin watershed should be identified.
- Road relocation/moving the road and allowing the river to encroach on the former roadway will result in the movement of sediment downvalley.
- Gravel mining may have unintended consequences elsewhere.

### Land Exchange (68 comments, plus 6 related to impacts—see above)

#### *Land Exchanges: Lower Field*

- Disposition of the Lower Field should be reconsidered. It should be removed from the 1995 Land Protection Plan list of eligible properties. The Lower Field is northern spotted owl habitat. The Lower Field offers good wildlife viewing opportunities.

#### *Land Exchanges: Concern About Need for / Desire for NPS Purchase*

- Land purchase and exchanges are the most effective means of allowing the Stehekin River to migrate within its floodplain. Land acquisition is an effective means of allowing the river to migrate naturally.
- The effects of land exchanges on private property should be considered in the plan.
- Before any land is identified for exchange, there should be a survey of the need for additional exchange lands, analysis of the amount of property in the floodplain, analysis of eligibility for FEMA buyout, and other factors.
- The emphasis in the plan should be on land purchase, rather than exchange and on strategies to ensure the protection of existing public lands. Land exchanges and easements should be a secondary consideration.
- Public lands should not be exchanged. Exchanging public lands will adversely affect Lake Chelan NRA resources. Land exchanges may reward poor decision making (buying land within the floodplain).
- Land exchanges have a variety of adverse effects, including shifting development to high ground, taking unfair advantage of government resources, encouraging development and speculation, and resulting in increased development.
- Consider the Walker property for land exchange.
- Condemnation of lands should be considered in the Land Protection Plan.
- NPS should seek funding for land acquisition.
- The plan should establish criteria for land exchanges and analyze effects on adjacent lands and values.

- Justification for a revised Land Protection Plan should be included in the plan, followed by systematic evaluation of the relative values of public lands identified for exchange. Evaluation should include those lands that might be available for acquisition instead of exchange.
- Land exchanges should/should not occur in the Stehekin Valley.
- There should be a list of available lands for exchange in the plan. Lands adjacent to private property in Keller's Park should not be on the list.
- The plan should identify whether floodplain lands can be exchanged for lands at higher elevation and whether partial exchanges of flood-affected portions of private property can occur.
- Land exchanges may include covenants/restrictions. Exchanged lands should have the same development rights.
- The plan should include and identify the benefits of clustering development.
- Proposed land acquisitions and exchanges should be evaluated with respect to management viability and access.

#### *Land Exchanges: Availability*

- There are few lands available for exchange compared to the amount of private land within the floodplain.
- Other strategies (beyond land exchanges) may need to be used in the plan to remove private lands from the floodplain.
- The criteria for evaluating whether to offer public lands for exchange should be revisited, including the aesthetic criteria and whether an entire parcel should be excluded for one criterion.
- Land exchanges should be limited to those lands with low resource or scenic values.

#### *Land Exchanges: Priority Setting*

- Land exchanges should focus on removing private lands from the floodplain.
- The plan should identify the criteria for prioritizing land exchanges.

### Jurisdiction (12 comments)

- Land management agencies with responsibility for Stehekin should cooperate in the plan.
- The plan should describe consultation with Native American Tribes.
- The plan should identify jurisdictional responsibility along the Stehekin River, especially at the mouth and with respect to floating or submerged large woody debris.
- The plan should clarify the jurisdiction and management of large woody debris for NPS and private landowners.

### Policy/Regulation Changes (6 comments)

- The plan should clarify the policy for and management of gravel mining.

### Potential Modifications to GMP (5 comments)

- The plan should make changes to the management of large woody debris.
- The plan should reaffirm the GMP policy of manipulating large woody debris to minimize recreational boating impacts.
- The plan should clarify how the GMP can be modified.

### Fisheries Habitat (10 comments)

- The plan should identify the ecological need for large woody debris and how the amount now present relates to that need. Large woody debris should be used for bank protection and erosion control.
- The plan should identify the ecological benefits of large woody debris for fish and fish habitat.
- The plan should identify whether large woody debris left high and dry is beneficial to fish or whether it could be available for use.

### Floodplain Facilities / Mapping (13 comments)

- The plan should identify options for floodplain mapping, including the advantages and disadvantages of each.
- The plan should take into account the time needed to develop new FEMA floodplain maps.
- New floodplain maps are key to determining sustainable management strategies in the plan.
- The plan should identify what facilities would be allowed to remain in the floodplain and why.
- The plan should evaluate public essential and nonessential facilities in the floodplain and whether they are still needed and should be relocated.
- The plan should identify if there are any structures (other than buildings) that should be removed from the floodplain.

### Stehekin Community Principles / Viability (14 comments)

- The plan has the potential to affect the viability of the Stehekin Community if additional private lands are purchased or exchanged. There should be no reduction in the amount of private land within the Stehekin Valley.
- The proposed clustering of development will affect the privacy of landowners who purchased lands away from other developed lands.

### Proposed Projects (26 comments)

- The plan should consider what would occur if the Stehekin River changes course at Buckner Homestead hayfield and pasture.
- The 12 projects identified as potentially needed at the public scoping meetings should be implemented.
- The plan should consider taking a broad look at long-term visitor needs in the Stehekin Valley, including changes to the location or configuration of campgrounds and potential demand for additional low-elevation camping.

- The plan should consider implementing work to protect the road/private property north of Milepost 5.5.
- Bank erosion above the Stehekin River Resort should be stabilized.
- The plan should identify opportunities for public-private partnerships on proposed projects.
- The plan should identify removal of gravel and/or large woody debris from the head of the lake to minimize flooding impacts to the river mouth and hazards for recreational boaters.
- The plan should consider taking action near Frog Island [and at the maintenance facility].
- The plan should leave the logjams at McGregor Meadow and No Name Creek in place.
- The plan should include replacement and relocation of NPS facilities in the floodplain, including the maintenance yard.
- The plan should identify future problem flooding areas and plan for them before they occur.
- The plan should encourage Chelan County to modify zoning related to floodplain development.
- The plan should identify whether gravel bars can or should be manipulated.
- The plan should consider filling the deep channel on the White property.

### Erosion Protection (8 comments)

- The plan should consider/should avoid additional actions to stabilize the banks of the Stehekin River.
- The placement of large woody debris for erosion protection/flood control can result in downstream effects.
- Adding bank hardening, such as levees, may result in exacerbating the effects of flooding.

### Road Relocation (27 comments)

- If road relocation threatens private property, that property should be added to the list of those that have the option for land exchange.
- The Stehekin Valley Road should/should not be relocated.
- The plan should identify how private landowners will access their property should the road be relocated.
- Access roads could be minimally constructed/maintained.
- Rerouting the road will affect the stability of properties it is rerouted around.
- Constructing and maintaining rerouted roads will have a wide array of adverse effects.
- Modifications to Company Creek Road need to be considered in the plan.
- Work done on the Company Creek side of the Stehekin River has adversely affected properties on the Stehekin Valley Road side. No comparable work has been done to protect them.

### Emergency Planning / Landowner Interim Actions (23 comments)

- The plan should address emergency actions landowners can take.
- What criteria define how landowners can treat large woody debris, including floating logs, on their private property? What permits are needed?

- Private landowners can take action to install flood protection measures on their own property. NPS should provide technical assistance to landowners undertaking flood protection measures and emergency actions.
- Agencies have a responsibility to communicate flooding risk to landowners so they can take action.

### Agency/Political/Community Involvement and Technical Assistance (9 comments)

- There should be increased involvement of the U.S. Army Corps of Engineers, politicians, technical experts and the Stehekin Community in the planning process and its outcomes.
- Technical assistance is needed for Stehekin landowners.
- Educational and interpretive, as well as technical, information related to flood protection and climate change needs to be more available for Stehekin landowners, residents, and the general public.

### Recreational Use (4 comments)

- The plan should determine the effect of the accumulation and management of large woody debris on recreational uses.
- Effects on the viability of the Lower Valley Trail should be considered in the plan.
- A recommendation that modifications to the River Trail be included in the plan.

### Water Quality (2 comments)

- Flooding of septic systems has an effect on water quality. Good water quality is important to maintain for the Stehekin Community water system.

### Research / Climate Change Issues (6 comments)

- The flooding regime on the Stehekin River has been affected by climate change. Future effects are unknown.
- Ongoing effects from climate change need to be projected to the degree possible to aid in planning for the future. Climate change effects need to be considered in the environmental analysis.

### Restoration (2 comments)

- Restoration of purchased and exchanged lands, as well as abandoned sections of roadway, should occur.

### Funding the SRCIP (8 comments)

- How will plan implementation be funded? Funding of proposed actions should be identified and addressed.
- The costs of alternatives should be determined.

## a. Issues and Concerns Addressed in this Document

All of the above issues and concerns were considered in the planning process or are addressed in this document except for those identified under the second heading below.

## b. Issues Considered but Dismissed

The following issues were initially considered by the planning team, but were eventually rejected for various reasons. This reasoning is given in Chapter II: Management Alternatives under the heading –D. Alternatives and Actions Considered but Dismissed” (from further review).

- The scope of the plan should include the entire Stehekin River watershed, including wilderness area above High Bridge.
- The Stehekin River should be contained within a channel to reduce flooding of private property and public facilities.
- The goal of the plan should be to allow natural processes to occur unimpeded so that natural flooding can continue to occur without regard to its effect on facilities and private property.
- Plan alternatives should include consideration of rerouting the Company Creek Road.
- There is a great deal of suitable gravel for Stehekin projects in the valley that could be used instead of importing materials at high cost.
- Pile burning of large woody debris generated by the plan should be considered.
- Sediment and large woody debris sources above High Bridge/in the whole Stehekin watershed should be evaluated for treatment.
- Gravel removal should be used instead of land exchanges.
- Dredging should be part of the plan as long as it is done in a way that minimizes impacts.
- The plan should consider changes to the Sand, Rock, and Gravel plan to allow use of gravel generated by plan actions.

## c. Issues and Concerns outside the Scope of this Document

The following issues generated through public scoping are not within the scope of this project and are therefore not analyzed in detail in the document:

- Concern that the plan would modify the wilderness boundary.
- A recommendation to include plans for the road/trail above High Bridge.
- Selective tree removal in the upper valley may have an effect on reducing logjams. Plan actions should reduce the potential for the additional formation of logjams.
- A recommendation that the plan include establishment of the Bridge Creek hiker’s hostel.

These actions are outside the scope of the proposed plan because they include actions that would take place above High Bridge (outside the project area that has been defined for the plan) or because they are actions that are not related to the effects of flooding on public facilities and private lands within the Stehekin Valley. They are therefore not considered in the accompanying analysis.

The following two issues were also brought up during public scoping:

- Concern about the Lake Chelan NRA using the most effective strategies for treating invasive plants, including comparing the strategies with respect to cost, repeated applications of pesticides, nonchemical means of control, effectiveness/use in other areas, and the effects of pesticides on water and nontarget plants and wildlife.
- A recommendation that volunteer groups be used in invasive plant management.

These actions are beyond the scope of the proposed project. Although invasive plant management would continue to occur, the SRCIP is not the means under which planning for invasive plant treatment is orchestrated. Lake Chelan NRA is currently in the process of creating an Invasive Plant Management Plan and these comments are being considered within the scope of that plan.

Included in public scoping was:

- A recommendation that the plan include actions for supporting sustainable economic activity in Stehekin.

Although the SRCIP considers economic impacts associated with changes in land use in Stehekin, creating a plan that would create sustainable economic activity in Stehekin is beyond the scope of the proposed plan.

Some comments suggested items that the park could consider in future Stehekin planning, including:

- Concern that the need to relocate campsites or campgrounds be part of a much larger plan for long-term visitor use in the Stehekin Valley.
- Concern that there would be increased demand for low-elevation camping as lodging costs increase.

A long-term plan for campground management/dealing with increasing lodging costs in Stehekin is beyond the scope of managing flood-related impacts in the river corridor. Because these actions are not part of the plan, they are not considered in the accompanying analysis. What is considered are modifications to the use of campsites consistently affected by flooding and the development of new campgrounds to replace these, as well as the relocation of a camp affected by hazard trees.

The following concerns are related to the plan, but are not within the scope of the plan to solve:

- Land exchange appraisals should consider the effects of flooding.

There would be no changes to the way land exchange appraisals are conducted for the plan. Land exchange appraisals are conducted under a set of laws, regulations, policies, and professional appraisal standards, which take into consideration flood-related impacts to buildings, access, and structures. This plan does not supersede this legislative or policy direction. It should also be noted that appraisals do take into account the elements that contribute to fair market value.

- Stehekin landowners need an emergency response plan.

Emergency response on private property is under the jurisdiction of Chelan County. The NPS has been coordinating, and will continue to coordinate, with the County on emergency-response planning and actions, including by providing staff to assist with planning.

- Plan alternatives should focus on climate change, or climate change educational opportunities.
- Future impacts and costs associated with climate change should be modeled and predicted in the plan.

All alternatives are based on ongoing research related to potential impacts from climate change, river dynamics, and flooding. Analysis of flood data for the last century points to a shift in the Stehekin system from one dominated by spring floods to one dominated by larger fall events. The analysis of the alternatives considers how this changing flood regime will influence the proposed actions within the project area. Modeling future climate change and its effect on flooding is beyond the scope of the plan. Further, uncertainty in the pace of changes caused by global warming precludes making specific management decisions based on models. In the same way, focusing the alternatives on climate change would not result in a wide range of options to address flooding of public and private property in the Stehekin Valley.

- The plan should identify management policies that should be changed.
- Public domain lands (never in private ownership) should be considered for exchange.

Changing government and NPS policies is a lengthy and controversial process that is beyond the scope of the plan.

- Designate/do not designate the Stehekin River as a Wild and Scenic River.

The SRCIP is not the right vehicle for a Wild and Scenic River designation for the Stehekin River. That process requires a separate study, which is currently unfunded. Nonetheless, the lower Stehekin River is eligible for Wild and Scenic River designation for its recreational values. In adherence to NPS *Management Policies 2006* (NPS 2006a), however, the SRCIP will not affect the criteria which make the Stehekin River eligible as a Wild and Scenic River.

## 3. Management Alternatives Scoping

Additional public scoping took place during the alternative development period. Three public open houses were held, two in Stehekin (August 26 - 27, 2008) and one in Seattle (August 28, 2008). In addition, 17 comment letters were received via fax (1), PEPC (3), e-mail (8), or regular mail (6)—some were received in more than one format.

The 17 letters were received from 12 individuals (some duplicate or signed by more than one person), 3 nonprofit organizations (National Parks and Conservation Association, Western Lands Project, and Stehekin Heritage); 1 school district (Stehekin School District); 1 county government (Chelan); and 2 businesses (Island Resources, Ltd., and Stehekin River Resort).

These letters contained approximately 65 individual comments, summarized as follows in the following 62 concerns:

## Alternatives

### General

- There should be a “community” alternative that would show increased cooperation among federal, state, county, and private parties.
- There is support / lack of support for various alternatives and portions of alternatives.
- Wild and Scenic River designation for the Stehekin River should be considered in the plan.
- The proposal for the Stehekin Valley Trail should be more fully developed, including how it relates to the plan (including impacts from relocating the road on the Old Wagon Road proposed alignment).
- There should be additional interpretive information about living in Stehekin as part of the proposed plan.
- There are ongoing concerns about gravel accumulation.
- There is concern about paving unstable sections of the Stehekin Valley Road.
- What will happen to the existing maintenance facilities (including the YACC yard)?

### Implementation

- The SRCIP should include an implementation plan with a timeline and identify potential funding sources, both public and private.
- There were questions about the details of implementation that are not fully described within the current array of alternatives (in the newsletter).
- There were questions about the cost of implementing the alternatives.

### Drainage Modifications

- There should be routine preventative maintenance on culverts and drainages.
- Wilson Creek flow is outside the channel, causing it to make a circuitous route back to the culvert, overflowing the road.
- Jonathan Creek is plugged.
- Culverts and catch basins should be checked in the spring and fall.

### Vehicle Turnaround

- There were questions about the vehicle turnaround and other measures that are incorporated into the plan as a result of the Stehekin Valley Road Improvement Project implementation.
- There was concern about the large size of the parking area / turnaround.

### Large Woody Debris Management

- There was concern about whether or not large woody debris manipulation is included in the alternatives.
- There was a question about the alternatives proposing NPS vs. private use of large woody debris.

- The SRCIP should include active and ongoing management of large woody debris in the Stehekin River and provide opportunities for relocation of large woody debris within the system.

### Bank Erosion Protection

- The NPS should implement immediate bank-protection action on NPS land to protect the Stehekin River Resort.
- Erosion protection measures on NPS land above the Stehekin River Resort would protect private property.
- The plan should include additional bank-hardening measures.
- The Stehekin River should not be confined.
- Additional information about bank-protection measures, such as cabling logs, should be provided.
- Current and future bank stabilization projects where both private and public lands are involved should be approached in a comprehensive manner.
- The plan should use a reach-based approach that considers an entire project regardless of land ownership to design bank stabilization projects.

### Reroutes

- There were concerns about private property being on “the wrong side” of the reroute due to the protection measures afforded the public access route (along the Stehekin Valley Road).
- The cost of /need for the reroutes was questioned.
- There were concerns about future access to McGregor Meadows when the reroute is implemented.
- The plan should address concerns about utility, firefighting, and other access as well as egress on the former Stehekin Valley Road access to McGregor Meadows if a reroute is implemented.
- Impacts to downstream neighbors should be included in reroute decisions.
- The access road through McGregor Meadows might not be maintained to a standard that would allow protection of adjacent properties.
- The cost of reroute alternatives in comparison to annual maintenance and maintenance of the proposed access road was questioned.
- The reroutes may be subject to rockslides, and snow and debris avalanche risk.

### Recreational Development

- The group camp near Rainbow Falls would be more desirable than the north bank of Company Creek.
- There was a question about the need for raft ramps at Harlequin and above the Stehekin River Resort based on the volume of rafting and the impacts, when there is a raft ramp at Bullion.

## Land Acquisition and Exchange

- Land exchanges may not provide a public benefit.
- There should be a moratorium on land exchanges until all parcels have been made available (post EIS).
- The corral land near the bakery should be considered for land exchange.
- The plan may result in the continued loss of private property in Stehekin.
- There is erosion of the private land base in Stehekin and potential long-term negative effects of that on the Stehekin Community.
- The Land Protection Plan should provide financial assistance as well as purchase for property owners willing to relocate out of the channel migration zone.
- The Rice property should not be exchanged.
- There would be impacts to the Stehekin School from proposed land exchanges, including adjacency of private vs. public property, particularly from the Rice property.
- There were questions about the NPS's use of land acquisition / exchange as a strategy and how it relates to U.S. Forest Service use of the same (i.e., why the NPS does not have a step-by-step policy).
- The plan may concentrate activity in the lower valley.
- There was a question about whether an existing life-estate where the Stehekin River has occupied the property would qualify for exchange.
- There was concern about the Webb-Walker and the Griffin-Getty properties on the list of potential exchange lands.
- The lands available / potentially available / unavailable for exchange were inadequately portrayed on maps at the public open houses in Stehekin and Seattle.
- Land exchanges should include the removal of not only buildings from the floodplain but also the water systems, septic systems, and electrical systems (including septic tanks, plastic infiltrators, conduit, plumbing, well casings, pumps, etc. buried in the ground).
- The above items should also be removed when NPS acquires developed lands.
- There should be oversight and completion inspections to ensure removal of NPS acquired structures.
- NPS buildings that were torn down this summer still have water systems, wastewater systems, and power conduits buried in the ground at these sites. NPS should remove this buried utility system infrastructure.
- All proposed land exchange property should meet the criteria of nonfederal ownership.
- There was a question about whether the property adjacent to and upvalley of the Stehekin Ranch was part of the Maxwell homestead.
- The criteria used to determine NPS property eligibility for exchange should consider the channel migration zone before other priorities, such as wildlife.
- Land exchanges should be a high priority in the final plan.
- Chelan County offered a commitment to working with NPS to address zoning and cluster development opportunities that may help to facilitate additional land exchanges.

### Other Questions

There were questions about

- Whether the road would be elevated through McGregor Meadows if the reroute was implemented
- Jurisdiction and a request for resolution of it by the NPS related to large woody debris build-up
- Where the alternatives would allow the manipulation of large woody debris.

All of these were considered in the additional development of the alternatives except the following, which are (at least) partially outside the scope of the proposed plan (explanations follow):

- The NPS should implement immediate bank-protection action on NPS land to protect the Stehekin River Resort.

The NPS is prohibited from expending funds or taking actions specifically to protect private property. In addition, actions proposed within the context of this plan must undergo environmental analysis and approval in a Record of Decision before implementation can occur.

- There should be a moratorium on land exchanges until all parcels have been made available (post EIS).

Land exchanges were specifically included within the scope of the plan because they are currently available as a protection strategy under the 1995 plan (NPS 1995b). The NPS cannot alter the LPP priority system without modification to the LPP, which is being done as part of this planning process.

- The Land Protection Plan should provide financial assistance as well as purchase for property owners willing to relocate out of the channel migration zone.

The NPS cannot provide financial assistance to landowners for exchange or acquisition, except where it is specifically authorized due to the need for compensation for unequal exchange property values or where it adds value to land purchases.

- There were questions about NPS's use of land acquisition / exchange as a strategy and how it relates to U.S. Forest Service use of the same (i.e., why the NPS does not have a step-by-step policy).

The NPS does not have a ―cookbook" of how to conduct land acquisition or exchanges, because compared to other agencies, like the Bureau of Land Management (BLM) or U.S. Forest Service (USFS), the NPS conducts a very small number of exchanges and the criteria that allow NPS exchanges are more narrowly defined.

In addition, because the following concern was raised during initial scoping, reasoning for its exclusion is given above (see ―C. Issues and Concerns outside the Scope of this Document"):

- Wild and Scenic River designation for the Stehekin River should be considered in the plan.

## E. IMPACT TOPICS

This section describes the issues developed with public involvement during the planning process. It also includes the impact topics which will be carried forward in the analysis of the alternatives. Impact topics are the potentially affected resources. Laws or policy related to their inclusion in this EIS are also noted. This section also identifies those resources that have been dismissed from further analysis due to their having no identified or negligible potential environmental consequences.

## 1. Introduction

NPS resource specialists and planning staff identified issues and concerns that may have an effect on or be affected by actions in the proposed alternatives. Other agencies, including Chelan County, the Washington State Department of Fish and Wildlife, and the U.S. Army Corps of Engineers provided input at meetings and through the Technical Committee. Permanent and seasonal residents of the Stehekin Valley and the general public provided comments at meetings and open houses.

Impact topics have been identified on the basis of the NPS *Management Policies 2006* (NPS 2006a), federal laws, regulations, and orders, and NPS staff knowledge of resources in the Stehekin Valley. Additional issues and concerns were identified from internal scoping responses and public meetings held in Stehekin, Wenatchee, and Seattle. Some of the main issues and concerns included the following:

- Frequent flooding of the Stehekin Valley Road impacts Lake Chelan NRA operations and visitor experience by reducing access to the interior of the park.
- Construction of riverbank erosion protection measures would impact water quality and streamflow, because it would be necessary to perform in-water work and the proposed rock barbs would alter streamflow. These structures also affect the natural erosion process of the river.
- A series of actions related to maintaining the Stehekin Valley Road and Company Creek Road, including raising the roadbed, road reroutes, and bank stabilization, would occur within the floodplain / channel migration zone of the Stehekin River and could affect their characteristics.
- Construction activities would temporarily increase noise that may affect visitor experience in the wilderness area surrounding the road.
- Soils and vegetation would be impacted by the road reroutes, which would require clearing and grading and removal of soils and vegetation.
- Proposed road reroutes could impact threatened and endangered species in areas where the road is moved closer to occupied habitat. Actions could include habitat removal, increased long-term noise from road traffic and human disturbance, and temporary construction noise.
- Gravel roads cause dust, and impacts to water quality, vegetation, and visitor experience. Maintaining gravel roads also requires either gravel extraction from the Lake Chelan NRA Company Creek borrow pit, which is a limited resource, or importing material by barge, which is expensive.

NPS staff consolidated the issues and selected the impact topics described below to facilitate the analysis of environmental consequences. A brief rationale for the selection of each impact topic is given below. In addition, a discussion of impact topics dismissed from further consideration and the rationale for dismissing them is located in the following section.

## 2. Impact Topics Analyzed

Impacts of each action and alternative have been analyzed for the topics discussed below. These impact topics focus the discussion on comparing the environmental impacts among alternatives on affected resources.

## Physical Resources

**Land Use**: NPS *Management Policies 2006* (NPS 2006a) provides direction for protection of lands and resources within park units, acquisition of nonfederal lands that are within park units, and cooperation with agencies, tribes, and private property owners to provide appropriate protection measures. The Lake Chelan NRA GMP (NPS 1995a) provides the framework for the types of land uses allowed within the project area. Land use refers to the general characteristics of how land is allocated among various administrative, preservation, recreational, and development needs. Management zones were established under the Lake Chelan NRA GMP and land use priorities were identified in the LPP (NPS 1995c). Because land use could change as a result of the implementation of the action alternatives, it is included as an impact topic.

**Air Quality**: The Clean Air Act of 1963 as amended (42 USC 7401 et seq., PL 88-206) was established to promote the public health and welfare by protecting and enhancing the Nation's air quality. The act establishes specific programs that provide special protection for air resources and air quality-related values associated with NPS units. Section 118 of the CAA requires a park unit to meet all federal, state, and local air quality pollution standards.

Lake Chelan NRA is a class II area under the CAA. The surrounding North Cascades National Park and Glacier Peak Wilderness are class I areas. Class II areas allow only moderate increases in certain air pollutants, while class I areas (primarily large national parks and wilderness areas) are afforded the highest degree of protection, meaning that very little additional deterioration of air quality is permitted. The Act states that park managers have an affirmative responsibility to protect air quality-related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse air pollution impacts (EPA 2000). Because road rehabilitation and construction could affect air quality, air quality is included in the impact topics.

**Geologic Hazards**: Geologic hazards are common within Lake Chelan NRA and include earthquakes, rock falls, debris flows, and swift mountain streams. The proposed alternatives, would have measurable effects on increasing or reducing impacts from or exposure to some geologic hazards. Within the proposed project area hazards exist at the following locations: alongside steep valley slopes on the edge of the moraine at McGregor Meadows; at Milepost 8.0 (from the steep slope beyond the angle of repose); rock fall hazards off the steep valley side walls (Alternatives 2 and 3); and debris cones along the reroutes in Alternatives 2 and 3. Because of the potential impacts of the alternatives on these features, geologic hazards are included as an impact topic.

**Soils**: *Management Policies 2006* (NPS 2006a) require the NPS to understand and preserve and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil. The alternatives include ground-disturbing activities of previously disturbed and undisturbed soils. Road reroutes would result in alteration of geomorphology (land forms) because of proposed road cuts and slope regrading. The concurrent loss of vegetation would also likely increase the potential for erosion and cause additional alteration of soil properties. Therefore, soils impacts are included in this DEIS.

**Water Resources**: The 1972 Federal Water Pollution Control Act, as amended by the CWA (33 USC 1251 et seq., PL 92-500 and PL 95-217), is a national policy to restore and maintain the chemical, physical, and biological integrity of the nation's waters, to enhance the quality of water resources, and to prevent, control, and abate water pollution. *Management Policies 2006* (NPS 2006a) provides direction for the preservation, use, and quality of water in national parks.

> **Water Quality**: Section 401 of the CWA as well as NPS policy requires analysis of impacts on water quality. The Stehekin River is a Category 1 waterway that is given maximum protection

under state water quality regulations (WAC 173-201A). The alternatives would take place within, and in close proximity to, the Stehekin River. Construction activities may include in-water work and earth disturbance, which increases the potential for erosion and sedimentation to occur and can adversely impact water quality. In addition, the current annual maintenance of the Stehekin Valley Road requires replenishment of gravel on the roadway. The use of this material on the road is a source of continuing sediment input to the Stehekin River from road/riverbank erosion, where those areas of the road are located in close proximity to the river from flooding, and major stormwater runoff. Because of potential impacts from sedimentation and work that might occur within and next to the Stehekin River, water quality is addressed in this EIS.

**Hydraulics and Streamflow Characteristics**: The Lake Chelan NRA GMP (NPS 1995a) provides guidelines for the implementation of actions that affect the Stehekin River, its tributaries, and the Stehekin Valley Road. The GMP allows manipulation of the river only for road projects in erosion/river conflict zones under certain conditions. The Stehekin River is prone to severe flooding in spring and fall, which periodically damages the roadway. The largest floods recorded occurred in 1948, 1995, 2003 and 2006, and have caused major changes to the river and associated damage to the Stehekin Valley Road and Company Creek Road. When extreme flood velocities and depths occur, rapid erosion of the riverbank and road may occur. The proposed alternatives would involve riverbank improvements to protect the road, which may affect hydraulics and streamflow characteristics.

**Wetlands**: Executive Order 11990 requires that impacts to wetlands be addressed. Numerous wetlands are located along the Stehekin River. Section 404 of the Clean Water Act requires federal agencies to avoid, minimize and mitigate impacts to wetlands. Executive Order 11990, NPS *Management Policies 2006* (NPS 2006a), and *Director's Order 77-1: Wetland Protection* (NPS 2002a) direct that wetlands be protected and that wetlands and wetland functions and values be preserved. They further direct that direct or indirect impacts to wetlands be avoided whenever there are practicable alternatives. Actions within the alternatives would affect the edge of the Stehekin River, a riparian area, considered a wetland.

**Floodplains**: Executive Order 11988 (Floodplain Management) requires an examination of impacts to floodplains and potential risk involved in placing facilities within floodplains. NPS *Management Policies 2006*, The Planning Sourcebook (General Management Planning) NPS 2005, and Director's Order 12 (Conservation Planning, Environmental Impact Analysis, and Decision Making) (NPS 2001a), and Director's Order 77-2 (Floodplain Management Guideline) (NPS 2003b) provide guidelines for proposals that occur in floodplains. Executive Order 11988 requires that impacts to floodplains be addressed (see Appendix 17: Draft Floodplains Statement of Findings). A key purpose of the plan is to remove development from the Stehekin River floodplain / channel migration zone to the extent possible.

## Biological Resources

**Vegetation**: NEPA calls for examination of the impacts on the components of affected ecosystems. *Management Policies 2006* (NPS 2006a) calls for protecting the natural abundance and diversity of park native species and communities, including avoiding, minimizing, or mitigating potential impacts from proposed projects. The alternatives are likely to result in tree removal and other vegetation loss as well as enhancement or restoration of vegetation. Therefore, vegetation is included as an impact topic in this DEIS.

**Wildlife**: NEPA calls for examination of the impacts on the components of affected ecosystems. NPS policy is to protect the natural abundance and diversity of park native species and communities, including avoiding, minimizing, or mitigating potential impacts from proposed projects. More than 163 native species of terrestrial and aquatic vertebrates have been recorded in the park, including 40 mammals, 104 birds, 8 reptiles, 5 amphibians, and 6 native fish (Kuntz and Glesne 1993; Duke Engineering and Services [DES] 2000). Many wildlife species may reside in or near the project areas. The alternatives will involve impacts to wildlife such as the removal of wildlife habitat, increased noise levels caused by construction activities, and increased turbidity caused by work in water. The loss or alteration of habitat has a direct effect on wildlife, which is often greatest when it affects their nesting/denning and foraging areas. Therefore, wildlife is included in this DEIS.

**Special Status Wildlife**: The Federal ESA requires an examination of impacts to all federally listed threatened or endangered species. The NPS *Management Policies 2006* (NPS 2006a) calls for an analysis of impacts to state-listed threatened or endangered species and federal candidate species. Under the ESA, the NPS is mandated to promote the conservation of all federally listed threatened and endangered species and their critical habitats within the park and Lake Chelan NRA boundary. NPS policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. Ongoing informal consultation with the USFWS and the WDFW has identified several important rare, threatened, and endangered species that occur in Lake Chelan NRA. Therefore, special status wildlife is included in this DEIS.

## Cultural Resources

**Prehistoric and Historic Archeological Resources / Historic Structures / Cultural Landscapes**: Consideration of the impacts to historic properties is required under provisions of Section 106 of the NHPA (1966), as amended, and the 2008 NPS Programmatic Agreement among the National Park Service, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation (NPS et al. 2008). It is also required under the NPS *Management Policies 2006* (NPS 2006a). Conformance with the Archeological Resources Protection Act in protecting known or undiscovered archeological resources is necessary. NPS *Management Policies 2006* calls for ongoing inventory and analysis of the significance of archeological resources found within parks. Federal land managing agencies are required to consider the effects proposed actions may have on properties listed in, or eligible for inclusion in, the National Register of Historic Places (i.e., Historic Properties), and to allow the Advisory Council a reasonable opportunity to comment. Agencies are required to consult with federal, state, local, and tribal government/organizations, identify historic properties, assess adverse effects to historic properties, and negate, minimize, or mitigate adverse effects to historic properties while engaged in any federal or federally assisted undertaking (36 CFR Part 800).

There are 33 archeological sites recorded in Lake Chelan NRA. Of these sites, 25 are prehistoric. An archeological survey near and within the Stehekin Valley Road Improvement Project area was conducted near in June of 2004 and no pre-contact-age archeological sites were located. Therefore, cultural resources is included in this DEIS

## Recreational / Social Resources

**Visitor Experience**: Providing for the enjoyment of national park resources is one of the foundations of the NPS Organic Act. The Organic Act directs the NPS to promote and regulate the use of national parks to conserve resources and to provide for their enjoyment by existing and future generations. In accordance with this act, NPS *Management Policies 2006* (NPS 2006a) and Director's Order 17 (Tourism) (NPS 1999) identify visitor use patterns and the desired visitor carrying capacity, and allow for appropriate recreational activities within park units. The Lake Chelan NRA LPP (NPS 1995b) calls for the protection of cultural and natural resources and the provision of safe visitor facilities and services. In addition, the enabling legislation for Lake Chelan NRA has as one of its goals to provide for public outdoor recreation use and enjoyment of the Stehekin River and Lake Chelan. Depending on the selected alternative, a variety of impacts to visitor use may occur. The impacts considered in this section related to visitor use, include access and transportation, visitor use opportunities, interpretation and education, safety, and scenic resources.

**Wild and Scenic Rivers**: The Stehekin River, throughout its entire length, is considered eligible for Wild and Scenic status. Under the Wild and Scenic Rivers Act (16 USC 1271 - 1287), ~~c~~certain selected rivers of the Nation, which with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." As noted in *Management Policies 2006*:

> Potential national wild and scenic rivers will be considered in planning for the use and development of a park's water and related land resources. The Park Service will compile a complete listing of all rivers and river segments in the national park system that it considers eligible for the National Wild and Scenic Rivers System. General management plans and other plans potentially affecting river resources will propose no actions that could adversely affect the values that qualify a river for the National Wild and Scenic Rivers System. After a determination of eligibility is made, a decision concerning whether or not to seek legislation to designate a river or river segment may be made only through a general management plan, an amendment to a general management plan, or the legislative review process. (NPS 2006a:2.3.1.9)

If the Stehekin River were designated as a National Wild and Scenic River, a 0.25-mile corridor on either side of the river would be designated to preserve its Wild and Scenic values. Some components of the alternatives under consideration could have beneficial or adverse effects on the free-flowing characteristics of the river and/or some of its outstandingly remarkable values. Therefore, wild and scenic rivers is included in this DEIS

**Park Operations**: Impacts to park operations and visitor services are often considered in environmental documents to disclose the degree to which proposed actions would change park management strategies and methods and what additional costs (including staffing) are associated with the proposal. The alternatives would affect short- and long-term transportation and access, as well as the quality of the transportation infrastructure and the ability of the park to maintain the infrastructure and conduct park operations. The Stehekin Valley Road is the primary access to North Cascades National Park and the road is used by staff to conduct resource surveys, maintain park facilities, perform hazard fuel reduction (including prescribed fire), and to assist visitors / protect park resources. Therefore, park operations is included in this DEIS

**Socioeconomics**: Socioeconomic impact analysis is required, as appropriate, under NEPA and *Management Policies 2006* (NPS 2006a) pertaining to gateway communities. Because of the unique nature of Lake Chelan NRA, it is also appropriate to address it with respect to the Stehekin Community and Chelan, where most visitors embark on their Lake Chelan NRA visit. The local and regional economy and most business of the communities near the park are based on tourism and resource use. Agriculture, manufacturing, professional services, and education also contribute to regional economies. Therefore, socioeconomics is included in this DEIS

**Hazardous Materials**: There are a variety of opportunities to encounter hazardous materials in the proposed project area under Alternatives 1 - 4. Therefore, this topic has been included.

## 3. IMPACT TOPICS DISMISSED FROM FURTHER ANALYSIS

The topics listed below either would not be affected by, or would be affected only negligibly by, the alternatives evaluated in this DEIS. Therefore, these topics have been dismissed from further analysis. Negligible effects are localized effects that would not be detectable over existing conditions. Many of these effects would be short term and would occur only as a result of construction activities. A detailed rationale for dismissing these and other impact topics is given below.

**Water Quantity**: There would be no major changes in the use of water associated with the implementation of the alternatives. Replacement and relocation of the maintenance area has the potential to decrease administrative water use. Other uses of water, such as during road construction, would be short term and negligible. Although replacement and relocation of housing has the potential to increase water use at that location, the likelihood of that potential is currently unknown because housing would accommodate the same number of staff and would shift existing water use from one location to another. Impacts, if likely, would be described as part of a site-specific EA once designs are complete.

**Threatened and Endangered Plants**: The ESA requires an evaluation of impacts from federal projects on all federally listed rare, threatened, and endangered plant species. During surveys conducted for the Stehekin Valley Road Improvement Project, two federally listed plant species were identified by the USFWS as potentially being present within the project area. These species included: showy stickseed (*Hackelia venusta*) and Wenatchee Mountains checker-mallow (*Sidalcea oregana* var. *calva*). An NPS plant survey conducted on May 19, 2004, revealed no sensitive plant species along the Stehekin Valley Road, and neither showy stickseed nor Wenatchee Mountain checker-mallow was found during this survey (Bivin, pers. comm., 2004) (Appendix 8: Vascular Plants Observed within Proposed Project Areas). During initial surveys for these species, conducted during key life stages for the plants, none were found either in the proposed project areas or within the lands proposed for exchange under any of the alternatives. Because additional site-specific surveys would be conducted for these plants prior to actual implementation of project actions, where warranted, and because project actions would then be modified to avoid any plants found, no impacts to special status species would occur.

**Traditional Cultural (Ethnographic) Resources**: NPS *Management Policies 2006* (NPS 2006a) and the NPS Cultural Resource Management Guideline (Director's Order 28 and handbook) (NPS 1998a) direct parks to consider potential impacts of planned actions on cultural resources, including ethnographic resources. Lake Chelan NRA and the surrounding area have a history of habitation and resource use by prehistoric and contemporary American Indians. Analysis of impacts to known resources is important under the NHPA and other laws, including the Native American Graves Repatriation Act, American Indian Religious Freedom Act, and Executive Order 13007: Indian Sacred Sites. The NPS defines American Indian traditional cultural (ethnographic) resources as any ―site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (NPS 2006a). Traditional cultural properties are ethnographic resources listed on or eligible for the National Register of Historic Places. The Confederated Tribes of the Colville Reservation have expressed the idea that there could be traditional cultural properties in the Stehekin River Watershed, but none have been specifically identified. Rock art sites, however, are considered traditional cultural properties. There are no rock art sites in the area of potential effects (APE) for the SRCIP. Although two prehistoric rock shelters are located in the lower valley and are 7 considered ethnographic resources, these are outside of the APE and would not be affected by the 8 proposed actions under the implementation of the alternatives described in this DEIS.

It is known that several tribes traditionally used the Stehekin River valley for hunting, foraging, subsistence, and occupation, and that Lake Chelan NRA holds many resources important to tribes, such as archeological sites, wildlife, plants, and water. Thus, it is likely that some types of resources would occur in the project area. Based on ongoing consultation, there have been no ethnographic resources found or identified in the proposed project area to date. Consultation with the Colville and Yakama tribes is continuing. If the tribes were to identify ethnographic resources or if ethnographic resources are discovered during project implementation, immediate consultation and resource significance assessments will be undertaken, in compliance with NHPA and NPS *Management Policies 2006* (NPS 2006a). Therefore, there would be no impacts to known ethnographic resources from the implementation of Alternatives 1 - 4.

**American Indian Religious Freedom Act**: To comply with the American Indian Religious Freedom Act, federal agencies must consider the effects of their actions on American Indian traditional religious practices. Based on analysis in the APE, there are no known traditional or religious use areas within the proposed project area. In addition, there are no known Indian sacred sites that would require compliance with Executive Order 13007: Indian Sacred Sites (61 FR 26771, 42 USC 1996).

**Museum Collections**: *Management Policies 2006* (NPS 2006a) and other cultural resources laws identify the need to evaluate effects on NPS collections, if applicable. Requirements for proper management of museum objects are defined in 36 CFR 79. The North Cascades National Park Service Complex museum collection is comprised of specimens and objects that document the natural and cultural resources of the park. Much of the collection is the result of research projects within the complex (including artifacts from the mines, sawmills, and other pioneering enterprises of the region) and prehistoric site surveys and excavations. Field notes, photographs, maps, and other resource management records are integral parts of the collection. The museum collection also includes materials from San Juan Island National Historical Park and from Ebey's Landing National Historic Reserve. It is distributed among four different repository sites (Marblemount Curation Facility, Burke Museum, Fort Vancouver, and University of Idaho) and consists of over 2.3 million objects. These collections, including those from Lake Chelan NRA, would not be affected by the proposed project, except by the potential addition of material to the collections if any is found (see mitigation measures under ―12. Cultural Resources: Archeological Resources" in the ―Environmental Consequences" section).

**Wilderness**: NPS wilderness management policies are based on provisions of the 1916 NPS Organic Act, the Wilderness Act (1964), and legislation establishing individual units of the national park system. These policies establish consistent NPS-wide direction for the preservation, management, and use of wilderness and prohibit the construction of roads, buildings, and other man-made improvements and the use of mechanized transportation in wilderness. All park management activities proposed within wilderness are subject to review following the minimum requirement concept and decision guidelines. The public purpose of wilderness in national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes of recreational, scenic, scientific, education, conservation, and historical use.

The Washington Park Wilderness Act of 1988 (Public Law 100-668) designated 639,840 acres, or 93 percent, of the North Cascades National Park Service Complex as the Stephen Mather Wilderness. The Stephen Mather Wilderness is connected to a number of other USFS wilderness areas, including the Mount Baker, Pasayten, Noisy-Diosbud, Glacier Peak, Lake Chelan-Sawtooth, and Henry M. Jackson wilderness areas.

Beginning at High Bridge, the Stehekin Valley Road bisects the Stephen Mather Wilderness. The wilderness boundary is 50 feet from the centerline of the road as it existed at the time of the Washington Park Wilderness Act. The wilderness boundary is generally at the 1,640-foot elevation contour.

The wilderness, however, does not include the Stehekin Valley Road, but essentially surrounds the road and the area immediately adjacent to the road. Therefore there would be no direct impacts on the wilderness. Indirect effects on visitor experience within the wilderness, however, may result from construction noise or views of construction activity. Several trails, including the Rainbow Loop Trail, are located within wilderness, close to the road. Use of this trail and other areas within wilderness near the road may be affected by construction noise or views of construction activity. The proposed Lower Valley Trail would be constructed outside of wilderness. Since the project does not directly affect wilderness, and the impacts of construction on the wilderness experience would be short term negligible and localized, this topic was dismissed from further discussion.

**Lightscapes**: *Management Policies 2006* (NPS 2006a) states that “the Service will preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light.” The stars, planets, and moon, visible during clear nights, influence people and many other species of animals, such as birds terrestrial predators and prey. The proposed actions under the alternatives described in this DEIS would not introduce or increase artificial light sources in the environment beyond current or historic levels and would preserve the ability to see natural features visible on clear nights. Lights that would be part of the relocated maintenance / housing complex would replace lighting now on these existing facilities. New lighting would be directed inward and downward and would be an improvement over existing conditions at current facilities.

**Soundscapes**: Park soundscape resources encompass all the natural sounds that occur in parks, including the physical capacity for transmitting those natural sounds and the interrelationship among natural sounds of different frequencies and volumes in the park (NPS 2006a). NPS Director's Order 47 (Sound Preservation and Noise Management) (NPS 2000) defines operational policies that will protect, maintain, or restore the natural soundscape. Natural sounds are part of the park environment and are vital to the functioning of ecosystems and may also be valuable indicators of their health. Soundscape is the total ambient acoustic environment associated with an area. It may be composed of both natural and human-made sounds. In a high noise environment, natural ambient sounds may be masked by other noise sources. Natural quiet is another term for characterizing the expected natural soundscape.

Construction activities associated with the alternatives under consideration, such as excavation, clearing and grading, earth hauling, gravel spreading, and operation of construction equipment and vehicles, would generate the primary sources of noise from the project (changes in operations are not expected to have an appreciable effect on existing noise levels, since the project would not result in an increase in traffic volumes or new uses). Construction noise impacts would largely be short term, localized, and minor for the public. Although there is a potential for some impacts to visitors or wildlife, mitigation measures would be used to minimize these impacts. Mitigation measures that would be used include avoiding construction during the breeding and nesting period of threatened and endangered bird species, and the following general construction Best Management Practices (BMPs):

- Construction would be limited to daylight hours.
- Construction equipment would be located as far as possible from sensitive receptors such as wildlife, visitors, and residents.
- Equipment would not be left idling when not in use.
- Mufflers would be used on all equipment.
- Only well-maintained and properly functioning equipment would be used.

Since impacts would be short term, localized, and mitigation would be used to further reduce or limit impacts, soundscape impacts were dismissed. Noise impacts, however, are addressed in the “Wildlife, Threatened, and Endangered Species” and “Visitor Experience” sections. There would be a negligible long-term increase in noise (intermittent) from rerouting the road under Alternatives 2 and 3 and a similar decrease in the area it was rerouted away from. No other long-term noise impacts would occur; therefore, this topic has been dismissed from additional consideration.

**Prime and Unique Farmlands**: The Farmland Protection Policy Act was implemented to preserve and protect the dwindling supply of farmland in the nation. In 1980, the CEQ directed that federal agencies assess the effects of their actions on farmlands classified by the U.S. Department of Agriculture Natural Resources Conservation Service as prime or unique. The U.S. Department of Agriculture defines these lands as having soils that are best suited for producing food, feed, forage, and fiber or oilseed crops. The alluvial river soils in the Stehekin River Valley are classified as prime farmland soils, but not unique soils. Use of land for farming and the type of farmland soils are considered in determining prime and unique farmland. There is not much current use of the land in the Stehekin Valley for farming, except for some pasture and small vegetable gardens. Historically, however, farming was associated with homesteads, including the Buckner Homestead hayfield and pasture. The alternatives would not affect the use of land for farming.

The alternatives under consideration would not have an appreciable effect on prime farm soils for several reasons:

- The road alignment would remain similar. Although there would be some road widening for pullouts in places, there would be little additional loss of farmland soils caused by this work. Topsoil would be removed to locate road base materials and then pulled back over the surface of the road.
- Under the road reroute alternatives, the topsoil would also be preserved and would be used to rehabilitate the old alignments, saving farmland soils.
- The amount of farmland soil loss compared with the total area of these soils within the valley is very small (less than 1 percent).

Therefore, this impact topic was dismissed from further analysis.

**Energy Consumption**: Implementation of the proposed actions would not cause measurable increases in the overall consumption of electricity, propane, wood, fuel oil, gas, or diesel associated with visitation or for park operations and maintenance. A measureable decrease, however, is expected to be achieved with the construction of the new maintenance facility.

**Environmental Justice**: Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations (59 FR 7629, as amended by Executive Order 12948, 60 FR 6381, 42 USC 4321), requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse levels of human health or environmental effects from their programs and policies on minorities and low-income populations and communities. This executive order does not apply to the subject of this document. The actions evaluated in this DEIS would not have an effect (either beneficial or adverse) on socially or economically disadvantaged populations.

# CHAPTER II:

## Management Alternatives

# CHAPTER II: MANAGEMENT ALTERNATIVES

This chapter describes the proposed alternatives, including the reasons for dismissing options that do not meet project objectives or other defined criteria. The alternative comparison chart (Table II-1) highlights the major differences among the alternatives. This chapter also identifies and provides analysis related to the selection of the environmentally preferable alternative.

This chapter is divided into the following sections:

- Section A: Introduction (containing a brief description of each alternative)
- Section B: Actions Common to All Alternatives (1 - 4)
- Section C: Description of Alternatives 1 - 4
- Section D: Alternatives and Actions Considered but Dismissed
- Section E: Mitigation Measures (see the detailed explanation of these in Chapter IV: Environmental Consequences and Appendix 6: Summary of Mitigation Measures)
- Section F: Environmentally Preferred Alternative (the alternative with the most benefits and fewest impacts, defined according to Council on Environmental Quality (CEQ) criteria).

## A. INTRODUCTION

The alternatives were developed from collaborative interdisciplinary analysis based on the expertise of planning team members from the National Park Service (NPS) and Federal Highway Administration (FHWA,) as well as from internal and external scoping with the Stehekin Community; federal, state, and local agencies, including Chelan County; Native American Indian Tribes; and interested organizations and individuals. The technical merit of alternative concepts and actions was reviewed by an interagency committee, comprised of state, federal, and county jurisdictions. Representatives included the Washington Department of Ecology, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Chelan County, Chelan County Public Utility District (Chelan PUD), and Geomax PC.

Four alternatives are included:

- Alternative 1: No Action (Continue Current Management Practices and Existing Plan Implementation)
- Alternative 2: At-Risk Public Facilities Removed from Channel Migration Zone Where Possible; More High-Priority Land Acquisition in Channel Migration Zone (Preferred)
- Alternative 3: At-Risk Public Facilities Removed from Channel Migration Zone in Most Areas; Same Land Acquisition as in Alternative 2
- Alternative 4: At-Risk Public Facilities Removed from Channel Migration Zone in Some Areas; Less High-Priority Land Acquisition in Channel Migration Zone.

The differences among the alternatives are primarily related to the different management strategies applied to them (see Table II-1: *Alternative Comparison Chart*).

**Table II-1: Alternative Comparison Chart**

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| **FOCUS** | | | | |
| **Management concept / working title** | Continue Current Management Practices and Existing Plan Implementation. | At Risk Public Facilities Removed From Channel Migration Zone (CMZ) Where Possible; More High Priority Land Acquisition in CMZ. | At Risk Public Facilities Removed From Channel Migration Zone in Most Areas; Same Land Acquisition as in Alternative 2. | At Risk Public Facilities Removed From Channel Migration Zone in Some Areas; Less High Priority Land Acquisition in the CMZ. |
| **Floodplain and land use concept** | Large floods would continue to be constricted by development in the floodplain.<br>The Stehekin Valley Road would be retained in its current alignment, with the grade raised through McGregor Meadows. Because of the road grade raise, water from large floods would be restricted from some of the floodplain.<br>NPS administrative facilities would be moved out of the floodplain, causing minor changes in the current pattern of development.<br>There would continue to be a potential for new development to occur within the CMZ.<br>Erosion protection measures would be implemented at one site, but could eventually be needed at the same sites in Alternative 4. | Large floods could occupy more of the floodplain.<br>Most development in the floodplain would be relocated through long-term actions proposed by the revision of the LPP.<br>A major reroute of the Stehekin Valley Road would occur around the floodplain at McGregor Meadows. Erosion protection measures would be implemented at three sites (near the Stehekin River mouth, Frog Island, and Wilson Creek). NPS administrative facilities would be moved out of the floodplain. | Large floods could occupy most of the floodplain (less than Alternative 2).<br>Same as Alternative 2 except that only the McGregor Meadows portion of the Stehekin Valley Road would be rerouted.<br>Erosion protection measures would be implemented at five sites (including the same sites in Alternative 2 plus Lower Field and Weaver Point).<br>NPS facilities moved. | The Stehekin River would be restricted from its floodplain at McGregor Meadows.<br>Most developments remain in floodplain. As in Alternative 1, there would be the potential for new private development in floodplain.<br>Stehekin Valley Road would be retained in its current alignment, with bank hardening at several sites and raising the road grade through McGregor Meadows. Because of the road grade raise, water from large floods would be restricted from some surrounding areas of floodplain.<br>Erosion protection measures would be implemented at seven sites, including those identified in Alternative 3, plus at Milepost 7.0 and 9.2. |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| **Land acquisition and exchange concept /LPP** | The NPS would continue to implement existing 1995 LPP to remove private development from the floodplain and to protect natural, cultural and scenic resources.<br>As properties with improvements are acquired or exchanged, buildings and infrastructure would be removed and the sites restored to natural conditions. | Under the revision to the 1995 LPP, the NPS would acquire land through exchange and purchase (from willing sellers) to remove private development from the channel migration zone.<br>The 1995 LPP has been revised to identify new priorities for acquisition and exchange based on nine criteria weighted more toward river protection than scenic qualities.<br>More high priority sites have been identified for acquisition / exchange from willing sellers in the channel migration zone so more structures / infrastructure (including buildings, septic systems, and power lines) would be removed and restored than in Alternative 1. | Same as Alternative 2. | Under the revision to the 1995 LPP, the NPS would acquire land through exchange and purchase (from willing sellers) to remove private residential development from the channel migration zone.<br>The 1995 LPP has been revised to identify new priorities for acquisition and exchange based on nine criteria weighted less toward river protection and more toward retaining the Stehekin Valley Road in its current alignment than in Alternatives 2 and 3.<br>As properties with improvements are acquired or exchanged, buildings and infrastructure would be removed and the sites restored to natural conditions. |
| **Response to flooding and erosion** | As needed, the NPS would continue case-by-case response to flood-related damage affecting public facilities.<br>Private landowners with development in the channel migration zone would continue to be responsible to self-implement flood protection measures. No actions would be undertaken by NPS to prevent private property from flooding.<br>Road through McGregor Meadows would be elevated, but prong to erosion/scour damage | Actions would be similar to Alternative 1; however, NPS would relocate roads and administrative facilities out of channel migration zone, proactively anticipating effects from future flooding. | Same as Alternative 2. | Same as Alternative 1.<br>Road through McGregor Meadows would be elevated, but prone to erosion/scour damage. |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| **MANAGEMENT ACTIONS** | | | | |
| **Roads** | | | | |
| Stehekin Valley Road: Reroutes | **Reroutes**<br>None.<br>Road grade raise at Milepost 6.25 to 6.53. Road grade raise of 1 - 3 feet at Milepost 6.95 to 7.14.<br>Slight realignment and slope work at Milepost 6.0 to 6.5.<br>**Lower Field Riparian Restoration**<br>Riparian restoration would occur along the bank to the edge of the existing roadway adjacent to the Lower Field. | **Reroutes**<br>McGregor Meadows and Lower Field.<br>**McGregor Meadows Reroute Actions**<br>Remove and restore Stehekin Valley Road above Milepost 6.5 but maintain grade control structures at Milepost 7.0 and as long as private access is needed (see below). The reroute would be from Milepost 5.7 to 7.5.<br>**Lower Field Reroute Actions**<br>Remove existing road at Lower Field, restore road alignment and implement riparian restoration, while retaining the agricultural area. | **Reroutes**<br>McGregor Meadows.<br>**McGregor Meadows Reroute Actions**<br>Same as Alternative 2 except a slightly shorter reroute of Milepost 5.7 to 7.3 since portion of the existing road that borders Lower Field would be stabilized with riparian vegetation and rock barbs.<br>**Lower Field Riparian Restoration**<br>Same as Alternative 1, plus:<br>Install 2 rock barbs and bioengineering to protect road in current location along Lower Field. | **Reroutes**<br>Same as Alternative 1.<br>**Lower Field Riparian Restoration**<br>Same as Alternative 3. |
| McGregor Meadows Access Road | N/A | Approximately 0.8 miles of road would be maintained until it is no longer needed. This access road could be impassable during peak flood events.<br>Retain access to maintain grade control structure in road to prevent the river from eroding a channel down the McGregor Meadows Access Road.<br>Approximately 0.7 miles of abandoned road would be revegetated to accommodate a trail.<br>Construct turnaround at Milepost 6.5. | Same as Alternative 2 except: Approximately 0.4 miles of abandoned road would be restored. | N/A |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| Stehekin Valley Road / Road: private access | Private access would be via existing spur roads off the Stehekin Valley Road.<br>Private access would be limited during flooding.<br>Access would be maintained where the road grade is raised in McGregor Meadows. | Same as Alternative 1 plus:<br>Private access would be maintained in areas bypassed by the Stehekin Valley Road realignment.<br>Develop criteria to maintain reasonable private access across federal property as warranted. | | Same as Alternative 1 plus:<br>Develop criteria to maintain reasonable private access across federal property as warranted. |
| Company Creek road protection strategy / erosion protection measures | Maintain road in its existing alignment consistent with GMP.<br>Maintain the existing levee and existing erosion protection measures (barbs and grade control structures). | | | |
| **Harlequin Bridge** | Continue to maintain. If replacement is needed, install a longer span bridge. | | | |
| **Administrative Facilities*** | | | | |
| Maintenance Area | Implement the GMP to relocate the maintenance area to the north end of the airstrip. Restore riparian and upland area at vacated site. | | | |
| NPS<br>Housing | Implement the GMP to construct new and replacement NPS housing at the north end of the airstrip in conjunction with the new maintenance area. Remove three houses located in the channel migration zone along the Company Creek Road (NPS Tracts 06-118, 06-104, 06-121 and 06-122). Expanded housing would be for operations (fire crew and concessions staff).<br>Existing housing, currently subject to flooding in the channel migration zone, would be removed and sites restored by removing infrastructure, including buildings, septic systems and powerlines. | | | |
| **Recreational Facilities** | | | | |
| Weaver Point Cultural Resources | Continue to maintain Weaver Point Campground in its existing location and implement GMP and Chelan PUD recommendations to relocate campsites affected by shoreline and bank erosion to the east of the docks.<br>Implement proposed Federal Energy Regulatory Commission (FERC) logjam.<br>Relocate docks to the west, away from the river when lake is drawn down. | Same as Alternative 1 plus:<br>Coordinate with proposed FERC projects to protect Weaver Point cultural resources. | Same as Alternative 1 plus:<br>Extend proposed FERC logjam up-river, and install two rock barbs and bioengineering to prevent river shoreline erosion and protect Weaver Point Campground.<br>Coordinate with proposed FERC projects to protect Weaver Point cultural resources | |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| Harlequin Campground | Maintain Harlequin Campground, including group sites, in its existing location. Take actions as needed in response to flooding.<br>Continue to use Harlequin Campground except during flooding and unless catastrophic impacts occur. | Same as Alternative 1 except:<br>Harlequin Campground group site would be seasonally closed during anticipated flooding in spring and fall. | | |
| Purple Point Horse Camp | Purple Point Horse Camp would continue to be used for horse parties plus as an overflow group campsite. | Construct additional group/individual campsites at Purple Point Horse Camp to replace seasonally flooded group site at Harlequin. New campsites would include corresponding infrastructure. | | |
| Rainbow Falls Campground (proposed) | N/A | Construct new individual campsites near Rainbow Falls. Campsites would include corresponding infrastructure. | | |
| Company Creek Campground (proposed) | N/A | | Construct new campsites along lower Company Creek below Power Plant. Campsites would include corresponding infrastructure. | |
| Bullion Campground | Relocate Bullion Campground across the road to avoid hazard trees. Allow day use at existing site. Add vault toilet. New campsites would include corresponding infrastructure. | | | |
| Lower Valley Trail | Implement the GMP recommendation for a Lower Valley Trail (hiker/equestrian) to connect the High Bridge area with Stehekin Landing. Trail alignment would follow segments of the historic road and use 6.1 miles existing trail and build 6.3 miles of new trail. | Alignment for trail would be on the old Stehekin Valley Road where realignments occurred around McGregor Meadows and Lower Field and would take advantage of 7.9 miles of existing trail and road, including some segments of the historic road. It would require 4.6 miles of new trail. | Same as Alternative 2 except alignment would not be along Lower Field. | As in Alternative 1, trail alignment would follow more segments of the historic road. |
| Stehekin River Trail connector to Lower Valley Trail | Implement the GMP recommendation to add a bridge crossing at the former bridge site above Boulder Creek to connect the proposed Lower Valley Trail with the Stehekin River Trail. | | | |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| Raft launches / takeout / boat access | Retain the existing raft launch near Bullion Campground. | Same as Alternative 1 plus:<br>Construct new raft takeout / boat access near the Stehekin River Mouth and add new 300-foot long spur road off Stehekin Valley Road. Coordinate actions with private landowners. | Same as Alternative 1. | Same as Alternative 2. |
| Shooting Range | Retain shooting range in its existing location. | In conjunction with the Lower Field Reroute, remove the shooting range, rehabilitate potential contamination and restore the abandoned site. | Same as Alternative 1 | |
| **Management of Large Woody Debris** | | | | |
| NPS Actions | Continue to Implement GMP Guidance and to salvage floating logs from the head of Lake Chelan.<br>Limited actions could continue to be taken to trim or turn individual large pieces for the purpose of enabling recreational opportunities and to protect roads and bridges.<br>The NPS would seek to acquire through purchase or exchange properties that could be threatened by large woody debris jams so as to preclude manipulation of large woody debris in the system.<br>(There would continue to be no use of logs from logjams for erosion management.) | Same as Alternative 1 plus:<br>Logjam manipulation could occur in the Lake Chelan backwater zone from the head of Lake Chelan to Boulder Creek.<br>Manipulation of logjams would be the minimum needed to relieve threats from shoreline erosion to public roads, water quality, public safety, and regular access to private property.<br>Use of LWD from logjams for bank stabilization and restoration would be limited to single pieces on top of logjams above ordinary high water mark that would not destabilize the jam.<br>In all actions wood remains within the channel migration zone, and would be used only for erosion management actions. | Same as Alternative 2. | Same as Alternative 2 except:<br>Logjam manipulation could occur anywhere along the Stehekin River below Bullion Raft Launch for same purposes as in Alternatives. 1 and 2. |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| Private use | Continue to Implement GMP Guidance. | Same as Alternative 1 plus:<br>Woody debris from the tops of logjams or from Lake Chelan salvage (according to the criteria above) could be made available to private landowners from NPS stockpile for bank stabilization and restoration provided applicable permits are obtained. | Same as Alternative 2. | Same as Alternative 2 plus:<br>Use of logs from the tops of some logjams would extend from Lake Chelan to Bullion. |
| Sourcing of rock for erosion protection and road | NPS would continue to honor limitations on rock procurement within Lake Chelan NRA from GMP and Sand, Rock, and Gravel Plan. Large angular rock would continue to be barged in for rock barbs. Material from the Company Creek Pit that has been determined to be excess to Lake Chelan needs (oversize and some screened material) could be used. | | | |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| **Flood Protection Measures** | | | | |
| Public facilities / private development | NPS would continue to respond to periodic flooding events as they occurred, installing bank protection devices, or relocating sections of former roadway as needed, subject to individual project-by-project environmental analysis.<br>Maintain integrated grade-control structures in McGregor Meadows and upper Company Creek Road under existing agreements.<br>Continue to maintain road surfaces after flood damage.<br>Encourage Chelan PUD to keep Lake Chelan level as low as possible during spring and fall flood seasons.<br>Work with Chelan County to require raised drain fields for new construction and modification of existing drain fields that frequently flood.<br>Provide Stehekin Valley landowners with technical support for using ACOE recommended Advance Protection Measures on private property.<br>Maintain Company Creek levee.<br>NPS maintenance and housing would be removed from the channel migration zone to avoid impacts from flooding. | Actions would be similar to Alternative 1, except that a revised LPP would allow more private land to be removed from the channel migration zone to avoid impacts from flooding by exchanging properties in the channel migration zone for properties outside of it. | | Actions would be the same as Alternatives 2 and 3 except that less private development would be removed from the channel migration zone because land exchanges would emphasize retaining the Stehekin Valley Road more than allowing the river to migrate within the channel migration zone. |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| **Erosion Protection Measures** | | | | |
| Proposed number of barbs | Unknown number of new rock barbs | 6 - 8 new rock barbs | 4 new rock barbs | 16 - 17 new rock barbs |
| Logjams | 0 | 2 new logjams | 5 new logjams | 3 new logjams |
| Company Creek Road and Stehekin Valley Road | Maintain erosion protection measures (rock barbs and grade control structures) installed by the NPS since the 1980s on Company Creek Road and those installed since the 1930s by the NPS along the Stehekin Valley Road. | | | |
| Weaver Point | See Weaver Point Campground above. | | | |
| Stehekin River Mouth | Except under emergency conditions, no action would be taken by NPS to prevent the Stehekin River from eroding or overtopping the left (northeast) bank on NPS land above the Stehekin River mouth. | Replace approximately 100 feet of rip-rap on public land with 3 rock barbs and bioengineering and construct small logjam to minimize potential for a river channel shift. | Replace rip-rap with engineered logjam (no raft takeout) to slow bank erosion. | Same as Alternative 2. |
| **Stehekin Valley Road Erosion Protection Measures** | | | | |
| 1. SVR Milepost 2.0 (Boulder Creek Area) | NPS would repair the Stehekin Valley Road near bakery as needed after flood damage. | Same as Alternative 1 plus: construct a logjam atop a grade control structure (avulsion sill) away from the bank of the river and back into the forest to the Boulder Creek alluvial fan to slow floodwater and maintain sheet flow of water over bank. | | |
| 2. Buckner Homestead Hayfield and Pasture | N/A | Plant native vegetation in riparian area and use large woody debris to slow bank erosion. | | |
| 3. SVR Milepost 3.8 (Frog Island) | N/A | Stabilize bank with 1 - 2 barbs and bioengineering to stabilize the bank within 30 feet of the road. | Construct an engineered logjam and use bioengineering to stabilize the bank adjacent to the road. | Same as Alternative 2. |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| 4. SVR Milepost 5.3 (Wilson Creek) | Install clusters of rip-rap near the toe of the slope and log cribbing in the mid-slope area.<br>Regrade slope for approximately 400 feet, lower roadbed 10 feet, and move road laterally 15 feet into the hillside. Install two new 60-inch culverts and a new ditch. If the road becomes undermined, rebuild the road in place. If necessary, purchase land or easement to access site.<br>If the need for additional erosion protection impacts private property at Milepost 5.5 to implement work at Wilson Creek, work with the landowner to identify mitigation and/or compensation for impacts. | Same as Alternative 1 except:<br>Instead of rip-rap clusters, construct 2 - 3 rock barbs to stabilize the toe of the slope and augment natural bank armoring. | Same as Alternative 2 except:<br>Instead of rock barbs or rip-rap clusters, install a large logjam at the toe of the slope. | Same as Alternative 2. |
| 5. SVR Milepost 6.25 - 6.53 and Milepost 6.95 - 7.14 | As called for by the Road Improvement Project, raise roadbed 1 - 3 feet. | Road would not be raised because the McGregor Meadows Reroute would occur. | Same as Alternative 2. | Same as Alternative 1. |
| 6. SVR Milepost 6.0 - 6.5 | As called for by the Road Improvement Project, lay back slope, remove eyebrow, construct drystack rock wall, and implement minor road realignment between Milepost 6.0 - 6.5 to improve sight distance. | Action would not be taken because the road would be rerouted. | | Same as Alternative 1. |
| 7. SVR Milepost 7.0 | Continue to maintain grade control structures and reroute constructed as part of earlier implementation of the Road Improvement Project. Repair road following flooding. | Road abandoned above Milepost 6.5, but continue to maintain grade control structures at Milepost 70. | | Same as Alternative 1 plus construct 2 rock barbs to maintain road at Milepost 7.0. |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| 8. SVR Milepost 7.3 - 7.4 Lower Field | Implement riparian restoration along edge of Lower Field. | Same as Alternative 1 and revegatation of the abandoned road section to accommodate a trail. | Same as Alternative 2 plus:<br>Add two rock barbs and bioengineering to protect Stehekin Valley Road alignment. | Same as Alternative 3. |
| 9. SVR Milepost 7.8 Thimbleberry Creek | Retain 72-inch and two 48-inch culverts. | Replace 72-inch culvert with one 72-inch culvert and two 36-inch culverts and retain the two 48-inch culverts. | | |
| 10. SVR Milepost 8.0 | Continue to and maintain armored section of roadway monitored slope for stability. If the road becomes undermined, rebuild it in place. | Scale (remove) rocks off the steepest sections of the slope and augment rip-rap along road embankment. A rock wall (100 - 150 feet long and 3 - 8 feet high) would also be added at the base of the slope. Maintain raised section of roadway, including rock barbs and bioengineering. If the road becomes undermined, rebuild it in place. | | |
| 11. SVR Milepost 8.5 | As called for by the Road Improvement Project, realign culvert to meet creek at point of entry rather than forcing it parallel to the road and then under the road. | Construct low water crossing to allow water flow across road.<br>Elevate the road approximately two feet, install low water concrete plank crossing, and excavate an outlet channel between the low water crossing and the Stehekin River. | | |
| 12. SVR Milepost 9.2 (Above Stehekin Valley Ranch) | As called for by the Road Improvement Project, construct vehicle turnaround and parking area for 10 vehicles or 5 vehicles and one bus.<br>Continue to monitor threats to Stehekin Valley Road and maintain existing grade control structures. | Construct low water crossing to allow water flow across road.<br>Elevate 300 feet of road, install low water concrete plank crossing, and excavate an outlet channel between the low water crossing and the Stehekin River. | | Same as Alternative 2 plus add three rock barbs and bioengineering to protect Stehekin Valley Road. |
| **Interpretation and Education** | | | | |
| | Continue to conduct existing interpretive and educational programs and activities related to the Stehekin River. | Enhance interpretive and educational programs related to natural riverine processes, such as channel migration and the ecological role of large woody debris in rivers. | | |

| | Alternative 1: No Action | Alternative 2: Preferred | Alternative 3: | Alternative 4: |
|---|---|---|---|---|
| **Research and Monitoring** | | | | |
| | Continue existing research and monitoring programs, including LWD, main and side channel habitat, hydrology, fish surveys, cultural resources research and analysis, nonnative/invasive plants, climate change effects, special status species research, and other inventory and monitoring work. | Enhance research programs related to the Stehekin River. | | |
| * These actions will require additional site specific environmental review and are not analyzed in detail in this document. | | | | |

## Overview of Alternatives

**Introduction**: All action alternatives embrace the concept of floodplain utilization to varying degrees. Under floodplain utilization, rivers are not constrained by dikes or levees, but rather are allowed to spread out across the floodplain to reduce flood damage in any one area during the largest events.

The action alternatives also attempt to develop sustainable linked public-private actions. Past integrated actions undertaken by the NPS include private-public partnerships to maintain floodplain utilization in McGregor Meadows (1998), the ―1948” channel (2007), and upper Company Creek Road (2007). In this plan, integrated solutions to erosion and floodplain utilization include the proposed actions at Boulder Creek and the Stehekin River Mouth, and using the Land Protection Plan (LPP) revision to focus on floodplain protection.

For public land, all action alternatives attempt to avoid the channel migration zone, rather than the 100-year floodplain. The reasons for using this more conservative approach include observed rapid changes in floodplain boundaries during large floods, the high cost of using computer models to determine flood elevations, and the inaccuracy of the models.

The alternatives conform to recreation area policies in the Lake Chelan General Management Plan (GMP), which call for removing public and administrative facilities from the floodplain. Options for private development in the floodplain include exchange of land with the NPS, purchase of private property out of the floodplain, elevating cabins, or construction of a variety of physical features to reduce the impacts of flooding. Other alternatives, such as construction of additional levees or dikes or dredging were considered and dismissed because they would have unacceptable impacts on the Stehekin River floodplain, would have more ecological damage, or would require repeated, costly management actions (see ―D. Alternatives and Actions Considered but Dismissed” below).

Because all alternatives involve various treatments of the Stehekin Valley Road for which the FHWA would provide the necessary funding, design, and construction expertise, the FHWA is participating as a cooperating agency in the development of this Draft Environmental Impact Statement (DEIS).

## 1. SUMMARY OF ACTIONS COMMON TO ALL ALTERNATIVES (1 - 4)

Several actions in this plan are common to all Alternatives (1 - 4) because they were identified in the GMP. These actions would also protect public facilities or support the concept of floodplain utilization (Figure II-1: *Actions Common to All Alternatives*).

Actions called for by the 1995 Lake Chelan National Recreation Area (NRA) GMP that would be implemented by all alternatives include replacement and relocation/construction of the NPS maintenance compound to the north end of the airstrip; replacement and relocation/construction of administrative housing in the same area; creation of a Lower Valley Trail that connects from Stehekin Landing to High Bridge and which is also connected to the Stehekin River Trail via a footbridge; and the ongoing use of willing seller-willing buyer land acquisition and exchange to remove development from the Stehekin River floodplain. Actions involving administrative facilities require additional site specific environmental review and are not analyzed in detail in this document.

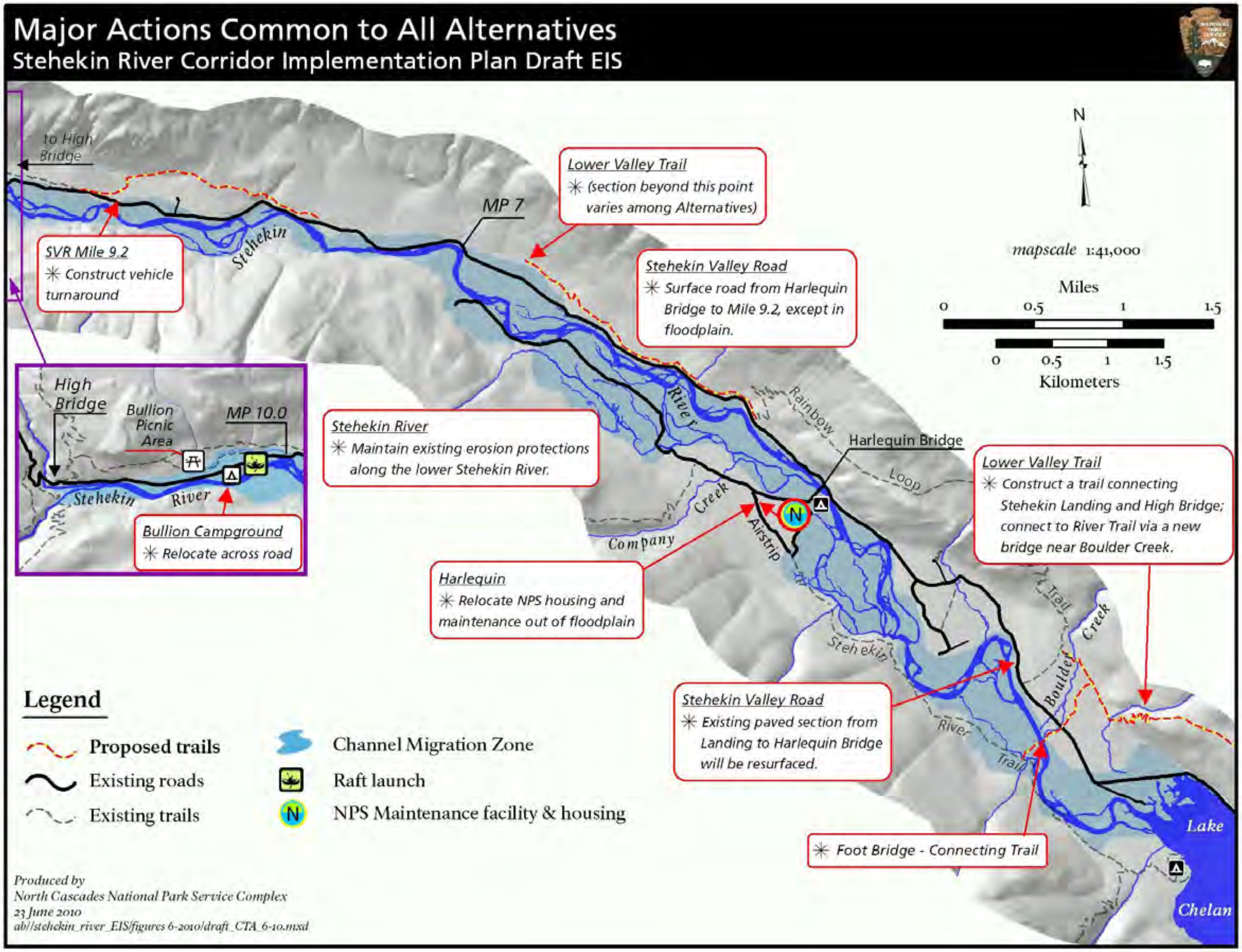


**Figure II-1: Actions Common to All Alternatives**

In addition, because there is a large volume of wood now in the river system and because of the backwater influences of Lake Chelan, there is the potential for a large logjam to cause flooding of the densely developed area near the Bakery or to preclude access on the Stehekin Valley Road. Under these emergency conditions, large logjams in this area could be manipulated to remove the threat consistent with the GMP. As with other use of large woody debris, the wood taken from this area could only be used in the channel migration zone for erosion protection and/or restoration projects.

The Company Creek Road would be maintained in its existing alignment and existing erosion protection measures along the Stehekin Valley and Company Creek roads would be maintained, including the 400-foot-long levee constructed in the 1980s. The levee has virtually no effect on floodplain utilization because of its short length and location and is necessary to maintain the Company Creek Road in place as called for by the GMP.

The Stehekin Valley Road at Wilson Creek, Milepost 8.0, and Frog Island would be protected in place in all alternatives because these locations have severe erosion problems and no viable reroutes. Actions to protect these areas, however, would vary among the alternatives. Grade-control structures designed to maintain sheet flow in floodplains during large floods at Mileposts 7.0 and 9.2 on the Stehekin Valley Road and along the upper Company Creek Road would also be maintained. These structures were installed by private-public partnerships in 1998 and 2008, and are consistent with the concept of floodplain utilization they protect the road from being occupied by the river. Consistent with the current GMP, logjams could be manipulated on the Stehekin River to protect Harlequin Bridge and the roads.

**Recreational Facilities**: Bullion Camp would be relocated downstream and across the road to mitigate safety concerns associated with hazard trees in the current camp. Day use, however, would be retained at the former Bullion Camp.

## 2. Alternative 1: No Action

### Continue Current Management Practices and Existing Plan Implementation

This alternative would continue existing management practices and improvements called for by existing plans (see Figure II-2: *Major Actions Proposed in Alternative 1*). Foremost among these would be continuing implementation of the GMP, as described previously under ―Actions Common to All Alternatives (1 - 4)," and the 1995 LPP (NPS 1995b).

Implementation of the 1995 LPP would continue using existing criteria and potential exchange lands. Decisions regarding land acquisition priorities would continue to be based on properties identified based on currently out-of-date floodplain boundaries and protecting scenic resources (areas of high visual sensitivity) along the Stehekin Valley Road. Both the Stehekin Valley Road and the Company Creek Road would be retained in their existing alignments.

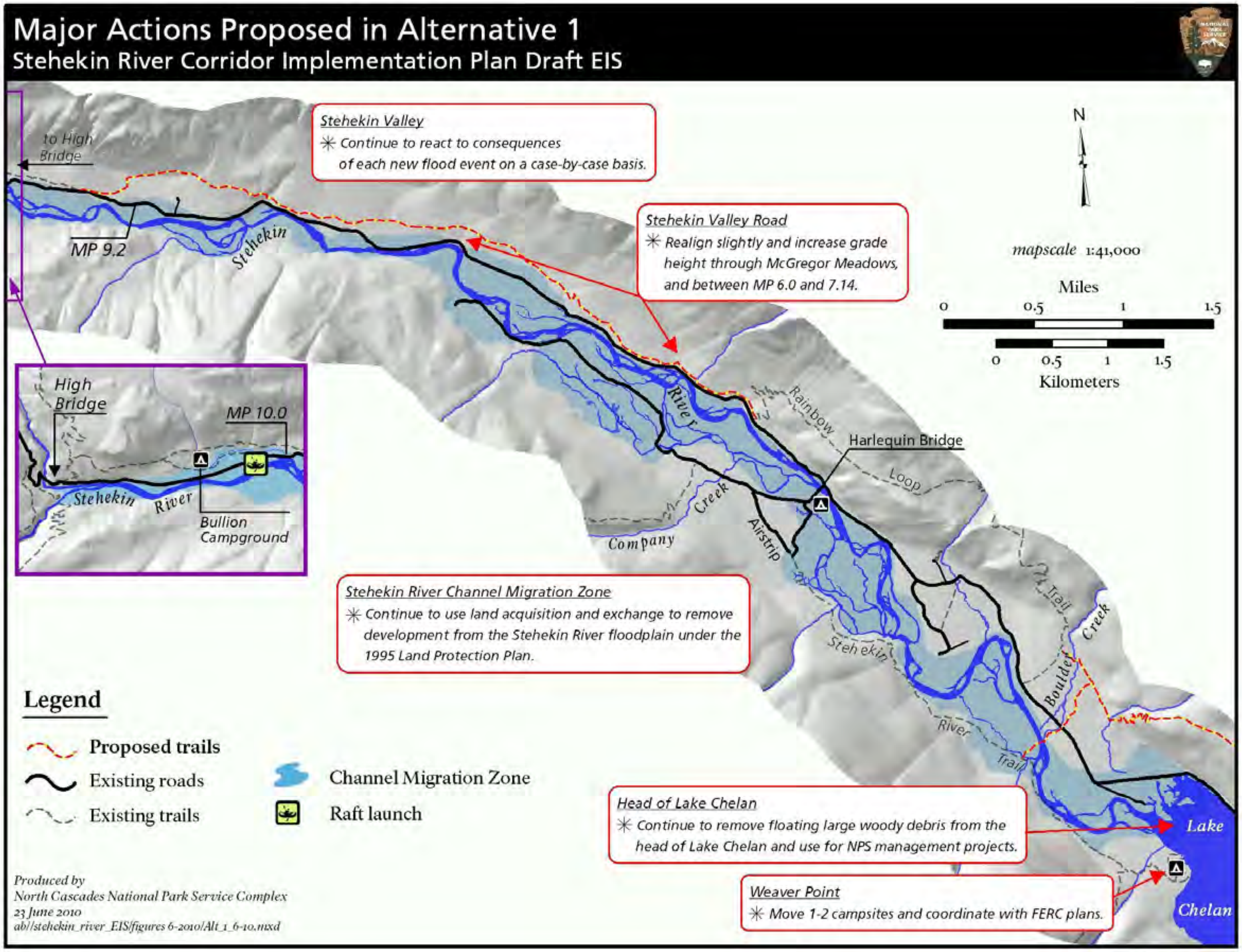


**Figure II-2: Major Actions Proposed in Alternative 1**

The Stehekin Valley Road would be retained in its existing alignment. Stehekin Valley Road Improvement Project actions would be implemented and would include rehabilitation and surfacing of the road with an asphalt chip seal for 4.9 miles from Harlequin Bridge to the winter turnaround (Milepost 9.2), except for areas within the floodplain. There would be a slight realignment (between Mileposts 6.0 and 6.5) and two grade increases (from Milepost 6.25 to 6.53 and from Milepost 6.95 to 7.14) using nearly 5,600 cubic yards of fill through McGregor Meadows, as well as implementation of erosion protection measures at Wilson Creek (NPS 2005). To retain the roads, Alternative 1 would also include maintenance of, but not major improvements to, existing erosion protection measures along the lower Stehekin River. Routine maintenance actions, including snow removal; spring opening; unpaved road grading, shaping and repair; paved road asphalt patching; ditch clearing; culvert cleaning; vegetation maintenance; traffic control striping; and sign replacement, would also continue as needed. It is anticipated that existing pavement would be resurfaced during or shortly after road projects above Harlequin Bridge.

In Alternative 1, unlike other alternatives, the NPS would continue to react to the consequences of each new flood event on a case-by-case basis, producing individual environmental assessments (EAs) as needed to implement management actions.

Floating large woody debris could continue to be removed from the head of Lake Chelan and used for NPS management projects. Individual pieces could also be turned or trimmed (subject to NPS approval) to maintain safe rafting in the Stehekin River, while logjams could only be removed to protect Harlequin Bridge and public roads.

Parts of the Stehekin Valley Road and Company Creek Road would continue to lie adjacent to and within the floodplain / channel migration zone of the Stehekin River. Over time, it is anticipated that this would continue to require the NPS to install additional erosion protection measures in the river (e.g., rock barbs) to protect roads and public facilities. There would continue to be limited improvements to visitor and administrative facilities within the lower Stehekin Valley to implement the GMP. In Alternative 1, rehabilitation of the Stehekin Valley Road would be implemented upon approval of this DEIS. Replacement and relocation of the maintenance facility and NPS housing (NPS Tracts 06-118, 06-104, 06-121, and 06-122) would be implemented following site specific environmental analysis and approval of a tiered environmental assessment.

In Alternative 1 as in other alternatives, private landowners could continue to implement the U.S. Army Corps of Engineers ―Advanced Flood Protection Measures" (Appendix 7), including elevating cabins or constructing measures to protect private structures from the largest floods.

Recreational opportunities associated with the Stehekin River would continue, including camping, rafting, and hiking. As noted above, the Lower Valley Trail would be constructed to link the Landing with High Bridge, including connecting it to the Stehekin River Trail with a bridge near the mouth of Boulder Creek. In this alternative the trail would use 6.1 miles of existing trail and would require 6.3 miles of new trail to be constructed.

## 3. Alternative 2

### At Risk Public Facilities Removed From the Channel Migration Zone Where Possible; More High Priority Land Acquisition/Exchange in the Channel Migration Zone (Preferred)

Compared to other alternatives, Alternative 2 would allow the Stehekin River the most space to utilize its floodplain and move within its natural channel migration zone over time (see Figure II-3: *Major Actions*

*Proposed in Alternative 2*). Proposed new bank stabilization on the left bank would be installed at three new sites to protect the road, including the Stehekin River mouth, Milepost 3.8 (Frog Island), and Milepost 5.3 (Wilson Creek). At Mileposts 3.8 and 5.3 the river is at the edge of the channel migration zone, and relocation into steep cliffs is not feasible. As in other alternatives, Alternative 2 would also implement GMP provisions (including maintenance facility and housing relocation and construction of the Lower Valley Trail); however, there would be a change in the use of large woody debris to implement erosion protection measures. Alternative 2 would include limited use of wood from logjams in the river mouth area, where it is influenced by backwater from Lake Chelan. Such use would only be from the tops of prescreened jams, and only if the jam would not be destabilized.

The revised LPP would be used to encourage relocation of private property from within the floodplain / channel migration zone to outside the channel migration zone, using management actions such as land exchange or land acquisition from willing sellers. Land protection priorities would identify specific properties that are most threatened by the Stehekin River as it migrates across its channel migration zone. If development at these sites were claimed by the river, debris from cabins, wells, and septic systems, including effluent, would be incorporated into the river. The criteria in the LPP used to identify NPS lands for potential exchange has been weighted more toward removing private development from the floodplain in Alternatives 2 and 3 than in Alternative 4 (see Appendix 11 for the priority ranking of private lands in Alternatives 2 and 3). New exchange parcels outside the channel migration zone would be made available, while some lands available for exchange in the 1995 GMP would no longer be available due to new or changed conditions.

The Stehekin Valley Road would be rerouted from Milepost 5.7 to 7.5. An access road would be maintained into McGregor Meadows from Milepost 5.7 to 6.5, to the last parcel of private property (07-157), until it is no longer needed. From a turnaround at Milepost 6.5 to Milepost 6.8, administrative access would continue to provide administrative access to the grade-control structures. From Milepost 6.8 to 7.5, the road would be rehabilitated as part of the Lower Valley Trail. The portions of the Stehekin Valley Road before and after the reroute would also be rehabilitated and surfaced with an asphalt chip seal.

Under Alternative 2, there would also be a series of erosion protection measures to stabilize those sections of the Stehekin Valley Road that are at the edge of the channel migration zone and cannot be relocated without major slope removal or extensive new road construction. Rock barbs would be constructed at Wilson Creek (two to three barbs) and Frog Island (one to two barbs). Three more barbs and a small logjam would be located at a key point on the left bank above the river mouth. One or two of the barbs would replace 100 feet of rip-rap, and the bank would be revegetated with native shrubs. Another logjam would be constructed near Boulder Creek atop a grade-control structure (avulsion sill) away from the bank of the river and back into the forest. The raveling slope at Milepost 8.0 would be stabilized by laying back the uppermost part of the slope brow, which produces most of the large rocks that fall onto the road. A rock wall (100 - 150 feet long and 3 - 8 feet high) would also be added at the base of the slope. At Weaver Point, bank stabilization would be coordinated with plans under development by Chelan PUD for recreation, erosion, and cultural resource management. Riparian restoration and/or bioengineering would enhance riparian vegetation along the bank, at the Lower Field, Buckner Homestead hayfield and pasture, Wilson Creek, Frog Island, and the river mouth.

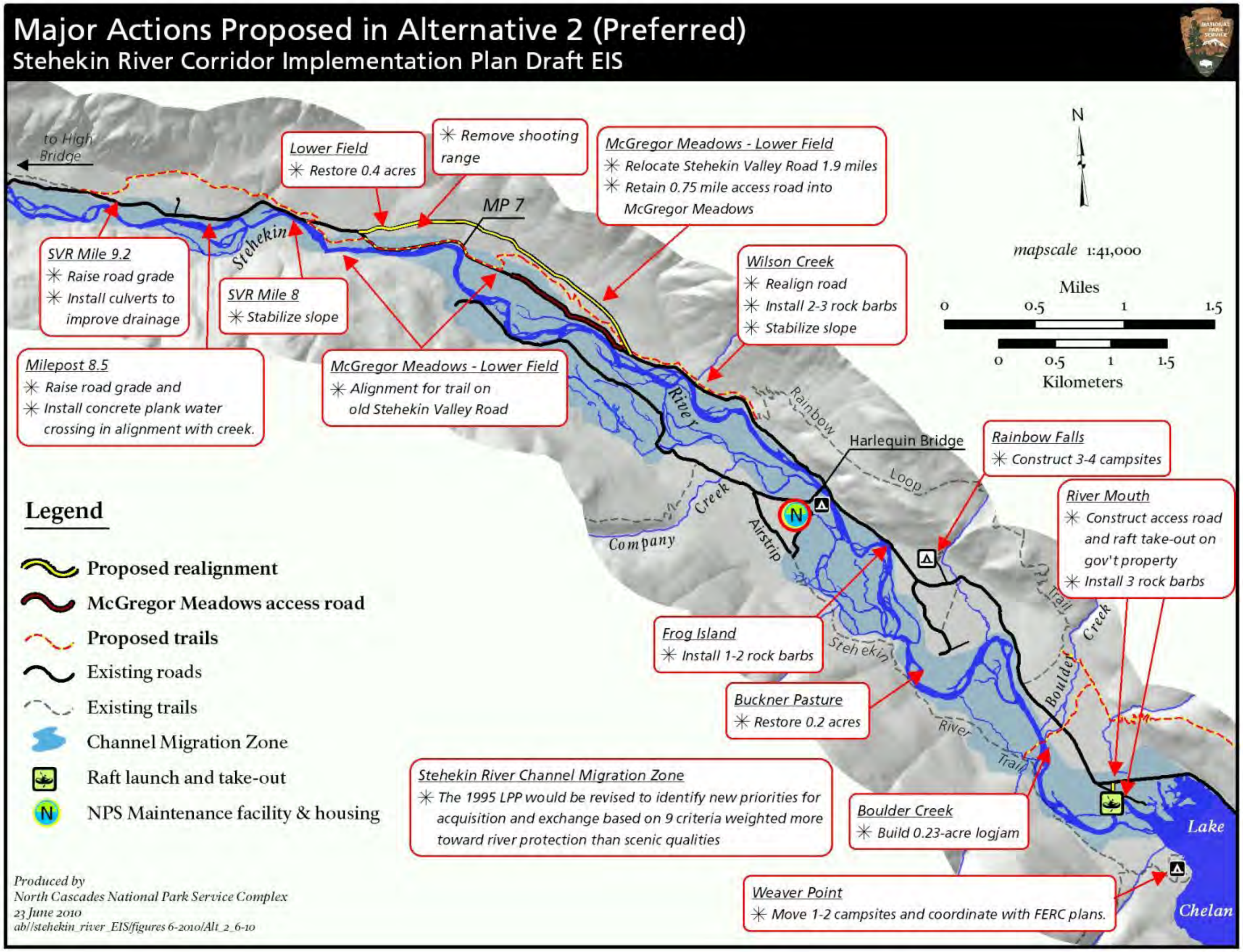


**Figure II-3: Major Actions Proposed in Alternative 2**

Compared to Alternative 1, Alternatives 2 - 4 would propose some manipulation of woody debris within the Lake Chelan backwater zone (extending 0.25 mile from the head of the lake up the Stehekin River). In this area of the lower Stehekin River and Harlequin Bridge, large logjams that threatened public roads, water quality, public safety, and regular access to private property could be altered to relieve threats. Woody debris from the tops of some logjams and from floating logs in Lake Chelan could also be made available to landowners (for agency-permitted erosion protection) under a permit system. The wood could only be used in the channel migration zone for erosion protection and/or restoration projects. This action would limit importation of large rock and acknowledges the large amount of wood currently on the river.

Recreational opportunities, including camping, rafting, and hiking, associated with the Stehekin River would be enhanced. As in Alternative 1, the Lower Valley Trail would be constructed to link the Landing with High Bridge, including connecting it to the Stehekin River Trail. In this alternative (as in Alternative 3), fewer miles of new trail (4.6 miles) would be needed since the trail would use some former roadway (1.7 miles) and existing trail (6.2 miles). New group camping opportunities would be located at Purple Point Horse Camp to replace the group campsite at Harlequin when it is seasonally flooded. Three or four new individual sites would also be located near Rainbow Falls. In addition, a new raft takeout would be provided near the Stehekin River mouth, which would require a small new parking area and a 300-foot-long access road off of the Stehekin Valley Road. Because the shooting range is located along the proposed Lower Field Reroute, it would be closed and restored. No replacement shooting range would be constructed.

## 4. Alternative 3

### At-Risk Public Facilities Removed from Channel Migration Zone in Most Areas; Same Land Acquisition/Exchange as in Alternative 2

Alternative 3 would allow the Stehekin River slightly less room to move within its natural channel migration zone and requires the use of different erosion protection measures than in Alternative 2 (with four barbs and five logjams, instead of six to eight barbs and two logjams) (see Figure II-4: *Major Actions Proposed in Alternative 3*). As in other alternatives, Alternative 3 would implement the GMP replacement and relocation of the maintenance facility and housing and construction of the Lower Valley Trail. Different erosion protection approaches were developed since the rock barbs and logjams have different benefits and installation impacts. The erosion protection measures increase from Alternative 2 through Alternatives 3 and 4, consistent with the overall degree to which each alternative constrains the river. As in Alternative 2, there would be a minor change regarding the use of woody debris, and the revised LPP would be used.

The reroute of Stehekin Valley Road in Alternative 3 would be slightly shorter than the one proposed in Alternative 2. The reroute would begin at Milepost 5.7 and would end at Milepost 7.3 (see Figure II-5: McGregor Meadows Reroute Map). With the shortening of the reroute (compared to Alternative 2), the portion of the existing road that borders Lower Field would be stabilized with riparian vegetation and rock barbs. As in Alternative 2, an access road from Milepost 5.7 to Milepost 6.5 would be retained up to the last private parcel in McGregor Meadows until it is no longer needed; and administrative access would also be maintained to Milepost 6.8 for maintenance of grade-control structures. From Milepost 6.8 to Milepost 7.3, the road would be rehabilitated as part of the Lower Valley Trail.

Four rock barbs would be constructed along the bank at Weaver Point (two barbs) and Lower Field (two barbs), while large logjams would be constructed at Weaver Point, near the Stehekin River mouth, Boulder Creek (and avulsion sill), Frog Island, and at Wilson Creek. Restoration and/or bioengineering (layered planting using native shrubs) would also occur in the same locations as in Alternative 2.

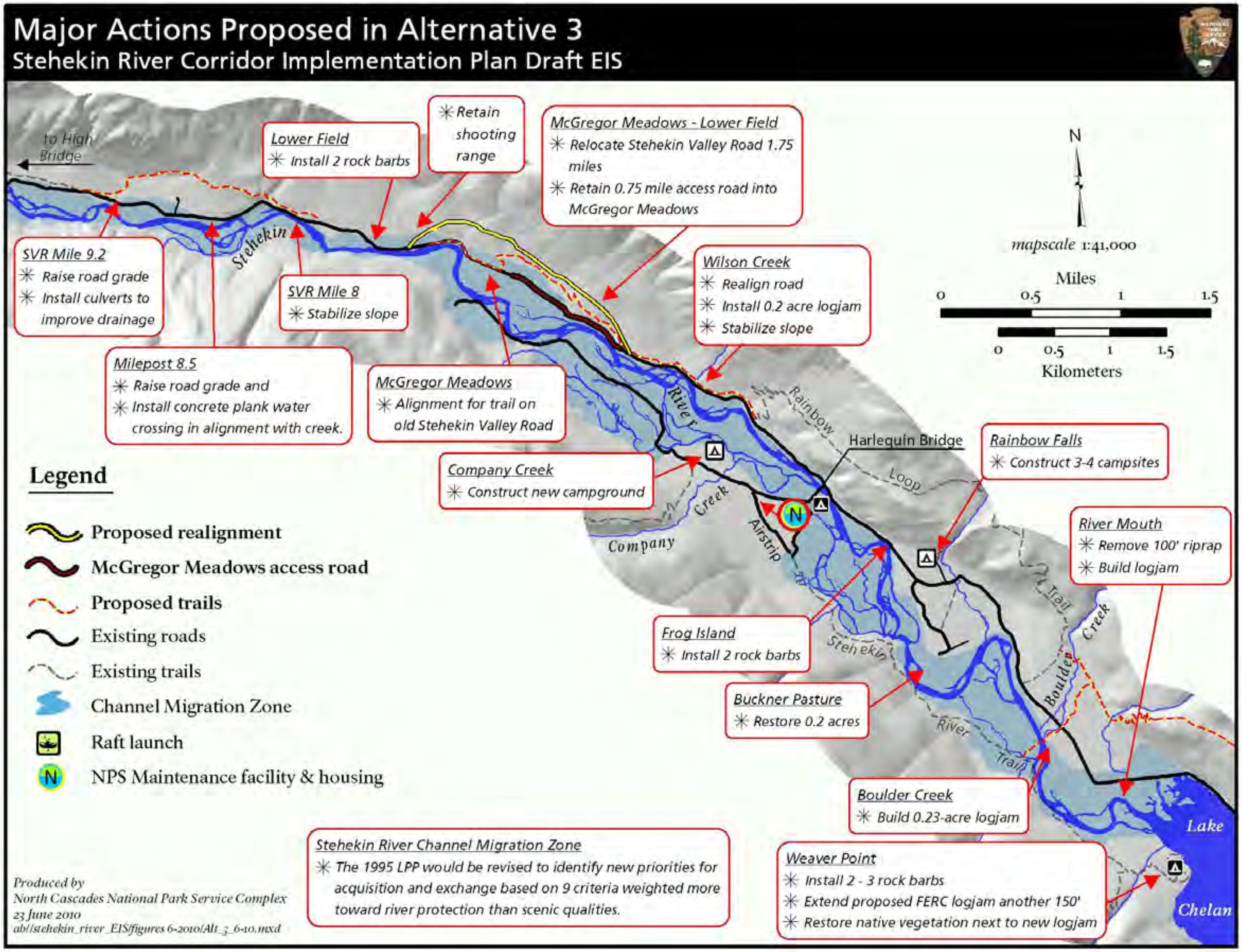


**Figure II-4: Major Actions Proposed in Alternative 3**

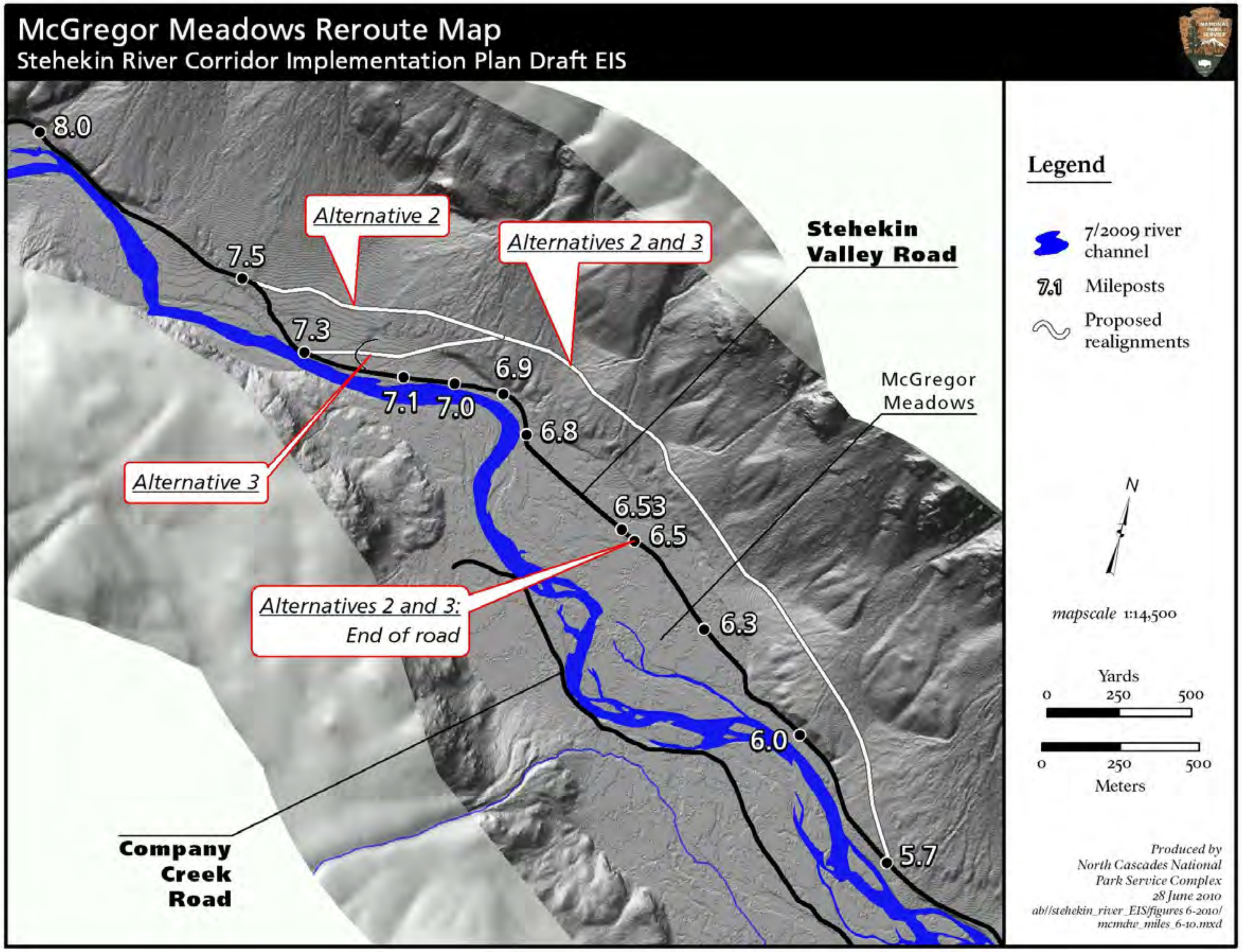


**Figure II-5: McGregor Meadows Reroute Map**

Management of woody debris would be the same as in Alternative 2. Recreational improvements would be similar to Alternative 2; however, additional camping opportunities would also be provided at Company Creek at a previously disturbed site outside of the Stehekin River channel migration zone, and no new raft takeout would be constructed near the Stehekin River mouth.

## 5. ALTERNATIVE 4

### At-Risk Public Facilities Removed from Channel Migration Zone in Some Areas; Less High-Priority Land Acquisition/Exchange in Channel Migration Zone

Compared to Alternative 1, Alternative 4 would allow for some additional movement of the Stehekin River within its channel migration zone, if private property was purchased or exchanged. Unlike Alternatives 2 and 3, if Alternative 4 was selected, the draft LPP (Appendix 13) would be revised to rank high priority lands per the criteria shown later in this chapter in Table II-15. As in Alternative 1, without rerouting, Alternative 4 would constrain the movement of the Stehekin River from a large part of its floodplain through McGregor Meadows and at Lower Field (Figure II-6: *Major Actions Proposed in Alternative 4*). The LPP revision would be different than in Alternatives 2 and 3. Appendix 11 lists the priority ranking of private lands for Alternatives 2 and 3 while Appendix 12 lists the priority ranking of private lands for Alternative 4 (see Appendix 12 for the priority ranking of private lands for Alternative 4). Exchanges would be focused less on properties along the river, and more on sustaining the current development pattern. Because of this, there would be fewer parcels with a high priority for acquisition that would allow for their removal from the channel migration zone. Some private development in flood-prone areas near the river channel, however, would be considered for exchange or purchase. Actions associated with GMP implementation (including replacement and relocation of the maintenance facility and NPS housing and construction of the Lower Valley Trail) would be the same as in ―Actions Common to All Alternatives (1 - 4).”

As in Alternatives 2 and 3, there would be stabilization and riparian restoration of the bank along the Lower Field. As in Alternative 1, instead of a reroute around McGregor Meadows, Stehekin Valley Road would be raised in some locations to minimize flood damage, and 4.9 miles of the road would be rehabilitated and paved between Harlequin Bridge and the winter turnaround.

There would be additional placement of barbs and bioengineering for erosion protection measures implemented along the Stehekin River, not only at the Lower Field, but also near Milepost 7.0 and Milepost 9.2. To maintain the Stehekin Valley Road in its existing alignment, Alternative 4 would have the greatest number of locations where erosion protection measures would be undertaken. Rock barbs would be constructed at Weaver Point (two barbs), Stehekin River mouth (three barbs), Frog Island (two barbs), Wilson Creek (two to three barbs), Lower Field (two barbs), Milepost 7.0 (two barbs), and Milepost 9.2 (three barbs), and a large logjam/avulsion sill would be constructed at Boulder Creek along the bank extending into the forest. Riparian restoration and/or bioengineering (layered planting associated with rock barbs or logjams) would also occur in the same locations as in Alternatives 2 and 3.

Use of woody debris would be the same as in Alternatives 2 and 3, with both NPS and private permitted use, except that woody debris could be used from the tops of prescreened logjams from areas below the Bullion raft launch, including at McGregor Meadows. (This is in contrast to Alternatives 2 and 3, which restrict taking logs from the river to below Boulder Creek in the Lake Chelan backwater zone).

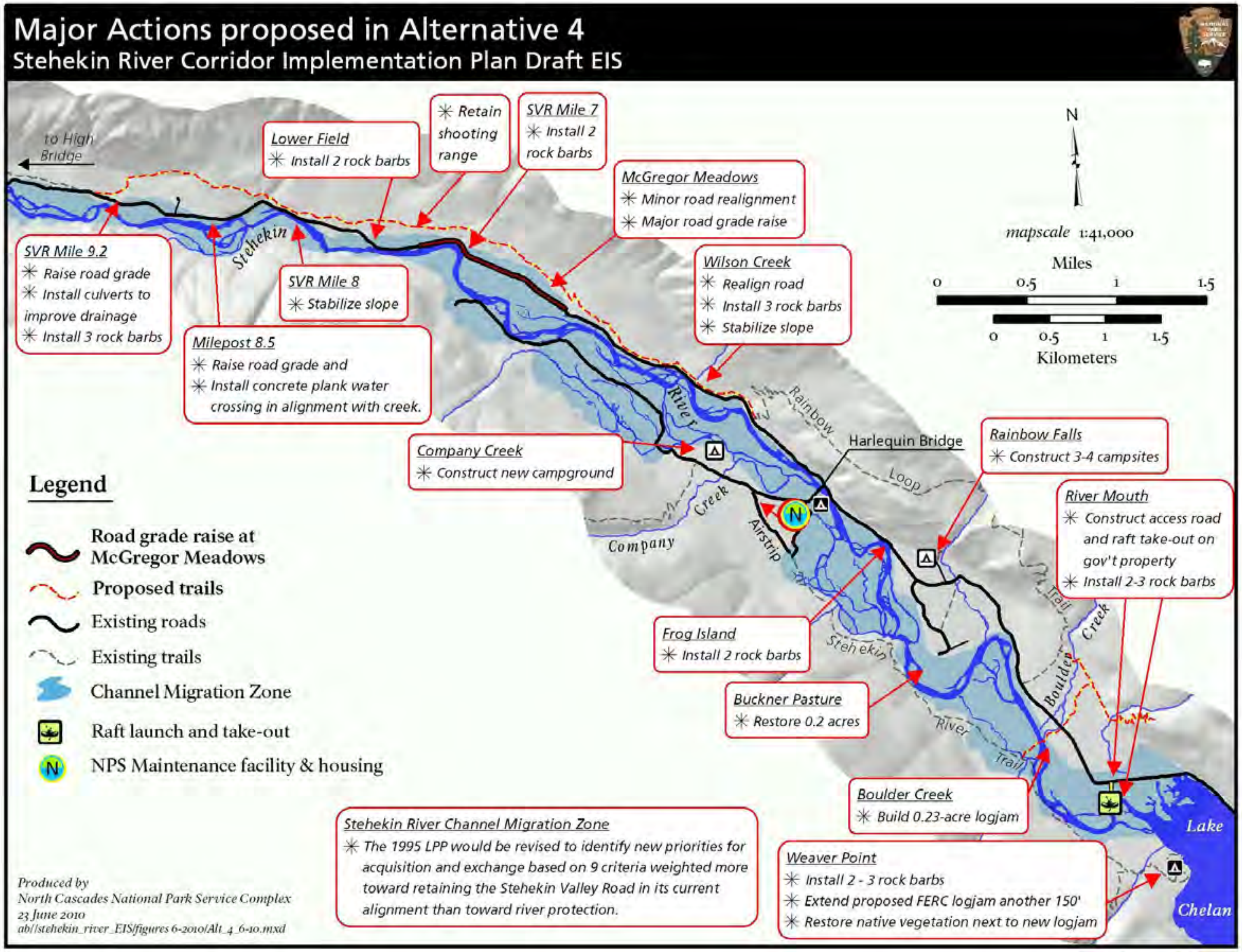


**Figure II-6: Major Actions Proposed in Alternative 4**

Recreational improvements would be the same as in Alternative 3 except there would be a raft launch in this alternative, as in Alternative 2. Construction of the Lower Valley Trail would be similar to that proposed in Alternative 1, with 6.1 miles of existing trail and 6.3 miles of new trail, but it would follow more sections of the historic road under this alternative.

## B. DESCRIPTION OF ACTIONS COMMON TO ALL ALTERNATIVES (1 - 4)

**Overview**: This section gives a detailed overview of project components that would be implemented regardless of which alternative is selected, followed by a more detailed discussion of each component. The alternatives are tiered off the GMP and other recent Stehekin plans, including the Road Improvement Project. A number of individual actions that are part of these plans would be part of all alternatives.

1. **GMP Implementation**: Actions would include relocating the maintenance area, NPS housing, and 1 - 2 campsites out of the floodplain constructing a fire cache and dorm, and constructing the Lower Valley Trail, including its connection with a bridge to the Stehekin River Trail.

2. **Road Maintenance**: Ongoing maintenance of the Stehekin Valley Road and Company Creek Road would continue, including cyclic, seasonal, and routine (day-to-day) maintenance activities.

3. **Harlequin Bridge**: Harlequin Bridge would be maintained in its current condition. If replacement was proposed, a longer span would be recommended. As called for by the GMP, logjams threatening the bridge would be removed.

4. **Company Creek Road and Stehekin Valley Road—Private Access**: There would continue to be no manipulation of the Stehekin River to protect private property. If access was lost, the NPS would work with private landowners on a case-by-case basis to evaluate alternative access across federal land, if needed, or to encourage land exchange, if appropriate.

5. **Existing Company Creek Road Erosion Protection Measures and Strategy**: As called for by the GMP, Company Creek Road would continue to be maintained in its existing alignment. The array of erosion protection measures along the Company Creek Road would continue to be maintained and would be replaced if necessary.

6. **Existing Stehekin Valley Road Erosion Protection Measures and *Stehekin Valley Road Improvement Project* (2005) Implementation**: The array of erosion protection measures along the Stehekin Valley Road would continue to be maintained and would be replaced if necessary. Road rehabilitation (surfacing, pullouts, culverts, etc.) would occur in the sections of the Stehekin Valley Road that would be treated the same by all alternatives. (Road Improvement Project proposed grade raises and Wilson Creek actions vary by alternative.)

7. **Flood Protection Measures**: The NPS would continue to respond to emergency conditions as needed to protect NPS facilities. To allow the Company Creek Road to remain in its current location, the existing levee would be retained. Removal of administrative structures from the floodplain / channel migration zone, including the existing maintenance area and housing, would also occur. Near McGregor Meadows, grade-control structures designed to maintain shallow flood flows (sheet flow) on both sides of the river would be maintained until no longer needed.

8. **Materials Sources, Construction Staging, Restoration, and Mitigation/Monitoring**: The success of road rehabilitation called for by the Road Improvement Project and other actions associated with this plan, as well as limiting its impacts on recreation area resources through

project actions would be ensured through a variety of measures common to construction projects implemented in Stehekin.

## Actions Common to All Alternatives (1 - 4)

### 1. GMP Implementation

In accordance with the GMP, the NPS would:

- Relocate administrative facilities (maintenance and housing) from the Stehekin River floodplain to a 5 - 8-acre site near the north end of the airstrip. Actions involving administrative facilities will require a separate environmental review and are not analyzed in detail in this document.
- Construct a new fire cache, helispot, and dormitory near the airstrip.
- Construct a Lower Valley Trail and its connection to the Stehekin River Trail (a footbridge crossing of the Stehekin River).

**Relocate Administrative Facilities/Construct New Maintenance Compound**: The current maintenance compound and septic system is within the 100-year floodplain and is subject to routine inundation and flood damage during peak flows occurring every few years. Hazardous-material storage is elevated, but is currently located within the 500-year floodplain. Both would be relocated to near the north end of the airstrip out of the floodplain and channel migration zone. Proposed plans call for comprehensive design and construction of a replacement maintenance compound near the airstrip. Future site planning would identify building locations and footprints and would be subject to additional environmental analysis. Replacement and relocation of the maintenance area and fire cache to an area not subject to flooding would result in improved emergency access to equipment and long-term protection of buildings and structures and would minimize impacts to water quality from debris and hazardous materials stored in the floodplain.

Development of the relocated maintenance area would include the functions and buildings in Table II-2*: Proposed Maintenance Compound Structures*.

***Maintenance Area Problems***

**Susceptibility to Flooding**: During floods in November 1995, October 2003, and November 2006, the maintenance compound and access road were under several feet of water. Standing water and silt damaged stored electrical appliances, furniture, paper products, and other equipment. Emergency response was delayed because equipment at the maintenance area is essential for evacuation of residents and visitors as well as for repairing roads. Heavy equipment, such as the backhoe and grader, are the only high-clearance vehicles that can get to or from the compound during flooding. Because of increasing flood frequency and severity, the cost of repairs following flooding at the maintenance compound is increasing. In 1995, damage cost approximately $30,000 to repair, and in 2003, more than $56,000.

**Inadequate Building Construction**: The maintenance facilities, which were constructed in the 1950s or 1960s or were inherited from the U.S. Forest Service (USFS), have exceeded their useful life. The poorly designed facility compound includes a collection of cramped, poorly lit, under-insulated buildings, generally not constructed to function as maintenance facilities. These facilities are inadequately designed to handle snow-load. Roof-pitch and physical locations make it difficult to remove snow. Several roofs must routinely be hand-shoveled to prevent collapse. Buildings are also inadequately insulated and are heated with various systems, including propane, wood pellet, and electric heating. Due to the distance from supply facilities, extra parts for each of these must be kept on hand.

The relocated maintenance area would be designed to meet a Leadership in Energy and Environmental Design (LEED) rating of silver or greater and would include associated utility systems, including new solar power generation. As construction of the new maintenance buildings occurred, the existing maintenance facilities would be dismantled and their sites restored; however, some facilities in good condition could be relocated and repurposed for new uses.

**Table II-2: Proposed Maintenance Compound Structures**

| Building | Area |
|---|---|
| Equipment repair shop | 4,000 sq ft |
| Maintenance storage (propane, hazardous materials, supplies) | 4,800 sq ft |
| Search and rescue / fire cache | 2,400 sq ft |
| Solid waste compaction / recycling | 2,000 sq ft |
| Helipad | 400 sq ft |
| Gas station | 800 sq ft (two 6,000 gallon fuel-storage tanks and dispensing facility) |
| Power generation | Unknown |
| Water distribution | 100,000 gallon tank 400 sq ft foundation<br>10 × 10 ft well house |
| Wastewater treatment | Unknown; likely to be individual septic systems |
| **Total circulation space** | **10,890 sq ft** |
| **Total building space** | **14,900 sq ft** |

Note: Total figures do not include unknown categories.

**Relocate/Construct Park Housing**: Implement the GMP action to relocate housing threatened by flooding and construct new seasonal and permanent housing at the north end of the airstrip, in conjunction with the maintenance area on about 5 - 8 acres. Up to 11 housing units could be constructed; however, the exact location of the housing would be based on site specific design and planning beyond the scope of this plan. Future site planning would identify building locations and footprints and would be subject to additional environmental analysis.

**Construct Lower Valley Trail**: Implement the GMP recommendation to create a Lower Valley Trail to connect High Bridge to Stehekin Landing. As noted in the GMP:

> An 11-mile pedestrian and horseback trail would be developed from the Landing to High Bridge… A pedestrian and horseback riding trail system that connects key lower valley features to the Stehekin Valley Road would also be developed. (NPS 1995a:33)

**Lower Valley Trail**: The Lower Valley Trail would be maintained for horses and hikers. Bicyclists would continue to use the Stehekin Valley Road. The trail would begin at the Landing and climb the hillside either using the Purple Creek Trail or heading off from the Imus Trail to reach a relatively flat bedrock bench. The trail alignment would traverse the bench above Lake Chelan descending in the vicinity of Little Boulder Creek (approximately 1.9 miles new trail). From Little Boulder Creek, it would traverse the slope crossing Boulder Creek and meet with the Rainbow Loop Trail (approximately 0.6 miles new trail). It would then follow the Rainbow Loop Trail for the rest of its length to the upvalley trailhead (approximately 3.8 miles, existing trail). From the upper Rainbow Loop Trailhead, it would travel a flat, mostly open area paralleling the road at approximately 1,300 ft elevation and through the Skinny Wilson property to the site of the proposed road reroute (approximately 0.9 mile new trail).

Depending on the alternative, the trail would:

- Alternatives 1 and 4: Connect with the Old Wagon Road alignment and generally follow it to the Stehekin Valley Ranch (approximately 3 miles new).
- Alternatives 2 and 3: Follow the McGregor Meadows Access Road and abandoned sections of the Stehekin Valley Road (approximately 0.7 mile access road and 1.1 miles of abandoned road). The trail would cross the Stehekin Valley Road in the vicinity of 8-Mile and continue upvalley

following the Old Wagon road to the vicinity of the Stehekin Valley Ranch (approximately 1.2 miles new trail)

In all alternatives, the trail would connect with the Bullion Trail network then with the High Bridge and Coon Lake Trail (approximately 2.3 miles existing trail).

In Alternatives 1 and 4, the Lower Valley Trail would use 6.1 miles of existing trail and would require approximately 6.3 miles of new trail. In Alternatives 2 and 3, the trail would use approximately 7.9 miles of existing trail or road and would require approximately 4.6 miles of new trail. The trail would be approximately 2 feet wide and 12. 5 miles long and would take 200 - 300 days to construct depending on the alternative and crew size.

**Lower Valley Trail and Stehekin River Trail**: The trail would tie into the existing Stehekin River Trail via a footbridge across the Stehekin River up valley of Boulder Creek and would make use of the existing concrete bridge abutments if possible. At this location, the river is approximately 129 feet wide and the channel is relatively stable.

**Relocate Weaver Point Campsites**: The NPS would continue to maintain Weaver Point Campground and to replace / relocate the boat docks. In accordance with the GMP, all alternatives would relocate one or two shoreline campsites inland. Erosion control, recreation, improvement, and cultural-resources projects related to the Lake Chelan Hydroelectric project would be integrated with NPS actions.

***Weaver Point***

Weaver Point is the largest boat-in campground near the head of the lake. It contains approximately 16 campsites (including fire rings / grates, tables, potable water, and both flush and pit toilets). There is also an administrative cabin, which is being rehabilitated and which has been used in the past for park housing and may be used again.

In the 2006 flood, the mouth of the Stehekin River eroded away a major portion of its right bank (facing downstream) at Weaver Point, washing out one of the boat docks and destabilizing the piers of another. Since that time, the Stehekin River has continued to move against Weaver Point, and one of the shoreline campsites is threatened by erosion. It is likely that the river will continue to affect the shoreline, causing the need for shoreline campsites to be relocated (as called for by the GMP).

## 2. Road Maintenance

The NPS would continue to maintain the designated Stehekin Valley Road within the project area. The NPS would also continue to maintain the Company Creek Road in its current alignment for public and private vehicle access, subject to available funds and with concurrence from property owners, where no easement access authority exists.

The NPS would continue to perform regular maintenance of the road surface, including a variety of seasonal work, such as snowplowing on major roads (winter); windfall, tree, and debris removal, culvert cleaning, and pothole patching (spring); and grading, shoulder maintenance, and sign replacement (summer/fall). More substantial repairs of the road, such as culvert replacement and crack and slurry seals, is considered beyond the scope of routine road maintenance and would be subject to further planning and environmental analysis.

## 3. Harlequin Bridge

Harlequin Bridge would continue to be maintained under all alternatives. As called for by the GMP, removal of bridge-threatening logjams would occur as necessary. Because the span of Harlequin Bridge is too short, it is exposed to a higher risk of flood damage and could be damaged by erosion or a logjam during floods. When replacement becomes necessary, the NPS would recommend constructing a bridge with a longer span. A longer span bridge would be more sustainable, would have less impact to the river, and would be less susceptible to flood damage.

## 4. STEHEKIN VALLEY ROAD / COMPANY CREEK ROAD—PRIVATE ACCESS

**No Manipulation of the Stehekin River to Protect Private Property**: As stated in the GMP: “The Park Service would not manipulate the river to protect private property. No action would be taken to prevent private property owners from manipulating the river on their land to protect their property unless such actions would significantly harm recreation area resources or were in violation of local, state, or federal ordinances, regulations, or laws. Such actions would not be encouraged, however.” (NPS 1995a: 21 - 22)

Because of *NPS Management Policies* and the legislation that authorized the NPS to maintain the Company Creek Road, the NPS would continue to be prohibited from taking actions or expending funds solely to protect private property (see Chapter I: Purpose of and Need for Management Action); however, ensuring access to private property and recreation area lands would continue to be a priority, as would protection of public roads and facilities.

**Stehekin Valley Road / Company Creek Road Private Access**: Stehekin Valley Road / Company Creek Road access would continue to be via existing driveways or spur roads off the public roads as maintained by private landowners. If major road failure occurred from a catastrophic river avulsion (major channel shift) and loss of major sections of either road occurred and affected private property access, the NPS would work with private landowners to determine whether to restore access across federal land, if needed, or to encourage land exchange, if appropriate. Landowners would continue to be responsible for maintaining access roads on their property.

Whether restoration of access would include rebuilding the access road, rerouting, or some combination of these would be determined as it has been, on a case-by-case basis, and would be designed to limit impacts to Lake Chelan NRA resources.

## 5. EXISTING COMPANY CREEK ROAD EROSION PROTECTION MEASURES

**Land Use and Development (Transportation Plan Elements) Actions**: “Company Creek Road would be maintained in its current alignment and condition.” (NPS 1995a: 33)

Company Creek Road would be maintained in its existing alignment, and existing erosion protection structures would be maintained and replaced as needed. These include 10 rock barbs, three grade control structures, extensive bioengineering, and a 400-foot-long levee along the Company Creek Road that would need ongoing maintenance (see Appendix 5: Cumulative Impacts Project List).

The risk of catastrophic river avulsion (major channel shift) would remain for all alternatives. Should this occur and include loss of the Company Creek Road, road reroutes could be considered (if road repair is not feasible) to continue to provide motor vehicle access to recreation sites and to private property in the area.

**Bank barbs** consist of approximately 100 cubic yards of large rock, placed at an upstream angle (see Figure II-10). They affect downstream flow for approximately 100 feet, or four to five times their length (see Photo 12).

Because they have little downstream impact and because they are eventually buried in aggrading rivers, such as the Stehekin River, barbs have a minimal effect on the river compared to other erosion protection or bank-hardening techniques such as rip-rap or levees.

Barbs increase river bank stability and capture wood and sediment coming downriver to the benefit of fish. Barbs also allow for safe raft passage.

**Bioengineering** is a riverbank slope-stabilization technique that consists of layering soil and riparian plants into an excavated bank between layers of coconut fiber matting that decomposes over time as the plants become established (see Figure II-11). If given a few years to grow, these structures increase in strength over time (see Photo 12).

Plants would include dormant cuttings from red osier dogwoods (*Cornus* sp.), willows (*Salix* sp.), or other suitable species collected in the fall from nearby locations for wet areas, and stems of oceanspray (*Holodiscus* sp.) and wild rose (*Rosa* sp.) in drier areas.

Where needed, cuttings may be provided supplemental water through the first two summers.

**Riparian restoration** is a technique that allows for return of natural rates of bank erosion, and is proposed primarily in areas where native vegetation was removed for agriculture.

Riparian restoration also can be used alone or in combination with the installation of bioengineering or logs.

## 6. EXISTING STEHEKIN VALLEY ROAD EROSION PROTECTION MEASURES AND *STEHEKIN VALLEY ROAD IMPROVEMENT PROJECT* IMPLEMENTATION

**Stehekin Valley Road Erosion Protection Measures**: Similar to the Company Creek Road, numerous erosion protection measures have been implemented by the NPS along the Stehekin Valley Road (see Appendix 5: Cumulative Impacts Project List). As with the Company Creek Road, several erosion protection structures and have been constructed to protect the Stehekin Valley Road. Over time, it is likely that some reaches of the Stehekin River would continue to fill with gravel, causing bank barbs to be rendered ineffective. As a result, future barb reconstruction or a road grade raise would be considered.

**Road Improvement Project General Improvements**: Actions from the Road Improvement Project (NPS 2005a) addressed by all alternatives include a series of road and drainage improvements on approximately 4.58 miles of the Stehekin Valley Road. The majority of the road rehabilitation would occur within the existing road prism (the area affected by original construction of the road). Exceptions would include improving sight distance and drainage problems and constructing pullouts.

Note: Road rehabilitation does not apply to the proposed reroutes in Alternatives 2 and 3.

**Road Rehabilitation / Pullout Construction**: The Stehekin Valley Road would be rehabilitated as a single-lane road above Harlequin Bridge, with a variable top-width of approximately 12 - 14 feet (Alternative 1) or 14 - 16 feet (Alternatives 2 - 4) and an adequate number of pullouts to safely accommodate two-way traffic.

The Road Improvement Project calls for approximately 20 new pullouts (8 feet wide by 20 feet long with a taper on each end) along the road. Five existing pullouts between Harlequin Bridge and the winter turnaround would be reconstructed or improved. In places where the road base is failing, the base and subgrade would be excavated and replaced with suitable material. New pullouts would improve safety by correcting sight distance problems caused by curves along the road. Other improvements would provide a uniform surface and improve driving and safety conditions for visitors, especially for large vehicles, including snowplows.

Culverts would be cleaned, replaced, or extended as needed. Additional culverts would be installed to correct drainage deficiencies. Road ditches and other minor features would be removed, replaced, repaired, or added, as appropriate, to correct drainage problems. Approximately 0.4 mile of new side ditches would be constructed and 3.6 miles of existing side ditches would be retained.

Vegetation clearing along the road would vary considerably, depending on location, according to whether or not a pullout is needed; whether or not alignment modifications are needed to improve sight distance; whether drainage ditches would need construction or reconstruction; and whether culverts were added, removed, or replaced.

**Road Surfacing**: A new asphalt chip seal surface would be constructed under all alternatives. The existing road from the Landing to Harlequin Bridge would be repaved. The pavement would then be extended from the bridge to the northern terminus at the new winter bus turnaround and parking area. The new surface would cover the existing variable top-width. Where necessary, shoulder grades would be raised with compacted aggregate to the level of the new surface; and where appropriate, pavement markings would be applied to the surface of the road. Road signs would also be replaced and/or added as appropriate.

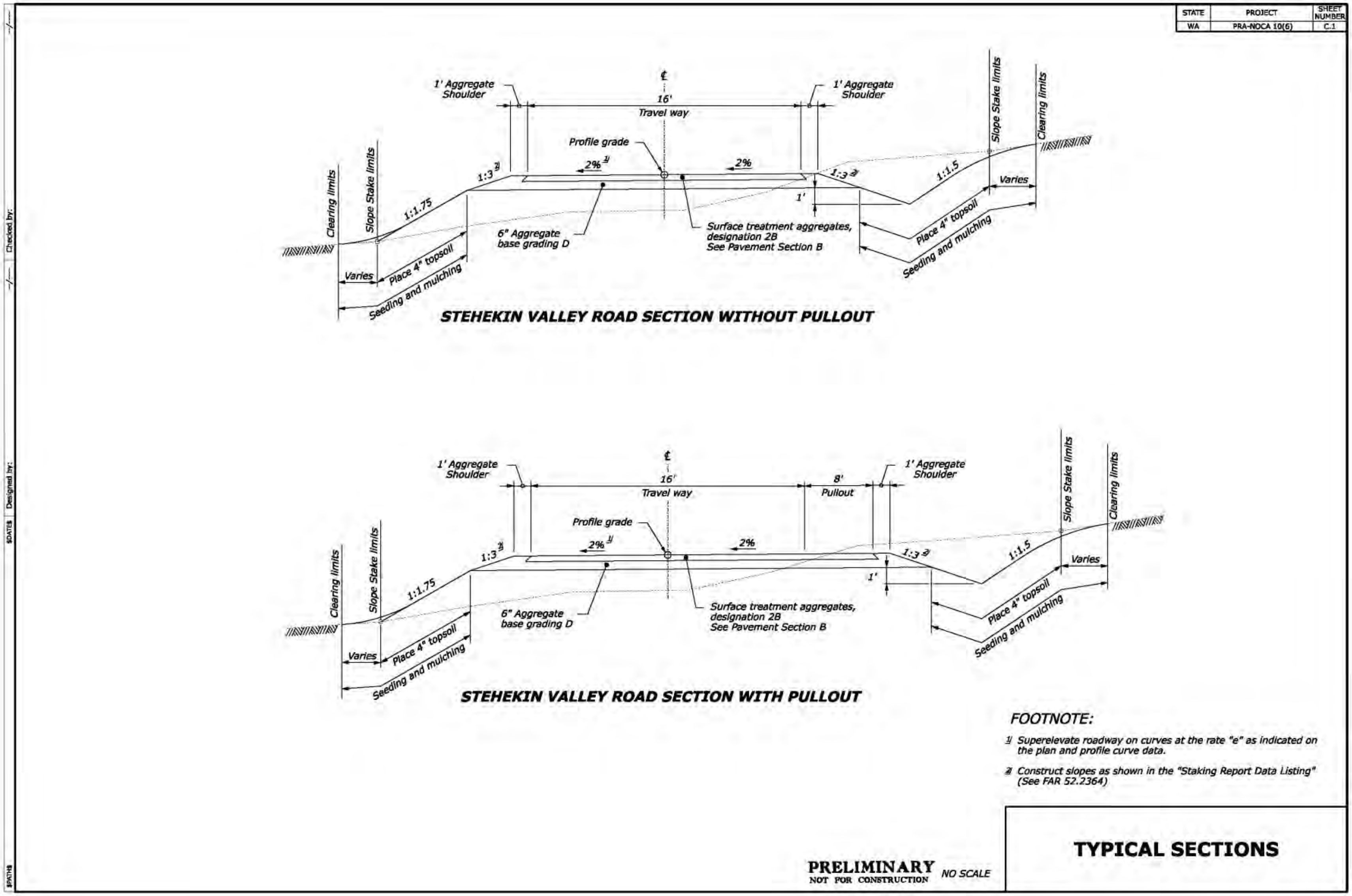


**Figure II-7: Typical Road Cross Section and Cross Section with Pullout**

All work, except for the new pullouts and for sight distance corrections, would be performed within the existing road prism. Surfacing would improve driving and safety conditions for vehicles, and allow for a designated travel speed of 25 miles per hour.

## Road Improvement Project Site-Specific Improvements

### Wilson Creek Improvements: Stehekin Valley Road Milepost 5.3

A portion of the Wilson Creek erosion protection improvements are common to Alternatives 1 - 4. At Wilson Creek there are drainage and/or erosion problems on both sides of the Stehekin Valley Road. On the north side, the Stehekin River has eroded the bank along the toe of the road slope and there is a near-vertical drop of approximately 20 feet between the river and the road. In February 2004, cracks were observed that had developed along the side of the road shoulder, indicating the potential for future slope failure. Should this occur, portions of the road shoulder or the road itself would fail.

Wilson Creek is prone to periodic massive debris deposition on the roadbed. During high flows, the creek deposits large quantities of rock and gravel onto the road and into the culvert. It also tends to jump its bank during flooding, spreading out across the slope and causing water to flow across and erode the road in several places. This results in erosion of the road surface and additional destabilization of the riverbank.

Riverbank improvements proposed at this location include laying back the slope (reducing it) above the waterline for approximately 400 feet (this would generate approximately 1,100 cubic yards of material) and then stabilizing the slope (the method varies among alternatives) to allow native vegetation to reestablish.

After stabilization, the road would be rebuilt in place. All alternatives would regrade the slope for approximately 400 feet, lower the roadbed 10 feet, move the road laterally away from the river about 15 feet into the hillside, and install two new 60-inch culverts and a new ditch (NPS 2005a:22 - 24). If the road becomes undermined, it would be rebuilt in place. No reroutes are possible given the location of the road along the edge of the bank and the steep adjacent terrain.

The slope is sparsely vegetated, and no large trees would be removed. Moving the road farther from the river would allow the shoreline room to adjust naturally over time and the slope to be stabilized and revegetated. It is likely the proposed solution would continue to require maintenance after big floods to remove gravel deposited on the road by Wilson Creek.

The new culverts would replace the current 36-inch culvert to reduce damage from heavy rains and flooding caused by Wilson Creek. In addition, a ditch would be constructed on the uphill side of the road to capture water from Wilson Creek and direct it to the culverts to minimize the potential for water running over the road surface.

Access across private property may be needed to implement Wilson Creek erosion protection. There is no access across NPS land; therefore, there is no room to work between the slope of the road and the Stehekin River. The NPS would work with the landowner to identify appropriate mitigation and/or compensation for impacts, such as an easement or purchase.

### Winter Turnaround: Stehekin Valley Road Milepost 9.2

As called for by the Road Improvement Project, a winter vehicle turnaround and parking area for up to 5 passenger vehicles and 1 bus, or 10 passenger vehicles, would be constructed. The turnaround area would be approximately 140 feet by 75 feet (0.24 acre), large enough to enable buses to turn around without backing up (with a turning radius of approximately 40 feet).

The turnaround would be the end of snowplowing in winter (NPS 2005b:25).

## 7. Flood Protection Measures

**Public Facilities (McGregor Meadows Private Development / Company Creek Private Development)**: The NPS would continue to respond to emergency conditions on an as-needed basis. Because gravel removal and additional levees have been dismissed from further analysis, the focus of floodplain management in this plan is on floodplain utilization, which allows floodwater to spread out and slow down during large events, thereby minimizing damage in any one part of the valley. Grade-control structures placed in the floodplain on both sides of the river near McGregor Meadows would be maintained. These structures allow sheet flow of floodwaters through floodplains, consistent with floodplain utilization. This approach is widely considered the most sustainable in the management of steep mountain rivers.

The NPS would also encourage Chelan PUD to keep the level of Lake Chelan as low as possible during spring and fall flooding periods (while remaining in conformance with lake level management to enable fish access to tributaries). Lake Chelan NRA would also continue to work with Chelan County to require raised drain fields for new construction in the channel migration zone and to advocate for modifications to existing drain fields that frequently flood and other actions to avoid development impacts in the channel migration zone, including additional pollutant contributions.

The NPS would not support attempts by individuals, local, state, or federal agencies to implement flood protection measures (e.g., dredging, dike, or levee construction) if such actions are deemed to detract from or otherwise impair the purpose and values for which Lake Chelan NRA was established.

**Technical Assistance to Stehekin Landowners**: For development that remains within the floodplain, private landowners would continue to be encouraged to use ―Advanced Flood Protection Measures" as outlined by the Army Corps of Engineers (ACOE) (Appendix 7), including elevating cabins and constructing ring dikes.

The NPS would provide Stehekin landowners with technical assistance for designing these recommended Advanced Protection Measures. The NPS would also encourage landowners to work with the county on implementing other measures to minimize water-quality impacts associated with flooding of wells and septic systems. Staff would continue to be available to consult with Stehekin Valley landowners to implement these measures.

Some of the Advanced Protection Measures may require applicable landowner-obtained permits from Chelan County, the ACOE, and/or the Washington Department of Ecology, Washington Department of Fish and Wildlife, and approval from the U.S. Fish and Wildlife Service. Among the measures contained in the packet of information include the following: flow deflector, ring dike, debris fence, grade control, and scour protection. Refer to Chapter VII: Glossary for explanation of each of these measures and Appendix 7: ACOE Advanced Flood Protection Measures for a copy of the packet.

## 8. MATERIALS SOURCES, CONSTRUCTION, STAGING, RESTORATION, AND MITIGATION/MONITORING

The following construction, staging, restoration and mitigation/monitoring conditions and requirements, derived from previous and ongoing work within the Stehekin Valley, would be common to all alternatives.

### Materials Sources

Road construction materials (gravel and rock) would be obtained from reject material within the Company Creek Pit in accordance with the Sand, Rock, and Gravel Plan (NPS 1995e). Additional rock and gravel would be obtained from sources in the vicinity of Chelan and barged uplake to Stehekin Landing and then loaded into trucks to be hauled to project areas. Reliance on imported materials would be minimized by balancing cut and fill needs within the project area when reroutes are considered (Alternatives 2 - 3) and by using material that has been determined to be unsuitable for other park needs from the Company Creek Pit.

As directed by the GMP, no sand, rock, or gravel would be removed from the Stehekin River floodplain. Other materials from the Company Creek Pit would be used if they meet the prescriptions in the Lake Chelan Sand, Rock, and Gravel Plan, which specifically defines when and for what uses this material is available, which in general, is for emergency repairs or for ongoing maintenance needs.

Materials barged in from outside the area would be from an approved site that has been evaluated to ensure that it does not contain nonnative invasive plants (noxious weeds) and/or that treatment of affected areas has occurred before removal and/or before importation of materials.

### Construction Staging

To the degree possible, construction staging would occur on existing sections of roadway to be abandoned or within otherwise disturbed areas (Company Creek Pit, Lower Field, and within proposed surfacing areas before the asphalt chip seal is applied).

Staging areas for equipment and materials would also be in previously disturbed, park-approved locations, such as in existing pullouts. For the proposed project under all alternatives, major staging would occur at Company Creek Pit and Lower Field and within wide areas in the existing roadway. Additional staging for the reroutes in Alternatives 2 and 3 would occur within the reroute areas. Staging areas would be protected from spillover impacts by the placement of erosion- and sediment-control barriers as appropriate and would be returned to preconstruction conditions or restored upon completion of the proposed project. Construction crews would stay at the Stehekin Landing Resort or private accommodations in the valley or in temporary housing in a previously disturbed site near the airstrip. Approximately 10 - 12 temporary trailers could be used to house workers on site.

### Rehabilitation of Abandoned Structures, Sites, and Facilities

As resources permit, the NPS would continue to remove flood-affected derelict structures from the floodplain and to restore NPS-managed former areas of development. As properties with improvements are acquired or exchanged, the NPS would continue to remove buildings and utility system infrastructure and restore the sites to natural conditions to minimize contamination of the Stehekin River and to enhance aesthetics.

Among the kinds of structures and infrastructure that would be removed would be septic, electrical, and water systems, including septic tanks and drain field materials such as plastic infiltrators and conduit; electrical infrastructure such as power poles and lines; water system elements such as plumbing, well casings, and pumps. Foundations on concrete slabs or piers would also be removed. Where possible, all these materials would be recycled or salvaged rather than removed to a landfill outside Lake Chelan NRA. Where existing structures but not utility systems have been previously removed, NPS would return to remove infrastructure.

## Disturbed Area Rehabilitation and/or Restoration

As noted in the GMP:

> The natural character of the lake and river edge on public lands (includes areas within 200 feet of the lake and river shoreline) would be restored. (NPS 1995a:27 - 28)

Site rehabilitation and/or restoration would occur as needed, subject to site conditions and available resources on lands where buildings and utility systems were removed. Restoration would also occur following construction of erosion protection measures, reroutes or rehabilitation of the existing roadway. As earthwork concludes, revegatation of disturbed areas would include topsoil replacement, planting and/or seeding. Topsoil and duff would be salvaged and applied to priority areas by the contractor as directed by Lake Chelan NRA staff.

Restoration would generally consist of the following activities:

- Prior to construction, site-specific and species-specific seed collection would occur along the length of the project area.
- The road contractor would complete earthwork (including scarification) according to contract documents to ensure adequate surface preparation for restoration/revegetation.
- Revegetation treatments would include mulching, transplanting, and hand seeding with native plants, as well as seed propagation and restoration treatments such as duff salvage, plant propagation, and planting.
- Revegetation would begin following completion of work in affected areas.
- The revegetation strategy would rely on natural regeneration from conserved topsoil. Revegetation plantings would use native species that are slower to establish naturally and would be from genetic stock originating in the recreation area. The principal goal is to assist natural regeneration in reestablishing a sustainable native plant community similar to surrounding undisturbed vegetation.
- Revegetation would be monitored by park staff to ensure its successful establishment and would be in compliance with applicable permitting requirements.
- The primary revegetation areas would include obliterated sections of road and clearing limits along the reroutes. Additional areas of riparian restoration are also proposed within the alternatives.

### Mitigation Measures and Post-Project Monitoring

Where actions would be implemented by FHWA, FHWA would work in cooperation with the NPS to ensure the contractor complies with all mitigation measures identified for the proposed work to avoid or minimize impacts on Lake Chelan NRA resources during rehabilitation and construction activities throughout the duration of the project.

Mitigation measures listed in Chapter IV: Environmental Consequences and summarized in Appendix 6: Summary of Mitigation Measures would be implemented. To ensure that mitigation measures are followed, appropriate mitigation measures would be included in the appropriate Special Contract Requirements section, and with FHWA oversight, NPS staff would periodically conduct on-site inspection of construction activities and materials.

Following completion of the project, the NPS would monitor the success of revegetation treatments and supplement these with additional seeding or plantings if needed. For at least three years following project completion, the NPS would monitor for the presence of invasive plants. Invasive species would be removed as they are found during monitoring and through ongoing maintenance.

## C. DESCRIPTION OF DIFFERENCES AMONG ALTERNATIVES 1 - 4

This section describes the **differences** among the four alternatives. A brief overview of the project components that are treated differently by at least one alternative is described below. This is followed by a detailed discussion of how each component is treated by each alternative.

1. **Land Protection Plan Modifications**: Implementation of the LPP varies among alternatives. The existing 1995 LPP (NPS 1995b) does not change under Alternative 1; it has been revised in the same way under Alternatives 2 and 3; and would be revised in a different way under Alternative 4. The priority ranking of private lands for Alternatives 2 and 3 is found in Appendix 11, and for Alternative 4 in Appendix 12. The criteria and scoring used to rank private lands for Alternatives 2 - 4 is found in Table II-5.

2. **Stehekin Valley Road Modifications (Stehekin Valley Road Improvement Project Implementation)**: The road would be raised and maintained in its current alignment under Alternatives 1 and 4, while different road reroutes to remove the road from the floodplain / channel migration zone are proposed in Alternatives 2 and 3.

> ***Land Protection Plans (LPP)***
>
> The purposes of an LPP for a unit of the National Park System are to:
>
> (1) Determine what land or interests in land need to be in public ownership and what means of protection other than fee acquisition are available to achieve unit purposes as established by Congress.
>
> (2) Inform landowners about NPS intentions for buying or protecting land through other means within the unit.
>
> (3) Help managers identify priorities for making budget requests and allocating available funds to protect land and unit resources.
>
> (4) Find opportunities to help protect the unit by cooperating with state or local governments, landowners, and the private sector. (NPS 1995b:1)
>
> LPPs establish priorities for the acquisition of, or government interest in, private lands. Within an LPP, all private lands within a national park unit are classified regardless of actual intent or means to acquire them.

3. **Stehekin Valley Road / Company Creek Road—Private Access**: In Alternatives 2 - 4, if major road failure occurs, a criteria-based decision-making process would be used to determine if the original access should be restored or a reroute should occur.

4. **Recreational Facilities**: In Alternative 1, existing facilities would be maintained and the Lower Valley Trail constructed. In Alternatives 2 - 4, there would be modifications of varying degrees made to add or change campgrounds. Construction of the Lower Valley Trail would vary slightly between Alternatives 1 and 4 and Alternatives 2 and 3, as described in the preceding section. A new raft takeout and access road near the river mouth would also be constructed in Alternatives 2 and 4.

5. **Management of Large Woody Debris**: In Alternative 1, large woody debris would be manipulated only to protect public roads and bridges, and individual logs would continue to be trimmed or turned for safer recreational use. Floating woody debris could continue to be collected from the head of Lake Chelan after floods. Alternatives 2 - 4 would allow for collection from the tops of some logjams in the lake backwater zone for use in erosion protection measures. In Alternative 4, the collection zone would extend farther. Woody debris could be made available to private landowners for streambank restoration and erosion protection projects under specific conditions in Alternatives 2 - 4.

6. **Flood Protection Measures**: In Alternatives 2 - 4, land exchanges or acquisition to remove development from the floodplain would be emphasized to allow the Stehekin River to spread floodwater across its floodplain. A portion of the Stehekin Valley Road would be rerouted out of the floodplain / channel migration zone in Alternatives 2 and 3 (two different reroutes).

7. **Interpretation and Education**: In Alternatives 1 - 4 existing interpretive programs would continue. Under Alternatives 2 - 4, enhanced interpretation emphasis on the value of large woody debris in the river environment, the role of flooding in river ecosystems, on the value of minimizing human impacts to river systems, on river processes, and the sensitive and flood-prone nature of the Stehekin River would occur.

8. **Research and Monitoring**: Under all alternatives, the NPS would continue existing research and monitoring programs, focused on large woody debris, main and side channel habitat, hydrology, fish surveys, historical research and analysis, nonnative/invasive plants, climate change effects, and special status species research. In Alternatives 2 - 4 the NPS would expand research and monitoring programs to determine the effectiveness/consequences of erosion and flood protection measures, large woody debris manipulation, etc. and would add more flow gauges on the upper river if funding is available.

9. **Weaver Point Erosion Protection Measures**: In all alternatives, actions called for under the Federal Energy Regulatory Commission (FERC) relicensing Environmental Assessment (constructing a lake shoreline logjam and rock wall and developing cultural resources management plans) would occur. In Alternatives 1 and 2 some campsites would be moved away from the eroding riverbank east of the docks. In Alternatives 3 and 4, two rock barbs and bioengineering would be constructed and the FERC logjam extended to stabilize the bank and to protect the campground from future erosion.

10. **Stehekin River Mouth Erosion Protection Measures**: No actions would be taken under Alternative 1 to remove rip-rap on public land and restore the stream bank, or to prevent potential river channel changes that could ultimately threaten the Stehekin Valley Road. In Alternatives 2 and 4, rock barbs, a small logjam, and bioengineering would replace a portion of the rip-rap (on NPS land). In Alternative 3, a large engineered logjam would replace the rock barbs and bioengineering proposed in Alternatives 2 and 4.

11. **Stehekin Valley Road Erosion Protection Measures**: In Alternatives 2 - 4, a series of erosion protection measures (including engineered logjams and/or rock barbs and bioengineering) would protect the Stehekin Valley Road. Fewer of these same measures would occur in Alternatives 2 and 3 because of the proposed road reroutes. There would be actions in four locations in Alternative 2, six in Alternative 3, and eight in Alternative 4.

## 1. Land Protection Plan Modifications

**Background**: National parks containing private lands are required to have LPPs (see sidebar ―Land Protection Plans"). The 1995 Lake Chelan NRA LPP (NPS 1995b) consists of management objectives, compatibility criteria, ranking criteria, and priorities that direct NPS land exchanges and acquisition of private parcels. The priorities are based on park-identified resource criteria and on legal authority (see sidebar ―Authority for Land Exchanges").

**Management Objectives**: Seven management objectives to meet the overall goal of ensuring that land uses on public and private lands are compatible with the purpose of the recreation area. Fourteen guidelines form the basis for implementing the plan (see Appendix 3: 1995 Land Protection Plan Management Goals / Objectives and Guidelines).

**Compatibility Criteria**: Compatibility criteria assist in determining how uses contribute to or detract from the purposes of the recreation area (Appendix 3). ―The alteration, development, and use of all public and private properties within Lake Chelan NRA must comply with … and must be compatible with the congressionally designated purposes of Lake Chelan NRA" (NPS1995b:13).

**Priorities**: All private lands within Lake Chelan NRA were classified in the LPP in terms of priority for acquisition, regardless of actual intent or means to acquire them. These priorities were ranked high, moderate, and low (see Table II-3: *1995 Land Protection Plan Ranking of Private Lands*). This allowed the 1995 LPP to then identify the acres targeted for exchange based on a system of resource-based criteria. Changes in the floodplain boundaries from large floods in 1995, 2003, and 2006 have altered conditions on many private parcels.

### *Authority for Land Exchanges*

Public Law 90-544, title III, Section 301 authorized Lake Chelan NRA to acquire and exchange lands (see "C. Relationship to Other Plans" in Chapter I: Purpose of and Need for Management Action). The 1995 LPP consists of priorities, management objectives, and ranking criteria to direct NPS land exchanges for private parcels.

To allow for exchange of federal lands for private lands, the 1995 LPP defined when exchanges could occur: when the private lands have a high resource value and the public lands have a low resource value (NPS 1995c:35). The four resources of concern identified in the 1995 LPP included wetlands, high flood influence areas, riparian communities, and high visual sensitivity areas (NPS 1995c: 27).

*The secretary of the interior has the authority to exchange federally owned property , or interests therein, which has been determined to be suitable for exchange, or other disposal, for nonfederal property within Lake Chelan NRA… Exchange properties will be limited to certain selected federal lands that have been acquired since the establishment of the Lake Chelan NRA in 1968. Federal lands acquired since 1968 total 1,173 acres. In addition to the proposed exchange possibilities described below, future acquired properties may be subsequently considered for disposal by exchange after two years from the date of acquisition in order to enhance historic or traditional development patterns; consolidate new forms of approved development proposals into the most suitable areas; or protect areas of higher resource values.*

*All potential exchanges will be based on near equal value for value real estate appraisals, not acre for acre, and may be limited by the availability of appropriated funds if the nonfederal lands exceed the value of the federal lands to be exchanged.*

**Table II-3: 1995 Land Protection Plan Ranking of Private Lands**

| Priority | Proposed Minimum Interest | Number of Tracts | Acres |
|---|---|---|---|
| High | Fee | 1 | 0.77 |
| | Easement | 43 | 99.45 |
| | Combination | 18 | 272.04 |
| Moderate | Fee | 7 | 3.69 |
| | Easement | 11 | 17.60 |
| | Combination | 0 | 0 |
| Low | Fee | 43 | 23.37 |
| | Easement | 43 | 19.06 |
| | Combination | 0 | 0 |

## Existing (Alternative 1) LPP Ranking Criteria and Proposed Acquisition and Exchange Lands

Nonfederal land was evaluated for the presence of certain resource values, including wetlands, high flood influence areas, riparian communities, and areas of high visual sensitivity. The criteria also identified lands in visually sensitive sites along public roads (NPS 1995b:27).

Once these criteria were applied to all nonfederal lands, these same criteria and others were applied to determine whether potential exchange lands had high resource value, identified by the 100-year floodplain, wetland soils, geohazard areas, slopes greater than 20 percent, and/or areas of high visual sensitivity (NPS 1995b:16).

After application of both sets of criteria, the following ranking based on parcel size was applied to determine the final ranking.

- **Low**: Tracts less than 1 acre (85 total). Due to small size, the potential for significant impact on resource values is significantly less than for tracts greater than 1 acre.
- **Moderate**: Tracts greater than 1 acre, with high-priority resources for protection over less than 50 percent of the area (17 total).
- **High**: Tracts greater than 1 acre, with high-priority resources over more than 50 percent of the area (64 total). (NPS 1995b:27).

The 1995 LPP ranked 167 private tracts, comprising approximately 460 acres, as shown in Table II-3 (NPS 1995b:iii).

The ranking for specific private lands within Lake Chelan as classified by the 1995 LPP is found in Table 2: Priorities for Protection and Proposed Minimum Interest in the 1995 LPP (NPS 1995b:31 - 34), which is duplicated in the Stehekin River Corridor Implementation Plan (SRCIP) in Appendix 10: 1995 Land Protection Plan Ranking of Private Lands.

## Actions Since the 1995 Land Protection Plan

As noted earlier, the 1995 GMP and LPP called for moving private development out of the floodplain as the most viable solution to minimize flood damage to private property and resources. Of the more than 62,000 acres that then comprised Lake Chelan NRA (including lands within the boundary owned by other entities), the 1995 LPP identified 1,173 acres of land acquired by the recreation area upon or after its establishment in 1968 (and owned in fee). These lands were therefore determined to be potentially available for exchange because they had at some point been privately owned (outside the public domain).

Of the 1,173 acres, 1,123 acres were determined to have high resource value in the 1995 LPP and were identified for retention by Lake Chelan NRA because they had one or more of the development constraints or four resources of concern identified in the LPP (see sidebar ―Authority for Land Exchanges"), because they were part of historic properties, or because they could be used for visitor facilities at the Landing. This left approximately 50 acres that could potentially be exchanged with Stehekin landowners to meet the objectives of protecting high resource value lands and/or moving critical residential development out of the Stehekin River floodplain. Those 50 acres that were suitable at the time for exchange were made available pending ―appropriate deed reservations … to ensure compatible use subsequent to the exchange" (NPS 1995b:36).

In the 1995 LPP, ―although private lands in the valley could be exchanged for public lands outside the recreation area, this possibility" was ―considered beyond the scope of" that plan. Nonetheless, the LPP went on to state: ―If landowners show interest on a willing seller / willing buyer basis, the National Park Service would work with the Bureau of Land Management and other federal agencies under the Federal Land Exchange Act of 1988, to determine if federal lands outside the recreation area would be available for exchange" (NPS 1995b:35).

Since 1995, the NPS has completed two land exchanges (12.75 acres) from the identified 50 acres available for exchange, leaving approximately 37 acres still available (see Table II-4: *1995 Land Protection Plan Proposed Exchange Parcels*) (NPS 2005c:36). Some of this land, however, may no longer be suitable due to new information regarding resource significance or changes in conditions related to flooding. Areas that may no longer be suitable include one combined parcel (1.34 acres) mostly within the floodplain without enough buildable area, and the Lower Field (19.2 acres) which is known habitat for northern spotted owls, elk, deer, bears, and other wildlife. Because the LPP has not been updated until now, however, these lands remain ―currently available" for exchange. (They are included in the ―no-action" Alternative 1 to facilitate comparison with the other alternatives.)

**Table II-4: 1995 Land Protection Plan Proposed Exchange Parcels**

| Area | Acres Available |
|---|---|
| Vicinity of Lower Field | 21 |
| Little Boulder / Boulder Creek (both sides of the road) | 16 |
| East of the Airstrip | 6 |
| Vicinity of Stehekin Valley Ranch | 5 |
| Above Rainbow Creek (west side of the road) | 2 |

Since 1995, the NPS has also acquired six tracts (totaling roughly 30 acres); acquired easements or deed restrictions on several other parcels (roughly 20 acres); and completed a boundary adjustment along Lake Chelan based on a property survey that resulted in a deletion of approximately 23 acres from the Lake Chelan NRA (the original survey line had been drawn inaccurately).

There were originally 167 tracts (totaling 460 acres) of privately owned land identified in the 1995 LPP, plus a mixture of Washington State, Chelan County Public Utility District #1, and Stehekin School District lands (totaling roughly 2,273 acres). There are now 168 privately owned tracts totaling 417 acres. (The number of tracts has increased due to the actions of some landowners splitting existing tracts into more than one tract or combining some tracts into a larger parcel, and the splitting of some tracts into two tracts to account for easements established with the NPS) Updated information on the mixture of state, Chelan PUD, private land, and Stehekin School District lands now indicate those lands total roughly 2,613 acres.

## Treatment of the Land Protection Plan by Alternative

### Alternative 1: Land Protection Plan Implementation

Under Alternative 1, implementation of the 1995 LPP (NPS 1995b) would not change. The purposes, management objectives, compatibility criteria for public and private lands, land protection techniques, and land protection priorities as identified in that plan would remain the same (Table II-4: *1995 Land Protection Plan Proposed Exchange Parcels*).

### Elements Common to Alternatives 2 - 4: Land Protection Plan Modifications

Although LPP priorities would be different among alternatives, the key purposes of the LPP would be the same as in Alternative 1. Lands that would remain in public ownership and lands available for exchange would be the same under Alternatives 2 - 4. These potential exchange lands are located on alluvial fans and other landforms outside the channel migration zone. Some exchange parcels have also been identified where they would augment a cluster of existing development. Prioritization of private lands for acquisition, however, varies between Alternatives 2 and 3 and Alternative 4, to reflect slightly different approaches to floodplain management, particularly in McGregor Meadows. Alternatives 2 and 3 emphasize removal of more private parcels from the channel migration zone than Alternative 4. Alternative 4 gives lower priority scoring to parcels in the channel migration zone and near the river channel. See Appendix 11 for the priority ranking of private lands for Alternatives 2 and 3, and Appendix 12 for the priority ranking of private lands for Alternative 4.

### Elements Common to Alternatives 2 - 4: Land Protection Plan Implementation

**Land Protection Plan Ranking Criteria (to determine priorities)**: The 1995 Lake Chelan LPP criteria to identify lands of high resource value have been revised in Alternatives 2 and 3 and Alternative 4 to reflect a new emphasis on removing development from the channel migration zone, not just the floodplain, as was done in the 1995 LPP (NPS 1995b) . There is also increased emphasis placed on clustering new development in areas away from the river, despite potentially being visible to the public. Therefore, the focus on the Stehekin River migrating within its natural channel migration zone necessarily redirects some of the LPP criteria away from protecting scenic resources and more toward avoiding the river. Because the NPS remains concerned about the aesthetic qualities of development in the lower valley, appropriate Covenants, Conditions, and Deed Restrictions (CCRs) would continue to ensure that exchange lands remain visually compatible with the rustic vernacular characteristics of the Stehekin Community and the purposes of Lake Chelan NRA. The NPS would also continue to apply these same general standards to public and administrative facilities.

Since the passage of the three largest floods on record in the last 15 years, consideration of land protection priorities has changed, although many remain the same. The focus in Alternatives 2 - 4 is on removing development threatened by the river and on planning for future river changes. Other development effects, such as the unsuitable locations of septic drain fields and structures (with the potential to be inundated and/or incorporated into the river, with resultant adverse effects on water quality and scenic resources) have also been considered.

Under Alternatives 2 - 4, new LPP criteria would be adopted to acknowledge the changing conditions related to recent massive flooding in the lower Stehekin Valley. This list of criteria would be applied differently in Alternatives 2 and 3 as compared to Alternative 4 (see descriptions of Alternatives 2, 3, and

4 below) (Table II-5). The criteria are used to determine what lands would have the highest priority for protection within Lake Chelan NRA and would revise the similar list of criteria in the 1995 LPP identified in Alternative 1 (Table II-5: *Proposed Land Protection Plan Criteria Weighting for Alternatives 2 and 3 and Alternative 4*).

**Table II-5: Proposed Land Protection Plan Criteria Weighting for Alternatives 2 and 3 and Alternative 4**

| Criteria | SRCIP Alternatives 2 (Preferred) and 3 | SRCIP Alternative 4 |
|---|---|---|
| **1. Stehekin River channel migration zone (CMZ)** | **2 points**: Structure within CMZ and/or if less than 1 acre of property is outside the CMZ<br>**1 point**: No structure within CMZ and greater than 1 acre of property is outside CMZ<br>**0 points**: Entire parcel outside CMZ | **1 point**: Structure within CMZ and/or less than 1 acre of property is outside CMZ<br>**0 points**: No structure within CMZ and greater than 1 acre of property outside CMZ |
| **2. Alluvial fan migration zone (AFMZ) of Boulder, Company, or Rainbow Creek** | **2 points**: Structure within AFMZ and/or less than 1 acre of property is outside AFMZ<br>**1 point**: No structure within AFMZ and greater than 1 acre of property is outside AFMZ<br>**0 points**: Entire parcel outside AFMZ | **1 point**: Structure in AFMZ and/or less than 1 acre of property outside AFMZ<br>**0 points**: No structures within AFMZ |
| **3. Wetlands or riparian habitat** | **1 point**: Wetlands or riparian habitat present<br>**0 points**: No wetlands or riparian habitat | **1 point**: Wetlands or riparian habitat present<br>**0 points**: No wetlands or riparian habitat |
| **4. Rare species or suitable habitat for those species** | **1 point**: Rare species or habitat present<br>**0 points**: No rare species/habitat present | **1 point**: Rare species or habitat present<br>**0 points**: No rare species/habitat present |
| **5. Potential to reduce habitat fragmentation** | **2 points**: Parcel greater than 5 acres and adjacent to public land<br>**1 point**: Parcel less than 5 acres and adjacent to public land<br>**0 points**: Parcel not adjacent to public land | **2 points**: Parcel greater than 5 acres and adjacent to public land<br>**1 point**: Parcel less than 5 acres and adjacent to public land<br>**0 points**: Parcel not adjacent to public land |
| **6. Potential for public use/access** | **1 point**: Parcel adjacent to public land used for administrative use or has potential for public use<br>**0 points**: No administrative use or potential for public use adjacent to parcel | **2 points**: Parcel adjacent to public land used for administrative use or has potential for public use<br>**0 points**: No administrative use or potential for public use adjacent to parcel |
| **7. Cultural resources or related concerns** | **1 point**: Parcel has known cultural resources<br>**0 points**: No cultural resources present | **1 point**: Parcel has known cultural resources<br>**0 points**: No cultural resources present |
| **8. Permanent structures** | **2 points**: Parcel has a permanent structure<br>**1 point**: Parcel has no permanent structures | **1 point**: Parcel has a permanent structure<br>**0 points**: Parcel has no permanent structures |
| **9. Urgency of threat to development** | **2 points**: Parcel has structure less than 50 ft from main or major side channel of Stehekin River<br>**1 point**: Access road to parcel is less than 50 ft from main or major side channel of Stehekin River<br>**0 points**: Entire parcel and access road greater than 50 ft from main or major side channel and/or no structures located on property | **1 point**: Parcel has structure less than 50 ft from main or major side channel of Stehekin River<br>**0 points**: Parcel has access road less than 50 ft from main or major side channel of the Stehekin River and/or no structure located on property |

**Land Use Protection Priorities**: These would vary by alternative; see descriptions in Alternative 2 (Alternative 3 would be the same) and Alternative 4 (Table II-5: *Proposed Land Protection Plan Criteria Weighting for Alternatives 2 and 3 and Alternative 4*) below.

**Lands Available for Exchange**: Approximately 24 acres would be available for exchange in Alternatives 2 - 4, although this could increase by a few acres if development of the NPS maintenance and housing in the airstrip area requires less acreage than anticipated (Table II-6: *Alternatives 2 - 4 Revised Land Protection Plan Proposed Exchange Parcels*). Although initial review of park-owned (fee) lands resulted in approximately 76 acres that were potentially suitable for exchange consideration, further resource analysis and field reconnaissance resulted in the reduction of this acreage to the approximately 24 acres that are proposed as being available under Alternatives 2 - 4 for exchange.

**Table II-6: Alternatives 2 - 4 Revised Land Protection Plan Proposed Exchange Parcels**

| Area | Acres |
|---|---|
| Above Stehekin Valley Ranch | 5.2 |
| Near airstrip (former Peterson property) | 2.0* |
| West of Rainbow Falls (former Webb property) | 1.33 |
| Near Stehekin School (former Rice property) | 1.68 |
| Boulder Creek area (former Griffin/Getty property) | 3.79 |
| Boulder Creek area (former Brownfield property) | 2.61 |
| Keller"s Park | 7.2 |
| **Total** | **23.81** |

*Up to 10 additional acres could be added to this site following completion of the development plan for the NPS maintenance and housing facility identified here and in the GMP.

Parcels have been identified for potential exchange based on evaluation of the above resource criteria as applied to formerly private lands acquired in the recreation area. As noted earlier in the quote from the 1995 LPP, no lands that have always been within the public domain are able to be exchanged, including lands transferred from other agencies of the federal government, such as the U.S. Forest Service (USFS), and/or that were once part of one of the surrounding historic Forest Reserves.

As in Alternative 1, lands identified for exchange would be conveyed with Covenants, Conditions and Restrictions (CCRs) to ensure that subsequent private development remains compatible with Lake Chelan NRA and the Stehekin Community. Each parcel identified for exchange would be ground-truthed to tailor the CCRs to the specific conditions of the property and would be subject to future environmental analysis. Easements or terms and conditions for development would be identified to fit the topography, vegetation, visibility, and character of existing or potential developments on each tract (NPS 1995b:21). See Appendix 9: Proposed Conditions, Covenants, and Deed Restrictions for a list of potential criteria that would be applied as part of land exchanges, where applicable.

Such provisions would protect recreation area resources by specifications related to:

- Clearing of vegetation;
- Location and design of new access roads and utilities;
- Density, height, design and color of development visible to the public; and
- Access for management of natural and cultural resources. (NPS 1995b:21).

The NPS envisions that some individual parcels available for exchange may be desired by multiple landowners seeking exchange. It is conceivable that given the heightened concerns associated with the increasing flood magnitude and frequency on the Stehekin River, the NPS's continued desire to pursue land exchanges as a means of land and resource protection, the limited availability of federal funding to complete land exchanges, and the limited availability of potential federal lands for exchange, there may be interest from multiple landowners in pursuing exchanges or multiple landowners interested in exchanging for the same federal parcel.

To ensure there is a fair, objective, and transparent process for determining who should be given priority for exchange, the NPS proposes to consider the following criteria when multiple landowners are interested in a particular parcel:

Primary criteria:

- The landowner's current parcel is a priority in the acquisition ranking described above (high, medium, or low).
- The landowner is willing to consider other ways to equalize values, including paying for costs associated with structure removal on their current parcel, or considering an unequal trade.
- The landowner is willing to comply with CCRs to protect resources.
- The landowner is willing to consider clustering development or sharing utilities as a means of reducing the overall development footprint.

Secondary criteria:

- The timing of the request for exchange (a request for a parcel made months before others may be considered first).
- The landowner is willing to help defray due diligence costs, such as appraisals, surveys, and environmental site assessments.

### Elements Common to Alternatives 2 and 3: Criteria Weighting to Determine LPP Priorities

The following criteria (Table II-7: *Summary of Revised LPP Ranking for Private Lands in Alternatives 2 and 3* and Figure II-8: *Potential Exchange Lands in 1995 and Revised Land Protection Plan*) would be used to determine LPP priorities if the revised LPP is adopted. For Alternatives 2 and 3, these criteria are weighted toward allowing the Stehekin River to migrate to the greatest extent possible in its channel migration zone while protecting Lake Chelan NRA resources, including key wetland, wildlife, vegetation, water quality, and cultural resources.

**Table II-7: Summary of Revised LPP Ranking for Private Lands in Alternatives 2 and 3**

| Tentative Priority | Number of Tracts | Acres |
|---|---|---|
| High | 66 | 271.50 |
| Medium | 98 | 141.22 |
| Low | 4 | 4.75 |

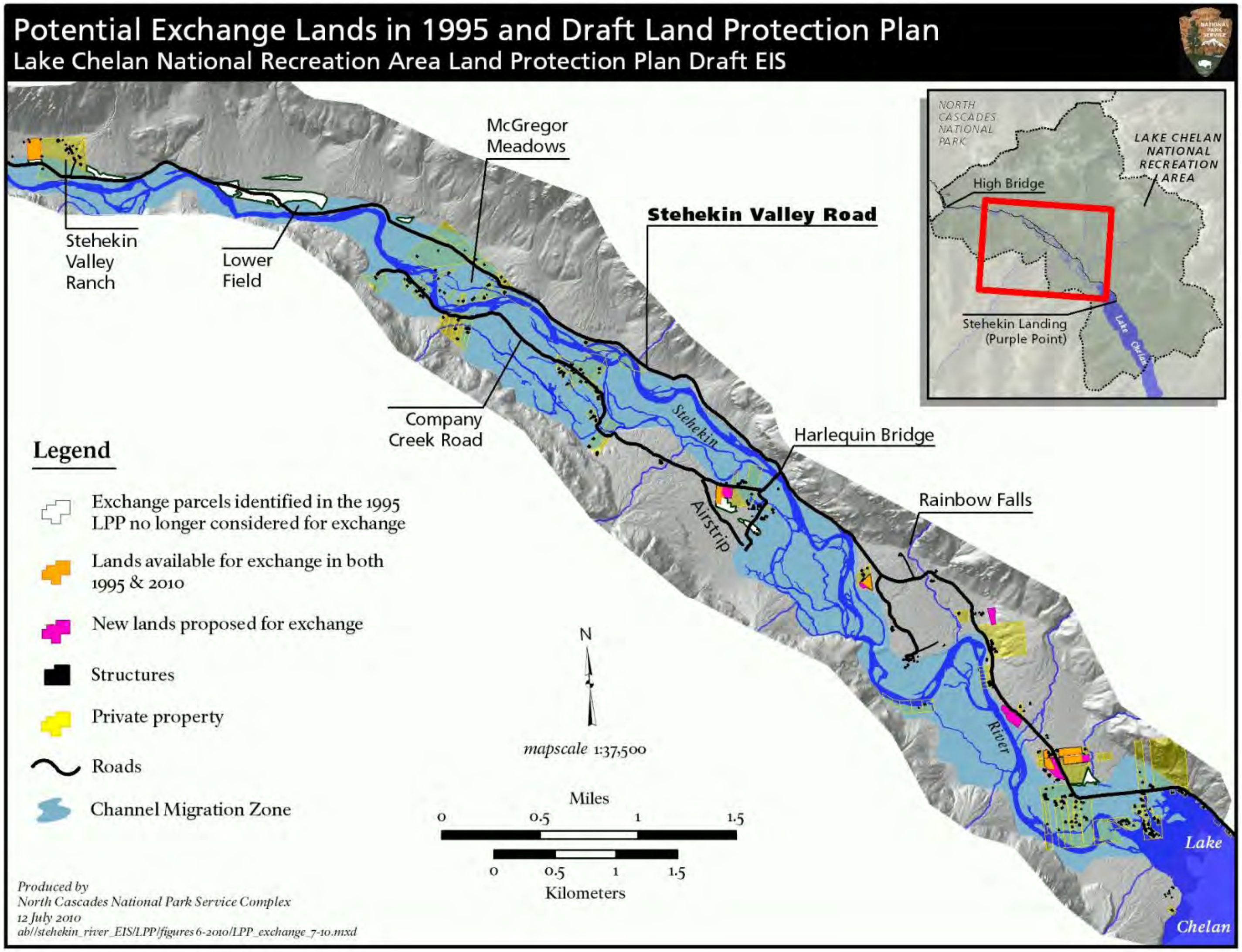


**Figure II-8: Potential Exchange Lands in 1995 and Revised Land Protection Plan**

Under the revised LPP the remaining 168 private tracts, comprising approximately 417 acres, would be ranked as shown in Table II-7.

The revised priority acquisition parcel list for the remaining 168 private parcels in Lake Chelan NRA (revising Table 2 in the 1995 LPP) for Alternative 2 can be found in Appendix 11: Alternatives 2 and 3 Proposed Ranking of Private Lands for the Revised Land Protection Plan.

### Alternative 4: Criteria Weighting to Determine LPP Priorities

The criteria in Table II-8: *Summary of Revised LPP Ranking for Private Lands in Alternative 4* would be changed slightly from Alternatives 2 and 3 to determine LPP priorities in Alternative 4. In Alternative 4, the criteria are weighted toward protecting existing Lake Chelan NRA development and infrastructure in place, while protecting recreation area resources, including key wetland, wildlife, vegetation, and cultural resources. This alternative would not allow the Stehekin River to migrate within its channel migration zone in McGregor Meadows to the same extent as in Alternatives 2 and 3. As a result, the priorities in Alternative 4 are inherently different than those in Alternatives 2 and 3 because of the desire in Alternatives 2 and 3 to avoid conflicts between development and the river and the desire in Alternative 4 to maintain the Stehekin Valley Road in its current location.

**Table II-8: Summary of Revised LPP Ranking for Private Lands in Alternative 4**

| Tentative Priority | Number of Tracts | Acres |
|---|---|---|
| High | 14 | 102.55 |
| Medium | 72 | 237.44 |
| Low | 82 | 77.48 |

Under the revised LPP, the remaining 168 private tracts, comprising approximately 417 acres, would be ranked as shown in Table II-8.

The revised priority acquisition parcel list for the remaining 168 private parcels in Lake Chelan NRA (revising Table 2 in the 1995 LPP) for Alternative 4 can be found in Appendix 12: Alternative 4 Proposed Ranking of Private Lands.

## 2. Stehekin Valley Road Modifications

### Alternative 1: Stehekin Valley Road Alignment

**Reroutes / Protection Strategies**: There would be no major reroutes of the Stehekin Valley Road. The road would continue to be maintained in its current location through the additional implementation of bank-protection strategies. Minor realignments would occur at Wilson Creek (see ―B. Actions Common to All Alternatives [1 - 4]") and within McGregor Meadows to implement the Road Improvement Project (NPS 2005a) (see below).

**Major Road Failure**: Actions would be the same as ―B. Actions Common to All Alternatives (1 - 4)."

### Alternative 2: Stehekin Valley Road Alignment

**Reroutes**: McGregor Meadows and Lower Field.

Under Alternative 2, the Stehekin Valley Road would be rerouted for approximately 1.9* miles beginning at Milepost 5.7 (see Figure II-5: *McGregor Meadows Reroute Map*). The reroute would be a single-lane road with new pullouts appropriately spaced to provide adequate sight distance to allow two-way traffic to pass safely. In contrast to the relatively flat existing section of the Stehekin Valley Road, the maximum grade of the reroute would be as steep as 6 percent, and the road would be moderately rolling in nature, with fairly steep ascents and descents, as it passes through the forested area above the current Stehekin Valley Road. Overall, the new roadway would affect an area of up to 18* acres of previously undisturbed land.

To ensure continuing access to private property, a portion of the original alignment of the Stehekin Valley Road would be retained as the 0.75 mile* —McGregor Meadows Access Road" from the beginning of the realignment to approximately Milepost 6.5, at the last private driveway.

Access to McGregor Meadows would be maintained for emergency and utility access vehicles, except during flooding. Access to private property would be maintained, although to a lesser standard than the relocated Stehekin Valley Road. Periodic maintenance, such as grading, would continue to occur; however, the road would be plowed in winter for approximately 0.5 miles, to Milepost 6.3, and grading would be less frequent. Because no plowing of this road would occur beyond this area, other residents and visitors could use snowmobiles to access other private property in winter or could arrange for snow removal.

Between Milepost 6.5 and Milepost 7.5, the existing road surface would be removed and restored to trail standards to become the alignment for a portion of the Lower Valley Trail. The trail would remain accessible for maintenance of grade-control structures at Milepost 6.8. These structures were designed to minimize the potential for the river to flow down the road, inundating drain fields and other development. Restoration of the then abandoned section of road (after the access road) would be restored, including the former road alignment and the riparian area near Lower Field. Access to the Lower Field would be maintained from the upstream end for the existing Special Use Permit for the agricultural field.

**Road Specifications**: The reroute would be 16 feet wide and would tie in to the existing alignment of the Stehekin Valley Road before McGregor Meadows and above the Lower Field. All of the new disturbance from the roadway would be outside the channel migration zone, thereby greatly reducing impacts to riparian areas and the likelihood of future flood damage to the road or temporary road closure during floods. If the material generated from proposed cuts is adequate, fill needs would be accommodated. If not, the balance of material needed would be acquired from other project areas or would be barged in from outside the park. Combined, the McGregor Meadows and Lower Field reroutes would produce approximately 57,000 cubic yards* of material from cuts, and 48,000 cubic yards* would be needed for fills. The road surface would then be overlain with compacted gravel and surfaced with asphalt chip seal.

Clearing width for the new roadway would range from 40 to 100* feet. Vegetation disturbance would be limited to the minimum necessary for construction activities, including construction of cuts and fills, drainage features such as ditches and culverts, and use of construction equipment. Clearing limits would be delineated in advance of any construction activities. Soil-erosion and sediment-control devices would be implemented and maintained during and after construction until vegetation is established.

**Pullouts**: Up to 50* pullouts would be designed as needed to provide adequate sight distance. On average, the pullouts would be approximately 8 feet wide and 20 feet long, but would vary in size and spacing depending on available terrain, encompassing a taper on both ends. They would have a trapezoidal shape and would be surfaced. Drainage, including roadside ditches and culverts (30 inches in diameter), would be provided where needed (approximately every 500 feet on the existing alignment).

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* This and other included estimates indicated by asterisks in the text that follows are based on 30 percent design. As a result, the actual quantities could change by approximately 10 percent.

Like the current alignment, the proposed realignment would cross approximately seven intermittent streams. These streams have the potential to carry large amounts of water and debris during floods but also run dry for several months each year. To accommodate this capacity, approximately seven 60-inch culverts would be installed. Ditch relief culverts (generally 30 inches in diameter) are planned approximately every 300 to 350 feet.

Approximately 18.0* acres would be cleared for road construction; about 17.3* acres of this would be within suitable and potentially occupied northern spotted owl habitat.

**Major Road Failure**: In addition to the actions in Alternative 1, if loss of the roadway occurred at Milepost 3.8 (Frog Island), Milepost 5.3 (Wilson Creek), or Milepost 8.0, the NPS would reconstruct the road in place because the road is adjacent to a steep slope at the edge of the channel migration zone and it would not be feasible to relocate the road in these areas. Although the road could be moved, the impacts of doing this (requiring either the removal of an excessive amount of material or very long reroute) would be greater than retaining the road in its existing location. (See –D. Alternatives and Actions Considered but Dismissed”.) These areas would also be reconstructed following major flood damage.

**Private Access, including through McGregor Meadows**: With the road reroute, access would continue to be maintained along the former alignment of the Stehekin Valley Road, termed here the –McGregor Meadows Access Road.” The McGregor Meadows Access Road would be maintained as a one-lane road of variable width (14 - 16 feet wide). Unlike in Alternative 1, however, this portion of the road would not be realigned or raised, nor would it be paved. As a result, it would continue to be affected periodically by flooding.

This section of the former Stehekin Valley Road would continue to provide access to approximately 12 parcels now in private ownership as long as those parcels remained private, as well as for utility system infrastructure and emergency access / egress. As noted, access would also continue to be maintained along the Company Creek Road and Stehekin Valley Road, except in some areas during flood conditions. No winter plowing would occur on the McGregor Meadows Access Road after approximately 0.5 mile. If necessary, priority for restoring access, would be given to the public road prior to actions along the McGregor Meadows Access Road.

## Alternative 3: Stehekin Valley Road Alignment

**Reroutes**: Only the McGregor Meadows reroute would be constructed. As a result, the existing alignment of the Stehekin Valley Road alongside the Lower Field would be retained (see Figure II-5).

**McGregor Meadows Reroute Actions**: In Alternative 3, a smaller portion of the Stehekin Valley Road (1.75 miles) would be rerouted around McGregor Meadows and would connect with the existing alignment at approximately Milepost 7.41. The rerouted road segment would descend to reconnect with the existing road near the downstream end of the Lower Field. Instead of rerouting the road around the Lower Field (as in Alternative 2), the existing alignment would be reinforced with a series of rock barbs, bioengineering, and riparian restoration measures to stabilize the section of roadway in its current alignment.

As in Alternative 2, the road would be designed as a single-lane road, 14 - 16 feet in width, with pullouts to allow two-way traffic to pass safely. With a maximum grade of 6* percent, the road would have fairly steep ascents and descents, including a very steep descent across a large amount of fill to the Stehekin Valley Road at the Lower Field. Overall, the new roadway would affect about the same amount of area as the reroute in Alternative 2 (approximately 18.0* acres). Approximately 64,000 cubic yards* of material would be produced from cuts and 54,000 cubic yards* would be needed for fills. As in Alternative 2, the road surface would be overlain with compacted gravel and paved.

**Photo 11 – Stehekin Valley Road in McGregor Meadows during the 2006 Flood**

Similar to the current alignment, the proposed realignment would have about seven stream crossings with the same design as Alternative 2. Road restoration, grade-control maintenance, and private access to McGregor Meadows would be the same as in Alternative 2.

Of the approximately 18.0 acres cleared for road construction, about 17.3 acres would be within northern spotted owl habitat (the same as in Alternative 2); however, 1.2 acres also would remain within the channel migration zone (unlike Alternative 2).

**Private Access, including through McGregor Meadows**: Actions would be the same as in Alternative 2. There would continue to be access to the approximately 12 parcels of private land located along the McGregor Meadows Access Road.

## Alternative 4: Stehekin Valley Road Alignment

**Specific Reroutes/Protection Strategies**: Actions would be the same as in Alternative 1. There would be no reroutes of the Stehekin Valley Road. The road would continue be maintained in its current alignment, the grade would be raised, and sections in the channel migration zone at McGregor Meadows would not be paved.

**Major Road Failure**: Actions would be the same as ―B. Actions Common to All Alternatives (1 - 4).”

**Private Access**: Actions would be the same as in Alternative 1. Access would continue to be maintained where the road grade is raised through McGregor Meadows.

## Alternative 1: Stehekin Valley Road Improvement Project Implementation

**General Improvements**: Actions would be the same as described in ―B. Actions Common to All Alternatives (1 - 4).”

**Site-Specific Improvements**: To increase survivability of the section of road through McGregor Meadows in future flooding, the grade would be raised in two sections to complement another section that was raised in response to the 2003 and 2006 flooding. Over time, additional erosion protection strategies and bank-hardening measures would likely be implemented as the river moved in this direction, including additional barbs currently proposed in Alternative 4. Minor reroutes could also be considered if necessary, but there would be no major reroute of the road. A small section of road near Wilson Creek would be realigned away from a 20-foot-tall, eroding bank. Rock and log-cribbing would be placed on the slope below the road to slow future erosion during floods (see ―Wilson Creek” Section 11. d. Stehekin Valley Road Milepost 5.3 (Wilson Creek)).

**Raising the Road**: Between Milepost 6.25 and 6.53 and Milepost 6.95 and 7.14, in McGregor Meadows, the road would be raised 1 - 3 feet, and culverts would be added as appropriate. Raising the road grade would elevate part of the road above floodwater that occurs during spring and fall flooding. Elevating the road grade could prevent the Stehekin River from occupying sections of the floodplain and channel migration zone in this area, with consequent effects on floodwater depth and flow velocity on neighboring properties. Although the road grade raise is proposed to protect the Stehekin Valley Road, it could result in additional flood protection for some private property, while potentially worsening flooding elsewhere.

Raising the road above the level of flooding would require importation of approximately 5,600 cubic yards of fill.* Raising the road grade would also allow ditches to be recreated to help direct water away from the road surface. Where fill is proposed to raise the road, fill slopes would be kept as steep as possible to minimize the disturbance footprint.

**Milepost 6.0 - 6.5**: Between Mileposts 6.0 and 6.5, the Stehekin Valley Road would be raised and realigned and a portion of the adjacent slope would be laid back to improve sight distance, with a dry-stacked rock wall constructed to retain the slope. Laying back the slope and removal of a protruding eyebrow of material may lessen the potential for material to slough off the slope onto the road. Actions at this location would partially affect private property, and therefore require an easement.

The slope soil is very loose (unconsolidated), and revegetation of the slope may require covering the slope with fallen trees, duff, and litter. A dry-laid rock wall would be constructed at the toe of the slope to collect any material sliding off the slope and to enhance slope stability. Eyebrow removal would produce approximately 1,000 cubic yards* of material and the drystack rock wall would be approximately 200 feet long and 10 feet high.* Nearby, the road grade may need to be raised to allow access to private property (NPS 2005a:24).

## Alternatives 2 and 3: Stehekin Valley Road Improvement Project Implementation

**General Improvements**: Actions would be the same as described in ―B. Actions Common to All Alternatives (1 - 4).”

**Site-Specific Improvements**: Actions would be the same as described in “B. Actions Common to All Alternatives (1 - 4).”

### Alternative 4: Stehekin Valley Road Improvement Project Implementation

**General Improvements**: Actions would be the same as described in “B. Actions Common to All Alternatives (1 - 4).”

**Site-Specific Improvements**: Actions would be the same as described in Alternative 1.

## 3. Stehekin Valley Road / Company Creek Road—Private Access

### Alternative 1: Stehekin Valley Road / Company Creek Road—Private Access

Actions would be the same as described in “B. Actions Common to All Alternatives (1 - 4).”

### Elements Common to Alternatives 2 - 4: Stehekin Valley Road / Company Creek Road—Private Access

Under Alternatives 2 - 4, unless catastrophic changes prevented it and it became necessary to limit impacts to recreation area resources, reasonable access to private property would continue to be achieved via privately maintained spur roads that branch off the Stehekin Valley and Company Creek roads. If catastrophic loss occurs, a criteria-based decision-making process (including additional environmental analysis as warranted) would be used to determine whether reestablishment of the original access to the private property, or a reroute, or some combination of these would be implemented.

## 4. Recreational Facilities

### Alternative 1: Recreational Facilities

#### General

Actions would be the same as described in “B. Actions Common to All Alternatives (1 - 4).”

Compatible recreational facilities located in the floodplain would remain, subject to their persistence and the continued ability to use them safely. These include campgrounds, picnic areas, Bullion Raft Launch, and area trails. In addition, as noted under “I. GMP Implementation,” construction of the Lower Valley Trail, including connecting it to the Stehekin River Trail, would occur.

#### Campgrounds

Actions would be taken as needed in response to flooding. Seasonal closures would continue to occur during the spring and fall. No new campgrounds would be established.

**Harlequin Campground**: The campground would be maintained in its existing location. Harlequin Campground currently contains one 24-person group site and six individual sites, each with a limit of 4 people. Harlequin Campground is located across Harlequin Bridge off the Company Creek Road. Seasonal flooding in fall and spring has continued to affect the campground, particularly the group site, which like others is close to the Stehekin River, and which is slightly lower in elevation than other sites.

**Purple Point Horse Camp**: There would be no changes to this camp. It would continue to be used as an overflow group site and horse camp.

**Bullion Campground**: Bullion Campground would be relocated across the road to avoid an area of hazard trees that are deteriorating because of root rot. The two campsites would be moved across the road, near the Stehekin River, upstream from the raft launch. The current site, however, would be retained for day-use picnicking to accommodate longstanding Stehekin Community events that occur there.

The proposed relocated campground would be concealed from most views along the Stehekin Valley Road and would have adjacent river access in a relatively open area with scattered Douglas-fir and moss strewn boulders and an understory of kinnickinnick, Oregon grape, serviceberry, ceanothus, spiraea, yarrow, and other forbs and grasses. The proposed area is approximately 100 feet by 20 feet (2,000 square feet, or 0.05 acre).

### Trails

**Lower Valley Trail**: The Lower Valley Trail would be designed and constructed as time and funding allowed. Construction would eventually include a trail bridge across the Stehekin River to connect it to the Stehekin River Trail. A footbridge across the Stehekin River at or near the former concrete road bridge abutments above Boulder Creek would enhance access to the River Trail and Weaver Point Campground from the lower Stehekin Valley, and would make additional loop trails available. In Alternative 1, the Lower Valley Trail would use approximately 6.1 miles of existing trail and 6.3 miles of new trail.

**Raft Launches / Boat Access**: The existing raft launch downstream from Bullion Campground (across from Bullion Loop Trail) would be retained. No new raft launches or takeouts would be constructed.

**Shooting Range**: The shooting range would be maintained in its existing location.

## Elements Common to Alternatives 2 - 4: Recreational Facilities

### Existing Campgrounds

**Purple Point Horse Camp**: Under Alternatives 2 - 4, the individual sites at this campground would be modified to accommodate group use during seasonal flooding anticipated to occur in spring and fall at Harlequin Campground.

The proposed group site additions to the Purple Point Horse Camp are located 1.4 mile from the Golden West Visitor Center near an existing horse corral, by the well water tank near Purple Creek. The new sites would be managed primarily for the ability to replace the group site at Harlequin Campground during seasonal flooding; however, they would also be available at other times of year for individual use. Approximately four sites would be established that could be used in combination as one or two group sites (12 people) when needed in the spring and fall. Sites would have two to three tent pads, picnic tables, a food-storage container, and a fire grate. Existing toilets would be improved or additional vault toilets would be added.

The area that would be used is approximately 150 feet by 50 feet (7,500 square feet, or 0.17 acre) and is within a Douglas-fir-ponderosa pine forest with scattered bigleaf maple among cobbles and occasional boulders. The understory primarily consists of grasses, Oregon grape, and spiraea.

**Harlequin Campground**: As in Alternative 1, Harlequin Campground would be maintained in its existing location and would continue to be used except during periods of flooding. In Alternatives 2 - 4, Harlequin Campground group sites would be temporarily closed during flooding. Campsites constructed at Purple Point Horse Camp to replace the seasonally flooded group sites at Harlequin would compensate for the temporary closure of Harlequin Campground group site prior to the advent of likely flooding.

**Bullion Campground**: As in Alternative 1, Bullion Campground would be relocated across the road to avoid an area of hazard trees that are deteriorating because of root rot. The two campsites would be moved across the road, near the Stehekin River, upstream from the raft launch. The current site would be retained for day-use picnicking to accommodate longstanding Stehekin Community events that occur there.

**Rainbow Falls Campground (New)**: In Alternatives 2 - 4, approximately three to five individual walk-in campsites would be constructed near Rainbow Falls. The campsites would be separated from each other along a former roadway just north of the existing Rainbow Falls toilets. The campsites would include access to improved Rainbow Falls toilets, as well as picnic tables, tent pads, food-storage containers, and fire pits / grates. The proposed campground at Rainbow Falls would take advantage of existing parking. Water would be available from nearby Rainbow Creek. The area is located in the lower Stehekin Valley, within easy walking distance of Stehekin Landing (approximately 3 miles) and Buckner Homestead. Proposed campsites would be located away from a rock fall area, and would be concealed from the Stehekin Valley Road.

The proposed campground area would be about 200 feet long by 20 feet wide and would occupy 4,000 square feet (0.10 acre) within a Douglas-fir-ponderosa pine forest with a low-growing understory of kinnickinnick and other forbs. Not all of this area, however, would be impacted, because the campsites would be separated from each other. Large gneiss boulders scattered throughout the area would partially conceal the sites.

### Trails

**Lower Valley Trail**: In Alternatives 2 - 4, the Lower Valley Trail would be constructed in a single complete project to connect Stehekin Landing with High Bridge using sections of existing trail and construction of new trail as described in –B. Actions Common to Alternatives (1 - 4).” As noted, a footbridge crossing of the Stehekin River would be added to connect the proposed Lower Valley Trail with the Stehekin River Trail.

## Alternative 2: Recreational Facilities

**Campgrounds**: Actions for campgrounds would be the same as described in –B. Actions Common to All Alternatives (1 - 4)” and –Elements Common to Alternatives 2 - 4: Recreational Facilities” in this section.

**Trails**: Actions would be the same as described in –B. Actions Common to All Alternatives (1 - 4).” The Lower Valley Trail would use 4.6 miles of new trail and 7.9 miles of existing trail.

**Stehekin River Raft Takeout / Boat Access**: In Alternative 2, a new raft takeout and small parking area would be constructed above the mouth of the Stehekin River. This takeout would enable more direct egress from the river following a trip and would reduce conflict with adjacent private landowners by providing public egress not currently available. It would also provide for nonmotorized boat access to the lower Stehekin River and the head of Lake Chelan. To provide access to public land, the new raft takeout would be located off a small (300-foot-long, 14-foot-wide) spur road from the Stehekin Valley Road and would include a small parking area (see Stehekin River Mouth description below). The takeout would be approximately 20 feet wide and 40 feet long, similar to the existing raft launch downstream from Bullion Campground. Raft launches or takeouts consist of a constructed slope (usually sand and gravel with no surface treatment) wide enough for the raft and passengers to stage before entering the river. They are usually in pools to allow for safe entry into and exit from the water.

**Shooting Range**: Because Alternative 2 reroutes the Stehekin Valley Road along the Lower Field, the direction of existing targets would be toward the road, creating a safety hazard. As a result, the shooting range would be removed and the existing shooting range would be restored or used for the road reroute. No replacement shooting range would be constructed.

## Alternative 3: Recreational Facilities

**Campgrounds**: Actions for campgrounds would be the same as described in “B. Actions Common to All Alternatives (1 - 4)” and “Elements Common to Alternatives (2 - 4): Recreational Facilities” under “4. Recreational Facilities.” In addition, another campground would be constructed on NPS land downhill from the Company Creek Power Plant.

**Trails**: Actions would be the same as described in “B. Actions Common to All Alternatives (1 - 4)” and Alternative 2. The Lower Valley Trail would use approximately 4.6 miles of new trail and 7.9 miles of existing trail.

**Company Creek Campground (new)**: The proposed walk-in campground would be in a previously disturbed area downhill from the Company Creek power plant, affecting approximately 0.02 acre within an area that contains scattered Douglas-fir, ponderosa pine, and bigleaf maple and an understory of bracken fern, wild raspberry, Oregon grape, wild rose, and needlegrass. Access would be on foot via the former roadbed down to the area, which would be cleared of downed logs. There would be one large group site that could also be used for 26 individual sites if warranted. Picnic tables, fire grates, tent pads, and food storage would be provided. A vault toilet would also be constructed.

Although there is currently no shuttle access to this site, it may be possible to provide access in the future, which could facilitate use. The site would provide opportunities for visitors using the Company Creek/Devore Trail and the Stehekin River Trail in a setting away from the noise along the main valley road. Camping during low water conditions could be affected by noise if the powerhouse generators were in use.

**Raft Takeout / Boat Access**: Because of safety concerns associated with locating a large logjam adjacent to a takeout, no raft launch would be constructed in Alternative 3.

**Shooting Range**: Because the Lower Field Reroute would not occur, as in Alternative 1, the shooting range could be maintained in its current location. The McGregor Meadows reroute would descend to the current road just before the shooting range.

## Alternative 4: Recreational Facilities

**Campgrounds**: Actions would be the same as in Alternative 3.

**Trails**: Actions would be the same as described in “B. Actions Common to All Alternatives (1 - 4)” and Alternative 1. The Lower Valley Trail would be able to use additional sections of the Old Wagon Road because the McGregor Meadows reroute would not occur.

**Raft Takeout / Boat Access**: Actions would be the same as in Alternative 2.

**Shooting Range**: Actions would be the same as in Alternative 1. The shooting range would be maintained in its existing location because the Stehekin Valley Road would not be rerouted.

## 5. Management of Large Woody Debris

### Alternative 1: Management of Large Woody Debris

**Park Actions**: The NPS would continue to implement GMP provisions related to the management of large woody debris. In addition NPS would continue to collect free-floating large woody debris from the head of Lake Chelan after flood events to prevent boating accidents and to use in erosion protection projects. Consistent with the GMP, limited actions would continue to be taken to trim or turn individual large pieces for the purpose of protecting roads and bridges.

According to the GMP:

> The National Park Service would manipulate woody debris in the Stehekin River or its tributaries only to protect public roads and bridges according to the criteria above. Woody debris could also be trimmed or turned in the lower 9 miles of the Stehekin River to allow safer recreational use of the river for rafting, kayaking, and canoeing if it did not alter the function or stability of woody debris accumulations and was permitted by the appropriate regulatory agency. Woody debris would not be removed from the river system in any case. The Park Service would not remove or manipulate woody debris on public land or water to protect private property, and it would take no action to prevent private landowners from removing or manipulating woody debris on their land to protect their property, unless these actions would significantly harm recreation area resources or were in violation of local, state or federal ordinances, regulations or laws. Such actions would not be encouraged. (NPS 1995a: 21 - 22)

**Lake Chelan Woody Debris Salvage**: As noted in Appendix B: *Draft LWD Plan* of the Chelan PUD relicensing EIS (Chelan PUD 2002), the purpose of collecting floating large woody debris is to provide raw material for erosion control projects on the lake and to eliminate hazards to boats and float planes on Lake Chelan. These projects include use of woody debris for construction of erosion protection, as well as to provide mitigation for perceived impacts of construction activities. Collection is not meant to be comprehensive, or to wholly ensure safe boating conditions on the lake. Removal has been conducted since large floods in 1995 and 2003.

Most woody debris would continue to be collected by the NPS at the head of Lake Chelan in the days following flood events. Some of the collected material would be stored within a log boom to be established west of Weaver Point, while other material could be transported directly to an erosion protection site or stored temporarily on the barge deck. Woody debris would be collected by NPS staff using a barge and hydraulic crane purchased by Chelan PUD. The Weaver Point site was agreed to by the NPS and permitting agencies. It is also likely that some of this material will be used at USFS sites farther downlake, and potentially by private parties.

Existing criteria for woody debris suitable for collection and storage include:

- Large pieces of wood at least 10 feet long.
- Large pieces of wood at least 1.0 feet in diameter.
- Large pieces of wood with root wads attached.
- Large pieces of wood with branches.

**Private Use**: The NPS would continue to implement GMP guidance and to provide technical assistance to landowners. Per the GMP, there would be no provisions for private landowners to use large woody debris from the head of Lake Chelan or from the Stehekin River in Alternative 1. Private landowners, however, could use trees from private land for erosion control projects with a permit from appropriate agencies. To use logs along the river, including those in logjams or side channels, private landowners would continue to need permits from applicable county, state, and federal agencies.

## Elements Common to Alternatives 2 - 4: Management of Large Woody Debris

**Park and Private Actions**: Alternatives 2 - 4 would allow for minimal manipulation of woody debris to protect public facilities, including roads, water quality, public safety, and regular access to private property. In Alternatives 2 - 4 the NPS could purchase or exchange properties to minimize manipulation of large woody debris. As in Alternative 1, actions could also be taken to manipulate large woody debris that threatens public roads and bridges and to trim or turn pieces to enable recreational activities and to collect wood from the head of Lake Chelan.

Unlike Alternative 1, in Alternatives 2 - 4 in select areas, and on a case-by-case basis, logs could be removed from the tops of logjams for use in erosion management and riparian restoration projects. In Alternatives 2 and 3, logs could be taken from within the Lake Chelan backwater zone, on the lower 0.25 mile of the river. In Alternative 4, the area of collection would be expanded to Bullion Camp. In all cases, where logs are used, they would be taken from above the ordinary high water mark and would not be removed if doing so would destabilize the logjam. Use of large woody debris from the tops of logjams is being proposed in Alternatives 2 - 4 to minimize importation of rock and fill into Stehekin and because the use of wood is a fish-friendly measure in barb construction and/or could be used to construct engineered logjams instead of barbs.

In Alternatives 2 - 4, manipulation of logjams could occur in the mouth of the Stehekin River from Lake Chelan to Boulder Creek in the Lake Chelan backwater zone (from the head of the lake 0.25 mile up the Stehekin River), where manipulation of the lake level has been shown to influence flooding and deposition of gravel and wood. This area has seen major growth in the volume of woody debris since 2000 (see Figure I-6: *Stehekin River Large Wood Monitoring 1984 - 2007*). A logjam in this zone could also be manipulated under emergency conditions if it flooded the Stehekin Valley Road or caused flooding of densely developed areas and threatened water quality. Manipulation would be the minimum needed to relieve the problem and all wood would remain within the channel migration zone.

In Alternatives 2 - 4, landowners would also be encouraged to use large woody debris in agency permitted erosion protection and flood protection measures. To facilitate this, large woody debris from the tops of logjams or from floating Lake Chelan salvage could be made available to landowners under an NPS permit system. Encouraging landowners to use woody debris and use of wood from logjams would constitute a change to the GMP.

## Alternative 4: Management of Large Woody Debris

**Park and Private Use of Large Woody Debris**: Actions would be the same as in ―Elements Common to Alternatives (2 - 4)" in this section; however, manipulation of large logjams that threaten roads or water quality and use of wood from the tops of logjams for erosion protection projects could occur anywhere along the lower Stehekin River (below the Bullion Raft Launch), instead of just up to Boulder Creek in the Lake Chelan backwater zone. As in ―Elements Common to All Action Alternatives (2 - 4)," landowners could use large woody debris in agency-permitted erosion protection and flood protection measures, and a limited amount of wood from floating Lake Chelan salvage or the tops of logjams would be made available to landowners. As in ―Elements Common to All Action Alternatives (2 - 4)," encouraging landowners to use woody debris and using wood from logjams would change existing GMP direction.

## 6. Flood Protection Measures

### Alternative 1: Flood Protection Measures

Actions would be the same as in ―B. Actions Common to All Alternatives (1 - 4).”

### Elements Common to Alternatives 2 - 4: Flood Protection Measures

Actions would be similar to Alternative 1, except for the following:

- Land exchanges would be emphasized to avoid continuing to take actions that affect the ability of the Stehekin River to use its floodplain
- The revised LPP would allow land acquisition and exchange of properties in the channel migration zone for properties outside of it
- For NPS facilities that cannot be relocated out of the channel migration zone, grade-control and erosion protection measures, including bioengineering, would be used to protect sites
- As in all alternatives, NPS recreational and administrative infrastructure would be removed from the channel migration zone to avoid impacts from flooding.

The combined strategies of increasing floodplain utilization and removing development would increase the sustainability of developments in the valley more than altering the river would. Allowing water from large floods to spread out and occupy the floodplain would decrease the erosive potential and minimize the possibility for flood damage to be focused in any one area. Land exchanges would also improve water quality by removing structures from the floodplain and would preclude actions on private lands that would impede channel migration, such as the construction of additional levees.

In Alternatives 2 - 4, actions at Boulder Creek (extension of a natural logjam over a grade-control structure) would also provide some protection from catastrophic river changes during floods by maintaining sheet flow in this low-lying floodplain.

### Alternative 4: Flood Protection Measures

Management would be the same as in ―B. Actions Common to All Alternatives (1 - 4)” and ―Elements Common to Alternatives 2 - 4” in this section. As in Alternative 1, raising the road grade in part of McGregor Meadows could increase flood protection for some private properties and worsen it for others.

## 7. Interpretation and Education

### Alternative 1

The NPS would continue to conduct existing interpretive and educational programs and activities related to the Stehekin River.

### Elements Common to Alternatives 2 - 4: Interpretation and Education

In addition to existing interpretive programming in Alternative 1, Alternatives 2 - 4 would enhance Stehekin River interpretive and educational programs for the general public, local residents, and media, with an emphasis on the value of logjams, floodplain utilization, and other key river features.

The enhancement of interpretive and educational programming for the general public, local residents, and the media would include an emphasis on the value of large woody debris in the river environment, the role of flooding in river ecosystems, and the value of minimizing human impacts to river systems, as well as highlighting river processes and the sensitive and flood-prone nature of the Stehekin River. These programs would continue to include safety messages regarding park experiences and, where appropriate, related to river hazards and other visitor safety issues.

## 8. RESEARCH AND MONITORING

### Alternative 1

The NPS would continue existing research and monitoring programs, focused on large woody debris, main and side channel habitat, hydrology, fish surveys, cultural research and analysis, nonnative/invasive plants, climate change effects, and special status species research. This ongoing monitoring provides a framework for understanding the Stehekin River including how often large floods occur (flow gauge monitoring). Ongoing monitoring inventories are more fully described in Chapter III: Affected Environment).

### Elements Common to Alternatives 2 - 4: Research and Monitoring

In addition to the actions in Alternative 1, the NPS would expand research and monitoring programs in Alternatives 2 - 4 to determine the effectiveness/consequences of erosion protection and flood protection measures, document large woody debris manipulation, etc., and would add more flow gauges on the river pending funding (at Agnes Creek and between High Bridge and Bridge Creek). The NPS would also continue to conduct more comprehensive species analysis, including repeating existing wildlife inventories.

Additional studies would include:

**Relative Hydrologic Influence of Agnes Creek, Upper Stehekin River, and Bridge Creek**: Draining the drier east slope of the North Cascades, Bridge Creek is dominated mainly by spring snowmelt floods. In contrast, the upper Stehekin River and Agnes Creek are located much farther west on the Pacific Crest and have both fall-winter rain-on-snow and spring snowmelt floods. There is a need for at least one and possibly two gauges on the upper river to understand the contribution of each major Stehekin tributary to flooding in the lower valley and to provide enhanced flood forecasting and warnings.

**Up-to-date Floodplain Maps**: With passage of the record floods in 1995, 2003, and 2006, the river has undergone several changes. Channel filling and river realignment have rendered the Federal Emergency Management Administration (FEMA 1981) and NPS (1993b) floodplain maps obsolete in many parts of the valley. As a basis for planning and future county floodplain management, the NPS and Chelan County are joining with Chelan PUD to create a new floodplain insurance rate map. This effort would include surveying of 50 or more river cross sections, development of a one-dimensional hydraulic model, and creation of a computer-based map. The model would also produce supporting data such as flood depth and velocity for the lower valley. It would also be subject to FEMA approval.

**Sediment Movement**: Measuring sediment discharge is difficult. Only approximate estimates for total sediment load exist for the Stehekin River. Areas of valley width and slope change, channel instability, and large wood storage zones are generally areas of rapid sediment deposition and storage in the floodplain. This study is proposed to refine understanding of sediment transport and storage in these zones, using two approaches. First, it would compare the 2007 channel topographic survey with historical FEMA, USGS, Chelan PUD, and NPS surveys to estimate the volume of sediment deposition or erosion in various reaches. Chelan PUD surveys of the river mouth in 2001 (Chelan PUD 2001a) will be particularly useful in this comparison because they give an estimate of change induced by the big floods of 2003 and 2006. Second, it would identify major sources of gravel within the watershed, including landslides and cut banks.

## 9. Weaver Point Erosion Protection Measures

### Elements Common to Alternatives 1 and 2: Weaver Point

As described in ―B. Actions Common to All Alternatives (1 - 4)," the NPS would relocate shoreline campsites and the docks to minimize the need to take erosion protection actions along the right bank (facing downstream) of the Stehekin River, where erosion has recently accelerated. Weaver Point improvements indentified in the FERC would be common to all alternatives.

No additional NPS actions would be taken on the east side of Weaver Point upstream of the cabled logs. River-caused erosion would likely proceed naturally, possibly threatening the upper end of the cabled logs.

***Weaver Point***

**Background***:* Weaver Point improvements identified in the FERC relicensing EIS for Lake Chelan include erosion control, recreation, and cultural resource projects (Chelan PUD 2002). The erosion control plan includes construction of a 200-foot-long logjam to protect the bank and 260 feet of rock walls to protect dock bulkheads on the south shore of Weaver Point. Although there are gentle slopes, wave and river erosion have produced an eroding bluff at the east end of the site and a 5-foot-tall bluff at the west end. At the east end of the site, vegetation was historically removed for agricultural use.

Parts of the east end of the site are protected by a series of cabled logs that have worked well to slow erosion. This would be enhanced by construction of the FERC logjam. Walls made of imported rock would also be constructed near the docks.

### Elements Common to Alternatives 3 and 4: Weaver Point

Pending completion of the FERC cultural resource site management plan by Chelan PUD, the proposed FERC 200-foot-long logjam on the south-facing side of the point would be extended approximately another 150 feet upstream to slow riverbank and lake wave erosion. The engineered logjam would be constructed using an excavator and thumb (see sidebar ―Bank Barb Construction" and Figures II-9, II-10, and II-11), and would include placement of about 150 logs. The design would include bank excavation and require the use of 10 - 20 cubic yards of large rock and cables for anchors. The bank above the logjam would be revegetated with native plants. Once erosion protection measures were complete, the docks would be relocated to the west. In addition, two to three rock barbs and bioengineering would be used to stabilize the bank and to protect the nearest campsite from future erosion.

***Bank Barb Construction***

Bank barbs would be constructed using an excavator with a thumb attachment, working "in the dry" from the bank when the river and/or lake are at low water in early spring or fall. Each bank barb includes approximately 100 cubic yards of rock and/or logs, a portion of which would be placed landward of the shoreline to allow the barb to "„key" into the bank and to prevent the river from eroding around the structure. The instream part of the barb would have a low profile that tapers into the channel, which would be completely submerged by flows over 5,000 cfs. The bank barbs would be approximately 20 feet long, and would protrude no more than 1/4 of the way across the low-flow channel to avoid creating too much turbulence (see Figure II-10: Barb Construction Detail).

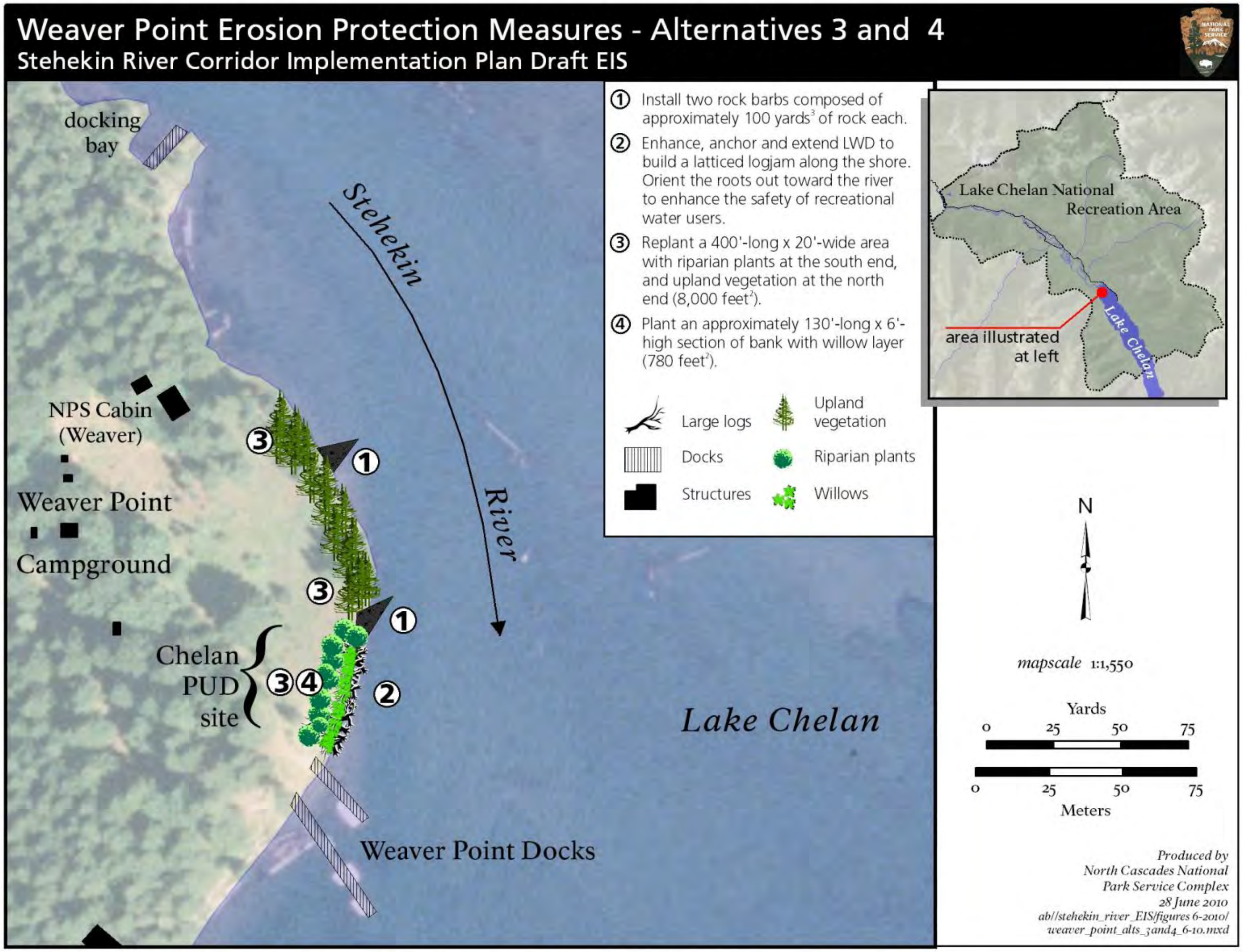



**Figure II-9: Weaver Point Erosion Protection Measures under Alternatives 3 - 4**

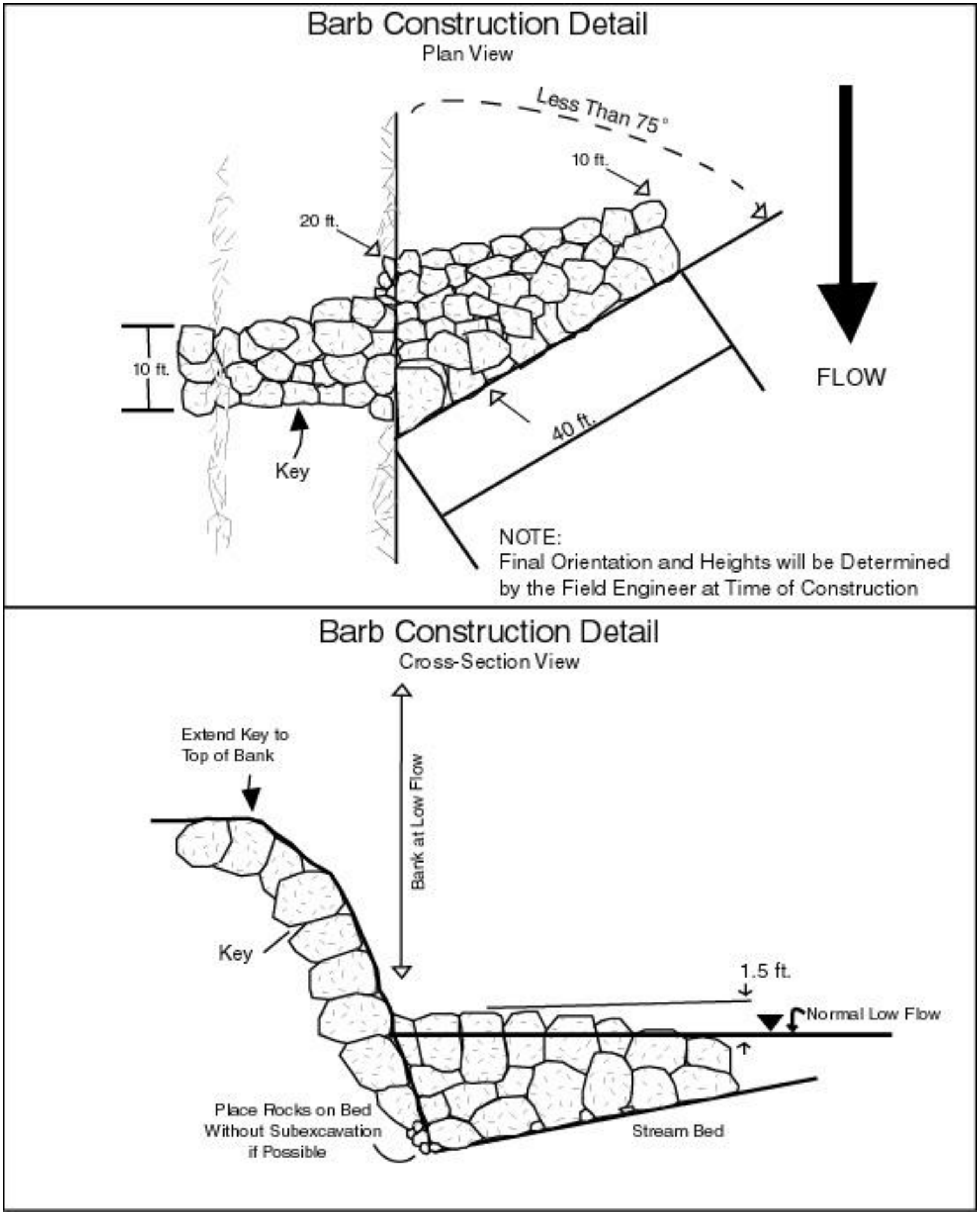



**Figure II-10: Barb Construction Detail**

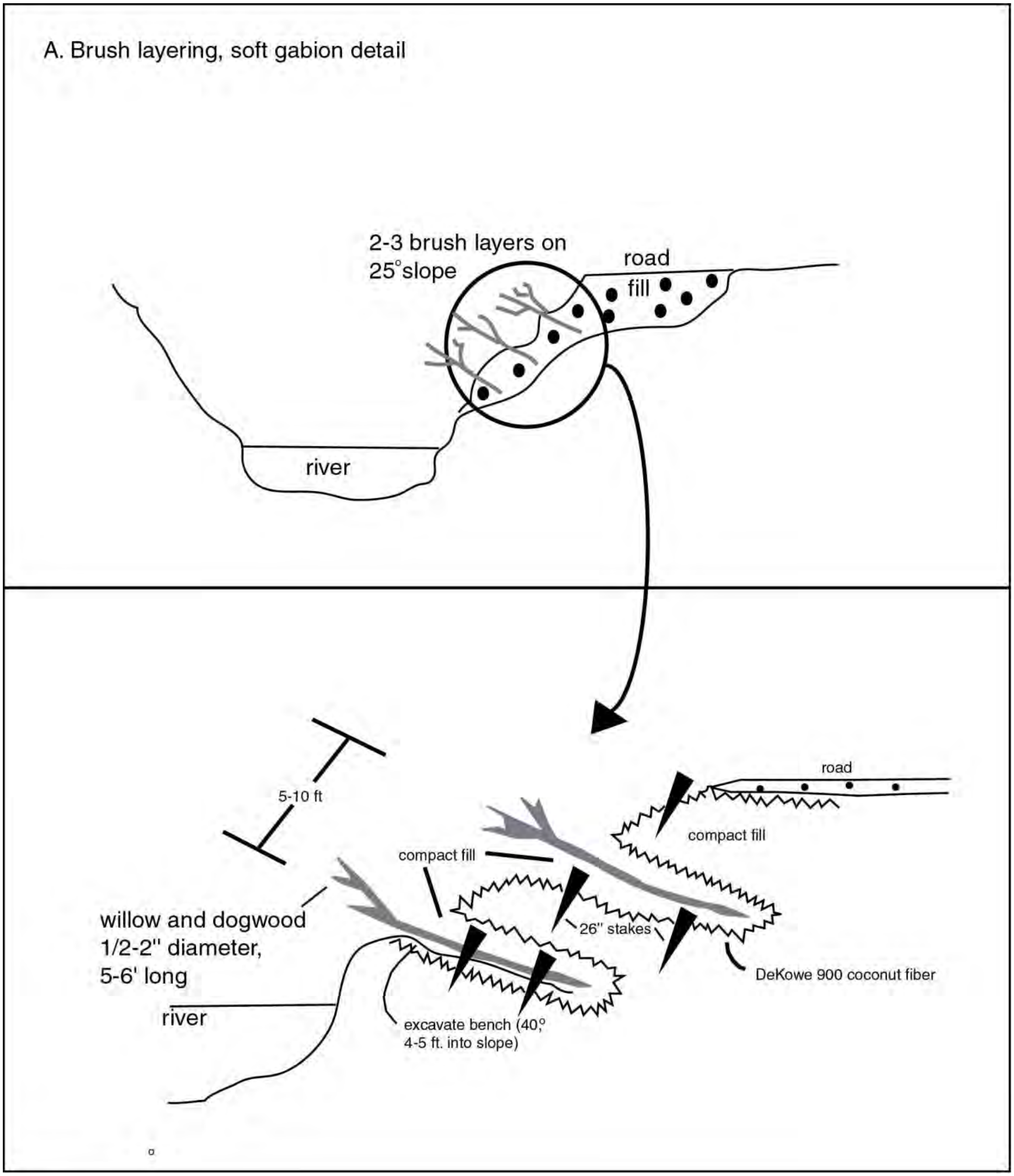



**Figure II-11: Bioengineering Construction Detail**

The rock barbs would be located along the left bank (looking downstream) of the mouth of the Stehekin River. Combined with placement of an engineered logjam (150 feet × 6 feet × 6 feet), an area approximately 130 feet by 6 feet (780 square feet, or 0.02 acre) would be restored with willows. In addition, riparian restoration would affect an area of approximately 400 feet by 20 feet (8,000 square feet, or 0.18 acre). Construction of the rock barbs could require that the docks be moved to the west, and pilings replaced with submerged anchors.

**Photo 12 – Rock Barb and Willow Layers (Bioengineering) on Upper Company Creek Road Shortly after Installation**

## 10. Stehekin River Mouth Erosion Protection Measures

### Alternative 1: Stehekin River Mouth

No action would be taken in Alternative 1 to restore the rip-rap bank or to prevent the river from cutting a new path on NPS land above the mouth of the Stehekin River. Along the River Resort Road, the Stehekin River is migrating rapidly into its northeast or left bank (facing downstream). At this location, the Stehekin River has the potential to cut a new channel across the access road toward the Stehekin Valley Road, where it could reconnect with old channels and affect a densely developed area, causing unacceptable water quality impacts in the low-lying Stehekin River and Lake Chelan. If this new channel formed, however, the river would not be expected to immediately affect the Stehekin Valley Road or other NPS infrastructure but would be anticipated to affect it over time.

**Photo 13 – Bank Erosion at Weaver Point— Erosion at Site is Mainly Caused by the River when the Lake is Drawn Down, but Waves on the Lakeshore are also a Factor**

## Alternative 2: Stehekin River Mouth

In Alternatives 2 and 4, approximately 500 feet along the bank of the Stehekin River would be treated with several erosion protection measures, including a small logjam (100 feet × 6 feet × 6 feet) with about 50 logs, three rock barbs, and bioengineering. These actions would enhance habitat by replacing approximately 100 feet of rip-rap placed after the 1982 flood on NPS land with bioengineering and large woody debris; would prevent potential channel avulsion; would allow for the construction of a raft takeout (see –4. Recreational Facilities"); and would restore natural vegetation to this eroding bank (Figure II-12: *Stehekin River Mouth Erosion Protection Measures under Alternatives 2 - 4*). To avoid impacts to private land from a new public access point, a 300-foot-long access road would be built off of the Stehekin Valley Road. The new portion of the route to the take-out would follow an old disturbed road bed.

## Alternative 3: Stehekin River Mouth

In Alternative 3, a large engineered logjam (approximately 500 feet × 15 feet × 15 feet) consisting of several hundred logs would be designed to slow bank erosion. The design would include features to minimize hazards to boaters. Final design would be approved in consultation with a consortium of river rafting guides in a process developed by King County. The logjam would also be used to replace the rip-rap on federal land. The design would include use of about 50 cubic yards of large rock for anchors and revegetation of areas above and between logs (Figure II-13: *Stehekin River Mouth Erosion Protection Measures under Alternative 3*).

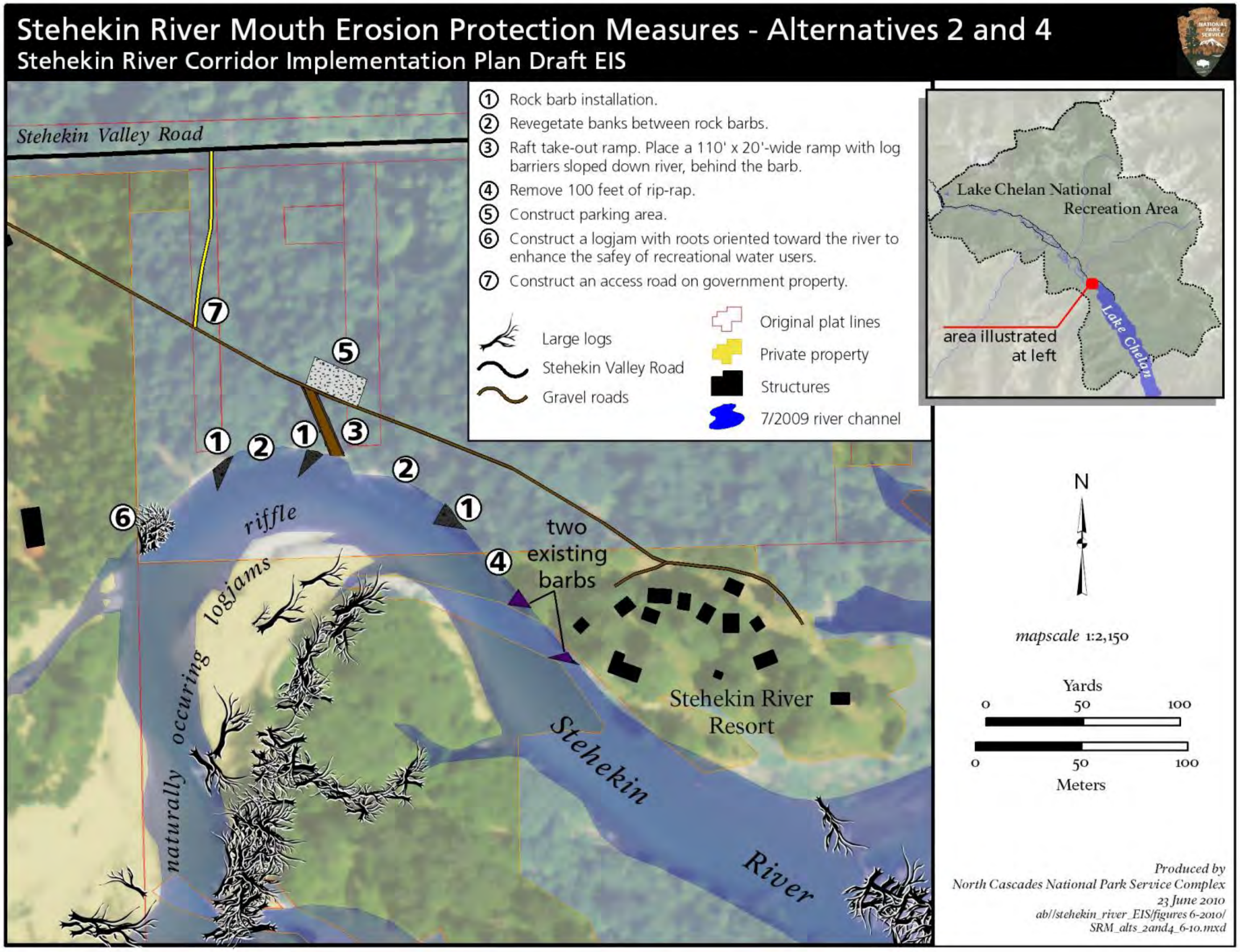



**Figure II-12: Stehekin River Mouth Erosion Protection Measures under Alternatives 2 and 4**

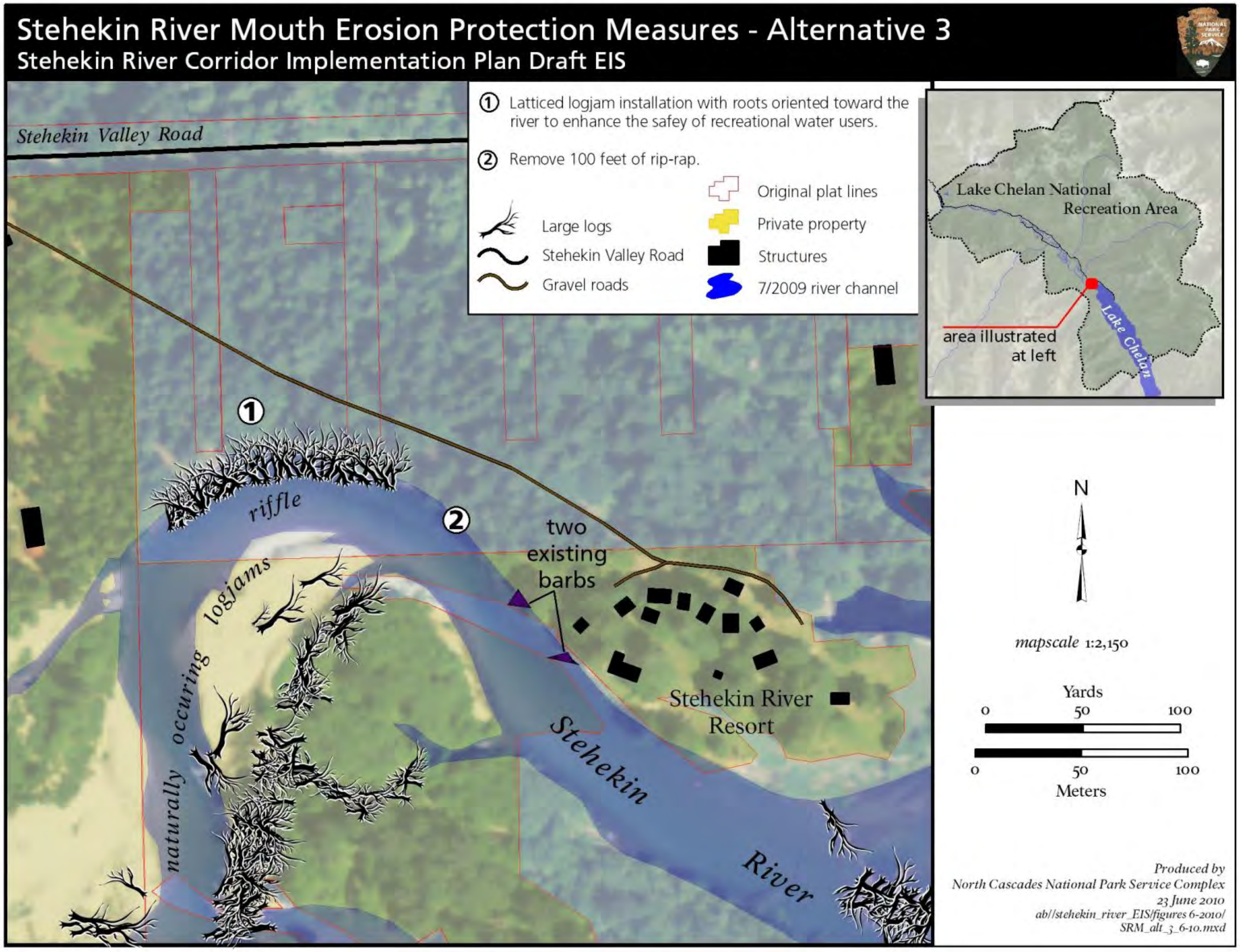



**Figure II-13: Stehekin River Mouth Erosion Protection Measures under Alternative 3**

### Alternative 4: Stehekin River Mouth

Actions would be the same as in Alternative 2.

## 11. STEHEKIN VALLEY ROAD EROSION PROTECTION MEASURES

### a. Stehekin Valley Road Milepost 2.0 (Boulder Creek)

#### Alternative 1: Stehekin Valley Road Milepost 2.0 (Boulder Creek)

The Stehekin Valley Road near the bakery would be repaired as needed following flood damage. During recent flooding in 2003 and 2006, the Stehekin River flowed overland in the vicinity of the developed area near the bakery, including near NPS and private housing (Figure II-14: *Stehekin River Mouth / Milepost 2.0, Boulder Creek*). Damage to the internal developed roads and Stehekin Valley Road has been minor, but these overland flows have the potential to consolidate into ever-deepening and faster channels. Unlike sheet flow, these channels can cause major damage to roads and development. In this alternative, no major actions would be taken to prevent the channelization of overland flow; however, if damage to the Stehekin Valley Road occurred, it would be repaired as needed.

Although NPS action would only be taken if the road needed repair following flooding, area residents would be encouraged to protect their property from flooding by using measures advocated by the Army Corps of Engineers ―Advanced Flood Protection Measures" memo (see ―B. Actions Common to All Alternatives [1 - 4]" above and Appendix 7).

#### Elements Common to Alternatives 2 - 4: Stehekin Valley Road Milepost 2.0 (Boulder Creek)

In Alternatives 2 - 4, the natural logjam at this location would be extended on top of the bank and into the forest over a grade-control structure (avulsion sill) constructed beneath it.

Approximately 150 yards below the confluence of Boulder Creek and the Stehekin River, the river has a very low left bank (Figure II-15: *Boulder Creek Erosion Protection Measures under Alternatives 2 - 4*). When water levels are high, water flows over the bank and travels along a low-lying area across the road and under several cabins before returning to Silver Bay (Chelan County 2007). This results in the scouring and/or deposition of material along the road near the Bakery Corner in this location. Past events have required the removal and/or replacement of fill within the road corridor.

A logjam (200 feet × 5 feet × 3 feet) containing approximately 50 large logs would be constructed along the streambank in the forest. It would extend off of an existing natural logjam and would be underlain by a sill of rock (grade-control structure) designed to prevent a major stream channel shift into the densely developed area near the bakery that would also affect the Stehekin Valley Road. The grade-control structure (200 feet × 6 feet × 3 feet) would extend away from the river into the forest and tie into the Boulder Creek alluvial fan (the total area affected would be about 600 square feet, or 0.01 acre).

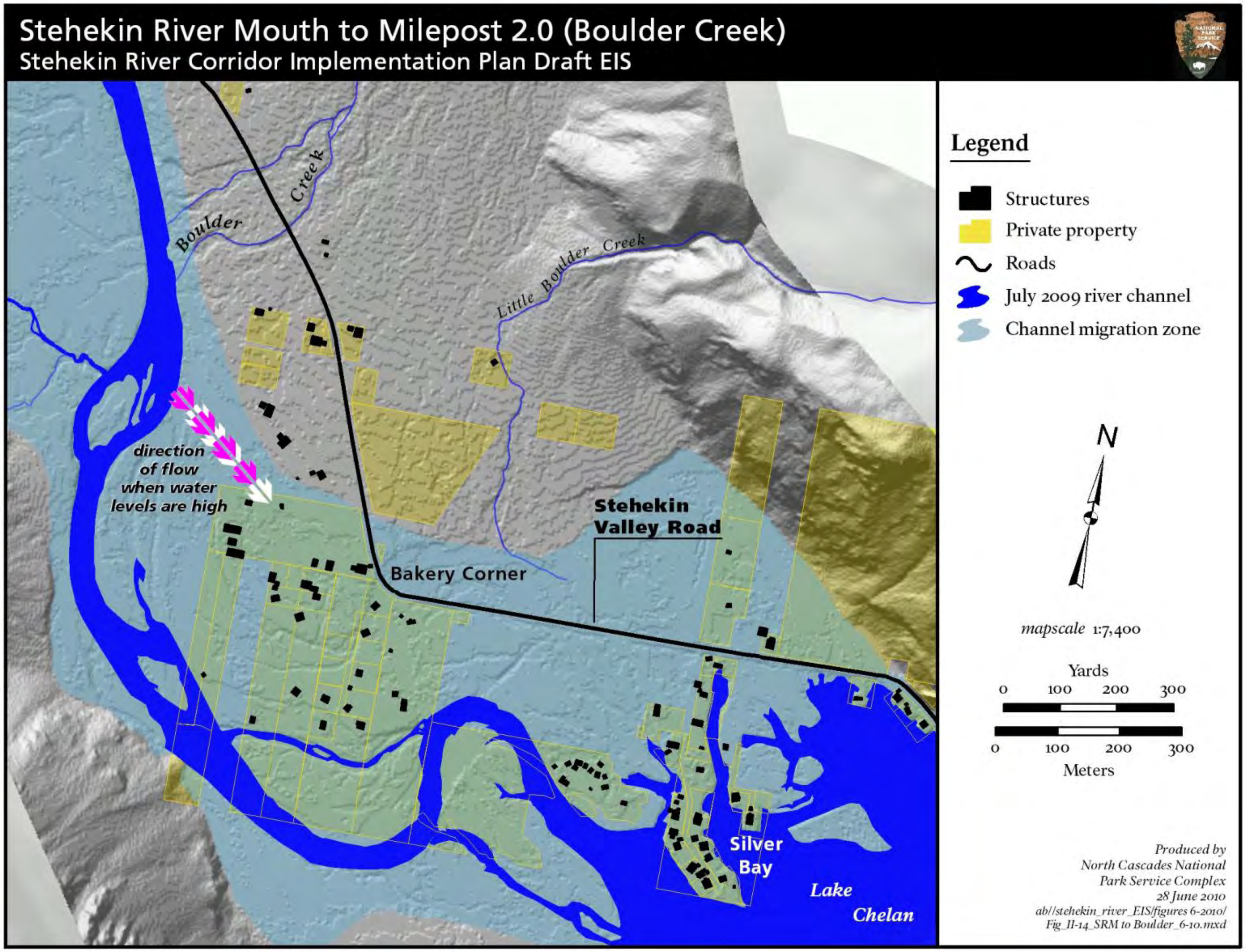



**Figure II-14: Stehekin River Mouth / Milepost 2.0, Boulder Creek**

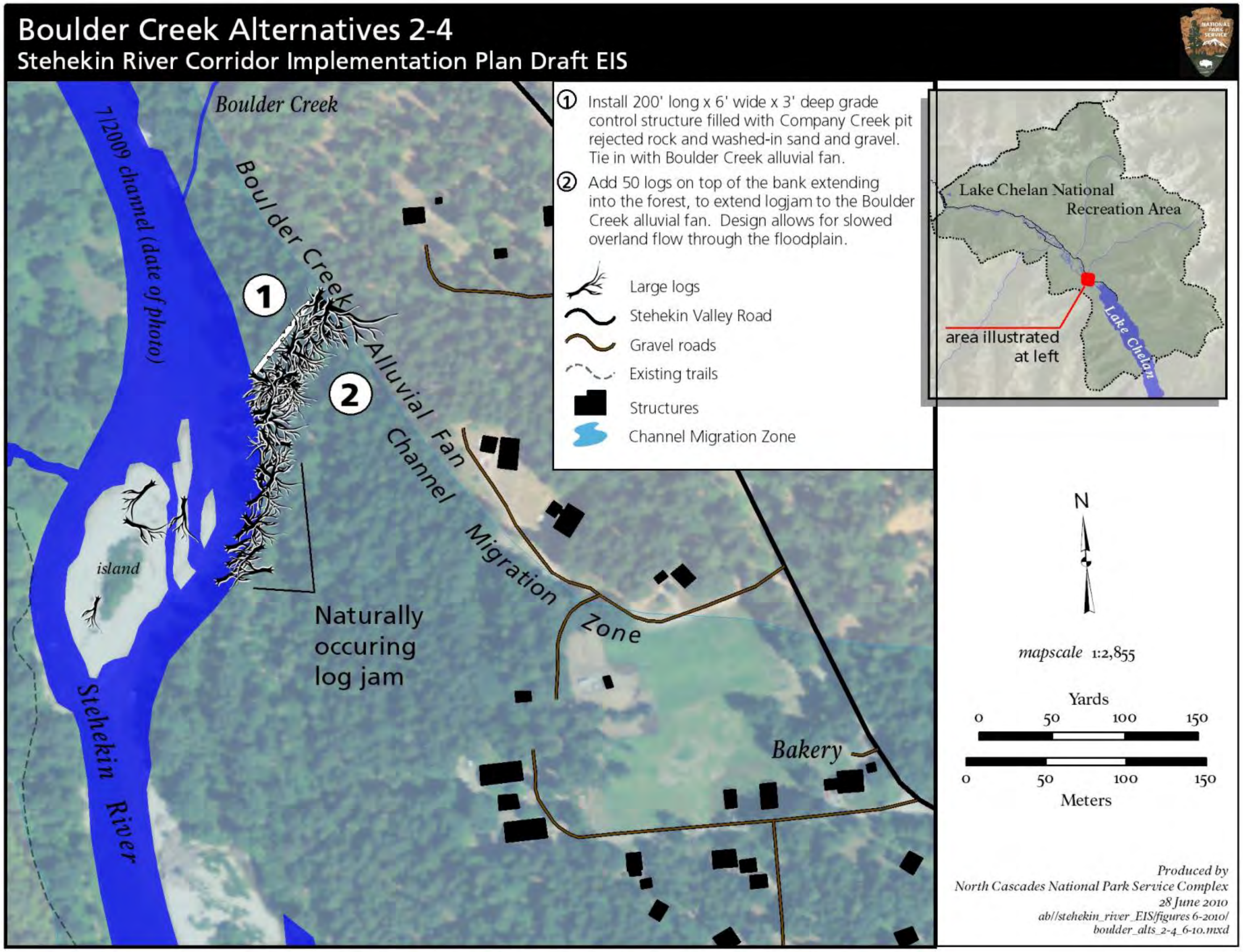



**Figure II-15: Boulder Creek Erosion Protection Measures under Alternatives 2 - 4**

The logjam and avulsion sill are intended to slow floodwater heading to the Stehekin Valley Road and NPS housing, but would also steer head-cutting and floodwaters away from other densely populated areas nearby. The logjam would slow floodwater from where the confluence of Boulder Creek and the Stehekin River are combining to flow overland through the forest toward the Bakery area developments, including toward NPS and private housing and the Stehekin Valley Road. River processes here are unnaturally influenced by the Lake Chelan backwater zone, which extends 0.25 mile upstream from the lake and is thought to raise water levels about 6 inches during a 100 year flood (Chelan PUD 2000).

## b. Stehekin Valley Road Buckner Homestead Hayfield and Pasture Restoration

### Alternative 1: Buckner Homestead Hayfield and Pasture

There would be no changes to this area, where bank erosion is occurring (see Figure II-16: *River Channel Changes at Buckner Hayfield 1988 - 2009*). Ongoing erosion would likely continue and would eventually need to be treated.

### Elements Common to Alternatives 2 - 4: Buckner Homestead Hayfield and Pasture

Native vegetation would be planted to slow bank erosion along the Stehekin River near the Buckner Homestead hayfield and pasture. The left bank (facing downstream) of the Stehekin River is eroding rapidly as the river moves into its left (east) bank. Low-growing grasses and other forbs are not enough to protect this sandy bank in the absence of riparian trees and shrubs, which were removed long ago to create the pasture. In addition to the riparian revegetation, as appropriate, additional plantings would transition away from the river to the pasture.

Three hundred linear feet of bank would be planted with native shrubs and trees, including cottonwood, alder, and red osier dogwood. Oceanspray, wild rose, and snowberry could be planted at the top. The plantings would extend back from the bank for about 30 feet. Small log structures and bioengineering would also be used to slow bank erosion.

## c. Stehekin Valley Road Milepost 3.8 (Frog Island)

### Alternative 1: Stehekin Valley Road Milepost 3.8 (Frog Island)

There would be no changes to this area, where the Stehekin River is undercutting a low terrace between the road and the river. Ongoing erosion would likely continue and would eventually need to be treated.

### Elements Common to Alternatives 2 and 4: Stehekin Valley Road Milepost 3.8 (Frog Island)

As the Stehekin River migrates into its left bank toward the road, it is undercutting a low terrace between the road and the river and is currently within 20 feet of the Stehekin Valley Road.

To slow continuing erosion of the bank, dogwood cuttings were planted, but the river has continued to undermine the bank. Under Alternative 2 (one to two rock barbs) and 4 (two rock barbs), and bioengineering, and anchored logs would be installed to slow bank erosion (Figure II-17: *Milepost 3.8 (Frog Island) Erosion Protection Measures under Alternatives 2 - 4*).

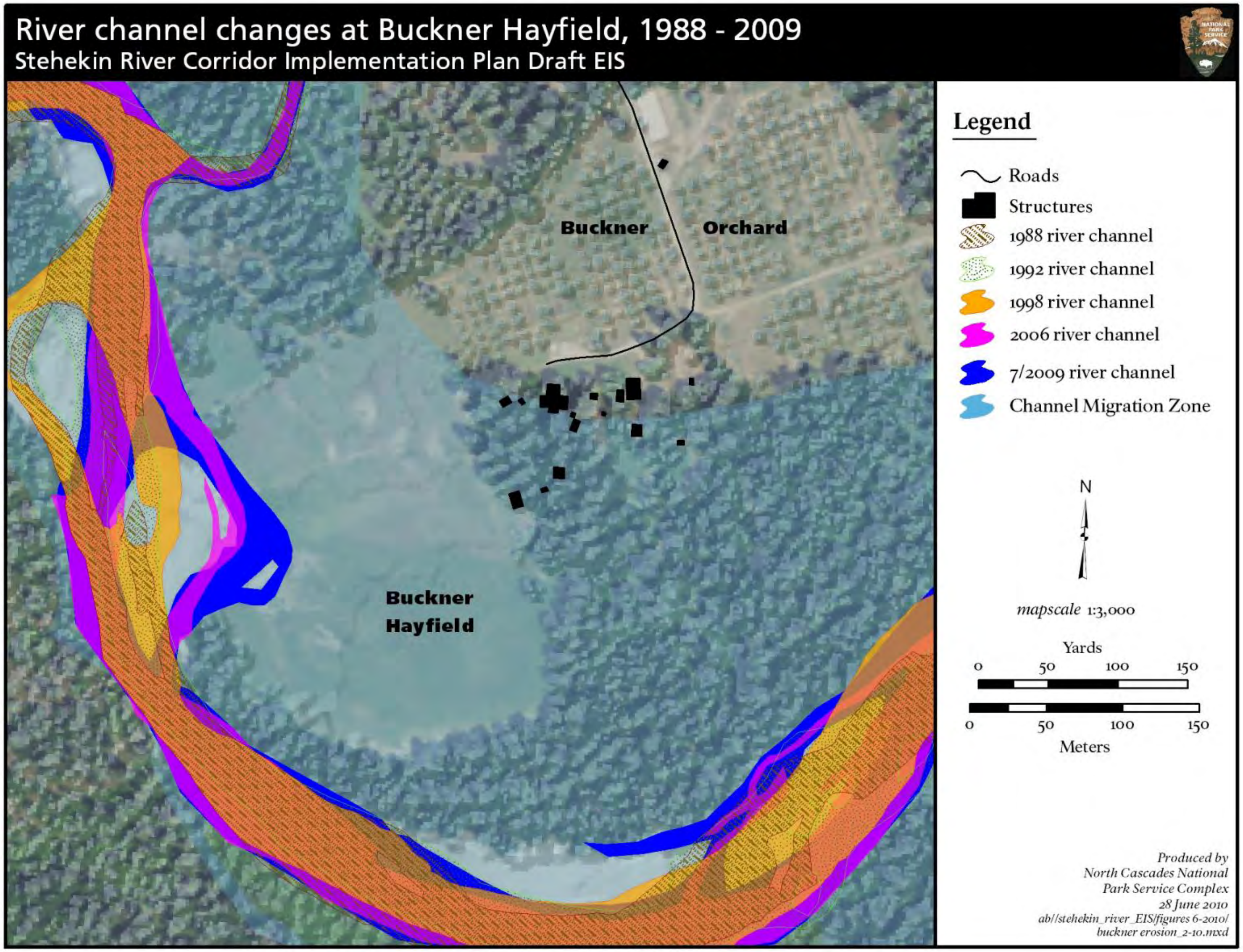



**Figure II-16: River Channel Changes at Buckner Hayfield 1988 - 2009**

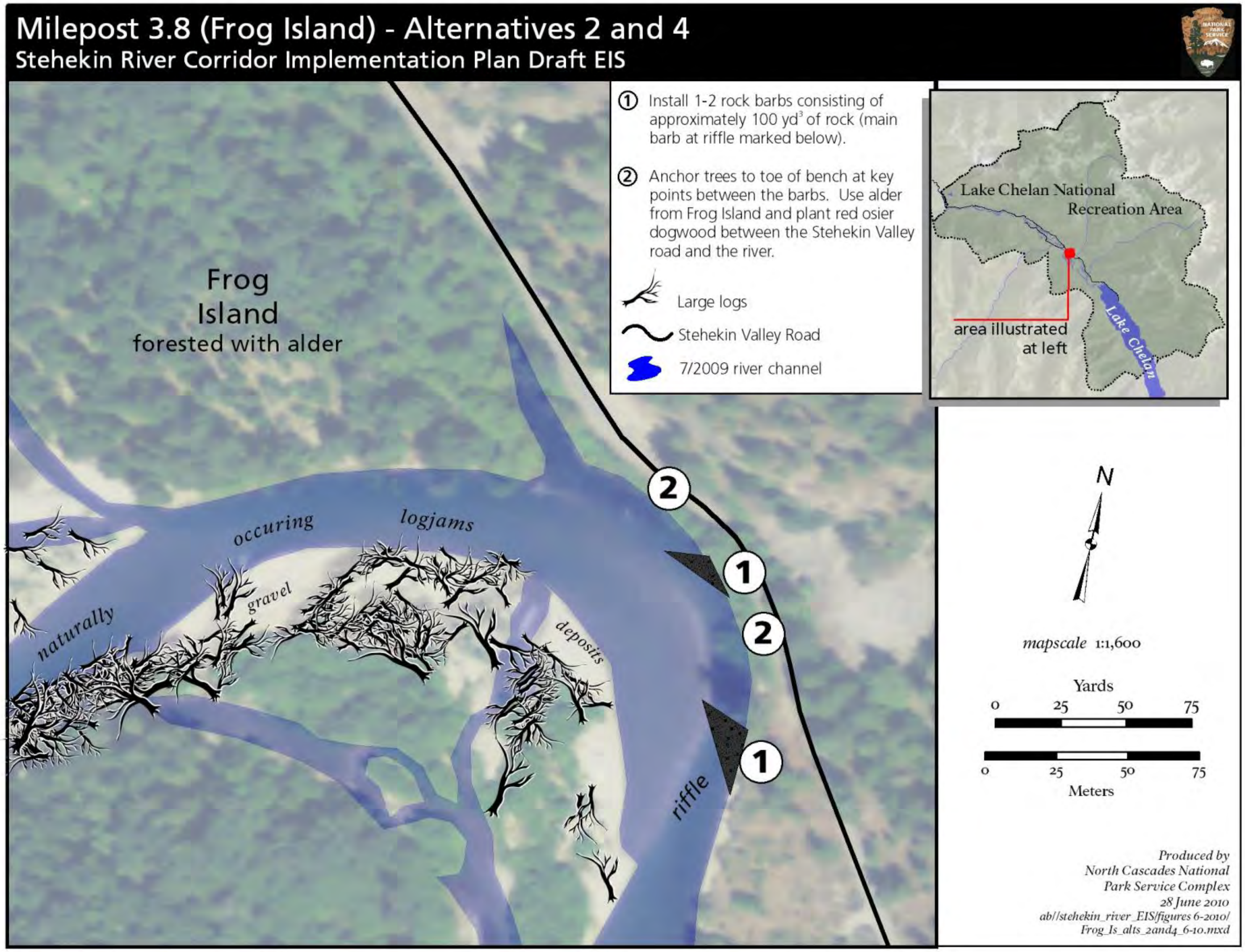



**Figure II-17: Milepost 3.8 (Frog Island) Erosion Protection Measures under Alternatives 2 - 4**

Construction of the bank barbs would be the same as described above for Weaver Point. Up to an additional 50 cubic yards of rock and large logs (with root wads attached for stability) would be placed between the barbs, at the toe of the bank. About five to six large trees would be anchored with duckbill-type steel anchors and rock along approximately 100 feet of the bank and partly buried. Holes or weak points would be fortified with additional rock or logs. No large (greater than 8 inches in diameter) living trees or riparian vegetation would be disturbed during construction, although some forbs and shrubs would be removed to accommodate the work.

### Alternative 3: Milepost 3.8 (Frog Island)

Under Alternative 3, a moderately sized engineered logjam (200 feet × 6 feet × 5 feet) would be constructed to stabilize the bank adjacent to the road (rather than using rock barbs, as in Alternatives 2 and 4) (see Figure II-18: *Milepost 3.8 (Frog Island) Erosion Protection Measures under Alternative 3*). As in the proposed logjam for Alternative 3 near the mouth of the Stehekin River, final design would be approved in consultation with a consortium of river rafting guides in a process developed by King County. The logjam would be keyed into the bank by burying several logs and using large rocks to fill in gaps and to anchor logs placed perpendicular to the banks. Construction would occur from the road shoulder and would require vegetation to anchor logs. Plants salvaged from the construction area would be used in revegetation following construction.

## d. Stehekin Valley Road Milepost 5.3 (Wilson Creek)

### Alternative 1: Stehekin Valley Road Milepost 5.3 (Wilson Creek)

As described in Actions Common to All Alternatives (1 - 4), the slope along the road would be regraded for approximately 400 feet and the roadbed would be lowered 10 feet and moved laterally 15 feet into the hillside. These actions would also involve installing two new 60-inch culverts and a new ditch. If the road becomes undermined, the road would be rebuilt in place.

In addition, in Alternative 1, the design from the Road Improvement Project would be installed to stabilize the riverbank. The design includes placement of clusters of rip-rap near the toe of the slope and installation of log-cribbing in the mid-slope area. The amount of rip-rap required would be about 100 cubic yards, and 10 - 15 large logs would be used for the cribbing. Construction would be from the base of the slope and would likely require access across private land downstream, including an easement or purchase.

### Elements Common to Alternatives 2 and 4: Stehekin Valley Road Milepost 5.3 (Wilson Creek)

Instead of the rip-rap and log-cribbing in Alternative 1, Alternatives 2 and 4 would construct two to three rock barbs and revegetate the slope with willow layering (see Figure II-19: *Milepost 5.3 (Wilson Creek) Erosion Protection Measures under Alternatives 2 and 4*). Some rock could be placed in select areas to supplement natural bank armoring.

### Alternative 3: Stehekin Valley Road Milepost 5.3 (Wilson Creek)

Construct a moderately-sized engineered logjam (400 feet × 6 feet × 10 feet) using approximately 300 logs (see Figure II-20: *Milepost 5.3 (Wilson Creek) Erosion Protection Measures under Alternative 3*). As in other logjam designs, final design would be approved in consultation with river rafting guides. The log structure would be keyed into the bank by burying several logs and using large rocks to fill in gaps and to anchor logs, with cables connecting logs. Construction access would be the same as in Alternative 1.

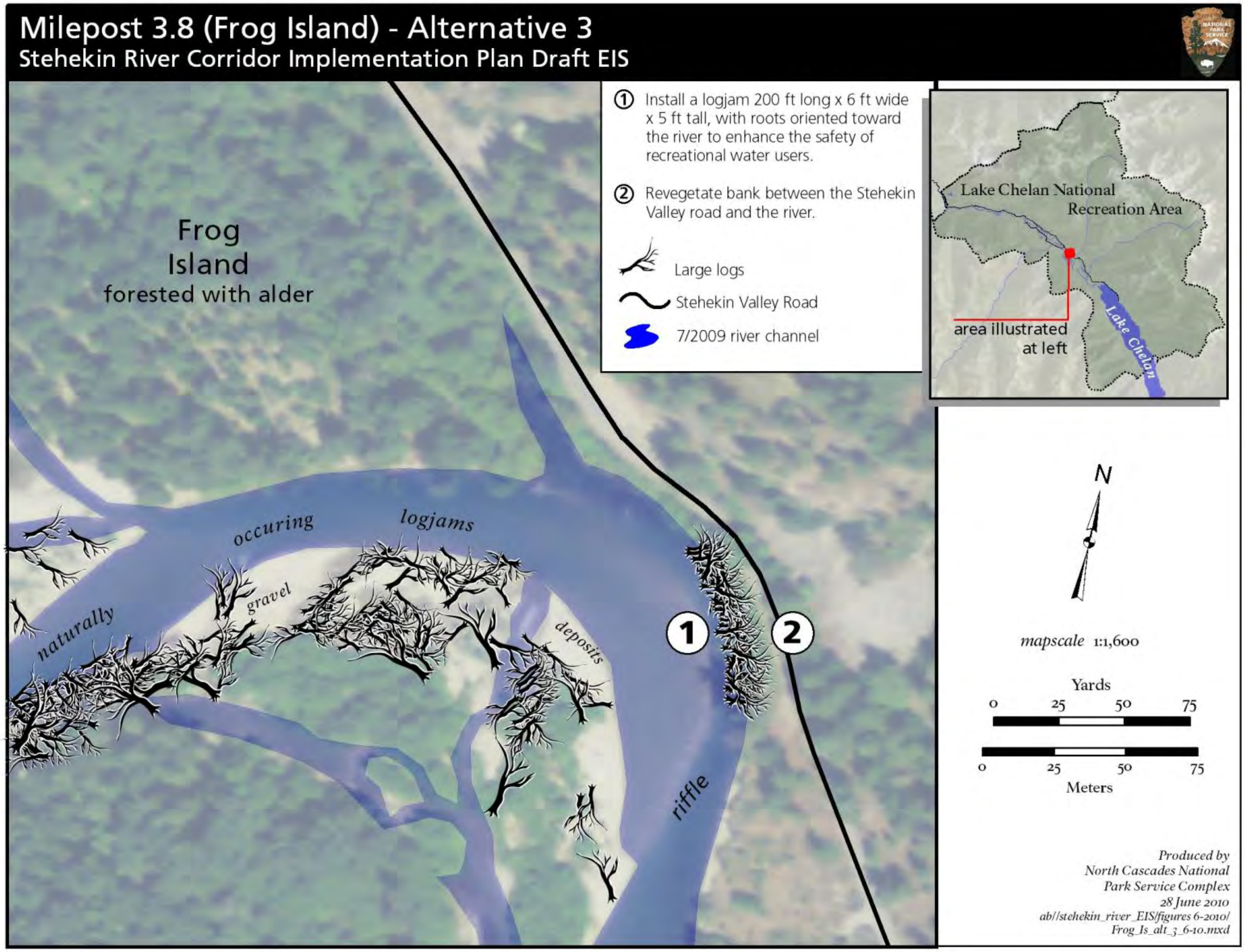



**Figure II-18: Milepost 3.8 (Frog Island) Erosion Protection Measures under Alternative 3**

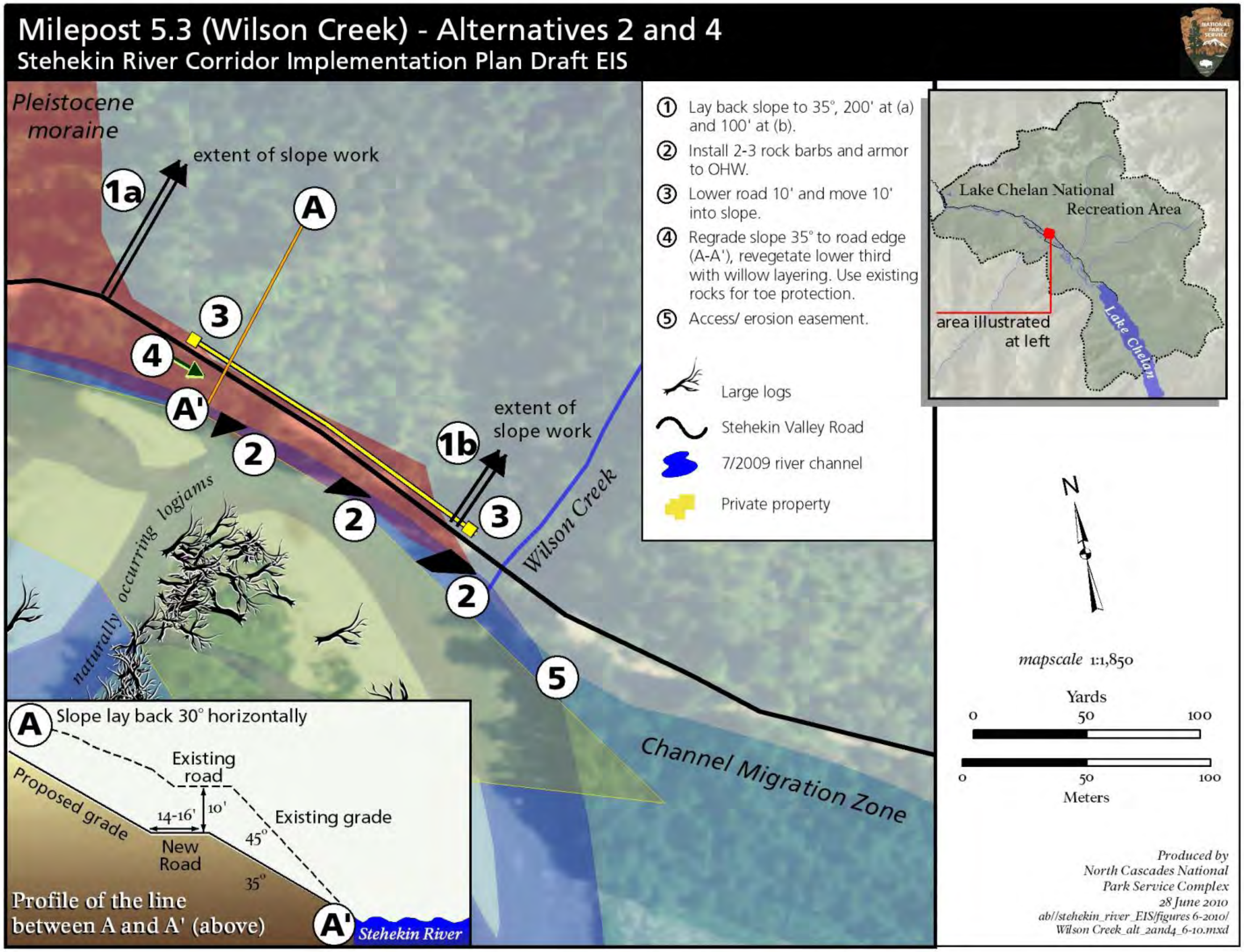



**Figure II-19: Milepost 5.3 (Wilson Creek) Erosion Protection Measures under Alternatives 2 and 4**

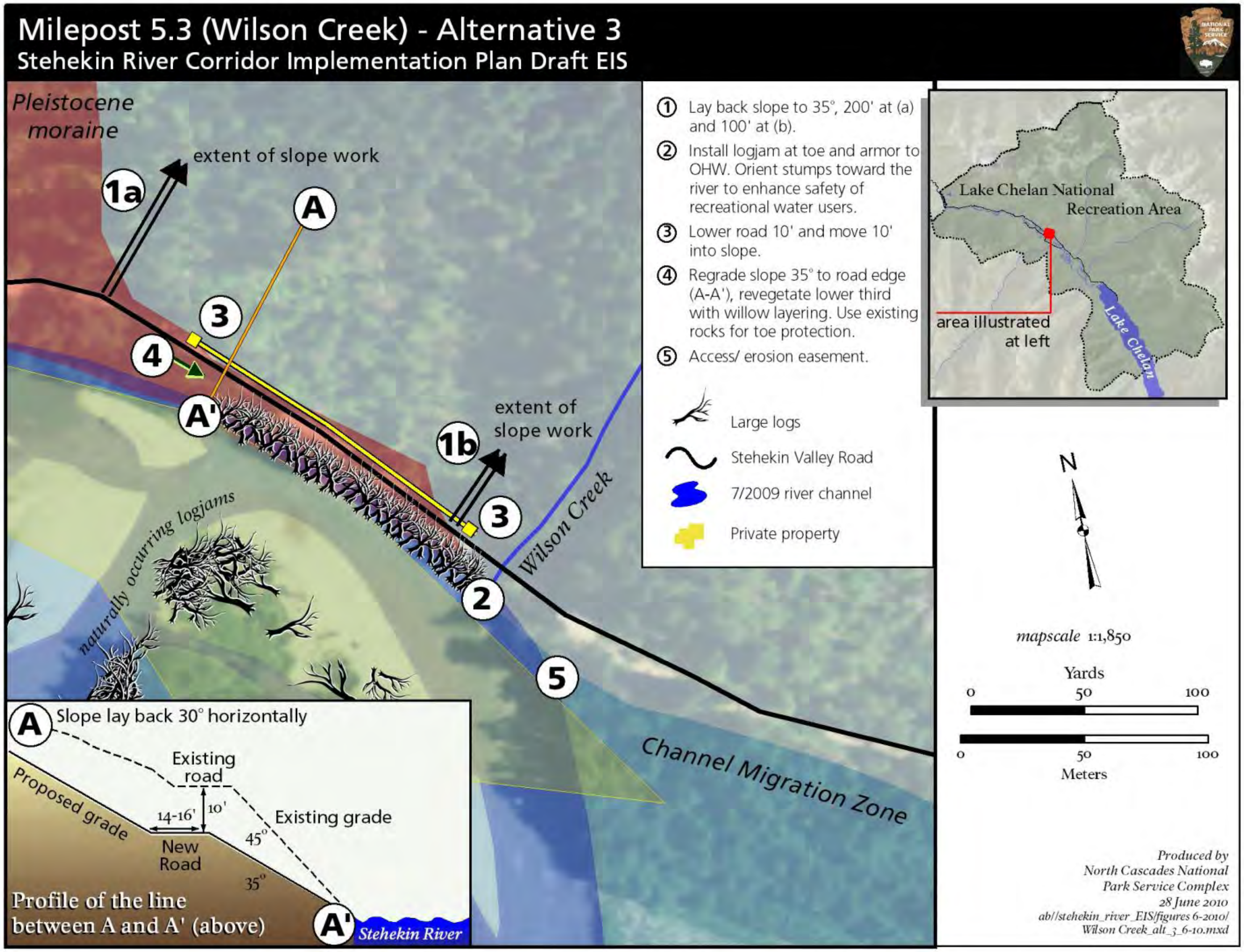



**Figure II-20: Milepost 5.3 (Wilson Creek) Erosion Protection Measures under Alternative 3**

## e. Stehekin Valley Road Milepost 7.0

### Alternative 1: Stehekin Valley Road Milepost 7.0

The three grade-control structures installed after 2006 flooding would continue to be maintained in this alternative. These structures are in place to prevent the river from following the road through McGregor Meadows. If the river flowed down the road into McGregor Meadows, it could cause flooding of private development there, contributing to adverse effects on the Stehekin River from release of contaminants from septic system drain fields and from other potentially harmful contaminants located within potentially flooded developed areas. Road flooding would also preclude vehicle access to campgrounds, trails, and private residences upvalley.

### Elements Common to Alternatives 2 and 3: Stehekin Valley Road Milepost 7.0

The grade-control structures would be maintained to protect the McGregor Meadows Access Road, even though the Stehekin Valley Road (reroute) would bypass this area. The access road into McGregor Meadows up to Milepost 6.5 would continue to be used and restored following flood events. Although it would periodically be affected by debris from flooding and would be subject to closure during flooding, it would continue to be maintained to Milepost 6.5 as long as the need for private access to McGregor Meadows continued.

### Alternative 4: Stehekin Valley Road Milepost 7.0

Actions would be the same as in Alternative 1, plus two rock barbs would be constructed to protect this portion of the Stehekin Valley Road.

## f. Stehekin Valley Road Milepost 7.3 to 7.4 (Lower Field)

### Alternative 1: Lower Field

The Stehekin Valley Road would remain along the edge of the Lower Field.

### Elements Common to Alternatives 2 - 4: Lower Field

Riparian restoration would be implemented along a 30-foot-wide strip, approximately 200 feet long, beginning from the Stehekin River bank and continuing back toward the road. Approximately 15,840 square feet (0.36 acre) would be restored with native vegetation, including seeding and planting. Large logs would be anchored to the bank to slow erosion until vegetation became established.

### Elements Common to Alternatives 3 and 4: Lower Field

In addition to the riparian restoration described above, two rock barbs and bioengineering would be added to maintain the adjacent Stehekin Valley Road alignment along the Lower Field. The rock barbs and bioengineering would increase bank stability in this area, an action needed because the reroute would not continue around Lower Field (Alternative 3) and because Alternative 4 would not have a reroute.

## g. Stehekin Valley Road Milepost 7.8 (Thimbleberry Creek)

### Alternative 1: Thimbleberry Creek

The road would be raised slightly and the 72-inch Thimbleberry Creek culvert and two new 48-inch culverts would be retained. Debris racks on the culverts would minimize their filling with sediment.

### Elements Common to Alternatives 2 - 4: Thimbleberry Creek

The road would be raised slightly and the Thimbleberry Creek culverts would be replaced, with the 72-inch culvert and the twin 48-inch culverts each being replaced with a 60-inch culvert. A ditch would then be excavated to connect the two new culverts. Debris racks on the culverts would minimize their filling with sediment.

## h. Stehekin Valley Road Milepost 8.0

### Alternative 1: Stehekin Valley Road Milepost 8.0

At Milepost 8.0 the Stehekin Valley Road is cut into a 50-foot-tall, steep, unstable slope along the edge of a glacial moraine studded with large boulders. Large rocks and debris frequently fall down this slope onto the road, creating a safety hazard and recurring road maintenance problem. In Alternative 1, ongoing monitoring of the steep, unstable slope adjacent to the road would continue.

### Elements Common to Alternatives 2 - 4: Stehekin Valley Road Milepost 8.0

In Alternatives 2 - 4, slope stabilization in this area would occur. In addition to maintaining existing barbs and bioengineering on the river side of the road, the raveling slope above the road would be stabilized by regrading portions of the steepest upper part (approximately the top one fourth to one third of the slope, in some places to a depth of 10 feet) to an angle of less than 40 degrees. Large rocks on the slope would be scaled off (removed) and the slope would be planted with native shrubs. A rock wall (100 - 150 feet long and 3 - 8 feet high) would also be added at the base of the slope. In addition, some rip-rap could be placed in the upper, finer-grained portion of the road embankment. As noted earlier, if the road is undermined further, it would be rebuilt in place (see ―D. Alternatives and Actions Considered but Dismissed"). (This would minimize or avoid impacts to northern spotted owls and to cultural resources, including Stehekin Wagon Road segments potentially eligible for the National Register of Historic Places.)

## i. Stehekin Valley Road Milepost 8.5

### Alternative 1: Stehekin Valley Road Milepost 8.5

As described in the Road Improvement Project, the existing culvert would be realigned to meet an unnamed creek where it comes down off the hillside, rather than forcing it parallel to the road (at a 90 degree angle to the culvert) and then under the road. The unnamed creek is located near the Stehekin Valley Ranch and hits the road at a right angle before turning and flowing west, parallel to the road, in a constructed ditch, where it is forced by adjacent boulders to turn 90 degrees into a culvert. Because of the angle where the creek meets the road, large quantities of sand and gravel plug the culvert and cause water to flow over the road, depositing debris on the roadway (NPS 2005a:24). Under Alternative 1, the culvert would be moved downvalley so that the creek flows directly under the road without making two 90-degree turns.

### Elements Common to Alternatives 2 - 4: Stehekin Valley Road Milepost 8.5

The misaligned culvert would be replaced with a low-water crossing (approximately 34 feet long) over the road where the creek flows off the hillside, so that the creek would be aligned with the construction of the low-water crossing (Figure II-22: *Low-Water Plank Crossing*). This would direct flow over the road into the Stehekin River without impacting the road shoulder or road base or continuing to modify the creek channel.

## j. Stehekin Valley Road Milepost 9.2

### Alternative 1: Stehekin Valley Road Milepost 9.2

Following rapid bank erosion just upstream during the 2006 flood, two grade-control structures were installed where the road meets the river. In summer 2009, a storm cell dropped a significant amount of rain over the area and caused a debris flow, which rerouted the creek onto the road. Water followed the road to the Stehekin Valley Ranch, depositing silt and sand on the private pastureland and the road.

In Alternative 1, ongoing monitoring of the threats to Stehekin Valley Road would continue, and existing grade-control structures that limit the potential for water to create a channel in the road corridor would be maintained. No action would be taken to address seasonal flooding. Ponding of water on the roadway would continue.

### Alternatives 2 and 3: Stehekin Valley Road Milepost 9.2

Actions would be the same as in –B. Actions Common to All Alternatives (1 - 4).” In addition, in Alternatives 2 and 3, 300 - 400 feet of the Stehekin Valley Road would be elevated 3 feet above grade (it is now 1 foot below grade). This would require about 500 cubic yards of clean fill. Another 50 cubic yards of fill would be used to construct a new parking area on the east side of the road to accommodate 10 passenger vehicles (or 5 passenger vehicles and a bus). A 2- to 3-foot-deep ditch dug along the road above the parking area would direct water to a culvert and new concrete plank low-water crossing (approximately 34 feet long) (see Figure II-23: *Milepost 9.2 Erosion Protection Measures under Alternatives 2 and 3*).

### Alternative 4: Stehekin Valley Road Milepost 9.2

In addition to actions described in Alternatives 2 - 3, three rock barbs and bioengineering would be constructed just upstream of Milepost 9.2. The rock barbs and bioengineering would limit additional loss of land between the road and the river.

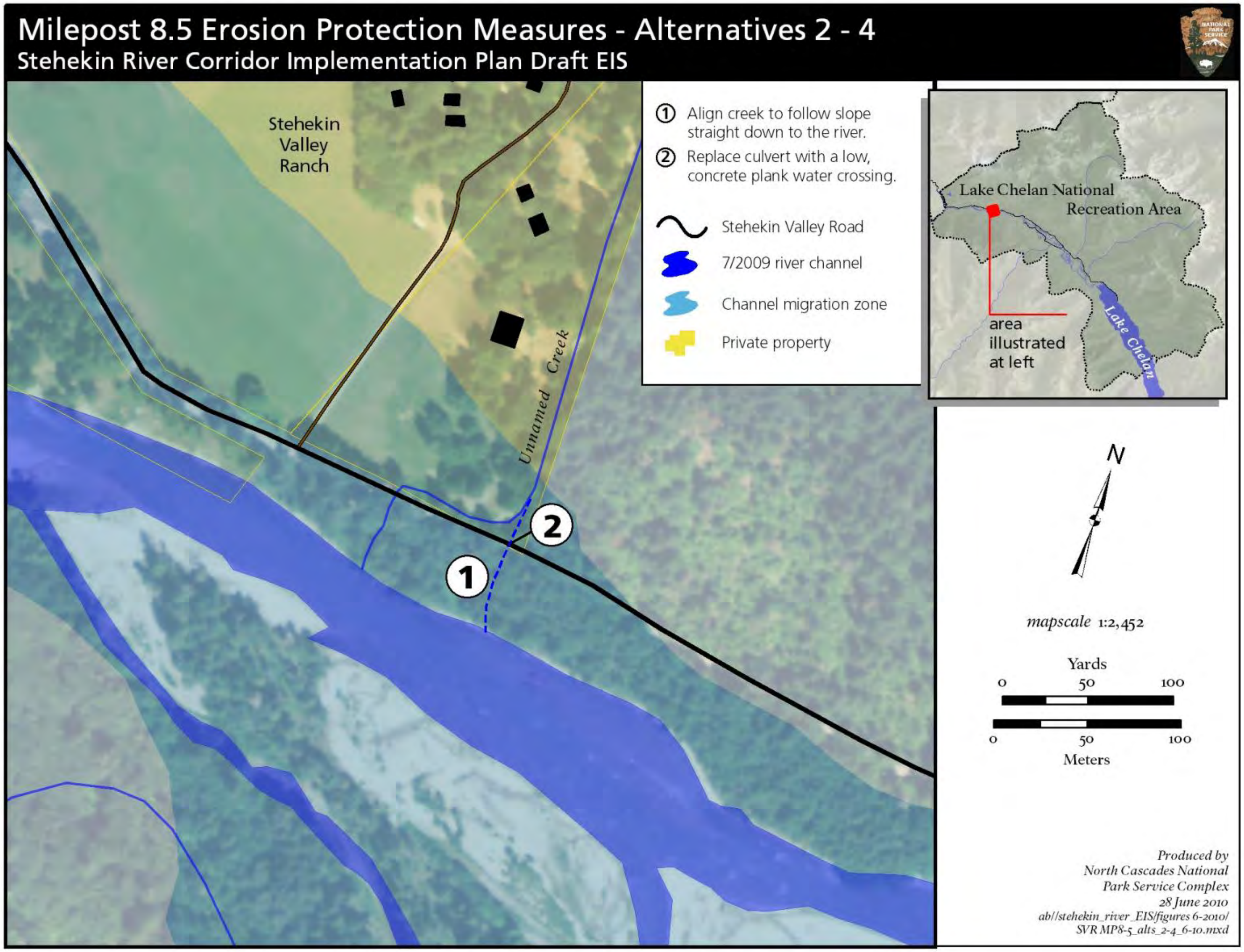



**Figure II-21: Milepost 8.5 Erosion Protection Measures under Alternatives 2 - 4**

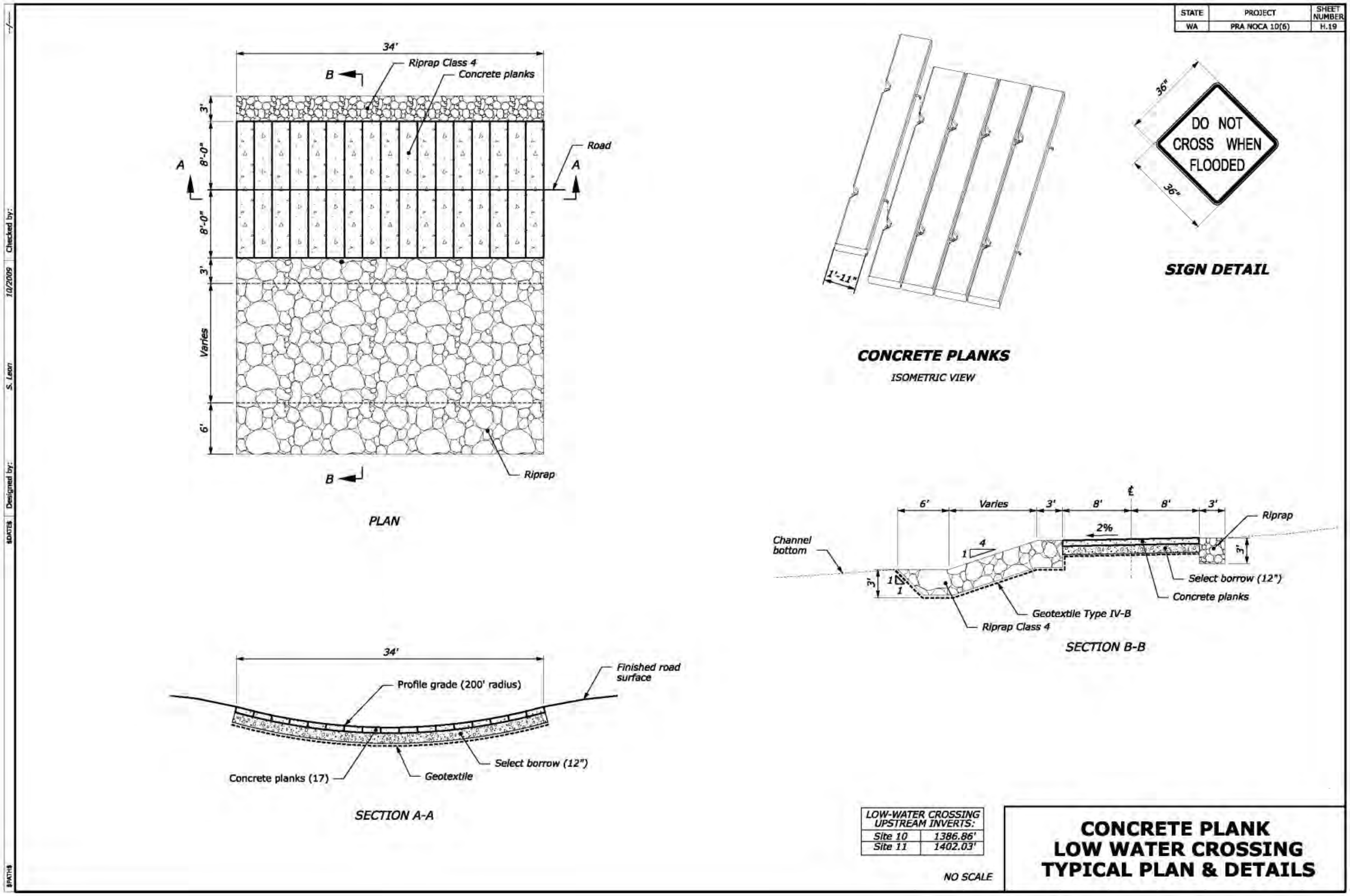



**Figure II-22: Low Water Plank Crossing**

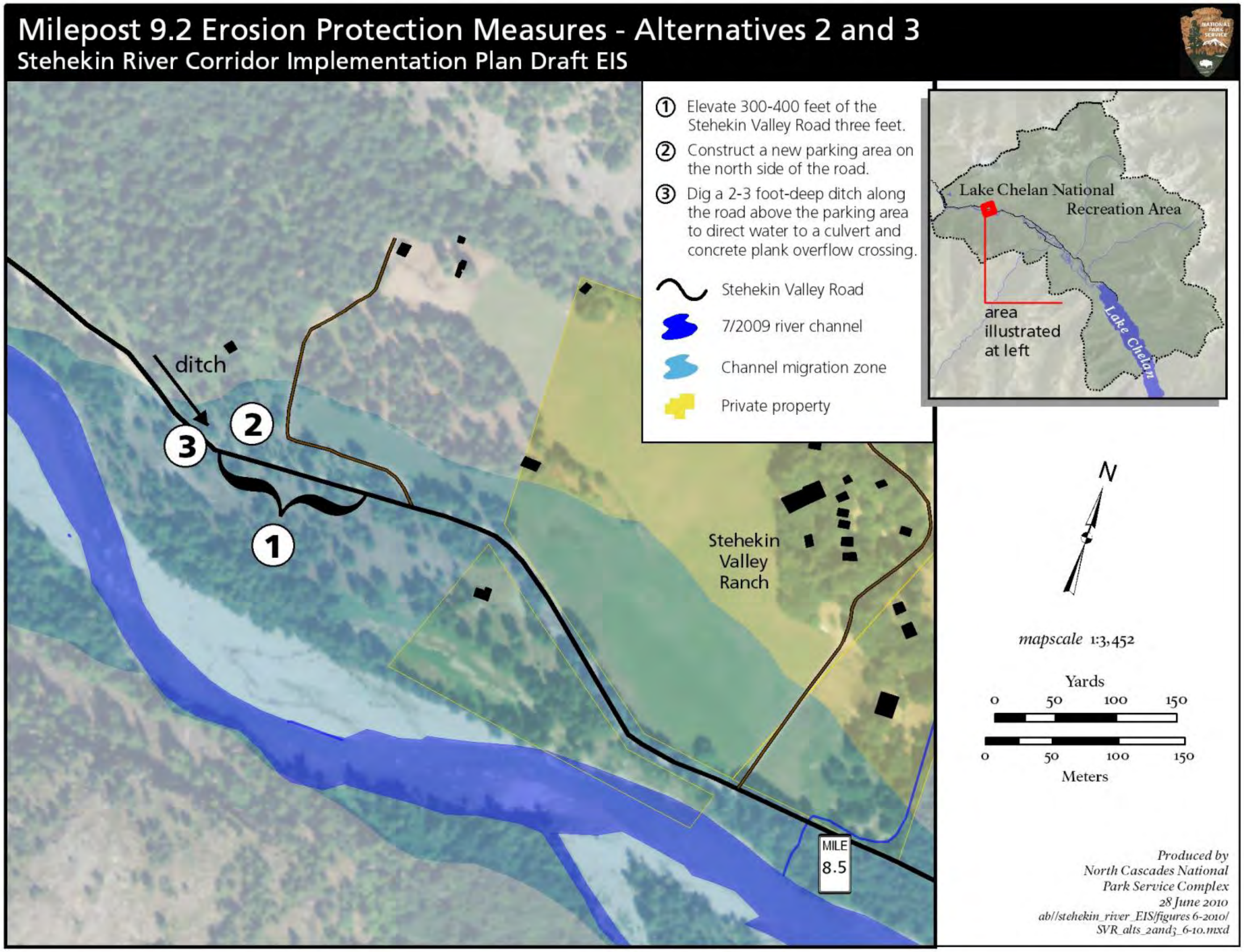



**Figure II-23: Milepost 9.2 Erosion Protection Measures under Alternatives 2 and 3**

# D. ALTERNATIVES AND ACTIONS CONSIDERED BUT DISMISSED

Under the NEPA, (40 CFR 1504.14 (a)), alternatives may be eliminated from detailed study based on the following reasons:

- Technical or economic infeasibility;
- Inability to meet project objectives or resolve need for the project;
- Duplication of other less environmentally damaging alternatives;
- Conflicts with an up-to-date valid plan, statement of purpose and significance, or other policy; and therefore, would require a major change in that plan or policy to implement; and
- Environmental impacts too great.

The following alternatives or variations were considered during the design phase of the project, but because they met one or more of the above criteria, they were rejected.

## Allow use of the Airstrip for Exchange to Relocate Private Property Outside of the Floodplain.

This action conflicts with the following GMP provision:

> The airstrip would be retained and operated under a special use permit with the Washington State Department of Transportation, Aeronautics Division, for noncommercial public use on a ―use at your own risk" basis. (NPS 1995a:33)

The airstrip area was also designated in the GMP as the location for the relocated maintenance compound / housing area.

## Implement Additional Flood Protection (Bank-Hardening) Measures, such as Rip-rap or Levees, along the Banks of the Stehekin River to Prevent Flooding.

Additional rip-rap was considered but rejected in favor of bank barbs and engineered logjams because

- Rip-rap is known to have substantial adverse impacts to riparian areas and stream banks.
- Rip-rap is expensive because rock has to be imported into the Stehekin Valley.
- Rip-rap would cause greater increases in the percent of riverbank modification (channelization of the river) compared to rock barbs or logjams.
- Rip-rap can increase accelerate erosion downstream.
- NPS and GMP management direction is to avoid hard armoring of riverbanks. NPS has successfully avoided use of large amounts of rip-rap in favor of using rock barbs, large wood, and bioengineering.
- Rip-rap would not meet the GMP goal of maintaining the river in its natural state as much as possible (NPS 2005a).

### Implement Additional Erosion Protection Measures at Buckner Homestead Hayfield and Pasture.

The proposed riparian restoration at this location is likely to slow erosion of the bank. Additional erosion protection measures could be considered later if warranted.

### Exchange Lands to Allow Private Landowners to Establish or Maintain Flood / Erosion Protection.

This strategy was initially considered under the following scenario: Allow exchange of the affected parcel under specific conditions, including when (1) no development would be permitted, (2) beneficial erosion control measures would be implemented, and (3) the exchanged property had limited resource value and the acquired property had high resource value. It was rejected because it blurs the line between the NPS allowing actions on its own property to protect private property, as specifically prohibited by the GMP and generally by NPS policy. Further, NPS is prohibited from exchanging land that has always been in federal ownership.

### Take Action as Part of the Plan Solely to Protect Private Property.

The NPS is prohibited from expending funds solely to protect private property. Actions that protect NPS administrative facilities and infrastructure may, however, have the inadvertent and indirect benefits of also protecting private property. Other federal agencies, such as FEMA and the Army Corps of Engineers, have the authority to spend public funds to protect private interests, but the NPS does not have this authority.

### Reroute the Stehekin Valley Road at Milepost 8.0.

This action was considered but rejected based on the following reasons: (1) upland impacts would be great, (2) the area has been stabilized by recent implementation of erosion protection measures, (3) there would be unacceptable cultural resources impacts (affecting the integrity of what remains of a historic dry-laid rock wall along the Old Wagon Road [determined eligible for the National Register]), (4) the reroute would affect a large area of northern spotted owl habitat and would therefore have high resource cost, (5) to reroute at this location would conflict with decisions made in previous planning documents, and (6) the reroute could require a very expensive rock wall and major blasting in bedrock (NPS 2008a).

### Reestablish the Southside Stehekin Valley Road along the Company Creek Road Alignment, including Constructing a New Bridge.

This action was considered but rejected for the following reasons: (1) the Company Creek Road would have to be widened considerably to accommodate sight distance needs, (2) the road alignment would continue to be subject to more flooding than the existing Stehekin Valley Road, (3) it would be very expensive to construct a second bridge, (4) there would be impacts to floodplain from fill needed in Lower Field to reach the bridge, and (5) there are no official easements in place for maintaining a road corridor through this area. If the road were widened, there would be no room for snow storage. Recent flooding has inundated much of the road at lower magnitudes than affect the Stehekin Valley Road, including the area between Harlequin Bridge and the current maintenance compound and after the road passes through the Company Creek alluvial fan (NPS 2008a).

### The Scope of the Plan should Include the Entire Stehekin River Watershed, Including the Area above High Bridge.

Areas above High Bridge are primarily located in wilderness, and there are limited actions that could be taken without altering the wilderness character or boundary. In addition, the Agnes Creek watershed represents about one-third of the Stehekin Basin and is managed by the USFS. The scope of the SRCIP was limited to focus on the problems caused by the 2003 and 2006 floods in the lower valley and to the Lower Stehekin Valley below High Bridge, where private property is threatened by flooding. Since the floor of the lower valley below High Bridge is outside of designated wilderness, the NPS has more options to relocate roads and facilities, to exchange lands, and to construct erosion protection measures.

### Sediment and Large Woody Debris Sources above High Bridge and/or in the Whole Stehekin Watershed should Be Evaluated for Treatment.

The NPS assessed a number of features across the watershed, including landforms, such as landslides, river canyons, alluvial fans, etc. The gauging station also integrates runoff from the entire watershed, and wood and gravel movement to, and storage within, the lower valley are a result of integrated watershed processes. Sources of gravel include landslides, river cut banks, alluvial fans, debris cones, and hundreds of other features. Most of the upper Stehekin River watershed is designated wilderness, where any large-scale erosion protection treatment would not only be extremely difficult to achieve, but would employ management actions not permitted in wilderness.

### The Stehekin River should Be Contained within a Channel to Reduce Flooding of Private Property and Public Facilities.

Containing the Stehekin River within a channel would not conform to NPS *Management Policies 2006* (NPS 2006a), which advocates allowing rivers to migrate naturally within their floodplain. Trying to keep the river from occupying parts of its floodplain would likely only be a temporary solution given the massive amounts of water, gravel, and wood that this mountain river transports. As a result, this action would be unlikely to be funded by NPS. Such an approach would adversely affect private land, public facilities, and ecological values and would be of questionable benefit over the medium to long term.

### The Plan should Include Actions that Would Resolve Issues in the Whole Lower Valley.

While the plan does address issues related to flooding of public and private property in the Stehekin corridor in many areas, it cannot solve all the flooding problems in the lower Stehekin Valley, particularly since flooding is getting worse. This alternative is beyond the scope of funding and NPS *Management Policies*.

### The Goal of the Plan Should Be to Allow Natural Processes to Occur Unimpeded so that Natural Flooding Can Continue to Occur without Regard to Its Effect on Facilities and Private Property.

In establishing Lake Chelan NRA, Congress recognized the significance of the Stehekin Community, which plays a central role in enabling recreational use of the area. The NPS is in a unique position to foster sustainable management strategies for the Stehekin Valley because it manages and most of the land in lower valley. Because the Stehekin River flows through a mix of public and private land, it is not possible to allow natural processes to continue wholly unimpeded. Frequent flooding and occasional destruction of cabins and inundation of drain fields and septic tanks represent serious threats to water quality, the ecological integrity of the river, and scenic values. Further, incorporation of glass, metal, plastic, and other debris from development into the river system causes long-term damage to natural and cultural resources values. The enabling legislation for Lake Chelan NRA recognizes that people will continue to live and work within the recreation area. Nonetheless, NPS *Management Policies 2006* (NPS 2006a) directs the NPS to allow natural processes to occur to the extent possible. Allowing the Stehekin River to migrate naturally within its floodplain is, in fact, one of the goals of the SRCIP. While this may be difficult to achieve throughout the valley given the way in which public and private property intertwine, it is one of the constraints within which the NPS must continue to work. Focusing on the goal of removing development from the channel migration zone will achieve the purpose of allowing the river to migrate as naturally as possible within its floodplain. Ignoring the public and private facilities that do exist would have adverse effects on both Lake Chelan NRA and the Stehekin Community.

### Plan Alternatives Should Include Consideration of Rerouting the Company Creek Road.

Rerouting the Company Creek Road was considered and dismissed in the 1995 GMP. As a result, additional analysis of this issue was considered but dismissed as part of this planning effort. The intent of the SRCIP is to implement, rather than amend, the GMP. Rerouting the road would result in significant disturbance of previously undisturbed areas, particularly when considering the need for private access off the Company Creek Road. NPS actions in the past 15 years have increased bank stabilization along the road. Relocation of the road could also leave private landowners to seek their own solutions to bank erosion.

- **Excess Materials, including Large Woody Debris and Excavated Gravel, Generated by the Plan Should Be Used for Other Public and Private Projects in Stehekin.**
- **Use Suitable Gravel for Projects in the Valley Instead of Importing Materials at High Cost.**
- **Pile Burning or Consumptive Use of Large Woody Debris Generated by the Plan Should Be Considered.**
- **The Plan Should Consider Changes to the *Sand, Rock, and Gravel Plan* to Allow Use of Gravel Generated by Plan Actions.**

NPS Management Policies have very strict guidelines regarding the consumptive use of recreation area resources. Consumptive uses of resources in Stehekin have previously been addressed by the *Sand, Rock, and Gravel Plan* and other plans, such as the Fire Management Plan (NPS 1995e).

No changes to the Sand, Rock, and Gravel Plan are needed to allow the use of materials generated by the proposed alternatives. To the extent possible, the proposed road improvement projects in Stehekin would balance cut and fill materials to avoid the importation of large amounts of similar materials. In some alternative actions gravel would need to be imported because of the unsuitability of material produced by the Company Creek Pit and because the amount of material needed would exceed the amount specified by the Sand, Rock, and Gravel Plan. In this plan, some material identified as excess and unsuitable for park needs would be used.

The SRCIP addresses changes in the management of large woody debris; however, continuing to retain that large woody debris as part of the valuable aquatic resource that it is in the Stehekin River system is one of the basic tenets of the proposal. Removing large amounts of woody debris or rock from the Stehekin River for consumptive uses outside the channel migration zone would adversely affect these and other recreation area resources. Some materials from the Company Creek Pit now considered reject rock, because of size, would likely be used for proposed work in this plan.

- **Gravel Removal Should Be Used Instead of Land Exchanges.**
- **Dredging Should Be Part of the Plan As Long As It Is Done in a Way that Minimizes Impacts.**

Removal of gravel from the floodplain of the Stehekin River would be an expensive and long-term undertaking. While selective gravel removal is one potential way to manage the Stehekin River over the short term, it generally does not conform to NPS *Management Policies 2006* or represent a fiscally or ecologically sustainable option due to the amount of gravel. The cost of this action, in terms of dollars and ecological values or associated with private land and public facilities is prohibitive. For example, the ACOE and the NPS estimate that to remove about 50,000 cubic yards of gravel from two 1-kilometer-long stretches of the river would cost an estimated $12 million (see Appendix 18: Estimates of Gravel Accumulation in Two Reaches of the Stehekin River). This would then need to be periodically repeated to remove gravel the river would move back in. At the McGregor Meadows Reach, it is estimated that 150,000 cubic yards of gravel have been deposited since the mid-1980s, making continued removal both costly and ineffective. It is also unclear how it could be undertaken based on initial analysis of the magnitude of gravel removal that would need to be repeated over time. At the Stehekin River mouth, repeated channel surveys indicate that gravel is being transported into Lake Chelan. The most effective flood-control action in this area would likely be to have Lake Chelan drawn down during potential seasonal flooding and the flooding to flush gravel into the deepest part of the lake. If NPS decided to remove gravel from the Stehekin River channel, and the permitting agencies approved it, removal from the river bed could only occur when gravel bars are exposed during late summer low-flow periods. This coincides with the primary visitor use season and the process would be highly disruptive to those visiting the Stehekin Valley.

### Reroute the Stehekin Valley Road at Milepost 9.2.

Although a reroute was initially considered at Milepost 9.2, this idea was discarded in favor of an alternative that would have many fewer impacts and still solve the problem of periodic water flow across the road (constructing a concrete plank crossing).

### Relocate the Shooting Range in Alternative 2.

Relocating the shooting range would not conform to current NPS management direction for removing these facilities from NPS units. Environmental concerns, such as lead contamination, introduced by shooting ranges in units of the national park system, are considered inconsistent with the purposes of the parks.

## E. MITIGATION MEASURES

See individual environmental impact analysis sections under Chapter IV: Environmental Consequences and Appendix 6: Summary of Mitigation Measures.

# F. ENVIRONMENTALLY PREFERABLE ALTERNATIVE

Implementing regulations for NEPA promulgated by the CEQ require that agencies identify "the alternative or alternatives which were considered to be environmentally preferable." "Environmentally preferable" is defined as the alternative that will promote the national environmental policy as expressed in Section 101 of NEPA, including:

- Fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations;
- Ensuring for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;
- Attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- Preserving important historic, cultural and natural aspects of our national heritage and maintaining, wherever possible, an environment that supports diversity and variety of individual choice;
- Achieving a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
- Enhancing the quality of renewable resources and approaching the maximum attainable recycling of depletable resources. (NEPA Section 101(b))

The environmentally preferable alternative is "the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources (46 FR 18026 - 18038). According to *Director's Order 12*, through identification of the environmentally preferred alternative, the NPS and the public are faced with determining the relative merits of the choices before them as represented among the alternatives and must clearly state through the decision-making process what values and policies were used in reaching a decision. As shown through the analysis below, the environmentally preferable alternative is Alternative 2.

**Fulfilling the responsibilities of each generation as trustee of the environment for succeeding generations**: All Alternatives (1 - 4) would fulfill this CEQ criterion because the NPS is required by law and policy to minimize its impacts on the environment and to preserve natural, cultural, and other park resources without impairment of its management of National Parks, including Lake Chelan NRA. Of the alternatives, Alternatives 1 and 4 would have the fewest new impacts on recreation area resources, while Alternatives 2 and 3 would have the fewest impacts on the floodplain / channel migration zone of the Stehekin River. Alternatives 2 and 3 also represent more sustainable, long-term solutions to current issues. Alternatives 2 - 4 would improve existing adverse impacts to water resources by removing development from both the floodplain and channel migration zone of the Stehekin River. Because Alternatives 2 and 3 would employ fewer erosion protection structures and would reroute the road away from the floodplain / channel migration zone of the Stehekin River instead of continuing to add structures to harden the banks of the river, Alternatives 2 and 3 would best meet CEQ criterion 1.

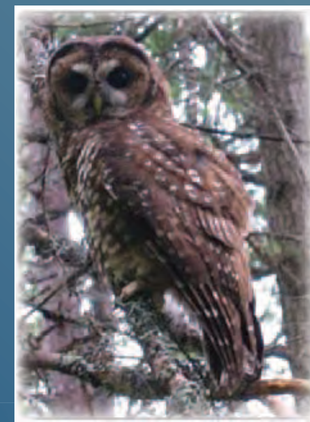
**Ensuring for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings**: Alternatives 2 - 4 would meet this CEQ criterion by minimizing impacts through implementation of mitigation measures, including impact avoidance and best management practices. Alternatives 2 and 3 would improve safety for employees, residents, and visitors to Lake Chelan NRA by relocating part of the road out of the floodplain / channel migration zone. Alternative 3, however, would have a shorter reroute and would remain partially within the floodplain / channel migration zone. Therefore, Alternative 2 would best meet this criterion.

**Attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences**: Beneficial uses in all alternatives would include ongoing residential, resource preservation, and recreational uses of the lower Stehekin Valley. Recreational uses would be broadest in Alternative 4, while protection of the Stehekin River floodplain / channel migration zone would be greatest in Alternative 2. Alternatives 2 - 4 would also increase the diversity of recreational experiences through new campgrounds (Alternatives 2 - 4) and a new raft takeout (Alternatives 2 and 4). The fewest new short-term impacts to existing resources would occur in Alternative 1. Safety improvements associated with the Stehekin Valley Road would occur in all alternatives. As noted above, Alternatives 2 and 3 would also have the greatest safety improvements from relocation of part of the Stehekin Valley Road out of floodplain. Overall, Alternative 2 best meets this criterion.

**Preserving important historic, cultural, and natural aspects of our national heritage and maintaining, wherever possible, an environment that supports diversity and variety of individual choice**: Although all alternatives would preserve historic and cultural resources, enhancement through interpretation would occur in Alternatives 2 - 4, which would best meet this criterion. None of the alternatives would affect portions of the Old Wagon Road eligible for the National Register.

**Achieving a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities**: The LPP revision implemented in Alternatives 2 - 4 would meet this CEQ criterion, because it would reduce the number of acres available for land exchanges and remove some sensitive lands still available in Alternative 1. Among Alternatives 2 - 4, Alternatives 2 and 3 would best meet this criterion because their intent is to remove development that is adversely affecting or could adversely affect the Stehekin River and its floodplain, but also its channel floodplain, but also its channel migration zone. They also would remove a portion of the Stehekin Valley Road within the floodplain / channel migration zone to higher ground. Private developments now threatened by the changing flood regime on the Stehekin River would be identified as high priority for exchange or acquisition, thereby allowing affected property owners a means to avoid future flooding impacts if they so choose.

**Enhancing the quality of renewable resources and approaching the maximum attainable recycling of depletable resources**: All Alternatives (1 - 4) would best meet this CEQ criterion because of the removal of the current maintenance facility and NPS housing from the floodplain and construction of new maintenance facility and housing on disturbed lands near the Stehekin Airstrip. These facilities would meet standards for LEED certification. Of these alternatives, Alternatives 2 and 3 would offer a slight advantage for this criterion because they would employ the least amount of imported resources, relying instead on the reuse of materials from within the proposed reroute areas.



# CHAPTER III:
## Affected Environment

# CHAPTER III: AFFECTED ENVIRONMENT

This chapter provides information about the Lake Chelan NRA environment, focusing on those resources that could be affected by the actions in the alternatives.

Among the resources included are land use, air quality, geologic hazards, soils, water resources (including hydrology and streamflow, water quality, floodplains, and wetlands), vegetation, wildlife, special status wildlife, archeological resources, cultural landscapes, visitor experience (including access and transportation, interpretation and education, visitor use opportunities, safety, and scenic resources), Wild and Scenic Rivers, park operations, socioeconomics, hazardous materials, and the following three topics required in environmental impact statements: unavoidable adverse impacts, relationship between short-term use of the environment and maintenance and enhancement of long-term productivity, and irretrievable and irreversible commitments of resources.

## A. INTRODUCTION

–Affected Environment” describes the resources of Lake Chelan National Recreation Area (Lake Chelan NRA), including those resources that are part of the North Cascades National Park Service Complex, that could be affected by implementation of the alternatives. The resource descriptions below serve as a baseline from which to compare the environmental effects, or impacts, of the management actions considered in this plan. The organization of this chapter is similar to the organization of the –Environmental Consequences” chapter.

## B. POTENTIALLY AFFECTED RESOURCES

## 1. LAND USE

The Stehekin Community is characterized by dispersed, low-density development, with higher-density clusters located at McGregor Meadows, along the Company Creek Road, and around the head of Lake Chelan. Development generally does not line the Stehekin Valley Road, rather it extends back from it, away from most areas seen by recreation area visitors (NPS 1995c:7). Of the federal lands, 50 acres were identified as available for exchange based on the 1995 Land Protection Plan (LPP).

Table III-1: *Land Ownership Changes in Lake Chelan NRA 1995 - 2010* compares landownership in Lake Chelan NRA between 1995 (when the LPP was written) and in 2008 upon embarking on this plan:

**Table III-1: Land Ownership Changes in Lake Chelan NRA 1995 - 2010**

| Owner | 1995 Acres | 2010 Acres |
|---|---|---|
| Federal (NPS and BLM) | 59,307.22 | 59,337.01 |
| State (submerged lands) | 2,020.00 | 1,994.43 |
| Chelan County Public Utility District (Chelan PUD) #1 | 249.43 | 198.94 |
| Stehekin School District | 3.20 | 3.20 |
| Private | 459.28 | 417.47 |

Note: The above numbers are the same as those contained in the 1995 and revised draft LPP.

Land use within the Stehekin Valley includes undeveloped federal and private land, agriculture land, rural residential private land, and some densely developed federal and private land. Other land uses include maintenance of the Buckner Homestead hayfield and pasture, some irrigated gardens, pastures and corrals, lands used for recreation (camping and hiking), and (as noted above), school district and Chelan PUD lands.

Human disturbance in the Stehekin Valley has been extensive. It includes selective and clear-cut logging, and clearing for development and agriculture, including National Park Service (NPS) administrative and private residential development. Recreation facilities include trails, bridges, camps, and a visitor center. Sixteen gravel pits were identified in the General Management Plan (GMP), but only the Company Creek Pit is active today. There are two main roads, with the Stehekin Valley Road extending 12 miles from Lake Chelan. The Company Creek Road extends from Harlequin Bridge for 3 miles up the west side of the valley. Lake Chelan floods the lower mile of the valley. The Silver Bay development is built on fill along the Stehekin River and Lake Chelan. An estimated 283 acres of land have been affected by development. This represents about 11.1 percent of the 2,543 acres in the lower valley not in wilderness (at the 1,640-foot contour). Approximately 188 acres of the developed land (66 percent) is within the riparian zone (NPS 1995a:184 and 187). An additional 1,400 acres of the valley have been impacted by the removal of snags and downed logs for firewood, for a total of 1,683 acres directly affected by human activities. If areas with past logging are added to this disturbance, approximately 2,253 acres, or 88 percent, of the Stehekin Valley has been directly or indirectly affected by human activities (NPS 1995a:187). These areas are slowly recovering and most are now second-growth forest.

**Photo 14 – Beaver Activity in Riparian Zone near Buckner Rock**

### Stehekin River Floodplain Development

Because development is generally limited to the relatively flat floor of the valley, much of it has occurred within the Stehekin River floodplain. The Stehekin Valley Road traverses the 100-year and 500-year floodplain in numerous locations (including at Mileposts 7.0 and 8.0 and McGregor Meadows) (see Figure II-5: *McGregor Meadows Reroute Map*). Numerous private homes and some administrative facilities are located within the 100-year floodplain / channel migration zone.

Only in a few areas, where development occupies old river terraces or higher parts of alluvial fans, is it likely to be safe from flooding. Elsewhere, various riverine processes such as bank erosion, sediment deposition, periodic channel shifts, and swift water during floods will continue to cause the river to change shape and location as it flows toward Lake Chelan. For approximately 3 miles of its 12-mile length through the lower Stehekin Valley, the Stehekin Valley Road is directly adjacent to the river or within its 100-year floodplain. These 3 miles and other locations on the Stehekin Valley Road are also within the Stehekin River “channel migration zone.” This is the area within which the Stehekin River has historically migrated during the last 1,000 years.

Stehekin Valley locations available for development are limited due to the steep valley walls and relatively confined nature of the valley. Ongoing threats to development include relatively rapid bank erosion, sediment deposition, periodic channel shifts, and swift water velocities. Floodplain conditions are summarized in Appendix 17: Draft Floodplains Statement of Findings, but along the road at McGregor Meadows and upper Company Creek, flood events that occur every few years can make the road impassible (see Appendix 17). Due to the recent changes in the floodplain and river channel process, floods occur more frequently at lower discharges at McGregor Meadows (Riedel 2004).

## 2. AIR QUALITY

Under the Clean Air Act, the Lake Chelan NRA is in a class II area, while surrounding North Cascades National Park and Glacier Peak Wilderness are class I areas. Although valley air quality is generally good, it is affected by pollutant discharges within and outside the Stehekin Valley. The area is fewer than 90 miles from the Seattle, Washington and Vancouver, British Columbia metropolitan areas. Prevailing wind patterns can bring pollutants such as ozone, sulfur dioxide, nitrogen oxides, mercury, and other metals as well as particulates into the area, where they are trapped by mountain valleys and concentrated in snowfall at high elevations. Pollution sources west of the watershed include automobiles, refineries, smelters, incinerators, power plants, and forest fires. These pollutants can cause impacts such as reduced visibility and acid rain (which may affect forest productivity, degrade surface water quality, affect amphibian reproduction, and cause damage to metal and painted surfaces). Recent analysis of snowpack indicates that pesticides from orchards in the Methow and Columbia valleys are being transported to the upper reaches of the Stehekin River watershed. Recent research by the U.S. Geological Survey (USGS) has documented elevated levels of mercury and organochlorine compounds in fish tissues from the park’s high-elevation lakes. Additional work is planned to determine the source of these contaminants (NPS 2009).

Pollutants from within the Stehekin Valley include negligible to minor emissions from auto exhaust, moderate localized outputs from diesel-powered generators at the valley’s small hydroelectric plant, particulate emissions related to travel by residents and visitors on numerous unpaved roads, and emissions from wood and pellet heating devices. Intermittent wildfires and prescribed burns and dust from the exposed mudflats at the head of Lake Chelan in spring can also degrade air quality.

The North Cascades National Park Service Complex is considered within an attainment zone for all ambient air quality standards. Air quality is very good, although it is periodically affected by the above-named sources of pollutants. Impacts to air quality, including smoke from nearby fires, usually dissipates rapidly with wind from the west, but lingers if winds are from the east, if there is a temperature inversion, or if there is no wind. Air quality-related values include human health, visitor enjoyment, scenic vistas, and the preservation of natural systems and cultural resources.

Deterioration of pristine air quality in the Complex is likely due to prevailing westerly winds that carry vehicle emissions and industrial and large urban area pollutants from Puget Lowland, and marine pollutants from the Puget Sound. Recent research also indicates that polluted air from Asia is transported across the Pacific Ocean and deposited in the Cascade Mountains, including the Stehekin Watershed. Currently, only visibility and acid rain are being monitored. Visibility cameras have recorded the presence of airborne particulate matter. A webcam view of the Picket Range from the North Cascades Visitor Center gives an hourly (real-time) perspective on visibility.

## 3. GEOLOGY

The northern portion of the Cascade Range is one of the youngest mountain ranges in the world, with dramatic geologic events continuing to occur, including active shaping and carving of the land by glaciers, water, and gravity. Approximately 316 glaciers cover about 30 square miles in the North Cascades NPS Complex.

The Stehekin River Valley is a classic example of a U-shaped glacial trough, formed during multiple ice ages. It is deeply incised into resistant bedrock, with steep valley walls that carry snow avalanches and debris torrents. The valley floor is broad and flat, and reaches 1.8 miles in width at the head of Lake Chelan. Narrow winding river canyons characterize lower Agnes and Bridge creeks and the Stehekin River from High Bridge to Park Creek. The summit of McGregor Mountain, at 8,122 feet above mean sea level (amsl), stands nearly 7,000 feet above the lower Stehekin Valley, east of High Bridge (NPS 2005b).

The Stehekin Valley is located in the Chelan Mountains terrane, an area bounded by faults that has a distinct bedrock geology and history from adjacent areas. This terrane contains rocks that originated both from the ocean and from volcanic activity. Through intense heat and pressure (metamorphosis) these former oceanic rocks have recrystallized into the metamorphic Skagit Gneiss, which is the primary bedrock in Lake Chelan NRA. Sedimentary and volcanic rocks were also metamorphosed into mica schists. In many places these older metamorphic rocks were intruded by younger granite.

The Stehekin Valley is carved out of the Skagit Gneiss complex, known as the crystalline core of the North Cascades. These quartz- and feldspar-rich rock types provide abundant amounts of sand and gravel to the Stehekin River system. Relief within the watershed varies from 9,511 feet amsl at Bonanza Peak to a low of 350 feet below mean sea level in Lake Chelan, making the valley one of the deepest gorges in the world. Ice age glaciers created most of this relief by erosion of hard crystalline rocks.

Although the valley walls of the lower Stehekin were over-steepened by glaciers, the competency of Skagit Gneiss has allowed the remarkable development of the Lake Chelan basin. Thirteen large landslides have been mapped by the NPS in the entire Stehekin watershed within North Cascades National Park and Lake Chelan NRA. Eight of these landslides have delivered sediment directly to major tributaries of the Stehekin River. However, the Agnes Creek watershed has not been examined for mass movements to date.

The trend of the Stehekin River follows the northwest-southeast alignment of most major faults and valleys in the region. However, geologist do not think the Stehekin River exploited this structural grain, rather it is thought that the Stehekin River was superimposed on the crystalline core of the range as the North Cascades were uplifted.

Below High Bridge, the Stehekin River and Agnes Creek emerge from deep box canyons into the broad lower Stehekin Valley (Figure III-1: *Stehekin River Watershed* and Figure III-2: *Lower Stehekin Valley Landforms above Harlequin Bridge*). This part of the valley was glaciated by both alpine glaciers and the massive Cordilleran Ice Sheet. During multiple ice ages these glaciers created the valley's characteristic U shape, straight profile, and flat valley floor. On the southwest side of the valley, glaciers from the last ice age left a long, lateral moraine feature 14,000 years ago that can be traced from the Stehekin Valley Ranch to the Orchard (Figure III-2).

As they flowed down the Lake Chelan trough and encountered weaker bedrock, the glaciers eroded the floor of the lake valley to a depth more than 2,000 feet below mean sea level. The modern floor of Lake Chelan is covered in a blanket of glacial sediment 1,700 feet thick, which thins to a few hundred feet where the Stehekin River meets the lake. Thus, the bedrock floor of Lake Chelan is about 2,000 feet below mean sea level.

The Stehekin River channel in the lower valley above the orchard is incised 10 - 15 feet within sand and gravel terraces. Extensive alluvial fans deposited by major tributaries Company, Boulder, and Rainbow Creeks define the area in which the Stehekin River has meandered. The alluvial fans themselves have older upper terrace surfaces that have presumably not been affected by flooding for a very long time, and represent appropriate sites for development to avoid flooding from the river or its tributaries.

The fan terraces grade to elevations more than 20 feet above the modern floodplain, when the level of Lake Chelan was higher following the end of the last ice age. Thus, base level for the lower Stehekin Valley decreased until 1902, when Chelan PUD raised the level of the lake 20 feet with a hydroelectric dam. The backwater effect of the lake is discussed below. The base level of the river above Buckner Homestead hayfield and pasture may be bedrock controlled. The river channel at this site is currently superimposed across a bedrock valley spur known as Buckner Rock (Figure III-3: *Lower Stehekin Valley Landforms below Harlequin Bridge*).

At the end of the last ice age, about 12,000 years ago, Lake Chelan covered the lower valley to High Bridge and had a surface elevation near 1,700 feet. Erosion at the south end of the lake at the outlet lowered the lake surface to about 1,200 feet by 9,000 years ago. Below the orchard, the lower valley is underlain by a thick silt and clay layer that represents the former bed of Lake Chelan. Evidence uncovered by the NPS indicates that the Stehekin River met Lake Chelan just below Buckner Homestead hayfield and pasture 9,000 years ago. NPS tract #05-107 cabins sit on a layer of thick gravel over fine sand and silt that was the river delta at that time. Downvalley of the delta deposit, the silt and clay from deeper parts of the former lake bed are exposed near the surface in low-lying areas near the river, and at depths of 25 - 30 feet, as documented in well logs from sites on the Boulder Creek and Rainbow Creek fans. The presence of this layer probably limits stream gradient in the lower valley.

There is a pronounced asymmetry in the geomorphology of the lower Stehekin Valley due to the extreme northeast-southwest faces of the valley walls (Figure III-3: *Lower Stehekin Valley Landforms below Harlequin Bridge*). The hot, dry north side (southwest facing) of the valley is characterized by steep streams that are known to carry debris flows to the valley floor. The small, steep streams are also prone to flooding caused by isolated summer thunderstorms. In contrast, forest cover is thicker on the northeast facing side of the valley, and runoff is generally less flashy.

While the North Cascades mountains continue to rise, earthquakes in the area are infrequent. The largest event on record was the 1872 earthquake. Although the epicenter of this event is unknown, it is believed to have occurred somewhere near Chelan (Baukun et al. 2002). Smaller quakes occur on the order of one every few decades, with the most recent an earthquake in January 2007 in the Bridge Creek Watershed.

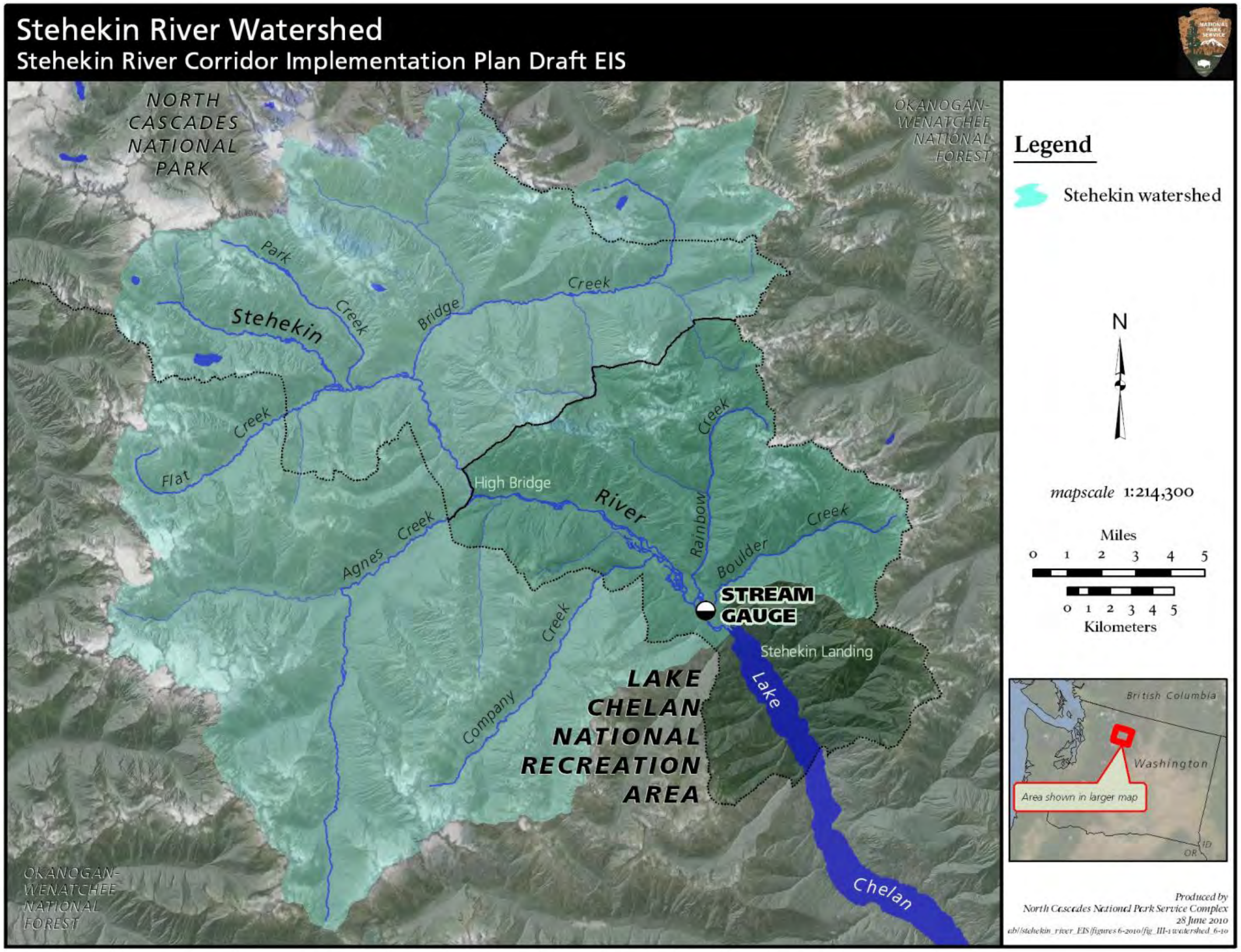



**Figure III-1: Stehekin River Watershed**

(Note location of stream gauge above Lake Chelan)

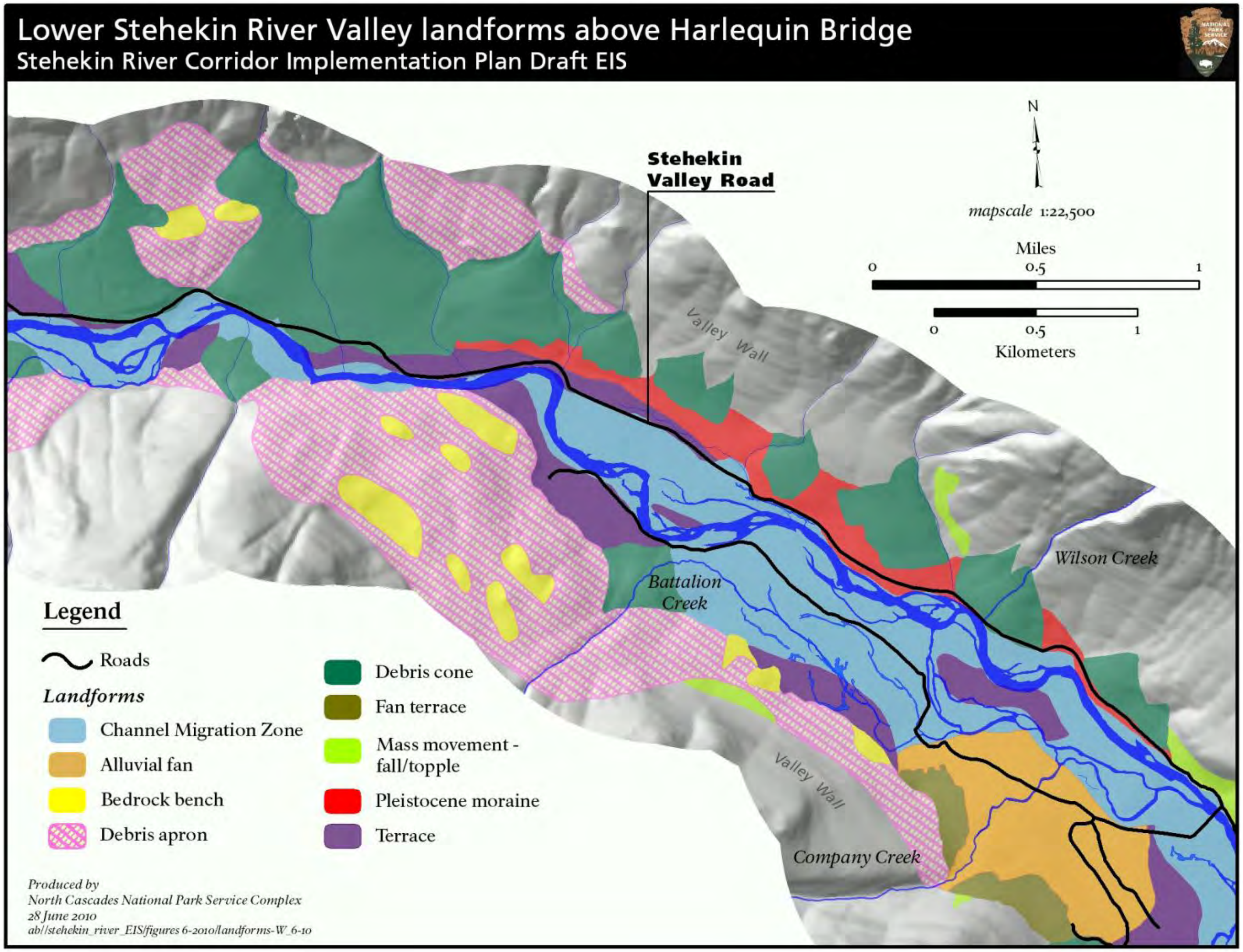



**Figure III-2: Lower Stehekin Valley Landforms above Harlequin Bridge**

(Note the orange colored alluvial fans built by tributary streams and purple colored terraces above the floodplain)

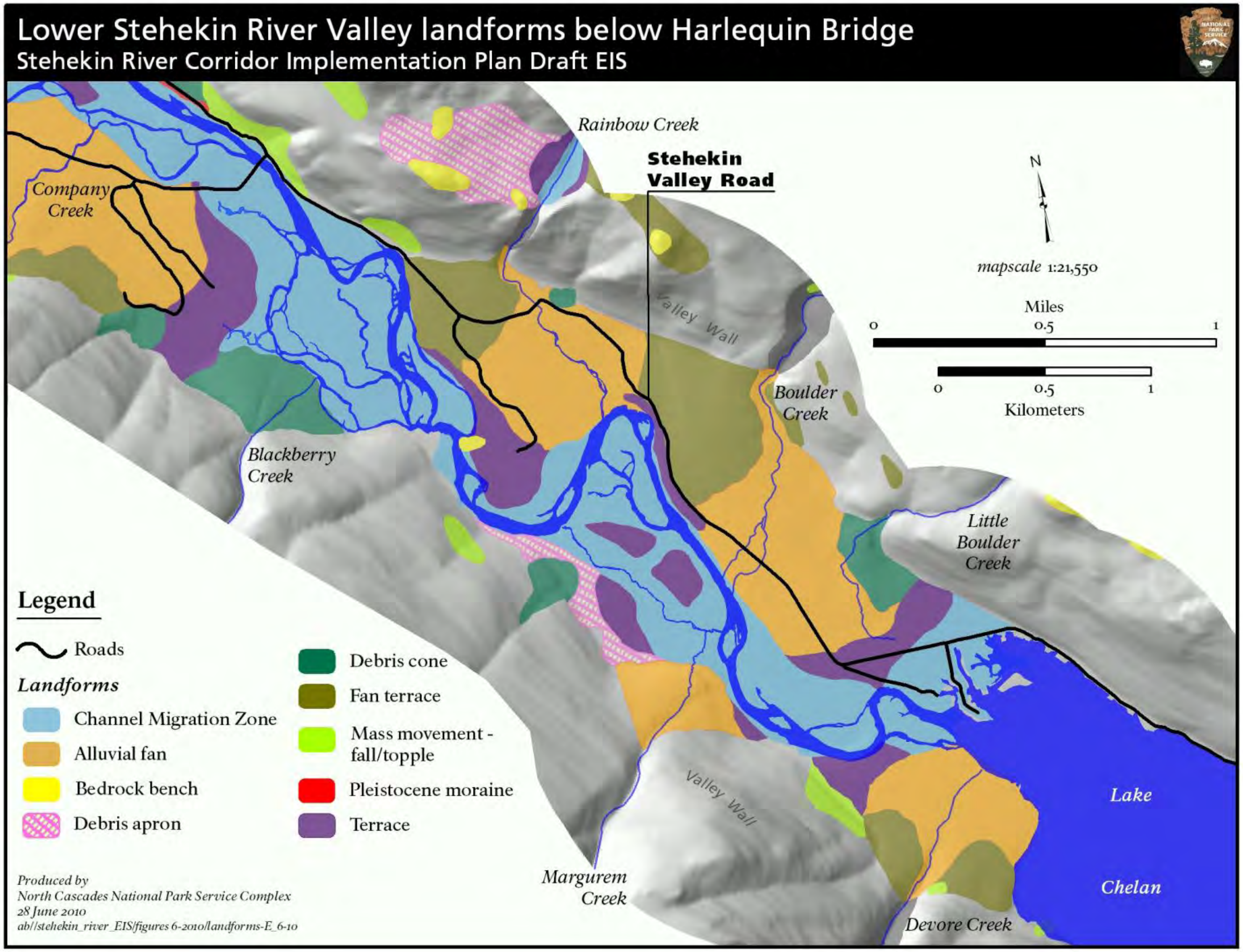



**Figure III-3: Lower Stehekin Valley Landforms below Harlequin Bridge**

# 4. SOILS

Uplift and metamorphism of the North Cascades and repeated, intense glaciation during ice ages have created the topography of the Stehekin Valley. Several very active processes continue to shape the landscape, including glaciation, landslides, and flooding. Major soil orders in the valley include Entisols, Inceptisols, Spodosols, and Andisols. Soils in the Stehekin Valley are generally fairly young, shallow, and coarse grained, having developed from sand and gravel deposited by streams, glaciers, and gravity. They also lack cohesion and, if sandy, are prone to rapid rates of erosion and resistant to compaction. Entisols (young, poorly developed soils) may support plant growth, but have little horizon development. Inceptisols have some subsoil development but are generally noncohesive (loose, with little clay), subject to rapid rates of erosion, and low in organic matter. Spodosols occur on older stable landforms at higher elevations. Andisols form in soils with high amounts of volcanic ash. They are fine grained, and prone to rapid erosion (NPS 2005b).

The steep valley walls are covered with varying amounts of glacial sediment, talus, bare rock, colluvial (slope) deposits, and volcanic ash. Most soils are Entisols and Andisols, although some flat bedrock benches can have soil crusts. The Stehekin River is largely responsible for the distribution of soil types on the valley floor. The movement of the river and its tributaries erodes and deposits sediment, creating floodplains and terraces. The age, texture, and topography of these features characterize the type of soil development. Most soils in the floodplain are Entisols and Inceptisols, but their sensitivity to disturbance varies widely.

Soils previously identified in the valley include the Stapaloop and Goddard series. These Entisols formed in recent Stehekin River and large tributary deposits. Stapaloop series soils are very deep, well-drained soils formed in old flood deposits in forests and can have a component of loess and volcanic ash in the surface (NPS 2005b).

# 5. GEOLOGIC HAZARDS

Geologic hazards present in the Stehekin Valley include those associated with flooding along the Stehekin River and debris torrents on tributary streams. When these streams reach the flat floor of Stehekin Valley, they deposit ―debris cones.” Alluvial fans form where larger tributaries meet the Stehekin, but these landforms are not as hazardous as debris cones. In general, debris cones can be distinguished by having slopes greater than 10 degrees, while alluvial fans have slopes less than 5 degrees. Steep slopes contribute to snow avalanche and rockfall hazards. Instability of unconsolidated glacial and valley wall deposits occurs where they are undercut by the river.

Debris cones form over time by the rapid mass movement of boulders, mud, and trees during heavy rain, and especially where landslides or fire have removed vegetation in the upper portion of a steep stream channel. Wilson Creek is an example of an active debris torrent system, when debris has been recently transported down a steep, straight valley and a deep river canyon, to the valley bottom. In contrast, larger Boulder, Rainbow, and Company creeks have formed alluvial fan deposits where they reach the flat valley floor. Several factors influence the activity of debris torrents, including slope, faults, or bedrock weakness and vegetation disturbance.

Similar to river channels, alluvial fans have a migration zone, in which the stream is most active. The unstable areas of the major alluvial fan terraces (Boulder, Company, and Rainbow Creeks) have been identified. Older portions of these fans are more stable than the fan migration zone and have been identified in the Stehekin River Corridor Implementation Plan action alternatives and revised LPP (NPS 1995b) as suitable for relocation of some development out of the floodplain.

Snow avalanches and rock falls are common along the steep walls of the Stehekin Valley and off the unstable edges of river or glacial terraces. Talus slopes, such as the one near Harlequin Bridge, are actively accumulating rocks from cliffs above.

Potential geologic hazards within the Stehekin Valley exist at the following locations within the proposed project area:

- Alongside steep valley slopes on the edge of the moraine at McGregor Meadows
- Rock falls at Milepost 8.0, where the Stehekin Valley Road cuts across a glacial moraine studded with boulders
- Rock fall hazards off the steep valley side walls in Alternatives 2 and 3 along the reroute, at Frog Island, and along the lakeshore
- Debris cones along the reroute proposed in Alternatives 2 and 3 and at Wilson Creek
- Existing portions of the Stehekin Valley Road and Company Creek Road along the main channel and in the lowest parts of the floodplain.

# 6. WATER RESOURCES

Note: See also Chapter I: Purpose of and Need for Management Action, ―Background" section

## Overview

The Stehekin River is the focal point of Lake Chelan NRA. The river drains 220,000 acres (344 square miles) of mostly public and undeveloped land in the rugged Glacier Peak Wilderness Area, Lake Chelan NRA, and North Cascades National Park. Most of the watershed is comprised of designated wilderness. Major tributaries to the Stehekin include Bridge Creek, Agnes Creek, Company Creek, Rainbow Creek, and Boulder Creek (Riedel 2007) (Figure III-1: *Stehekin River Watershed*).

The Stehekin River's headwaters rise from glaciers located along the Pacific Crest of the Cascade Range. Approximately 103 small glaciers cover about 3 percent of the watershed, but provide as much as 15 percent of runoff during the dry summer months, or 21 billion gallons (Post et al. 1971). Most glacial meltwater comes from the mainstem Stehekin River and Agnes Creek, which contains the largest glacier in the watershed (1.8 square miles), the Chickamin Glacier (Riedel 2007).

Because the river's headwaters originate near Cascade Pass along the Pacific Crest, it receives the heavy precipitation characteristic of the west side of the Cascades. Steep slopes, a dense network of steep tributary streams, the location of the river's headwaters along the Pacific Crest, and the circular shape of the watershed contribute to the frequent and rapid rise of floodwaters in the lower valley.

**Photo 15 – Deep pool on Stehekin River at Buckner Rock**

## a. Climate

The Stehekin watershed climate varies by elevation and distance from the Pacific Crest. The North Cascades create a strong rain shadow on the leeward (east) side of the range. The Stehekin Valley climate is generally characterized as continental, with cold, wet winters and hot, dry summers. Prevailing westerly winds bring a steady winter flow of storms and precipitation from the Pacific Ocean (see Table III-2: *Stehekin Average Temperature and Precipitation*). High-elevation headwater areas along the crest receive about 150 inches of precipitation a year, including approximately 20 - 30 feet of snowfall. At the opposite extreme, at the low-elevation eastern end of the watershed in Stehekin, annual rainfall is about 35 inches. Most of the precipitation within the watershed falls as snow between November and March, with average annual snowfall at Stehekin 10.3 feet.

**Table III-2: Stehekin Average Temperature and Precipitation**

| Measurement | Minimum | Maximum |
|---|---|---|
| Extreme annual temperature (2 years in 10) | −6°F | 100°F |
| Average daily winter temperature range | 24.6°F | 35.4°F |
| Average daily summer temperature range | 50.8°F | 79.4°F |
| Extreme annual precipitation (2 years in 10) | 24.0 in. | 42.7 in. |
| Average annual monthly precipitation range | 0.5 in. (Jul) | 6.6 in. (Dec) |

Source: NPS 1995a:200

Lake Chelan is a natural lake, 50 miles long and 1,500 feet deep, with a variable width of about 1.2 miles. The upper 4 miles of Lake Chelan are in Lake Chelan NRA. The dam raised the water level in the lake by 21 feet, giving it a full-pool surface elevation of approximately 1,100 feet amsl. Even without the dam impoundment, Lake Chelan is one of the deepest lakes in North America. Lake levels fluctuate seasonally, with an average drawdown of 18 feet by late winter / early spring to accommodate snowmelt for hydropower generation. Full pool usually occurs in late July (NPS 2008b:151). A 2001 study indicates that at full pool, Lake Chelan's backwater effect extends at least 0.25 mile upstream (Chelan PUD 2001b).

## b. Hydraulics and Streamflow Characteristics

***RIVER CHARACTERISTICS***

**Main Channel**: The channel currently occupied by the main body of a river, with the fastest, deepest water.

**Side Channel**: Channels peripheral to the main channel that may or may not have flowing water in them at all times. Side channels can also be abandoned main channels.

**Reach**: The length of a stream channel that is uniform with respect to discharge, depth, area, and slope; also the length of a stream between two defined stations.

**Gradient**: Degree of inclination of the part of the earth"s surface; steepness of slope. Gradient may be expressed as a fraction, ratio, percentage, or angle.

**Sinuosity**: A quantifiable value to measure the degree to which a river channel meanders.

**Bankfull Stage**: The elevation of the water surface of a stream flowing at channel capacity.

***TOPOGRAPHIC FEATURES***

**Alluvial fan**: A gently sloping deposit of sand and gravel left by a stream. Viewed from above, it has the shape of a fan.

**Debris Cone**: A deposit with a shape like a fan, steeper than an alluvial fan, that is formed by active debris torrents and flooding.

**Lateral Moraine**: A low ridge deposited along a mountain glacier, composed of a wide range of material from silt to large boulders.

***CHANNEL CHARACTERISTICS***

**Substrate**: Gravel and cobbles on the bed of a stream that provide habitat for some organisms.

**Riffle**: Part of a stream where water flows over a gravel bar, with gradients usually between 1 percent and 3.5 percent.

**Pools**: Deep sections of a river channel between riffles and near logjams or larger rocks, with gradients usually under 1 percent. Pools are important habitat for river life during storm events.

Floods can occur at several times a year on the Stehekin River. Summer flooding occurs during thunderstorms and associated periods of intense rainfall. These floods usually affect small areas. Spring floods occur in May or June during peak snowmelt. The magnitude of these floods varies, depending on the depth of winter snowpack and spring weather (precipitation, freezing level, and temperature). Spring floods can persist for weeks, with river level fluctuating in response to daily cycles of snowmelt. Fall and early winter floods are larger than spring floods, but usually pass within a few days. These occur during heavy rainfall and are usually associated with unusually warm temperatures (high-elevation freezing levels) and a preexisting snowpack (rain-on-snow events) (NPS 2008b:152).

The geology and shape of the Stehekin River watershed contributes to the valley's frequent and large floods (see Figure I-7: *Magnitude and Timing of the Annual Peak Flood on the Stehekin River*). Resistant bedrock, steep slopes, and a well-developed drainage network feed rain and snowmelt water rapidly to trunk streams. The three main branches of the Stehekin River join within 5 miles, bringing floodwaters together in deep bedrock canyons that deliver the floods rapidly to the lower valley, along with large amounts of gravel and large woody debris.

The floods of 1995, 2003, and 2006 were fall rain-on-snow floods. Unlike the 1995 and 2006 events, which took weeks to build, the 2003 event happened in 10 days and occurred early in the flood season, on October 20.

Like their drier eastside counterparts, the Stehekin River and its tributaries also flood during periods of rapid snowmelt in May and June. The fourth-largest flood on record was a spring flood that occurred in 1948, with a peak discharge of 18,900 cubic feet per second (cfs). The largest spring floods occur when an above-average snowpack persists late into the spring and is melted rapidly by high temperatures. The average spring flood on the Stehekin River is about 9,000 cfs. The large 1997 spring flood had several peaks above 10,000 cfs and persisted into July.

Eastern Stehekin River tributaries (the sources of which are mainly east of the Pacific Crest), including Bridge, Rainbow, and Boulder creeks, are currently dominated by spring snowmelt floods. In fact, none of these tributaries underwent substantial flooding in 1995, 2003, or 2006, and the flood of record for these streams remains the spring 1948 event. Current weather patterns appear to have moved the Stehekin River's flood hydrology toward smaller spring snowmelt floods and larger, more frequent fall rain-on-snow floods.

Small, steep, first- and second-order tributaries in the valley are prone to flash flooding in summers as a result of intense convective precipitation. Those streams in southwest-facing valleys in the lower Stehekin Valley are particularly prone to debris torrents triggered by heavy rainfall.

### Flood Magnitude and Frequency

The Stehekin River has been gauged almost continuously since 1911 by the USGS (#12451000). The flood history on the river contains both fall rain-on-snow and spring snowmelt floods. Until 1995, the largest flood on record was the 1948 spring event, and six of the seven largest floods occurred during the spring. On November 29, 1995, a flood equaling the 1948 event passed down the Stehekin River. It was followed by large spring floods in 1997 and 1999, and two large fall floods in October 2003 and November 2006.

The 2003 event had a peak discharge of 25,600 cfs, and is estimated to have only a 1 in 500 chance of occurring in any given year (see Table III-3: *Comparison of Two Methods for Estimating Flood Frequency and Magnitude on the Stehekin River*). It is by far the largest flood on record for the Stehekin River, with a discharge about 30 percent greater than any other large flood since 1911. The 2003 flood was not the flood of record on the adjacent Skagit, Methow, or Entiat Rivers, underscoring the flood-prone nature of the Stehekin River.

**Table III-3: Comparison of Two Methods for Estimating Flood Frequency and Magnitude on the Stehekin River**

| Recurrence Interval (probability in given year) | Discharge (cfs) for Combined Fall and Spring Floods (85 events) | Discharge (cfs) for Spring Floods Alone (70 events) | Discharge (cfs) for Fall Floods Alone(16 events) |
|---|---|---|---|
| 10 years (0.1) | 14,950 | 13,740 | 21,360 cfs |
| 20 years (0.04) | 17,560 | 15,100 | 26,220 cfs |
| 50 years (0.02) | 19,490 | 16,190 | 29,850 cfs |
| 100 years (0.01) | 21,400 | 17,910 | 33,490 cfs |

Note: This approach is used to analyze flood records with mixed fall and spring floods.

Given the narrow box canyons on lower Stehekin River and Agnes Creek, it is possible that failure of a temporary debris dam in the canyons led to the high peak discharge. Review of available satellite Landsat images and inspection of the Stehekin River canyon above High Bridge did not reveal any evidence of a temporary dam. However, undercutting of a 50-foot-tall bank 4 miles above High Bridge and evidence of very high water near Tumwater Bridge 2 miles downstream may support the inference of a debris dam.

A research project written for the relicensing of the Lake Chelan Hydroelectric Project has added some perspective to understanding Stehekin River hydrology. In 1999 Bob Jarret of the USGS estimated the largest possible flood on the Stehekin River at 36,000 cfs, considerately larger than the 2003 event. This estimate, however, is based on geologic data and should be considered a first-order estimate. Further, it is possible that a flood of this magnitude occurred many thousands of years ago under different climatic conditions, or that it was related to a debris dam burst event. The other large floods on the Stehekin River since 1911 are given in Table III-4: *Chronology and Features of the 10 Largest Floods on the Stehekin River*. This table also shows the likely reoccurrence interval of these floods based on data recorded at the gauge between 1911 and 1917 and 1927 and 2007.

**Table III-4: Chronology and Features of the 10 Largest Floods on the Stehekin River**

| Date | Flood Type | Discharge (cfs) | Recurrence Interval |
|---|---|---|---|
| October 20, 2003 | Intense rainfall and rain on snow | 25,600 (estimated) | Probability 0.01 |
| November 29, 1995 | Rain on snow | 20,900 | 100 years |
| November 07, 2006 | Rain on snow | 19,100 | 100 years |
| May 29, 1948 | Snowmelt | 18,900 | 100 years |
| November 07, 1948 | Rain on snow | 18,400 | Probability 0.02 - 0.04 |
| December 26, 1980 | Rain on snow | 17,300 | Probability 0.02 |
| June 16, 1974 | Snowmelt | 16,600 | Probability 0.04 |
| November 24, 1990 | Rain on snow | 14,700 | 10 years |
| June 02, 1968 | Snowmelt | 14,400 | 10 years |
| June 10, 1972 | Snowmelt | 14,400 | 10 years |
| June 21, 1967 | Snowmelt | 13,900 | Probability 0.1 |

Passage of the large floods in 1995, 2003, and 2006 has shifted the magnitude-frequency relationship toward larger, more frequent floods. This coincides with a general shift in the late 1970s from a spring snowmelt-dominated system to one dominated by fall and early winter rain-on-snow flooding (see Figure I-7: *Magnitude and Timing of the Annual Peak Flood on the Stehekin River*). The shift to a fall rain-on-snow-dominated flood regime on the Stehekin River means that events like those in 1995 and 2006 may be typical for this system in the foreseeable future. Jarret (1999) noted that probable maximum floods on west-slope Cascade streams are larger than their eastside counterparts. How far the Stehekin River watershed moves toward a west-slope-type flood system remains to be seen. Considering the flood-prone nature of the Stehekin system, a shift toward larger, more frequent fall flooding, and channel changes caused by the three large recent fall floods underscores the need for careful land use planning.

## Stehekin River Floodplain and Channel Migration Zone

Floodplains are a very important component of a river. They slow and disperse the energy of floodwaters, providing diverse habitat for wildlife and plants that thrive on flood disturbance. Large woody debris and variably textured river sediment collects in floodplains, increasing biodiversity. As described in the Lake Chelan NRA GMP/EIS (NPS 1995a), the floodplain performs several important functions, including (1) conveying and storing floodwater, (2) storing river sediment, (3) supporting a variety of plants that provide food and habitat to a rich diversity of wildlife species (large floods may scour out an area exposing spawning gravels for fish, or conversely may pile up logs and woody debris and form a logjam that becomes cover for fish and other wildlife), and (4) groundwater recharge.

The Stehekin River's floodplain and existing and former flood channels comprise much of the valley floor. The 100-year floodplain of the Stehekin Valley has been mapped by FEMA and later by the NPS based on a one-dimensional hydraulic model (Riedel 1993 Stehekin Floodplain Mapping Project NPS 1993b) (Figure III-4: *Channel Migration Zone in the Lower Stehekin Valley*). Over time, the river has occupied most of the valley floor, defining the channel migration zone, although tributary alluvial fans and terraces stand above the modern floodplain.

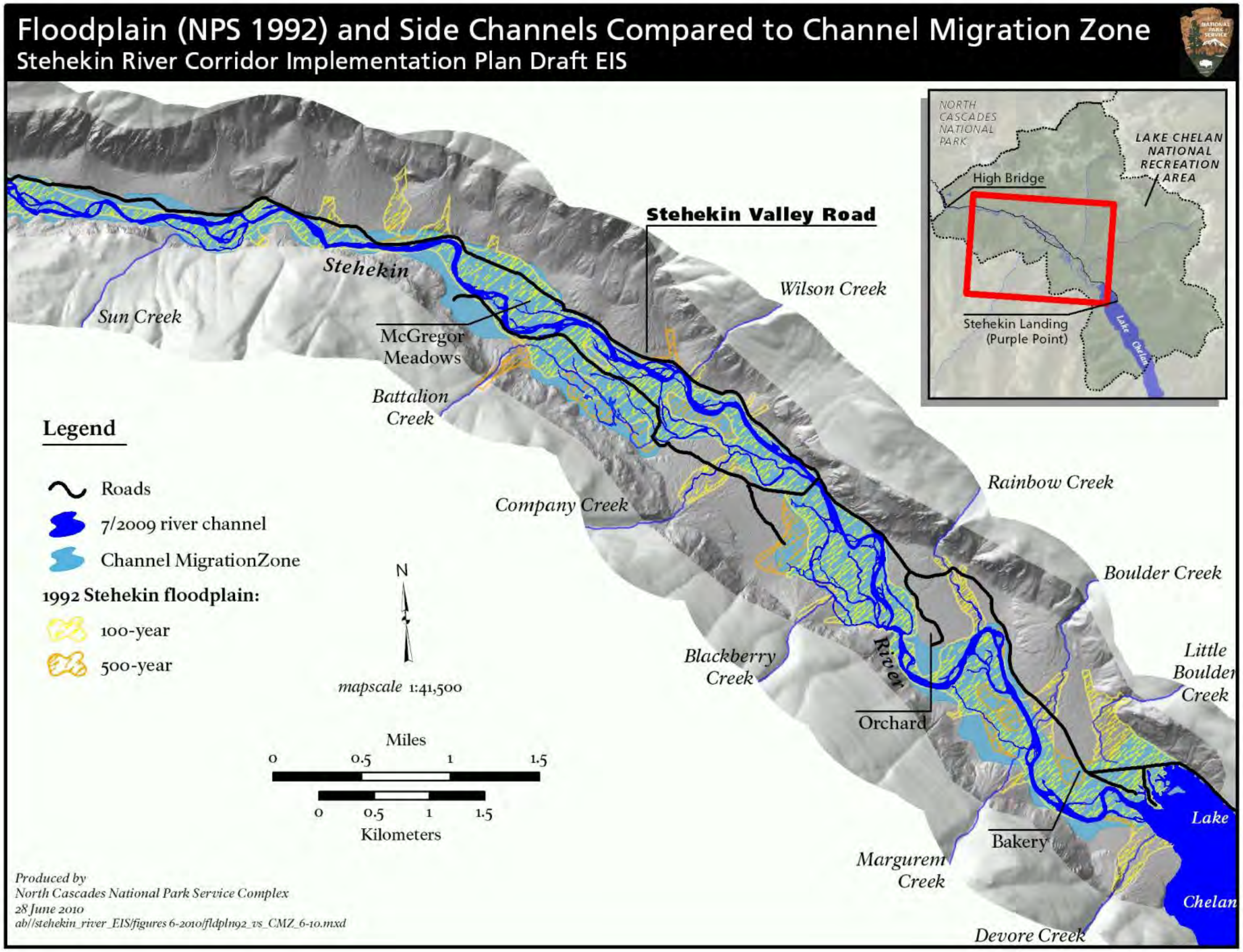



**Figure III-4: Channel Migration Zone in the Lower Stehekin Valley**

Movement of the Stehekin River across its floodplain will continue to occur, with the passage of floods and the temporary storage of gravel and large wood causes the river to change course. The pattern of depositional (unstable) and transport (stable) zones is clear in the landforms maps, and is confined in the gravel and large wood surveys described below. It is a natural occurrence for the river to produce flows that cannot be contained within its stream channel. During flood events, the river jumps out of its channel and flows relatively slowly at shallow depths through the floodplain. Large floods, sediment movement, and the presence of semi-stable large woody debris make the channel and floodplain ever-changing.

River channel patterns in the lower Stehekin Valley are variable. The Stehekin River is generally a single channel with stable side channels and islands. In some places it becomes wider and can have multiple braided channels, or wide meanders. Areas of sediment storage in the lower valley are marked by channel instability and wide floodplains. These deposition zones occur at McGregor Meadows where the valley width increases threefold, where the river meets the lake, and between the alluvial fans. Between deposition zones, the floodplain and river channel are relatively narrowed on the upstream edge of the three alluvial fans. Within these areas the channel is stable, and there is relatively little storage of wood, gravel, or water within these transport zones.

For the period of record, mean monthly low flows (i.e., base flow) ranged from approximately 400 to 600 cfs. During summer, glacial melt buffers what would otherwise be lower flows for the Stehekin River.

The estimated discharge of flooding has been calculated for the Stehekin River for the 10-, 50-, 100-, and 500-year floods. Frequency estimates are based on the log-Pearson Type III analysis by the USGS Water Resources Division (NPS 2005). Recent flooding on the Stehekin River has caused major changes in the river channel and its floodplain. Flooding of some areas is now occurring during lower flow conditions because of where the river is located in the floodplain and because of gravel accumulation in the channel. Ongoing bank erosion, as the river occupies new or former parts of its floodplain, as well as periodic mass wasting events (landslides) and loss of portions of the Stehekin Valley Road have contributed to this naturally high sediment load.

### Sediment Movement and Storage

The annual total sediment load that the Stehekin River has been estimated to carry is approximately 25,000 cubic yards per year. The amount and size of material carried by the Stehekin River varies considerably. Massive quantities of small boulders are carried in some river reaches during floods, while the river transports little sediment during low-flow periods. During floods, the river moves large quantities of gravel in waves.

While modern glaciers cover but a small fraction of the Stehekin watershed, extensive deposits were left by ice age glaciers between 30,000 and 12,000 years ago. These deposits are as much as several hundred feet deep in the wide, upper parts of the watershed. Some of these deposits are perched adjacent to the channel and active floodplain. Together with gravel produced by steep tributary streams and landslides, the glacial gravels introduced by bank erosion during modern floods contribute to the gravel load of the Stehekin River and river channel instability in the lower valley. Identified large glacial gravel sources include the Shady Slide 1 mile below the mouth of Bridge Creek and the Cottonwood Terrace 8 miles above Bridge Creek. With the exception of numerous river-cut banks in the lower valley below High Bridge, all of the major gravel sources are in designated wilderness. The load of the Stehekin River undergoes a dramatic transition in the lower valley, changing from cobbles and boulders near McGregor Meadows to pebbles, gravel, and sand within 8 miles, at its margin with Lake Chelan.

Sediment transported through the bedrock-walled Stehekin and Agnes gorges above High Bridge is stored at various points in the lower valley. Major points of deposition include areas where valley width increases, such as McGregor Meadows, and between the large alluvial fans of Company, Boulder, and Rainbow Creeks. In the McGregor Meadows area above the logjam, it is estimated at about 44,000 cubic yards of gravel were deposited by floods between 1986 and 2007 (see Appendix 18: Estimates of Gravel Accumulation in Two Reaches of the Stehekin River). Another major sediment deposition / storage point is where the river enters the slack-waters of the lake.

Changes in the size of the gravel mirror changes in the gradient of the channel profile. At its confluence with Agnes Creek, the Stehekin River gradient is about 80 feet per mile. Above McGregor Meadows, the river moves cobbles and small boulders along its bed, and its gradient is approximately 50 feet per mile (1 percent). By the time it reaches Lake Chelan, 7 miles downriver, the gradient decreases to about 25 feet per mile (0.5 percent) and the bed load is sand and pebble gravel. Within straight, narrow reaches in the lower valley, including between river kilometers 2 - 3, 6 - 7, and 11 - 12, the Stehekin transports clasts with median diameters of 38 - 64 inches. These areas correspond with the more stable channel zones described above and the wood transportation zones discussed below, while areas of smaller-diameter gravels correspond with areas of increased floodplain and channel width and wood storage zones. At finer scales of resolution, pockets of sand are found in pools and near logjams.

Large bed load, rapid sediment movement during floods, and rapid changes in stream capacity to move material of different sizes create instability in the deposition zones of the lower Stehekin River channel. Often, coarse material deposited during a large flood is abandoned by the river as it erodes into finer-grained material. Coarse gravel deposits often form the core of a building river terrace. This often leads to bank erosion in reaches that are characterized primarily by channel deposition.

Several studies have attempted to estimate the amount of sediment that the Stehekin River moves annually. In a survey of sites in the upper Columbia River basin of Washington State, Nelson (1974) estimated annual suspended sediment load on the Stehekin River (silt, clay, and fine sand) at 19,400 cubic yards per year, which was comparable to the Methow River near Pateros. Nelson measured suspended load concentration as high as 22 milligrams/liter during a 7,000 cfs flow event on the Stehekin River in June of 1970; however, he did not attempt to measure the total load of the river (bed load and suspended load).

In 1999, the NPS used growth of the delta from Buckner Homestead hayfield and pasture to the Landing over a 9,000-year period to estimate mean annual total sediment yield at 25,000 cubic yards. This estimate does not include silt and clay carried deeper into Lake Chelan and not deposited on the pro-grading delta. Considering the indirect method of measurement used by the NPS, the 25,000 cubic yard per year estimate should be viewed as a first-order approximation. Whether the actual value is significantly lower or higher, the amount of sediment the Stehekin River moves is impressive, and comparable to other large rivers in the Pacific Northwest (Table III-5: *Comparison of Stehekin River Sediment Yield*).

The bedload (gravel) component of steep rivers such as the Stehekin is typically greater than 11 percent (Schumm 1963, 1977). Use of the total and suspended load estimates given above indicate that the bed load of the Stehekin River comprises about 17 percent of the total load, or 5,600 cubic yards per year. Annual bed load volume probably varies by 50 percent or more, with larger quantities of sediment moved during large flood events.

**Table III-5: Comparison of Stehekin River Sediment Yield**

(With estimates on other rivers in the Pacific Northwest, in the U.S. and the world)

| River System | Load Type[a] | Sediment Load ($yd^3/mi^2/yr$) |
|---|---|---|
| Stehekin | Total | 28 |
| Skagit[b] | Bed | 12 |
| Columbia - North Pacific[c] | Total | 340 |
| Rocky Mountain region[d] | Total | 84 |
| Sierra Nevada[d] | Total | 410 |
| Coast Range, Oregon[d] | Total | 207 |
| Amazon[e] | Total | 58 |
| Mississippi[e] | Total | 207 |

[a]Load types include dissolved, suspended, bed, and total.
[b]Stewart and Bodhaine 1961.
[c]U.S. Water Resources Council 1968; average sediment yield for drainage areas <100 miles$^2$.
[d]Geiger 1958; sediment yield from studies of reservoir deposits in small watersheds.
[e]Sundborg 1983.

Considering a relative lack of change in the position of the channel at the river mouth and other important locations, it appears that much of the gravel was being transported through the lower Stehekin Valley prior to deposition of the massive 2003 flood gravels. Comparisons of channel surveys in 1978, 2000, and 2009 show that channel changes at the river mouth were relatively small. Gravel bars have grown, increasing river meandering and bank erosion, but the elevation of the river bed has not increased.

## Large Woody Debris Accumulation

Due to its relatively wet climate, the Stehekin carries an unusually large amount of large woody debris for an eastside watershed. Logjams form in several locations along the Stehekin River, including at the entrances to side channels, on mid-channel gravel bars, and on gravel bars adjacent to side channels and points of overbank flow. Historically, large logjams were removed. Below Harlequin Bridge, the Army Corps of Engineers removed most large wood piles as recently as 1972.

Large woody debris has a valuable place in the ecological processes of the Stehekin River system. It provides habitat and shelter for fish, insect, bird, and mammal species using the river corridor. Large woody debris provides nutrients by depositing and collecting organic matter in the river, and also serves to spread floodwater and slow velocity during flood events. Logjams provide erosion protection and catch other debris in the river system. Standing trees in the floodplain catch large woody debris as it floats through inundated areas (NPS 2005).

Three comprehensive inventories of large wood accumulations in 1984, 2000, and 2007 have documented rapid accumulation of wood on the lower Stehekin River (Figure III-5: *Large Woody Debris Accumulation on the Stehekin River 1984 - 2007*). Large woody debris has increased dramatically on the Stehekin River. In 2000, total volume below Bullion Raft Launch was estimated at 130,000 cubic yards; in 2007, at 370,000 cubic yards.

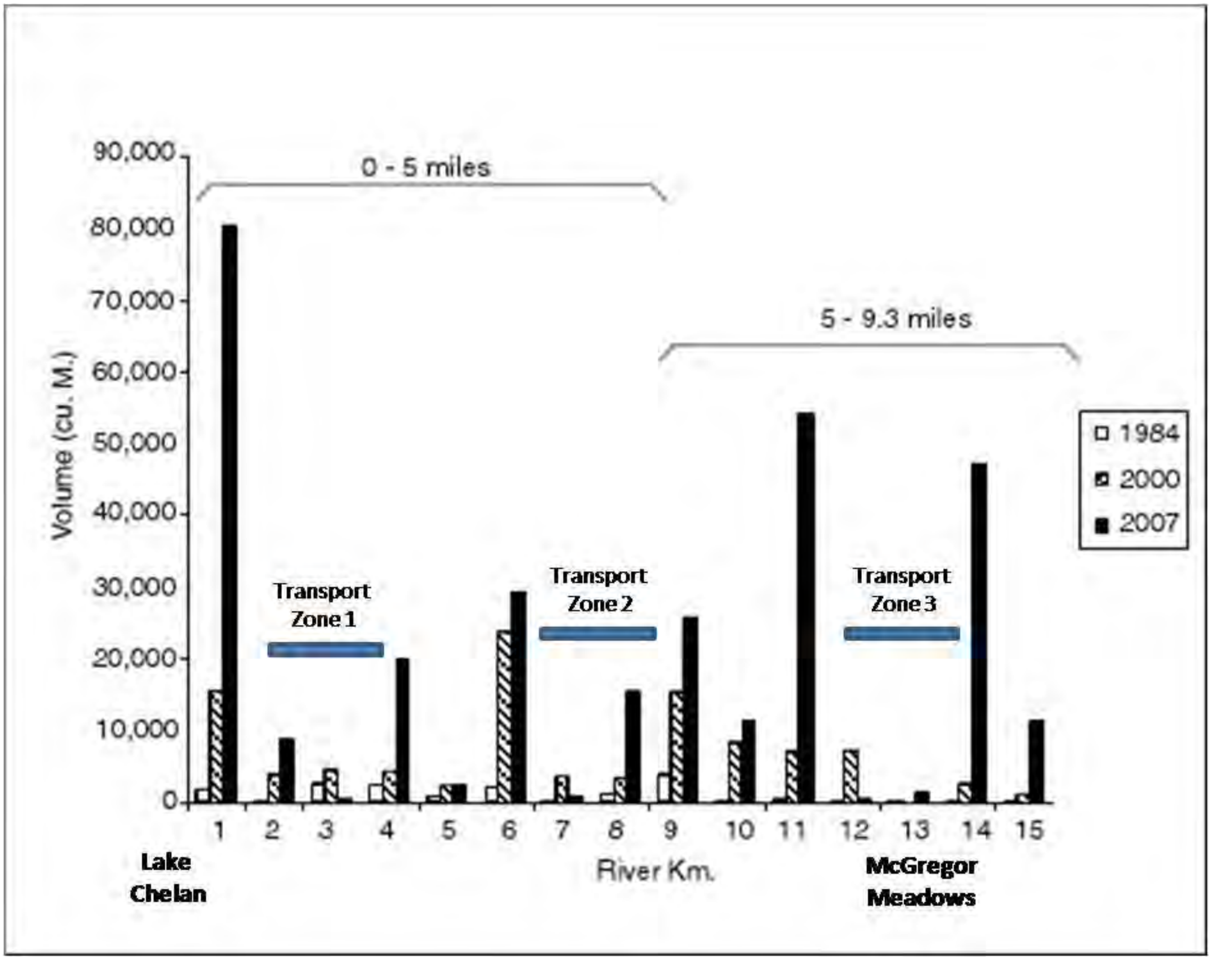



**Figure III-5: Large Woody Debris Accumulation on the Stehekin River 1984 - 2007**

Following the large recent floods, massive new accumulations of wood now occur below High Bridge, at the mouth of the canyon, at McGregor Meadows, and at the river mouth. Two particularly large logjams have formed in the past 15 years in the McGregor Meadows area. Combined, the McGregor Meadows area logjams alone cover an area of almost 5 acres and contain more than 3,000 large logs stacked as high as 20 feet (Figure III-6: *Large Woody Debris Storage and Transport Zones* and Figure III-7: *2007 Large Logjam Locations*.

Several dozen logjams in the lower valley have become stable features of the floodplain. Many of the logjams have grown progressively with passage of the 1995, 2003, and 2006 floods. While the number of logjams has remained constant in some locations, at others logjams have formed, been removed, and reformed.

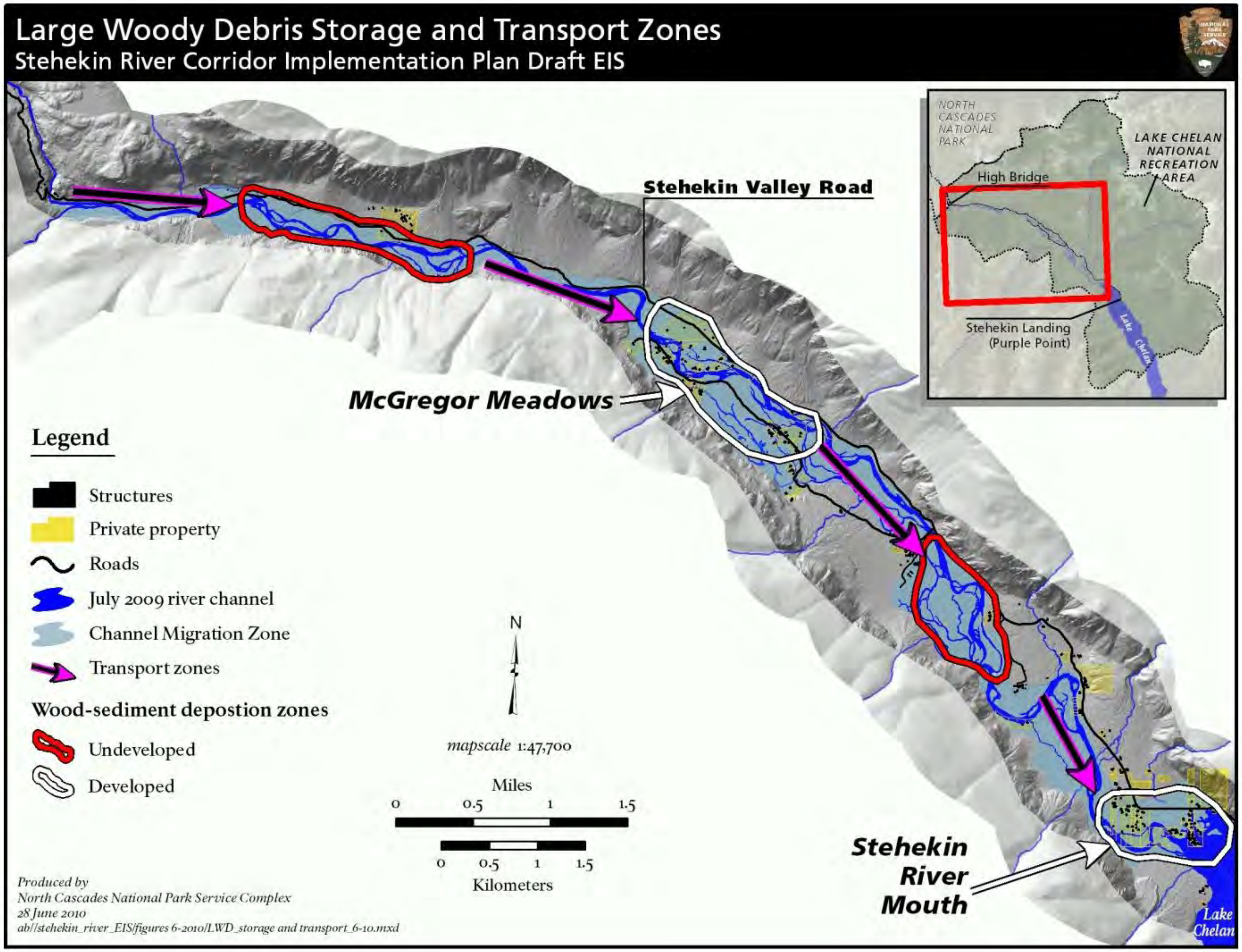



**Figure III-6: Large Woody Debris Storage and Transport Zones**

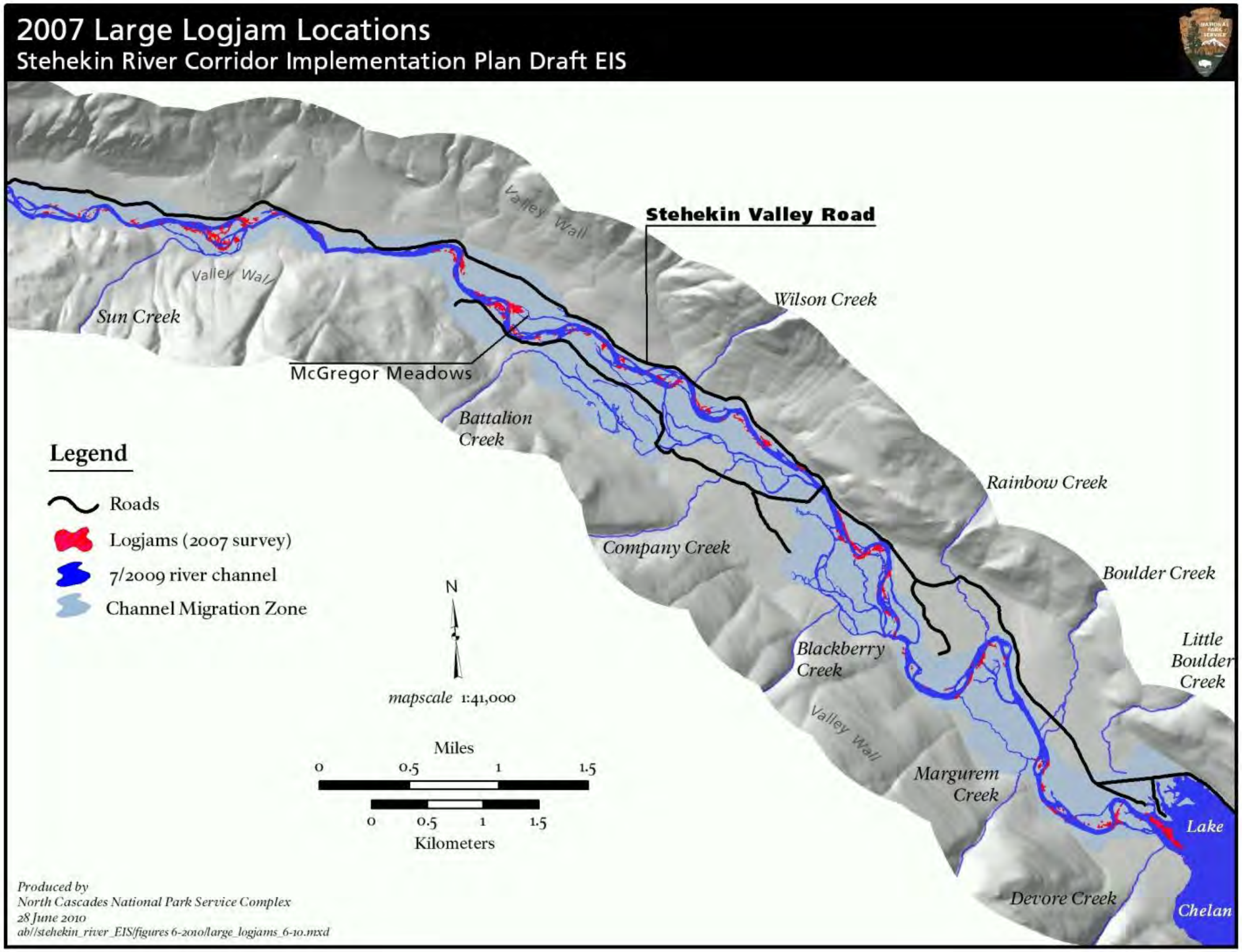



**Figure III-7: 2007 Large Logjam Locations**

**Photo 16 – Logjam at McGregor Meadows—Combined with Another Logjam on the Other Side of the River, this Feature Covers Nearly 5 Acres, Contains More than 3000 Logs, and is 20 feet Deep in Places**

The effect of the large woody debris accumulations is generally to increase hydraulic roughness (resistance to flow) and width-to-depth ratio, while reducing sinuosity and flood flow velocity. The presence of large wood makes the Stehekin more like a west-slope stream than its neighbors on the east slope of the Cascades. Thus, the Stehekin is a shallower stream than is typically found on the east slope of the North Cascades (Southerland 2003). It has been suggested that large woody debris deposited in sites with dense streambank vegetation can facilitate bed load transport (Riedel 2007).

## Application of Hydrology, Flooding, Channel Migration Zone, Sediment Deposition, and Large Woody Debris Studies

Two sites in the lower Stehekin Valley with persistent flooding and erosion problems stand out when examining the information summarized above. These sites are both areas of sediment and large wood storage that have extensive development in the floodplain and along the river. However, there are different reasons why these sites have unstable channels and persistent flood issues.

### *McGregor Meadows*

At McGregor Meadows, the width of the Stehekin Valley increases threefold, and as a result the gradient drops and sediment and logs are deposited in this location. Through the process of river migration away from the coarse gravel left by the big floods, the channel has become particularly unstable. The position of the Stehekin River channel have been plotted at various times since 1905. In the McGregor Meadows reach, channel sinuosity has increased as floods of the past half-century have filled the main channel with gravel, which causes erosion of streambanks and deposition of large woody debris (Figure III-8: *Stehekin River Channel Migrations 1953 - 2009*).

The NPS has observed a 3- to 4-foot increase in the elevation of the bed of the Stehekin River in upper McGregor Meadows in the past 21 years. This represents about 44,000 cubic yards of material. Following the 1995 flood, a private consultant and NPS river managers agreed that the loss of channel conveyance due to gravel accumulation on the river bed would ultimately result in a channel shift to the left bank, through McGregor Meadows along No Name Creek. However, growth of a log jam has blocked the entrance to this route, and the river appears to be seeking a new path a few hundred feet upstream. It is also possible that continued deposition of wood and gravel in the channel will result in the river breaking out of its channel farther upstream and following the Stehekin Valley Road through McGregor Meadows.

In response to the formation of pilot channels in McGregor Meadows, about 10 grade-control structures were installed on private land along the left (north) bank floodplain in the late 1990s. Grade-control structures are essentially trenches filled with large rocks and gravel that are built perpendicular to flow. They are designed to spread water out across a floodplain and to prevent flood channels from enlarging. Since the tops of these structures are at grade, they are not visible and do not raise the water surface elevation of floods. In response to overbank flooding and scour of roads upstream and on the opposite bank, five additional grade-control structures were installed at two sites by the NPS in 2007.

Along the opposite bank, filling of the channel with gravel has led to rapid bank erosion of the right bank and an increase in width-to-depth ratio. The NPS has installed 10 rock barbs in a half-mile-long reach to slow erosion, while private landowners have placed another three barbs on the other side of the channel. Plugging of the channel with gravel and wood is forcing a large amount of water overbank on both sides of the river.

### *Stehekin River Mouth and Lake Chelan*

Deposition of gravel and large wood, and channel instability, also occur where the Stehekin River enters Lake Chelan. In a 2001 study, Chelan PUD used a hydraulic model to analyze the effects of manipulating the level of Lake Chelan on the Stehekin River (Chelan PUD 2001b). They showed that the backwater effect of Lake Chelan at full pool when river discharge is 20,000 cfs (i.e., a 100-year flood) extends nearly 0.25 mile upstream of the river mouth, raising the 100-year flood elevation 0.5 foot. The backwater effect extends several hundred feet farther upstream for smaller floods that occur at full pool. No effect from Lake Chelan was observed when lake level is below 1,094 feet. When the lake is lower than this level, more gravel is transported deep into the lake.

The effect of the lake backwater on slowing river velocity is to cause sediment deposition and accumulation of large woody debris. Further Chelan PUD modeling of the effect of large wood on floodwater surface elevations near the river mouth indicated that logjams blocking side channels on the right bank raise the water surface elevation another 0.5 - 1.0 foot. In summer 2007, one of these logjams was removed from the head of a side channel near river kilometer 1 on the right bank. This channel was occupied by the river prior to the 1948 flood, and is known as the 1948 flood channel. A large spring flood in 2008 blocked this side channel with logs again, but they were removed the following fall. Comparison of channel surveys indicates that some gravel is transported through the river into Lake Chelan. At the same time, growth of point bars represents temporary storage of gravel.

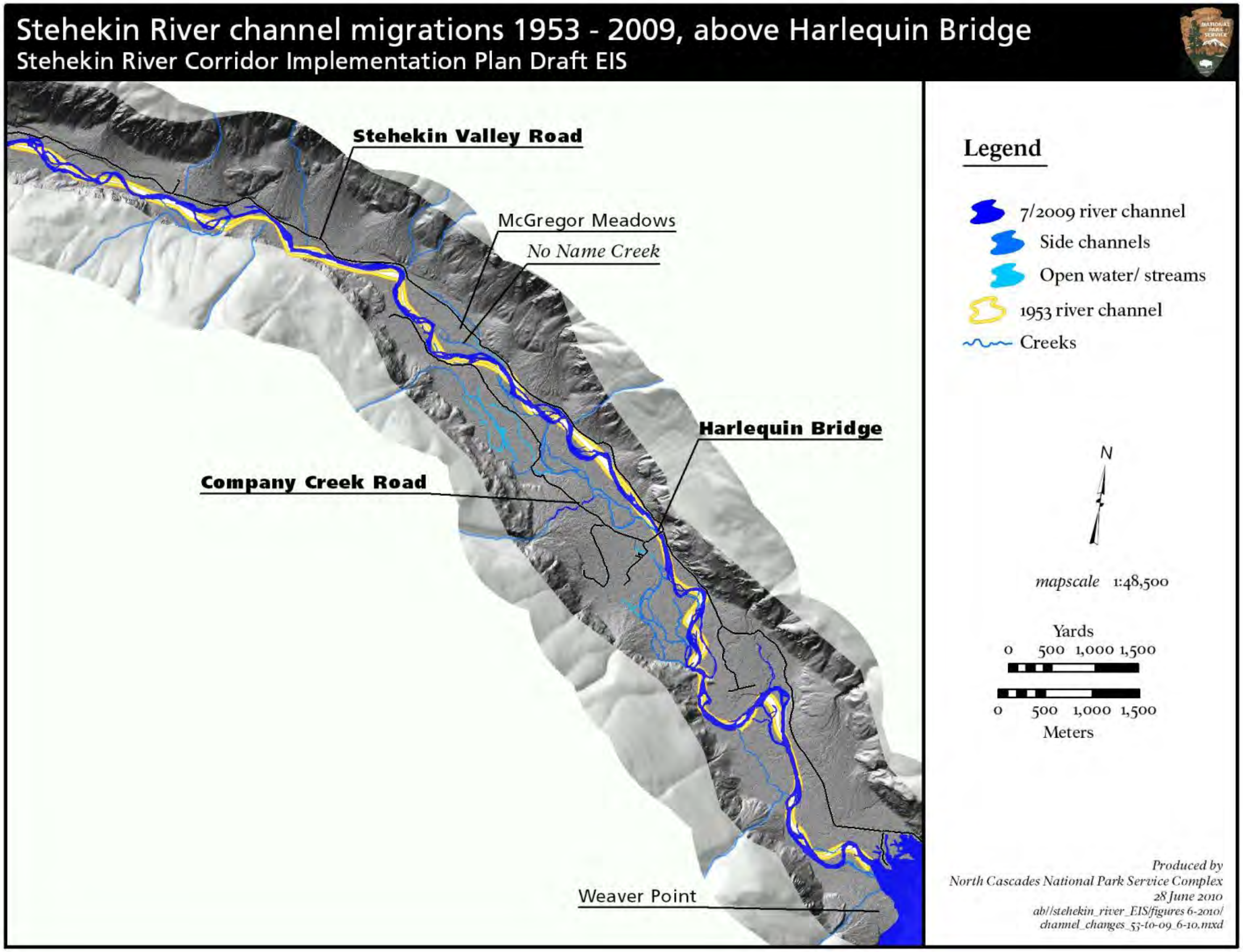



**Figure III-8: Stehekin River Channel Migrations 1953 – 2009, above Harlequin Bridge**

## Response to Flooding on Stehekin River

**Stehekin River Modifications**: The earliest channel modifications to the Stehekin River were made in the 1930s by Chelan PUD, although removal of logs has been a continuing historic practice. By 1995, approximately 3.9 percent, or 4,861 feet, of the banks of the Stehekin River below High Bridge were affected by engineered erosion protection or flood-control structures (NPS 1997:13). By September 2001, approximately 6,965 feet, or 5.6 percent, of the Stehekin River banks were affected similarly (NPS 2007a). Today, approximately 8,211 feet, or 6.5 percent, of the Stehekin River is affected similarly (Table III-6: *Lower Stehekin River Shoreline Affected by Erosion or Flood Control Structures*).

**Table III-6: Lower Stehekin River Shoreline Affected by Erosion or Flood Control Structures**

| Erosion Protection Structures | 1993 | 2001 - 2001 | 2009 |
|---|---|---|---|
| Number of Sites | 28 | 35 (with 80 structures) | 46[a] |
| Length | 4,861 ft | 6,965 ft | 8,211 ft[b] |
| Number of Barbs | 0 | 10 | 30[c] |
| Percentage of Bank | 3.9 | 5.6 | 6.5 |

Note: Total shoreline length (estimated left and right banks) is 124,847 feet.

[a]Sites added since 2001 - 02 are upper Company Creek Road (2007), Courtney Ranch (2007), Scutt (2007), and Leader Levee (2008).

[b]Added 427 feet to upper Company Creek Road, 427 feet to Milepost 8.0, and 328 feet to Leader.

[c]NPS added 6 barbs at Milepost 8.0 (1993, 2008), 10 barbs at Company Creek Road (1997, 2007), and 4 barbs near the orchard (1999). Private owners added 2 barbs on Leader (1997), 4 barbs at Stehekin Valley Ranch (2007), 1 barb at Company Creek Road (1997), and 3 barbs near the River Resort Road (1997).

The USGS studied the effects of rock groins and rip-rap on stream velocity (Nelson 1986) at several sites. The NPS examined the hydraulic effect of rock barbs using two-dimensional models at upper Company Creek Road and at Stehekin Valley Road Milepost 2.2. Based on the models and direct observations, barbs decrease bank erosion, but cause increased scour of the channel bed within a few hundred feet downstream of the lowest barb on same side of the river. Rip-rap tends to draw and hold the fastest and deepest water against itself and can cause bank erosion downstream.

Erosion protection structures have proliferated on the lower Stehekin River in the past 15 years in response to flooding and river changes. During this period rock barbs became the preferred measure of bank-erosion management, although rip-rap and cabled logs are also common. In 1993 the first two rock barbs were installed by NPS at Milepost 8.0 after the 1990 flood. Ten barbs were installed on public land at two sites and five on private land at three sites following the 1995 and 1997 floods. In response to bank erosion from the 2003 flood, eight more rock barbs were added by the NPS on upper Company Creek Road and Milepost 8.0 and four barbs were added on private property at the Stehekin Valley Ranch. In total there are now 30 rock barbs on the river, with 13 in the McGregor Meadows area (Figure III-9: *Erosion Protection Structures on the Stehekin River 2009*).

Only two extensive flood-control projects are in place in the lower Stehekin Valley: A 400-foot-long, 4- to 5-foot-tall levee was constructed by the NPS in the early 1980s along the upper Company Creek Road at Milepost 5.5, and a 300-foot-long, 3-foot-tall levee was constructed on private land in McGregor Meadows in 2008.

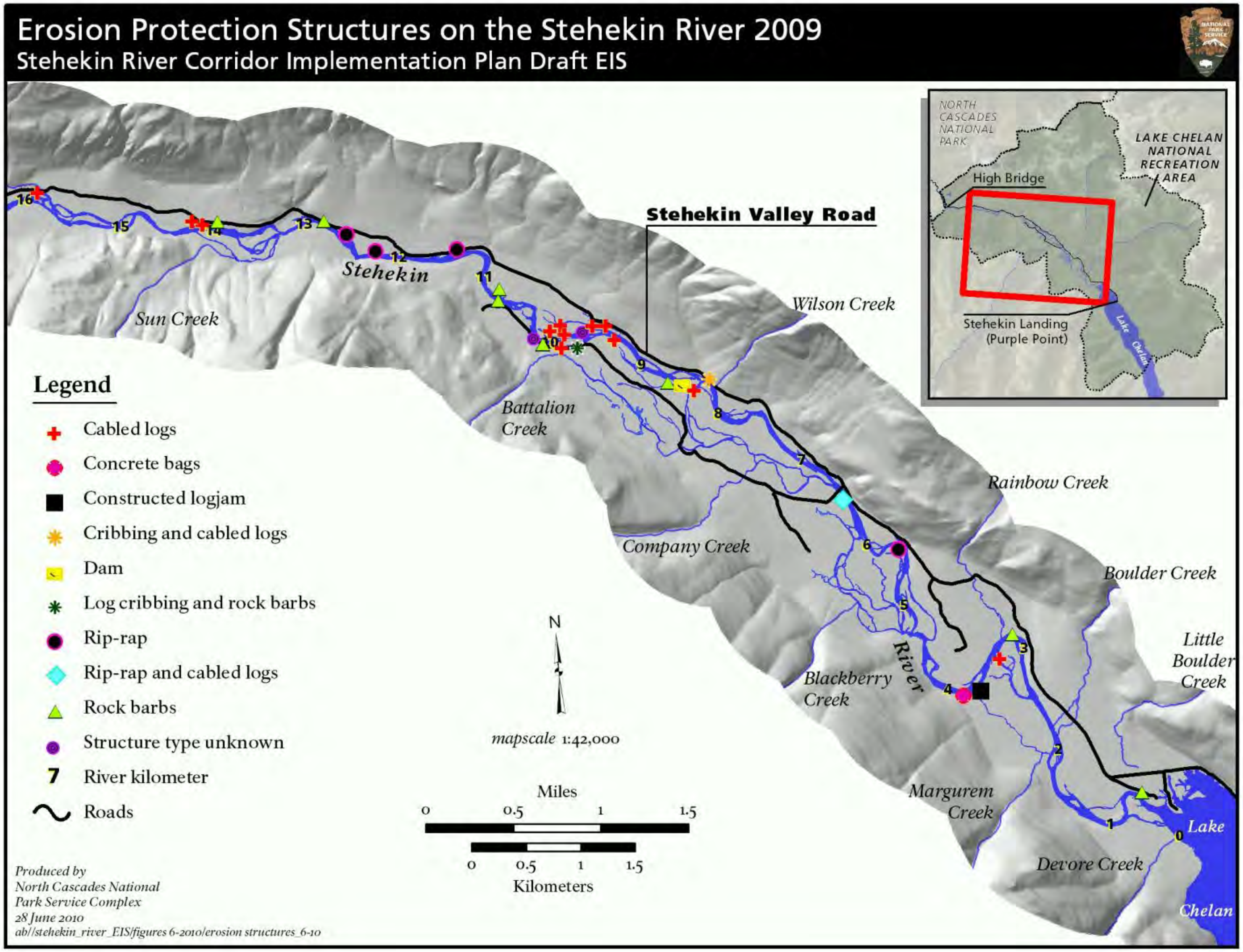



**Figure III-9: Erosion Protection Structures on the Stehekin River 2009**

Models comparing existing conditions to the proposed alternatives were constructed to assess the impacts of barbs and rip-rap on channel hydraulics in the immediate vicinity of the proposed barbs and downstream. Thus two models were developed to evaluate (1) local-scale effects and (2) reach-scale effects of the alternatives. The two-dimensional local-scale models were quite detailed and examined the maximum flows contained within the channel for the rock barb and rip-rap alternatives at upper Company Creek Road (1997) and Stehekin Valley Road Mile 2.8 (1998). The reach-scale model covered 1.06 miles of the Stehekin River through the study site. It was a less detailed study, but included overbank and flood-prone areas within the study reach for low and high flows. The local-scale model was more useful for site-specific impact analysis, while the reach-scale model was useful for more general analyses. The reach-scale model analyzed the combined effects of 10 rock barbs (three existing and seven proposed additional) for the 100-year flood and for average spring high flows. Because this model included areas of the channel with poorly defined topography and large, flat, flood-prone overbank areas, the model resolution was quite coarse. Therefore, the reach-scale model results for each alternative are less reliable than necessary to make local-scale interpretations. However, flow modeling at both scales seemed to agree with the hydraulic conditions predicted based on prior experience with rock barbs. These included no major displacement of energy or bank-erosion problems with rock barbs, but accelerated flow downstream with use of rip-rap. The downstream effect of barbs is approximately 3 - 5 times their length, or 80 - 100 feet.

### c. Water Quality

Water quality is determined by a measure of the characteristics of water, including temperature, dissolved oxygen, suspended sediment, nutrients, and chemical pollutants. Water quality parameters include levels of dissolved oxygen, conductivity, turbidity, pH level, temperature, and other characteristics (such as mineral concentrations). The concentrations and interactions of these elements affect the ability of fish and other aquatic organisms to survive. Generally, water quality parameters exhibit a great degree of natural variation among different water resources (rivers, streams, lakes, hot springs, etc.). Water quality also refers to the suitability of surface water for recreational use and wildlife habitat.

The water quality in the Stehekin River is generally excellent. There are relatively few potential sources of water pollution within the valley because of the limited development in the area. Some potential sources of pollution include nutrients and pathogens from septic systems, pesticides from farming or orchards (in particular, DDT has been a problem in Lake Chelan, but this pesticide was not extensively used in the Stehekin Valley), or pollutants in stormwater runoff, such as sediment. There may also be chemicals from various activities, such as small spills of oil or fuel from vehicles, or use of other toxic materials that can be taken up in stormwater runoff, such as fertilizers.

The Stehekin River is a Category I waterway under the *Water Quality Standards for Surface Waters of the State of Washington* (NPS 2006c). Category I waterways meet testing standards for clean water and are given maximum protection under state water quality regulations (Washington Administrative Code 173-201A). In addition, the surface water in Lake Chelan NRA has been determined to be Class AA (extraordinary). Class AA waters are also designated under state administration of the Clean Water Act and are characterized by exceptional water quality. Class AA waters are given maximum protection under state water quality regulations (Washington Administrative Code 173-201A).

Although the Stehekin River is listed as Category 1, it does have higher levels of arsenic than the listed standard. When investigated, these were determined to be from a naturally high background concentration of that element (Johnson and Cassidy 1997; Patmont et al. 1989). Although these natural background concentrations exceeded the arsenic standard, they are natural conditions; therefore, they do not violate water quality standards.

Both flooding and human activities can affect a variety of water quality parameters, including sedimentation. Although flooding and sedimentation are natural processes, sustained high levels of sedimentation, or sedimentation which occurs during sensitive life stages, as well as changes in water quality that occur over longer periods can affect fish and other aquatic organisms and cause stress or mortality. Given the frequent nature of flooding on rivers, organisms are somewhat adapted to disturbances. Pools and tributaries represent important refuge for aquatic organisms during disturbance events.

Among the most prevalent water quality problems in the Stehekin River is sediment loading. Sediment inputs occur from bank erosion during flood events. The erosion and resulting sediment cause increased turbidity in the water, which can adversely affect fish and other aquatic organisms in several ways. Sediment can fill the spaces within spawning gravels, which adversely affects spawning success and can also destroy other fish habitat areas such as pools used by fry and juveniles. Sediment can also clog the gills of fish, impairing respiration or causing mortality.

Sediment can also change the chemical components of water quality, including dissolved oxygen, pH levels, or biological oxygen demand. This in turn may adversely affect aquatic species. According to the GMP/EIS (NPS 1995a), the Stehekin River contributes approximately 4,120 metric tons of suspended sediment to Lake Chelan each year. This is evidenced by the large mudflat located at the mouth of the river at the north end of Lake Chelan. The GMP estimated that during a 12-year period, over 25,000 cubic yards of sand, rock, and gravel were used to maintain roads in the Stehekin Valley, and stated that the largest human-caused input of sediments to the Stehekin River and Lake Chelan is probably attributable to erosion from roads (NPS 1995a:199).

Despite the impacts of sedimentation, erosion of riverbanks is a natural process, and the introduction of sediment and large woody debris also remains an important element that provides a number of beneficial effects for aquatic species, including the creation of aquatic habitat such as gravel bars and logjams.

Other effects on water quality come from the contribution of nutrients and pathogens from septic drain fields, fertilizers, and other wastewater sources (such as from camping) within the Stehekin Valley. Of the inputs to the Lucerne and Wapato basins within Lake Chelan, those from the Wapato or downriver basin are primarily from human sources. According to the GMP (NPS 1995a:198), approximately 25 percent of the phosphorus inputs in the Stehekin Valley are from agricultural runoff (23 percent) and septic systems (3 percent). Pathogens from septic systems normally is low, based on water quality testing by the Washington Department of Health at seven sites within the Stehekin Valley, which met safe drinking water standards, however, during flooding, inputs may be higher. Analysis of 23 pesticide residue compounds in 1986 found only DDT and its associated metabolites in quantifiable levels; however, those near Stehekin were very low (Patmont et al. 1989 in NPS 1995a:198).

## d. Wetlands

Wetlands are a critical resource that supports a high diversity of species. Wetlands and deepwater habitats (excluding Lake Chelan) cover approximately 584 acres within Lake Chelan NRA, including low-lying areas near the Stehekin River, along its tributaries and portions of the drawdown in Lake Chelan (NPS 1993b) (Figure III-10: *Wetlands in the Lower Stehekin Valley*). Of the 283 acres of development in the Stehekin Valley, there are an estimated 188 acres within the riparian zone. This development includes roads, houses, and administrative facilities. Some of this developed land includes wetlands.

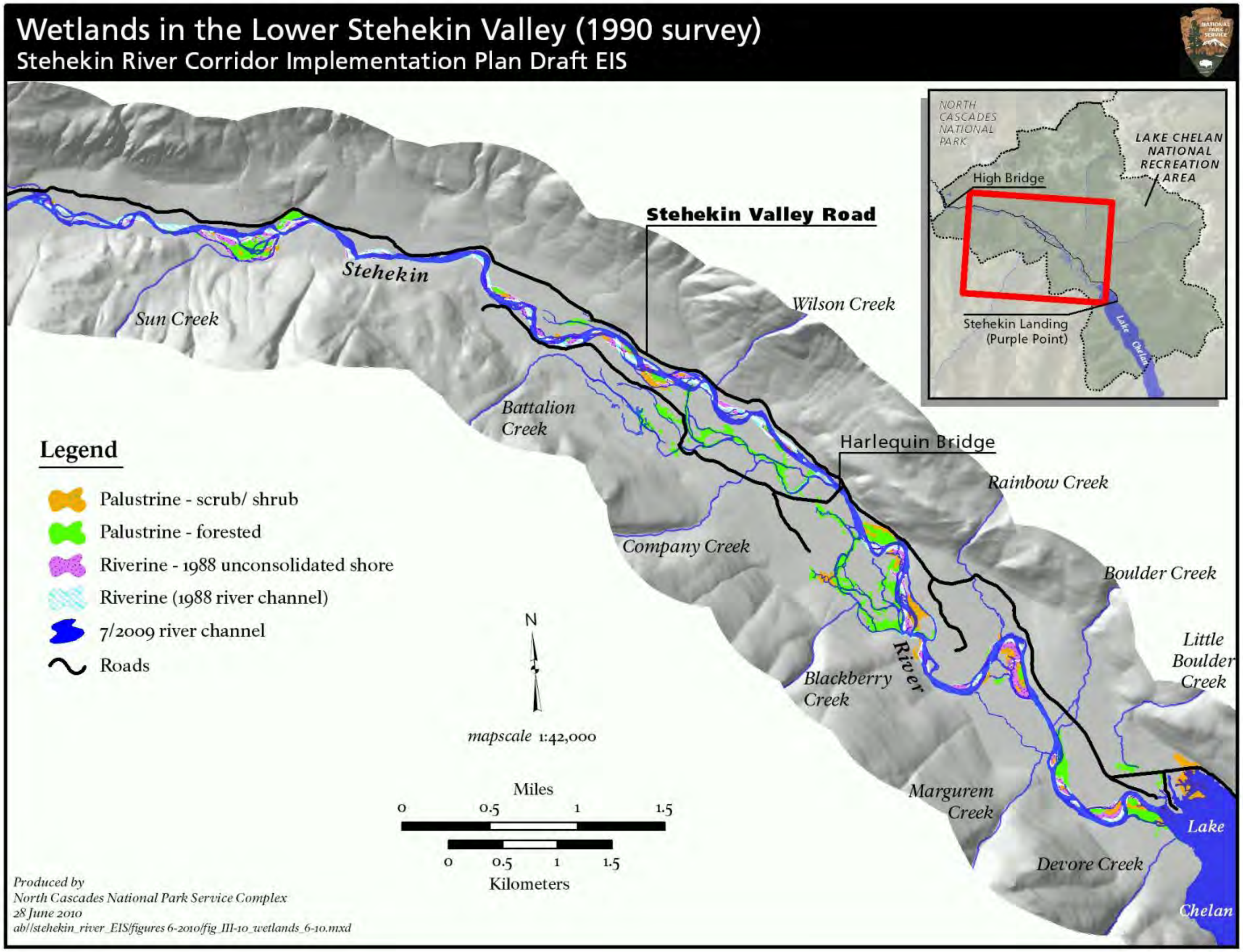



**Figure III-10: Wetlands in the Lower Stehekin Valley**

Wetlands perform key ecological functions, including moderating surface and groundwater flow; controlling sediment transport, erosion, and deposition; mediating physical and chemical processes affecting water quality and nutrient cycling; and generating plants and providing food and habitat for animals (Strickland 1986; Kusler 1983 in NPS 1995a:178).

Wetlands were mapped within the Stehekin Valley in 1990. Mapping included field observations and existing mapped information, including National Wetlands Inventory maps, soil surveys, topographic maps, orthorectified aerial photography(1988), and the Stehekin Valley Habitat Types map (NPS 1993b *in* NPS 1995a:178). Among the largest wetlands are a matrix of about 65 acres of forested and shrubby wetlands between Harlequin and Buckner Homestead hayfield and pasture and about 101 acres just above Harlequin.

According to the NPS, wetlands are identified by hydrophytic soil types, hydrophytic vegetation, and hydrology (wet soil characteristics, wetland-dependent vegetation, and the presence of water). Wetlands within Lake Chelan NRA were classified according to the system developed by the United States Fish and Wildlife Service (USFWS) (Cowardin et al. 1979). These wetlands are first characterized by what kind of water they are associated with and then by the type of vegetation or substrate. Recreation area wetlands fall into one of three categories: palustrine (wet vegetated areas), riverine (river or stream channels), or lacustrine (associated with a lake).

Palustrine wetlands are those freshwater areas not associated with lakes, but rather with persistent groundwater. Palustrine wetlands include all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and some saltwater wetlands. Palustrine wetlands include those areas called marshes, bogs, fens, and prairies as well as shallow permanent or intermittent ponds. Palustrine wetlands are further classified as forested, emergent wetland persistent, and scrub-shrub wetlands (Cowardin et al. 1979).

Based on the GMP (NPS 1995a:178), within the Stehekin Valley, palustrine wetlands cover approximately 159 acres, most (139 acres) of which is forested wetland, and the rest (50 acres), scrub-shrub wetland. These areas may shift rapidly during flooding, depending on the erosive forces of the Stehekin River as the river changes course within its channel migration zone.

Riverine wetlands include all wetlands and deepwater habitats contained within a channel, except for wetlands dominated by trees, shrubs, persistent emergent plants, emergent mosses, or lichens and those near saltwater. Water is usually, but not always, flowing in the channel and these wetlands may also be surrounded on their floodplain by other kinds of palustrine wetlands (Cowardin et al. 1979).

Based on the GMP (NPS 1995a:178), within the Stehekin Valley, riverine wetlands are comprised of unconsolidated shore (88 acres) and open-water riverine habitat (167 acres). Similar to the palustrine wetlands, riverine wetlands change depending on the location of the Stehekin River and its associated side channels and tributaries.

Of the Weaver Point palustrine forested wetlands mapped in 1988 (8.7 acres), approximately half an acre have been destroyed by the river (in 2006).

Major wetlands within the project area include shoreline areas along the Stehekin River and the open-water channel of the Stehekin River, where some proposed actions, such as the installation of rock barbs, may occur. Most wetlands within Lake Chelan NRA remain undisturbed; however, according to the GMP, about 11 acres are affected by development (excluding roads). At the time of the GMP, there were eight private and two NPS buildings located within wetlands. A portion of the Stehekin Valley Road is also within wetlands (near McGregor Meadows) and a portion of the Company Creek Road (near the NPS Maintenance Area**)** is also located within a wetland.

The following wetlands are located in or near the proposed project area:

- Company Creek
- McGregor Meadows
- Coon Run (outside the project area).

**Company Creek**: The Company Creek wetlands extend up valley from where Battalion Creek meets the valley floor to the confluence with Company Creek. The entire area is a matrix of beaver ponds damming side channels from both Battalion Creek and the Stehekin River. Using aerial photography from both February 2004 (leaf-off) and July 2006 (leaf-on), the palustrine-forested wetlands in this area are estimated to be approximately 101 acres.

**McGregor Meadows**: McGregor Meadows is a former agriculture site located between the road and the river. A 5.5-acre clearing is surrounded by a mixed conifer-deciduous stand. The meadow and its surrounding forest lie within the channel migration zone of the Stehekin River. Changes in the channel caused by the recent large floods have caused channel instability in the area, increasing the rate of conversion from upland to wetland and riverine habitats. For example, in 1993, just over 3 acres of palustrine forested wetlands were mapped within McGregor Meadows. An additional 3/4 acres were classified as scrub-shrub palustrine wetlands and approximately 7 acres as riverine, unconsolidated shoreline. Much has changed in the intervening years. Flooding in 2003 and 2006 has left substantial accretions of rock over the forested upper part of the greater McGregor Meadows, and has scoured much of the meadows themselves, as well as the Stehekin Valley Road and portions of the low-lying areas inland of the road. A large logjam has formed at the head of No Name Creek (actually a side channel of the river). The GMP did not include the length of No Name Creek in its palustrine-forested habitat. July 2007 (leaf-on) and February 2004 (leaf-off) imagery shows that there is approximately 8.7 acres of this habitat along the creek. The logjam has contributed another 1.9 acres to the wetlands. The scrub-shrub wetland habitat has been washed away, and the river occupies what was unconsolidated shoreline in 1988 (NPS 1995f).

**Coon Run**: The 11-acre Coon Run wetland follows Coon Creek down an ancient river channel of the Stehekin River. The wetland is fed by Coon Creek, surface and groundwater drainage from the lower slopes of McGregor Mountain, and by flood backwater at its lower end. A lack of drainage under the Stehekin Valley Road has increased water levels in the wetland. Deposition of gravel in the main channel of the river during the 2003 flood has also raised water levels in the lower part of the wetland throughout the year.

# 7. VEGETATION

North Cascades vegetation is diverse, with over 1,627 plant species identified. Differences in vegetation types are attributed to rock and soil types, exposure (aspect), slope, elevation, and rainfall/precipitation.

Approximately 2,543 acres within the Stehekin Valley (below the 1,640-foot wilderness boundary elevation contour) was classified by Tanimoto (1991, with revisions by NPS in 1992) into 36 different vegetation cover types associated with five different soil moisture / nutrient condition categories (NPS 1995a:183) (Figure III-11: *Lower Stehekin Valley Vegetation*).

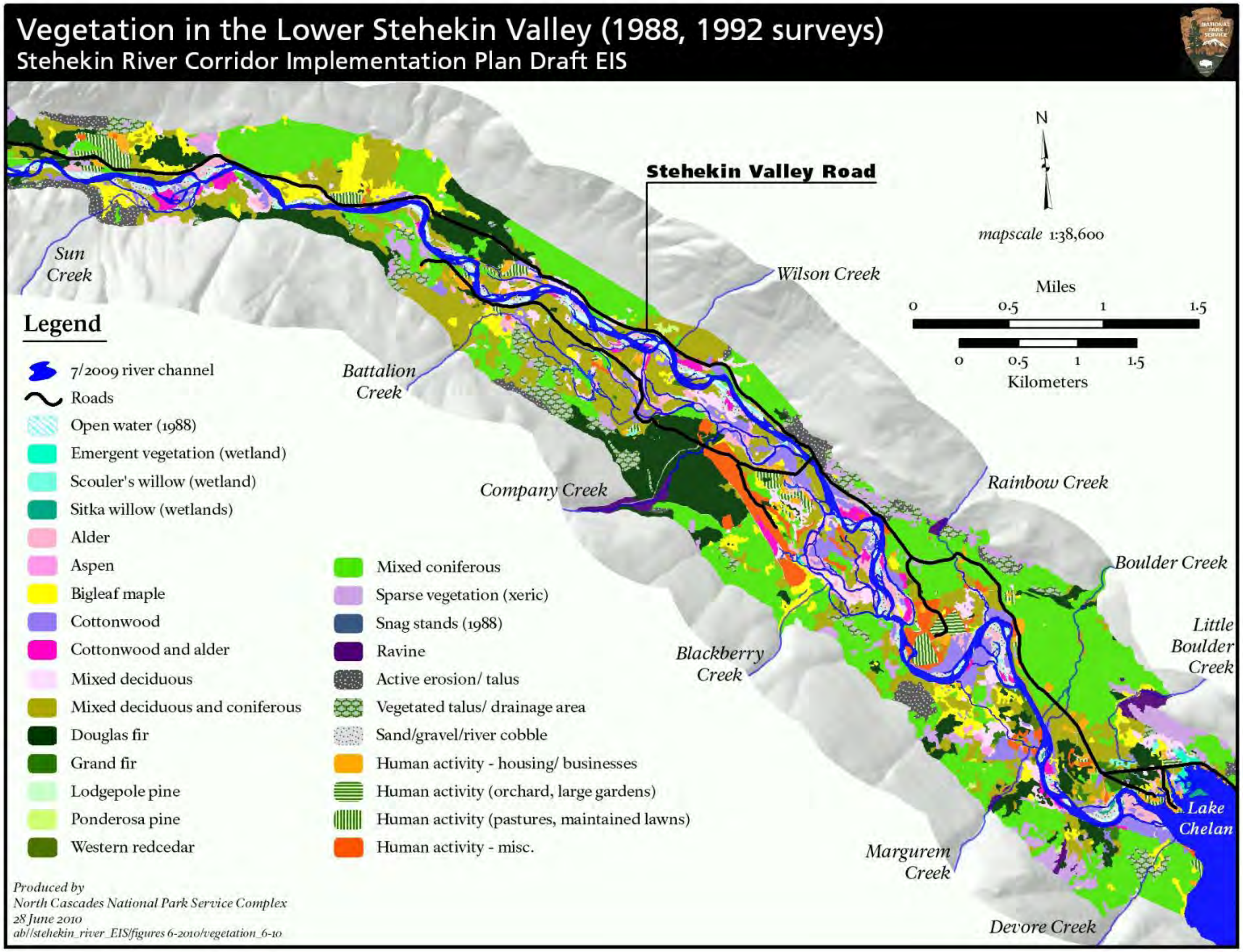



**Figure III-11: Lower Stehekin Valley Vegetation**

The five soil moisture / nutrient condition categories are:

- Riparian—Nutrient Poor
- Riparian—Nutrient Rich,
- Upland Mesic (moderate moisture)
- Upland Xeric (dry)
- Miscellaneous.

The 36 vegetation cover types are listed below according to these moisture/nutrient categories.

Overall, the riparian zone comprises 936 acres, or 36 percent, of the Stehekin Valley.

**Riparian—Nutrient Poor** is characterized by red alder/black cottonwood cover types, including those dominated by the following species:

- Red alder (*Alnus rubra*)
- Sitka willow (Salix sitchensis)
- Black cottonwood (Populus balsamifera ssp. trichocarpa)
- Alder / cottonwood mixed stands.

These vegetation types are comprised of invading woody species on recent river deposits, mostly along the margins and floodplain of the Stehekin River and its tributaries.

**Riparian—Nutrient Rich** is characterized by the following dominant species: grand fir (*Abies grandis*), western red cedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), bigleaf maple (*Acer macrophyllum*), black cottonwood, red alder, quaking aspen (*Populus tremuloides*), Scouler's willow (*Salix scouleriana*), and wetland emergent areas dominated by sedges. It contains the following:

- Mixed deciduous forest
- Mixed coniferous forest
- Mixed deciduous coniferous forest.

Mixed deciduous forest stands contain bigleaf maple in addition to alder and cottonwood and are found on older river terraces. These and other riparian-nutrient rich communities are found where soils have become enriched from silt deposits and accumulation of leaf litter from earlier successional trees. Mixed coniferous forest is found on well-developed soils on old point river bars. Mixed deciduous/coniferous forest is widespread throughout the valley and comprises the third most common vegetation cover type in the Stehekin Valley.

Relatively small, mostly pure stands of the following vegetation cover types are also part of the riparian-nutrient rich community:

- Grand fir (found near the mouth of the Stehekin River in moist sites with rich soil)
- Western red cedar (rare, comprising only 9 acres, but found on wet sites associated with the river and its tributaries)
- Douglas-fir (occurs as a climax species on the oldest parts of point bars)

- Bigleaf maple (occurs throughout the riparian zone in a wide variety of site conditions)
- Cottonwood (in the nutrient-rich version of this habitat, cottonwood is mixed with bigleaf maple, grand fir, Douglas-fir, or red cedar-cottonwood stands comprise a common sight, with 114 acres)
- Cottonwood/alder (in the nutrient-rich version of this cover type, these stands often contain bigleaf maple)
- Alder (in the nutrient-rich version of this cover type, alder forms distinct stands within old river channels and oxbows, especially near Company Creek Road)
- Aspen (uncommon; found only near Margerum Creek, possibly because of fire)
- Scouler's willow (Salix scouleriana) (pure stands occur near the mouth of the river on well-developed soils)
- Emergent vegetation (primarily grass or sedge-dominated stands at the head of the lake associated with the drawdown of the reservoir).

**Upland Mesic** cover is characterized by nonriparian communities on soils of moderate moisture content. Dominant species include grand fir, Douglas-fir, black cottonwood, bigleaf maple, and ponderosa pine (*Pinus ponderosa*). Upland mesic includes the following vegetation cover types:

- Mixed deciduous forest (an uncommon class comprised of bigleaf maple mixed with cottonwood, vine maple, Scouler's willow, or Pacific dogwood)
- Mixed coniferous forest (the most common vegetation cover type, comprising 501 acres; dominated by Douglas-fir but also containing ponderosa pine or grand fir)
- Mixed deciduous coniferous forest (the fourth largest vegetation cover type comprised of a wide variety of already named deciduous and coniferous species)
- Grand fir (pure stands of nonriparian grand fir are very rare)
- Douglas-fir (pure stands, comprising 236 acres, comprise the second most common vegetation cover type)
- Ponderosa pine (tolerates drier sites on both sides of the valley)
- Bigleaf maple (common on well-developed, well-drained slopes, with an understory of Scouler's willow and Pacific dogwood)
- Cottonwood (rare on river deposits associated with tributaries)
- Ravine (steep-sided tributary canyons with flowing streams and shallow soil, dominated by red cedar and other species).

**Upland Xeric** is relatively common and is found on the valley's steepest slopes and driest sites on either north- or south-facing slopes, including the following:

- Xeric uplands (largely unvegetated due to severe microclimates, characterized by exposed bedrock with little tree cover and little or no soil development)
- Active erosion/talus (largely unvegetated except for lichens, where present, due to severe microclimates)
- Slope or talus drainage area (found at the base of active erosion and talus areas, supporting some sparse herbaceous plants and trees).

**Miscellaneous** cover types include the active river channel and areas of human disturbance, including the following:

- Sand/gravel/cobble (common in areas adjacent to the river)
- Water (Stehekin River wet channel and Lake Chelan)
- Lawn/pasture
- Orchard/large garden (Buckner Homestead hayfield and pasture and large private gardens)
- Development/structures (residential, commercial, and public development, including buildings and other structures)
- Disturbed areas (tree cover of less than 10 percent and lawn or other clearing or ample evidence of human disturbance)
- Roads (estimated at 56 acres below High Bridge within the project area).

Dominant tree species within the Stehekin Valley are noted above. In native cover types, understory species consist of a variety of shrubs and small trees, including vine maple (*Acer circinatum*), serviceberry (*Amelanchier alnifolia*), dogbane (*Apocynum ansrosaemifolium*), snowberry (*Symphoricarpus albus*), oceanspray (*Holodiscus discolor*), snowbush (*Ceanothus velutinus*), mahonia or Oregon grape (*Berberis aquifolium*), red-flowering currant (*Ribes sanguineum*), wild roses (*Rosa* spp.), Pacific dogwood (*Cornus nuttalli*), boxwood (*Paxistima myrsinites*), and bearberry or pinemat (*Arctostaphylos nevadadensis* or *A. uva-ursi*). Common forbs include big leaf sandwort (*Moehringia macrophylla*) and Watson's willow-herb (*Epilobium watsonii*). Grasses include pine grass (*Calamagrostis rubescens*), Ross's sedge (*Carex rossii*), western fescue (*Festuca occidentalis*), onion grass (*Melica subulata*), and Lemmon's needle grass (*Achnatherum lemmonii*). Sword fern (*Polystichum imbricans*) is also a common understory plant.

The most diverse vegetation is found within the riparian zone, an area characterized by its proximity to active river or stream channels where vegetation communities are influenced by high water tables, flooding, and the ability of the soil to hold water (Naiman et al. 1993 in NPS 1995a:181). This zone of influence between the abundant moisture and the higher, drier terraces above it is important to both plants and wildlife and, in fact, is characterized by species from wide geographical, altitudinal, and ecological ranges (Mason and Koon 1985). Studies have found that nearly 70 percent of vertebrates in a region use riparian corridors during their life cycle (Naiman et al. 1993 in NPS 1995a:181). Riparian areas provide a means of transfer for water, nutrients, sediment, organic matter, and aquatic and terrestrial organisms between this area and the drier montane or forested areas above it (Gregory et al. 1991 in NPS 1995a:181).

Other vegetation classes that were identified as being the most important / sensitive to the Stehekin ecosystem are the open water, upland xeric, and active erosion/talus areas (NPS 1995a:184). These areas provide unique habitats for waterfowl, major vertebrates, and reptiles and amphibians, respectively.

## Fungi

The Stehekin watershed is unique for its numerous fungi species. Between April 2005 and 2006, fungi inventories led by emeritus professor James Trappe of the University of Oregon have yielded 480 collections of macrofungi in the Stehekin watershed, of which three species are new to science and two are extremely rare (NPS 2007a:3).

## Changes to Native Plant Community Cover

Among the human activities which have affected the vegetation composition within the Stehekin Valley include logging, wildfire management (Forest Fuel Reduction Areas) and suppression, and farming. Some areas, including McGregor Meadows (Mileposts 6.5 - 7.0) and the Stehekin Valley Ranch (Milepost 9.0), where concentrated development, farming, and/or ranching activities altered vegetation, have not recovered their native plant community composition, even where that activity is no longer occurring. Others are dominated by nonnative, ornamental, or weedy species.

## Nonnative Plants and Noxious Weeds

Nonnative plants and noxious weeds are found within disturbed areas of the Stehekin Valley. These areas primarily include road edges, areas near NPS and private development, borrow areas such as the gravel pit, the Buckner Homestead hayfield and pasture, and the airstrip.

Among the plants found include: diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea maculosa*), mullein (*Verbascum thapsus*), Japanese knotweed (*Polygonum cuspidatum*), oxeye daisy (*Leucanthemum vulgare*), Dalmatian toadflax (*Linearia genistifolia dalmatic*), rush skeletonweed (*Chondrilla juncea*), Scotch broom (*Cytisus scoparius*), baby's breath (*Gypsophila paniculata*), Himalayan blackberry (*Rubus discolor*), tansy ragwort (*Senecio jacobea*), yellow salsify (*Tragopogon dubius*), bull thistle (*Cirsium vulgare*), Canada thistle (*Cirsium arvense)*, sweet pea (*Lathyrus odoratus*), vinca (*vinca minor*), white clover (*Trifolium repens*), sheep sorrel (*Rumex acetosella*), sow thistle (*Sonchus asper*), and foxglove (*Digitalis purpurea*), as well as a variety of nonnative grasses, including bulbous bluegrass (*Poa bulbosa*), cheatgrass (*Bromus tectorum*), and orchard grass (*Dactylis glomerata*).

An unknown number of acres within the Stehekin Valley are affected by nonnative plants or noxious weeds. Control is focused on containing, reducing, and eliminating populations. Most actions in recent years have been undertaken in the following areas: the Stehekin airstrip, the edges of the Stehekin Valley Road, and spot locations throughout the lower valley that had previously been heavily infested with knapweed.

## Vegetation Characteristics of Areas Potentially Affected by the Alternatives

Vascular plant surveys of potential properties, road alignments, and campsite locations in conjunction with activities associated with the Stehekin River Corridor Implementation Plan were conducted June 19 and July 8 - 9, 2008. The surveys were conducted by North Cascades National Park Service Complex, Mignonne Bivin, Botanist, and William Clark, seasonal vegetation biological technician.

## Exchange Properties within the Project Area (Alternative 1)

- Vicinity of Lower Field
- Little Boulder / Boulder Creek (both sides of the road)
- East of the airstrip
- Vicinity of Stehekin Valley Ranch
- Above Rainbow Creek (west side of the road).

## Potential Exchange Property Characteristics within the Project Area (Alternatives 2 and 3)

As shown in Table III-7, 12 formerly privately owned parcels now owned by NPS have been identified for potential land exchange. Each of the parcels was surveyed by (1) walking the parcel in such a manner so as to ensure that all habitats were surveyed and (2) completely surveying any potential sensitive plant species habitat (intuitive sampling).

**Table III-7: Potential Exchange Property Characteristics**

| Area | Former Private Owner / Parcel Number(s) | Vegetation Composition | Notes |
|---|---|---|---|
| Boulder Fan area | Griffin (05-115, 05-116, 05-118) | Dominated by ponderosa pine / Douglas-fir. Sparse to moderate understory of xeric to mesic species. | |
| Boulder Fan area | Getty (05-156) | | |
| Keller‟s Park / Boulder Fan area | Dineen (05-114) | | |
| School area | Rice (05-106) | Dominated by dense Douglas-fir with very little understory. | One large parcel shown as two separate ones of 1.68 ac res and 2.73 acres |
| Castle / Keller Park | Brownfield (part of 05-122) | Douglas fir with occasional ponderosa pines with moderate cover of shrubs and herbaceous plants. | |
| Airstrip area | Peterson (06-110) | Cleared of most trees. Dominated by introduced grasses with a few ponderosa pine, Douglas-fir, and bigleaf maple. | |
| Orchard | Webb (06-107, 06-108) | Outside wetland. Consists of widely spaced ponderosa pine and Douglas-fir with sparse understory (treated for fuel reduction). | 1.33 acres |
| Lower Field / Stehekin Valley Ranch | Courtney (08-104) | Xeric Douglas-fir / ponderosa pine. Riparian edge along Stehekin River, dominated by bigleaf maple, dogwood, cottonwood, western red cedar, and red alder. Diverse understory, occasionally dense. | |

Within the proposed project area, there are five areas identified for location or relocation of recreational development. These include: Company Creek potential group site, Purple Point Horse Camp group/individual sites, Rainbow Falls, Bullion, and an area near the mouth of the Stehekin River (Table III-8: *Potential Recreational Development Sites*).

In addition to these potential land exchange parcels and potential recreational development sites, proposed road realignment within the project area would primarily occur within the upland mesic vegetation type and include areas dominated by Douglas-fir, ponderosa pine, bigleaf maple, and western red cedar; however, a portion of it would also occur in the pasture vegetation type and in talus.

**Table III-8: Potential Recreational Development Sites**

| Area | Vegetation Composition | Notes |
|---|---|---|
| Company Creek Area | Open Douglas-fir forest. Disturbed understory with many nonnative, invasive species. | Potential campsite(s). |
| Purple Point Horse Camp Area | Comprised of FMP manipulated Douglas-fir and ponderosa pine. Sparse understory. | Fire Management Plan (FMP) identified wildland-urban interface. Potential campsite(s). |
| Rainbow Falls Area | Douglas-fir / ponderosa pine overstory and sparse understory of herbaceous shrubs and plants. | Potential campsite(s). |
| Bullion Camp Area | Douglas-fir / ponderosa pine forest with sparse understory of herbs and drought-tolerant shrubs. | Across Stehekin Valley Road south of current camp (near the Stehekin River). Potential campsite(s). |
| River Resort Road | Dense cover of grand fir (*Abies grandis*) and Western red cedar across the road from this site. The understory cover was very sparse throughout most of the site. Wetland depressions with standing water and obligate wetland plant species occur throughout the parcel but not within the area of the raft takeout. | Potential raft takeout. |

## 8. WILDLIFE

Wildlife species inhabiting the Stehekin Valley include approximately 40 species of mammals, over 100 bird species, seven reptile species, and five species of amphibians. From summer 1988 through late winter 1992, as part of the Stehekin Valley vertebrate inventory, the following numbers of species were detected: 5 amphibians, 8 reptiles, 25 mammals, and 104 birds (Kuntz and Glesne 1993).

### Terrestrial Mammals

Mammals found within the Stehekin Valley include black bear (*Ursus americanus*), elk (*Cervus elaphus*), mountain goat (*Oreamnos americanus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), northern flying squirrel (*Glaucomys sabrinus*), and snowshoe hare (*Lepus americanus*).

Small mammal species detected during the vertebrate inventory in live or pitfall traps included two kinds of mice (*Peromyscus maniculatus*, *P. oreas*); Trowbridge's, montane, and vagrant shrews (*Sorex trowbridgei*, *S. monticolus*, and *S. vagrans*); shrew-mole (*Neurotrichus gibbsii*); creeping vole (*Microtus oregoni*); Gapper's red-backed vole (*Clethrionomys gapperi*); bushy-tailed woodrat (Neotoma cinerea); Douglas's squirrel (*Tamiasciurus douglasii*); Townsend's chipmunk (*Eutamias townsendii*); yellow-pine chipmunk (*Eutamias amoenus*); western gray squirrel (*Sciurus griseus*); and Cascades golden-mantled ground squirrel (*Spermophilus saturatus*). Of these, the shrews were most abundant and were captured in all habitat classes (Kuntz and Glesne 1993:17 - 20).

In addition, the following large and medium-sized mammals were detected during the inventory: black bear, raccoon, beaver (*Castor canadensis*), marten (*Martes americana*), mountain lion (*Felis concolor*), elk (Cervus elaphus), moose (*Alces alces*), and mule deer (*Odocoileus hemionus*) (Kuntz and Glesne 1993:35).

**Photo 17 – Black Bear Fishing for Spawning Kokanee Salmon (Dick Bingham)**

## Bats

Little is known about bat populations in the Stehekin Valley. Riparian areas and open meadows are important foraging areas for bats. Area bats may use former mines, caves, and tree or rock crevices for roosting and rearing.

Park biologists conducted a systematic baseline inventory during the summers from 1998 to 2001 to identify species composition, distribution, and relative abundance of bats inhabiting the park complex. Sampling sites included riparian, forest, and subalpine areas, both east and west of the North Cascades crest. Five species were identified from capture techniques: Yuma myotis (*Myotis yumanensis*), little brown myotis (*Myotis lucifugus*), western long-eared myotis (*Myotis evotis*), California myotis (*Myotis californicus*), and long-legged myotis (*Myotis volans*), all of which showed evidence of breeding (Christopherson and Kuntz 2003). An additional three species were documented from acoustic recordings: big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*) (Christopherson and Kuntz 2003). Both acoustic and capture data suggest the Yuma myotis and little brown myotis are the most abundant species in the study area, while the hoary bat and long-legged myotis appear to be the most uncommon or elusive of the documented bat species in the park complex (Christopherson and Kuntz 2003). From other sampling sites, all of the above capture- and acoustic-detected species were documented except the hoary bat (Christopherson, pers. comm., 2009).

Other bats expected but not found during this survey include the following species: western small-footed myotis (*Myotis ciliolabrum*), Keen's myotis (*Myotis keenii*), fringed myotis (*Myotis thysanodes*), and western red bat (*Lasiurus blossevillii*) (Johnson and Cassidy 1997).

## Birds

Among the more than 100 species of birds that can be found in the Stehekin Valley are the pileated woodpecker, gray jay, dark-eyed junco, black-capped chickadee, sooty grouse, common raven, red-tailed hawk, and American kestrel. The predominant bird species detected during the Stehekin Valley vertebrate inventory (Kuntz and Glesne 1993) were Hammond's flycatcher, Swainson's thrush, American robin, red-eyed vireo, yellow-rumped warbler, MacGillivray's warbler, western tanager, and dark-eyed junco. These species accounted for 50 percent of the detections and were present across all habitat classes sampled (Kuntz and Glesne 1993:11). In winter counts, 25 species were detected, with wintering waterfowl predominating (nine species comprising nearly half the detections), followed by pine siskin, evening grosbeak, chestnut-backed chickadee, red-breasted nuthatch, and golden-crowned kinglet. Wintering waterfowl included horned grebe, Canada goose, mallard, American widgeon, ring-necked duck, common goldeneye, Barrow's goldeneye, bufflehead, and common merganser.

Brown-headed cowbirds are found in the Stehekin Valley and appear to be increasing in abundance (Kuntz, pers. comm., 2009). Brown-headed cowbirds are brood parasites, laying their eggs in other songbird nests. The cowbird young outcompete their host species young for food brought to the nest by the host species parents. Cowbird young survive to fledging, while most or all of the host species young die of starvation or are pushed out of the nest by the bigger cowbird young. Cowbirds have increased in the Pacific Northwest due to logging of forests and land conversion to agricultural uses. In Stehekin, Community land development and the presence of livestock (horses) have enabled cowbirds to increase in number. Cowbirds in the valley have been documented parasitizing yellow-rumped warbler nests (Kuntz, pers. comm., 2009).

## Reptiles and Amphibians

Common reptiles include the common garter snake (*Thamnophis sirtalis*), western terrestrial garter snake (*T.hamnophis elegans*), and the northern alligator lizard (*Gerhonotus coeruleus*). Amphibians include the northwestern salamander (*Ambystoma gracile*), rough-skinned newt (*Taricha ganulose*), Columbia spotted frog (*Rana luteiventris*), Cascades frog (*Rana cascadae*), and western toad (*Bufo boreas*).

In the vertebrate inventory the following reptiles were detected: western terrestrial garter snake, racer (*Coluber constrictor*), rubber boa (*Charina bottae*), northern alligator lizard (*Elgaria coeruleus*), western fence lizard (*Sceloporous occidentalis*), western terrestrial garter snake, common garter snake, and western rattlesnake (*Crotalus viridis*); and the following amphibians were detected: long-toed salamander, western toad, Pacific tree frog, Cascades frog, and spotted frog (*Rana pretiosa*) (Kuntz and Glesne 1993:10). Most reptiles in pitfall traps were captured in the upland mesic habitat type. Of these, western fence lizards were the most common species. Talus areas, though they comprised only 2.6 percent of the area studied, were important for their reptilian species diversity (Kuntz and Glesne 1993:10).

## Fish

Note: For more information on the status of both native and nonnative fish, see the North Cascades National Park Service Complete Mountain Lakes Fishery Management Plan EIS (NPS 2008b).

Large woody debris in the form of individual pieces and log jams is an important component of the Stehekin River for fish, amphibians, and aquatic invertebrates. The abundance of fish in streams and rivers is strongly related to the abundance of coarse woody debris. Woody debris within the river channel provides cover for fish, and creates pools and backwater areas, storing sediment and capturing gravel for spawning (NPS 1995a:175; Sedell et al. 1984 in NPS 1995a).

Lake Chelan, the Stehekin River, and its tributaries provide valuable spawning, incubation, rearing, and feeding habitat for a variety of fish species, including 6 native and 12 nonnative trout and salmon species. Nonnative species known to occur in the Stehekin River or its tributaries include kokanee salmon (nonnative, landlocked sockeye salmon) (*Oncorhynchus nerka*), Chinook salmon (*O. tshawytscha*); and brown (*Salmo trutta*), brook (*Salvelinus fontinalis*), lake (*S. namaycush*), golden (*O. mykiss aguabonita*), and rainbow trout (*O. mykiss*). Nonnative species compete with and prey on native species.

Most nonnative fish were introduced by the Washington Department of Wildlife and Washington Department of Fisheries (later the Washington Department of Fish and Wildlife (WDFW)). Kokanee were stocked beginning in 1917 and became the dominant sport fish until the mid-1970s. They can be found in the fall, spawning in tributaries of the Stehekin River, such as Company and Blackberry creeks. Chinook were introduced to Lake Chelan to provide a trophy fishery. Rainbow, brook, and golden trout were introduced to previously fishless high mountain lakes. Lake trout were introduced to Lake Chelan between 1980 and 1982.

Native species include bull trout (*Salvelinus confluentus*), dolly varden (*Salvelinus malma*), and westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Although there have been numerous surveys for bull trout, none have been found in the Stehekin or its tributaries for the last 50 years (see also ―Special Status Species" section below for more information on bull trout, dolly varden, and westslope cutthroat trout). Bull trout are considered extirpated from the Stehekin River since none have been found since the early 1960s. The USFWS, however, is considering their reintroduction (NPS 2008:173). Dolly varden have not been documented in the Stehekin River. Nonhybridized cutthroat trout occur above High Bridge, outside the project area. Below that area, they mix with nonnative rainbow trout.

It is unlikely that there were ever many anadromous fish (fish that spend most of their life cycle in saltwater but breed in freshwater) in the Chelan Subbasin (USDC draft 2004 in NPS 2006c). Studies in the late 1800s and archeological documentation of fish use by prehistoric people have uncovered very little evidence of anadromous fish. In addition, a series of chutes, cascades, and falls in the Chelan River on its way to the Columbia River are barriers to anadromous fish migration (USDC draft 2004 in NPS 2006c).

### Invertebrates

Recent surveys of butterflies in Stehekin have documented 30 species (David Droppers pers. comm. with R. Kuntz 4-18-08). The most common species include woodland skipper (*Ochlodes sylvanoides*), western tiger swallowtail (*Papilio rutulus*), pale swallowtail (*Papilio eurymedon*), cabbage white (*Pieris rapae*), California tortoiseshell (*Nymphalis californica*), echo azure (*Celastrina echo*), and Lorquin's admiral (*Limenitis lorquini*).

## 9. SPECIAL STATUS SPECIES

This section includes information on federally listed threatened and endangered species, state-listed or identified rare, threatened, and endangered species, and park-identified rare or sensitive species. Although sensitive species are not protected under the Endangered Species Act, NPS policy states that they will be managed similarly to federally listed species to the greatest extent possible.

## a. Special Status Plants

Each area potentially affected by the proposed alternatives was surveyed for sensitive plant species as identified by Washington State Department of Natural Resources and the USFWS. Ten species were identified as potentially occurring within the Stehekin area (Table III-9: *Special Status Plants*). No species listed by the USFWS as federally listed are known to occur in North Cascades National Park Complex. No sensitive plant species were observed in these surveys. All vascular plant species observed and their relative abundance for each site were recorded (Appendix 8: Vascular Plants Observed within Proposed Project Areas).

**Table III-9: Special Status Plants**

Potential Washington State Sensitive Plants from Stehekin Valley Surveys

| Species | Common name | Habitat | State Status |
|---|---|---|---|
| *Astragalus arrectus* | Palouse milk vetch | Sagebrush flats, grassy hillsides, openings in Ponderosa Pine or Douglas fir forest gravelly or sandy flats. | Threatened |
| *Botrychium lunaria* | Common moonwort | Moist open areas in meadows and forests. | Watch |
| *Botrychium minganense* | moonwort | Moist sites in deciduous and coniferous forest, subalpine sites. A fern-like plant known from two places in the lower Stehekin Valley. | Watch |
| *Botrychium pedunculosum* | Stalked moonwort | Moist wooded sites. | Sensitive |
| *Cicuta bulbifera* | Bulb-bearing hemlock | Edges of marshes, lakes, bogs, meadows, and shallow standing or slow-moving water. | Sensitive |
| *Epipactis gigantea* | Giant hellebore | Streambanks, lake shores, seeps, springs. A nonshowy orchid found along streambanks, seeps, and lake margins known from undisturbed sites south of the Landing. | Watch |
| *Githopsis specularioides* | Common blue-cup | Dry, open places in foothill areas of thin soils, talus slopes. | Sensitive |
| *Pellaea brachyptera* | Sierra cliff brake | Dry, Rocky slopes, talus, outcrops in Douglas-fir and Ponderosa Pine forest. | Sensitive |
| *Penstemon eriantherus* var. *whitedii* | Fuzzy-tongued penstemon | Open sagebrush shrub, open areas in valleys and foothills. | Sensitive |
| *Spiranthes porrifolia* | Western ladies tresses | Meadows, seeps, streams. An orchid that blooms in July and August, found in moist to wet areas, known from a disturbed site south of the Landing. | Sensitive |

Definitions:

State status is described as follows: Factors considered include abundance, occurrence patterns, vulnerability, threats, existing protection, and taxonomic distinctness. Values include:

**Extinct or Extirpated**: Possibly extinct or Extirpated from Washington.
**Endangered**: In danger of becoming extinct or extirpated from Washington.
**Threatened**: Likely to become Endangered in Washington.
**Sensitive**: Vulnerable or declining and could become Endangered or Threatened in the state.
P1 = Priority 1. Rare nonvascular plant but with insufficient information to assign another rank.
P2 = Priority 2. Nonvascular plant of concern but with insufficient information to assign another rank.
R1 = Review group 1. Of potential concern but needs more field work to assign another rank.
R2 = Review group 2. Of potential concern but with unresolved taxonomic questions.
**Watch**: More abundant and/or less threatened than previously thought.

The small number of rare plants located in previous surveys is found outside of the project area. Rare plant surveys were conducted in spring 2008 on parcels that could be affected by actions associated with this planning effort (see ―Vegetation” section).

## b. Special Status Wildlife

**Table III-10: Special Status Wildlife**

| Species | Federal Status* | State Status* | Park Status / Notes *See also information below this table.* |
|---|---|---|---|
| **Mammals** | | | |
| Gray wolf (*Canis lupus*) | FE | SE | |
| Canada lynx (*Lynx canadensis*) | FT | ST | Lynx critical habitat in Chelan County east of the Cascade Crest and above the 4,000 ft contour interval (outside the proposed project area) |
| Grizzly bear (*Ursus arctos horribilis*) | FT** | SE | All of the project area is within the North Cascades Grizzly Bear Recovery Area |
| California wolverine (*Gulo gulo luteus*) | FSC | SC | |
| Pacific fisher (*Martes pennanti pacifica*) | FC | SE | |
| Western gray squirrel (*Sciurus griseus*) | FSC | ST | |
| Pacific Townsend‟s big-eared bat (*Corynorhinus townsendii townsendii*) | FSC | SC | |
| *Small-footed (Yuma) myotis (*Myotis ciliolabrum*) | FSC | | |
| Western long-eared myotis (*Myotis evotis*) | FSC | SM | |
| Fringed myotis (*Myotis thysanodes*) | FSC | SM | |
| Long-legged myotis (*Myotis volans*) | FSC | SM | |
| Keen‟s myotis (*Myotis keenii*) (coastal species that does not occur in Lake Chelan NRA) | | SC | |
| **Birds** | | | |
| Bald eagle (Haliaeetus leucocephalus) | FSC (M) | SS | A pair has nested near the mouth of the Stehekin since 2001 |
| Northern spotted owl (Strix occidentalis caurina) | FT | SE | |
| Peregrine falcon (Falco peregrinus anatum) | FSC (M) | SS | |
| Golden eagle (Aquila chrysaetos) | | SC | |
| Merlin (Falco columbarius) | | SC | |
| Northern goshawk (Accipiter gentilis) | FSC | SC | |
| Olive-sided flycatcher (Contopus cooperi) | FSC | | |
| Harlequin duck (Histrionicus histrionicus) | | SC | |
| Black swift (Cypseloides niger) | FSC | | |
| Vaux‟s swift (Chaetura vauxi) | | SC | |
| Lewis‟s woodpecker (Melanerpes lewis) | | SC | |
| Black-backed woodpecker (Picoides arcticus) | | SC | |
| Pileated woodpecker (Dryocopus pileatus) | | SC | |
| Common loon (Gavia immer) | | SS | |
| Western grebe (Aechmophorus occidentalis) | | SC | |

| Species | Federal Status* | State Status* | Park Status / Notes *See also information below this table.* |
|---|---|---|---|
| **Reptiles** | | | |
| (none) | | | |
| **Amphibians** | | | |
| Columbia spotted frog (*Rana luteiventris*) | FC | SC | |
| Western toad (*Bufo boreas*) | FSC | SC | |
| Spotted frog (*Rana pretiosa*) | FSC | SC | |
| Cascades frog (*Rana cascadae*) | FSC | | |
| Tailed frog (*Ascaphus truei*) | FSC | | |
| **Fish** | | | |
| Bull trout (Salvelinus confluentus) | FT | SC | |
| Dolly Varden (Salvelinus malma) | FP, SC | | |
| Chinook salmon (Oncorhynchus tshawytscha) | FT | SC | |
| Westslope cutthroat trout (Oncorhynchus clarkii lewisi) | FSC | | |
| **Invertebrates** | | | |
| (none) | | | |

*Definitions

Federal (USFWS/ National Oceanic and Atmospheric Administration, National Marine Fisheries Service [NOAA Fisheries])

***FE = Federally Endangered**:* Listed by the USFWS or NOAA Fisheries as a species that is in danger of extinction throughout all or a significant portion of its range.

***FT = Federally Threatened**:* Listed by the USFWS or NOAA Fisheries as a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

***FP = Federally Proposed**:* Species for which the USFWS or NOAA Fisheries has determined are warranted for listing and are proposed in the Federal Register listing as threatened or endangered but for which rules have not yet been promulgated.

***FC = Federal Candidate**:* Species that are under consideration for listing by the USFWS or NOAA Fisheries but which do not yet have conclusive information to warrant listing as threatened or endangered.

***FSC = Federal Species of Concern**:* Species whose conservation standing is of concern to the USFWS, but for which status information is still needed. These are generally species from the former Category I, II, or III lists.

***(M)*** = Species that have been delisted but whose status is still monitored.

State (WDFW)

***SE = Washington State Endangered**:* A species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state as listed by the WDFW.

***ST = Washington State Threatened**:* A species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats as listed by WDFW.

***SC = Washington State Candidate**:* Includes species that the WDFW is considering for possible listing as endangered, threatened, or sensitive. According to the WDFW, a species will be considered for designation as a state candidate if sufficient evidence suggests that its status may meet the state listing criteria defined for endangered, threatened, or sensitive.

***SS = Washington State Sensitive**:* A species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats, as identified by WDFW.

***SM = Washington State Monitor**:* A species native to the State of Washington that is of special interest because (1) at one time it was classified as endangered, threatened, or sensitive; (2) it requires habitat that has limited availability during some portion of its lifecycle; (3) it is an indicator of environmental quality, (4) further field investigations are required to determine population status; (5) there are unresolved taxonomic problems that may affect its classification status; (6) it is competing with or affecting other species of concern; or (7) it has significant popular appeal.** The USFWS has determined that grizzly bears in the North Cascades Ecosystem are warranted for listing as Endangered under the Endangered Species Act, but that change in status has not yet been acted upon.

** The USFWS has determined that grizzly bears in the North Cascades Ecosystem are warranted for listing as Endangered under the Endangered Species Act, but that change in status remains precluded by other priorities.

## Gray Wolf

**Range**: Wolves formerly ranged throughout the North Cascades, but were extirpated from many areas by 1910. In the last 20 years, wolves have been seen near Ross Lake, in the Pasayten Wilderness, in Okanogan National Forest, and in Glacier Peak Wilderness. Recolonization of wolves from Canada into Washington State is occurring. Wolf packs require territories ranging from 40 to 1,000 square miles. Although essentially all of the Stehekin area is considered suitable habitat, winter deer range in the riparian zone and south-facing slopes of the lake may be particularly important.

Recent studies conducted by the North Cascades resource management biologist and biologists from the WDFW documented wolf presence in Lake Chelan NRA wilderness. Collared animals were tracked in the upper elevations of the wilderness area. The last sightings of gray wolves in the Stehekin Valley below High Bridge, however, were more than 10 years ago.

**Habitat**: Gray wolves are highly social animals with large home ranges comprising a variety of terrain. Key habitat components include a sufficient year-round ungulate prey base coupled with the availability of other prey species (mid-sized mammals); suitable, fairly secluded denning and rendezvous sites; and minimal exposure to human activity (USFWS 1987 in NPS 2006c).

**Recovery**: There is currently no USFWS recovery plan for gray wolves in the North Cascades.

**Photo 18 – Gray Wolf Pups (Conservation Northwest)**

## Grizzly Bear

**Range**: According to the USFWS, the North Cascades contain habitat capable of supporting a self-sustaining population of grizzly bears (USFWS 2005 in NPS 2006c). Only a remnant population exists, which is unlikely to persist without recovery efforts. Although suitable habitat exists within the Stehekin Valley below High Bridge, grizzly bears have not been documented in the last 10 years. In general, grizzlies are considered extremely rare in the North Cascades (NPS 2007).

**Habitat**: Key habitat requirements for grizzly bears include the availability of a reliable food source and isolation from humans (USFWS 1989 in NPS 2006c). Grizzlies may use low-elevation riparian areas and wet meadows during spring, and higher-elevation meadows, ridges, and open shrublands during summer. Avalanche chutes are likely an important habitat component from spring through fall (McLellan and Hovey 2001; Ramcharita 2000).

**Recovery**: The *Grizzly Bear Recovery Plan for North Cascades Ecosystem* was approved in 1997 (USFWS 1997), but major portions of it have not been funded. In the interim, the NPS and USFS have agreed to no net loss of core areas in the North Cascades ecosystem. Under this agreement, construction of roads or high-use trails in a core area (more than 1,640 feet from roads or high-use trails) requires closure of a road and/or a trail of similar size, use level, and habitat within the affected Grizzly Bear Management Unit. The upper Stehekin River Grizzly Bear Management Unit is 95,000 acres.

**Photo 19 – Bear Paw Prints (Roger Christophersen)**

## California Wolverine

**Range**: Wolverines are an uncommon resident of a wide variety of vegetation types in remote mountainous areas. They occupy high-elevation coniferous forests and subalpine areas.

**Habitat**: In Washington, they are associated with subalpine and alpine areas, moving down to forested valleys in winter. They feed on ungulates and small mammals (Johnson and Cassidy 1997). Most evidence of wolverines from the North Cascades has been within the Bridge Creek drainage, including the observance of tracks on the Bridge Creek Bridge. Two unconfirmed wolverine sightings from January 1974 and June 1983 in the Stehekin Valley are in the wildlife observation database (NPS 2006c). Wolverines were not detected in the Vertebrate Inventory (Kuntz and Glesne 1993:24). Wolverines were also not detected in the Forest Carnivore Surveys (Happe et al. 2006).

The activity areas of three wolverines fitted with radio collars during 2006 - 2009 include all of the lower Stehekin Valley. How much time these individuals spent within the lower valley is not known (USFS 2009).

**Recovery**: Since wolverines are not yet federally listed, no recovery plan has been established for this species.

**Photo 20 – California Wolverine (U.S. Forest Service)**

### Canada Lynx

**Range**: Although lynx are documented as occurring in the North Cascades, it is likely that lynx were uncommon visitors to the Stehekin River valley due to its lower elevation and a lack of available primary habitat (spruce-fir forest). Four unconfirmed sightings of lynx in the lower Stehekin Valley (below High Bridge) were documented between 1975 and 2000. A small number of lynx live in the Pasayten Wilderness east of Ross Lake (NPS 2007).

**Habitat**: Lynx are associated with subalpine and boreal forests throughout their range (Witmer et al. 1998; Aubry et al. 1999). The species requires a mosaic of forest seral stages connected by stands suitable for travel cover. Lynx use late-seral forests for denning and rearing young and use early seral forests for foraging (Aubry et al. 1999). Primary prey is snowshoe hare, although lynx will take other prey, particularly when hare density declines.

A vertebrate inventory conducted in 1990 and 1991 documented snowshoe hare presence in the Stehekin Valley (Kuntz and Glesne 1993). Lynx tend to use higher-elevation habitat (3,000 - 4,000 feet) than the Stehekin Valley. In addition, that habitat is often comprised of lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), and Engelmann spruce (*Picea engelmannii*), species generally absent from the lower Stehekin Valley. Lynx have not been reported from the Stehekin Valley since 1980. Lynx were not detected in the Forest Carnivore Surveys (Happe et al. 2006).

### Pacific Fisher

**Range**: Fishers formerly occurred throughout densely forested areas of Washington State. Records of fishers in the eastern North Cascades are associated with forests above 1,800 feet containing Douglas-fir and grand fir. Extensive surveys have been unable to confirm the existence of a population in the state (NPS 2007). However, a reintroduction effort to restore fishers to Olympic National Park is currently underway as part of an effort to reestablish self-sustaining fisher populations in the state.

**Habitat**: Fishers are associated with riparian areas in late successional coniferous forests (Ruggiero et al. 1994 in NPS 2006a). Large snags and logs provide denning and nesting sites. Fishers also use a wide variety of forested areas for foraging. Riparian areas, lakeshores, and ridgelines are used as movement corridors. Although the North Cascades area around Stehekin at one time had the highest density of recent fisher records in the state (10 records between 1980 and 1991) (NPS 1995a:194), fishers have not been documented in the Stehekin Valley since 1980 (Christopherson and Kuntz 2004; DES 2000 in NPS 2006a; Kuntz and Glesne 1993:24). Fishers were also not detected in the Forest Carnivore Surveys (Happe et al. 2006).

**Recovery**: Since fishers are not yet federally listed, no recovery plan has been established for this species.

### Western Gray Squirrel

**Range**: Although western gray squirrels are common in California and Oregon, where oak trees are common, park researchers are uncertain how the population persists in Stehekin Valley, where there are no oaks. The western gray squirrel population in Washington is believed to be declining. There are only three isolated populations in the state, including a very small population in the Stehekin Valley. The state's review of the Stehekin population concluded that the Stehekin population is highly vulnerable and may not survive without active management based on limited availability of analysis of populations and trends.

**Habitat**: Western gray squirrels prefer mixed oak and conifer forests. In areas without oaks, such as the Stehekin Valley, ponderosa pine and Douglas-fir are used. Stehekin Valley forests provide squirrels with conifer seeds, mushrooms, insects, berries, and canopies for nesting. Trees provide either seasonal or year-round cover, nest sites, travel corridors, and food. A small population of western gray squirrels occurs in the Stehekin Valley, where they were documented in the nutrient-rich conifer and upland mesic conifer habitat classes (Kuntz and Glesne 1993:24). Park researchers know little about the gray squirrels' habitat requirements in the Stehekin Valley and it is unknown whether, over the long term, they can continue to persist.

**Recovery**: Their small, isolated populations, sensitivity to habitat change, and low reproductive rates (one litter per year) make them susceptible to extinction. In partnership with the University of Washington and USGS, park biologists hope to learn more about the squirrels through a three year study (which began in fall 2007). Researchers intend to capture and attach radio-collars to approximately 30 squirrels to assess vital demographic rates and habitat requirements on western gray squirrel populations in Stehekin. The study will also try to determine how current recreation area management and private landowners' actions impact the western gray squirrel population in the Stehekin Valley. Ideally, management actions to maintain a viable population of western gray squirrels in Stehekin Valley will be identified (NPS 2007:4).

**Photo 21 – Western Gray Squirrel**

## Bats

The Stehekin Valley contains habitat or potential habitat for four bat species that are considered federal species of concern: the long-eared myotis, long-legged myotis, small-footed (Yuma) myotis, and Townsend's big-eared bat.

According to Christophersen and Kuntz (2003), 12 species of bats are thought to inhabit North Cascades NPS Complex. Nine of the 12 species assumed to occur in the park appear on the Washington State Priority-Habitats and Species List, including eight species of the genus *Myotis* (*M. yumanensis,* M. lucifugus, M. californicus, M. evotis, M. thysanodes, M. volans, M. ciliolabrum, M. keenii) as well as the big brown bat (*Eptesicus fuscus*) (Washington Department of Fish and Wildlife 2002 in Christophersen and Kuntz 2003). In addition, both Keen's myotis (*M. keenii*) and Townsend's big-eared bat (*Coryhorninus townsendii*) are listed as Washington State candidate species (Washington Department of Fish and Wildlife 2002 in Christophersen and Kuntz 2003). Keen's myotis, however, is a coastal species expected to occur on the west side of the Cascade Crest and not expected from Lake Chelan NRA (Christophersen, pers. comm., 2009). Currently, six forest bat species of the Pacific Northwest are listed as federal species of concern: M. volans, M. thysanodes, M. evotis, M. yumanensis, M. ciliolabrum and C. townsendii (USFWS 2001a in Christophersen and Kuntz 2003).

**Range**: Each of these species is known to occur in coniferous forests, and the availability of roosting areas (for resting and for maternal sites) is an important habitat component for the bats. Roost sites range from cavities and loose bark in large trees and snags to abandoned buildings, caves, and crevices in rock cliffs (Nagorsen and Brigham 1993). Older forests generally provide higher-quality roost sites than younger forests (Christy and West 1993). Most roosting bats are extremely sensitive to human disturbance.

## Habitat

**Pacific Townsend's Big-eared Bat**: Pacific Townsend's big-eared bats prefer coniferous forested habitat and hibernate in caves. They use loose bark in large trees, caves, crevices, and abandoned buildings for roosting. Nursery colonies are extremely sensitive to human activity, and sites are readily abandoned if disturbed. This species has not been detected in the Stehekin Valley.

**Western Long-eared Myotis**: This species is found in a wide range of habitats, including arid grasslands and ponderosa pine forests to humid coastal and montane forests, and at high elevations. It has been documented from the Stehekin Valley. Buildings or tree bark serve as day roosts. Caves and mines are used as night roosts, while maternity colonies are usually found in buildings. They eat moths, beetles, flies, and spiders and catch insects on the wing as well as glean from vegetation or off the ground (Nagorsen and Brigham 1993).

**Long-legged Myotis**: This bat occurs in arid range lands and interior and coastal montane forests. It uses buildings, crevices in rock cliffs, fissures in the ground, and tree bark for summer day roosts. It forages over ponds, streams, open meadows, and forest clearings and has been documented from the Stehekin Valley. Night roosts are usually in caves or mines. It eats mostly moths, but also termites, spiders, flies, beetles, leafhoppers, and lacewings (Nagorsen and Brigham 1993).

**Western Small-footed (Yuma) Myotis**: This bat lives near cliffs and rock outcrops in arid valleys and badlands. In summer it roosts in cavities in cliffs, boulders, vertical banks, ground and talus slopes, and under rocks. Night roosts include small caves, abandoned mines, and buildings. It feeds primarily on caddis flies, but eats other flies, beetles, and moths. They usually hibernate alone in tight crevices (Nagorsen and Brigham 1993).

**Fringed Myotis**: This bat ranges from Mexico to Canada, inhabiting desert, arid grasslands, and arid and/or coniferous forest habitat. It is associated with ponderosa pine-Douglas-fir forest in British Columbia. It roosts in tight clusters. It eats moths, flies, beetles, leafhoppers, lacewings, crickets, and harvestmen. Some prey is gleaned from foliage. Nursery colonies have been found in caves and buildings (Nagorsen and Brigham 1993).

### Bald Eagle

**Habitat**: Bald eagles prefer riparian and open water habitats with tall trees and adequate fish and waterfowl prey species. Bald eagles have been observed occasionally perched in trees along the lower Stehekin River, where they occasionally forage for fish and roost in fall, winter, and spring. In the fall, eagles are likely using older trees in the valley for night roosting. There is an active bald eagle nest located at the mouth of the Stehekin River near the head of Lake Chelan. It has been active since it was identified in 2001. Bald eagles are also seen in the fall and winter in this area. In 1995, the USFWS estimate of the lake's wintering population was five birds (NPS 1995a:193). Bald eagles also use portions of the river adjacent to the Stehekin Valley Road. The nearby Skagit River watershed supports one of the largest wintering populations of bald eagles within the contiguous United States (NPS 2007).

### Peregrine Falcon

Peregrine falcons usually nest on high cliffs and buttes, near water where avian prey species are most common (Johnsgard 1990). The species forages on a large variety of birds, and birds that regularly fly high in a way that exposes them to the peregrine's typical diving attack; namely, highly mobile, flocking, and colonially nesting species such as waterfowl and shorebirds. These species are particularly valuable prey (Johnsgard 1990).

Peregrine falcons have been sighted in the valley, but there are no records of nests. The steep, rocky cliffs along the Stehekin River provide suitable nesting and foraging habitat, particularly on the northeast side of the valley on the southwest-facing slopes of Rainbow Mountain between 2,800 and 5,600 feet in elevation, however, this habitat is not within the proposed project area.

### Northern Spotted Owl

**Range**: Northern spotted owls occupy structurally complex forested habitat in mature or old growth forests, where trees are of variable species, sizes, and ages, and snags and multi-storied canopies are present. They are found from British Columbia throughout the Pacific Northwest and into California.

**Photo 22 – Northern Spotted Owl**

**Habitat**: In 1993, park surveys located three nesting pairs and two additional single owls, all between the mouth of Bridge Creek and the southern boundary of Lake Chelan National Recreation Area. Since 1993, known pair sites in the Stehekin Valley and its tributaries up to the mouth of Bridge Creek have been surveyed three times each year. Sites where single owls have been observed have been surveyed most years at least once. Most of the pair sites are outside the proposed project area vicinity.

One pair, however, has been active within the project area for many years. Located approximately 500 feet from the Stehekin Valley Road on the south side of the Stehekin Valley, the pair was discovered in July 1998 during a cavity-nesting bird survey. Later, this discovery was confirmed when an adult pair and three juveniles were observed. Three birds were banded in August 1998 (Table III-11: *Summary Status for the McGregor Meadows Northern Spotted Owl Activity Site*).

**Table III-11: Summary Status for the McGregor Meadows Northern Spotted Owl Activity Site**

| Year | Occupancy (Presence of Northern Spotted Owls) | Reproduction? | Notes |
|---|---|---|---|
| 1998 | Pair occupancy confirmed. | Reproduction confirmed. | 2 young banded. |
| 1999 | Pair occupancy confirmed. | Reproduction unknown. | |
| 2000 | Single occupancy confirmed (male). Pair occupancy unknown. | Reproduction unknown. | |
| 2001 | Occupancy unknown. | Reproduction unknown. | |
| 2002 | Occupancy unknown. | Reproduction unknown. | |
| 2003 | No surveys. | | |
| 2004 | Single occupancy confirmed (male). Pair occupancy unknown. | Reproduction unknown. | |
| 2005 | Pair occupancy confirmed. | Reproduction confirmed. | 2 juveniles fledged. |
| 2006 | Pair occupancy confirmed. | Reproduction confirmed. | 1 juvenile observed. |
| 2007 | Pair occupancy confirmed. | Productivity failed or nonnesting. | |
| 2008 | Site unoccupied. No northern spotted owls detected. | | Pair of barred owls found. |
| 2009 | Site Unoccupied. No spotted owls detected. | Nonnesting. | Pair of barred owls found. |
| 2010 | Site occupancy confirmed (male). Pair occupancy unknown. Reproduction unknown. | Nonnesting. | |

Note: Several owls have been identified in the Stehekin Valley since 1993. Of those, a number of pairs have produced young.

The USFWS Action Area for this former northern spotted owl nest site in the Stehekin Valley (USFWS 2005) has a radius of 0.7 miles, which extends out from the nest tree in all directions. No construction work can occur within this area during the nesting season (March 1 to September 6, depending on fledging of young).

**Recovery**: The Stehekin River watershed is a Designated Conservation Area (DCA) for the northern spotted owl. The Recovery Plan for the species identifies most of the Stehekin Valley as a DCA. Based on the USFWS 1992 Draft Recovery Plan, there are four DCAs (WD-31, WD-33, WD-34, and WD-35) partially or wholly within lands managed by North Cascades National Park Service Complex. Within the four DCAs there are 35,730 acres of suitable habitat for northern spotted owls. There are 21 DCAs in the eastern Washington Cascades province. DCA WD-33 is within the proposed project vicinity.

In 1995 it was estimated that 2,500 acres of suitable habitat were available for owls from the Lower Field down valley to Lake Chelan (see USFWS 1995). NPS fuel management actions in the lower valley, as defined in the *Forest Fuel Reduction/Firewood Management Plan* (NPS 1995g), will reduce suitable habitat by 299 acres. For this reason, implementation of the NPS *Forest Fuel Reduction/Firewood Management Plan* required issuance of an ―incidental take” permit from the USFWS for the fuel reduction actions in the valley below the Lower Field.

### Golden Eagle

The 1995 GMP reports only 80 breeding pairs of golden eagles in Washington State (NPS 1995a:194). Golden eagles are associated with open areas containing low-lying shrubs, grasslands, open areas, or open ponderosa pine forests (Watson and Whalen 2003 in NPS 2006a). Golden eagles nest on cliffs or in large trees and prey on mid-sized mammals, including rabbits, ground squirrels, and marmots. Golden eagles have been observed foraging along the lower Stehekin River near the head of Lake Chelan in winter (NPS 2006c).

### Merlin

Merlins are associated with habitats similar to the golden eagle, and are generally not found in the Stehekin Valley. Merlins eat small, open-country birds such as larks, swallows, and finches as well as small mammals and insects. Three wildlife observation database records for merlins have been identified from the Stehekin Valley (in June 1986, May 1993, and September 1995) (NPS 2006c). These records probably represent birds migrating through the valley, since the dense forests characteristic of the valley do not provide suitable nesting habitat for this species.

### Northern Goshawk

Northern goshawks are present in upland mesic coniferous forests and deciduous riparian forests in the Stehekin Valley. Northern goshawks fly below the canopy in mature or old-growth forests to forage for ground-dwelling birds, ducks and mammals and nest in large trees. Goshawk nests have been documented on the shore of Lake Chelan south of the Landing and above High Bridge.

### Harlequin Duck

Harlequin ducks occur in mountain stream environments during the breeding season. Their breeding habitat consists of clear, clean, fast-flowing, low-gradient (less than 3 percent) mountain streams (second order or larger) with rocky substrates and riparian bank vegetation (USFS 1992). Nests may be located on top of stable cut banks, on side slopes of streams, on steep slopes, in undercut stream banks, in cliff cavities above the stream, and in piles of woody debris (MacCallum 2001), as well as in hollow trees and snags (Cassirer et al. 1993).

Surveys completed in the early 1990s concluded that 7 to 11 pairs nest along the Stehekin River between High Bridge and the head of Lake Chelan, among the highest nesting density recorded on any North American river. Most were found between Rainbow Creek and Harlequin Bridge, with the greatest concentration near the Buckner Homestead hayfield and pasture. Harlequins arrive in April and start nesting by the beginning of May. Young are usually first seen on the Stehekin River and its tributaries by late June - early July. Males leave the river by early July, migrating back to the Pacific Coast. Females and juveniles return to the coast in August to early September.

### Lewis's Woodpecker

Lewis's woodpeckers inhabit recently burned areas in open woodlands and forests. There is one 1971 record of this species at the head of Lake Chelan from the wildlife observation database (NPS 2006c).

### Black-backed Woodpecker

The black-backed woodpecker occurs in montane and pine forests, where it is confined mostly to burned areas with abundant snags (USFS 1992; Dixon and Saab 2000). Recent burns provide outbreaks of bark beetles, which are the main prey for this woodpecker (Dixon and Saab 2000). In the absence of burns, this woodpecker will forage in areas with diseased trees. Most studies indicate that the species prefers to forage on dead trees rather than live trees (Dixon and Saab 2000).

There are three records of these birds observed in the lower Stehekin Valley from the Wildlife Observation Database (1984 - 2001) (NPS 2006c). All three records occurred between July 25 and August 13. According to staff biologists, they probably represent post-breeding movement. In the project area, black-backed woodpeckers would be uncommon, due to the lack of high-intensity burned areas and/or diseased areas with abundant snags.

### Pileated Woodpecker

Pileated woodpeckers are known to be present and nest in lowland forests in the Stehekin Valley. They are found within Douglas-fir and ponderosa pine forests as well as in mature riparian forests. They excavate large rectangular holes in search of carpenter ants. These cavities are later used by saw-whet and screech owls, Vaux's swifts, flickers, chickadees, bluebirds, flying and tree squirrels, woodrats, and bats.

### Black Swift

According to the Seattle Audubon Society's Bird Web (www.birdweb.org), the Black Swift is an uncommon breeder in forested habitats at moderate elevations in the northern Cascades (both east and west sides north of Snoqualmie Pass). Black Swifts require a specialized habitat for nesting, in forested areas near rivers, where their nests are often located behind waterfalls or on damp cliffs where the environment is dark, wet, steep, and inaccessible to predators. This provides the birds with an unobstructed way to approach the nest. Black Swifts may nest singly or in small colonies. Nests may be reused from year to year, with more material added each year. Black Swifts are patchily distributed, with apparently stable numbers. Because of the difficulty in locating and observing nests, however, this species' ecology is not well known.

### Vaux's Swift

Vaux's swifts are common in April or May through September in the Stehekin Valley. They require large, hollow snags or cavities in the broken tops of live trees for nesting and roosting. Nesting occurs from June through August. Based on studies in Oregon, Vaux's swifts prefer grand firs for nesting and roosting (NPS 2006c). Swifts forage over open water. At least two pairs have been identified in the valley (NPS 1995a:196).

### Bull Trout

**Range**: The Stehekin River is within the range of Columbia River bull trout. Historically, bull trout inhabited the Stehekin River and Lake Chelan; however, the last confirmed report of bull trout in Lake Chelan was in 1957 (Brown 1984 in NPS 1995a:189) and they are now considered to be extirpated from the lower Stehekin River (NPS 2007). A large number of sick and dying bull trout had been observed in the fall of 1951 and there were few reports of the fish after that. In 1993, there were several unconfirmed reports of bull trout being captured in the Stehekin River (FERC 2002 in NPS 2006a; NOAA Fisheries 2004). Little is known about the historical status of bull trout in Lake Chelan. Some remnant bull trout may reside in tributaries to Lake Chelan, however verified captures from the lake have not occurred in two decades (FERC 2002 in NPS 2006a).

Although their fall spawning run in the Stehekin River was once a major angler and tourist attraction, based on the results from numerous creel and habitat surveys, bull trout are presumed to be extirpated from the Stehekin River. The project area does not contain designated or proposed bull trout critical habitat. Nonetheless, in the recreation area, bull trout habitat is managed to (1) avoid further degradation, (2) protect any potential remaining individuals or populations, and (3) preserve the option of species restoration.

**Life History**: Like rainbow trout/steelhead, bull trout exhibit two distinct life history strategies: resident and migratory. Resident bull trout spend their entire lives in headwater streams. Migratory populations spawn in headwaters, where rearing takes place. Juveniles then migrate downstream to larger rivers, lakes, or the ocean, where they mature before returning to the headwaters to spawn. Spawning occurs in the fall, with emergence in spring. Bull trout primarily feed on bottom-dwelling and drifting aquatic insects; however, larger fish mostly eat smaller fish.

**Habitat**: Bull trout juveniles feed on invertebrates and other fish, but primarily eat fish as adults. Optimal habitat is characterized by clear, cold water and gravel-cobble substrates free of fine sediments, abundant instream cover, and deep pools (Rieman and McIntyre 1993 in NPS 2006a). Bull trout populations are associated with high channel complexity and cold stream reaches within a basin (Rieman and McIntyre 1993 in NPS 2006a).

**Threats**: Bull trout are rapidly declining throughout their range. Identified risks to bull trout include dams and diversions, overharvest, habitat degradation, competition from and hybridization with competing species such as brook trout, and population fragmentation (Bader et al. 1993 in NPS 1995a:190; Lee et al. 1997 in NPS 2006a).

### Dolly Varden

Dolly Varden were proposed as threatened under the similarity of appearance provision of the Endangered Species Act. They occupy the same habitats and have nearly indistinguishable characteristics from bull trout.

### Westslope Cutthroat Trout

Westslope cutthroat trout were once the dominant sport fish in Lake Chelan. A combination of factors, including hatchery egg harvesting, introduction of competitive sport fish such as rainbow and brook trout and kokanee salmon, hybridization with rainbow trout, construction of the Chelan dam, and overfishing, led to a much-reduced population after 1910. Hatchery-reared fish began to be planted in Lake Chelan, its tributaries, and high mountain lakes in the mid-1920s.

**Range**: Native westslope cutthroat trout occur in the Stehekin River and its tributaries, including Bridge, Park, Canim, Buzzard, and McGregor creeks. Population densities in the upper Stehekin River and in Bridge and Park creeks are some of the highest recorded in the continental United States (FERC 2002 in NPS 2006a). Below Bridge Creek, the cutthroats hybridize with rainbow trout.

**Life History**: Similar to bull trout, westslope cutthroat trout also exhibit both resident and migratory life history strategies. Cutthroat trout spawn in the spring to mid-summer (between March and July) in low-gradient stream reaches that have clean gravel substrate in close proximity to cover (overhanging rocks, stream banks, or vegetation) (Behnke 1992; McIntyre and Rieman 1995 in NPS 2006a).

**Habitat**: Westslope cutthroat trout fry generally occupy shallow waters near stream banks and other low-velocity stream areas (backwaters or side channels); juveniles are most often found in pools and riffles (McIntyre and Rieman 1995 in NPS 2006a). Adult westslope cutthroat are associated with cold, high-gradient reaches that have pools and cover (Shepard et al. 1984; McIntyre and Rieman 1995 in NPS 2006a). Among the characteristics that identify westslope cutthroat trout habitat are clear, cold water; silt-free substrate in riffles; equal areas of pools and riffles; areas of slow, deep water; well-vegetated stream banks; abundant instream cover; relatively stable flow regimes and stream banks; and productive insect populations (Hickman and Raleigh 1982; Fraley and Shepard 1989 in NPS 1995a:189).

**Threats**: Risks to westslope cutthroat trout are the same as those affecting bull trout (Lee et al. 1997 in NPS 2006a).

### Chinook Salmon

The largest of the Pacific salmon, the Chinook salmon (king salmon) weigh between 12 and 40 pounds and have a silvery olive-brown and purple coloring. They prefer freshwater streams and deep pools, though they eventually migrate to the ocean. Wild Chinook persist in the Skagit River watershed, along with all five Pacific salmon species (NPS 2007). Chinook salmon were stocked in the Chelan Subbasin. Landlocked Chinook have established resident lake populations and currently spawn in the Stehekin River, Company Creek, and Blackberry Creek (FERC 2002 in NPS 2006a).

### Western Toad

Western Toads range in elevation from sea level to 2,250 meters amsl. Oviposit sites and aquatic habitat include lakes, springs, ponds, wetlands, stock ponds, and slow-moving parts of streams. Terrestrial habitats are forests, grasslands, and along streams. Western toads are most common near marshes and small lakes, but they may wander great distances through dry forests or shrubby thickets. Outside of the breeding season, western toads are nocturnal, spending the day buried in the soil, concealed under woody debris, or in the burrows of other animals. The western toad has been documented in the Stehekin Valley (Kuntz and Glesne 1993). They are the most frequently encountered amphibian in the Stehekin Valley (Kuntz and Glesne 1993). Adults live underground and can be found near breeding habitats in upland areas, particularly near seeps.

### Columbia Spotted Frog

Columbia spotted frog is nearly always found in or near a perennial water body (required for breeding) such as a spring, pond, lake, or stream backwater. It is most often associated with nonwoody wetland plant communities (sedges, rushes, and grasses). Breeding occurs in February or March at lower elevations of eastern and western Washington but does not occur until late May or early June at higher elevations. Kuntz and Glesne (1993) and others (e.g., Nussbaum et al. 1983 in NPS 1995a:195) have documented this species in the Stehekin Valley.

### Cascades Frog

The Cascades frog is found in quiet, sometimes ephemeral, ponds for breeding. Eggs are deposited in shallow water near the shoreline. Egg development through metamorphosis requires between 40 and 60 days, depending on water temperature. Aquatic and terrestrial insects comprise their diet. Cascades frogs are active from early spring through late fall. They estivate in mud over the winter. A 1991 survey found Cascades frogs in a variety of habitats in the Stehekin Valley (Kuntz and Glesne 1993), including on the south side of the Stehekin River, on Battalion Creek, in riparian areas south of the airstrip, and in overflow channels along the river.

### Tailed Frog

Tailed frogs are stream-breeding amphibians that occupy cold, rocky, mountain streams (Leonard et al. 1993). Adult tailed frogs occupy streamside and forest habitats adjacent to streams. Tailed frogs are not expected to occur in the Stehekin River adjacent to the project road alignment, due to the relatively large size and low gradient of the river in this area. The frogs may occur in higher-gradient streams above the Stehekin River and road alignment.

# 10. CULTURAL RESOURCES

## Overview

Most of the proposed project area has been surveyed for the presence of cultural resources, including archeological and ethnographic resources and historic buildings and structures. Accordingly, a review has been conducted of relevant literature and cultural resources inventory lists.

**Stehekin River Corridor Implementation Plan Project Area Summary**: The project area includes the lower Stehekin Valley, from High Bridge to the head of Lake Chelan, including Weaver Point.

**Area of Potential Effects**: As defined under Section 106 of the National Historic Preservation Act (NHPA), the area of potential effects (APE) of each undertaking would be specified following a concise description of the project’s associated NHPA undertakings.

The following cultural resources are within or adjacent to the project area:

### Historic Archeological Resources

- Stehekin Wagon Road (45CH429), a linear historic archeological feature.

### Cultural Landscapes

- Buckner Homestead Historic District (National Register Number [NR] 88003445)

These resources are currently listed on or have been formally determined eligible for the National Register of Historic Places. A number of other cultural resources are near the project area and would not be directly affected by the proposed actions contained within the alternatives described herein.

The following cultural resources are within or near the project area but would not be affected by proposed actions:

### Archeological Resources

- 55 total archeological sites in the Stehekin Watershed (historic and pre-contact periods)
- 12 pre-contact period archeological sites in the project area

- 7 historic-period archeological sites in the project area.

### Historic Buildings and Structures

- Stehekin School (NR 74000913)
- George Miller House (NR 88003464)
- Purple Point—Stehekin Ranger Station House (NR 88003460)
- Harlequin Bridge
- Buckner Cabin (NR 74000912).

### Cultural Landscapes

- Golden West Lodge Historic District (NR 88003442)
- High Bridge Ranger Station Historic District (NR 88003443).

## a. Archeological Resources

### Overview

The following studies document lower Stehekin Valley and Lake Chelan archeological resources:

- Archeological Overview (Mierendorf 1986)
- National Register Nomination (1989)
- Archeological Basemap (1990).

Prior to 1986, archeological surveys in the lower Stehekin Valley and head of Lake Chelan area were conducted sporadically by university-based consulting archeologists. In the early 1970s, using information provided by local residents, Rice conducted a survey of the Stehekin Valley Road prior to proposed road improvements and collected information on five pre-contact-age sites and other information linked to indigenous uses of the Stehekin area (Rice nd). In the summer of 1977 (Grabert and Pint 1978) a team of graduate students from Western Washington University surveyed in the upper and lower valley, where they recorded three sites and conducted test excavations at High Bridge (45CH69). From 1984 to 1986 Bob Mierendorf, employee of Washington State University and contracted by NPS, performed reconnaissance-level cultural resource surveys and visited and documented previously recorded archeological sites to gather background data for the preparation of the park's archeological overview and research design (Mierendorf 1986). Nine previously unrecorded pre-contact-age sites were documented in the Stehekin-Chelan watershed, thus increasing the total site inventory in the Stehekin watershed to 17 sites and to 28 sites in the park complex. Today the park complex-wide inventory of all archeological sites is 305.

Beginning in the summer of 1986, cultural resources surveys in the Stehekin watershed (as elsewhere in the park complex) were conducted by NPS archeologist Bob Mierendorf or by survey teams under his direction. The survey strategies consisted of two types: nonintensive reconnaissance-level surveys and intensive inventory-level surveys. The reconnaissance-level surveys provide an overview of the watershed's pre-contact- and historic-period archeological resources, while the compliance surveys cover smaller areas in great detail. Results from both survey strategies have revealed the widespread presence of a variety of site types in all elevation zones of the Stehekin watershed.

Although archeological surveys provide useful data regarding the types and geographic distribution of pre-contact sites, only controlled excavations of intact site deposits and analysis of the resulting collections yield chronological and functional information. To date in the Stehekin watershed, four pre-contact period archeological sites (45CH411, -412, -69, and -221) have been assessed for National Register eligibility through limited test excavations. Two of these sites are within the project area (45CH412 and -69): one at Buckner Homestead hayfield and pasture and one at the High Bridge Guard Station.

The first, the Buckner Homestead hayfield and pasture Site (45CH412), was found to contain intact deposits nearly 1 meter in depth with artifacts and prepared cooking features radiocarbon-dated at between 500 and 3,000 years old (park complex unpublished site excavation records); this site has been informally assessed as eligible for the National Register of Historic Places and is protected within the boundary of the Buckner Homestead Historic District.

The second, 45CH69, is located at the High Bridge Guard Station and was first test-excavated in 1977, but with poor results (Grabert and Pint 1978). In 2000 an intact pit feature was found buried under the floor of the historic garage; a large chipped stone tool assemblage excavated from inside and around the edges of the feature dated from several hundred years old at the top to 6,500 years old at the bottom, nearly 1 meter below the garage floor (unpublished park complex site excavation records). This site has been informally assessed as eligible for the National Register of Historic Places and it is protected within the boundary of the High Bridge Ranger Station Historic District.

The overall results of these investigations reveal a long and complex history of indigenous involvement with the Stehekin watershed. For at least 9,500 years, indigenous groups have been crossing the northern Cascade Range at Cascade Pass, located at the head of the Stehekin watershed, and using it as a temporary camp for hunting and gathering forays in the surrounding mountains. Presently, Cascade Pass is the oldest radiocarbon-dated site in the Stehekin watershed, in the park complex, and in the Cascade Range of Washington and British Columbia. At the time of European contact, about A.D. 1800, Lake Chelan and the Stehekin River valley were the traditional homeland of the Chelan Indians, who used the valley for hunting and gathering and as one of several travel corridors across the rugged northern Cascade Range. Today, descendents of these original inhabitants are associated with two eastern Washington federally recognized tribal governments, the Colville Confederated Tribes and the Yakama Nation.

Numerous cultural resources surveys have been conducted within the proposed APE over nearly two decades. The surveys were conducted pursuant to several types of proposed NPS undertakings, including road storm damage repair, road realignment, road resurfacing, trail construction, and fire management activities. The most recent survey for the proposed road modifications was conducted in July 2008 by Bob Mierendorf, park complex archeologist, and Ray DePuydt, Lake Roosevelt National Recreation Area archeologist.

Archeological surveys have been conducted in areas associated with proposed actions in all alternatives and/or would be conducted and/or monitored during soil-disturbance activities. These areas include the existing roadway; proposed relocated maintenance facility and housing near the airstrip; turnout locations along the existing Stehekin Valley Road (including areas of paving, culvert installation and replacement, and side ditch construction / reconstruction); the proposed winter turnaround / parking area; and areas along the Stehekin River previously disturbed by road improvements (including near Milepost 5.3 [Wilson Creek], Milepost 8.5, and the McGregor Meadows area; to construct the proposed Lower Valley Trail) and by ongoing implementation of land acquisition and exchange priorities from the 1995 LPP (NPS 1995b).

### i. Pre-contact Period Archeological Resources

None of the 12 pre-contact period sites within the project area are located in areas that are proposed for undertakings (APE). As additional detailed plans are completed and APEs for each undertaking are detailed, however, the park will comply with Section 106 of the NHPA to determine effects to cultural resources. Pre-contact archeological site types represented in the project area include lithic scatters (concentrations of chipped stone tools and fire-modified rocks, sometime buried up to 1 meter deep), rockshelters, pits in the ground, rock walls and cairns, and pictograph sites. Any of these site categories are potentially eligible for the National Register of Historic Places.

Two sites in the project area have been informally recommended for National Register eligibility, the Buckner Homestead hayfield and pasture Site (45CH412) and the High Bridge Site (45CH69), and each is inside the boundaries of a listed National Register historic district. Neither of these sites is within an APE.

Two other sites, although not fully assessed for significance, appear to be eligible and should be treated as significant until they can be more completely documented. Both of these are rockshelter sites with associated pictographs (45CH427 and 45CH450) and are considered to have traditional cultural significance. Although both are also within the project area, neither of these is within the APE of any of the potential undertakings.

**Table III-12: Overview of Pre-contact and Historic Period Archeological Sites in the Lower Stehekin Valley**

| **Pre-contact Period Archeological Sites** | |
|---|---|
| Courtney Ranch (45CH68) | Bullion Boulder (45CH427) |
| High Bridge Guard Station (45CH69) | Bullion Fan (45CH428) |
| Buckner Homestead hayfield and pasture (45CH412) | Rainbow Creek 1 (45CH431) |
| Bullion Bar (45 CH416) | Little Boulder Creek 1 (45CH432) |
| Boulder Creek 1 (45CH407) | McGregor Rockshelter (45CH450) |
| Boulder Creek 2 (45CH408) | Harlequin Rockshelter (45CH454) |
| **Historic Period Archeological Sites** | |
| Stehekin Wagon Road (45CH429) | Harlequin Bridge Abutment (45CH459) |
| Weaver Point Historic Site (45CH452) | Lower Buckner Field Can Dump (45CH455) |
| Buckner Lane Historic Site (45CH451) | Lower Field Irrigation Ditch (45CH468) |
| Stehekin Community Can Dump (45CH499) | |

### ii. Historic Archeological Resources

Historic archeological sites in the project area include a bridge abutment (45CH459), irrigation ditch (45CH468), historic artifact debris scatters (45CH455 and 45CH499), historic debris and structure depressions (45CH452), and road and trail segments (45CH429 and 45CH451). Two of these sites have the potential to be affected by project implementation, the Weaver Point Historic Site (45CH452) and the Stehekin Wagon Road (45CH429).

The first, the Weaver Point Historic Site, was test-excavated and assessed as eligible for inclusion in the National Register of Historic Places. The assessment was performed by a consulting firm under contract to Chelan PUD and working on NPS lands under authority of an ARPA permit issued by NPS to perform archeological studies in advance of the Chelan PUD's application for a license to continue operation of the Lake Chelan reservoir. It is likely that at least one of the two building remains, a dugout cabin foundation, is the Devore/Pershall cabin; historic artifacts recovered in the assessment point to an early historic-period residential occupation dating between 1886 and 1900 (Ozbun et al. 2005:51 - 59).

The second site, the Stehekin Wagon Road (45CH429), is a linear feature consisting of many discontinuous segments of now-abandoned roadbeds. Some of these segments may be the remains of the first Stehekin Wagon Road. Beginning in the early 1890s, plans were made for construction of roads linking mines in the upper valley with the head of Lake Chelan. The Stehekin Wagon Road was built between 1894 and the early 1900's to transport people and supplies to the mining communities at Bridge Creek and Horseshoe Basin. The original wagon road was constructed from the head of the lake along the south side of the valley up to the end of present day Company Creek Road. At that point, it crossed the river to the north side of the valley (where the bridge abutments can still be seen and where the proposed Lower Valley Trail would cross the Stehekin River) and then continued upvalley.

The wagon road on the south side of the Stehekin River was declared a public highway in 1892 and designated the Stehekin River County Road. After this initial road was roughed out it was used for a few years, but fell into disuse following the building of a new dock on the north side of the Stehekin River (Mierendorf 2009). At that point, most travel up the valley was, as it is today, on the current Stehekin Valley Road side as far as Bullion. Here the old road left the current road and began the approximately 400-foot ascent that brought the road almost to the elevation of Coon Lake. An unknown time later, a bridge was built over the Stehekin River at High Bridge in order to avoid the climb to Coon Lake. At today's High Bridge one can see an earlier roadbed immediately west of and below the current bridge.

Early historic-period roads in the lower Stehekin River Valley are potentially of local historic significance because they represent a critical aspect of late-19th-century mining development and settlement and recreational activities in the valley. Although the important roles that roads served in the Stehekin Valley's economic and settlement history is generally acknowledged, historic records documenting details of roads histories and uses are rare (Mierendorf 2009).

The Stehekin Wagon Road is a linear historic archeological feature. Abandoned road segments within the APE are common and can be recognized by one or a combination of several constructed road features. These extant road features consist of:

- Scraped or leveled road sections (10 - 13 feet or 3 - 4 meters wide) marked by a line or low mound of rocks and boulders that were moved to one or both sides of the roadbed
- Traces of roadbed visible as unforested corridors through the otherwise closed-canopy forest
- Retaining walls built of subangular rocks and boulders (of immediately local origin) to create or maintain a level roadbed across slopes or other natural terrain features
- Roadbed cuts into existing terrain that created or maintained a low-gradient road alignment profile through high ground.

Road segments are discontinuous and cannot clearly be linked to each other due to erosion and/or burial by hillslope runoff, snow and rock avalanches, deposition of debris cones and alluvial fans, overgrowth of native shrubs and trees, road rebuilding and repair, and development associated with adjacent private residences. Most disturbance to the physical integrity of these road segments occurs in the lower Stehekin Valley, where most people live and where development is the greatest; above approximately Milepost 8.0, these road segments appear to retain more historic integrity.

Within the proposed reroute APE between the head of Lake Chelan and Milepost 9.2, two sets of built rock features clearly define abandoned road segments. These discontinuous segments of the Old Wagon

Road parallel the existing Stehekin Valley Road near Mileposts 6.3 and 8.0. In addition, outside the APE, there is an additional segment of the road.

### *Milepost 6.3*

The first set of features from the Old Wagon Road is located within the APE above the existing Stehekin Valley Road at approximately Milepost 6.3. This feature was observed and recorded in May 1996 and revisited in July 2008, and consists of three closely spaced rock wall segments built on the downhill side of an abandoned roadbed where it traverses the sloping toe of a large, boulder-strewn debris cone. The three segments are 22, 34, and 46 feet (7, 10.4, and 14 meters) in length and together they span a distance of 360 feet (109.8 meters). The highest measured wall is 4.5 feet (1.4 meters) (six to seven courses of rock) and the lowest is 1.6 feet (0.5 meter) high (one to two courses of stone) (Mierendorf 2009).

Walls were built of locally derived, subangular cobbles and boulders that were stacked and fitted—sometimes tightly, but in most cases they appear to have been loosely piled. The rock walls served to hold and stabilize the downhill side of the constructed roadbed. They also retain an even bed of rocks and earth, where the road crosses shallow gullies and dips eroded into the toe of the debris cone. Portions of the rock walls are overgrown by lichens and native shrubs and have begun to dismantle through the processes of natural weathering and disturbance. As inferred from the wall design and construction techniques, the builders favored opportunistic and energy-minimizing techniques—in particular, moving aside or repositioning boulders and piling smaller rocks against and around larger boulders that served to anchor the wall segments. The age of the rock walls, their builders, and the history of maintenance or rebuilding are currently unknown. Because the ―original” Stehekin Valley wagon road is reported to have been on the other side of the valley at this mile point, this road segment may be associated with the road that subsequently replaced the earlier road following the building of a new dock on the north side of the Stehekin River at the head of the lake (Mierendorf 2009).

Based on archeological analysis, the features appear to lack integrity of association and workmanship; their age and affiliation with an original or early Stehekin Valley Road cannot be demonstrated; and they do not represent the best example of early road design and construction techniques. These features therefore do not appear to meet National Register eligibility criteria (Mierendorf 2009).

### *Milepost 8.0*

The second road segment, near the present Stehekin Valley Road at Milepost 8.0, covers an area of about 3,937 feet by 33 feet and also includes a rock retaining wall about 7 feet high where the road was built around a rock outcrop (NPS 1995a:202). It has been determined to be potentially eligible for inclusion on the National Register (see below).

This set of rock features is located approximately 0.2 mile above Milepost 8.0, on the north side of the river, and was recorded in 1992 as the ―Stehekin Wagon Road” (FS #212; 45CH429). This road segment is approximately 197 feet (60 meters) long and most of it is cut shallowly into the top of an alluvial fan. A much shorter dry-stacked rock wall segment consists of a lower foundation (or footing course of rocks) with a dry masonry rock wall built on top of this from several courses of locally derived subangular cobbles and boulders to a maximum height of 4.9 feet (1.5 meters); the roadbed is 10 feet (3 meters) wide (Mierendorf 2009).

The wall segments here vary from intact to disturbed (disturbance caused by stream erosion and natural deterioration). The wall is located above a steep slope where the road was constructed around a bedrock outcrop. It appears that rather than blasting out the bedrock, the road was built to go around it. The footing and retaining walls were built on the downslope side of the rock outcrop and the space between the wall and the outcrop were filled with small subangular rocks to create a fairly level roadbed. Compared to the rock walls at Milepost 6.3, the rock walls at Milepost 8.0 were built with more care and represent a much greater investment in time and energy, and because of their location were part of the road from its initial construction. A Ponderosa pine growing on the roadbed fill at this site was cored with an increment borer and found to be 78 years old, indicating that this part of the roadbed was built prior to 1914 (Mierendorf 2009).

Unlike the features at Milepost 6.3, based on analysis, the features associated with Milepost 8.0 do appear to retain integrity of association, workmanship, location, and setting. In addition, tree core data indicate that this road segment was built prior to 1914, consistent with the early mining period in the Stehekin Valley. Integrity of location, design, materials, and workmanship at this site therefore appear to preserve significant historic features directly associated with early transportation and the development of the mining industry in the Stehekin watershed and the northern Cascade Range. This cultural resource appears to meet National Register eligibility criteria at local and statewide levels of significance (Mierendorf 2009).

**Coon Run Vicinity** (approximately 20 feet to the east of the existing roadbed)

Above Milepost 8.0, outside the APE, is another segment of Old Wagon Road described in the Coon Run EA associated with flood damage improvements to the Stehekin Valley Road in that area (NPS 2005b).

This roadbed extends for approximately 300 feet. The wagon road remains are 15 feet wide. Rocks and soil scraped from the bed form a rock berm, or boulder line, on either side of the road. This road segment is devoid of artifacts or built road features such as retaining walls, foundation rocks, or drainage features. The existing road segment disappears abruptly at either end, where it has been truncated by road cuts created during construction of the present Stehekin Valley Road. Although the age of this road segment is unknown, it does not appear to be part of the original Stehekin Wagon Road because this segment is west of Bullion, and therefore cannot be the same road that climbed to the Coon Lake elevation. The Coon Run EA stated that the wagon road segment (considered part of 45CH429) near Coon Run does not appear to be eligible for inclusion in the National Register of Historic Places (NPS 2005b).

## b. Historic Buildings and Structures

The following studies document Lake Chelan historic resources:

- Historic Structure Inventory (1984)
- Historic Resource Study (1970/1986)
- Historic Structures Preservation Guide (1987)
- Resource Management Plan (1993).

### Historic Structures/Cultural Landscapes Overview

Historic contexts identified in the *North Cascades National Park Service Complex Historic Resource Study* included exploration, settlement, commercial development, recreation, and administration of the area by the USFS. These contexts, and the inventory data provided by these studies, were summarized in the multiple-property resource nomination prepared for the National Register, ―Historic Resources of North Cascades National Park Service Complex.” As a result of this nomination, 28 buildings and three Historic Districts were listed on the National Register in the project area.

The following buildings, structures, historic districts, and cultural landscapes within the project area are listed or are eligible for listing in the National Register of Historic Places: Buckner Homestead Historic District, Courtney / McComb Cabin, George Miller House, Golden West Lodge Historic District, Harlequin Bridge, High Bridge Ranger Station Historic District, Stehekin Ranger Station Residence, and the Stehekin School.

**Buckner Homestead Historic District**: See ~~e~~. Cultural Landscapes.”

**Courtney / McComb Cabin**: The Courtney Cabin, listed on the National Register of Historic Places, is located on the north side of Company Creek Road, near the south shore of the Stehekin River about 5 miles from the Landing. It is a log and wood-frame structure significant for its association with early homesteading in the valley. Hugh Courtney moved uplake with his family in the 1910s to work at the Stehekin sawmill. In 1918, he filed a claim for 53 acres and moved into a log cabin built by a previous squatter in about 1889. By the 1920s, he had built the wood-frame portion, doubling the size of the home; cleared and plowed land for a garden; and built a cellar, barn, and hayshed. He lived in it with his wife until the 1950s. Afterward it began to deteriorate as a rental unit until acquired by the NPS in 1971 (NPS 1995a:205).

The historic cabin is experiencing increased flood damage (e.g., water flowing through structure when road floods). It was moved once, but likely needs to be moved again due to changing conditions. (Addressing the damage is beyond the scope of this DEIS.)

**George Miller House**: This house is located near Stehekin Landing on the east shore of Lake Chelan. It is significant as an example of pre-World War II residential architecture and for its association with recreation in Stehekin. It is outside the APE for the alternatives.

**Golden West Lodge Historic District**: See ~~e~~. Cultural Landscapes.”

**Harlequin Bridge**: Located approximately 4.5 miles northwest of Stehekin Landing, the bridge was determined eligible for listing on February 17, 1995. It provides access to private residences and NPS facilities along Company Creek Road on the south side of the Stehekin River. Built by the U.S. Department of Agriculture in 1948, it replaced an older bridge destroyed that year in a flood. The bridge’s rare Baltimore truss design and timber construction were cited by the Washington State Historic Preservation Officer as contributing to its eligibility (NPS 1995a:207).

**High Bridge Ranger Station Historic District**: See ~~e~~. Cultural Landscapes.”

**Stehekin Ranger Station Residence and Woodshed (Purple Point)**: These buildings are significant for their association with the USFS era of land management in the North Cascades and are excellent examples of USFS residential architecture from the late 1920s. After the original ranger station was destroyed by rising lake waters, the station was rebuilt at its current location at Purple Point. Later a warehouse and bunkhouse (which have now been substantially altered) were added. The ranger station is currently used for NPS housing and is outside the project area for the alternatives.

**Stehekin School**: In 1921, Stehekin residents assembled to identify a site for a new school. Materials for the log building were crafted by Stehekin Community volunteers, funds were raised through ~~b~~ox socials” for flooring, windows, and doors, and construction began in late summer. Previous to this, various other log cabins served as schools. The old Stehekin School is significant for its association with the early settlement and development of the Stehekin Valley (NPS 1995a:206).


**Photo 23 – Historic Old Stehekin School**

### c. Cultural Landscapes

The following reports and inventories document cultural landscapes:

- List of Classified Structures Update (2005)
- High Bridge Ranger Station Cultural Landscape Inventory (2002)
- Buckner Homestead Cultural Landscape Inventory (1984)
- Golden West Lodge Cultural Landscape Inventory (1985).

Evaluation of cultural landscapes is divided into the following categories, which recognize contributing resources:

- **Spatial organization**—the composition and sequence of outdoor spaces within the district
- **Circulation**—the means and patterns of movement through the district
- **Topography**—the ways in which the landscape planning responds to the topographic features of the site and the modifications of that topography
- **Vegetation—**the response of existing vegetation as well as the management of vegetation through pruning, removal, or addition of trees and shrubs
- **Structures**—all contributing structures, including roads, trails, and other small-scale features such as rock walls and culverts
- **Buildings**—structures intended to shelter a human activity.

Three areas within Lake Chelan are managed as cultural landscapes: the Golden West Lodge Historic District, Buckner Homestead Historic District, and the High Bridge Historic District. The High Bridge Historic District is within the project area but not within the area of potential effects. A Cultural Landscape Inventory, completed prior to certification requirements, is available for the Buckner Homestead (Kennedy, pers. comm., 2008), as is the Buckner Orchard Homestead Historic District Final Management Plan (NPS 1998b).

**Golden West Lodge Historic District**: The district consists of seven contributing structures built on a 4-acre site to provide a wilderness resort. It is the oldest large-scale resort in the park complex and the only remaining example of large-scale resort development in the North Cascades. A cultural landscape inventory is available for this district (Kennedy, pers. comm., 2008).

When the early Field Hotel at the head of the lake was dismantled in 1926, the building materials were salvaged and used in the construction of the Golden West Lodge. After World War II, the lodge was expanded and five rustic cabins, a small swimming pool, fish pond, shuffleboard court, and other landscape features were added (NPS 1995a:204). Restoration of the Golden West Lodge has retained its historic character. Inside it has a bookstore, information desk, exhibits, and an open activity area. On the second floor are offices and storage space. Restrooms are located both upstairs and downstairs. The Golden West Lodge Historic District is not within the project area for the proposed alternatives.

**Buckner Homestead Historic District**: This district comprises 15 buildings, other structures, and ruins, as well as orchards, pasture, and hand-dug irrigation ditches, on approximately 90 acres. It is the largest group of structures representing the early settlement of the Stehekin Valley over the six decades from 1889 to the 1950s (NPS 1995a:203). Among the outbuildings include a brooder house, chicken coop, root cellar, barn, milk separator house, two sleeping cabins, and sheds.

The original log cabin on the site was owned by William Buzzard, who mined in Horseshoe Basin. It was originally the farthest homestead up the Stehekin Valley. Sold to William Van Buckner in 1910, it evolved from a single cabin into an intricate complex, including structures, paths, irrigation ditches, and fruit orchards, that contributes significantly to understanding homesteading in this wilderness region. It is the only example of an existing intact homestead complex in the Complex (NPS 1995a:204).

The Buckner Homestead hayfield and pasture plan states that the management direction for rehabilitation is to ―preserve the character-defining features of this unique resource while allowing compatible use" (NPS 1998b).

# 11. VISITOR EXPERIENCE

Since the late 19th century, large numbers of outdoor enthusiasts have been drawn to the North Cascades for physical and mental challenge, rest and relaxation, and enjoyment of scenic grandeur. Visitor use in the Stehekin Valley is generally concentrated in the lower 9 miles. Sightseeing, fishing, hunting, boating, horseback riding, and mountain climbing have been among the most favored activities (NPS 1995a:204). Other activities include hiking, bicycling, tours, photography, camping, and rafting.

Approximately 50,000 people annually visit Stehekin, arriving on one of two commercial passenger boats, on foot, or by air on one of two recently available chartered floatplanes. Stehekin residents (including NPS employees) also depend on the boats for visitors, mail, groceries, and freight. A commercial barge provides services intermittently (about every 10 days in summer and once a month during the rest of the year) to haul vehicles, fuel tanks, building materials, and other bulky freight items.

**Photo 24 – Angler on the Stehekin River, Credit: Mike Barnhart**

## a. Access and Transportation

The north end of Lake Chelan and the village of Stehekin serve as a gateway to the interior of the Lake Chelan NRA, Stephen T. Mather Wilderness, and North Cascades National Park. This is one of the few entry points on the southern end of the park complex that is readily accessible to visitors. Similarly, the Stehekin Landing and the Stehekin Valley Road form the main route from this gateway. Thus, the Stehekin Valley Road is the primary access route for recreation and is an integral part of the visitor experience in this area. In 2003, over 35,500 people visited the Lake Chelan NRA (Allen, pers. comm., 2005). This figure is down from a visitation level of 52,000 in 2000. Over 70 percent of the 2003 visitation occurred during the summer season, between June and September, which continues to be consistent with ridership statistics for the ferries.

The Stehekin Valley Road was built on the north side of the Stehekin River in 1897 to provide access to mines located in Horseshoe Basin (3.4 miles above Cottonwood Camp). Prior to the 1995 flood, shuttles took visitors to Cottonwood Camp. Beginning in 1995, the road became impassable above the Glory turnaround. Following flooding in 2003, which made the road impassable to vehicles between Car Wash Falls and Bridge Creek and caused a major landslide at Milepost 15.0, an Environmental Assessment was prepared (NPS 2006c) which called for closing the upper Stehekin Valley Road to motor vehicles at Car Wash Falls (Milepost 12.9), approximately 3 miles above High Bridge. As a result, that portion of the road was officially closed in 2006.

Visitors and residents travel by passenger ferry, floatplane, or trail to the Stehekin Valley from Chelan or other ferry Landing areas (Fields Point and Lucerne). Motorists, cyclists, hikers, stock users, and snowmobiles are allowed on the Stehekin Valley Road, and most also use the Company Creek Road. Vehicle traffic along the Stehekin Valley Road includes NPS and resident vehicles, private and power company vehicles, and shuttle buses.

Most visitors arrive on the Lady of the Lake, a 350-passenger commercial ferry that runs between Chelan and Stehekin. The boat ride takes about 4 hours one-way. Another, faster, ferry, the 100-passenger Lady Express, is also available and takes approximately 2 hours one-way. Both leave from Chelan and, depending on the boat, stop at Lucerne and/or Fields Point en route.

Taking the fast boat uplake and the slow boat downlake allows day-use visitors to spend approximately 3.5 hours in Stehekin. With the slow boat each way, a day-use visit is closer to 2 hours, which is enough time for a quick guided bus tour to Rainbow Falls and a stop at the visitor center before boarding for the return trip. Both boats offer a Rainbow Falls bus tour that starts just after the boats arrive at the Landing.

In 1991, 59 percent of visitors used the 4-hour boat, 38 percent used the 2-hour boat, 16 percent came or left on a private boat, 9 percent used a floatplane, and 6 percent hiked in or out (NPS 1995a:234). In 2007 (January - September), approximately 17,742 people came by boat (16,680, or 94 percent) or on the float plane (1,062, or 6 percent).

Access up the Stehekin Valley is via the Stehekin Valley Road, which is paved up to Harlequin Bridge. At Harlequin Bridge, the road narrows considerably and turns to gravel with strategic pullouts. Traffic is generally light, with a few private, government, and shuttle vehicles traveling upvalley to the Stehekin Valley Ranch (near Milepost 9.0).

Company Creek Road, which begins at Harlequin Bridge, is a 2.2-mile-long spur road. In addition to providing access to the current NPS maintenance area, airstrip, gravel pit, Chelan PUD power plant, and private homes located on the northwest side of the Stehekin River, it provides access to some visitor facilities, including Harlequin Campground and the Stehekin River Trail, Devore Creek Trail, and Company Creek Trail.

There is also a state-maintained emergency airstrip located in Stehekin about 4 miles from the Landing on Company Creek Road. It is operated by the Washington State Department of Transportation Aeronautics Division under a special-use permit from the NPS. The airstrip, which is 2,700 feet long and 80 feet wide, is used for emergencies and by residents and visitors. Consistent with its intent as an emergency-use airstrip, it posts a ―use at your own risk" statement. It is classified as a basic utility airstrip, able to be used by at least 75 percent of the single-engine and small twin-engine aircraft commonly used for business and recreation purposes. Cable tie-downs can accommodate up to six aircraft at one time. Reflective markers line both sides and identify the ends of the airstrip. An unlighted wind sock and a segmented circle made of painted rocks are the only navigational aids at the airstrip (NPS 1995a:223, 229).

## b. Visitation

As discussed in the GMP, visitors come to Stehekin primarily from the western United States, with 75 percent from Washington and Oregon and 6 percent from California, mostly (42 percent) in groups of two and with immediate family members (61 percent). About 1 percent of visitors were from other countries (primarily Canada). Nearly half were between 30 and 50 years old, 17 percent were over 60, and 16 percent were under 16. About 68 percent were first-time visitors (NPS 1992b in NPS 1995a:234).

Annual visitation to Stehekin varies. Average visitation between 1996 and 2006 was 40,457 (Table III-13: *Visitation to Lake Chelan NRA*). Visitor numbers have risen and fallen over the past 15 years, likely due to a host of factors related to the economy and tourism.

**Table III-13: Visitation to Lake Chelan NRA**

| Year | Visitation |
|---|---|
| 1996 | 36,891 |
| 1997 | 34,300 |
| 1998 | 45,779 |
| 1999 | 50,087 |
| 2000 | 51,825 |
| 2001 | 42,547 |
| 2002 | 40,590 |
| 2003 | 35,549 |
| 2004 | 42,529 |
| 2005 | 29,783 |
| 2006 | 35,151 |
| 2007 | 34,665 |
| 2008 | 25,139 |
| 2009 | 34,554 |

Source: http://www2.nature.nps.gov/stats/ (NPS 2008b:205).

Visitors come to experience the scenery and natural setting (78 percent), solitude, and access to wilderness, as well as other parts of the Lake Chelan NRA experience, including for wildlife, recreation/sports, and Stehekin Community, history and culture, among other reasons.

Visitation varies dramatically with the season, with sharp spikes between May and September and dramatic drops in the shoulder seasons (April and October) and fairly flat numbers at other times of year (November through March).

Of those who visit Lake Chelan NRA and Stehekin, approximately 63 percent are day-use visitors and 26 percent stay overnight. Of the day-use visitors, many stay for a very short period between boat landings and departures. For those who stay overnight, there are a variety of public camping, concession lodging (Stehekin Landing Resort), and private rental cabins; homes; a guest ranch; and several bed and breakfasts.

### Stehekin Residents

Approximately 100 people live in Stehekin year-round, with that number increasing to approximately180 people during the summer. Residents include families who have lived in the valley for generations, as well as recently arrived homeowners. At the time of the GMP (1995), approximately one-third of the year-round residents were employed by the NPS or a concessioner, with today's numbers similar or only slightly lower.

## c. Interpretation and Education

The park administrative operations headquarters is located at Stehekin Landing in the rehabilitated Golden West Lodge building, which also serves as the recreation area visitor center. Interpretive programs, including evening programs, talks, and walks are offered daily during the peak season and on weekends during the shoulder seasons. The visitor center is also staffed regularly.

Three interpretive trails allow self-guided tours for visitors: the Imus Creek Trail, McKellar Cabin Trail, and Buckner Lane. Wayside exhibits at the Landing, along the Stehekin Valley Road, and at High Bridge also assist visitors in learning about the area. Visitors also learn about the area on the ferry ride, from bus tours, and from Stehekin residents.

## d. Visitor Use Opportunities

### Facilities

In addition to the visitor center, visitor use facilities in Lake Chelan NRA include overnight lodging, a restaurant, general store/gift shop, marina, craft store, and a bakery/deli. Except for the bakery, the other facilities are clustered around the Stehekin Landing. Just upvalley from the Landing are bicycle and kayak rentals. Approximately 9 miles up the Stehekin Valley Road is the Stehekin Valley Ranch, which offers a family-style dinner, lodging, guided backpacking, bicycle rentals, rafting, and horseback riding. While most facilities are seasonal, operating only during the summer months, some operate year-round to accommodate winter visitors and the approximately 100 year-round residents.

### Activities

Visitors can enjoy a variety of recreational activities, including traveling by passenger ferry, floatplane, or trail into Stehekin. Once in the Stehekin Valley, they enjoy hiking, backpacking, camping, horseback riding, bicycling, whitewater rafting, kayaking, guided shuttle touring, snowshoeing, cross-country skiing, sightseeing, and nature trails. Some lodging accommodations offer the use of a car in the valley. Within Lake Chelan NRA and surrounding USFS land, hunting also comprises a small percentage of resident and visitor activities, particularly in the fall.

**Picnicking**: Picnicking is available at Stehekin Landing, Purple Point, and Harlequin campgrounds within the project area and at High Bridge and Tumwater campgrounds outside the project area.

**Bicycling**: Bicycle use on roads is permitted within Lake Chelan NRA. Bicycles can be rented in Stehekin or transported to Stehekin on the boats.

**Horseback Riding**: Horse use is permitted on the Pacific Crest Trail and day rides are offered from the Stehekin Valley Ranch.

**Rafting**: There is one formal raft launch downstream from Bullion Campground. Another informal raft launch / takeout is available along the sandy shore of Harlequin Campground. Other raft takeout locations vary, mostly on sandy beaches along the Stehekin River, particularly near the mouth.

**Camping**: Several first-come, first-served walk-in campgrounds (some also accessible by vehicles) exist in the Stehekin Valley below High Bridge. These include Bullion Camp, Harlequin Camp, Purple Point Camp, Purple Point Horse Camp, and outside the project area, High Bridge and Tumwater camps. Groups are accommodated at Harlequin Camp, except during flooding, when they are diverted to Purple Point or the overflow area if it is available.

**Photo 25 – Windsurfer on Lake Chelan**

**Backcountry Camping**: Free permits are available for backcountry camping. No permits are required for boat-in campgrounds or for USFS camps.

People enjoy the upper Stehekin Valley for its scenic beauty and recreational opportunities. The lower Stehekin Valley Road gives the visitor glimpses of the glacier-tipped peaks and cirques and towering rock cliffs. Glimpses of the river through the forest and alongside the road are available periodically. High Bridge Historic District, with its early 1920s Forest Service ranger station, is an attraction for visitors and residents. The Stehekin River at High Bridge cuts dramatically through a bedrock box canyon with steep walls. The road bridge is high above the clear whitewater. The district has become a destination for tour groups and has been a summer shuttlebus turnaround highlight over the past few years.

At High Bridge, the Stehekin Valley Road provides access to the Pacific Crest Trail, other trailheads, fishing, and camping. Since the 2003 flood, access to recreational opportunities beyond High Bridge has mostly been by hiking or horseback riding. Visitors can also bicycle or drive only as far as Car Wash Falls, approximately a half mile above High Bridge.

## Trails

Among the short trails that are used by many visitors in Stehekin include the interpretive Buckner Lane, Imus Loop Trail, Rainbow Loop Trail, and Lakeshore Trail. Longer trails include the Company Creek Trail, Stehekin River Trail, Rainbow Lake Trail (including spurs to McAlester Lake and Creek), Boulder Creek Trail, McGregor Mountain Trail (Coon Lake), Purple Creek Trail (Juanita Lake), Devore Creek Trail, Park Creek Trail, Cascade Pass Trail, and the Pacific Crest Trail (Agnes Gorge Trail (south) and Bridge Creek Trail (north)).

The National Trails System Act, signed by President Lyndon B. Johnson in 1968, created the Pacific Crest and Appalachian National Scenic Trails. National Scenic Trails are “extended trails so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass.” Although outside the project area, the Pacific Crest Trail is accessed from the end of the Stehekin Valley Road.

### e. Safety

Floods may create safety concerns for people using the Stehekin Valley Road. Currently, it can take from several hours up to half a day to warn residents and visitors about possible road flooding. Floodwaters generally rise fairly slowly and high ground is available in many areas within a short distance of the Stehekin Valley Road (generally within 0.5 mile).

The National Weather Service is preparing a flood warning system for the Stehekin Valley (NPS 2005). Road construction projects are by nature inherently hazardous to workers involved in the project and to recreation area visitors. Workers must have adequate training and knowledge, particularly in traffic safety operations as well as those associated with their individual areas of expertise, to effectively carry out their job. In a national park this knowledge must include familiarity with the terrain and park resources affected by the project and how these resources might respond to disturbance (including tree falling, rock fall, slumping, etc.). Although recreation area visitors must be aware of road hazards on a continuous basis, road construction areas are particularly hazardous, especially when implemented in scenic terrain. Visitors may be unaware of the road construction project and may come upon it suddenly, while focused on viewing scenery or wildlife. They may be unprepared for or become bothered by long delays during one-lane closures. Some are unfamiliar with the nature of historic, winding park roads, which often contain few of the traffic devices normally encountered in steep mountainous terrain, such as guard walls, reflectors, and sudden or sharp curve signs.

### f. Scenic Resources

Lake Chelan NRA is a powerful landscape that includes one of the deepest lakes in North America, thundering waterfalls, spectacular spring dogwood blooms, and the scenic beauty of the free-flowing Stehekin River. Towering peaks surround the valley and are graced by glaciers. Ancient human occupation of this major mountain valley is marked by pictographs and stone artifacts, while current seasonal cabins and homes are dispersed through forests, pastures, and the historic Buckner Homestead hayfield and pasture. The legislation establishing Lake Chelan NRA specified conservation of scenic resources as one of the primary reasons for its establishment.

The 1995 GMP included a detailed inventory of visual and scenic resources (NPS 1995a:206 - 218). In summary, 16 different landscape types were identified in the valley from Geographic Information System analysis of topography and vegetation. In addition, 21 different key viewpoints were inventoried based on interviews with park staff, visitors, and valley residents.

## 12. WILD AND SCENIC RIVERS

This section describes the characteristics of the Stehekin River that contribute to the river’s eligibility for listing as a component of the National Wild and Scenic Rivers System. This section is based on the *Stehekin River Wild and Scenic River Eligibility Report* (NPS 2002b) and is adapted from the discussion of Wild and Scenic Rivers in the Stehekin Valley Road Improvement Project EA (NPS 2005a). Information from the Eligibility Report is also used to evaluate potential impacts of the proposed project on its eligibility for inclusion in the National Wild and Scenic Rivers System.

The Stehekin River and its tributaries have been determined eligible, but have not been designated as part of the Wild and Scenic Rivers System. In addition, neither the Stehekin River nor any of its tributaries are part of the Washington State Scenic Rivers System. Therefore, currently the only way the river could be included in the system is via affirmative congressional action, and no action is believed pending or contemplated by Congress as of this writing.

In 2002, the NPS evaluated the Stehekin River and its tributaries for its eligibility for inclusion in the National Wild and Scenic Rivers System, and determined that the entire watershed of the Stehekin River is eligible for designation (NPS 2002b). The eligibility analysis was prompted by management guidance in the 1995 GMP for Lake Chelan NRA, and the miscellaneous provisions of a 1991 Consent Decree[*] between the Secretary of the Interior and the North Cascades Conservation Council. A brief summary of the eligibility report follows, along with its implications for river-related management actions on the part of the NPS.

The eligibility analysis used two criteria to evaluate the river's eligibility in accordance with the Act: (1) the ―Free-flowing" condition of the river; and (2) the river's ―Outstandingly Remarkable Values" including fish, wildlife, vegetation, prehistoric and historic resources, geology, scenery, and recreation. The ―Free-flowing" criterion was evaluated by dividing the river into three segments in light of differences in human activity and development along its shoreline. Segment 1 extends from the mouth of the Stehekin River to High Bridge (the segment within Lake Chelan NRA); segment 2, from High Bridge to Cottonwood Camp; and segment 3, from Cottonwood Campground to the headwaters. To evaluate the ―ORV" criterion, all three segments were considered collectively.

All three segments of the Stehekin River were determined to be eligible for inclusion in the Wild and Scenic Rivers System due to the river's generally free-flowing condition and outstandingly remarkable values, including wildlife, fish, prehistoric, historic, geologic, scenic, and recreational resources. The river's vegetation, however, was found to be exceptional but not sufficiently unusual to contribute to eligibility.

The Stehekin River Eligibility Report places the Stehekin River in the category of an ―Agency Identified, 5(d)(1) Study River." This administrative determination carries no direct legal authority, but does lay the foundation for future designation of the river should the U.S. Congress choose to do so. The eligibility finding does, however, influence NPS management actions that could potentially affect the river's free-flowing characteristics or the various ―Outstandingly Remarkable Values" that contribute to its eligibility. In accordance with guidance from the Interagency Wild and Scenic Rivers Coordinating Council, and Section 4.3.4 of NPS *Management Policies 2006*, the NPS must avoid taking management actions that would adversely affect the free-flowing condition and ―Outstandingly Remarkable Values" that qualify the river for inclusion in the National Wild and Scenic Rivers System.

## Classification of the Stehekin River under the Wild and Scenic Rivers Act (WSRA)

The WSRA defines three classes of national Wild and Scenic Rivers:

- **Wild river areas**: Those rivers or section of rivers free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and with unpolluted water. These represent vestiges of primitive America.

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* A judgment whereby the defendant agrees to stop the activity that was asserted to be illegal, without admitting wrongdoing or guilt.

- **Scenic river areas**: Those rivers or sections of rivers free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
- **Recreational river areas**: Those rivers or sections of rivers readily accessible by road or railroad that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Because levels of human activity and development are not uniform throughout the Stehekin River watershed, the eligibility report segmented the river to determine the appropriate classifications for each segment.

Segment 1 extends from the river mouth at Lake Chelan and ends at High Bridge, a length of approximately 11 miles, encompassing the proposed project area. Because of disturbance to the riverbank and the presence of houses, businesses, power lines, and other human development, the Eligibility Report recommended a classification of “recreational” for Segment 1. In Segment 1, the first quarter mile of the river’s tributaries (except for Company Creek) from their confluence with the river would be classified as recreational. The rest of those tributaries’ lengths would be classified as wild. The first half mile of Company Creek would be classified as recreational. All tributaries above Segment 1 would be classified as wild.

Segment 2, which extends from High Bridge to Cottonwood Camp and is not within the proposed project area, was classified as “scenic” in light of very limited road accessibility and shoreline development.

Segment 3, also outside the project area, extends from Cottonwood Campground to the headwaters. This segment was classified as “wild” because except for a few trails it is completely undeveloped.

## Wild and Scenic Characteristics of the Stehekin River

The WSRA identifies the characteristics that qualify rivers as eligible for inclusion in the National System as a river or river segment that

- Is free-flowing, as determined by standards set by the Departments of the Interior and Agriculture; and
- Possesses one or more resources of outstandingly remarkable value to the region or nation, such as exceptional scenery, recreational opportunities, geology, fisheries, wildlife, prehistoric values, or cultural heritage.

### Free-flowing

Free-flowing, as applied to “any river or section of a river,” is defined in section 16(b) of the WSRA as

> …existing or flowing in natural condition without impoundment, diversion, straightening, riprapping, or other modification of the waterway. The existence, however, of low dams, diversion works, and other minor structures … shall not automatically bar its consideration for inclusion: provided, that this shall not be construed to authorize, intend, or encourage future construction of such structures within components of the National Wild and Scenic Rivers System.

The Eligibility Report describes river flow in Segment 1 as primarily natural, with existing modifications that are well within the standards for a Wild and Scenic River. Segment 1 of the Stehekin River exhibits some level of channel modification or restriction, but the intrusions are generally unobtrusive and of short length. Existing channel modifications intended to protect the main road or private property include the then-estimated 80 erosion protection structures, such as cabled logs, rip-rap, rock barbs, or a combination of structures, at 35 sites in Segment 1. A vehicular bridge spanning the Stehekin River above Harlequin Campground also alters the channel. Some tributaries flowing into Segment 1, such as Company Creek, are also crossed by vehicular bridges. Several tributaries also have intakes for small irrigation systems. The report notes that these intakes have very little impact on streamflow.

### Outstandingly Remarkable Values

All three segments of the Stehekin River exhibit outstandingly remarkable values as discussed in the Eligibility Report. The outstandingly remarkable values identified in the report include wildlife, fish, prehistoric resources, historic resources, geology, scenic resources, and recreation.

The Stehekin River and its valley support a great diversity of game and nongame wildlife and fish species, and provide or potentially provide habitat for many species of special interest, including threatened and endangered species. Many of these species are dependent upon the Stehekin River for some or all of their life cycle and the river is an important habitat component and migration route. Thus, fish and wildlife are outstandingly remarkable values associated with the Stehekin River.

Where there is evidence of prehistoric resources (occupation or use by Native Americans) in the river or river corridor and these resources have rare or unusual characteristics or exceptional human-interest value, then these constitute an outstandingly remarkable value. Since the early 1980s, NPS inventoried approximately 5 percent of the Complex (684,000 acres). Even though only a relatively small area has been surveyed, over 250 pre-contact archaeological sites have been documented, with 12 of these in the Stehekin River Valley. These are resources associated with Native Americans before the time of contact with European settlers (approximately 1850). There are 33 archaeological sites recorded in Lake Chelan NRA, of these sites, 25 are prehistoric. Flake tools and unmodified flakes dating to 3,000 years ago have also been found in this area. As a result, the abundance and importance of the prehistoric resources in the Stehekin Valley qualify as an outstandingly remarkable value under the WSRA.

Historic resources include several sites listed in the National Register of Historic Places, and several more sites that are eligible for nomination. As a result, historic sites or features generally over 50 years in age that signify an important event, person, or cultural activity are categorized as an outstandingly remarkable value under the WSRA. The Stehekin River Valley contains three designated historic districts, which include log cabins, shelters, lookouts, mines, hostelries, and other structures built during the early exploration, settlement, commercial development, and federal management of the Stehekin Valley.

The geology of the Stehekin Valley includes excellent textbook examples of glacial features and processes, including glaciers, ice fields, cirques, spires, hanging valleys, and bedrock box canyons. The Golden Horn batholith is the only true granite found in the North Cascades and is a feature unique to the watershed. Therefore, the geology of the Stehekin Valley was found to be an outstandingly remarkable value under the WSRA.

Scenic resources include a landscape dominated by dramatic, glacially sculpted landforms, diverse vegetation, and exceptionally clear flowing water. Human impacts are few and unobtrusive and allow visitors to experience the grandeur of the wilderness. Though subjective, the quality of the scenery and natural landscape qualify scenic resources as an outstandingly remarkable value under the WSRA.

For a recreational resource to be considered an outstandingly remarkable value, it must be, or have the potential to be, unique enough to attract visitors from outside the geographic region to use the river resources for recreational purposes. This is true of the Stehekin River. Because of the difficulty in accessing the area (lack of vehicular roads into it), visitors must make extra arrangements to reach it. Stehekin Valley visitors come to sightsee, photograph, camp, hike, boat, and swim in / around the Stehekin River. Therefore, recreation resources qualify as an outstandingly remarkable value under the WSRA.

# 13. PARK OPERATIONS

Approximately 20 - 35 NPS employees work in Stehekin to provide visitor services, conduct resource management and law enforcement, and maintain NPS administrative facilities, including roads, buildings, structures, and utilities.

Park operations activities include a variety of administrative activities, maintenance activities (roads, trails, orchard, historic structure, building, and housing), resource management activities (native and nonnative plant and wildlife management, fire/fuels management, research, inventory, monitoring, and restoration), and visitor services activities (search and rescue and other emergency services, interpretation, and visitor center operations).

When the project statement for the replacement and relocation of the maintenance facility was developed in 2000, Lake Chelan NRA contained 12.9 miles of roads, 128 miles of trails, 14 camping areas, 27 quarters structures, a trash-compaction/transfer station, 44 acres of maintained grounds, three National Historic Districts (with a total of 27 historic structures), 19 vehicles, 6 pieces of major equipment, 2 large boats, 9 water systems (including 2 public ones), 15 septic systems, a wastewater treatment plant, 9,435 square feet of docks, and an 8,400-square-foot, three-story historic structure that serves as the district administration building / ranger station / visitor center.

## Roads and Bridges

**Stehekin Valley Road**: The Stehekin Valley Road runs from the Stehekin Landing through the project area and continues into North Cascades National Park. It is approximately 12 miles long and is paved for the first 4 miles between the Stehekin Landing and Harlequin Bridge. North of the Harlequin Bridge to the road end, the road is surfaced with gravel. In the project area, the paved road varies in width from 12 to 16 feet. The road is one lane, with various segments that have sight distance problems (both vertical and horizontal curves). Traffic volumes are light because there are few vehicles in the area (access to vehicles is limited because there is no direct access to Stehekin by vehicle unless the vehicle is brought in by barge). Most of the vehicles belong to residents or park concessioners (tour shuttles). NPS typically uses its own staff and vehicles (such as front-end loaders, graders, and dump trucks) to maintain the road.

NPS owns and maintains the road for Lake Chelan NRA. Annual maintenance may include filling potholes, grading the road, spreading gravel, and performing drainage work such as unclogging, replacing, or repairing culverts. To maintain the road during the winter, NPS hires a contractor who plows the road from the Stehekin Landing up to Milepost 9.2 so that access is maintained to this point. (Average monthly snowfall in Stehekin ranges from approximately 7 to 12 inches in March and November to 24, 40, and 44 inches in February, December, and January, respectively. Average annual snowfall is approximately 128 inches [Western Regional Climate Center 2004].)

The road is an important route for recreation area staff in accessing the Stehekin Valley. This road is used in emergency response such as fighting wildfires, transporting visitors out in an emergency situation (for example, if a hiker or camper were injured), or evacuating residents during floods. It is also used for more routine operations, such as implementing the Forest Fuel Reduction Program, performing resource surveys, providing assistance to visitors, and protecting and managing Lake Chelan NRA resources.

**Company Creek Road**: The Company Creek Road is a county road, and was originally part of the Stehekin Valley Road. It is now used for access across the Stehekin River from the current Stehekin Valley Road.

Company Creek Road is a 2.2-mile-long, one-lane road with occasional turnouts and a crushed aggregate surface. It provides the only access to numerous private parcels, Harlequin Campground, the hydroelectric power plant, the NPS maintenance area, the Company Creek Gravel Pit, and the airstrip on the southwest side of the Stehekin River.

The Company Creek Road is plowed in winter. In the spring and fall it is often subject to flooding, particularly in its upper and lower portion, near the NPS maintenance area and Mileposts 2.1 - 2.2. Other portions of the road have received floodwaters in the last several major floods, with portions of the road being damaged or lost and rebuilt in place.

**Other Roads**: There is a network of minor roads off the Company Creek and Stehekin Valley Roads, including Buckner Homestead hayfield and pasture area roads, Rainbow Falls access road, NPS maintenance area access roads, Company Creek pit access roads, NPS housing roads, and roads around Stehekin Landing to access the Golden West Lodge and other nearby buildings.

**Harlequin Bridge**: Harlequin Bridge is located approximately 4.33 miles up the Stehekin Valley, where it joins the Stehekin Valley Road and the Company Creek Road. It is approximately 75 feet long with average daily traffic of 50 - 75 vehicles. Routine inspections are coupled with formal bridge inspections occurring every two years. The bridge was last replaced in 2001. The rare Baltimore truss design and timber construction have contributed to make the bridge eligible for listing on the National Register of Historic Places (see –b. Historic Buildings and Structures” in –10. Cultural Resources”).

## Road Maintenance Activities

**Winter**: Mechanical removal of snow occurs regularly in the winter on the Stehekin Valley Road to Milepost 9.2 and on the Company Creek Road. The Stehekin Valley Road is plowed from the Stehekin Landing up to the turnaround at Milepost 9.15. Snow removal reduces the hazards of winter driving conditions and ensures that Lake Chelan NRA roads are open to residents and visitors in winter. The roads are plowed from approximately November to March each year, depending on snow conditions. Snow- and ice-melt chemicals or sand is not used.

**Spring**: Spring road-opening operations begin by April to ensure availability during the peak visitor use season (June to October). For nonpublic roads, work is done as needed or at the end of the public road opening. Road-opening activities include clearing roads of windfall trees and debris, clearing avalanches and rock slides, cleaning culverts, and minor repairs to the road surface, shoulders, and embankments.

**Summer/Fall**: Road maintenance activities occurring during normally dry weather include grading unpaved road surfaces, shoulder maintenance, removal of sloughed material from ditches, pavement repairs and leveling, pothole patching, crack sealing, slurry sealing, repaving, sign installation, etc.

Unpaved roads are graded, reshaped, and smoothed, replacing surface material as needed (without widening) to restore crown, proper shape, drainage, and a smooth traveling surface. Maintenance includes pulling material from and cleaning roadside ditches and culverts and disposing of this material as needed. It also includes reshaping shoulders as necessary.

Unpaved road surface materials are often lost due to traffic, erosion during storms, and other predictable and unpredictable events. As-needed repair and stabilization of unpaved roads occurs by adding crushed rock to the road surface. To accomplish this, reshaping and compacting to control ruts, potholes, washouts, and corrugation may also be done.

On paved roads, patching of small areas of asphalt paving with cold, premix asphalt concrete to correct abrupt depressions, potholes, edge failures, and other potential road/parking surface hazards is undertaken to provide a smooth paved surface. Occasionally, permanent pothole patching is conducted with a premix asphalt concrete and asphalt emulsion (tack) to correct abrupt depressions, potholes, edge failures, and other potential road/parking surface hazards to provide a smooth paved surface.

Other maintenance actions include clearing road shoulders and parking ditches to enable rapid meltwater and rain dispersion off the road surface. This includes the cleaning and reshaping of roadside ditches along paved and unpaved roads and parking areas as well as the removal, hauling, and disposal of excess material to restore the original grade and to ensure adequate drainage. On occasion, it can include the importation of additional material. It also includes the trimming or removal of woody vegetation from roadside ditches and shoulders and the removal of overgrown herbaceous vegetation. These actions are done to eliminate or improve edge ruts, washouts, ridges, corrugation, and encroaching vegetation.

When pavement failures are encountered, these areas may be repaired by removing and replacing areas of failed surfaces with premix asphalt, including a base course, if required, to provide a structurally sound surface and to eliminate safety hazards from roads and parking areas. Work may include the placement of a new asphalt surface leveling course on asphalt-paved surfaces to provide a smooth driving surface and to eliminate safety hazards. Premix asphalt concrete is then applied with either a grader or a spreader box. Slurry seal or chip seal is applied as needed, and includes the placement of liquid asphalt with an aggregate or chip seal coat to seal cracks and prevent water entry and related damage to base course materials, to correct minor surface depressions, to seal asphalt surfaces, to restore skid resistance, and to retard further surface deterioration.

Day-to-day maintenance may also include the following:

- Sweeping paved road/parking surfaces, including intersections and curb gutters to remove dirt, sand, and other debris
- Cleaning drainage structures by removing rocks, debris, and silt from pipe culverts, box culverts, and inlets to maintain adequate drainage and to prevent roadway flooding
- Repairing pipe culverts, drop inlets, catch basins, and culvert headwalls to provide proper drainage
- Cutting and removing brush, trees, and overhanging limbs along roads, in campgrounds, and in parking areas to maintain vistas and restore sight distances, to eliminate traffic hazards, and to remove encroaching vegetation
- Picking up and disposing of litter along roads, at overlooks, and along/in parking areas for aesthetics and to remove objects that could be hazardous, could obstruct drainage, or could damage road maintenance equipment
- Repairing slope failures and erosion near roads and developed areas and the removal of eroded material, including occasional reseeding, replanting, or installing mechanical erosion protection measures as needed to prevent such an occurrence from happening again in the same area
- Removing rock fall and slide material from the roadway and roadsides
- Cleaning road bridge decks and bearing surfaces to remove sand and other debris, including the cleaning of drain holes, joints, and curbs

- Repairing minor bridge components such as railing and decks.

**Other Maintenance Activities**: Among the other activities necessary to keep NPS administrative facilities running include ongoing testing and maintenance of recreation area water and septic systems and the wastewater treatment plant; repairs to NPS buildings and structures, including offices, houses, docks, and other transportation facilities; extraction and sorting of rock and gravel from the Company Creek Pit; vehicle maintenance; resupply of materials and fuel; ongoing cleanup and maintenance of recreational facilities, including trails, campgrounds, and restrooms; and maintenance of landscaping, including mowing, snow removal, etc. Table III-14: *Existing Maintenance Compound Structures* shows how the existing maintenance area is currently configured.

**Table III-14: Existing Maintenance Compound Structures**

| Building | Square Feet | Condition* |
|---|---|---|
| Fire cache | 1,637 | Poor |
| Maintenance office | 660 | Good |
| Maintenance shop | 1,140 | Good |
| Solid-waste compaction / warehouse | 2,440 | Poor |
| Solid-waste platform | 875 | Serious |
| Hazardous waste storage | 144 | Unknown |
| Gas station | 800 (12,000 gallons) | Good |
| Paint / flammable storage | 256 | Unknown |
| Covered storage 1 | 1,008 | Good |
| Covered storage 1 | 1,008 | Good |
| Covered storage 1 | 1,008 | Good |
| Carpenter shop | 900 | Poor |
| Water system | n/a | N/A |
| *Circulation space* | *10,890* | *N/A* |
| **Total** | 11,876 (without circulation space) | |

*The NPS uses a ranking system to identify the condition of its facilities. Under this system, the combined average asset priority index is 52 out of 100; the combined average facility condition index is 0.220 (poor). Overall, the existing maintenance facility is costly to maintain, inefficient to operate, and subject to recurrent flooding, with access through floodwater occurring approximately every other year.

**Vegetation**: The NPS staff is currently conducting long-term ecological monitoring of selected forest types (Douglas-fir-western hemlock and subalpine fir) as well as alpine-subalpine vegetation to monitor potential changes resulting from global climate change. In addition, nonnative invasive plants are inventoried and mapped as funding allows and are actively removed annually. Special status plants are inventoried and mapped associated with surveys for proposed projects and management actions. Mushroom surveys are also ongoing. Inventory work has included general vegetation mapping, surveys for state-listed vascular plant species, and limited surveys for mushrooms and nonnative species.

**Wildlife**: Annual long-term monitoring includes landbird surveys at five sites within the Stehekin Valley between the head of Lake Chelan and High Bridge. Periodic monitoring surveys also include Harlequin Duck surveys from High Bridge to the head of Lake Chelan (last done in 1992) and Spotted Owl Activity Site monitoring at one site in the Stehekin Valley (last surveyed in 2010). The extensive upper and lower valley spotted owl surveys of 1993 - 1994 were repeated in 2007 - 2008. Faunal surveys that include small mammals and several species of reptiles, are also done periodically. The last of these surveys was completed in 1992. In 2009, the NPS will begin monitoring nesting activity of Bald Eagles and Ospreys within the lower Stehekin Valley and along Lake Chelan within the NRA, as part of the new Federal Energy Regulatory Commission (FERC) license of the Lake Chelan hydroelectric project.

**Fish**: The NPS staff monitors spawning of cutthroat and rainbow trout in the lower Stehekin watershed (High Bridge to Lake Chelan). A number of index reaches (approximately 10 to 12) will be identified and surveyed for trout redds (either by walking or snorkeling) several times each spring. Spawning is likely taking place in side channels and tributaries (particularly Company, Blackberry, and Margerum creeks). The purpose is to monitor trends in abundance of cutthroat and rainbow spawners. Results will be used to evaluate progress toward restoration of adfluvial/fluvial westslope cutthroat trout and management efforts directed at reduction of nonnative rainbow trout in the lower 10 miles of the Stehekin River. Partial funding is provided by Chelan PUD under their FERC relicensing agreement.

**Stehekin River**: Monitoring programs for the Stehekin River include river discharge, channel patterns, and large woody debris surveys. Inventory of Stehekin River features has included surficial geology, soils, vegetation, river and side channel habitats, and wetlands (Table III-15: *Stehekin River Inventory and Monitoring Programs*).

**Table III-15: Stehekin River Inventory and Monitoring Programs**

| Subject | Agency | Date/Length of Record |
|---|---|---|
| **Monitoring** | | |
| River discharge | USGS | 1911 - present |
| River channel patterns | NPS | 1906 - 2007 |
| Large wood accumulation | NPS | 1985, 2000, 2007 |
| **Inventory** | | |
| Surficial geology | NPS | 2005 |
| Soils | NPS | 1988 + new project |
| Vegetation | NPS | 1988 + new project |
| Main stream and side channel habitat | NPS | 1988 |
| Wetlands | NPS | 1988 |

## Restoration

Vegetation / habitat restoration in the recreation area occurs in response to need and funding. It may consist of collecting (gathering seed from native species near the proposed restoration site), scarifying (raking or creating roughness in compacted areas), site preparation (incorporating forest duff or topsoil / placing large woody debris), and seeding (scattering or broadcasting seed collected from native species in the vicinity of the site). Occasionally, plants may be propagated from seeds or cuttings collected from the proposed revegetation site (generally avoided due to the need for supplemental watering to establish the young plants) (Gempko, pers. comm., 2009).

## Fire Management

There are currently 48 long-term fire-effects-monitoring plots located within the forest fuel reduction areas of the Stehekin Valley, which are used to track the progress and effects of prescribed fire and thinning as they are implemented through the North Cascades National Park Service Complex Forest Fuel Reduction/Firewood Management Plan (NPS 2005e). The NPS fire management team has been conducting prescribed fires and thinning to reduce hazardous fuels within the wildland-urban interface and to maintain the benefits of fire in a fire-dependent ecosystem. The fire-effects-monitoring plots document fuel loadings, tree mortality, species composition, and species abundance before and after thinning and prescribed fires, and monitor long-term changes through continued visits to the plots the first year, second year, and thereafter every five years following prescribed fire (Kopper, pers. comm., 2009). There are three fire-effects-monitoring plots located along the proposed reroute of the Stehekin Valley Road. These plots are located in areas that have been thinned but have not yet been burned. They are used to identify the impact of fire management program actions on area forest habitat.

The monitoring plots are 50 by 20 meters and are marked in all corners by rebar stakes with metal tags. Each tag contains the plot code ―FPSME2” followed by the individual plot number. The impacted plots are FPSME2-43, FPSME2-45, and FPSME2-46.

The plots are located in the Douglas Fir/Ponderosa Pine forest community. This vegetation type typically includes a well-developed shrub and understory component. The most common shrubs are common snowberry (*Symphoricarpos albus*), pinemat manzanita *(Arctostaphylos nevadensis*), serviceberry, *(Amelanchier alnifolia*), and white spiraea (*Spiraea betulifolia*). The understory is predominantly comprised of native perennial grasses, including bluebunch wheatgrass (*Psuedoroegneria spicata*) and pine grass (*Calamagrostis rubescens*), and various herbaceous species, including arrowleaf balsamroot (*Balsamorhiza sagittata*), hawkweed (*Hieracium* sp.), and lupine (*Lupinus* sp.).

### Road Safety

See also ―Safety” in ―11 Visitor Experience.”

In a road traffic safety study conducted in August 1991 (as described in NPS 1995a:227), average daily traffic volumes on the Stehekin Valley Road and Company Creek Road ranged from 33 to 221 vehicles per day. Between 1986 and 1990, 20 accidents were reported. Most involved only minor property damage and were attributed to the narrow roadway and/or limited sight distance.

Since 2003, there have been 11 documented vehicle accidents. None of these resulted in injuries or fatalities. Since 2003, there have also been 15 documented bicycle accidents which resulted in injuries.

## 14. SOCIOECONOMICS

Lake Chelan NRA is administered as part of the North Cascades National Park Service Complex (also including North Cascades National Park and Ross Lake NRA). The park is surrounded by the Glacier Peak Wilderness, the Lake Chelan / Sawtooth Wilderness, the Wenatchee National Forest, and North Cascades National Park. Lake Chelan NRA is located within Chelan County.

The closest incorporated city providing services and access to the area is Chelan. Chelan is within a few hours of several major cities in Washington State, including Spokane, Yakima, and Seattle. The next-closest large city near Lake Chelan NRA is Wenatchee. In addition to attracting tourists from the west side of the Cascades and beyond, these areas near the Columbia River have historically provided fruit, including apples and peaches.

Chelan County has a land base of 2,915 square miles and a population of approximately 71,000 people (city-data.com 2007). This density of people per square mile is low compared to the state average of 88.6 people per square mile (Wikipedia.com 2008). Chelan has a population of approximately 3,860 people (city-data.com 2007), East Wenatchee has a population of 11,570 people, and Wenatchee, approximately 27,856 people (Wikipedia.com 2008). The population of Chelan County in 2005 (69,950) ranked it 17th in the state (USDC 2005). Between 1960 and 1992, the population in Chelan County grew from 40,744 to 54,600, with decades between these years showing increases of from 0.09 percent to 2.63 percent (1990 census *in* NPS 1995a:244).

According to the Bureau of Economic Analysis Regional Economic Accounts (Bearfacts), in 2005 Chelan County had a per capita personal income of $29,657. This ranked it twelfth in the state, and was 84 percent of the state average ($35,479) and 86 percent of the national average ($34,471). When 1995 - 2005 data were compared, the average annual growth rate of the per capital personal income was 3.4 percent, compared to 4.1 percent for both Washington State and the United States. Table III-16: *Per Capita Personal Income* shows a comparison of this data to that reported in the 1995 GMP.

**Table III-16: Per Capita Personal Income**

| | 1980 | 1990 | 2005 |
|---|---|---|---|
| Chelan County Per Capita Income | $9,785 | $16,589 | $29,657 |
| Percent of State Per Capita Income | 95.5 | 89.9 | 84 |

Sources: NPS 1995a:245 and USDC 2005 (1995 - 2005).

Earnings of people employed in Chelan increased 5.1 percent between 2004 and 2005, which was slightly lower than the change for Washington State (5.7 percent) and the United States (5.6 percent). As noted in the GMP (NPS 1995a:245), the Chelan County economy is based on two seasonal industries, tourism and agriculture, which peak during the same general time each year (July through September), while technical trades and other year-round businesses diversify the economy of the Washington State.

Stehekin had a resident population of approximately 100 people in 2000. As noted above, this population nearly doubles during the summer. There are approximately 126 homes in Stehekin. Most of these are owner-occupied; however, a number of them are long- or short-term rentals. Based on City Data (city-data.com 2009), the estimated median house value in 2007 was approximately $223,327, which is slightly lower than for Washington State ($300,800). Estimated median household income for the Stehekin zip code was $44,161, compared to $55,591 for the state.

Because of the area's remoteness, residents must be independent and self-reliant. The Stehekin Community economy has traditionally been heavily dependent on providing visitor services. Among those visitor services currently provided include a shuttle bus, overnight accommodations, bicycle and kayak rentals, a restaurant and bakery, and a gift store. Some residents have home-based businesses, that include crafting furniture, photography, writing, and painting. Other residents are retired or make their living through tourism in other ways.

A concessioner manages the lodging at the Landing and the contract also includes marina services, a restaurant and general store, bus transportation, fuel, and other activities. One smaller concession is available for the craft store. There are approximately four additional commercial-use licenses and one special-use permit for the provision of other services, including rentals and tours.

In addition to the economic activity generated by the recreation area in Stehekin, day-use visitors to Stehekin may stay in lodgings and purchase food, gifts, and fuel as well as camping or backcountry supplies downlake in Chelan or Wenatchee. Other Stehekin visitors use private boats and likely purchase fuel and supplies for their day or overnight trips downlake.

Based on the 1995 GMP, the approximately 43,550 visitors (25,872 nonlocal) to Stehekin in 1992 spent an estimated $1.75 million in Stehekin and $3.91 million in Chelan, for a total of $5.67 million (NPS

1995a:248). As noted in the GMP, nonlocal visitors are estimated to generate expenditures for commercial transportation, lodging, food and drink, shopping, entertainment, automobile repair and services, private boats, and private aircraft. Local visitors also generate many of these costs; however, lodging and entertainment costs would be generally absent in Chelan and focused on Stehekin.

One of the most recent Money Generation Model (2) studies conducted by Michigan State University for the NPS shows that every dollar spent by the federal government on a national park generates $4.00 - $5.00 in the local economy. Figures for Lake Chelan NRA in fiscal year 2005 (October 2004 - September 2005), the most recent year of analysis, show that the recreation area generated 28 jobs, $412,000 in income, and $1,176,000 in spending (Michigan State University 2008). (Note: For the study, the impacts of job and income effects exclude spending by local visitors). According to the study, this is standard practice in economic impact analyses, because spending by local residents does not represent “new” money brought into gateway regions. Visitor spending is calculated for areas within 50 miles of the recreation area (Michigan State University 2008).

The money generation model study is based on recreation visits and overnight stays as reported by the NPS. Visitors are broken down into local day-trip visitors, nonlocal day-trip visitors, and visitors on overnight trips staying in motels or campgrounds inside or outside the recreation area based on previous visitor surveys. Visitor spending is estimated based on visitor-use survey data from selected parks where studies have occurred and extrapolated to parks without studies. Spending does not include expenditures on durable goods that cannot be attributed to a single trip (Michigan State University 2008). Payroll information (wages and salaries plus benefits) was also obtained from the NPS.

To account for different park settings, there are different multipliers for large urban, small urban, and rural areas. The multipliers are derived from IMPLAN, a federal land management agency standard used to evaluate economic impacts. IMPLAN was developed by the USFS to calculate economic impacts generated by national forests. A generalized list of these can be found in the GMP for the version of this software that was then available (1985) (NPS 1995a:256 - 257). The multipliers are for the following activities: construction sand and gravel, industrial and commercial construction, maintenance and repair of facilities, local transportation services, water transportation, air transportation, hotels and lodging places, eating and drinking places, automobile repair and services, recreation-related retail trade, amusement and recreation services, and government-federal.

The model does not include park operations expenses or construction activities, only base annual salaries. It also does not include the impacts of employees in regional offices or other administrative divisions, where visitation is not reported. Lake Chelan NRA has a payroll of 17 people in winter and approximately 32 in the summer, most of whom reside in Stehekin. Some work effort attributed to Lake Chelan NRA, however, is part of the North Cascades NPS Complex combined operations and is not directly related to either Stehekin or Chelan County. Based on concession contracts, additional staff is employed in visitor services for the concessioner. Money generated by the concession operation is reinvested to enhance visitor services for Lake Chelan NRA.

When annual operations costs are added in to the mixture, an additional $1.3 million is spent by Lake Chelan for ongoing resources, maintenance, and administration. In addition, an estimated $100,000 is spent annually on separately funded projects. These figures, however, do not represent actual spending in the local economy. Not all of these operational expenditures are made in Chelan County.

# CHAPTER IV:

## Environmental Consequences

# CHAPTER IV: ENVIRONMENTAL CONSEQUENCES

This chapter describes the impacts of each alternative on recreation area resources, including cumulative impacts. Methods used for the analysis are presented in the ―Impact” sections and provides information about methodology common to all impact sections. An expanded Methodology section is contained under each Impact topic. Similar to Chapter II: Management Alternatives, this chapter contains an Impact Comparison Chart (Table IV-16 at the end of this chapter) to compare the differences in projected impacts among the alternatives.

## INTRODUCTION

The National Environmental Policy Act (NEPA) requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided should the proposed action be implemented (in this document, ―effects” and ―impacts” are used interchangeably). This section analyzes the environmental impacts of project alternatives on affected recreation area resources. These analyses provide the basis for comparing the effects of the alternatives. NEPA requires consideration of context, intensity, and duration of impacts, indirect impacts, cumulative impacts, and measures to mitigate impacts. In addition to determining the environmental consequences of the preferred and other alternatives, National Park Service (NPS) *Management Policies 2006* (NPS 2006a) and Director's Order 12 (NPS 2001a) require analysis of potential effects to determine if actions would impair park resources. The basis for understanding the analysis within this chapter is provided below.

**Photo 26 – Stehekin River near Buckner Homestead Hayfield and Pasture**

## METHODOLOGY

This section describes the terms that are used in evaluating environmental impacts.

**Context of Impact**: The context is the setting within which impacts are analyzed—such as the project area or region, or for cultural resources, the project area or *area of potential* effects (APE).

**Type of Impact**: The type of impact is a measure of whether the action will improve or harm the resource and whether that harm occurs immediately or at some later point in time.

- **Beneficial**: The impact improves the resource or the quality or quantity of the resource.
- **Adverse**: The impact harms or depletes the resource or its quality or quantity.
- **Direct**: The impact is caused by and occurring at the same time and place as the action.
- **Indirect**: The impact is caused by the action, but occurs later in time, or at another place, or to another resource.

**Duration of Impact**: Duration is a measure of the time period over which the effects of an impact persist and may be short term (quickly reversible and associated with a specific event, such as construction, during project implementation) or long term (reversible over a much longer period or may occur continuously based on normal activity).

**Area of Impact**: Impacts may be localized, detectable only in the vicinity of the activity, or widespread, detectable on a regional or landscape level.

**Intensity of Impact**: In this document, the intensity of impacts is measured using the following scale: negligible, minor, moderate, and major. These are defined for each resource within the analysis sections. In addition, determinations of effect for actions that would affect threatened or endangered species comply with Section 7 of the Endangered Species Act (ESA) (no effect; may affect, not likely to adversely affect; and may affect, likely to adversely affect), while determinations of effect for cultural resources also comply with Section 106 of the National Historic Preservation Act (NHPA) (no historic properties affected, no adverse effect, and adverse effect).

**Impact Mitigation**: Impacts have been assessed under the assumption that proposed measures to minimize or mitigate the impact would be implemented. The following terms identify the way to change the intensity of impacts or to change the resource condition following impacts. Project actions can:

- **Avoid** conducting management activities in an area or at a time that affects the resource
- **Minimize** the type, duration, or intensity of the impact to an affected resource
- **Mitigate** the impact by:
  - **Repairing** localized damage to the affected resource immediately after an adverse impact
  - **Rehabilitating** an affected resource with a combination of additional management activities
  - **Compensating** for a major long-term adverse direct impact through additional strategies designed to improve an affected resource to the degree practicable.

## IMPAIRMENT

In addition to determining the environmental consequences of the preferred and other alternatives, NPS *Management Policies* (NPS 2006a) and Director's Order 12 (NPS 2001a) require a determination of whether proposed actions would impair park resources. ―Impairment" is a term from the 1916 act creating the NPS (the Organic Act) and is defined as an impact that would harm park resources or values (see Section 1.4.5 below).

Whether an impact results in impairment depends on the particular resource affected; the severity, duration and timing of the impact; and the direct, indirect, and cumulative effects of the impact. If an action is determined to result in impairment, the action may not be approved.

In this Draft Environmental Impact Statement (DEIS), determinations of impairment are provided in the conclusion section under each natural and cultural resource topic for each alternative. These determinations are rendered solely by the NPS; other agencies such as FHWA do not participate.

The following excerpts from NPS *Management Policies* define ―impairment" and highlight the difference between an impact and impairment.

Section 1.4.3: The NPS Obligation to Conserve and Provide for Enjoyment of Park Resources and Values

> The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. This mandate is independent of the separate prohibition on impairment and applies all the time with respect to all park resources and values, even when there is no risk that any park resources or values may be impaired. NPS managers must always seek ways to avoid, or to minimize to the greatest extent practicable, adverse impacts on park resources and values. The laws do give the Service the management discretion, however, to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, so long as the impact does not constitute impairment of the affected resources and values.
>
> The fundamental purpose of all parks also includes providing for the enjoyment of park resources and values by the people of the United States. The enjoyment that is contemplated by the statute is broad; it is the enjoyment of all the people of the United States and includes enjoyment both by people who visit parks and by those who appreciate them from afar. It also includes deriving benefit (including scientific knowledge) and inspiration from parks, as well as other forms of enjoyment and inspiration. Congress, recognizing that the enjoyment by future generations of the national parks can be ensured only if the superb quality of park resources and values is left unimpaired, has provided that when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant. This is how courts have consistently interpreted the Organic Act. (NPS 2006a, Section 1.4.3)

Section 1.4.4: The Prohibition on Impairment of Park Resources and Values

> While Congress has given the Service the management discretion to allow impacts within parks, that discretion is limited by the statutory requirement (generally enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. This, the cornerstone of the Organic Act, establishes the primary responsibility of the National Park Service. It

> ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.
>
> The impairment of park resources and values may not be allowed by the Service unless directly and specifically provided for by legislation or by the proclamation establishing the park. The relevant legislation or proclamation must provide explicitly (not by implication or inference) for the activity, in terms that keep the Service from having the authority to manage the activity so as to avoid the impairment. (NPS 2006a, Section 1.4.4)

Section 1.4.5: What Constitutes Impairment of Park Resources and Values

> The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.
>
> An impact to any park resource or value may, but does not necessarily, constitute an impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, or
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or
- identified in the park's general management plan or other relevant NPS planning documents as being of significance.

> An impact would be less likely to constitute an impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated. An impact that may, but would not necessarily, lead to impairment may result from visitor activities; NPS administrative activities; or activities undertaken by concessioners, contractors, and others operating in the park. Impairment may also result from sources or activities outside the park. (NPS 2006a, Section 1.4.5)

Section 1.4.6: What Constitutes Park Resources and Values

> The ―park resources and values" that are subject to the no-impairment standard include: the park's scenery, natural and historic objects, and wildlife, and the processes and conditions that sustain them, including, to the extent present in the park: the ecological, biological, and physical processes that created the park and continue to act upon it; scenic features; natural visibility, both in daytime and at night; natural landscapes; natural soundscapes and smells; water and air resources; soils; geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures, and objects; museum collections; and native plants and animals; appropriate opportunities to experience enjoyment of the above resources, to the extent that can be done without impairing them; the park's role in contributing to the national dignity, the high public value and integrity, and the

> superlative environmental quality of the national park system, and the benefit and inspiration provided to the American people by the national park system; and any additional attributes encompassed by the specific values and purposes for which the park was established. (NPS 2006a, Section 1.4.6)

Section 1.4.7: Decision-making Requirements to Identify and Avoid Impairments

> Before approving a proposed action that could lead to an impairment of park resources and values, an NPS decision-maker must consider the impacts of the proposed action and determine, in writing, that the activity will not lead to an impairment of park resources and values. If there would be an impairment, the action must not be approved. (NPS 2006a, Section 1.4.7)

## CUMULATIVE IMPACTS

The Council on Environmental Quality (CEQ) describes a cumulative impact as follows (Regulation 1508.7):

A ―Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The cumulative projects addressed in this analysis include past and present actions, as well as any planning or development activity currently being implemented or planned for implementation in the reasonably foreseeable future. Cumulative actions are evaluated in conjunction with the impacts of an alternative to determine if they have any additive effects on a particular resource. Because most of the cumulative projects are in the early planning stages, the evaluation of cumulative impacts was based on a general description of the project. These projects are included in the cumulative effects analysis presented in this chapter (see Appendix 5: Cumulative Impacts Project List).

Note: Except where inserted in the sections below, the context and duration is as follows for all resource impact topics.

Cumulative impacts are evaluated in terms of context and duration.

**Context of Impact**: Changes were considered within the lower Stehekin Valley below High Bridge to Lake Chelan in the nonwilderness portion of Lake Chelan National Recreation Area (NRA).

**Duration of Impact**: *Short term:* These impacts are often quickly reversible and associated with a specific event, such as construction, during project implementation, occurring for a period of less than one to five years. *Long term:* These impacts are reversible over a much longer period, may occur continuously based on normal activity, or may occur for more than five years.

### Impacts Associated with Future Proposed Materials Sources, Staging, or Spoils Areas

Contractor-selected noncommercial material sources, staging, or spoils areas not identified within this document for project work would, at a minimum, have written documentation submitted by the contractor prior to any use to ensure that potential effects on rare, threatened, or endangered species (ESA), waters of the United States (Clean Water Act (CWA)), or prehistoric or historic resources (NHPA) have been evaluated in association with the proposed activity or activities.

## IMPACT ASSUMPTIONS

The NPS and FHWA have used the design process to reduce impacts. For example in this project, the road design includes measures such as locating pullouts well away from sensitive nesting areas, avoiding the removal of large nest or perch trees where possible, and minimizing cleared areas.

Acreage impacts and other quantified impacts provided within the analysis are preliminary. This information is provided to convey the relative differences in impacts among alternatives and is from multiple sources, including the 30 percent road designs provided by the Federal Highway Administration (FHWA) to the North Cascades National Park Service Complex. Final impact numbers would likely be within 10 percent of the numbers provided in Table IV-1: *Impact Assumptions* and throughout this document. Estimated road impacts have generally been rounded to the nearest half or whole acre, although some more specific differences are given within, depending on the impact being discussed. Impacts associated with erosion protection measures and recreational features have been derived from designs based on the anticipated area that would be affected. Implementation of these measures would have similar impacts but could be slightly more or less than the approximate impact figures identified.

**Table IV-1: Impact Assumptions**

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| **Overall road mileage** | 4.9 mi | Same as Alt 1 | Same as Alt 1 | Same as Alt 1 |
| **Actual area** (road length × 16 ft) | 9.4 ac | Same as Alt 1 | Same as Alt 1 | Same as Alt 1 |
| **Estimated lands available for exchange** | 37 ac | 24 ac | Same as Alt 2 | Same as Alt 2 |
| **Site-specific road improvements** (pullouts, winter turnaround) | 0.8 ac | 0.9 ac | 0.9 ac | Same as Alt 1 |
| **McGregor Meadows Access Road** | N/A | 1.3 ac (0.8 mi) | Same as Alt 2 | N/A |
| **Number of barbs** (acres) | 0 | 6 - 8 (0.5) | 4 (0.3) | 16 - 17 (1.1) |
| **Number of logjams (acres)** | 0 | 2 (0.1) | 5 (0.3) | 3 (0.1) |
| **Maintenance / housing relocation** | 5 - 8 ac | Same as Alt 1 | Same as Alt 1 | Same as Alt 1 |
| **Recreational improvements** | 3.1 ac | 3.6 ac | 3.4 ac | 3.5 ac |
| **Restoration** | | | | |
| a. Riparian | 1.5 ac | 4.1 ac | 3.9 ac | 2.9 ac |
| b. Upland | 3.6 ac | 4.4 ac | 3.7 ac | 3.7 ac |
| c. Bioengineering (barbs and logjams) | n/a | 0.6 ac | 0.6 ac | 1.2 ac |
| **Total restoration** (a+b+c) | 5.1 ac | 9.1 ac | 8.2 ac | 7.8 ac |
| **Total disturbance** | 10 ac (new)<br>37 ac (LPP)<br>12 ac (existing) | 28 ac (new)<br>24 ac (LPP)<br>8 ac (existing) | 28 ac (new)<br>24 ac (LPP)<br>9 ac (existing) | 11 ac (new)<br>24 ac (LPP)<br>12 ac (existing) |

# ENVIRONMENTAL IMPACT ANALYSIS

# 1. LAND USE IMPACTS

## a. Land Use Methodology

**Methodology**: Land use analysis was based on a quantitative and qualitative assessment of the potential changes to lands within the project area encompassed by the alternatives. The amount of undisturbed natural landscape / recovering landscape was compared to proposals for potential new development and changes associated with existing development.

**Type of Impact***:* Types of land use changes considered include conversion from undeveloped land to developed land and additional protection of undeveloped or restored lands as public lands. The extent to which an area has been previously impacted by human activities is also considered. Beneficial impacts would result from sustainable future development out of the channel migration zone, protection of undisturbed land, and restoration of lands now developed to natural conditions. Adverse impacts would result from development remaining in the channel migration zone or new development in previously undisturbed areas. Indirect impacts could result from retention of the Stehekin Valley Road. Indirect impacts would also be associated with impacts from changes to lands identified by the LPP (NPS 1995b) for exchange since identifying lands for exchange would not necessarily mean that they would be developed.

### Intensity of Impact

- **Negligible**: Impacts would be imperceptible or not detectable.
- **Minor**: Impacts would be slightly detectable or localized within a small portion of the project area.
- **Moderate**: Impacts would be readily apparent.
- **Major**: Impacts would be substantial, highly noticeable, and widespread. Changes to the character of the Stehekin Valley would occur.

## b. Land Use Impacts

The following broad factors would affect land use in Alternatives 1 - 4:

- Introducing recreation facilities, relocating maintenance / housing, adding erosion protection measures, and offering exchange lands in currently undeveloped areas
- Relocating a portion of the Stehekin Valley Road in Alternatives 2 and 3 or raising the grade of a portion of the Stehekin Valley Road in Alternatives 1 and 4
- Changes to the 1995 LPP (Alternatives 2 - 4) to allow clustering of development (to provide a more sustainable land base not as susceptible to flooding).

These actions would affect the amount of undisturbed native landscape compared to restored native landscape and developed lands. While other actions, such as road rehabilitation, erosion protection measures, and recreational development, would have negligible to minor effects, these key components of the proposed plan would account for most impacts.

## Impacts from Actions Common to Alternatives 1 - 4

**Maintenance Facility and Housing Replacement and Relocation**: Alternatives 1 - 4 would implement the General Management Plan (GMP) direction to remove administrative facilities from the floodplain. Approximately 5 acres now used for the NPS maintenance complex within the 100-year floodplain / channel migration zone of the Stehekin River would be consolidated, with relocated administrative housing on 5 to 8 acres of uplands near the airstrip. The Stehekin airstrip is located on an alluvial fan above the 100-year floodplain and out of the channel migration zone. Most of the area surrounding it has been previously disturbed (cleared). The maintenance facility move would allow for the removal of hazardous waste storage facilities and outdated septic systems from within the 100-year floodplain to high ground, where more suitable site conditions exist to accommodate these facilities. Building materials would be salvaged where possible and most of the area would be restored to natural conditions, a long-term moderate beneficial effect.

The replacement and relocation of the maintenance facility would result in the restoration of lands within the 100-year floodplain and channel migration zone of the Stehekin River, as well as in the long-term persistence of the facilities because these would no longer be affected by flooding. The Stehekin River would benefit from the removal of facilities that contain numerous point sources of potential pollution, including from heavy equipment; electrical appliances; storage of cleaning materials and supplies, furnishings, and building materials, such as paints and solvents; and a solid-waste storage facility. These facilities have flooded approximately every other year (most recently in 2006). Because the facility would be designed to a silver or greater LEED rating, it would provide efficient, green building design intended to limit the effects of development. Unlike the current maintenance complex, buildings would be located close together and would be landscaped with native plants. Circulation spaces would be designed in concert with buildings and would contribute to efficient use that would further reduce the effects of development. Although some small structures in the old maintenance area could be relocated and repurposed, their removal from the 100-year floodplain would bring the facility into compliance with Executive Orders, NPS policies, and North Cascades National Park Service Complex plans.

Overall, there would be minor to moderate adverse effects on land use from the development of an additional 5 to 8 acres of upland within the lower Stehekin Valley. These effects would be offset by the moderate long-term beneficial effect from removing approximately 5 acres of development from within the 100-year floodplain and channel migration zone of the Stehekin River.

**Recreational Facilities**

**Campgrounds**: A long-term minor adverse impact on land use would occur from the establishment of new campsites at Bullion. Negligible beneficial effects would occur from the conversion of Bullion Camp to a day-use area.

## Impacts from Alternative 1

**Road Grade Raise**: Realigning and raising the grade of the road within McGregor Meadows would likely raise floodwater surface elevation on private land in McGregor Meadows by limiting flow from the river to its floodplain, including a side channel on the northeast side of the road. Retention of the road would continue to have long-term localized moderate adverse effects on land use. Other indirect effects on land use from retaining the road would occur over time as actions were taken to protect the road, including from adding new erosion protection measures.

Maintaining the road in place could also continue to encourage unsustainable development in the channel migration zone, a localized long-term moderate adverse impact.

**Implementation of 1995 Land Protection Plan**: The NPS would continue to implement the 1995 LPP (NPS 1995b) and the GMP direction to move administrative and private development out of the 100-year floodplain of the Stehekin River. The priorities for land protection (primarily acquisition and exchange) would remain the same. The criteria used to rank properties for acquisition and exchange would continue to be focused on removing development from the 100-year floodplain and on protecting scenic qualities as viewed from the Stehekin Valley Road, as well as on protecting key natural resources associated with water.

The NPS would also continue to have limited ability to influence the nature and extent of development on private lands within the Stehekin Valley. Development constraints and conditions would be developed by Chelan County and would generally be one dwelling per 5 acres (under current zoning). Some parcels were previously divided into 1-acre lots, which were considered buildable before current zoning was enacted. Most of these smaller parcels are located near the river mouth in the channel migration zone. Additional permitted uses include, but are not limited to, home occupations, bed-and-breakfast establishments, guest inns, recreation or tourist uses, and small-scale businesses. Construction constraints would include conformity to the Shoreline Management Act and zoning in the Chelan County Plan and would continue to include appropriate setbacks from the Stehekin River to protect environmental quality.

Ongoing NPS review of development within the lower Stehekin Valley (including exchanges and new lands) would include planning and pre-design; preliminary and final design; construction and monitoring; and maintenance and compliance actions (including regular inspection of the property by the NPS for compliance with Conditions, Covenants and Deed Restrictions (CCRs) (Appendix 9).

As noted in Chapter II: Management Alternatives, the tracts proposed for exchange in the 1995 LPP (approximately 37 acres) would remain possible for exchange at some later date (see Chapter II: Management Alternatives, Table II-4: *1995 Land Protection Plan Proposed Exchange Parcels*). Of these 37 acres, one combined parcel (part of 08-100) is primarily located within the floodplain and does not have enough buildable area. As a result, there would be approximately 35 acres that could be developed after exchanges. As many as 114 acres in high-priority acquisition, with no cap on the number of acres, could be put under land protection status through acquisition, exchange, easements, or covenants.

There are currently 168 privately owned tracts, comprising 417 acres. Although there are approximately 62 high-priority, 18 moderate-priority, and 86 low-priority properties in the LPP that are targeted for fee, easement, or a combination land protection strategy by the NPS, given the history of land acquisition and exchange in Stehekin over the past 15 years, it is likely that most (about 90 percent) of the remaining 417 acres of privately owned land in Stehekin would remain private. Therefore, there could be ongoing long-term minor to moderate indirect adverse effects on land use from development of some of this land in the channel migration zone. Long-term moderate adverse effects would also be associated with potential exchange of the 20 acres of the Lower Field parcel because there is currently no development at this site. Additional minor to moderate localized beneficial effects could occur from land acquisition of other high-priority lands or protection of exchange lands.

**Recreational Facilities**

*Lower Valley Trail*: The conversion of approximately 6.1 miles of existing trail (1.5 acres) to hiker / equestrian trail would have no effect on land use since the trail currently exists. Construction of 6.3 miles of new trail (1.5 acres) would result in a change in land use from development of the trail. This action could have long-term minor adverse effects from increased use of public lands that would affect McGregor Meadows and some residents between the Boulder Creek and Rainbow Creek alluvial fans.

## Impacts from Actions Common to Alternatives 2 - 4

### Recreational Facilities

*Lower Valley Trail*: In Alternatives 2 and 3, approximately 4.6 miles of existing trail (1.1 acres) would be converted to hiker / equestrian trail. Another 7.9 miles of existing trail would also be used, including some former Stehekin Valley Road (proposed McGregor Meadows Access Road) and other abandoned road restoration areas. Construction of 4.6 miles of new trail could result in long-term minor impacts from development of the trail. As with Alternative 1, impacts from development of the trail could affect nearby residents.

*Campgrounds*: A long-term minor adverse impact on land use would occur from the establishment of new and modified campsites (Purple Point and Rainbow Falls in Alternatives 2 - 4, and Company Creek in Alternatives 3 and 4).

**Restoration and Bioengineering**: Although restoration would vary among alternatives, there would be long-term negligible adverse effects and long-term minor to moderate beneficial effects on land use from the conversion of former developed areas to restored landscape. In addition to restoration of former housing and maintenance areas, there would be riparian restoration at Lower Field and Buckner Homestead hayfield and pasture as well as restoration of riverbank areas from bioengineering associated with rock barbs and logjams. The benefits of restoration would be greatest in Alternative 2, followed by 3, and 4.

**Land Protection Plan Modifications**: The key goal of the 1995 LPP (NPS 1995b) has been changed in the revised LPP to protect lands of high resource value within the Stehekin River channel migration zone. As a result, there are new criteria to establish priorities for acquisition and exchange in the revised LPP. These nine criteria would be weighted more toward protection of the Stehekin River than scenic qualities along the Stehekin Valley Road and general natural resources preservation. Therefore, although the NPS would continue to implement the GMP direction to move private property out of the 100-year floodplain of the Stehekin River, under Alternatives 2 - 4 that focus would be expanded to removing development from the channel migration zone, including areas subject to frequent flooding in McGregor Meadows. This would cause numerous low-priority properties (those with development) to become high-priority properties to facilitate their exchange or acquisition. Acquisition and exchange priorities would therefore be focused on relocating or removing private residential development from the channel migration zone, which would have long-term moderate to major beneficial impacts on land use from increasing sustainable development. Although these criteria are weighted differently in Alternatives 2 and 3 versus Alternative 4 to reflect different land use patterns, beneficial impacts would occur in all alternatives, although to a lesser degree in Alternative 4 (see ―Additional Impacts" sections below).

In Alternatives 2 - 4, most public land within Lake Chelan NRA would continue to remain in public ownership. Of the total current acreage (roughly 62,000 acres), only 24 acres, or 0.04 percent, would be offered for exchange. This total is much less than the total number of private lands remaining in the Stehekin Valley (417 acres). The 24 acres that would be available for exchange in the proposed revision to the LPP is also less than the approximately 37 acres remaining under the 1995 LPP (in Alternative 1).

It is unlikely that these exchange lands would be exchanged for a similar number of acres of private land because development actually increases the value of the land. Therefore it is possible that the amount of private land could grow by a few acres through the exchange process, however, when direct acquisition occurred, it would reduce the amount of private land. Overall the loss of public land would be small in comparison to the total number of acres preserved in public ownership in Lake Chelan NRA and in surrounding national forests and North Cascades National Park Service Complex and would have a minor beneficial effect on land use from allowing more sustainable development and from the protection of additional sensitive areas.

In total, approximately 24 acres of public land would potentially be exchanged for private land (Table II-6: *Alternatives 2 - 4 Revised Land Protection Plan Proposed Exchange Parcels*). Given the recent history of land acquisition and exchange in Stehekin over the past 14 years, therefore, it is likely that most, approximately 390 - 400 of 417 acres, or roughly 95 percent of the remaining privately owned land in Stehekin would remain private. Even though this is consistent with the purposes of Lake Chelan NRA, there would continue to be long-term minor to moderate adverse effects on land use from additional conversion of undeveloped land to developed land. This would be coupled with minor long-term beneficial impacts on land use from the potential protection of additional land from other acquisition methods. New development would also be balanced by conversion of some developed land to its natural state.

### Additional Impacts from Alternative 2

In addition to the impacts from actions common to all Alternatives (1 - 4) and impacts from actions common to Alternatives 2 - 4, there would be impacts to land use from the road reroute, erosion protection measures, new recreational facilities, and other changes associated with the revised LPP.

**Road Reroute**: Approximately 18 acres of undisturbed land could be affected by a road reroute, a major adverse effect on land use that would be partially offset by restoration of much of the old roadbed and revegetation of cut and fill areas over time (Table IV-1: *Impact Assumptions*). In addition, a portion of the existing Stehekin Valley Road alignment would be maintained as the McGregor Meadows Access Road, but the remaining portion (approximately 0.7 mile, or 1.4 acres) of road along the river would be restored. Road restoration would have a long-term minor beneficial effect on land use.

**Erosion Protection Measures**: Implementing erosion protection measures at three sites would increase the sustainability of the Stehekin Valley Road, a long-term minor beneficial effect. With the exception of the erosion protection near the river mouth, the other two sites are at the edge of the channel migration zone where the river's ability to migrate laterally is naturally constricted. As a result, actions at Wilson Creek and Frog Island would have no impact on land use.

**Recreational Facilities**

*Raft Launch*: A small area of land near the mouth of the Stehekin River (which currently has rip-rap) would be used for a raft takeout, parking area, and access road. Construction of this public access point to the river, surrounded by private land, is near where this activity now occurs informally and would have both localized minor beneficial and moderate adverse effects on land use. Beneficial effects could also result from consistent and defined public use, in contrast to the current random use pattern; however, having a defined location with parking could also increase recreational use adjacent to private lands. Because the access for the site would be constructed off the Stehekin Valley Road, instead of off the access road, some of the potential impact to the area residents from the change in land use would be reduced.

**Land Protection Plan Modifications**: In Alternative 2, the nine criteria would be ranked as shown in Chapter II: Management Alternatives, Table II-5: *Proposed Criteria Weighting to Determine Land Protection Plan Priorities for Alternatives 2 and 3 and Alternative 4*. In the revised LPP, there would be 66 high-priority properties (totaling 271.50 acres), 98 medium-priority properties (totaling 141.22 acres), while four properties (4.75 acres) would be low priority for acquisition. These high-priority properties could be acquired through acquisition, exchange, easements, or covenants. As noted above, because most lands would remain private and most impacts would convert private lands from undeveloped to developed, there would be minor to moderate long-term adverse effects on land use. Where additional private lands remained undeveloped or were protected by acquisition, easements, or covenants from exchange, or where exchanged lands were restored, there would be long-term minor to moderate beneficial effects on land use.

### Additional Impacts from Alternative 3

In addition to the impacts from actions common to all alternatives (Alternatives 1 - 4) and impacts from actions common to Alternatives 2 - 4, the road reroute (18 acres converted from forest to road) would have a major adverse effect; erosion protection measures at five sites would provide a long-term minor to moderate beneficial effect by fostering sustainable land use patterns; one new camp would have a long-term negligible adverse effect; and there would be the same impacts from the implementation of the LPP modifications (including both long-term minor to moderate beneficial and adverse effects).

### Additional Impacts from Alternative 4

Actions and impacts would be the same as in Alternative 1 for the road grade raise and the same as Alternative 3 for campgrounds, and the same as Alternative 2 for the raft takeout.

**Erosion Protection Measures**: Installation of 16 - 17 rock barbs at seven sites would provide a minor long-term beneficial effect by creating more stable land use associated from keeping the river in place, but would also continue to allow the road to remain in an unsustainable location within the channel migration zone at several sites. If these measures failed, there would be long-term moderate adverse effects from the need for their reconstruction or for road reroutes.

**Land Protection Plan Modifications**: As noted above, the LPP has been revised to identify new priorities for acquisition and exchange based on nine criteria weighted less toward protection of the Stehekin River than in Alternatives 2 and 3. Although these criteria and actions associated with the LPP would be the same as in Alternatives 2 and 3, the criteria would be weighted differently in Alternative 4, as shown in Chapter II: Management Alternatives, Table II-5: *Proposed Criteria Weighting to Determine Land Protection Plan Priorities for Alternatives 2 and 3 and Alternative 4*.

Based on the revised LPP, there would be approximately 14 high-priority properties (totaling 102.55 acres), 72 medium-priority properties (totaling 237.44 acres), and 82 low-priority properties (totaling 77.48 acres). Therefore, implementation of this alternative could continue to result in long-term moderate to major adverse impacts to land use from continuing an unsustainable pattern of land use in the channel migration zone particularly at McGregor Meadows.

As in Alternatives 2 and 3, most land within Lake Chelan NRA would continue to remain in public ownership, with only about 24 acres, or 0.04 percent, offered for exchange (the same lands as in Alternatives 2 and 3). In Alternative 4 there would be more lands in the channel migration zone that could continue to be developed because of the different ranking criteria compared to Alternatives 2 and 3. In Alternative 4 as in other alternatives, however, there would be no cap on the number of acres that could be put under land protection status through NPS acquisition, exchange, easements, or covenants associated with these, so the total acreage of public lands could increase slightly.

As in Alternatives 2 and 3, given the history of land acquisition and exchange in Stehekin over the past 14 years, it is likely that most of the remaining 417 acres of privately owned land in Stehekin would remain private, a long-term minor to moderate adverse effect on land use, coupled with a minor long term benefit on land use from protecting up to 24 additional acres of private land.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate depending on the alternative) to minimize impacts to land use would be as follows:

- Clearly identifying the construction limits to prevent expansion of construction operations into undisturbed areas.
- Work with Chelan County on zoning and land use planning.
- Minimizing disturbance from reroutes by incorporating toe walls at fill locations where feasible.
- Retaining some sensitive lands previously proposed for exchange.
- Concentrating the maintenance and housing area developments.
- Combining maintenance functions in buildings where possible.
- Restoring the former maintenance and housing areas.
- Limiting circulation space associated with new housing and maintenance areas to functional needs.
- Minimizing clearing of vegetation associated with the road rehabilitation.
- Continuing to acquire private lands in the floodplain and/or channel migration zone as identified by LPP priorities.
- Restoring some riparian areas to natural conditions.
- Continuing to use CCRs on exchanged public lands when private development is proposed.

**Cumulative Impacts**: For a list of past, present, and reasonably foreseeable future actions considered in this analysis, see Appendix 5: Cumulative Impacts Project List. Over time in the lower Stehekin Valley, there have been both actions that have increased the amount of undeveloped land (such as removal and restoration of existing developed roads and buildings) and actions that have decreased it (such as construction of new administrative and recreational facilities, road reroutes, buildings, and utilities, as well as development on private lands). A comparison of data from when Lake Chelan NRA was established (in 1968) to current data shows an increase both in development and in the number of acres of federally owned land.

Although private land acreage has decreased from approximately 1,700 acres in 1968 (at establishment of the recreation area) to approximately 417 acres now, most of the remaining private land is expected to remain in private ownership. The NPS has no intention of purchasing all the land within the Stehekin Valley. The Stehekin Community and visitor facilities would likely continue to both grow and diminish over time as lands are developed and/or redeveloped.

Projects that have added to the cumulative impacts of development in Stehekin include all of the former bank modifications along the Stehekin River (affecting 6.5 percent of the riverbank), several reroutes of the Stehekin Valley Road, construction of new NPS houses, impacts of NPS administrative and recreational facilities, and existing private development. Current and future impacts would also come from Federal Energy Regulatory Commission (FERC) relicensing mitigation projects and Lake Chelan NRA actions.

Future proposed bank modifications would likely be the greatest under Alternative 4 (see Table IV-13: *Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures*) due to the continued presence of more of the road within the channel migration zone, less under Alternative 3, and the least under Alternative 2, because of the proposed major road reroutes in those alternatives that would limit the ability of the river to affect the road, except associated with the McGregor Meadows Access Road. Alternative 1 currently has fewer identified impacts, but because it keeps the road in place, it would eventually require erosion protection measures similar to those in Alternative 4. To the extent that additional private lands were subdivided and/or developed, these would add to the overall effects on land use in the lower Stehekin Valley. These impacts would essentially be undifferentiated among alternatives, although the number of acres that could be exchanged is greatest under Alternative 1. While this plan would remove NPS facilities (housing and maintenance facilities, and portions of the road in Alternatives 2 and 3) from the channel migration zone, most private development would remain.

The road reroute (Alternatives 2 and 3), new residential and maintenance area clustering at the airstrip (Alternatives 1 - 4), raising the grade of the road (Alternatives 1 and 4), clustering of development (Alternatives 2 - 4), and introduction of public use facilities at the Stehekin River mouth (Alternatives 2 and 4) would contribute to both cumulative impacts and beneficial effects by increasing the amount of development on previously undeveloped land and restoring land through the removal of buildings and roads.

Alternatives 1 and 4 would contribute the fewest changes in land use (locally minor to moderate adverse effects on land use), since they would result in the least amount of additional development (see below); however, they would continue to have the potential to have the greatest impact on sustainability of road access and land use in the channel migration zone. The road reroutes in Alternatives 2 and 3 would contribute greater cumulative effects on development (minor to major adverse effects) from the relocation of the road from adjacent to the river to a currently forested area, and would have the fewest impacts on the movement of the river channel.

**Table IV-2: Changes to Land Use from Road Improvements**

| | Length of Rehabilitation* | Major Reroute Construction | Estimated Acres of Impact** for Road | Actual Area of Stehekin Valley Road | Restoration |
|---|---|---|---|---|---|
| **Alternative 1** | 4.9 miles | n/a | 9.8 | 9.5 acres rehabilitation<br>0 new | 5.1 acres |
| **Alternative 2** | 3.1 miles | 1.9 miles | 24<br>(18.0 reroute;<br>6.2 road rehabilitation) | 9.5 acres<br>3.4 acres new | 9.0 acres |
| **Alternative 3** | 3.3 miles | 1.7 miles | 25<br>(18.0 reroute;<br>6.6 road rehabilitation) | 9.5 acres<br>3.3 acres new | 8.2 acres |
| **Alternative 4** | 4.9 miles | n/a | 9.8 | 9.5 acres rehabilitation<br>0 new | 7.8 acres |

*Rehabilitation includes improvements to surfacing, drainage, sight distance, etc. The widest road sections (16 feet) are used in estimating impacts.

**FHWA estimates 2 acres of disturbance per mile for rehabilitation.

**Table IV-3: Changes to Land Use from Land Protection Plan Revision**

| | Lands Available for Exchange | Criteria-based Process? | Number and Priority of Properties | | |
|---|---|---|---|---|---|
| | | | High | Medium | Low |
| **Alternative 1** | Up to 37 acres | Yes (focused on removing development from 100-year floodplain) | 62 | 18 | 86 |
| **Alternative 2** | Up to 24 acres | Yes (focused on removing development from Channel Migration Zone) | 66 | 98 | 4 |
| **Alternative 3** | Same as Alternative 2 | Same as Alternative 2 | 66 | 98 | 4 |
| **Alternative 4** | Same as Alternative 2 | Same as Alternative 2 (except also focused on retaining the Stehekin Valley Road Current Alignment) | 14 | 72 | 82 |

**Conclusion**: Replacement and relocation of the maintenance facility and housing would have long-term localized moderate adverse effects on approximately 5 to 8 acres of disturbed and adjacent land near the airstrip. Concurrent moderate to major beneficial effects on the 5 acres now occupied by the existing maintenance area would result from restoration of riparian and upland areas and from creation of more sustainable land-use patterns for Lake Chelan NRA facilities out of the channel migration zone.

While Alternatives 1 and 4 would affect new areas for the winter turnaround and pullouts, Alternatives 2 and 3 would also affect more than 3 acres of new area for the rerouted roadway, but would restore abandoned sections, and could affect an additional 15 acres of surrounding area for cuts and fills. Combined, new development of currently undeveloped lands (road, maintenance facilities and housing area, erosion protection measures, etc.) would affect approximately 10 acres in Alternative 1, 28 acres in Alternative 2, 28 acres in Alternative 3, and 11 acres in Alternative 4. These would include short- and long-term minor to major adverse effects, with more effects in Alternatives 2 and 3 from reroute construction.

LPP implementation could convert up to 37 acres of existing public land to private land in Alternative 1, and up to 24 acres in Alternatives 2 - 4. Although private lands acquired would compensate for some of these acres, an unknown number of acres would be added as public land because exchanges do not occur on an acre-for-acre basis. Depending on the extent of development of these lands, effects would be localized, minor to moderate or major, and long term, with fewer impacts in Alternatives 2 - 4 from fewer available lands. An unknown amount of private land could also be acquired as public land through acquisition from willing sellers / donations.

Erosion protection measures to maintain the road would be different in all alternatives and would have negligible to moderate localized effects. Riparian restoration and bioengineering would have long-term minor to moderate beneficial effects on land use by slowing unnatural rates of erosion. Impacts from new recreational facilities would be similar among all alternatives (negligible to moderate).

The greatest direct effects on land use would occur in Alternatives 2 and 3 because they would relocate the road (with its existing adverse effects on the channel migration zone) to higher ground and disturb new areas (approximately 18 acres). At the same time, relocating the road would have long-term beneficial impacts on the sustainability of the Stehekin Valley Road. Because Alternatives 1 and 4 would retain the road (including its adverse effects on the channel migration zone) there would be fewer impacts on undisturbed lands (10 and 11 acres, respectively); however, these alternatives would result in a continuation of unsustainable land use and would affect the channel migration zone by leaving more of the road within it. Compared to the area that would be retained and protected within the lower Stehekin Valley, depending on the alternative selected, new development would occur on a very small percentage of the land within Lake Chelan NRA.

Because nearly all of Lake Chelan NRA would be retained in public ownership, reroute impacts in Alternatives 2 and 3 would occur in a common forest community type, and the Stehekin Community would continue to persist, there would be no significant adverse effects on land use as a result of the implementation of Alternatives 1 - 4.

# 2. AIR QUALITY IMPACTS

## a. Air Quality Methodology

Air quality analysis was based on both qualitative and quantitative assessment of typical air emissions from construction and operations activities. While localized emissions from the proposed project would contribute to effects on air quality, deterioration of air quality is also a regional issue influenced by a variety of factors, including weather, transportation, manufacturing, and other criteria occurring outside the recreation area.

**Context of Impact**: Air quality impacts were considered within the lower Stehekin Valley in the nonwilderness portion of Lake Chelan NRA and within the region.

**Type of Impact**: Beneficial air quality impacts would reduce pollutant emissions or lower pollutant concentrations, while adverse impacts would increase them.

### Intensity of Impact

- **Negligible**: Measurable or anticipated degree of change would not be detectable or would be only slightly detectable. Localized or at the lowest level of detection.
- **Minor**: Measurable or anticipated degree of change would have a slight effect, causing a slightly noticeable change compared to existing conditions. Often localized.
- **Moderate**: Measurable or anticipated degree of change is readily apparent, appreciable, and would be noticed by most people. Can be localized or widespread.
- **Major**: Measurable or anticipated degree of change would be substantial, causing a highly noticeable change compared to existing conditions. Often widespread.

## b. Air Quality Impacts

The North Cascades National Park Service Complex, including Lake Chelan NRA, is located in an attainment area for all ambient air quality standards. Air quality within the recreation area is very good, but is locally affected by automobile and ferry emissions, the diesel generator at the power plant, dust from the unsurfaced roads and lake bed, home heating and maintenance operations of residents, NPS administrative operations, wildland fires and prescribed fires, and weather conditions, such as temperature inversions.

Although it is unlikely that any effects from the proposed actions under the alternatives would cause either local or regional nonattainment of air quality or major changes in the emissions of criteria pollutants, it is likely that there would be localized short-term degradation of air quality within portions of the proposed project area.

In general, air quality effects from the actions proposed in the alternatives would be generated by the following:

- **Earth movement** (including blasting, clearing and construction/demolition activities, and vegetation clearing and restoration)
- **Exhaust emissions** from transportation-associated vehicle emissions and nonroad (construction / demolition / forest clearing) equipment
- **Evaporative emissions** from the use of construction materials, such as the use of even low-volatile organic compound (VOC) solvents and paints during construction.

## Impacts from Actions Common to All Alternatives (1 - 4)

**Maintenance Facility and Housing Replacement and Relocation**: Replacement and relocation of the maintenance complex and housing area would require excavation associated with the placement of utility (water, power, and sewer) lines and for constructing circulation space (including parking and walkways). These activities would constitute localized negligible to minor short-term adverse impacts on air quality from particulates released during soil-moving activities, since soils at the site have a coarse texture.

Transport of construction materials sufficient to build the maintenance complex and housing structures would be needed. These supplies would require numerous barge trips from Chelan to Stehekin, using approximately 200 gallons of diesel fuel per trip (see Table IV-4: *Transportation of Materials*). Barges can transport up to 230 tons per trip and would thus transport needed materials in about 20 trips. As a result, there would be short-term minor to moderate localized impacts to air quality that would dissipate quickly as the barge passes uplake and downlake. Once in Stehekin, additional vehicle trips in 12- 18-cubic-yard dump trucks would be required to transport the materials upvalley to the airstrip area. This would require burning approximately 58 gallons of diesel fuel. Along the unsurfaced sections of road (for example, the unpaved road above Harlequin Bridge), trucks would produce dust that could affect nearby residents and visitors.

**Table IV-4: Transportation of Materials**

| Action | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| Maintenance/housing | Unknown number of trips by barge and truck to transport materials and supplies to construct housing area | | | |
| Road grade raise (Alternatives 1,4) or reroute (Alternatives 2,3) | 5,600 cubic yards fill imported | 57,000 cubic yards cut and 48,000 cubic yards fill within project area | 64,000 cubic yards cut and 54,000 cubic yards fill within project area | Same as Alternative 1 |
| Road Surfacing | 2,540 base<br>1,439 surface | 3,541 base<br>2,054 surface | 3,285 base<br>1,886 surface | Same as Alternative 1 |
| Wilson Creek | 1,100 cubic yards<br>8 - 10 logs | Same as Alternative 1 | Same as Alternative 1 | Same as Alternative 1 |
| Rock for Barbs | 0 | 600 - 800 cubic yards | 400 cubic yards | 1,600 - 1,700 cubic yards |
| Logjams | 0 | 100 logs | 1,000 logs | 200 logs |

There would be evaporative emissions from the use of sealants and chemicals used in the project as well as from paints and solvents used in construction of the maintenance complex and new and replacement housing. To the extent possible, chemicals used in construction of the housing and maintenance areas would be low VOC emitters.

The carbon footprint of various activities is estimated by alternative in Table IV-5. Although Alternative 1 has 25% less tons of carbon than the others, over time its footprint would meet or surpass the other alternatives because new construction would be necessary to keep the Stehekin Valley Road in place.

**Table IV-5: Estimated Carbon Emissions by Action for Alternatives 1 - 4**

| Action | Alternative 1 (tons of carbon) | Alternative 2 (tons of carbon) | Alternative 3 (tons of carbon) | Alternative 4 (tons of carbon) |
|---|---|---|---|---|
| Road Rehabilitation and/or Reroutes | 210 | 259 | 234 | Same as Alternative 1 |
| Erosion Protection Measures | 74 | 100 | 112 | 138 |
| Maintenance, Housing and Helipad | 45 | Same as Alternative 1 | Same as Alternative 1 | Same as Alternative 1 |
| Recreational Improvements | Negligible | Same as Alternative 1 | Same as Alternative 1 | Same as Alternative 1 |
| TOTAL | 330 | 404 | 391 | 393 |

Source: Appendix 14: Carbon Emissions Estimates and Calculations.

NOTE: This analysis does not include carbon associated with vegetation loss or gain.

Construction of the new maintenance complex and housing would also result in long-term minor to moderate beneficial effects on air quality by replacing numerous inefficient, poorly constructed buildings with buildings that have state-of-the art energy efficient design and construction, utilities, and appliances. Among the features that would be incorporated into the new buildings would be solar panels; full insulation, including roof, walls, and crawl spaces; propane, rather than electric or wood, heat; double-glazed windows; low-flow water devices; water-efficient toilets; propane hook-ups for clothes dryers; insulated water pipes; compact fluorescent or LED lighting; and insulated water heaters.

**Road Construction, Maintenance, and Rehabilitation**: Ongoing maintenance and repair of the road surface and associated structures (including rock and vegetation removal, minor culvert work, crack sealing, chip sealing, and future asphalt overlays) would continue to result in construction exhaust emissions associated with the use of vehicles and equipment.

A variety of heavy equipment, including dump trucks, graders, rollers, excavators, backhoes, and other devices, would be used to rehabilitate and surface the road from Harlequin Bridge to the winter turnaround under all alternatives. Use of this equipment would be concentrated along this portion of the Stehekin Valley Road, but would also travel from the Landing to beyond the turnaround at Milepost 9.2.

The most intensive concentration of heavy equipment use would be where new pullouts needed to be constructed, where fill material needed to be imported to raise the grade of shoulder areas prior to surfacing, and in those portions of McGregor Meadows where the road grade would be raised (Alternatives 1 and 4) or where reroutes were constructed (Alternatives 2 and 3). Other areas of concentrated impacts would include slight changes in the road alignment through McGregor Meadows to improve sight distance (Alternatives 1 and 4) and actions to reduce the slope at Milepost 8.0 (Alternatives 2 - 4). There would also be excavation where culvert work was needed, areas of side ditch construction or reconstruction, and fill areas associated with Wilson Creek for barb/bioengineering construction and for restoration.

Although the length of the rehabilitation would vary among alternatives, actions and impacts would be similar, encompassing 4.9 miles of road in Alternatives 1 and 4, 3.0 miles (1.3 miles before the reroute and 1.7 miles after) in Alternative 2, and 3.2 miles of road (1.3 miles before and 1.9 miles after) in Alternative 3. Compared to Alternative 1 Alternatives 2 and 3 would have fewer rehabilitation actions and more new construction for the reroute sections.

Localized degradation of air quality would occur in the vicinity of earth-moving construction activities, including excavation, filling and grading, brush removal, blasting, and the use of heavy equipment, as well as from vehicles passing over temporarily or permanently unsurfaced road surfaces, causing dust to rise. Forest-clearing equipment (chainsaws) and other hand and power tools would also be used in the road rehabilitation and to clear areas where new pullouts and the winter turnaround would occur (all alternatives) and for the reroutes (Alternatives 2 and 3), causing negligible to minor exhaust emissions over a period of several days to several months.

There would be also be increased (locally negligible to moderate) gasoline and diesel emissions during rehabilitation of the road from the use of construction vehicles and equipment, particularly when actions resulted in temporary traffic delays and increased idling of vehicles, causing minor, localized emissions in the vicinity of the delay (due to the small number of public vehicles in Stehekin). Although traffic delays would temporarily increase the concentration of pollutants in the vicinity of idling vehicles, depending on air movement associated with weather conditions, these emissions would be short term, localized, and quickly dispersed and would be reduced through possible idling limitations during delays.

Negligible to minor localized adverse effects on air quality would occur from dust emissions, depending on the season, type of vegetation, fuel, and soil moisture levels, which (similar to other actions below) would be minimized by the use of best management practices (BMPs) such as use of a water truck during construction and covering soils during transport.

*Surfacing*: Surfacing the road (with asphalt chip seal) would involve importing materials and excavating, replacing, and/or compacting the road base and subbase, where necessary. This would result in minor short-term adverse effects from earth movement and transportation of materials. Localized long-term moderate beneficial impacts on air quality would occur from a decrease in the release of dust from driving over formerly unsurfaced roadways. Surfacing would occur on 3.9 miles in Alternative 1. Under Alternatives 2 and 3, surfacing would include the new reroutes but not the McGregor Meadows Access Road. Therefore, 4.9 miles would be surfaced in Alternatives 2 - 4. In addition, there would be a new asphalt chip seal surface from the Landing to Harlequin Bridge. Adverse effects on air quality, including dust from driving on unsurfaced roads and particulate releases from the movement of fill materials, would occur from the need to import and place approximately 3,979 cubic yards for surfacing in Alternatives 1 and 4; 5,595 cubic yards in Alternative 2; and 5,171 cubic yards in Alternative 3.

**Erosion Protection Measures**: All alternatives would include the need to transport approximately 1,100 cubic yards of soil and rock from Wilson Creek to other project areas or the Company Creek Pit, a negligible adverse effect on air quality.

**Restoration and Bioengineering**: All alternatives would also include long-term negligible to minor adverse impacts from restoration of abandoned sections of road, from riparian restoration in some areas, from additional plantings, and short-term negligible adverse impacts from transportation of plant materials and supplies. Restoration would be greatest under Alternative 2, followed by Alternatives 3, 4, and 1.

## Additional Impacts from Alternative 1

**Road Grade Raise**: Approximately 5,600 cubic yards of material would be imported and placed for the grade raise through portions of McGregor Meadows. Excavating and moving material for the road grade raise from a location outside of Stehekin would result in minor to moderate localized adverse impacts to air quality from transport and placement of these materials. Between 300 and 500 dump truck loads (12 - 18 cubic yards each) would be required to transport the material from the Landing to McGregor Meadows, and approximately 62 barge loads would also be required. Over time, it is likely that fill material would need to be replaced periodically following flooding, resulting in ongoing (long-term) minor localized adverse effects.

There would be no increase in roadway capacity or increased overall traffic volumes as a result of the road improvements. As a result, long-term exhaust emissions from vehicles using the Stehekin Valley Road are not anticipated to change. Although public transportation (buses) on the Stehekin Valley Road would not be affected by the proposed rehabilitation of the road, rehabilitation would increase the ability of buses and other large vehicles to stay on the road with additional surfacing and pullouts and an enlarged winter turnaround, perhaps having a negligible beneficial effect on decreasing particulate emissions.

**Erosion Protection Measures**: Additional actions to locate rip-rap and log-cribbing at Wilson Creek would require additional transport of large rock and logs and excavation of the bank, contributing additional localized minor adverse effects on air quality.

**Recreational Facilities**

**Lower Valley Trail**: Construction of the Lower Valley Trail in Alternatives 1 and 4 would require removing vegetation and excavating to mineral soil approximately 6.3 miles of new trail in an area comprising about 1.58 acres. Since most of this work would be done with hand tools and not large machinery, effects on air quality would be localized negligible to minor and adverse effect.

## Additional Impacts from Alternative 2

**Road Reroute**: Compared to the impacts of raising the grade through McGregor Meadows in Alternative 1, earthmoving associated with the 1.8-mile reroute would take longer, resulting in more potential impacts to air quality from the release of particulates (dust) and emissions from construction equipment and vehicle traffic. The 57,000 cubic yards of soil and rock would be both excavated and moved within the reroute area. Fill would be approximately 48,000 cubic yards. Cut and fill needs have been designed to be approximately balanced (cut areas used for fill areas).

Alternative 2 would also result in more forest clearing than Alternative 1, with minor localized adverse impacts from equipment use. Combining the 18 acres of impact for the road reroute and area of road impacted for rehabilitation (2 acres per mile), the total disturbance area could be up to 28 acres, which would have air quality impacts during removal of trees and other vegetation and from particulates disturbed by the equipment used for removal.

This alternative also differs from Alternative 1 because there would be additional vehicle (including diesel truck) travel related to constructing and surfacing an additional 1.9 miles of new Stehekin Valley Road reroute. Although there would be no increase in roadway capacity or increased overall traffic volumes as a result of the road improvements, because the road through McGregor Meadows would dead-end, there would be some additional trips to travel back through McGregor Meadows after reaching the end to continue on the Stehekin Valley Road for some residents, delivery services, and/or utility vehicles.

This would result in a negligible to minor increase in vehicle trips per day and consequent effects on air quality.

**Recreational Facilities**

**Lower Valley Trail**: In Alternatives 2 and 3, impacts from constructing the Lower Valley Trail would be similar, except that in these alternatives, more existing trail (7.9 miles) would be used and fewer miles of new trail (4.6) would be constructed, resulting in fewer new adverse impacts than Alternative 1.

**Campgrounds and Raft Takeout**: Localized negligible adverse effects on air quality from ground disturbance releasing particulates would also occur during construction of new campsites at Purple Point Horse Camp and Rainbow Falls, relocation of Bullion Camp, and construction of the new raft takeout and associated parking area.

**Erosion Protection Measures**: Approximately six to eight barbs would be constructed in Alternative 2 near the mouth of the Stehekin River, Wilson Creek, and at Frog Island, and two logjams (one on the bank at Boulder Creek, one near the mouth of the river). Because each barb would require up to 100 cubic yards of large rock, there would be transport by barge and truck of approximately 600 - 800 cubic yards of rock. Approximately another 130 cubic yards would be used for an avulsion sill at Boulder Creek. Each barb would require six to nine trips to transport rock from Stehekin Landing. In addition, there would be transport and placement associated with procurement of approximately 50 large logs each for the river mouth and Boulder Creek logjams. These would be gathered as floating logs from the head of Lake Chelan, from the tops of logjams below Boulder Creek, or from the reroute.

### Additional Impacts from Alternative 3

**Road Reroute**: As in Alternative 2, compared to the impacts of raising the road grade in Alternative 1, earthmoving associated with the 1.7-mile reroute would take longer, resulting in short-term localized adverse impacts to air quality from the release of particulates (dust) and from construction equipment and vehicle traffic. Because cut and fill amounts would be approximately balanced for the reroute, there would be no additional importation of fill material to Stehekin for that portion of the project; rather, this material (approximately 64,000 cubic yards of cut and 54,000 cubic yards of fill) would be transported within the area of the reroute. As in Alternative 2, there would be additional vehicle travel related to constructing and surfacing an additional 1.7 miles of new Stehekin Valley Road along the reroute, slightly less than in Alternative 2.

**Erosion Protection Measures**: Effects from building logjams at Weaver Point, at Stehekin River mouth, near Boulder Creek (along with a grade-control structure / avulsion sill), at Wilson Creek, and at Frog Island, as well as two barbs at Weaver Point and two at the Lower Field, would be short and long term, localized, and minor to moderate. These barbs would require up to 400 cubic yards of imported rock and more trips for transport from Stehekin Landing, a short-term minor adverse effect. Procurement of logs for the logjams at Boulder Creek would be the same as in Alternative 2, plus additional logs would be procured for Weaver Point (150), Frog Island (200), Wilson Creek (300), and near the Stehekin River mouth (300). As in Alternative 2, these would be gathered from floating logs or from the tops of logjams below Boulder Creek.

**Recreational Facilities**

**Lower Valley Trail**: Actions and impacts would be the same as in Alternative 2.

**Campgrounds**: Additional negligible adverse effects would occur from construction of an additional camp near Company Creek.

### Additional Impacts from Alternative 4

**Road Grade Raise**: Actions and impacts would be the same as in Alternative 1.

**Erosion Protection Measures**: Because 16 - 17 barbs would be placed at eroding bank areas, 1,600 - 1,700 cubic yards of rock would be transported for barbs, a short-term moderate adverse effect. In addition, there would be transport for logs for the small logjam and avulsion sill located near Boulder Creek (50 logs), the small logjam near the river mouth (50 logs), and the logjam at Weaver Point (150 logs).

**Recreational Facilities**

**Lower Valley Trail**: Actions and impacts would be the same as Alternative 1.

**Camps and Raft Takeout**: Actions and impacts would be the same as described in Alternative 2 plus the Company Creek campground from Alternative 3, with minor short-term adverse impacts during construction.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to air quality would be as follows:

- Chipping or mulching vegetation on site rather than disposing of it off site or burning it.
- Spraying water over exposed soil, particularly during dry conditions, to minimize fugitive dust on main roadway.
- Covering trucks when transporting materials outside the project area to reduce or eliminate particle release during transport.
- Encouraging contractor employees and NPS employees to travel in groups to and from the project site (rather than in multiple separate vehicles).
- Revegetating bare and staging areas as soon as possible (upon final grading or when staging area is no longer in use).
- Minimizing the extent of vegetation removal associated with road rehabilitation.
- Encouraging the use of local labor sources and large-volume material delivery to minimize trip generation during construction activity.
- Not locating wood-burning stoves or fireplaces in buildings.
- Using propane and solar devices for heating.
- Using low-VOC paints, solvents, and other chemicals in building construction.
- Encouraging idling of construction vehicles and equipment for no longer than 15 minutes when not in use.
- Encouraging use of a biodiesel mix fuel rather than traditional diesel fuel.

**Cumulative Impacts**: Over time, in the region, human impacts such as the development of roads, businesses, and housing have contributed to increasing vehicle travel to obtain goods and services and to access recreational experiences. In Washington, as elsewhere, population increases have resulted in dramatic increases in the number of vehicle miles traveled. In Stehekin, because the road network is isolated from others in Washington, miles traveled have not elsewhere increased as dramatically. Increases associated with vehicle travel have been coupled with increases in the number of industrial, commercial, and other vehicle sources of pollution. With the passage of the federal and state clean air acts, emissions controls have been implemented on stationary and mobile sources of air quality degradation. Washington has been proactive in establishing vehicle emissions standards for urban areas. Over time, these standards have changed and have resulted in moderating the effect of ever-increasing population and industry.

In Lake Chelan NRA, existing adverse impacts to air quality (vehicle traffic, lakebed dust, campfires, and power generation) would not increase as a result of the proposed actions under the alternatives described in this SRCIP/DEIS. There would also be no changes to existing long-term regional beneficial effects on air quality, such as carpooling and public transportation to and within the Stehekin Valley. Therefore, when added to the impacts of other actions that may occur in the recreation area and which would affect air quality, including other construction, transportation, and restoration projects, the proposed action, under Alternatives 1 - 4, would contribute negligible to minor localized short-term adverse effects. A long-term moderate localized beneficial impact would also be contributed under all alternatives from the reduction in gravel use from the Company Creek Pit and from reduced dust on the main valley road (from surfacing). If the project occurred at the same time as other projects having an effect on air quality, such as during other state transportation projects, effects would increase, but would remain localized and negligible to minor and would be generally undetectable, except within the vicinity of the actions. Regional air quality would not be affected by the proposed actions under the alternatives described in this SRCIP/DEIS.

**Conclusion**: Actions in the alternatives would result in a variety of particulate emissions (such as dust) during excavation, filling, and grading. Exhaust emissions would be produced from vehicle travel, transport of fill materials both to and within the project area, and ongoing operations during use (heating of buildings, etc.). Evaporative emissions would come from surfacing, painting, and solvent use, primarily during construction, but also later during operation of the maintenance area. There would also be negligible to minor evaporative emissions from ongoing use of the maintenance area.

Overall, the effects of clearing vegetation, excavating soil, and placing fill would contribute to short-term moderate increases in particulate concentrations, occurring only during construction activities. These impacts would be locally negligible to minor for recreational facilities; minor for erosion protection measures (Alternatives 1 - 4); minor to moderate for Milepost 8.0 actions (Alternatives 2 - 4); minor for construction of the maintenance and housing areas (Alternatives 1 - 4); negligible to moderate for road rehabilitation actions (Alternatives 1 - 4); minor to moderate for reroute construction soil transport and movement (Alternatives 2 and 3); and moderate for grade raise soil transport and movement (Alternatives 1 and 4). There would be no long-term contributions that would increase particulate concentrations from the implementation of Alternatives 1 - 4; however, long-term moderate beneficial impacts on air quality would occur from eliminating dust from unsurfaced sections of road. These beneficial impacts would be greatest in Alternatives 2 and 3, where the road and reroutes would be surfaced with an asphalt chip seal (except for the McGregor Meadows Access Road), and least under Alternatives 1 and 4, because the unstable area through McGregor Meadows would not be surfaced.

All alternatives would increase the need for barge transport due to the construction of the maintenance and housing areas and for the importation of surfacing materials. Long-term exhaust emissions under all alternatives would result from ongoing vehicle travel in Stehekin and would be similar to Alternative 1, since overall vehicle use would not rise as a result of the implementation of the action alternatives (Alternatives 2 - 4). Short-term effects, however, would vary between the alternatives and would be associated with rehabilitation and grade raises (Alternatives 1 and 4) or rehabilitation and construction of reroutes (Alternatives 2 and 3). Minor road realignments, the construction of varying numbers of barbs under each alternative, and the construction of recreational features (Lower Valley Trail, campsites, and the raft takeout) would also vary by alternative and would contribute to short-term minor air quality effects from diesel exhaust during construction. Road improvements would take from 2 to 3 years to implement, while other portions of the project would take place over a period of approximately 3 to 15 years as other portions of the alternatives (erosion protection measures, recreational improvements, and housing and maintenance facility construction) were funded and implemented. As a result, emissions would occur in a number of areas, often widely spaced in time and distance from each other. Most of these impacts would be associated with impacts from carbon monoxide and particulates associated with diesel exhaust. Where biodiesel was used, these impacts would be fewer.

Vehicle and evaporative emissions and dust would be largely dispersed by air movement in the project area, although lingering effects from vehicle emissions would occur during traffic delays and some temperature inversions. Airborne particulates would be more likely to increase in concentration on dry, windless days. Overall impacts from dust and construction equipment emissions would be short term and negligible to moderate along the project corridor under Alternatives 2 and 3, primarily due to road construction, and negligible to minor under Alternatives 1 and 4, primarily due to road rehabilitation. Effects would be the same under all alternatives for construction of the maintenance and housing areas, and similar effects would occur in the action Alternatives 2 - 4, from construction of recreational facilities, since there would be one more camp in Alternatives 3 and 4. Alternative 1, with construction of only the Lower Valley Trail, would likely have fewer impacts related to recreational features.

Overall, the action alternatives would result in negligible to moderate degradation of local air quality, but the effects would be temporary, lasting only during construction activities. Surfacing the road would reduce the level of dust currently generated by vehicle travel over the unsurfaced road, thus eliminating fugitive dust emissions over time. Dust reduction would be one of the primary achievements of the road project and would produce moderate long-term beneficial effects on air quality, helping to preserve and improve the status of the local airshed (NPS 2005). Other beneficial long-term impacts would be realized by reducing the number of dump trucks and grader trips needed to maintain the gravel road in the flood-prone McGregor Meadows. Energy-conservation measures employed in the housing and maintenance area structures would also achieve long-term air quality benefits by reducing emissions, primarily those associated with heating, and by constructing efficient heat-retaining structures. Restoration and bioengineering would also contribute some negligible beneficial effects from plant establishment.

There would be no major adverse impacts and no impairment of air quality or air quality-related values from the proposed actions under the alternatives described in this SRCIP/DEIS.

## 3. SOILS AND VEGETATION IMPACTS

Note: These impact topics are considered together because many of the same actions that would affect soils would also affect vegetation.

### a. Soils Methodology

Soils analysis was based on a qualitative assessment of generalized soil types and typical effects of the type of impact described. Quantitative analysis was also conducted to determine the amount of soil to be removed in major excavation and fill areas.

**Type of Impact**: Activities that result in soil impacts include the construction of buildings or structures, parking areas, roads, trails, and other facilities. Adverse impacts to soil include soil removal, profile mixing, compaction, erosion, and contamination. Adverse impacts would degrade chemical or physical properties of soils or result in the loss or temporary removal of soils. Beneficial impacts result from actions that protect soils from erosion or restore natural soil conditions. Restoration and revegetation have both adverse and beneficial effects.

- **Soil Removal**: Surfacing and construction remove and/or cover the soil surface, resulting in changes to basic soil properties, including altering the ability of water to penetrate the soil, nutrient availability, and water-holding capacity. Excavation and removal of the soil surface would result in a long-term impact because basic soil properties (such as compaction, texture, and physical and chemical composition), which may have taken tens to hundreds or thousands of years to develop are removed. Covering the surface reduces water movement and minimizes the opportunity for the normal physical and chemical soil processes.
- **Soil Profile Mixing**: Soil excavation and redistribution causes removal or mixing of the soil profile and disrupts soil structural characteristics, interrupting the chemical, physical, and biological processes that naturally occur in soil horizons. The level of change is dependent on the level of the alteration. It may take centuries to redevelop the soil profile.
- **Soil Compaction**: Soil compaction may occur as a result of construction activities or in areas of intensive use such as trails, campgrounds, and picnic areas. Finer-grained soils, including wetland and silty-sandy river soils, are very susceptible to compaction effects. Soil compaction reduces infiltration rates and decreases pore space, thereby increasing surface runoff and the potential for erosion. Deep compaction of soils may impede subsurface water movement. In turn, these effects can alter soil chemical processes such as nutrient transfer, biological processes such as root development and microbial patterns, and physical processes such as soil structure. Vegetation growth on compacted soils is often limited due to low infiltration, poor root penetration, and lack of nutrients.
- **Soil Erosion**: Removal of vegetation and organic-rich soil horizons through grading or casual pedestrian use may result in accelerated erosion of the soil surface, particularly on slopes steeper than 50 percent. Where vegetation is replaced by hard surfacing, such as buildings, surfacing, or walkways, soils are also compacted and physical and biotic processes are disrupted. Sandy soils on steep slopes and along watercourses are especially susceptible to erosion, especially poorly consolidated alluvial soils such as those found along the Stehekin River. In contrast, gravelly soils on alluvial fans and some river terraces are far less susceptible to erosion. *Rare or Sensitive Soils*: Certain microclimates in the lower Stehekin Valley have distinct vegetation cover and soils. Bare rock exposures host slow-developing, easily disturbed cryptogrammic soils. Wetlands and other areas with fine-grained soils are prone to erosion and compaction impacts.
- **Soil Contamination**: The addition of chemical constituents into the soils as a result of surfacing and untreated runoff from surfaced surfaces, or from incidental spills, may alter micro- or macroorganism populations, diversity, and dynamics. Machinery involved with construction activities may deposit small amounts of natural and synthetic petroleum-hydrocarbons onto soils through equipment failure or normal operations.
- **Soil Restoration**: Ecological restoration that would minimize erosion potential and increase organic matter in the soil is considered a beneficial effect. Short-term adverse effects may occur during site-restoration activities where construction equipment may compact soils, temporarily eliminate groundcover vegetation, and cause potential erosion from surface water runoff over the exposed soils; however, over the long term, restoration will restore the soil-forming processes by reducing erosion.

### Intensity of Impact

- **Negligible**: The effects to soil resources would be generally undetectable. Any effects to soil productivity or fertility would be slight and no long-term effects to soils would occur.
- **Minor**: The effects to soils would be detectable and would include loss of organic surface horizons. Effects to soil productivity or fertility and the area affected would be small.
- **Moderate**: The effect on soils would be readily apparent and likely long term, and would potentially include loss of subsurface soil horizons. Impacts would result in a change to the character of the resources over a relatively wide area, or in changes to a rare or sensitive soil.
- **Major**: The effect on soils would be readily apparent and long term, and would cause soil erosion over large areas (or over small areas, if a particularly rare soil type is threatened).

## b. Vegetation Methodology

Vegetation analysis was based on a qualitative assessment of project area vegetation and the effects anticipated as a result of ongoing maintenance, construction, or rehabilitation. Quantitative analysis was also conducted to determine the effects of vegetation loss. This analysis was based on the amount of disturbance (removal of or damage to vegetation) from construction or road operations compared to current conditions. It is also considers the benefits of site restoration. Assessment of the potential for the project to introduce or spread nonnative plant species, such as exotics and noxious weeds, was also made.

The geographical extent of plant communities has been determined through field and aerial vegetation mapping. Field reconnaissance of areas of potential impact was used to analyze plant community types and to look for any rare, threatened, or endangered species. Human use can disturb or compact soils, create conditions favorable for nonnative species or introduce nonnative species, and decrease native vegetation cover. Because human use impacts such as recreational use and foot traffic can extend beyond developed areas and affect plant community size and continuity, the potential for these indirect impacts beyond development boundaries was considered as a factor in determining the intensity of impacts on vegetation.

The evaluation of the integrity of plant communities was based on:

- **Biodiversity** (diversity of communities within an ecosystem, species within a community, and genetic variation among individual species): Measures of biodiversity may include plant community structure and composition, connectivity of ecosystems, variation in age, structure (density and arrangement), individual species composition and abundance, and the presence or absence of natural structural layers.
- **Exotic species introduction and spread**: Nonnative species can alter soil chemical and physical properties, hamper native species establishment, and alter native plant community structure and function. This impact analysis considered whether proposed actions would favor the establishment of nonnative species and the ability to contain and reverse nonnative plant infestation.
- **Resilience of the plant community**: Resilient plant communities are more capable of withstanding human impacts without long-term deformation because they can recover more quickly.

**Type of Impact**: Actions that reduce the size of or disrupt the continuity and/or integrity of native plant communities are considered adverse impacts. Ground disturbance and importing nonnative plants can adversely impact native plant communities because they provide means for nonnative species to gain a foothold. Restoration of disturbed areas using native seeds and reusing topsoil and plants, mulch, or other stabilizing materials accelerates site recovery and reduces opportunities for exotic plants to become established. Actions that preserve and/or restore these essential qualities of native plant communities constitute beneficial impacts. New development within an otherwise intact and undisturbed area may fragment or disassociate plant communities. Small areas of restoration surrounded by existing or new development may constitute a lesser beneficial impact on plant communities than restoration of a small area adjacent to a larger intact community. In general, reducing and limiting fragmentation and maintaining connections within and among plant communities can minimize adverse effects on plant communities.

### Intensity of Impact

- **Negligible**: Impacts would have no measurable or perceptible changes in plant community size, continuity, or integrity. Individual native plants would be affected, but there would be no effect on native species populations. There would be no increases or barely detectable increases in the number of nonnative species and the extent of their range. The effects would be short term and on a small scale.
- **Minor**: Impacts would be measurable or perceptible and localized within a relatively small area, and the overall viability of the plant community would not be affected. Individual plants and/or a relatively minor segment of populations would be affected. Changes in the extent of nonnative species would be short term, localized, and measurable.
- **Moderate**: Impacts would cause a change in the plant community (e.g., size, continuity, and integrity); however, the impact would remain localized. The change would be measurable and perceptible, but could be reversed. The alternative would affect some individual native plants and would also affect a sizeable segment of the species' population in the long term and over a relatively large area. Changes in the extent of several or more nonnative species would be over a relatively long period of time. Nonnative plants could spread beyond the localized area.
- **Major**: Impacts would be substantial, highly noticeable, and permanent in their effect on plant community size, diversity, continuity, or integrity. The alternative would have a considerable long-term effect on native plant populations and nonnative plants.

## c. Soils and Vegetation Impacts

Under all Alternatives 1 - 4, soils and vegetation would be affected at various sites along the Stehekin Valley Road and Company Creek Road, wherever excavation, fill, vegetation disturbance or removal, and/or covering areas with hard surfaces would occur. Soils and vegetation would also be affected in the proposed maintenance and housing areas, for erosion protection measures, and near the recreational facility improvements. Much of this disturbance would be limited to the existing road prism (in the area affected by original road construction activities) and/or other existing disturbed areas. Some actions, however, including those associated with the construction of the maintenance and housing areas, would occur in areas that either are recovering from former disturbance from human activities or have not been affected by recent human activities. Restoration of native riparian and upland plant communities which varies by alternative would benefit soils and vegetation.

Vegetation loss combined with construction, including compaction from grading for gravel, concrete, or asphalt surfacing, would also change soil water infiltration. During excavation and grading, soils would be mixed, moved, and replaced with fill, causing a long-term change in soil profiles, loss of vegetation, and decreasing soil productivity. Fine-grained soils would be more likely to be compacted by construction activities, which would temporarily decrease soil permeability, change the soil moisture content, and lessen water storage capacity.

### Impacts from Actions Common to All Alternatives (1 - 4)

**Maintenance Facility and Housing Replacement and Relocation**: There would be minor to moderate effects on soils and vegetation from development of about 5 - 8 acres of existing disturbed area near the airstrip for the maintenance area and housing. This area contains bigleaf maple and Douglas-fir; shrubs, including ceanothus, elderberry, and willows; and a variety of forbs. With the proposed clearing for the new maintenance and housing areas, there would continue to be long-term moderate adverse effects on soils and vegetation. Construction would require excavation of relatively young, coarse-textured soils for placement of foundations. This would cause loss of relatively young, weakly developed soil profiles and would change infiltration through placement of impervious structures and surfaces, such as buildings, parking areas, roads, and paths. Compaction would occur from the placement of utility system infrastructure (water, sewer, and electric lines), and could result in limited soil and vegetation recovery following construction. Much of this area, however, is comprised of coarse-grained gravel soils not prone to compaction. In addition to space occupied by buildings, accompanying circulation and parking areas for the housing and maintenance areas would also affect soils and vegetation. Approximately 0.3 acre of impermeable surfacing would be added for the maintenance area (including for buildings and circulation). It is likely that a similar area would contain impermeable surfacing in the housing area. Combined, the loss of vegetation, soil profiles, mixing of soil with fill, and loss of infiltration would have a localized long-term minor adverse effect, with impacts limited because of the poorly developed (young) coarse-grained soils and highly modified vegetation type (primarily comprised of nonnative species of grasses and forbs in open areas).

Restoration of the former maintenance area, comprising approximately 5 acres, would result in long-term major localized beneficial effects on riparian and upland vegetation and soils within this currently impacted floodplain, from restoration of topsoil and vegetation. Soils in the existing maintenance area are finer-grained and more productive than those at the airstrip. Ongoing minor adverse effects would also continue to occur from the effects of maintaining the Company Creek Road near the former maintenance area.

**Road Rehabilitation**: Routine, ongoing maintenance of the road surface would involve shoulder, culvert, and ditch maintenance. Vegetation would continue to be removed and soils would be mixed and removed, causing localized displacement of poorly developed soils, a long-term negligible to minor adverse effect occurring at various locations over time. During flooding, soils in recently disturbed or vulnerable areas would also erode.

Road improvements would occur over 4.9 miles of road (Alternatives 1 and 4) and on existing road in Alternatives 2 and 3, from Harlequin Bridge to the winter turnaround, and would affect approximately 9.5 acres of existing disturbed area. New soil and vegetation disturbance would occur from the addition of pullouts, the winter turnaround, and construction of new side ditches. There would be long-term minor to moderate adverse effects over much of this area, plus short-term impacts to accommodate construction limits. Overall construction limits are estimated at 2 acres per mile for the 4.9 miles but would likely not affect areas much beyond the existing roadway except for improvements at Wilson Creek, Milepost 8.0, Milepost 9.2, pullouts, and the winter turnaround.

Road construction and improvements would include placement of fill materials on top of the soil profile and covering soil with impervious surface treatments, a long-term localized minor to moderate adverse effect. Surfacing would result in water running off rather than infiltrating, with potential resultant soil erosion from water concentrated off of impervious surfaces and placed in ditches and culverts. Water runoff would also pick-up contaminants such as oil and gasoline residue and would enter the soil through adjacent unsurfaced shoulders and side ditches. The presence of these contaminants would have a localized but long-term minor adverse effect on vegetation and soils. Negligible to minor long-term beneficial effects would occur from retaining the topsoil during construction of new areas, such as pullouts, and pulling it back along the edges of the road to allow for restoration by natural or broadcast seeding of native plants.

In addition to direct vegetation loss, other negligible to minor indirect effects on vegetation would include changes to the existing plant community. These would occur in areas where, over time, the addition or loss of direct sunlight changes the local plant community type or favors nonnative species inadvertently imported in fill. Vegetation adjacent to the newly surfaced road would receive a long-term minor to moderate localized beneficial effect from reduced dust.

**Erosion Protection Measures**

*Milepost 5.3 (Wilson Creek)*: Excavation at Wilson Creek to lay back the slope and lower the road would affect 0.3 acre of upland soils and vegetation. This action would generate 1,100 cubic yards of gravel, sand, and boulders, with 550 cubic yards reused on site. Among the trees that would be affected are Douglas-fir, western red cedar, and bigleaf maple in a variety of size classes. Approximately 12 trees and a snag (between 20 and 30 inches diameter at breast height [dbh]) would be removed. Other observed vegetation includes false Solomon's seal, wild rose, snowberry, dogwood, wild raspberry, and bracken fern. The slope is primarily comprised of rocky cobbles interspersed with trees and grasses. Several large cedars on the river side would be retained, as would a large cottonwood. Impacts from the vegetation removal would be adverse and moderate. Short- and long-term beneficial impacts would occur from vegetation reestablishing at the site after construction.

*Weaver Point*: Soils and vegetation would be disturbed from relocation of 1 - 2 campsites threatened by lakeshore and riverbank erosion.

**Large Woody Debris**: There would be no impacts from the continued procurement of floating large woody debris from Lake Chelan after major floods under Alternative 1.

**Recreational Facilities**: The Lower Valley Trail would be constructed from new and existing trail (and in Alternatives 2 and 3 from sections of abandoned road). The trail would be constructed by pulling back the topsoil to expose bare mineral soil, with little deep excavation, except where needed to place water-flow structures, such as culverts or water bars, or to locate the footings for the bridge crossing to the Stehekin River Trail if existing concrete bridge supports were not used. Because mostly hand tools would be used rather than heavy equipment, effects on soils would be minor, with less compaction, less mixing of soil, and less physical soil removal from one area to another. Over time, plants would reestablish at the edges of the trail and plant debris would fall on the trail tread and would both soften the appearance of the trail and contribute to reestablishment of the surface horizon. Depending on trail use and soil type, compaction would take place over many years or would not occur. Because no hard surfacing would be applied, water would continue to infiltrate both the pathway and adjacent areas. Overall, effects on soils and vegetation in a variety of plant communities from construction of the Lower Valley Trail would be localized, but because they would combine to affect more than an acre of land in all alternatives, impacts would be adverse, minor to moderate, and long term. More impacts would occur from some aspects of trail construction, including where the trail is constructed across steep slopes and drainages and near Little Boulder Creek. Adverse effects from construction would be coupled with long-term minor beneficial effects from the reestablishment of native vegetation from formerly cleared areas along the trail and road and from the ongoing effect of leaf and needle fall onto the soil surface, recreating the humus layer over time.

**Restoration and Bioengineering**: Restoration in all alternatives would include approximately 5 acres in the former maintenance area, plus areas of former development associated with land purchases and exchanges. Over time, long-term negligible to moderate beneficial effects would be realized as these areas became less visible and more like the surrounding community through additional plant establishment.

**Campgrounds**: Relocation and modification of Bullion Campground would affect soils and vegetation. Approximately 400 square feet per would be affected, a long-term minor adverse effect. Over time the effects of construction would be diminished as vegetation reestablished, while trampling and compaction from foot traffic would constitute a long-term minor adverse impact. Coarse-textured soils at this site would limit compaction and surface erosion. Vegetation includes scattered Douglas-fir, Ponderosa pine, and moss-strewn boulders, with an understory of kinnickinnick, Oregon grape, serviceberry, spiraea, and other forbs and grasses.

### Additional Impacts from Alternative 1

**Road Grade Raise**: The Stehekin Valley Road at Milepost 6.25 to Milepost 6.53 (0.28 mile) and Milepost 6.95 to Milepost 7.14 (0.19 mile) would be elevated with imported clean fill and rock. This would affect up to 0.9 acre of existing road surface and up to 0.6 acre on either side, for a total area of 1.5 acres. The placement of fill would result in a negligible to minor short-term impact on vegetation, depending on the rate of vegetation recolonization adjacent to the road. Long-term minor adverse effects would occur from compaction of nearby soils.

**Road Realignment**: For the minor realignment near Milepost 6.0 and construction of a toe wall, there would be both long-term negligible to minor adverse effects on soils and vegetation and short- and long-term minor beneficial effects from stabilizing the slope. Soil would be displaced to implement sight distance improvements, and 5,000 square feet would be affected by the construction of the dry-stacked rock wall, a localized minor adverse effect since the excavated soil and rock would be used to raise the grade of the road and to build the wall. Combined, up to 2.4 acres of existing road and vegetation in a common forest community dominated by Douglas-fir and big-leaf maple would be affected by the realignment and grade raise.

**Erosion Protection Measures**

*Milepost 5.3 (Wilson Creek)*: In addition to changes in the location of the road, implementing the Road Improvement Project would result in placement of clusters of rip-rap and log-cribbing at the toe of the slope. This would have additional minor adverse impacts on soils from the excavation of the bank (there is no vegetation on the bank).

**Implementation of 1995 Land Protection Plan**: Approximately 37 acres could be impacted by development on the currently proposed land exchange parcels. It is likely, however, that not all of this area would be affected. With exchange, it is anticipated that 10 - 15 parcels would be developed with home sites of an average size, including some potential outbuildings, gardens, and utilities, such as septic systems, affecting up to 5,000 square feet per parcel. Current county zoning establishes a 5-acre minimum lot size for most areas. Estimating a 0.25 mile of road (12 feet wide) for each parcel would add 15,840 square feet each, for a total of up to 0.5 acre. If all 10 - 15 parcels were developed with 5,000 square feet of buildings and a 0.25-mile driveway (though it is likely many would be smaller), direct impacts from development could affect approximately 5 - 8 acres. Because there would be variability in development of the parcels as well as in potential road access, and because actual impacts would likely be smaller, this acreage is likely an overestimate of potential vegetation and soil disturbance. Because there would be no change in the availability of exchange parcels, and because these parcels were identified primarily for scenic and general natural resources values, proposed land exchanges could have long-term minor to moderate adverse effects from development and long-term minor to moderate beneficial effects from acquisition of some high-priority lands, such as riparian areas in the floodplain / channel migration zone.

### Additional Impacts from Alternative 2

**Road Reroute**: Approximately 18 acres could be cleared of vegetation within the construction limits for the 16-foot-wide, 1.9-mile-long reroute around McGregor Meadows. Approximately 57,000 cubic yards of cut and 48,000 cubic yards of fill would be excavated and replaced for the roadway, pullouts, and culverts. Estimated clearing would include the road segment plus pullouts and side ditches within the 18 acres. Because much of this area has not been disturbed by human activity except for portions that intersect with the Old Wagon Road, this would constitute a long-term localized moderate adverse effect on soils and both short- and long-term moderate to major adverse effects on vegetation, since forested landscape would be converted to new roadway.

Restoration of parts of the bypassed Stehekin Valley Road would have long-term beneficial impacts on 1.4 acres. Although vegetation could reestablish within the area surrounding the road where cuts and fills were constructed, it would take many years for trees to reestablish. Disturbance would reduce the productivity of soils and vegetation along the reroute corridor, including within adjacent areas disturbed to create cuts or fills within the road corridor (20 - 25 feet on either side of the proposed road). Topsoil would be removed, structural fill material would be placed on top of the soil, and the road would be surfaced with an asphalt chip seal. Outside the road corridor, after construction, topsoil would be returned to the cleared areas up to the road shoulder and the areas seeded and contoured to allow revegetation to take place. Stabilization by temporary sediment and erosion protection barriers would occur to allow for maximum revegetation and retention of soils, a long-term negligible to moderate beneficial effect, depending on whether it occurred adjacent to the road or in cut and fill areas following disturbance.

The reroute section is located primarily within upland mesic mixed coniferous forest dominated by Douglas-fir and ponderosa pine that grades to a riparian—nutrient-rich mixed deciduous / coniferous forest near the Lower Field. Although the reroute has been designed to avoid the largest trees, loss of vegetation in this area would include trees, shrubs, forbs, grasses, and ferns, as well as vegetation associated with rock outcrops and boulders, such as mosses and lichens. Among the trees that would be removed would be Douglas-fir, western red cedar, bigleaf maple, vine maple, Douglas maple, and ponderosa pine. Among the shrubs that would be removed would be Oregon grape, dogwood, alder, serviceberry, Oregon boxwood, and birch-leaved spiraea. Forbs include lupine, wintergreen, dogbane, wild ginger, bead lily, columbine, pipsissewa, yarrow, and many others. Among the trees that were identified by fire management staff based on two fire effects plots (each approximately 164 × 66 feet) were 35 Douglas-fir approximately 20 and 30 inches dbh and seven ponderosa pines in the same size classes that would be removed by the construction of the reroute. More than 243 other trees between 1 and 20 inches dbh and six snags of undetermined size were also counted. This survey yielded between 209 and 281 mature trees per acre. Another recent survey of areas within the reroute found 55 trees greater than 20 inches dbh, 170 trees between 3 and 20 inches dbh, and 33 trees less than 3 inches dbh, yielding approximately 225 mature trees per acre. Therefore, taking an average of these surveys, there would be a loss of approximately 238 trees per acre, or about 4,290 trees over 18 acres.

In addition to direct vegetation loss, indirect effects identified in ―Impacts of Actions Common to All Alternatives (1 - 4)" would also occur, including changes to the existing soils and plant community over time, such as invasion by nonnative species inadvertently imported in fill or within bare areas remaining from limited rehabilitation / restoration success. In addition, because of the reroute there would be a break in an area of formerly contiguous plant community cover that would result initially in these kinds of changes to the edges of this community that would eventually spread outward. Because there would be more sunlight reaching road edges, the vegetation community could become more diverse over time.

Road and maintenance area relocation would have long-term minor beneficial effects on soil-forming processes and forest dynamics from redevelopment of a riparian zone in the Stehekin River floodplain / channel migration zone.

**McGregor Meadows Access Road Retention**: To retain the 0.8 mile of road into McGregor Meadows, there would be long-term maintenance actions similar to those noted under “Impacts from Actions Common to All Alternatives (1 - 4),” although this access road would be maintained to different standards than the reroute. Approximately 0.3 mile of former road (bypassed by the reroute) would also be retained as a trail and treeless lane to maintain the grade-control structures at Milepost 7.0. Routine maintenance actions would occur within the prism of the access road, over approximately 1.3 acres, and would constitute a long-term minor adverse effect on vegetation and soils.

**Restoration of Stehekin Valley Road Old Alignment**: Maintaining motor vehicle access into McGregor Meadows would limit restoration to approximately 0.7 mile (1.4 acres) of the current Stehekin Valley Road alignment. Revegetation of this abandoned section of road would be accomplished by scraping off gravel, scarifying the road surface, and placing woody debris, and forest litter and duff. Topsoil collected from the reroute areas would also be used to the extent practicable. The area would then be seeded with local native seed and mulched. Natural recruitment of vegetation would also occur. If the cover of native vegetation is considered too low (less than 80 percent) after five years, then native plants would be collected from a nearby site (and nursery grown) to augment planting at the site. Restored vegetation would provide habitat and natural soil retention in the channel migration zone. Where reserved topsoil for the road reroute was not used to rehabilitate cleared areas, it would be used to rehabilitate this road. Because a portion of this section of rehabilitated road would be used for the Lower Valley Trail, not all of this area would be revegetated. Restoration of this area would have a long-term minor to moderate beneficial effect.

Where the abandoned road is used for staging, the soil would be temporarily compacted by construction equipment and materials. These would be short-term negligible adverse impacts. Because the reroute rehabilitation areas would also be scarified and topsoil pulled back over the shoulders to allow for better moisture retention, organic material incorporation, and aeration of compacted soils for revegetation activities, there would be short-term negligible adverse and minor long-term beneficial effects.

**Erosion Protection Measures**: In addition to actions to stabilize the road near Wilson Creek, the construction of six to eight barbs, a logjam, and a grade-control structure (avulsion sill) and logjam near Boulder Creek would contribute to additional minor localized short- and long-term adverse effects on soils and vegetation from the importation of rock and fill, compaction, loss of plant cover, and other factors. This would be coupled with long-term negligible to minor beneficial effects from bioengineering and reuse of excavated soils in the design of these features. Soil productivity could be retained because barbs and logjams would reduce the rate of erosion, which would, if not implemented, result in the continued loss of soil and riparian vegetation as the riverbank continued to erode.

*Weaver Point*: Actions would be the same as in Alternative 1.

*Stehekin River Mouth*: A new 300-foot-long access road would be built off the main Stehekin Valley Road. The 12-foot-wide road would follow a mostly treeless existing lane, but 5 - 10 trees would be removed at various points. Three rock barbs would also be built along this sparsely vegetated shoreline, currently containing about 100 linear feet of rip-rap on public land. Restoration of the rip-rap area (0.1 acre), bioengineering (0.1 acre), and construction of the barbs would limit bank erosion, including loss of vegetation and soils, on 0.2 acre. There would be a long-term moderate adverse effect on up to 0.5 acre of vegetation and soils alongside the bank and in the adjacent forested area, coupled with long-term minor beneficial effects from bioengineering, removal of the rip-rap, and willow restoration along the bank.

*Milepost 2.0 (Boulder Creek)*: The logjam and grade-control structure below Boulder Creek between the Stehekin River channel and the Boulder Creek alluvial fan would affect approximately 0.07 acre of soils and vegetation, including for excavation of the sill and logjam. In this area, vegetation disturbance would primarily affect a few western red cedars, Douglas-fir, cottonwood, and an understory of forbs, and logs, a localized minor adverse effect on vegetation, combined with localized moderate adverse effects on soils.

*Milepost 3.8 (Frog Island)*: One to two barbs at Frog Island and riparian restoration / bioengineering along the bank would affect up to 0.1 acre of soils and vegetation for the barbs, along with 0.1 acre of restoration. Combined, these actions would have a minor, long-term, localized adverse effect, coupled with short-term negligible to minor adverse effects and long-term minor beneficial effects from the restoration.

*Milepost 5.3 (Wilson Creek)*: In addition to the lowering of the road and regrading the slope, two to three rock barbs and bioengineering would be installed. Bioengineering would be used to rehabilitate the slope below the road, while seeding and stabilization would retain the slope above the road. Installation of the barbs would have localized short- and long-term minor adverse effects on soils and vegetation, while restoration, including bioengineering, and would have long-term minor beneficial effects.

**Photo 27 – Stehekin River at High Spring Flow Near Frog Island (Stehekin Valley Road is Located at Base of Steep Cliffs, about 20 feet from the Eroding Bank)**

**Milepost 8.0 Slope Stabilization**: Laying back the upper one-quarter to one-third of the steep slope above the road would result in the removal of several dozen small trees and shrubs and disturb topsoil over an area of about 0.2 acre. Scaling (removal) of rocks off the slope would also result in some vegetation disturbance. Together, these actions would result in minor to moderate short-term adverse impacts to soils and vegetation. Among the trees on the slope and at the base of the slope that would be affected would be Douglas-fir, bigleaf maple, red alder, Pacific dogwood, and a few ponderosa pines and silver firs. Existing trees are between 6 and 48 inches dbh. Approximately two trees and one snag (between 18 and 48 inches dbh) could be removed. Stabilization of the slope would reduce erosion of soils and side casting of material from the road onto the riverbank. Minor localized long-term beneficial effects would also occur from the ability of more plants to establish on a stable slope.

**Milepost 9.2 Realignment**: Construction of a parking area, raising of the road grade, installation of drainage structures and ditches, and surfacing would impact about 0.6 acre, and would require the removal of 10 - 20 small Douglas-fir and lodgepole pines. This would result in localized long-term minor adverse effects on area vegetation and soils.

**Large Woody Debris**: Obtaining large woody debris from the tops of logjams from the Stehekin River below Boulder Creek would result in short-term minor adverse effects on vegetation and soils from access equipment and disturbance, coupled with long-term minor beneficial and adverse effects from use and placement of the woody debris in bank erosion protection measures.

**Recreational Facilities**

*Campgrounds / Raft Takeout*: In addition to the Lower Valley Trail (common to all alternatives), establishment of campsites and river access would affect soils and vegetation over approximately 0.5 acre. Not all of this area would be affected by direct removal of vegetation. Approximately 400 square feet per campsite plus the raft takeout would be affected, a long-term minor adverse effect. Over time the effects of construction would be diminished as vegetation reestablished, while trampling and compaction from foot traffic would constitute a long-term minor adverse impact. Coarse-textured soils at several of these sites would limit compaction and surface erosion.

Vegetation affected at Purple Point Horse Camp would include Douglas-fir, ponderosa pine, and scattered bigleaf maple with an understory of grasses, Oregon grape, and spiraea. Rainbow is within a Douglas-fir-ponderosa pine forest with a low-growing understory of kinnickinnick and other forbs.

**Restoration and Bioengineering**: Long-term beneficial effects from riparian and upland restoration and bioengineering on 9.1 acres would compensate for some of the adverse effects of excavation and fill in some areas in the lower valley. Although there would be some negligible adverse effects during installation, restoration of native species along the bank of the Stehekin River would contribute to the long-term stabilization of soils and the continuation of natural physical and biotic processes of soils and reestablishment of vegetation. In addition to maintenance area restoration (5.0 acres), there would be restoration of approximately 3.3 acres of abandoned Stehekin Valley Road, Stehekin River mouth, Weaver Point, Frog Island, Wilson Creek, Lower Field, and the Buckner Homestead hayfield and pasture, the former maintenance/housing areas, and the shooting range. Approximately 0.5 acre would also benefit from bioengineering.

Restoration of the Buckner Homestead lower hayfield and pasture would include seeding and planting trees and shrubs over 0.3 acre of Stehekin riverbank, a short-term negligible adverse effect from disturbance (compaction, etc.) during revegetation activities, coupled with a long-term moderate beneficial effect that would slow erosion threatening shallow-rooted grasses in this area. Restoration of the Stehekin River bank near the Lower Field would also include seeding and planting of 0.4 acre, resulting in additional short-term negligible adverse effects coupled with long-term moderate beneficial effects. Restoration would be combined with removing the road from this section. Species seeded and planted would include trees and shrubs, including alder, bigleaf maple, cottonwood, and willow.

**Photo 28 – Rapid bank erosion at Buckner Homestead Hayfield and Pasture**

**Land Protection Plan Modifications**: Under the revision to the LPP, approximately 24 acres could be impacted over the long term by future development on the proposed land exchange parcels. Most of the proposed exchange parcels are located within the upland mesic mixed coniferous forest vegetation type, one of the most common in the lower Stehekin Valley. Exceptions to this include areas adjacent to the airstrip, which currently are part of the pasture/disturbed vegetation type (primarily consisting of nonnative species). Exchange parcels are also mainly on gravelly soils, which are not sensitive to compaction or surface erosion. Because the proposed land exchange parcels are more than one acre (1.33 - 7.2 acres) and most of the land from the larger parcels would likely remain undeveloped, development of portions of these 10 - 15 parcels would have a long-term minor to moderate adverse effect on vegetation and soils. Effects would be from conversion of native landscape to developed area and from the potential invasion of nonnative species associated with that development. Negligible to minor beneficial effects would result from stipulations that retained key vegetation characteristics, including from covenants associated with how the parcels would be developed (stipulated in exchange/purchase agreements). Long-term moderate to major beneficial effects would occur from acquiring riparian area parcels in exchange or by direct purchase from removal of development from the Stehekin River floodplain and channel migration zone. Vegetation that could be affected is described in Appendix 8: Vascular Plants Observed within Proposed Project Areas.

**Removal of Buildings and Structures on Acquired and Exchanged Lands**: Removal of buildings and structures from acquired and exchanged lands would result in short-term minor adverse impacts on vegetation during removal. Restoration, including seeding or planting local native species, such as dogwood and willow, and using stabilization measures in denuded areas would reduce some impacts. To the extent that cabins and other infrastructure would be removed before being claimed by the river, there would be long-term minor to moderate beneficial effects on soils and vegetation.

### Additional Impacts from Alternative 3

Most actions from Alternative 2 would also occur in Alternative 3. Impacts would be the same for the housing and maintenance facility replacement and relocation (including former maintenance area restoration), McGregor Meadows Access Road retention, Mileposts 8.0 and 9.2 actions, recreational facilities, and implementation of the revised LPP. Alternative 3, however, would have a shorter reroute a different array of erosion protection measures (barbs and logjams), and one additional campground.

**Road Reroute**: Vegetation and soils impacts would be similar to that described above for Alternative 2, with approximately 18 acres cleared within the construction limits for the reroute. This would constitute a short-term moderate to major adverse effect and a long-term moderate to major adverse effect, since forested landscape would be converted to roadway and vegetation reestablishment would take many years. As in Alternative 2, constructing the reroute around McGregor Meadows would require major soil disturbance, with 64,000 cubic yards of cut and 54,000 cubic yards of fill. FHWA road design would balance the cut and fill to the extent practicable to minimize the need to barge in material or to barge out waste. The cut and fill work would result in a long-term localized moderate adverse effect on soils.

**Erosion Protection Measures**

*Weaver Point*: There would be long-term minor adverse effects on soils and vegetation from construction of a logjam at this site, combined with localized minor to moderate beneficial effects on 0.18 acre from riparian restoration, bioengineering, and slowing of bank erosion. Construction of the logjam would disturb the bank as far back as 30 feet, but would also protect soils from erosion. Adverse impacts on soils and vegetation would be long term and negligible because the area is comprised of mostly nonnative sod-forming grass. Other plants would be affected in this sparsely vegetation area, including trailing blackberry, horsetail, Himalayan blackberry, and other exotic grasses.

*Stehekin River Mouth*: Instead of three rock barbs in Alternative 2, a large logjam would be constructed to deflect erosion at the bank, a long-term minor to moderate adverse effect on soils and vegetation from excavation to construct the logjam coupled with a long-term minor to moderate beneficial effect from the reestablishment of vegetation in the area. As in Alternative 2, the removal of rip-rap and restoration of a willow riparian area would have a long-term minor beneficial effect

*Boulder Creek*: Actions and impacts would be the same as in Alternative 2 for the logjam / avulsion sill.

*Milepost 3.8 (Frog Island)*: Instead of one to two rock barbs and riparian restoration (as in Alternative 2), a logjam would be constructed to retain the road along the bank. Impacts would be long-term and minor on soils and minor to moderate from the removal of riparian vegetation because of the short length of the bank affected. Slowing the erosion of existing native vegetation and replanting would have minor beneficial effects.

*Milepost 5.3 (Wilson Creek) / Lower Field*: The two rock barbs at the upper end of the Lower Field and the logjam at Wilson Creek, coupled with bioengineering, would have long-term minor adverse effects on soils and vegetation and negligible beneficial effects from bioengineering and bank stabilization. In this alternative, barbs at the Lower Field would help to retain the road and restored riparian area.

**Large Woody Debris**: Actions and impacts would the same as Alternative 2.

**Recreational Facilities**

*Campgrounds*: Combined effects of actions in Alternative 2 and one additional camp would have a negligible adverse effect in a highly disturbed grassy area near Company Creek with scattered Douglas-fir. Up to 0.3 acre of vegetation and soil (0.1 acre for just the campsites) would be affected, with a series of negligible to minor localized adverse effects from designating campsites and access pathways. Because the raft launch access road would not be constructed in Alternative 3, soil and vegetation impacts at the river mouth would be less than in Alternative 2.

**Restoration and Bioengineering**: A slightly shorter section of the abandoned Stehekin Valley Road would be restored (approximately 0.6 mile, or 1.0 acre) compared to Alternative 2. Adverse impacts would be short term and negligible to minor, while beneficial impacts from restoration of approximately 8.2 acres of upland and riparian areas” after —impacts would be long term and minor to moderate.

**Land Protection Plan Modifications**: Actions and impacts would be the same as in Alternative 2. There would be long-term minor to moderate adverse effects on vegetation and soils coupled with long-term moderate to major beneficial effects from potential acquisition of riparian areas and from the decrease in development in the floodplain / channel migration zone.

## Additional Impacts from Alternative 4

Actions and impacts in Alternative 4 would be the same as Alternative 1 for retaining the Stehekin Valley Road in its current alignment and for maintenance and housing area construction; similar to Alternatives 2 and 3 for restoration of Buckner Homestead hayfield and pasture and the Lower Field; the same as Alternatives 2 - 4 for the retaining wall at Milepost 8.0; and similar to Alternative 3 for erosion protection measures but with new actions at Milepost 7.0 and Milepost 9.2 (five more barbs). For recreational improvements, there would be the additional camp from Alternative 3 and the raft takeout from Alternative 2. There would be less restoration than in Alternative 3 because there would be no road reroute; however, additional bioengineering would occur in areas affected by more barb placement.

**Erosion Protection Measures**

*Milepost 2.0 (Boulder Creek)*: Actions and impacts would be the same as in Alternatives 2 and 3 for the logjam and avulsion sill.

*Weaver Point / Milepost 5.3 (Wilson Creek) / Lower Field*: Actions and impacts would be the same as in Alternative 3 at Lower Field and at Weaver Point, and the same as in Alternative 2 at Wilson Creek.

*Stehekin River Mouth / Milepost 3.8 (Frog Island)*: Actions and impacts would be the same as in Alternative 2 for the installation of three barbs, bioengineering, and riparian restoration.

*Milepost 7.0 / Milepost 9.2*: Construction of two barbs at Milepost 7.0 and three at Milepost 9.2 would affect 0.3 acre. Adverse effects on soils and vegetation would be minor and beneficial effects would be negligible to minor from bioengineering.

**Photo 29 – View Upstream at the Left (East) Bank of the Stehekin River Near its Intersection with Lake Chelan (Note Rip-rap Bank Armor on Upper Right)**

**Large Woody Debris**: Large woody debris procurement would occur over a larger area than in Alternatives 2 and 3, including areas from the lake up to the Bullion Raft Launch. Procurement of large woody debris from the tops of logjams over a wider area would result in short-term moderate adverse effects from equipment disturbance, coupled with long-term minor beneficial and adverse effects from use and placement of the large woody debris in bank erosion-protection measures. Obtaining large woody debris from a wider area than in Alternatives 2 and 3 would spread impacts over a wider area, or could result in impacts to areas where wood was more easily obtained, therefore resulting in fewer overall impacts.

**Land Protection Plan Modifications**: Implementation of the revised LPP would allow more development along the existing road alignment and would focus less on moving affected properties out of the channel migration zone. Although priorities for land acquisition and exchange would be different, similar effects (development of approximately 2.75 acres for each exchange parcel) could occur. As in Alternatives 2 and 3, because the proposed land exchange parcels are larger than 1 acre and most of the land associated with the larger parcels would likely remain undeveloped, development of portions of these 10 - 15 parcels would have a long-term minor to moderate adverse effect on vegetation and soils, including from conversion of native landscape to developed area and from the potential invasion of nonnative species associated with that development. There would be similar negligible to minor beneficial effects from covenants stipulated in exchange/purchase agreements. Long-term moderate beneficial effects would also occur from acquiring riparian parcels and removal of development from the Stehekin River floodplain and channel migration zone. Because more development would continue to exist in the channel migration zone in Alternative 4 and because there would be fewer high-priority parcels acquired or exchanged, there would continue to be long-term moderate adverse effects on floodplain vegetation and soils.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to soils include the following:

- Locating staging areas where they will minimize new disturbance of area soils and vegetation.
- Minimizing ground disturbance to the extent practicable.
- Minimizing construction along water courses during periods of heavy precipitation.
- Minimizing driving over or compacting root-zones.
- Using mats or plywood to minimize soil-compaction impacts in sensitive areas or fine-grained soils.
- Salvaging topsoil from excavated areas for use in recovering source area or other project areas.
- Windrowing topsoil at a height that will help to preserve soil microorganisms (less than 3 feet).
- Covering salvaged topsoil with a breathable, water-repellent fabric and anchoring the perimeter to limit erosion.
- Avoiding leaving excavated soil alongside trees, and providing tree protection if needed for specimen trees.
- Reusing excavated materials where possible in the project area.
- Revegetating project areas through native seeding or planting.
- Importing weed-free clean fill and topsoil.
- Identifying clearing limits to minimize the amount of vegetation loss.
- Clearing and grubbing only those areas where construction would occur.
- Reusing topsoil from the reroute areas, to the extent practicable, to obliterate and revegetate abandoned road sections.
- Preparing and approving a Hazardous Spill Plan before construction begins.
- Encouraging the use of vegetable oil in place of hydraulic fluid in heavy equipment.

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to vegetation include the following:

- Minimizing construction limits and areas to be cleared where possible.
- Clearly identifying the construction limits, to prevent expansion of construction operations into undisturbed areas.
- Rehabilitating or restoring road reroute clearing areas not occupied by the roadway.
- Retaining specimen trees where possible adjacent to erosion protection sites and along the reroute / realignment areas (as identified by park staff).

- Salvaging plant material, prior to construction, from areas to be disturbed.
- Replanting salvaged plants on reroute side slopes and obliterated areas to accelerate site recovery and to reduce the opportunity for exotic species to establish (Alternatives 2 and 3).
- Continuing to use CCRs associated with the development of exchanged lands to address clearing of vegetation; location and design of access roads and utilities; density, height, design, and color of visible development; and access for management of natural and cultural resources.
- Restoring staging and other temporarily impacted areas following construction.
- Obliterating and revegetating abandoned road segments and areas disturbed by construction with native plant species.
- Using bioengineering techniques, such as willow layering, to stabilize riverbanks.
- Minimizing actions that affect endangered, threatened, or sensitive plant species in the project area.
- Keeping fill slopes as steep as possible where fill is proposed to raise the road to minimize the disturbance footprint.
- Minimizing clearing of vegetation associated with reroutes by incorporating toe walls at appropriate locations (Alternatives 2 and 3).

Mitigation measures for preventing the spread of noxious weeds include the following:

- Importing only freshly exposed subsurface materials from outside the recreation area.
- Avoiding the use of stockpiled materials from the Company Creek Pit unless designated for the project.
- Covering trucks when transporting materials outside the project area to reduce or eliminate particle release during transport.
- Washing all vehicles that have come into contact with soil or materials that may contain noxious weed seed prior to working in weed-free areas or transporting weed-free materials.
- Covering stored soil and rock to prevent exposure to noxious weed seed.
- Separating contaminated soil from weed-free soil and using it for subsurface fill.
- Conducting annual monitoring for potential weed infestation.
- Identifying and controlling exotic plant species infestations prior to construction (especially associated with the airstrip and old roads).

**Cumulative Impacts**: Habitat modification within the recreation area includes broad-scale changes in vegetation characteristics due to fire suppression and administrative and private development. Loss of vegetation has occurred where land has been developed for facilities, trails, and roads, and for private homes and businesses. Development, including roads, private property, and recreation area administrative facilities, in the Stehekin Valley currently affects approximately 283 acres of the approximately 13,000 acres on the Stehekin River valley floor from High Bridge to Lake Chelan. The original 23-mile road development disturbed approximately 50 acres of vegetation and soils (NPS 2005). Combined, past actions have had localized moderate long-term adverse impacts on soils and vegetation due to the increased impervious surface, decreased infiltration, soil compaction, loss of soil moisture, and loss of organic soil horizon spread over some of the lower Stehekin Valley, occurring mostly within the channel migration zone of the Stehekin River.

When the effects of development are combined with those from specific projects along the Stehekin Valley and Company Creek roads to build the levee, rock barbs, grade-control structures, and other features, there have been long-term minor to moderate cumulative adverse impacts on soils and vegetation, especially in riparian areas. The Forest Fuel Reduction Program has impacted soils and vegetation in the lower Stehekin Valley by thinning (removing) trees, downed woody debris, and other vegetation to reduce the potential for ground fuels to carry fire near developed areas. Overall development has contributed to the introduction and spread of nonnative (including invasive) species. Recreation area actions to reduce the distribution and spread of nonnative invasive species have been effective in some areas. Similarly, acquisition of land and the purchase of scenic easements since 1968 have resulted in major beneficial impacts to soil and vegetation in the lower valley.

Past projects to relocate the Stehekin Valley Road have resulted in several reroutes along with similar areas of restoration. In addition, a series of erosion protection measures at 46 sites, including rock barbs, grade-control structures, and other features, have affected 1.6 miles of riverbank. Use of bioengineering and rock barbs since the 1990s has mitigated some impacts that would have occurred with extensive placement of rip-rap.

Alternatives 1 - 4 would contribute additional long-term minor adverse and minor to major beneficial effects from the replacement and relocation of the housing and maintenance complex. Alternatives 1 and 4 would also contribute additional negligible to moderate adverse effects from continuing to maintain the Stehekin Valley Road in place and localized moderate adverse effects to soils and vegetation by adding 16 to 17 additional rock barbs either as part of the implementation of this plan (Alternative 4) or later as the need arose (Alternative 1). Alternatives 2 and 3 would contribute short- and long-term negligible to moderate adverse effects from clearing and grading the reroutes and long-term minor to moderate beneficial effects from moving the road out of the floodplain and channel migration zone. Over time, conversion of McGregor Meadows back to riparian vegetation would contribute a long-term minor to moderate beneficial effect. Recreational facility development would be similar under Alternatives 2 - 4, with slightly more effects in Alternatives 4 from more new trail development and Alternatives 3 and 4 from one additional camp. Alternatives 2 - 4 would also contribute new long-term localized moderate to major beneficial effects from restoration at Buckner Homestead hayfield and pasture, the Lower Field, acquired private land in the channel migration zone, and the former maintenance yard and housing area. Alternatives 2 and 3 would also add some restoration from the former roadway and would contribute negligible to minor long-term beneficial effects from minimizing effects on soils by retaining topsoil for the road reroutes.

Most of the recreation area continues to be undisturbed by human impacts. The low-elevation mixed forests of the lower Stehekin Valley that would be affected represent only 2 percent of the overall watershed. Therefore, the amount of area affected by past and possible future project soil and vegetation impacts is localized and moderate when considered within the context of the Stehekin River watershed or the lower Stehekin Valley. Impacts from the above actions, together with the impacts of implementing one of the alternatives, would continue to result in a range of localized long-term negligible to moderate adverse and negligible to moderate beneficial cumulative impacts to soils and vegetation in the recreation area.

In Alternative 1, future adverse impacts to soils and vegetation would continue to occur from road maintenance. Over time, it is likely that the measures to keep the road in place now proposed in Alternative 4 would be implemented in Alternative 1 and impacts would be expected to increase as the river continues to encroach on the road. Long-term minor to moderate cumulative adverse effects would continue to occur from maintaining the Company Creek Road in its current alignment.

Alternatives 2 and 3 would contribute fewer long-term impacts to vegetation because the Stehekin Valley Road would be moved away from the channel migration zone where possible, thus limiting the future extent of flooding on the road (less in Alternative 2). In some areas, where the road is adjacent to steep terrain and cannot be moved without major additional impacts on vegetation, additional minor impacts could continue to occur from erosion of soils and loss of vegetation. As in Alternative 1, ongoing effects would occur from maintaining the Company Creek Road in its current alignment. Alternative 4, compared to Alternative 1, would also likely contribute fewer long-term impacts on soils and vegetation because more erosion protection measures would be constructed.

**Conclusion**: Alternative 1 would have negligible to moderate adverse and negligible to major beneficial effects. Alternative 2 would have negligible to major adverse effects and negligible to major beneficial effects. Alternative 3 would have impacts similar to Alternative 2, with adverse and beneficial effects both somewhat less from a shorter reroute, less restoration, and more erosion protection measures. Alternative 4 would contribute negligible to moderate adverse effects and minor to major beneficial effects. In Alternative 1, there would be approximately 10 acres of new disturbance. In Alternatives 2 and 3, an additional 18 acres would be disturbed for the road reroutes. In total, Alternatives 2 and 3 would have approximately 28 new acres of disturbance and Alternative 4 would have approximately 11 acres of new disturbance. Restoration in all alternatives would improve soils and vegetation on from 5.1 (Alternative 1) to 9.0 acres (Alternative 2). The range of impacts is summarized in Table IV-6: *Summary of Soils and Vegetation Impacts*.

Because there would be no widespread major adverse impacts on vegetation and no major widespread adverse impacts to soils or effects on rare vegetation or soils, there would be no impairment of park resources or values related to soils or vegetation.

**Table IV-6: Summary of Soils and Vegetation Impacts**

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| **Maintenance and housing areas** | Localized long-term minor to moderate adverse effects to upland vegetation.<br>Long-term negligible to major beneficial effects from riparian and upland restoration. | Same as Alternative 1 | Same as Alternative 1 | Same as Alternative 1 |
| **Road rehabilitation** | Long-term negligible to moderate adverse effects.<br>Long-term negligible to minor beneficial effects. | Long-term negligible to moderate adverse effects.<br>Long-term negligible to minor beneficial effects. | Similar to Alternative 2 | Same as Alternative 1 |
| **Grade raise** | Short- to long-term negligible to minor adverse effects. | N/A | N/A | Same as Alternative 1 |
| **Reroute** | N/A | Short- and long-term localized moderate to major adverse effects;<br>Long-term negligible to moderate beneficial effects. | Similar to Alternative 2, with slightly shorter reroute | N/A |

| | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| **Access road** | N/A | Long-term minor adverse effects. | Long-term minor adverse effects. | N/A |
| **Erosion protection measures** | Short- and long-term minor adverse effects;<br>Long-term negligible beneficial effects. | Short- and long-term minor to moderate adverse effects;<br>Long-term negligible to minor or moderate beneficial effects. | Similar to Alternative 2, with fewer barbs and more logjams. | Short- and long-term minor to moderate adverse effects, with more barbs than Alternative 3;<br>Long-term negligible to minor beneficial effects. |
| **Milepost 8.0 / 9.2** | N/A | Long-term localized minor to moderate adverse effects.<br>Long-term minor beneficial effects. | Same as Alternative 2 | Same as Alternative 2 |
| **Large woody debris** | No effects. | Short- and long-term negligible to minor adverse effects. Long-term minor beneficial effects. | Same as Alternative 2 | Similar to Alternative 2, with moderate impacts spread over a wider area. |
| **Recreational facilities** | Long-term minor adverse effects; long-term negligible beneficial effects. | Long-term minor adverse effects;<br>Long-term negligible beneficial effects. | Similar to Alternative 2 with one more camp and no raft takeout. | Similar to Alternative 2 with one more camp. |
| **Restoration and bioengineering** | Long-term beneficial effects from restoration of former maintenance area. | Same as Alternative 1, plus long-term minor to major beneficial effects from additional restoration and bioengineering. | Same as Alternative 2, with slightly less road restoration. | Similar to Alternative 2, but with fewer beneficial effects. |
| **Land Protection Plan** | Long-term minor to moderate adverse and beneficial effects. | Long-term minor to moderate adverse effects. Long-term moderate to major beneficial effects. | Same as Alternative 2 | Same as Alternative 2, with fewer potential beneficial effects. |
| **Conclusion** | Negligible to moderate adverse effects. Negligible to minor beneficial impacts. | Negligible to major adverse effects. Negligible to moderate beneficial impacts. | Similar to Alternative 2; however, both adverse and beneficial effects would be somewhat less from a shorter reroute. | Minor to moderate adverse impacts.<br>Minor beneficial effects. |
| **Contribution to cumulative impacts** | Localized minor adverse cumulative impacts and localized negligible to minor beneficial effects. | Localized moderate adverse cumulative impacts and localized minor beneficial impacts. | Similar to Alternative 2. | Minor to moderate cumulative adverse effects. |

# 4. GEOLOGIC HAZARDS IMPACTS

## a. Geologic Hazards Methodology

Geologic hazards were mapped for the 1995 GMP, and were used to qualitatively assess beneficial and adverse impacts of actions in the alternatives.

**Type of Impact**: As a natural area, a variety of geologic hazards, including flooding, rock fall, avalanches, and hazards associated with extreme storm events, such as debris flows, are possible within Lake Chelan NRA. Beneficial impacts would reduce the potential risk from geologic hazards; adverse impacts would increase the potential risk.

### Intensity of Impact

- **Negligible**: The alternative would result in a change in the potential risk associated with geologic hazards, but the change would not be measurable or perceptible.
- **Minor**: The alternative would result in an apparent change in the potential risk associated with geologic hazards. Some people or structures would be periodically exposed to this risk.
- **Moderate**: The alternative would result in a readily apparent and appreciable increase in potential risk associated with geologic hazards. More people or structures would be more consistently exposed to this risk.
- **Major**: The alternative would result in a substantial increase in potential risk associated with geologic hazards. Most people or structures would be routinely exposed to this risk.

## b. Impacts from Geologic Hazards

### Impacts from Alternative 1

Ongoing geologic hazards would continue along the Stehekin Valley Road and in other areas from rock fall associated with steep valley slopes composed of loose glacial deposits at McGregor Meadows, and from rock falls at Frog Island, below cliffs at Rainbow Falls, and near Harlequin Bridge. Slope instability at Milepost 8.0 also represents a rock fall hazard. Swift, deep water during floods along the Stehekin River channel and its tributaries is also a major hazard. The potential for injury or damage from these hazards would continue to be minor to moderate. Over time, if floods continued to increase in frequency and magnitude and if slopes adjacent to the road remained unstable, the potential for hazards to increase would occur, a long-term moderate adverse effect from geologic hazards. There would also continue to be ongoing exposure to flood hazards on the Stehekin Valley Road and Company Creek Roads, creating a short-term localized minor to moderate adverse effect. The new maintenance area and housing would be outside of geologic hazard (floodplain / channel migration) zones, a moderate long-term beneficial effect.

There would also be some new risk associated with new or relocated recreational facilities along the Stehekin River at Bullion Camp.

### Impacts from Actions Common to Alternatives 2 and 3

Impacts from Alternatives 2 and 3 would be the same as Alternative 1, except for those associated with Milepost 8.0 and those associated with most flood hazards on the Stehekin Valley Road. Actions at Milepost 8.0 would reduce the slope hazard there, resulting in a long-term minor to moderate beneficial effect. Unlike Alternative 1, Alternatives 2 and 3 would also eliminate exposure to the considerable hazard in the Stehekin River floodplain by rerouting 1.9 miles (Alternative 2) or 1.7 miles (Alternative 3) of road. The proposed reroute, however, would traverse several debris cones prone to periodic flows of large rock and debris. One of these carried a snow avalanche to the proposed road site in 2008. Given the higher frequency of flood events compared to snow avalanches or debris flows, the reroute would result in a lower likelihood of geologic hazards, but hazards would continue to be minor to moderate. Construction of a campground at Rainbow Falls would place visitors near a rock fall hazard. Locating campsites according to site-specific conditions, and the fact that most rock falls occur in the winter when the camp would be closed by snow, would reduce exposure. Exposure to hazards along the Stehekin Valley Road in McGregor Meadows would be reduced the most in Alternatives 2 and 3; however, because the access road would remain, there would continue to be exposure to flood hazards for some residents and visitors. There would also be some new risk associated with new or relocated recreational facilities along the Stehekin River and at Bullion Camp. Construction of new visitor facilities near the river mouth in Alternative 2 would also present a minor increase in risk during high flow periods on the river.

### Impacts from Alternative 4

Impacts would be the same as Alternative 1, plus Alternative 4 would reduce slope hazard at Milepost 8.0, a localized minor to moderate long-term beneficial effect on geologic hazards. As in Alternative 2, there would be long-term minor to moderate adverse effects from exposure to geologic hazards from recreational facilities at Rainbow Falls and Bullion Camp and the raft takeout near the river mouth.

**Cumulative Impacts**: A variety of potential minor to moderate adverse effects from geologic hazards would continue to exist. Alternatives 1 - 4 would contribute additional negligible to minor adverse impacts.

**Conclusion**: Alternatives 1 - 4 would result in minor increases from exposure to geologic hazards. Alternatives 2 and 3 would reduce roadway flooding hazards along the reroute sections. Alternatives 2 - 4 would have long-term minor beneficial impacts from stabilizing the slope at Milepost 8.0.

There would be no impairment associated with geologic hazards because impacts would continue to be moderate.

## 5. HYDRAULICS AND STREAMFLOW CHARACTERISTICS IMPACTS

### Intensity of Impact

- **Negligible**: The alternative would result in a change in streamflow conditions, but the change would not be measurable or perceptible at the reach scale or the lower valley scale.
- **Minor**: The alternative would result in modification of streamflow and hydraulics within a given reach by actions to protect the road at the edge of the channel migration zone. It would increase impervious surfacing, and the measurable or anticipated degree of change would be detectable.
- **Moderate**: The alternative would result in modification of streamflow and hydraulics within a given reach by actions to protect the road within the channel migration zone. Some erosion protection measures are within the channel migration zone. It would noticeably increase impervious surfacing, and the measurable or anticipated degree of change would be readily apparent and appreciable.
- **Major**: The alternative would result in modification of streamflow and hydraulics within a given reach and along a major portion of the river in the lower Stehekin Valley. Most erosion protection

measures are within the channel migration zone, limiting long-term river migration and restricting the river from utilizing its floodplain. The measurable or anticipated degree of change would be substantial, causing a highly noticeable change.

**Photo 30 – Stehekin River at its Junction with Lake Chelan**

## b. Hydraulics and Streamflow Characteristics Impacts

**General Effects of Rock Barbs**: Rock barbs have a localized effect by directing the stream away from the riverbank and creating eddies or pools, but do not generally change the overall flow regime in the river (NPS 1995a). As noted in the Stehekin Valley Road Improvement Plan Environmental Assessment (EA), while barbs protect the immediate area by deflecting streamflow away from the bank, the altered streamflow can but usually does not result in riverbank erosion farther downstream (NPS 2005a). If the erosion problem is pushed downstream and it becomes necessary to construct additional erosion protection measures, this would result in additional impacts on the Stehekin River and its banks. When located within the channel migration zone, barbs or other structures can limit stream migration and potentially increase stream velocity and depth. When located at the edge of the channel migration zone, such as against a valley wall or alluvial fan, the impact of erosion protection structures on river processes is comparatively small since these topographic features naturally limit river migration.

Results of computer modeling at a local scale are consistent with field observations of rock barbs in the Stehekin River and elsewhere. Water surface elevation increases 1 foot immediately upstream of the barbs and is lowered downstream by a similar amount. This is accompanied by a shift of high-velocity flow from the bank toward the mid-channel area. These displacements combine to reduce the energy of flow along the affected riverbank. Examination of the effects of rock barbs two channel-widths downstream show that the water surface elevation is not affected; however, downstream velocity is slightly reduced (NPS 1997). Barbs affect the riverbank and channel for approximately four times their length (25 feet), or about 100 feet downstream.

Barbs also unnaturally increase the diversity of habitats in the Stehekin River at the reach scale by increasing the amount of pool habitat compared to the amount of riffle habitat. Pools are less frequently observed on the Stehekin River than riffles, which are the most common habitat type in the main channel of the Stehekin River (Appendix 4: Stehekin River Reach Analysis). Rock barbs create pool habitat (eddies or ―pocket pools”) upstream and downstream of individual barbs. This effect results in an overall change to instream flow characteristics, wherever barbs are inserted. As with other bank-hardening measures, barbs also reduce the amount of large woody debris and gravel recruitment from the bank where they are located. Because the rate of large woody debris and gravel recruitment is very high in the Stehekin River and the areas of bank small in comparison, when it occurs, this impact would be long term, minor, and adverse. A summary of the current status of altered stream banks in the four reaches impacted by this implementation plan is in Appendix 4 and Table IV-7.

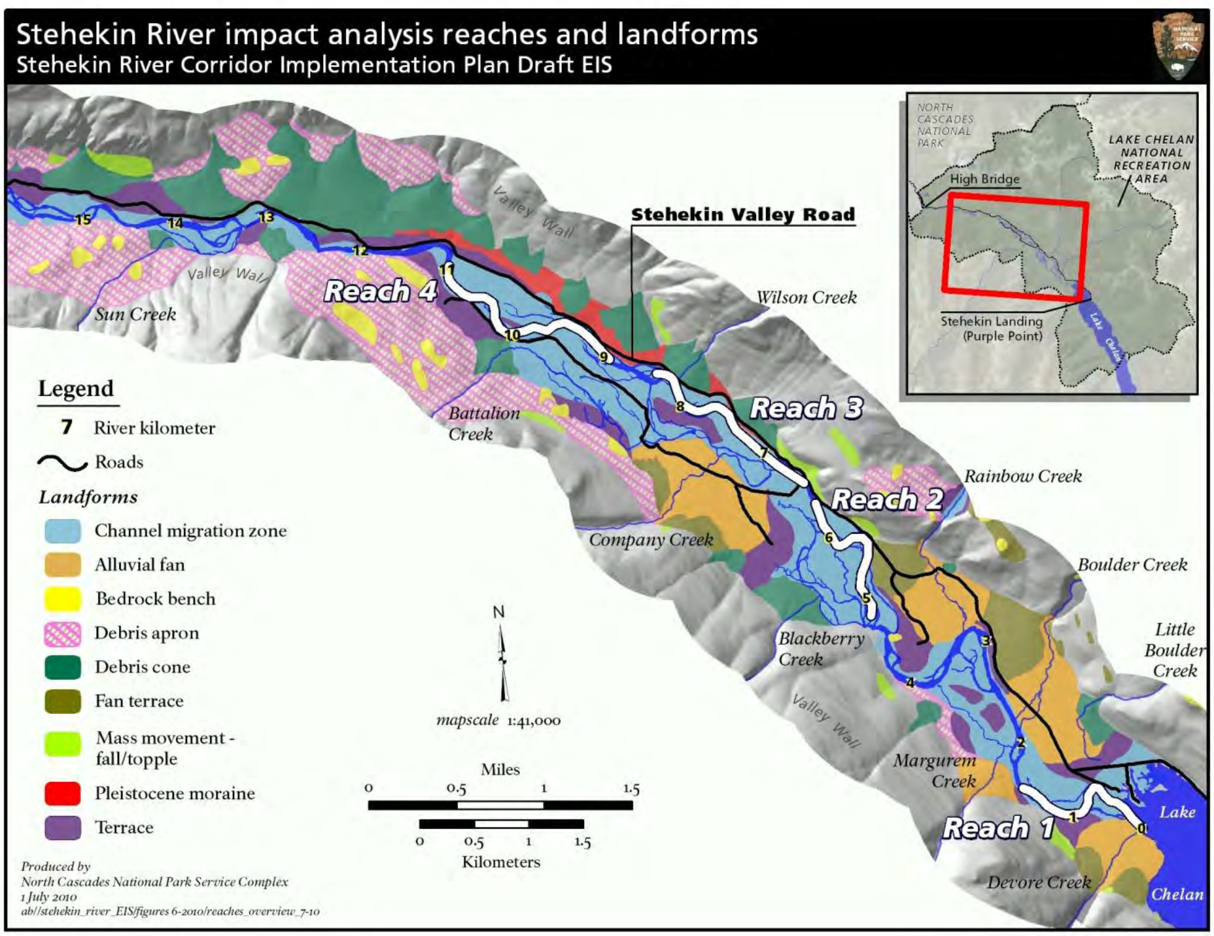


**Figure IV-1: Overall layout of the Stream Reaches Analyzed on the Stehekin River**

Note the Pleistocene moraine (red) along the left bank and the alluvial fans (orange) along the lower valley, which generally defines the channel migration zone.

**Table IV-7: Percentage of Bank Affected Currently by Erosion Protection Measures and Proposed under Alternatives1 - 4 in Reaches 1 - 4**

| Action | Bank Currently Affected (%) | Alternative 1 (%) | Alternative 2 (%) | Alternative 3 (%) | Alternative 4 (%) |
|---|---|---|---|---|---|
| Reach 1 | 10 (304/3,000 m) | 0 | 9 (270 m) | 13 (396 m) | 15 (436 m) |
| Reach 2 | 4 (92/2,400 m) | 0 | 5 (122 m) | 5 (122 m) | 5 (122 m) |
| Reach 3 | 3 (92/3,000 m) | 4 (120 m) | 4 (122 m) | 4 (122 m) | 4 (122 m) |
| Reach 4 | 22 (884/4,000 m) | 0 | 0 | 3 (122 m) | 6 (244 m) |

Note: See Appendix 4: Stehekin River Reach Analysis for location of reaches.

Barbs do not cause increases in flooding of overbank areas because they are designed to be topped by high flows. Most of their effect is directed laterally away from the bank, and as a result they do not increase floodwater surface elevation in large overbank areas.

Rock barbs are effective over periods of 5 to 30 years or more, depending on location. In areas of rapid gravel accumulation, they may be buried by a single event. In areas where there is less gravel movement, they can be effective for several decades. Rock barbs may require repairs after large floods.

**General Effects of Logjams**: Constructed logjams are, in general, similar to rock barbs in that they deflect and absorb energy to slow bank erosion, and cause local pool formation by creating turbulence that erodes a scour hole into the bed of the stream. They are composed of logs, often cabled together, and anchored or buried or pinned to the bank. Their installation requires more excavation of the bank over a wider area than for barbs. They offer the advantage of being made from native material that is often far less costly than imported rock. Logjams also offer the advantage of allowing the beneficial effects of large woody debris to be used effectively to create habitat for fish, amphibians, and aquatic insects.

When placed in the wrong location, logjams can cause unwanted bank erosion when water flows around the obstruction. Logjams can also present a hazard to river runners. The use of logjams on the Stehekin River can be viewed in two ways. On one hand, there are currently 166 logjams, and adding 2 - 3 more would therefore have a negligible to minor effect. On the other hand, adding logjams to locations where they do not naturally form may have unforeseen effects and increase hazards.

**General Effects of Levees**: Levees are long features along a riverbank that are tall enough not to be topped by a given flood event. While they can provide some local relief from flooding, they can cause minor to major long-term impacts to flooding and river processes over wide areas. By preventing floodwater from occupying major parts of the floodplain, levees raise floodwater levels on the opposite side of the river and downstream. By keeping floodwater in the channel, levees also increase water velocity, channel and bank erosion, and floodwater elevation downstream.

The impact of levees is directly related to their height, length, and location. Tall, long levees adjacent to the river channel have major long-term adverse impacts to streamflow and hydraulics. Short, low levees set back from the river have smaller effects.

## Impacts from Actions Common to Alternatives 1 - 4

**Existing Development**: The Stehekin Valley and Company Creek roads and other Stehekin watershed development have constrained the Stehekin River from moving naturally across its floodplain and channel migration zone in some areas. In many cases this development lies within or adjacent to the floodplain and/or channel migration zone. There would continue to be long-term moderate to major adverse effects from retaining the Company Creek Road and levee, which constrains the Stehekin River from eroding into about a third of its channel migration zone in this reach.

Under all alternatives, parts of the Stehekin Valley Road would be retained adjacent to the Stehekin River within the floodplain / channel migration zone because there is not room to move the road due to topographic features and/or because of the need for very long reroutes through sensitive resources.

All alternatives would retain the Stehekin Valley Road within the channel migration zone between Milepost 1.0 and 1.5 (from the head of the lake to the Bakery). In this location the road is at grade and does not have a large impact on the floodplain. All alternatives would also keep the road at the edge of the channel migration zone near Milepost 3.8 (Frog Island), Milepost 5.3 (Wilson Creek), and Milepost 8.0. At these sites, the Stehekin Valley Road does not significantly constrict the river within the channel migration zone because the road is located at its edge and is naturally constrained by topography.

About 0.5 mile of the road into McGregor Meadows would remain in the floodplain until no private property access was needed (Alternatives 2 and 3). In Alternatives 1 and 4, the road would run for about 0.75 mile through the floodplain, and would be raised 1 - 3 feet with 5,600 yards of fill. The low elevation of the floodplain and deposition of gravel in the channel have led to a long-term trend toward increased flooding in this area as the river seeks a new channel. Impacts from keeping a road in this location (either the access road or the Stehekin Valley Road) would therefore be moderate to major over time.

Existing development along the Company Creek Road and most of the road itself would continue to affect the ability of the river to migrate laterally within the channel migration zone on the opposite side of the river from McGregor Meadows. The retention of the road would continue to result in a long-term minor to moderate adverse effect on the natural flow and channel changes in the Stehekin River since the Company Creek bank of the river is several feet higher than McGregor Meadows and the right bank floodplain is not as wide.

**Road Rehabilitation**: Actions that concentrate runoff into culverts or ditches or sediment flows to new, unstable areas, including actions such as excavation, importation of fill, placement of fill, loss of vegetation, and surfacing existing gravel portions of the Stehekin Valley Road would have a variety of localized to minor to moderate adverse effects on hydraulics and streamflow. With surfacing, erosion of fill on the roadway during flooding would diminish, a minor long-term beneficial effect.

*Culverts / Side Ditches*: Rehabilitation actions for the whole road (Alternatives 1 and 4) and for the area before and after the reroutes (Alternatives 2 and 3) would affect existing culverts (approximately 19) and would substantially increase the number of culverts. Culverts would be extended, removed, or replaced, affecting intermittent and perennial streamflows to varying degrees, depending on the location and type of culvert. Because sediment barriers and diversion would be employed, as appropriate, and work would be done during dry periods, effects on streamflow for small tributaries between Harlequin Bridge and Milepost 9.2 would be short term and minor. Similarly, constructing new side ditches in Alternatives 1 and 4 and additional side ditches over the length of the reroutes in Alternatives 2 and 3 would have minor adverse effects on streamflow characteristics. Long-term beneficial effects would occur from improved drainage along and beneath the Stehekin Valley Road.

**Maintenance Facility and Housing Replacement and Relocation**: Replacement and relocating the maintenance facility and housing from within the floodplain / channel migration zone and constructing new and replacement facilities outside of these areas would have moderate long-term beneficial effects.

**Large Woody Debris**: The continued collection of large woody debris floating in the head of Lake Chelan after large floods for erosion protection would not affect river hydrology or streamflow characteristics; however, it would reduce the amount of woody debris available in the lake ecosystem by a very small amount. This would be a negligible adverse effect on the ecology of the lake because a comparatively small amount of wood would be removed from the lake in contrast to the huge volume of material that naturally enters the lake during flooding. Further, much of the wood would be incorporated into erosion protection structures on the lakeshore as part of the PUD license. Overall, there is currently an abundance of large woody debris on the lower Stehekin River.

**Recreational Facilities**

*Lower Valley Trail*: Construction of the Lower Valley Trail would result in minor to moderate localized long-term effects on flow of the Stehekin River at the proposed foot bridge and negligible to minor adverse effects elsewhere. If bank stabilization became necessary to protect the trail bridge, impacts could increase locally.

**Removal of Flood-Damaged Structures / Restoration**: Ongoing and new removal of unoccupied flood-damaged structures would create long-term negligible to moderate benefits to water resources. Bioengineering and riparian restoration would provide added beneficial impacts by slowing floodwater and bank erosion and restoring natural floodplain processes.

## Additional Impacts from Alternative 1

**Road Grade Raise**: Raising the level of the road through McGregor Meadows in the floodplain with 5,600 cubic yards of fill would further obstruct floodwater and potentially augment flood damage on both sides of the road by unnaturally affecting the river hydraulics during flood stage. Over time, the road would also constrain and limit the width of the channel migration zone. Taken together, raising the roadbed and constraining the river would cause a localized long-term moderate to major adverse effect on Stehekin River floodwater levels and flow in the vicinity of McGregor Meadows.

**Erosion Protection Measures**: Implementing the Stehekin Valley Road Improvement Project with installation of clusters of rip-rap and log-cribbing at the toe of the slope at Wilson Creek would have moderate adverse effects on streamflow characteristics because rip-rap has a tendency to increase downstream bank erosion and to require supplementation of rock (see Table IV-8: *Alternative 1 Flood and Erosion Protection Measures*). The impact of this action, however, would be greater if not for the location of this area on the edge of the channel migration zone.

**Table IV-8: Alternative 1 Flood and Erosion Protection Measures**

| Action | Location | Area | Impact to Streamflow |
|---|---|---|---|
| Wilson Creek clusters of rip-rap and large woody debris | Edge of CMZ | River km 8<br>400 ft<br>(0.3 acre) | Minor localized adverse. Changes in way water moves along and downstream from the bank. |
| Maintain Company Creek Road / levee | Within floodplain / CMZ | River km 7.5<br>400 ft<br>(0.4 acre) | Moderate to major localized adverse. Changes water movement along and downstream from bank. |

**1995 Land Protection Plan Implementation**: Ongoing actions to implement the 1995 LPP (NPS 1995b) would continue to focus on protecting the scenic qualities along the Stehekin Valley Road and on removing development from the 100-year floodplain of the Stehekin River. These would continue to be the highest priorities for acquisition and exchange, but would not consider the recent changes to the Stehekin River floodplain. Changes wrought by the 1995, 2003, and 2006 floods have put several structures on the verge of being incorporated into the river. As a result, there would continue to be ongoing major adverse impacts to streamflow from the effects of development within the floodplain and channel migration zone in this alternative that would not be resolved. Combined, these effects would continue to be long-term and minor to moderate, with occasional moderate to major localized impacts when destroyed cabins, drain fields, and effluent from septic tanks are incorporated into the river. Development within the 100-year floodplain would continue to be moved, a long-term beneficial effect; however, because the 100-year floodplain has changed and some developments now threatened are not listed as high priority for acquisition, the benefit would be minor.

### Impacts from Actions Common to Alternatives 2 - 4

**Boulder Creek Logjam and Avulsion Sill**: There would be no effect on floodwater elevation or floodwater depth from the location of a logjam and grade-control structure (avulsion sill) on the bank between the Stehekin River and the Boulder Creek alluvial fan. The logjam, however, would affect flood flow conditions by slowing water as it approached the nearby developed area and the sill would prevent head-cutting from forming a large channel directed toward the developed area. Because these structures would be located near the edge of the floodplain / channel migration zone, they would not prevent lateral river migration, which is limited naturally by the Boulder Creek alluvial fan.

**Milepost 8.0 Slope Stabilization**: As in Alternative 1, the road would be retained at this location. In Alternatives 2 - 4, laying back the upper one-quarter to one-third of the slope and scaling rocks would allow for revegetation and gradual slope stabilization. Slope modification would not affect the river since it would be done well above the 100-year flood elevation. Actions would have short-term minor adverse and long-term moderate beneficial effects.

**Restoration and Bioengineering**: Combined restoration and bioengineering would increase riparian bank cover alongside the Stehekin River, a long-term localized minor to moderate beneficial effect on hydraulics and streamflow characteristics by restoring more natural rates of bank erosion.

### Additional Impacts from Alternative 2

**Road Reroute**: Constructing the reroute around McGregor Meadows and Lower Field would move the road outside the channel migration zone, away from frequent flooding and road erosion, creating a long-term moderate to major beneficial effect that allows natural river processes, floodplain storage of floodwater, wood, and gravel, and lateral migration of the channel. Additional culverts would be added for the road reroute, affecting seven intermittent side streams, but these would not directly impact the Stehekin River. These would be crossed using a series of 60-inch pipe culverts. They could affect local streamflow characteristics from scouring and erosion of the road and ditches during floods, a long-term minor adverse effect.

**McGregor Meadows Access Road**: Impacts of retaining 0.8 mile of McGregor Meadows Access Road would be much less than impacts of raising this section of roadway in Alternatives 1 or 4 because the road grade would not be raised or realigned and it would comprise a shorter segment. On this section, road material would continue to be eroded and transported downstream as floodwaters rise and flow through this area, but the amount of gravel would be reduced compared to Alternatives 1 and 4, and is relatively insignificant compared to gravel transport on the river. As a result, there would be minor impacts (less than Alternative 1), depending on how much material was dislodged and/or needs to be replaced following future flooding. Retention of grade-control structures beneath the road between Mileposts 6.5 and 6.8 would slow cutting of new channels and result in short term moderate impacts to stream processes.

**Erosion Protection Measures**: In addition to maintaining the Company Creek levee, modifying the road at Wilson Creek, and constructing the Boulder Creek logjam, proposed erosion protection measures and impacts are shown in Table IV-9: *Alternative 2 Erosion Protection Measures*. The barbs, bioengineering, logjams, and grade-control structures proposed in this alternative would have varying impacts to Stehekin River flow due to their location with respect to the channel migration zone. Those on the edge of the channel migration zone would have less impact because they would not limit the ability of the river to migrate through its floodplain. Those within the channel migration zone would have greater effects because they would limit the river from occupying parts of its floodplain / channel migration zone.

**Table IV-9: Alternative 2 Erosion Protection Measures**

| Action | Location | Area | Impact on Streamflow |
|---|---|---|---|
| Boulder Creek logjam and avulsion sill | Edge of CMZ | River km 2.4<br>400 ft<br>0.02 acre | Minor localized adverse. Would prevent head-cutting toward nearby developed area. |
| Stehekin River mouth barbs (3) | Within CMZ | River km 1<br>600 ft<br>0.21 acre | Moderate localized adverse. Conversion of riffle habitat to pool habitat (6,000 square feet). Redirects flow from alongside bank to middle of channel. |
| Frog Island barbs (1 - 2) | Edge of CMZ | River km 5.5<br>200 - 400 ft<br>0.07 - 0.14 acre | Minor localized adverse. Conversion of riffle habitat to pool habitat (2,000 - 4,000 square feet). Redirects flow from alongside bank to middle of channel. |
| Wilson Creek barbs (2 - 3) | Edge of CMZ | River km 8<br>400 ft<br>0.14 acre | Minor localized adverse effects. Conversion of riffle habitat to pool habitat (4,000 - 6,000 square feet). Redirects flow from alongside bank to middle of channel. |
| Maintain Company Creek Road / levee | Within floodplain / CMZ | River km 7.5<br>400 ft<br>(0.4 acre) | Moderate to major localized adverse. Changes water movement along and downstream from bank. |

Combined, effects from Alternative 2 erosion protection measures would affect up to 2,150 feet of Stehekin River riverbank. This represents about 1.7 percent of the total linear feet of riverbank on the lower Stehekin River, a minor to moderate long-term adverse effect. This would be in addition to the 8,211 linear feet (6.5 percent) of bank currently affected in the lower 12 miles of the Stehekin River (see Table IV-10: *Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures*). The increase in bank hardening at the scale of the lower valley by implementing Alternative 2 would be considered minor to moderate.

At the reach scale, the largest impacts from Alternative 2 would be in Reach 1 (Appendix 4). Installation of barbs and a logjam at the Stehekin River mouth would represent a 9 percent increase in the length of hardened banks in Reach 1, and would increase total affected streambank in Reach 1 from 10 to 19 percent. It is anticipated that this increase would result in a long-term moderate impact to streamflow at the reach scale because of location within the channel migration zone. Impacts would be greater if not for the restoration of 100 feet of bank at the site by removal of rip-rap, and if this reach of the river were not strongly influenced by the backwater from Lake Chelan.

**Table IV-10: Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures**

| | Number of Sites | Number of Structures | Feet of Shoreline* | Added and Total Percentage of Shoreline Affected** |
|---|---|---|---|---|
| **Shoreline currently affected by erosion protection structures** | 46 | Estimated 64 (including levee, rip-rap, cabled logs and barbs) | 8,211 | 6.5% |
| **Alternative 1** | 1 | Rip-rap | 400 WC | 6.8% total<br>0.3% added |
| **Alternative 2** | 4 | 6 - 8 barbs<br>2 logjams<br>Removal of 100 ft rip-rap | up to 1,600<br>(100 SRM,150 BC 400 WC, −100 SRM) | 8.3% total<br>1.7% added |
| **Alternative 3** | 6 | 4 barbs<br>5 logjams<br>Removal of 100 ft rip-rap | 800<br>(150 WP, 500 SRM,150 BC, 200 FI, 400 WC, −100 SRM) | 8.3% total<br>1.7% added |
| **Alternative 4** | 9 | 16 - 17 barbs<br>3 logjams<br>Removal of 100 ft rip-rap | up to 3,400<br>(150 WP,100 SRM, 150 BC,−100 SRM) | 9.5% total<br>3.0% added |
| **Total** | Alternative 1: 47<br>Alternative 2: 50<br>Alternative 3: 52<br>Alternative 4: 54 | Alternative 1:1<br>Alternative 2:8 - 10<br>Alternative 3:9<br>Alternative 4:19 - 20 | Alternative 1: 8,611<br>Alternative 2: 10,361<br>Alternative 3: 10,311<br>Alternative 4: 11,911 | N/A |

Note: Total estimated shoreline in Lake Chelan NRA (left and right bank) is 124,847 feet.
*Key: WC = Wilson Creek, SRM= Stehekin River Mouth, BC = Boulder Creek, WP = Weaver Point, FI = Frog Island.
**All numbers preliminary.

In Reach 2, installation of rock barbs to protect the road at Frog Island would add minor to moderate long-term impacts by increasing the amount of hardened banks by 5 percent from the 4 percent currently modified at Harlequin Bridge. Impacts would be higher except that the barbs and bioengineering would be at the edge of the channel migration zone.

In Reach 3, installation of rock barbs to protect the road at Wilson Creek (Milepost 5.3) would add minor to moderate long-term impacts by increasing the amount of hardened banks by 4 percent from the 3 percent currently modified. Impacts would be higher except that the barbs and bioengineering would be located at the edge of the channel migration zone.

**Revised Land Protection Plan**: With the revision to the LPP, the focus of land acquisition and exchange would be on protecting sensitive resources and removing private development from not just the 100-year floodplain but also from within the channel migration zone. Over time, as properties are acquired or exchanged, fewer would remain in the channel migration zone. As a result, there would be long-term beneficial effects on the ability of the Stehekin River to move within the channel migration zone. Because it is uncertain how many or which properties would be exchanged or acquired, the beneficial effects would be long term and minor to major.

The focus would be on federal acquisition of properties that would most affect the ability of the Stehekin River to migrate within its channel migration zone. Based on the new LPP, there would be 12 properties in the vicinity of McGregor Meadows that require motor vehicle access via the McGregor Meadows Access Road. All of these would be high priority for acquisition in the new ranking except three that would be of medium priority because either they do not contain development or the development footprint is very small and therefore if flooding occurred, additional adverse effects would be minor.

### Additional Impacts from Alternative 3

Among the additional actions that would affect hydrology and streamflow characteristics of the Stehekin River in Alternative 3 would be the construction of the road reroute around only McGregor Meadows and construction of different erosion protection measures. Surfacing, culverts, and side ditches would also vary slightly under Alternative 3.

**Road Reroute**: As with the reroute in Alternative 2, constructing the 1.6-mile reroute around McGregor Meadows would relocate most of the road out of the floodplain and channel migration zone. Because the reroute would not be as long, some areas within the channel migration zone adjacent to the Lower Field would remain part of the road. This would require placement of fill within the channel migration zone, a long-term moderate adverse impact. Still, natural river processes, including lateral migration of the channel and head-cutting, would be allowed to occur in parts of McGregor Meadows. This would be an improvement over Alternative 1, but less of one than in Alternative 2. Similar to Alternative 2, the reroute would reduce the potential for future erosion management measures. As a whole, rerouting the road would enable natural processes within the Stehekin River 100-year floodplain and/or channel migration zone to continue. This would have long-term moderate beneficial effects to river flows.

**McGregor Meadows Access Road Retention / Milepost 8.0 Slope Stabilization**: Actions and impacts would be the same as described in Alternative 2.

**Erosion Protection Measures**: Effects from building logjams at the Stehekin River mouth, near Boulder Creek, at Frog Island, and at Wilson Creek, combined with installation of two barbs at Weaver Point and two at the Lower Field, would be long term, localized, and minor to moderate (see Table IV-11: *Alternative 3 Erosion Protection Measures*). The construction of the 150-foot logjam at Weaver Point (0.02 acre) would have negligible to minor localized adverse effects on streamflow characteristics because it would be located adjacent to the river near the edge of the channel migration zone. It would also allow floodwater to pass through the structures and would not raise the floodwater elevation.

Combined effects from adding erosion protection measures at six locations in Alternative 3 would add up to 2,100 feet of hardening to the Stehekin River riverbank. This represents about a 1.7 percent increase in the total linear feet of hardened riverbank on the lower 12 miles above Lake Chelan, a minor to moderate long-term adverse effect on hydraulics and streamflow (Table IV-10: *Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures*). This would be in addition to the 8,211 linear feet (6.5 percent) of bank currently affected in the lower valley.

**Table IV-11: Alternative 3 Erosion Protection Measures**

| Action | Location | Area | Impact on Streamflow |
|---|---|---|---|
| Weaver Point logjam | Edge of Channel Migration Zone (CMZ) | River km 0<br>130 ft<br>0.12 acre | Minor localized adverse. Deflects and absorbs flow, creating slowing of water and pool and scour hole formation. |
| Weaver Point barbs (2) | Edge of CMZ | River km 0<br>400 ft<br>0.14 acre | Minor localized adverse. Conversion of riffle habitat to pool habitat (4,000 square feet). Redirects flow from alongside bank to center of channel. |
| Stehekin River mouth logjam | Within CMZ | River km 1<br>500 ft<br>0.17 acres | Minor to moderate localized adverse. Deflects and absorbs flow, creating slowing of water and pool and scour hole formation. |
| Boulder Creek logjam and avulsion sill | Edge of CMZ | River km 2.4<br>400 ft<br>0.02 acre | Minor, localized adverse. Would prevent head-cutting toward nearby developed area. |
| Frog Island logjam | Edge of CMZ | River km 5.5<br>200 - 400 ft<br>0.09 acre | Minor localized adverse. Deflects and absorbs flow, creating slowing of water and pool and scour hole formation. |
| Wilson Creek logjam | Edge of CMZ | River km 8<br>400 ft<br>0.14 acre | Minor localized adverse. Deflects and absorbs flow, creating slowing of water and pool and scour hole formation. |
| Lower Field barbs (2) | Within CMZ | River km 9.5<br>400 ft<br>0.14 acre | Moderate localized adverse. Conversion of riffle habitat to pool habitat (4,000 square feet). Redirects flow from alongside bank to center of channel. |
| Maintain Company Creek Road / levee | Within floodplain / CMZ | River km 7.5<br>400 ft<br>(0.4 acre) | Moderate to major localized adverse. Changes water movement along and downstream from bank. |

At the reach scale, Alternative 3 would add 13 percent more hardened bank in Reach 1 by actions at Weaver Point and the Stehekin River mouth. This would bring the total affected area in Reach 1 to 23 percent, and would be a moderate adverse impact on streamflow and hydraulics, primarily by reducing river migration and increasing stream velocity. In Reaches 2 and 3, actions at Frog Island and Wilson Creek would affect the same 5 percent of the bank as under Alternative 2, and would have a minor to moderate impact on streamflow because the sites are located at the edge of the channel migration zone. In Reach 4, Alternative 3 actions at the Lower Field would add about 3 percent to the total linear feet of hardened banks, and would have a moderate impact since the site is within the channel migration zone.

**Revised Land Protection Plan**: Actions and impacts would be the same as those described above in Alternative 2.

## Additional Impacts from Alternative 4

**Road Grade Raise**: Action and impacts would be the same as described in Alternative 1.

**Erosion Protection Measures**: Actions and impacts at Weaver Point and Lower Field would be the same as in Alternative 3; Stehekin River mouth, Boulder Creek, Frog Island, and Wilson Creek (except for an additional barb) actions would be the same as Alternative 2. In addition, two barbs would be added near Milepost 7.0 and three near Milepost 9.2 (Table IV-12: *Alternative 4 Erosion Protection Measures*).

**Table IV-12: Alternative 4 Erosion Protection Measures**

| Action | Location | Area | Impact on Streamflow |
|---|---|---|---|
| Weaver Point logjam | Edge of CMZ | River km 0<br>130 ft<br>0.12 ac | Minor localized adverse. Deflects and absorbs flow, creating slowing of water and pool and scour hole formation. |
| Weaver Point barbs (2) | Edge of CMZ | River km 0<br>400 ft<br>0.14 ac | Minor localized adverse. Conversion of riffle habitat to pool habitat (4,000 sq ft). Redirects flow from alongside bank to center of channel. |
| Stehekin River mouth barbs (3) | Within CMZ | River km 1<br>600 ft<br>0.21 ac | Moderate localized adverse. Conversion of riffle habitat to pool habitat (6,000 sq ft). Redirects flow from alongside bank to middle of channel. |
| Boulder Creek logjam and avulsion sill | Edge of CMZ | River km 2.4<br>400 ft<br>0.02 acre | Minor, localized adverse. Would prevent head-cutting toward nearby developed area. |
| Frog Island barbs (1 - 2) | Edge of CMZ | River km 5.5<br>200 - 400 ft<br>0.07 - 0.14 ac | Minor localized adverse. Conversion of riffle habitat to pool habitat (2,000 - 4,000 sq ft). Redirects flow from alongside bank to middle of channel. |
| Wilson Creek barbs (2 - 3) | Edge of CMZ | River km 8<br>400 ft<br>0.14 ac | Same as above except 6,000 sq ft of riffle to pool habitat. |
| Lower Field barbs (2) | Within CMZ | River km 9.5<br>400 ft<br>0.14 ac | Moderate localized adverse. Conversion of riffle habitat to pool habitat (4,000 sq ft). Redirects flow from alongside bank to center of channel. |
| Milepost 7.0 barbs (2) | Within CMZ | River km 11<br>400 ft<br>0.14 ac | Same impact as above. |
| Milepost 9.2 barbs (3) | Within CMZ | River km 11.5<br>600 ft<br>0.21 ac | Moderate localized adverse. Conversion of riffle habitat to pool habitat (6,000 sq ft). Redirects flow from alongside bank to center of channel. |
| Maintain Company Creek Road / levee | Within floodplain / CMZ | River km 7.5<br>400 ft<br>0.4 ac | Moderate to major localized adverse. Changes water movement along and downstream from bank. |

Effects from installation of 16 - 17 new barbs and two logjams at nine sites under Alternative 4 would affect approximately 3,500 - 3,700 feet of Stehekin River riverbank, or about 3 percent of the total in the lower 12 miles of the river (Table IV-10: *Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures*). This would be in addition to the 6.5 percent of bank currently affected. This level of riverbank manipulation would have a moderate to major long-term adverse effect, in part because of the number of structures, but also because five of seven sites are within the channel migration zone.

In Reach 1, bank stabilization at three sites would affect 15 percent of the total riverbank, in addition to the 10 percent currently affected by bank hardening. This would represent a moderate to major impact to streamflow and hydraulics in Reach 1 because of the amount of bank that would be hardened, as well as the fact that the Weaver Point and River Mouth sites are within the channel migration zone. Impacts in Reaches 2 and 3 under this alternative would be the same as in Alternative 3. At the reach scale near McGregor Meadows, construction of rock barbs at Milepost 7 on the Stehekin Valley Road and the

Lower Field would add about 6 percent more hardened banks, in addition to the 22 percent already modified in Reach 4, a moderate adverse impact on hydraulics and streamflow.

In addition, three barbs would be built near Milepost 9.2 on the Stehekin Valley Road. These would be located near the edge of the channel migration zone, and would cause a moderate impact to stream processes in this reach. There are currently four other rock barbs on private land just downstream.

**Revised Land Protection Plan Implementation**: As in Alternatives 2 and 3, with the revision to the LPP, the focus of land acquisition and exchange would be on protecting sensitive resources and removing private development from the floodplain and channel migration zone. In Alternative 4, however, actions would contribute to protecting the Stehekin Valley Road in place where possible.

As in Alternatives 2 and 3, over time, as properties are acquired or exchanged, fewer would remain in the channel migration zone; however, the priorities for acquisition and exchange would be focused on obtaining those properties that helped to maintain the Stehekin Valley Road over those that were within the channel migration zone. As a result, although there would be long-term beneficial effects on the ability of the Stehekin River to migrate within its floodplain and channel migration zone, these would be fewer because most of the road would be retained in place. Because it is uncertain how many or which properties would be exchanged or acquired and whether these would benefit the channel migration zone or just the road, the beneficial effects would be long term and minor to major.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to water resources (including hydraulics and streamflow characteristics, water quality, wetlands, and floodplains) include:

- Locating staging and stockpiling areas located away from the Stehekin River.
- Delineating staging areas to prevent incremental expansion of the staging area.
- Covering stockpiled fine-grained soil and rock near surface water and, if overwintered, with a breathable, water-repellent fabric, such as silt fence, anchored around the perimeter.
- Using temporary sediment-control devices such as filter fabric fences, sediment traps, or check dams as needed during culvert replacement.
- Identifying the area to be cleared to define the extent and clearing only those areas necessary for construction.
- Minimizing the amount of disturbed earth area and the duration of soil exposure to rainfall.
- Using bioengineering to stabilize riverbanks where erosion protection measures are employed.
- Minimizing soil disturbance, and reseeding or revegetating disturbed areas as soon as practical.
- Using topsoil and duff from the reroute areas to rehabilitate (recreate habitat) the obliterated road segments and road shoulders where reroutes occur.
- Scarifying slopes, if necessary, to slow erosion.
- Retaining silt fencing in disturbed areas until stabilization (by reseeding or revegetation).
- Constructing temporary diversion devices such as swales, trenches, culverts, or drains to divert stormwater runoff away from disturbed areas, including exposed slopes.
- Using native duff and topsoil to cover exposed soil as soon as practical.

- Installing protective construction fencing around, adjacent to, or near wetland and/or riparian areas that are to be protected, or using other erosion protection measures to protect water resources in the project area.
- Avoiding machinery use below the wetted perimeter of water bodies where possible (work would be done from the bank).
- Using equipment excavators from the bank to place rock below the ordinary high water mark for rock barbs, to reduce the potential for introducing pollutants, including possible leaks of hydraulic fluid or other substances from heavy equipment.
- Using vegetable-based hydraulic fluid in heavy equipment.
- Limiting the duration of the instream work as much as possible.
- Timing instream work to occur at lower-flow periods (i.e., work would not occur during heavy river flows).
- Minimizing creation of impervious surface.
- Using a Storm Water Pollution Prevention Plan for construction activities to control surface runoff, reduce erosion, and prevent sedimentation from entering water bodies during construction.
- Developing and implementing a comprehensive Spill Prevention/Response Plan that complies with federal and state regulations and addresses all aspects of spill prevention, notification, emergency spill response strategies for spills occurring on land and water, reporting requirements, monitoring requirements, personnel responsibilities, response equipment type and location, and drills and training requirements.
- Use work area isolation techniques when water is present in adjacent streams (not the Stehekin River itself).

**Prevention of Fuel Spills**: The following BMPs to control adverse impacts of fuel spills would also be used:

- Refueling activities would be done at least 100 feet from the river and its tributaries or other surface water.
- Areas where refueling or maintenance of equipment would occur would be identified and would have containment devices such as temporary earth berms.
- Absorbent pads would be available to clean up spills.
- Restrictions on the location of fueling sites, requirements for spill containment, and other measures to safeguard aquatic and terrestrial habitat from construction-related contaminants would be identified.

**Cumulative Impacts**: There have been a series of actions that have affected hydraulics and streamflow characteristics, including development and bank stabilization within the floodplain and channel migration zone. This includes existing hardened surfaces, such as roads and buildings, as well as the creation of Lake Chelan Dam. All alternatives would add to these by increasing the number of control structures and continuing the long-term trend toward constraining the lower reaches of the Stehekin River (where flow is already affected by the presence of the dam and erosion protection at 46 sites). Implementation of the alternatives would result in additional cumulative minor to major long-term adverse impacts by preventing the Stehekin River from moving within part of its channel migration zone. There would be no changes to side channels or tributaries entering the Stehekin River. Large sections of the channel migration zone on the right bank of the river below and above Harlequin Bridge would be available to store floodwater, large wood, and gravel, and for future river migration.

Over time, instream structures, including rock barbs, rip-rap, and other channel modifications, have increased. Past projects have resulted in a total of 30 barbs and up to 50 other erosion protection structures (i.e., cabled logs, rip-rap, or a combination of structures) at 46 sites on the lower Stehekin River (Table IV-13: *Lower Stehekin River Shoreline Affected by Erosion Protection or Flood-Control Structures*). Most of these are concentrated in sediment deposition zones at McGregor Meadows and at the Stehekin River mouth (Figure III-9). Large parts of the river and valley remain unaltered.

**Table IV-13: Lower Stehekin River Shoreline Affected by Erosion Protection or Flood-Control Structures**

| Erosion Protection Structures | 1993 | 2001 - 2002 | 2009 |
|---|---|---|---|
| Number of Sites | 28 | 35 (with 80 structures) | 46[a] |
| Length | 4,861 ft | 6,965 ft | 8,211 ft[b] |
| Number of Barbs | 0 | 10 | 30[c] |
| Percentage of Bank | 3.9 | 5.6 | 6.5 |

Note: Total shoreline length (estimated left and right banks) is 124,847 feet.

[a]Sites added since 2001 - 2002 are upper Company Creek Road (2007), Courtney Ranch (2007), Scutt (2007), and Leader Levee (2008).

[b]Added 427 feet to upper Company Creek Road, 427 feet to Milepost 8.0, and 328 feet to Leader.

[c]NPS added 6 barbs at Milepost 8.0 (1993, 2008), 10 barbs at Company Creek Road (1997, 2007), and 4 barbs near the orchard (1999). Private owners added 2 barbs on Leader (1997), 4 barbs at Stehekin Valley Ranch (2007), 1 barb at Company Creek Road (1997), and 3 barbs near the River Resort Road (1997).

Long-term minor beneficial effects would be contributed under all alternatives from replacement and relocation of the housing and maintenance areas. Under Alternatives 1 and 4, where an attempt would be made to hold the Stehekin Valley Road in place in McGregor Meadows, there would be an increase in the number of these erosion protection measures either initially (Alternative 4) or over time (Alternative 1). Although Alternative 1 would be limited in its current contribution to cumulative effects, over time it would likely result in a contribution to cumulative effects, similar to Alternative 4, from inhibiting the Stehekin River from occupying parts of its channel migration zone. Alternative 4 proposes the most erosion protection measures and would add the most to cumulative effects. In contrast, the reroute in Alternative 3 would allow for this channel migration in McGregor Meadows, whereas it would prevent it alongside the Lower Field. Alternative 2 would contribute the least to cumulative impacts by relocating the road away from both of these areas and by proposing erosion protection measures at the fewest number of sites compared to Alternatives 3 and 4.

Thus, combining Alternative 1 with other past and future projects would result in the construction of additional structures to control erosion. Alternative 1 would add additional rip-rap at one site on the lower river (Wilson Creek). Alternative 2 would add six to eight rock barbs, two logjams, and an avulsion sill at four sites. Alternative 3 would add four rock barbs, five logjams, and an avulsion sill at six sites, and Alternative 4 would add 16 - 17 rock barbs, three logjams, and an avulsion sill at eight sites on the lower Stehekin River. Together, these structures would cause changes in streamflow that would be measurable and would have consequences on channel-forming processes and downstream erosion processes. Therefore, the cumulative adverse impacts under all alternatives would be moderate and long term. As noted, these would be potentially greatest, in sequence, under Alternatives 4, 1, 3, and 2 (see Table IV-10: *Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures*).

**Conclusion**: Effects of erosion protection measures are summarized in Table IV-10: *Cumulative Impacts of Stehekin River Shoreline Erosion Protection Measures*. In Alternative 1, one measure would be located within the floodplain / channel migration zone and one outside of it. Under Alternative 2, one new measure would be within the channel migration zone and three outside of it. In Alternative 3, there would be three new inside and four outside the channel migration zone. If implemented, Alternative 4 would have five new measures inside and five outside. There would be minor to moderate beneficial effects from restoration and bioengineering in all alternatives.

Total impervious areas could be up to 5 - 8 acres for the maintenance and housing areas plus additional area for the rehabilitated road (Alternatives 1 and 4), or for the rehabilitated/rerouted road (Alternatives 2 and 3). New impervious surfaces could also cover an additional 5 - 8 acres of the 37 acres available for exchange in the 1995 LPP and Alternative 1, and approximately 7 of the 24 acres available for exchange in Alternatives 2 - 4. Impervious surfaces would result in faster runoff. In Alternatives 2 and 3, relocating the road away from the eroding banks would have a long-term beneficial effect because it would diminish the need for additional erosion protection structures and allow natural river processes to predominate in more areas.

Alternative 2 would have the fewest adverse effects on hydraulics / streamflow characteristics (minor to moderate), followed by Alternative 3 (moderate adverse), and finally Alternatives 4 and 1. All alternatives would result in long-term moderate beneficial effects from relocation of the maintenance area. Ultimately, Alternative 1 would likely have greater adverse effects (moderate to major) on hydraulics / streamflow characteristics (similar to Alternative 4) because of the long-term need to continue to maintain the road and to install additional erosion protection measures that would help achieve this. Effects from Alternative 1 could eventually increase beyond those described in this SRCIP/DEIS if bank stabilization measures continue to increase over time.

Because there would be no significant adverse impacts to streamflow characteristics or channel-forming processes, there would be no impairment of park resources or values.

## 6. WATER QUALITY IMPACTS

### a. Water Quality Methodology

For water quality methodology, see ~~–a~~. Hydraulics and Streamflow Characteristics Methodology.”

**Type of Impact:** The following characteristics of water would be affected by the proposed actions described in the alternatives: temperature, dissolved oxygen, suspended sediment, nutrients, and chemical pollutants. The concentrations and interactions of these elements not only affect the ability of organisms to survive but exhibit a great degree of natural variation among water resources.

#### Intensity of Impact

- **Negligible**: Chemical, physical, or biological effects would not be detectable, would be well below water quality standards or criteria, and would be within historic or desired water quality conditions.
- **Minor**: Chemical, physical, or biological effects would be detectable, but would be well below water quality standards or criteria and within historical or desired water quality conditions.
- **Moderate**: Chemical, physical, or biological effects would be detectable but would be at or below water quality standards or criteria; however, historical baseline or desired water quality conditions would be temporarily altered.

- **Major**: Chemical, physical, or biological effects would be detectable and would be frequently altered from the historical baseline or desired water quality conditions. Chemical, physical, or biological water quality standards or criteria could temporarily be exceeded.

## b. Water Quality Impacts

### Impacts of Actions Common to Alternatives 1 - 4

Most of the same actions that would affect hydraulics and streamflow characteristics, vegetation, and soils would also potentially affect water quality from the introduction of sediments and pollutants (e.g., from septic systems). Multiple recent large floods have increased scouring of the Stehekin Valley Road and have contributed to a relatively small amount of road gravel being moved into riparian areas downstream, however, most of the sediment in the river channel is being produced naturally by tributary streams and by bank erosion upstream and is not a direct result of human activity. These events have also led to the proliferation of erosion protection structures.

**Ongoing Maintenance and Operations**: Existing impacts on water resources would continue. The ongoing effects of development located in the channel migration zone would continue to have localized negligible to moderate long-term adverse effects by continuing to alter the passage and quality of overland water flow through these areas. These development effects include ongoing maintenance and repair of the Stehekin Valley Road and the Company Creek Road, including gravel inputs for the Company Creek Road (under all alternatives), which may erode during stormwater runoff or floods. The gravel would likely enter creeks and the Stehekin River and affect water quality by contributing oil and other hydrocarbons.

Contaminants in stormwater from hardened or surfaced and gravel roads can also affect several water quality conditions, including the amount of dissolved oxygen in the water, turbidity, and pH, which can adversely affect biological resources. Traffic on the Stehekin Valley Road is relatively low, the road is well separated from the river in most places, and there is a relatively high volume of water in the river; therefore, it is likely that these contaminants would have long-term but negligible to minor adverse impacts.

Gravel roads generate dust during dry periods and the dust coats vegetation next to the roads and washes away into the surrounding area, including the river, during storms. In Alternatives 1 - 4, overall impacts related to the use and procurement of gravel would be fewer since more areas of the Stehekin Valley Road would be surfaced and raised or relocated. Use of the unsurfaced Company Creek Road (all alternatives) and McGregor Meadows Access Road (Alternatives 2 and 3), however, would continue to contribute a small amount of road fill during flooding.

Localized flooding due to undersized, damaged, or clogged culverts and poor drainage conditions under affected roads would also cause sedimentation. Poorly located or plugged culverts would continue to cause rapid erosion of road fill during floods and contribute to road failure resulting in disturbed soil being carried into nearby streams, which could adversely impact water quality. Adverse impacts would include minor to moderate short-term localized impacts and long-term minor impacts, since most material is sand and gravel, not silt or clay.

**Road Rehabilitation**: Because less gravel would be needed over time from the Company Creek Pit due to surfacing of the Stehekin Valley Road, there would be less dust generated both from transport of this material and from driving over unpaved surfaces.

*Surfacing*: This would affect water quality by contributing faster runoff of dirt and oil and other roadway contaminants, generated from vehicle travel over hardened surfaces, into the Stehekin River. These would cause short-term negligible to minor effects on water quality. Flushes of runoff during storms would also contribute to long-term minor to moderate adverse effects to the extent that these pollutants persisted in the river and/or Lake Chelan. Petroleum products and metals would be deposited onto road and parking lot surfaces from vehicles and picked up during rain, snowmelt, and carried into water sources. These contaminants would also indirectly affect water resources through infiltration into groundwater over time.

*Culverts*: Most culverts affected by the proposed project do not contain perennial or intermittent streams: rather, they are used to convey rain and snowmelt in season and are known as ―ditch relief” culverts. Coupled with work along the Stehekin River, at Wilson Creek and Thimbleberry Creek, and work in water to place barbs or logjams (Alternatives 2 - 4), work on existing culverts and installation of new and replacement culverts would have the potential to contribute sediment directly and indirectly to the Stehekin River, during low-flow period, a negligible to minor localized short-term effect on water quality.

**Construction**: Actions and impacts from construction, including excavation, grading, importing fill, loss of vegetation, and potential spills, would occur from rehabilitation of the road and from the implementation of erosion protection measures (different measures, but similar impacts, under all alternatives). Impacts would also be associated with construction of the maintenance and housing areas and construction of the Lower Valley Trail. Construction activities such as refueling and use of heavy equipment may result in spills of oil or fuel that could enter the river during stormwater runoff. Accidental release of hydraulic fluid, diesel fuel, and other petroleum products during construction is also possible if mitigation measures fail. Small amounts of these contaminants could also enter the river in stormwater runoff, causing short-term adverse negligible to minor effects to water quality.

Stockpiled earth and other materials in staging areas within the project area are also susceptible to erosion from stormwater. Potential erosion-generated sediment associated with construction is likely to be undetectable because most of the work would not occur close to surface water, mitigation measures can largely control erosion and sedimentation, and much of the soil is comprised of sand and gravel, which would not easily erode.

Proposed project actions under the alternatives, including the development of the new maintenance and housing area (grading, construction, circulation, and parking) (5 - 8 acres) and the rehabilitation of up to 4.9 miles of roadway, would have the potential to affect water quality. Impacts would occur from excavation (which would loosen soil materials); stockpiling of topsoil and other materials (which could be affected by runoff during seasonal rain or snowmelt); vegetation disturbance and modifications (removal and grubbing and flush-cutting, which would also open up new areas to erosive action by water once soil was disturbed); and drainage improvements such as installation of new culverts (which would affect wet soils and would loosen soil materials and temporarily subject them to erosion).

Combined, short-term effects on water quality would be minor and localized in the area of improvements and would depend on weather conditions during construction. Most construction sites are flat and located some distance from the river or perennial streams, and most construction activities would be limited to later in summer, after snowmelt. The new maintenance area would be located on young, gravelly soils. The removal of the fuel storage and maintenance facility from the 100- and 500-year floodplains would have a long-term moderate to major beneficial impact on water quality. Moderate-term impacts would be related to the period of time between disturbance and rehabilitation or restoration and would be minimal from road rehabilitation.

**Recreational Facilities**

*Lower Valley Trail*: Construction of the Lower Valley Trail would result in the same kinds of impacts as described above for road rehabilitation. Trail impacts, however, would be more localized and much less extensive. There could be short- and long-term minor localized impacts on water quality, depending on soil moisture, weather conditions, and the effectiveness of BMPs and mitigation measures. Because most actions would occur in areas removed from Stehekin River, during the summer dry season, they would likely result in fewer and indirect impacts compared to those associated with road rehabilitation.

**Removal of Flood-Affected Structures**: Because removal would be conducted during dry periods when the structures themselves were out of the water (post-flooding), actions would have a limited effect on water quality. If, however, additional flooding occurred before site restoration had taken place, this action would contribute short-term minor to moderate localized adverse effects. Because these actions would be undertaken intermittently as structures were affected, they would occur spaced widely in time (and usually distance) from one another and would also have moderate to major beneficial effects by removing potential sources of contaminants from the channel migration zone.

**Table IV-14: Rehabilitation Actions—Alternatives 1 - 4**

| | Number of Pullouts / Acres Affected | Number of Culverts* | Barbs / Bioengineering | Logjams | Other Road Stabilization Measures |
|---|---|---|---|---|---|
| **Alternative1** | 5 existing<br>Up to 20 new<br>0.28 acres | Approximately 52 30-inch corrugated metal pipe culverts (every 500 feet on main road) plus 4 60-inch culverts and 2 additional 30-inch culverts | Existing | Existing | Wilson Creek |
| **Alternative 2** | Up to 25 new<br>0.34 acres | Same as above, plus new culverts (approximately 30) every 300 - 350 feet on the reroute, 7 additional 60-inch culverts, one 72-inch culvert and two 36-inch culverts plus two low water crossings | Stehekin River mouth<br>Frog Island<br>Wilson Creek | Stehekin River mouth<br>Boulder Creek | Wilson Creek<br>Milepost 8.0 |
| **Alternative 3** | Up to 23 new<br>0.30 acres | Same as above, except slightly fewer culverts on the reroute | Weaver Point<br>Lower Field | Weaver Point<br>Stehekin River mouth<br>Boulder Creek<br>Frog Island<br>Wilson Creek | Same as Alternative 2 |
| **Alternative 4** | Same as Alternative 1 | Same as Alternative 1 | Weaver Point<br>Stehekin mouth<br>Frog Island<br>Wilson Creek<br>Lower Field<br>Milepost 7.0<br>Milepost 9.2 | Weaver Point<br>Stehekin River mouth<br>Boulder Creek | Same as Alternative 2 |

*Affecting an estimated 70 - 350 square feet each.

**Maintenance Facility Replacement and Relocation**: It is possible that some contamination is present in the vicinity of the former maintenance area, which would need to be remediated by removal of soil. If contamination was found during the proposed project and remediated, it would have a long-term negligible to moderate beneficial effect on water quality.

### Additional Impacts from Alternative 1

**Road Grade Raise**: Retaining the Stehekin Valley Road in its current alignment within the floodplain, including the addition of 5,600 cubic yards of fill material required to raise the height of the road, could affect water quality during construction and flooding. Raising the height of the road in some sections and realigning other sections through McGregor Meadows would result in short-term negligible to minor adverse impacts from construction and could result in erosion of road fill by floodwaters, a long-term moderate to major localized adverse effect on water quality because this fill could be released into the river during a major flood.

**Erosion Protection Measures**

*Milepost 5.3 (Wilson Creek)*: Actions to install rip-rap clusters with large wood at Wilson Creek and to lower the road and move it laterally away from the river would have both short-term minor localized adverse effects on water quality from the potential for sedimentation during construction, especially related to accessing the toe of the slope where work would occur, and minor long-term beneficial effects from stabilizing this eroding slope, thereby minimizing the potential for sedimentation from slope failure.

**Large Woody Debris**: Obtaining large woody debris from the head of Lake Chelan after floods in spring and fall would have minimal effect on sedimentation and water quality, because only floating logs would be procured using a barge floating on the lake.

**1995 Land Protection Plan Implementation**: There would continue to be periodic impacts from flooding of buildings and structures, including septic system drain fields, from unchanged implementation of the existing priorities for acquisition and exchange from the 1995 LPP (NPS 1995b). Depending on the degree to which implementation of the 1995 LPP focused on removal of structures from the 100-year floodplain of the Stehekin River, there would be long-term minor to moderate beneficial impacts on water quality from the removal of both buildings and their accompanying infrastructure. Compared to Alternatives 2 - 4, in Alternative 1 fewer buildings and structures would be removed from the channel migration zone because these would not be high priority acquisition and exchange. As a result, there would be increasingly adverse effects as the river and flood channels encroached on developments, particularly in McGregor Meadows. Because these effects would primarily be associated with flooding and not with day-to-day actions, potential effects on water quality would be long term, localized, and negligible to moderate.

### Impacts from Actions Common to Alternatives 2 - 4

**Erosion Protection Measures**: Work in seasonally saturated soils to locate barbs would have the potential to contribute a moderate localized short-term adverse impact on water quality, coupled with a point source effect that would diminish with the distance downstream from the excavation of these soils and the placement of rock and logs, and construction of soil and bioengineering layers. Overall, adverse impacts would primarily be short term and minor in Alternatives 1 and 2, with slightly greater impacts associated with Alternative 3. All would have fewer impacts than Alternative 4, although anticipated future impacts in Alternative 1 could eventually rise to equal or exceed those in Alternative 4.

Similarly, there would be minor to moderate impacts from constructing engineered logjams. Logjams require greater excavation than do barbs to ensure that they remain anchored to the bank. Further, much of this excavation would be within the wetted perimeter of the Stehekin River. Two logjams would be constructed in Alternative 2 and five in Alternative 3, with impacts greater in Alternative 3 because of the much larger size of the logjam near the mouth of the Stehekin River combined with the moderate one at Wilson Creek and the small one at Frog Island. Alternative 4 would have three logjams, two small ones at Weaver Point and the river mouth and a larger one at Boulder Creek.

Installation of barbs and logjams would result in retention of key portions of the Stehekin Valley Road, thus contributing to long-term beneficial impacts on water quality by decreasing slope instability adjacent to the river at Wilson Creek and Milepost 8.0, among other areas.

*Milepost 3.8 (Frog Island), Milepost 5.3 (Wilson Creek), Milepost 8.0*: Where reroutes would not occur, there would be a long-term potential for catastrophic flooding to erode portions of the road in these areas, an effect that would be partially precluded by the installation of barbs or logjams. These would have long-term negligible to moderate beneficial effects, coupled with short-term localized minor to moderate adverse effects if erosion from flooding occurred before bank stabilization measures were installed.

*Milepost 9.2*: Construction of a parking area and grade raise of 300 feet would have minor localized adverse impacts on water quality since this area is not within the floodplain.

**Large Woody Debris**: Under Alternatives 2 - 4, because targeted logs would be plucked from the tops of some jams, impacts would primarily be related to gaining access to the jams and would be implemented only if adverse impacts were negligible to minor short-term and localized. These impacts could include future sedimentation during runoff from tracked heavy equipment disturbing vegetation. Access to logjams would be only from the tops above the high water mark, in a way that would not affect the stability of the jam or conditions downstream. In Alternative 4, wood would be obtained from a larger area; therefore, it is likely that impacts would be greater than in Alternative 2 and 3, but they would not exceed localized minor adverse impacts from access.

**Recreational Facilities**

*Campgrounds and Raft Takeout*: Construction of the new campgrounds and raft takeout would have the potential to contribute negligible to minor localized adverse impacts on water quality, primarily from long-term impacts related to vegetation loss and short-term impacts related to runoff from disturbed areas. Impacts from the raft takeout, however, would not occur in Alternative 3.

**Restoration and Bioengineering**: Riparian restoration and/or bioengineering associated with rock barbs and logjams would result in long-term localized negligible to moderate beneficial impacts on water quality from the ability of vegetation to retain soils along these eroding banks. There would be greater beneficial effects in Alternatives 2, 3, and 4 and fewer in Alternative 1.

### Additional Impacts from Alternative 2

**Road Reroute**: The loss of vegetation from 1.9 miles of new roadway (3.21 acres) plus the clearing needed to construct this road (approximately 18 acres within an overall disturbance area of 28 acres) would result in short- and long-term minor impacts on water quality from runoff before restoration of vegetation occurred. Most of the reroute would be distant from the river or wetlands, and seven streams crossed by the new route run intermittently. During and immediately following construction and until stabilization of potential impacts has occurred, BMPs, including sediment barriers and soil cover, would remain in place.

**Shooting Range**: There is a possibility that soil contamination from lead bullets and shot is present in the vicinity of the shooting range, which would need to be remediated by removal of soil. If contamination is found during the proposed project, it would be remediated, a long-term beneficial effect on water quality.

**Revised Land Protection Plan**: Changing the priorities in the 1995 LPP would result in the potential for long-term moderate to major beneficial impacts on water quality by removing buildings and structures, including septic system drain fields, from both the floodplain and channel migration zone of the Stehekin River. Depending on the degree to which priorities allowed for this removal to occur, there would also be a potential for short-term moderate to major adverse effects from buildings and structures that remained and were affected by future flooding.

### Additional Impacts from Alternative 3

Actions and impacts would be the same as in Alternative 2 for implementation of the revised LPP, Milepost 8.0 and 9.2, large woody debris, and similar for erosion protection measures but with a different array of logjams and rock barbs at two additional locations. There would also be similar impacts from additional barbs at Lower Field (because the road would not be rerouted in this section).

**Road Reroute**: As in Alternative 2, the loss of vegetation from 1.7 miles of new roadway (about 3.4 acres) plus the clearing needed to construct the reroute (approximately 18 acres) would result in short- and long-term minor impacts on water quality from runoff before restoration of vegetation occurred. During construction and until stabilization, BMPs (including sediment barriers) would remain in place. Erosion protection measures would reduce impacts, but these would be greater than in Alternative 2 because of not rerouting the road adjacent to the Lower Field.

### Additional Impacts from Alternative 4

Actions and impacts would be the same as in Alternative 2 for Milepost 8.0 and 9.2, and similar to Alternative 3 for erosion protection measures with logjams at Weaver Point, near the river mouth, and Boulder Creek and barbs elsewhere, plus additional barbs at Milepost 7.0 and 9.2. Impacts associated with the road grade raise / realignment would be the same as in Alternative 1.

**Large Woody Debris**: Impacts would be similar to Alternatives 2 and 3, but because there would be additional areas to procure logs from, there would be more areas of impact.

**Land Protection Plan Revision**: A revised LPP with different priorities than in Alternatives 2 and 3 would also result in removal of buildings and structures from the floodplain and channel migration zone of the Stehekin River; however, because the focus in this alternative would be on retaining the current development pattern, these impacts would be more beneficial in Alternatives 2 and 3 than Alternative 4. Nonetheless, Alternative 4 would have long-term minor to major beneficial effects from the removal of some buildings and structures, and adverse impacts similar to Alternatives 2 and 3.

### Measures to Avoid, Minimize, or Mitigate Impacts

See “Measures to Avoid, Minimize, or Mitigate Impacts” in “b. Hydraulics and Streamflow Characteristics Impacts.”

**Cumulative Impacts**: Past, present, and future actions may have affected, or will affect, water quality. For example, construction of the original roads and subsequent maintenance to retain and reconstruct them has provided a relatively minor source of erodible material that has frequently been transported by floodwaters. Flooding has washed away segments of the road and resulted in minor short-term additions to turbidity during floods. This adverse water quality impact is temporary in nature, and because the river already carries a high volume of sediment during flood events, the incremental increase is insignificant. Other visitor uses and facilities in the recreation area and project area contribute to sediments and pollutants, including from litter, oil, and other contaminants that can enter drainages and affect water quality. Septic systems are the primary source of threats to water quality from private development. Some restoration and development projects (e.g., addition of new visitor service facilities and restoration of old roads and campgrounds or building sites) would continue to occur within the recreation area and would contribute both beneficial and adverse impacts to water quality. Given the localized nature of these actions, overall effects on recreation area waters would generally be limited to short-term adverse impacts from construction coupled with long-term beneficial impacts from removing facilities from floodplains and slowing erosion of riverbanks that support the road. Nonhuman-caused factors, such as natural erosion of exposed soils, would continue to affect water quality.

Alternatives 1 and 4 would initially contribute minor localized inputs to cumulative impacts, primarily from construction of the new maintenance area and housing. If the fill placed in the McGregor Meadows section of roadway were to be eroded by future flooding, or if it increased flooding of septic systems, it would contribute moderate short-term adverse impacts. In addition, because the road would be retained in more areas adjacent to the Stehekin River, there would continue to be periodic inputs of sediment from the roadway as future sections failed. These would be fewer in Alternative 4 than in Alternative 1 due to the additional erosion protection measures proposed in Alternative 4. Negligible to minor long-term beneficial effects from road rehabilitation actions improving drainage conditions would also occur. Impacts of past, present, and future actions, combined the impacts of Alternative 1, would continue to result in negligible to moderate adverse cumulative effects on water quality.

Alternatives 2 and 3 would also contribute minor localized inputs to cumulative impacts from construction of the maintenance and housing areas; however, additional impacts would occur from construction of the reroutes. These would be short-term localized minor adverse effects on water resources during construction and long-term minor to moderate beneficial effects during operations from the removal of a portion of the road from the channel migration zone of the Stehekin River.

Additional cumulative impacts would result if erosion and sedimentation BMPs and for mitigation measures failed following construction. Overall, water resources would benefit as a result of past and reasonably foreseeable actions in the recreation area as a result of the proposed plan, especially through the relocation of some administrative facilities (including the road in Alternatives 2 and 3).

Revision of the LPP, particularly in Alternatives 2 and 3, would contribute a moderate beneficial effect on water quality by creating the framework for removal of private cabins and drain fields. Combined with relocating hazardous-materials storage and heavy equipment from the floodplain in all alternatives (with the relocation of the maintenance area), there would be long-term moderate to major beneficial effects on water quality.

**Conclusion**: Excavation, grading, importing fill, loss of vegetation, and the addition of impervious surfacing or developed areas would be present in all alternatives and would affect or have the potential to affect local water quality for short periods. Alternatives 1 and 4 would result in the greatest amount of additional fill placed in the floodplain. The amount of excavation and vegetation loss would also be lower in Alternatives 1 and 4 than in other alternatives due to the retention of the existing road in both alternatives. As noted in other sections, however, it is likely that erosion protection measures in Alternative 1 would eventually need to be similar to those in Alternative 4.

Restoration of degraded riparian areas would be lowest in Alternative 1, resulting only from the removal of the former maintenance area. Alternatives 2 - 4, however, would include additional riparian restoration, road obliteration, and bioengineering associated with installation of barbs and logjams. Additional beneficial impacts would result from road surfacing. Alternative 1 would have the potential for short-term minor to moderate adverse impacts and localized minor long-term beneficial effects. Alternative 4, in comparison, would have short-term moderate adverse impacts; however, beneficial effects would be greater and more widespread than in Alternative 1.

Alternatives 2 and 3 would expose the greatest amount of undisturbed soil to runoff because of the reroute and would also result in the greatest vegetation loss, from excavation, and fill. These alternatives would use the least amount of imported fill since most fill would come from within the reroute. Compared to Alternative 1, there would be slightly more impervious surfaces and developed areas from surfacing of the reroute sections.

Acres of direct and indirect impacts and short-term impacts would also be greater in Alternatives 2 and 3 because of the reroutes. Removing the road from the floodplain in Alternatives 2 and 3, however, represents a moderate long-term beneficial effect on water quality. Slightly more restoration and bioengineering would occur in Alternative 2 than in Alternative 3, and both alternatives would have more restoration and bioengineering overall than Alternative 1. Alternative 4 would have more bioengineering and less restoration. Similar to Alternatives 1 and 4, there would be both adverse and beneficial effects from surfacing. Both adverse and beneficial effects would be greater than in Alternatives 1 and 4 because of the greater amount of surfacing (causing more impervious surfacing and less dust and repeated transport of loads of gravel for the roadway). Alternatives 2 and 3 would have major long-term benefits on water quality because of the Land Protection Plan revision and relocation of the maintenance area. Alternatives 1 and 4 provide only the benefit of the maintenance area relocation.

Alternatives 1 - 4 would have moderate to major beneficial impacts from moving the maintenance area out of the floodplain / channel migration zone. Alternatives 2 - 4 would have moderate to major beneficial effects from Land Protection Plan actions. All alternatives (1 - 4) would have short-term negligible to moderate adverse impacts from construction, with increasing impacts in Alternatives 2, 3 and 4 from construction of barbs and logjams. Alternatives 1 and 4 would also have potential long-term moderate to major localized adverse effects from adding fill in McGregor Meadows if it was eroded during future flooding.

Because there would be no significant adverse impacts to water quality or water quality values, there would be no impairment of water quality or its values under Alternatives 1 - 4.

## 7. WETLANDS IMPACTS

### a. Wetlands Methodology

This analysis considers whether proposed actions would breach applicable federal laws, regulations, or executive orders. For the action alternatives, in addition to overall qualitative analysis of impacts to wetlands, quantitative analysis was conducted by determining the acreage of wetlands affected by each alternative. This analysis relies on the more liberal Cowardin system of wetland classification used by the NPS. *Director's Order 77-1: Wetland Protection* (NPS 2002a) requires that the NPS use the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) as the standard for defining, classifying, and inventorying wetlands. This system generally requires that a positive indicator of wetlands be present for only one of the indicators (vegetation, soils, or hydrology) rather than for all three parameters as mandated by the U.S. Army Corps of Engineers (ACOE) and Environmental Protection Agency (EPA) under the CWA. Impacts to jurisdictional wetlands based on the criteria established by the ACOE and EPA (under the CWA) will be made later to obtain necessary permits.

**Type of Impact**: Adverse impacts would degrade the size, integrity, or connectivity of wetlands. Beneficial impacts would enlarge the size or enhance the integrity and connectivity of wetlands.

**Intensity of Impact**: Three primary measures were used to evaluate the intensity of impacts on wetlands: the size and type of the wetland, the integrity of the wetland, and the connectivity of the wetland to adjacent habitats.

- **Negligible** impacts would be imperceptible or not detectable.
- **Minor** impacts would be slightly detectable, localized within a small area, and would not affect the overall viability of wetlands in the recreation area.
- **Moderate** impacts would be apparent and would have the potential to become major impacts if they persisted.
- **Major** impacts would be substantial, highly noticeable, and permanent.

## b. Wetlands Impacts

### Impacts of Actions Common to Alternatives 1 - 4

Wetlands are identified by wet soil characteristics, wetland-dependent vegetation, and/or the presence of water. Wetlands, which overlap with riparian areas, covered approximately 444 acres within Lake Chelan NRA in 1995. Wetlands are classified as palustrine (forested or scrub/shrub), riverine (open water or unconsolidated shore), and lacustrine (open water). Actions under the alternatives that occur in or near water would affect wetlands.

With many of the proposed actions, there would be short-term localized negligible to minor adverse effects on wetlands during construction and long-term negligible to moderate or major beneficial effects once implementation is complete. These impacts would be associated with specific areas and are described below, but would generally include adverse impacts from excavation for culverts and installation of erosion protection measures, and beneficial impacts from riparian restoration.

**Maintenance and Housing Replacement and Relocation**: Removal of the maintenance facility and three houses from the floodplain near Harlequin Bridge would have long-term localized moderate to major beneficial effects on wetlands in the vicinity of the maintenance area. The parking areas, road surfaces, fuel storage, and septic systems would be relocated from their current location, adjacent to a wetland, to an upland area that would not affect wetlands.

**Road Rehabilitation**

*Culverts*: For the rehabilitation of the Stehekin Valley Road between Harlequin Bridge and the beginning of the proposed reroutes (Alternatives 2 and 3), which would be common to all alternatives, rehabilitation/reroute actions would include ditch relief culverts (spaced approximately every 500 feet on the existing road and every 300 - 350 feet on the reroute) as well as culverts for perennial or intermittent streams. Actions affecting existing culverts would include replacing or extending them. Excavation near the exposed ends of the culverts for rip-rap rundowns and ongoing maintenance could affect palustrine forested wetlands where these were located at perennial or intermittent drainages (Alternatives 2 and 3). Approximately seven perennial or intermittent drainages occur in the project area along the proposed reroute. Except for Milepost 5.3 (Wilson Creek), Milepost 8.5, Milepost 9.2, and Thimbleberry Creek, most culverts are or would be designed for snowmelt rather than for intermittent or perennial streams. Actions associated with culverts would have short-term minor adverse effects from construction, coupled with long-term negligible adverse effects from periodically cleaning out the culverts to maintain them.

Ongoing repair of flood damage on the road would have minor long-term adverse impacts from introducing gravel into the river and adjacent wetlands.

**Restoration and Bioengineering**: Approximately 1.5 acres of palustrine forested wetland in the former maintenance area would be restored after the removal of the maintenance functions, a localized long-term moderate to major beneficial effect from increasing wetland acreage and function near the Stehekin River.

### Additional Impacts from Alternative 1

**Road Grade Raise**: Retaining the road in its current alignment and raising it through McGregor Meadows would result in fewer opportunities for the river to create new wetlands and replenish existing ones in its channel migration zone, including natural palustrine forested and scrub-shrub wetlands in old flood channels in McGregor Meadows and in the Company Creek area. As a result, there would continue to be long-term localized moderate adverse impacts on wetlands at this location.

### Additional Impacts from Alternative 2

**Erosion Protection Measures**: There would be minor to moderate adverse and beneficial impacts from implementing erosion protection measures (Table IV-15: *Impacts to Wetlands*). Some of the affected areas are riverine wetlands, including Frog Island and Boulder Creek. Stehekin River mouth and Wilson Creek sites, where steep river cut-banks intersect upland forest, have no riparian zone. Adverse effects from initial construction of the barbs and logjams would be minimized over time by restoration and bioengineering associated with barbs and would result in short-term localized minor adverse impacts where located at the edge of the channel migration zone (three sites), and moderate adverse effects where located within the channel migration zone (one site).

**Large Woody Debris**: Collection of large woody debris would affect some riverine wetland (riparian) areas adjacent to the Stehekin River through compaction and potential vegetation disturbance and sedimentation when logs are obtained from the tops of logjams below Boulder Creek. Depending on the type of equipment used, success of mitigation measures, and the site, effects would be short term and negligible to minor.

**Restoration and Bioengineering**: Riparian restoration would occur along the Stehekin River at two locations that have been previously disturbed by human activities. At Buckner Homestead hayfield and pasture, a riparian area was converted to pasture and has recently been subjected to rapid erosion due to lack of native vegetation and sandy soils along the bank of the river. At Lower Field, native vegetation was removed and bank erosion is also proceeding at an unnaturally high rate. Riparian restoration associated with dense dogwood and willow plantings at Weaver Point, Frog Island, and the Stehekin River mouth would also have minor beneficial effects. Riparian restoration at Buckner Homestead hayfield and pasture and the Lower Field would have moderate beneficial effects. Not raising the road through McGregor Meadows would also allow old flood channels to be reoccupied. This would result in localized long-term minor to moderate beneficial effects on riverine wetlands, particularly at McGregor Meadows and Milepost 7.0.

**Road Reroutes / Priorities for Land Acquisition and Exchange**: With the road reroute around McGregor Meadows and Lower Field, combined with the modified priorities for acquisition and exchange focusing on removing development from the floodplain and channel migration zone, there would be long-term beneficial impacts. These benefits would be associated with restoring natural river processes that allow the river to flood this area, renewing wetland areas. Approximately 1.5 acres of old road would be restored in the channel migration zone. At Milepost 7.0, the road currently cuts through a riparian wetland, and removal of the road fill would allow the wetland to function naturally. These actions would result in localized long-term negligible to moderate beneficial impacts on wetlands.

**Table IV-15: Impacts to Wetlands**

| Site | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| Culvert installation perennial and intermittent creeks | Two 60 inch culverts (Wilson Creek)<br>Two 30 inch culverts (Milepost 8.5) | Same as Alternative 1 plus<br>seven 60 inch culverts for reroute<br>One 72-inch culvert and two 36-inch culverts<br>Low-water crossing (Milepost 8.5)<br>Low-water crossing (Milepost 9.2) | Same as Alternative 2 | Same as Alternative 1 |
| Wilson Creek | Log-cribbing 0.21 acres | Rock barbs (see below) | Logjam (see below) | Rock barbs (see below) |
| McGregor Meadows Grade Raise | 0.2 acres | N/A | N/A | 0.2 acres |
| Milepost 8.5 culvert | 0.02 acres | 0.02 acres | 0.02 acres | 0.02 acres |
| Barbs / Logjams (adverse) | 0 | 6 - 8 barbs<br>0.45 - 0.59 acres<br>**Barbs**<br>0.21 River mouth<br>0.07 - 0.14 Frog Island<br>0.14 - 0.21 Wilson Creek<br>**Logjams**<br>0.01 River mouth<br>0.02 Boulder Creek | 4 barbs<br>0.58 acres<br>**Barbs**<br>0.14 Weaver Point<br>0.14 Lower Field<br>**Logjams**<br>0.02 Weaver Point<br>0.17 River mouth<br>0.02 Boulder Creek<br>0.03 Frog Island<br>0.06 Wilson Creek | 16 - 17 barbs<br>1.17 - 1.24 acres<br>**Barbs**<br>0.14 Weaver Point<br>0.21 River mouth<br>0.07 - 0.14 Frog Island<br>0.21 Wilson Creek<br>0.14 Lower Field<br>0.14 Milepost 7.0<br>0.21 Milepost 9.2<br>**Logjams**<br>0.02 Weaver Point<br>0.01 River mouth<br>0.02 Boulder Creek |
| Total Adverse | 0.43 acres | 0.5 acres | 0.6 acres | 1.4 acres |
| Bioengineering Barbs and Logjams (beneficial) | 0 | 0.5 acres | 0.6 acres | 1.17 - 1.31 acres |
| Riparian Restoration (beneficial) | 1.5 acres<br>**Restoration**<br>Maintenance area: 1.5 acres | 4.1 acres<br>**Restoration**<br>Maintenance area: 1.5 acres<br>Road reroute 1.46 acres<br>River mouth: 0.07 acres<br>Wilson Creek: 0.21 acres<br>Buckner: 0.34 acres<br>Lower Field:0.36 acres<br>Frog Island:0.21 acres | 3.9 acres<br>**Restoration**<br>Same as Alternative 2 except:<br>Road reroute: 1.0 acres<br>Weaver Point: 0.18 acres | 2.9 acres<br>**Restoration**<br>Same as Alternative 2 except for road reroute |
| Total Beneficial (Bioengineering plus Restoration) | 1.5 acres | 4.6 acres | 4.5 acres | 4.1 acres |

### Additional Impacts from Alternative 3

**Erosion Protection Measures**: Adverse and beneficial effects are shown in Table IV-15: *Impacts to Wetlands*. Impacts would be similar to Alternative 2, with additional impacts from the barbs at Lower Field, plus logjams instead of barbs in some locations. As in Alternative 2, adverse effects would occur from initial construction of the barbs and logjams but would be minimized over time by restoration and bioengineering. At these sites, short-term localized minor adverse effects would occur where actions are located at the edge of the channel migration zone (five sites), and moderate adverse effects where located within the channel migration zone (two sites). Long-term minor beneficial effects would occur at all six sites as a result of bioengineering.

**Restoration and Bioengineering**: Actions and impacts would be the same as described in Alternative 2, but there would be fewer acres restored (due to the shorter reroute) and ongoing impacts from location of the road next to the Lower Field. This would result in short-term negligible adverse effects from planting and other actions, coupled with long-term minor to moderate beneficial effects.

**Large Woody Debris**: Actions and impacts would be the same as in Alternative 2.

**Road Reroutes / Priorities for Land Acquisition and Exchange**: Actions and impacts would be similar to Alternative 2; however, because the reroute would be shorter, there would be less opportunity for the river adjacent to the Lower Field to migrate into its channel migration zone. Therefore, in Alternative 3 because of the reroute, there would be a slight decrease in available area for the river to create wetlands, a minor adverse effect.

### Additional Impacts from Alternative 4

**Road Grade Raise / Land Protection Plan**: Actions and impacts would be similar to those described in Alternative 1; however, there would be additional opportunities to allow the river to migrate within its channel migration zone associated with new priorities for land acquisition and exchange, particularly near McGregor Meadows. This alternative would therefore have a minor to moderate beneficial effects not part of Alternative 1.

**Erosion Protection Measures**: Effects would be similar to Alternatives 2 and 3, with minor beneficial and minor to moderate effects, but more moderate adverse effects would occur from placement of more structures. This alternative would have four new measures in the channel migration zone and five outside it.

**Large Woody Debris**: Actions and impacts would be the same as described in Alternative 2 except that because large woody debris would be procured from a larger area below Bullion Raft Launch to Lake Chelan, there would be additional localized short-term minor adverse effects.

**Restoration and Bioengineering**: Actions and impacts would be the same as described in Alternative 2, except that there would be no reroute therefore, fewer riparian areas (not including bioengineering) would be restored.

### Measures to Avoid, Minimize, or Mitigate Impacts

See “Measures to Avoid, Minimize, or Mitigate Impacts” in “b. Hydraulics and Streamflow Characteristics Impacts.”

**Cumulative Impacts**: Of the approximately 2,300 acres in the lower Stehekin Valley affected by human activities, an estimated 188 acres of riparian areas (of the 283 acres of development) have been affected by development. This development in riparian areas (riverine wetlands) includes roads, houses, campgrounds, trails, and administrative facilities. Overall, the alternatives would contribute localized long-term negligible to major beneficial effects from the removal of the road, maintenance area, and housing from the floodplain. Negligible to moderate adverse effects on wetlands would occur during installation of erosion protection measures. Alternative 1 would contribute both fewer beneficial and more adverse impacts. Alternative 4 would contribute slightly more beneficial impacts from restoration, bioengineering, and potential acquisition of lands within the channel migration zone than Alternative 1. Alternatives 2 and 3 would have similar beneficial and adverse effects, although Alternative 2 would contribute slightly fewer adverse effects due to the longer reroute. Because all alternatives would include wetland restoration at the maintenance area and would not include additional development of wetlands (with the exception of barbs) their contribution to cumulative impacts on wetlands would be small in comparison to the number of acres where development currently exists and affects riverine wetlands / riparian areas in the Stehekin Valley.

Actions proposed within the GMP and by other plans, including the Lake Chelan hydropower relicensing EIS, would result in additional long-term beneficial effects and would not contribute to increased degradation of existing wetlands. For example, the GMP called for approximately 26 acres of habitat in or near wetlands to be restored where possible and another 63 to be protected by acquiring interests. The acquisition of wetlands would continue to be a high priority based on the LPP revision in Alternatives 2 - 4.

**Conclusion**: Overall, impacts from rehabilitation of old and installation of new culverts would be similar across the alternatives, with most impacts being short term, localized, and related to construction. In Alternatives 1 and 4, where the river would be more confined, it would move at higher velocities through constricted areas, indirectly resulting in less potential creation and nourishment of wetlands from floodwaters reoccupying the floodplain and the river cutting new channels. In contrast, Alternatives 2 and 3 would allow for some potential expansion of wetland areas as the river continues to migrate within its floodplain in areas where the road was rerouted or in areas where lands were acquired.

*Alternative 1:* In Alternative 1, there would be the potential for additional loss of portions of the road and long-term localized moderate adverse impacts to wetlands from trying to maintain the road in its current alignment in McGregor Meadows. Actions at Wilson Creek would have long-term minor adverse effects on wetlands from installation of log-cribbing along the riverbank. Bioengineering and slope stabilization at Wilson Creek would also have long-term minor beneficial effects. Culvert replacement at Milepost 8.5 would have short-term negligible to minor impacts. Because less than 1 acre of wetlands would be affected and restoration would comprise an area greater than the area impacted (in the same vicinity and elsewhere), no wetlands statement of findings would be required.

*Alternative 2:* In comparison, Alternative 2 would result in similar short-term minor adverse impacts from installation of more culverts coupled with more (negligible to moderate or major) localized beneficial effects from additional restoration of riparian areas, removal of the road, and acquisition of property in the floodplain / channel migration zone. Because less than 1 acre of wetlands would be affected and restoration would comprise an area greater than the area impacted (in the same vicinity and elsewhere), no wetlands statement of findings would be required.

*Alternative 3:* Alternative 3 would have very similar effects on wetlands with the same riparian restoration impacts (negligible to moderate or major) from Alternative 2, and additional negligible beneficial impacts from additional bioengineering, coupled with minor adverse impacts from the construction of barbs or logjams in two more locations. Because less than one acre of wetlands would be affected and restoration would comprise an area greater than the area impacted (in the same vicinity and elsewhere), no wetlands statement of findings would be required.

*Alternative 4:* Alternative 4 would result in the same beneficial impacts as Alternatives 2 and 3, but would have additional adverse impacts from trying to maintain the Stehekin Valley Road in its current alignment in McGregor Meadows. Similar to Alternative 1, impacts would range from negligible to moderate. Because potential riverine wetland impacts would occur over an area greater than one acre, a wetlands statement of findings would be required, but adequate mitigation would be in place from the associated bioengineering and riparian restoration.

Because there would be no widespread major adverse impacts on wetlands there would be no impairment of park resources or values from the implementation of Alternatives 1 - 4.

# 8. FLOODPLAINS IMPACTS

## a. Floodplains Methodology

A draft floodplains statement of findings has been included as Appendix 17 to analyze the impacts from installation of additional erosion protection measures, from changing policy associated with large woody debris, and from occupation of high-flood-hazard areas on debris cones.

The impact analysis for floodplains was conducted based on site visits, analysis of Geographic Information System data layers of the floodplain landforms and side channels of the Stehekin River, a 1993 floodplain study (NPS 1993), a statement of findings for the Stehekin floodplain prepared by NPS staff (Riedel 2004), personal observations by NPS staff, and professional judgment.

**Type of Impact**: The removal of roads or structures from the 100- or 500-year floodplain would be considered a beneficial impact to human life or property and to natural floodplain values and functions. Development of new facilities in the 100- or 500-year floodplain would be considered an adverse impact to floodplain values. Class I actions include administrative, residential, warehouse, and maintenance buildings and overnight parking facilities. NPS policy is not to have these facilities in the 100 year floodplain. Class II actions include schools, hospitals, fuel-storage facilities, and emergency services. Based on the NPS Floodplain Management Guideline class II actions be should be located out of the 500-year floodplain.

### Intensity of Impact

- **Negligible**: There would be no ongoing impacts or change in floodplain values and function. The alternative would not contribute to increased severity or duration of flooding.
- **Minor**: Ongoing impacts or changes in floodplain values and functions, as described above, would be barely measurable and local. The alternative would not contribute to the severity and/or duration of flooding, and most new erosion protection measures would be on the edge of the channel migration zone, where they would not limit channel migration (the area within which the Stehekin River has migrated during the past 1,000 years).
- **Moderate**: Ongoing impacts or changes in floodplain values and functions would be measurable and local. The alternative would contribute to the severity or duration of flooding. New erosion protection structures may be within the channel migration zone, where they would limit channel movement and creation or recharge of floodplains.

- **Major**: There would be ongoing impacts or changes in floodplain values and functions that would be measurable and widespread. The alternative would contribute to the severity or duration of flooding. New erosion protection measures may be within the channel migration zone on low banks.

## b. Floodplains Impacts

### Impacts of Actions Common to Alternatives 1 - 4

**Ongoing Impacts**: The Stehekin Valley Road is within the 100-year and 500-year floodplain and/or the channel migration zone (extreme floodplain) in two main locations, McGregor Meadows for approximately 1 mile and from the Bakery to Lake Chelan (see Figure III-3: *Lower Stehekin Valley Landforms below Harlequin Bridge*). Most of the Company Creek Road near Harlequin Bridge and above Company Creek is also within the 100-year floodplain. Both of these roads would continue to have long-term moderate to major adverse effects on floodplain values and functions, with effects in Alternatives 2 and 3 from continued maintenance of the McGregor Meadows Access Road, rather than the Stehekin Valley Road, and effects in Alternatives 1 and 4 from retention of the road in its current alignment.

Numerous private homes and some administrative facilities are also located both within the 100-year floodplain and within the channel migration zone. Bank erosion, sediment, and large woody debris deposition during big floods have caused changes in the Stehekin River floodplain boundaries over time. Future floods are expected to continue to alter floodplain boundaries and to create conflicts with public and private development, particularly in developed deposition zones McGregor Meadows and the Stehekin River mouth (Figure I-4). Administrative facilities that would continue to remain within floodplains or the channel migration zone would include recreational facilities such as campgrounds and trails, actions that are excluded from compliance with the Floodplain Management Guideline. The presence of these facilities within the floodplain would continue to have negligible to minor adverse effects.

Under all alternatives, the Stehekin Valley Road would continue to remain adjacent to the floodplain and/or channel migration zone where reroutes cannot be undertaken, including at Mileposts 3.8 (Frog Island), 5.3 (Wilson Creek), and 8.0, a long-term minor to moderate adverse effect on floodplains because these areas are on the edge of the channel migration zone, the barbs or logjams, and do not raise flood elevations. Relocating maintenance and housing facilities would remove most park facilities from the regulatory floodplain, a long-term major beneficial effect.

In all alternatives floodwaters would be able to overtop riverbanks, a minor to moderate long-term beneficial effect, except in the vicinity of the existing 400-foot-long Company Creek levee. The current height of the levee along the Company Creek Road is four to six feet above the road. The levee continues to take pressure off the lower section of the upper Company Creek Road by keeping floodwater from a small part of the floodplain and has a minor long-term impact on the floodplain in this area. The primary area where past road-protection actions have restricted the river is along the right bank of the river adjacent to the upper Company Creek Road, where 11 rock barbs have been installed since 1995. These structures restrict the river from about a third of the channel migration zone (see Table IV-12: *Lower Stehekin Shoreline Affected by Erosion Protection or Flood Control Structures*). There would continue to be a long-term moderate to major adverse effect in this reach. In addition, about 400 linear feet of rip-rap on the left bank near the river mouth, installed between 1960 and 1983 to protect private development, is within the channel migration zone and continues to have a moderate long-term adverse impact on floodplains. Most other reaches of the river are unaltered, allowing the river to utilize its floodplain and to store water gravel and large wood.

**Erosion Protection Measures**: Existing rock barbs and other structures would continue to restrict the river from some parts of the channel migration zone but would not raise floodwater elevation, because they are designed to be overtopped during high flows. Therefore, these erosion protection measures would have a negligible to minor short-term adverse effect on flood elevation and a long-term minor to moderate adverse effect on channel migration, depending on how long they last and whether they are within gravel deposition or channel migration zones.

**Maintenance Facility Replacement and Relocation**: Because the maintenance facility has remained within the regulatory100-year floodplain and fuel storage within the 500-year regulatory floodplain, the maintenance area has continued to have localized moderate to major adverse effects on the Stehekin River floodplain. Replacement and relocation of the facilities from this 5-acre site would result in long-term moderate to major beneficial effects from the restoration of a large area in the floodplain and reduced potential for adverse effects from pollution from fuel storage, vehicles, and other maintenance area objects and functions.

### Additional Impacts from Alternative 1

**Road Grade Raise**: Retention of the Stehekin Valley Road through McGregor Meadows would continue to result in the road restricting the flow of water into the floodplain. Floodwater typically overtops the road by 1 - 3 feet. The elevated roadbed would likely affect river meandering and floodwater elevation over a wide area in McGregor Meadows. Localized moderate to major adverse impacts in the floodplain would result from placement of 5,600 cubic yards of fill to elevate the roadbed within the 100-year floodplain and the channel migration zone. Effects could include loss of this fill during future flooding.

### Additional Impacts from Alternative 2

**Road Reroute**: Rerouting the Stehekin Valley Road around the floodplain in McGregor Meadows and the Lower Field would have long-term moderate to major beneficial effects on the floodplain from restoring natural hydrologic and ecological processes. Benefits would be provided by slightly increasing the flood storage capacity of the floodplain, reducing the potential for erosion of the road, allowing the river more room to meander in these areas over time, and reducing the potential to restrict or channel flood flows. Retaining the McGregor Meadows Access Road, however, would contribute some localized long-term minor to moderate adverse effects. Keeping the road at grade over the short term and acquisition of private properties over the long term would reduce this impact.

**Erosion Protection Measures**: In Alternative 2, new erosion protection measures would be installed at three sites: near the river mouth, at Frog Island, and at Wilson Creek. Impacts to floodplains at Frog Island, Boulder Creek, and Wilson Creek would be minor because they are located at the edge of the channel migration zone. Adverse impacts to floodplains at the river mouth bank stabilization site would be moderate and long term because it is located within the channel migration zone. There would also be long-term minor to moderate adverse effects from creating the access road to the raft takeout site near the river mouth.

**Restoration and Bioengineering**: Restoration of riparian vegetation at Lower Field and Buckner Homestead lower hayfield and pasture would restore natural floodplain function by reestablishing a riparian buffer zone of native forest vegetation where none currently exists. This would have long-term minor beneficial effects on the floodplain / channel migration zone in the general vicinity of these areas, which would likely increase as the vegetation matured and bank erosion slowed.

**Removal of Flood-Affected Structures**: Demolition and removal of flood-affected structures from the floodplain, including septic tanks and drain fields, would result in localized long-term moderate to major beneficial effects. These developments continue to be long-term threats to the integrity of the Stehekin River floodplain, water quality, and other floodplain values.

**Land Protection Plan Modifications**: With the modified priorities for acquisition and exchange focusing on removing development from not only the 100-year floodplain, but also the channel migration zone of the Stehekin River, there would be long-term moderate to major beneficial effects on floodplains and/or the channel migration zone, depending on which properties were acquired or exchanged, how long it took, and whether these contained development within the floodplain or channel migration zone.

### Additional Impacts from Alternative 3

Actions would be similar and impacts would be the same as described in Alternative 2 for restoration and bioengineering, removal of flood-affected structures, and LPP modifications.

**Road Reroute**: Rerouting the Stehekin Valley Road around McGregor Meadows would have long-term minor to moderate beneficial effects on the floodplain; however, these would be fewer in Alternative 3 than in Alternative 2 because more of the road (approximately 1.2 acres) would remain within the channel migration zone. Less of the roadway would also be restored within the floodplain / channel migration zone, compared to Alternative 2. As in Alternative 2, retaining the McGregor Meadows Access Road would continue to contribute some long-term minor to moderate adverse effects, depending on river changes and the frequency and severity of floods. A portion of the road reroute would remain within the channel migration zone would be where it connects to the existing road within the Lower Field.

**Erosion Protection Measures**: Actions and impacts would be similar to Alternative 2, with logjams instead of barbs constructed at most locations, plus two additional barbs at the Lower Field and barbs and a logjam at Weaver Point. Because three of the sites are in the channel migration zone, there would be additional long-term minor to moderate adverse effects on floodplains from their construction, particularly at the river mouth.

### Additional Impacts from Alternative 4

All alternatives would continue to have moderate to major adverse effects from retaining parts of the Stehekin Valley Road and Company Creek Road.

**Erosion Protection Measures**: Actions and impacts would be similar to Alternative 3, with barbs constructed at all locations, plus two near Milepost 7.0 and three near Milepost 9.2. Because both new locations are at high banks in the channel migration zone, there would be additional long-term minor to moderate adverse effects on floodplains from their construction.

**Land Protection Plan Modifications**: As in Alternatives 2 and 3, the modified priorities for acquisition and exchange would focus on protection of key resources, although to a lesser extent regarding removing development from the floodplain and channel migration zone. These actions would contribute minor to moderate beneficial effects on floodplains, depending on which properties were acquired or exchanged and how long it took.

### Measures to Avoid, Minimize, or Mitigate Impacts

See ―Measures to Avoid, Minimize, or Mitigate Impacts” in ―b. Hydraulics and Streamflow Characteristics Impacts.”

**Cumulative Impacts**: Past transportation development, erosion protection and flood-control projects have had minor to moderate adverse effects on how water spreads across the floodplain and how water is conveyed downstream. These projects have also affected the ability of the floodplain to store water and to flush wetlands and side channels. Past actions included construction of the Stehekin Valley Road, the Company Creek Road and levee, and Harlequin Bridge; the placement of fill at various locations in the floodplain; and channelization of the Stehekin River with bank hardening that changed the natural evolution of the floodplain. The levee and maintenance of the Company Creek Road have resulted in the construction of log-cribbing, 11 rock barbs, and several grade-control structures in an effort to keep the river from destroying the road. These features have reduced the beneficial processes of off-channel flooding and channel migration, wetland formation, sediment and woody debris transport, and formation / renewal of plant and animal habitats in the riparian zone. In the McGregor Meadows reach, these actions have had a moderate to major long-term impact on floodplains.

The placement of fill within a floodplain blocks the flow of floodwaters until they rise to overtop it. Where vegetation is removed and the road is within the floodplain, the road has often served as a conduit for floodwaters, which have removed road fill during floods. Where the road remains in the floodplain, there is the potential for the river to create a new channel along or down the road.

Under the proposed plan, large parts of the Stehekin River floodplain would remain in a natural state. This includes most areas above McGregor Meadows and most of the right bank below Harlequin Bridge. Alternatives 1 and 4 would contribute additional moderate adverse cumulative effects from the placement of additional fill within the floodplain to raise the section of roadway through McGregor Meadows. Alternatives 2 and 3 would not place additional fill in this area, but would retain a portion of Stehekin Valley Road in the floodplain, contributing some continued minor adverse effects. Maintenance of the grade-control structure at Milepost 6.8, at the north end of McGregor Meadows, would also impede channel migration (avulsion) into a portion of McGregor Meadows. At the same time, there would be a long-term moderate to major beneficial effect from the reroute(s). There would be an additional contribution of localized minor to moderate adverse effects from all alternatives from the placement of barbs within the Stehekin River channel / floodplain where the road either cannot be moved (Alternatives 1 and 4) or where reroutes (Alternatives 2 and 3) are not possible. Long-term moderate to major beneficial effects would be contributed in Alternatives 2 and 3 from the changed priorities for land acquisition and exchange that could allow for removal of more development from the channel migration zone. All action Alternatives (2 - 4) would move toward less development within the floodplain, a long-term minor to major beneficial effect, depending on the alternative.

**Conclusion**: All alternatives would continue to have moderate to major adverse effects from retaining parts of the Stehekin Valley Road and Company Creek Road. The combined effects of the actions in Alternative 1 would result in a series of localized long-term negligible to major adverse effects from several actions. These include retaining the road, levee, and existing and additional erosion protection measures. In addition, there would be long-term localized major beneficial effects from the replacement and relocation and restoration of the maintenance facilities and housing outside the floodplain and the channel migration zone.

Alternative 2 would result in similar negligible to moderate adverse effects from additional erosion protection measures and from maintaining the McGregor Meadows Access Road, while it would have more long-term moderate to major beneficial effects from the road reroute, restoration, and LPP priority changes that could lead to removal of structures and septic systems from the floodplain. There would be improvements to floodplain function from restoration of the former maintenance area, road reroute (McGregor Meadows and Lower Field), riparian restoration, and bioengineering.

Alternative 3 would have effects similar to Alternative 2, including a range of negligible to moderate adverse and beneficial impacts from many of the same actions. In Alternative 3, however, these would include fewer beneficial effects from the shorter reroute and from the implementation of additional erosion protection measures in areas where the road is within the floodplain / channel migration zone, such as at Weaver Point and the Lower Field. As in Alternative 2, there would be improvements primarily within the floodplain from removal of the maintenance area, road reroute (Lower Field), riparian restoration, and bioengineering.

Alternative 4 would retain the Stehekin Valley Road in its current alignment, a long-term moderate to major adverse effect on floodplains. These impacts would be combined with the erosion protection and restoration measures in Alternatives 2 and 3, resulting in some long-term negligible to moderate beneficial effects. While overall adverse effects would be less than in Alternative 1, they would be greater than in Alternatives 2 and 3, primarily as a result of installing 16 - 17 new rock barbs to retain the road in its current location and because of different LPP priorities. There would be moderate beneficial impacts within the floodplain from the replacement and relocation of the maintenance facility, riparian restoration, and bioengineering.

Because there would be no widespread major adverse impacts on floodplains, there would be no impairment of park resources or values.

# 9. WILDLIFE IMPACTS

Impacts on wildlife are assessed in terms of changes in the amount and distribution of wildlife habitat, the size and connectivity of habitat, the integrity of the site (including past disturbance), the potential for habituation of wildlife to humans, and the relative importance of habitats.

## a. Wildlife Methodology

Habitat types were based on the Tanimoto vegetation classification (Tanimoto 1991), the Washington State Gap Analysis for vertebrate animals, Kuntz and Glesne (1993), the Chelan PUD Lake Chelan vertebrate inventory (Chelan PUD 2002), the North Cascades National Park Service Complex Wildlife Database, and best professional knowledge.

Wildlife analysis was based on a qualitative assessment of wildlife that could occur in the project area and the effects anticipated as a result of ongoing activities, new activities, and rehabilitation, and/or construction. Actions were also assessed as to their potential for causing human/wildlife conflicts resulting from increased recreation disturbance in sensitive habitats and the introduction of unnatural food sources. Recreational impacts can result in changes in animal behavior, increased mortality, and altered habitat use.

**Type of Impact**: Adverse impacts would reduce the size, continuity, or diminish the quality or integrity of wildlife habitat, or result in unnatural changes in the abundance, diversity, or distribution of wildlife species. Adverse impacts also include those that directly remove, relocate, or affect wildlife or wildlife habitat or that indirectly affect wildlife or wildlife habitat through increased disturbance. Disturbance, including noise, can adversely affect wildlife foraging, mating, and nesting behavior. Construction activity can also directly interfere with normal animal movement patterns. Beneficial impacts would result from restoration of wildlife habitat (size, continuity, or integrity).

### Intensity

- **Negligible**: These impacts would not be measurable or perceptible.
- **Minor** impacts would be measurable or perceptible and would be localized within a relatively small area; however, the overall viability of wildlife would not be affected. Without further impacts wildlife populations or species would recover.
- **Moderate** impacts would be sufficient to cause a change in the abundance, distribution, quantity, or quality of wildlife or wildlife habitat; however, the impact would remain localized. The change would be measurable and perceptible.
- **Major**: These Impacts would be substantial and highly noticeable, and could cause widespread changes in species or populations.

## b. Wildlife Impacts

### Impacts from Actions Common to All Alternatives (1 - 4)

The following general impacts (noise and activity during construction, habitat modification, sediment and fill and other impacts) would occur under all alternatives (differences are noted).

**General Impacts**

*Noise and Activity during Construction*: Above ambient noise and activity would occur during project implementation. Road rehabilitation (Alternatives 1 - 4) and reroute construction (Alternatives 2 and 3) would coincide with the peak visitor use season, when some of the heaviest visitor use and traffic occurs. The noise and activity associated with the construction would be in addition to the noise and disruption of wildlife caused by visitor use. Because construction noise and activity would be concentrated in various locations throughout the visitor use season, wildlife, particularly medium and large mammals, would tend to avoid construction areas during daylight hours when project work was occurring. In the evening and on weekends when work would generally cease, wildlife would be expected to return to the project areas. Some species, such as birds, deer, and squirrels, might also be seen throughout the day. Road rehabilitation impacts would be localized alongside an already highly modified road corridor whereas reroute construction would occur in an area once disturbed by a wagon road and would have greater impacts on disturbing wildlife unused to noise and activity from visitors or construction. Because a great deal of suitable habitat for wildlife would continue to be present in the vicinity, most wildlife disturbance impacts would be short term, localized, and negligible to minor in the context of the lower valley.

*Habitat Modification*: Staging of machinery and construction materials would cause some vegetation to be removed, trampled, or run over. These activities would affect wildlife habitat until the areas were restored. Excavation needed to repair various portions of the road would likely result in disturbance and mortality of some small mammals and invertebrates. Habitat modification due to vegetation removal varies under all alternatives but would preclude short- and long-term return to the former level of use by some species of wildlife. Perching birds, in particular, use trees and shrubs for roosting, nesting, and food or to forage for food. Therefore, habitat loss would have long-term localized minor to moderate effects from incremental loss of trees and associated habitat that may have been used for perching, nesting, or procurement of food for a variety of species. Over time, restoration of habitat along the former road in the floodplain could offset some of these impacts.

*Vehicle Travel*: In addition, there would continue to be vehicle-wildlife collisions on the road as a result of normal use. Vehicle travel speed varies by season and road area. Minor alignment changes would not be expected to result in faster speeds. If faster speeds do occur, there would be greater potential for vehicle-wildlife collisions, resulting in a minor long-term adverse effect on wildlife use in the project areas.

*Sediment and Fill*: Road work in some areas also has the potential to cause sedimentation in adjacent or nearby aquatic habitat, should BMPs fail. Sedimentation can have negative consequences on fish and amphibian species occurring in, and downstream of, areas where sedimentation occurs. Because sediment barriers would be used and would remain in place during rehabilitation / restoration, however, impacts to wildlife from these measures would be minor and short term, having no lasting effects beyond construction. The importation of fill materials, including topsoil, combined with compaction from construction equipment has the potential to change the soil's physical and chemical composition and therefore its viability for some organisms, a minor impact because of the coarse nature of most valley soils.

*Restoration*: Restoration of the former maintenance area would have a long-term negligible to moderate localized beneficial impact in increasing native plant cover and decreasing invasive nonnative plant abundance, improving wetland and edge habitat for a wide-range of local wildlife species.

*Other Impacts from Construction*: The following additional impacts from construction would also affect wildlife:

- Dust and light emanating from construction sites would affect the use of surrounding habitats by wildlife.
- Diversion of water flows during construction would result in unnatural drying or wetting of habitats adjacent to sites.
- Wildlife could be killed by traffic or machinery associated with construction.
- Pits and trenches could entrap and potentially kill wildlife.
- Although mitigation measures would be used, there is a slight possibility that inadvertent spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals could affect wildlife, especially where spills were large or unmitigated or where they reached surface water.
- Construction personnel at recreation area residences or at work sites could provide a source of human food to wildlife, resulting in habituation of wildlife and in human/wildlife conflicts that adherence to mitigation measures would prevent.

Combined, these would result in short- and long-term negligible to moderate localized impacts on wildlife in the construction area that would be diminished by mitigation measures.

**Maintenance Facility and Housing Replacement and Relocation**: Construction would result in long-term loss of habitat for wildlife species, although much of this area near the airstrip has been previously disturbed. There would be long-term minor to moderate adverse effects on wildlife, including from habitat loss, but also from short-term impacts due to noise and disturbance during construction.

**Road Rehabilitation**: Most road rehabilitation actions would result in minimal new disturbance of areas outside the existing road surface. In general, these actions would have short-term effects during construction from noise and disturbance which would cause wildlife to avoid the area. In some areas, such as road pullouts, however, proposed actions would result in long-term effects from the loss of vegetation, including wildlife habitat.

Among the actions in all alternatives which would result in ongoing noise and disturbance to wildlife would be road rehabilitation and maintenance and facility maintenance. The road rehabilitation actions which would remove wildlife habitat would include construction of the new pullouts, new culverts, and the winter turnaround, as well as actions at Wilson Creek. Ongoing work to repair the road (including crack sealing, asphalt overlays, etc.) would result in periodic noise and human presence that would have localized short-term negligible to minor impacts on wildlife presence.

If a larger flood claimed part of the road and caused the loss of surface and/or subsurface materials, wildlife habitat would be altered, water quality in the Stehekin River would be degraded, and longer-term noise associated with reconstruction of the roadway would result in short-term minor to moderate adverse impacts on wildlife.

*Surfacing*: Road surfacing would minimize sediment runoff from the road, but would also increase impervious areas, causing faster runoff. Surfacing would also increase the delivery of contaminants such as petroleum products originating from the asphalt, adversely affecting water quality for wildlife.

**Erosion Protection Measures**

*Milepost 5.3 (Wilson Creek)*: Excavation to lay back the slope and lower the road would have minor adverse effects on wildlife from some reduction in habitat. Instream work in Wilson Creek could cause potential sedimentation to the creek, and subsequently the Stehekin River downstream of the construction, if mitigation measures are unsuccessful. Wilson Creek is an intermittent stream, however, and would likely be dry during construction. Additional potential for sedimentation that would affect aquatic wildlife would also occur as a result of the lowering of the road surface and its realignment into the new cut. These adverse impacts, including noise and disturbance and potential sedimentation, would be short term, localized, and minor.

**Recreational Facilities**

*Lower Valley Trail*: Construction of about half of the trail would result in long-term loss of mostly undisturbed habitat for wildlife. However, because the trail would be narrow, impacts would be negligible to minor. Localized minor to moderate adverse effects on wildlife would include habitat loss and short-term impacts due to noise and disturbance during construction.

**Restoration and Bioengineering**: Restoration in all alternatives would include approximately 5 acres of riparian and upland habitat in the former maintenance area, plus areas of former development associated with land purchases and exchanges. Most of these areas are disturbed but could become high-quality habitat through restoration. Over time, long-term negligible to moderate beneficial effects would occur and would increase wildlife habitat.

## Additional Impacts from Alternative 1

**Road Grade Raise**: The road grade raise in McGregor Meadows would potentially cause additional sedimentation in the Stehekin River and adjacent wetlands during future flooding from the addition of 5,600 cubic yards of fill. To some degree, the erosion of this fill would be prevented by its compaction and by raising the road in selected areas. If dislodged, sediment from the road would result in short-term minor adverse effects on fish and other aquatic species in the Stehekin River, particularly just downstream of where the material entered the river. Because most of this material would be imported, there would be the potential for long-term minor adverse effects from potential importation of weed seed as well as additional minor impacts (noise and activity) from moving this material from Stehekin Landing upvalley to McGregor Meadows. Encroachment of the Stehekin River on this low lying section of the road would, over the long-term, result in the need for more erosion structures and associated disturbance, a long-term moderate adverse impact.

**Road Realignment**: Construction of the proposed realignment near Milepost 6.0 also has the potential to introduce some sediment into the Stehekin River via a small creek within the realignment area. Because silt barriers would be used, because this creek flows for about 0.25 mile through a low-gradient meadow prior to entering the Stehekin River, and because this stream runs dry for several months in the summer, there would be negligible to minor sedimentation impacts.

**Erosion Protection Measures**: There would be additional impacts from the placement of rip-rap clusters and log-cribbing at the toe of the slope adjacent to the river at Wilson Creek. These structures would reduce aquatic habitat and change conditions adjacent to them within the river and alongside the bank, a long-term localized moderate adverse effect.

**Large Woody Debris**: Continued procurement of large woody debris from the head of Lake Chelan for use in erosion protection measures would result in some negligible to minor short-term adverse impacts to fish and other aquatic species.

**Implementation of 1995 Land Protection Plan**: Continued exchange and acquisition of lands based on the priorities of the 1995 LPP would result in the acquisition of lands within the 100-year floodplain of the Stehekin River and lands where protection of the scenic qualities along the Stehekin Valley Road would be achieved. Removal of structures from flood-affected lands would continue to occur, as would removal of structures from lands within the floodplain. These actions would result in some long-term negligible to moderate beneficial effects on wildlife from protection of additional disturbed habitat that would be restored in the riparian zone. Retention of 20 acres at the Lower Field in the lands available for exchange could have localized long-term minor to moderate adverse impacts to wildlife. This area of the valley is currently undeveloped, and contains valuable habitat for a number of species. As a result, in Alternative 1, future revision of the LPP could remove the Lower Field from exchange consideration. Adverse effects on wildlife would continue to occur from the development of previously undeveloped and/or intact parcels offered for exchange. Depending on the size and features of the parcels, these adverse impacts would be negligible to moderate and localized.

Because the proposed land exchange parcels in the 1995 LPP are over 1 acre (1.33 acres to 7.2 acres) and because most of the land associated with the larger parcels would likely remain undeveloped (as a result of Chelan County zoning and NPS covenants), development of portions of the 10 - 15 parcels would have limited adverse effects on wildlife habitat. These impacts would from conversion of native landscape to developed area and from the potential invasion of nonnative species associated with the development. Considering these factors and restoration of some developed areas, these impacts would likely remain minor to moderate. Specific adverse or beneficial impacts of this plan and its actions, however, are currently unknown and would be analyzed as the land exchanges occur.

### Additional Impacts from Alternative 2

**Road Reroute**: The road reroute would affect approximately 1.9 miles of mostly undisturbed habitat (up to 18 acres within an overall disturbance area of 28 acres), including the long-term removal of vegetation / wildlife habitat from the road bed, a long-term localized moderate to major adverse impact. There would also be short- to long-term adverse impacts from the loss of habitat in cut and fill areas. Adjacent forest would be lost where cuts and fills were constructed, resulting in fewer perches and nest sites for birds and less cover for mammals, as well as a change in the microclimate, with fewer trees contributing to changes in sunlight and shading, among other impacts. Negligible beneficial effects would result from the creation of edge habitat for wildlife. The road would increase the possibility of wildlife mortality along this edge. Because the road reroute would result in the removal of vegetation and the conversion of the area from native landscape to developed, effects from habitat loss would be long-term and moderate to major. Over time, however, it is likely that vegetation would return to many of the cut and fill areas, though not to the same level, a negligible to minor long-term beneficial effect. Some soil-dwelling organisms would be killed during construction, because of the extensive cover of this upland forest habitat, a localized, minor, short-term adverse impact.

Impacts to upland habitat on the reroute would be offset to some degree by removal of 1 mile of road from the floodplain in McGregor Meadows. Since the lower valley (and watershed) contain far less riparian than upland habitat, the reroute would result in a moderate to major long-term benefit for wildlife.

**Erosion Protection Measures**: Although the construction of six to eight rock barbs and two logjams would result in additional adverse impacts, the barbs would also decrease bank erosion during flooding and along the Stehekin River. Construction of the barbs and logjams would include rehabilitating riverbanks with bioengineering, contributing long-term, stable vegetation that would eventually spread over nearby areas and act as cover overhanging the bank for fish and other aquatic species and increasing riverbank cover vegetation for terrestrial species. As riverbank cover increased from bioengineering, minor to moderate beneficial effects would occur from shading of aquatic habitat. Pool habitat creation (6,000 - 8,000 square feet) from placement of the barbs would add to the diversity of Stehekin River habitats. There would be minor effects on gravel recruitment downstream of the barbs; however, eddies and pools created by the barbs would enhance local fish habitat for feeding and resting and would provide refuges during flooding up to approximately 0.5 acre would be affected by rock barbs and bioengineering, and 0.1 acre by logjams, including short-term minor to moderate and long-term minor adverse effects on wildlife habitat, (from sedimentation and possible fish passage impacts) and long-term negligible to minor beneficial effects from bioengineering.

**Milepost 8.0 Slope Stabilization**: There would be negligible to minor short-term adverse impacts on wildlife from laying back the upper one-fourth to one-third of the slope and rock scaling, from habitat changes. Long-term beneficial effects would be contributed from slope stabilization.

**Large Woody Debris**: Procurement of large woody debris in the Lake Chelan backwater zone would result in some minor short-term adverse impacts from noise and habitat disturbance. Because the procurement of the wood below Boulder Creek would be subject to a number of key stipulations, including that it be obtained from the tops of logjams well above the ordinary high water mark and in a way that did not affect the stability of the logjam, potential adverse effects on aquatic species would be minimized. Further, the NPS would control access to these sites, and would not allow disturbance of sensitive habitat. Informal surveys would be conducted before pieces were removed to further limit adverse impacts. Wood above the ordinary high water mark would be drier than wood below and the procurement of a limited number of pieces would have a negligible effect on the recruitment of large woody debris within the channel that would be available in the future for wildlife habitat. Based on large woody debris surveys over the last 15 years, the presence of wood in the Stehekin River has quadrupled since 1982. Most wood was deposited in the 1995, 2003, and 2006 floods. Below Harlequin Bridge the dramatic increase could be a return to conditions prior to routine removal of large woody debris by settlers and the ACOE for many years or it could be a new occurrence. Minimal use of large woody debris, under a set of very specific conditions, would have negligible to minor adverse effects on the presence of this key habitat component in the Stehekin River. Use of the large wood instead of imported rock in erosion protection designs and restoration of riparian areas would result in long-term minor beneficial effects on wildlife.

**Recreational Facilities**

*Campgrounds and Raft Takeout*: In addition to the construction of the Lower Valley Trail, there would be minor habitat modification from construction of the new campgrounds at Rainbow Falls, new group sites at Purple Point, a raft takeout, and a new, 300-foot-long access road. This would include changes in noise and activity during early morning and late evening hours related to use of the campsites, and changes during other times of the day associated with the raft takeout. This disturbance would result in wildlife avoidance of campgrounds and the raft takeout during these times. During other times, wildlife may be attracted to the smells from food preparation and activity at the sites. Because campers would be required to store their food in lockers and would be encouraged to use wildlife-friendly camping practices, the effects of campsite use on wildlife would be minimized. Overall effects would be intermittent, localized, and negligible to moderate from noise and disturbance and long term with negligible to minor impacts from habitat modification.

**Restoration and Bioengineering**: In addition to beneficial impacts from restoration of the former maintenance area and from lands acquired or exchanged, long-term beneficial effects would occur from the road reroute because of obliteration and restoration of the abandoned roadbed in the channel migration (including riparian) zone, where biodiversity would be restored, creating new habitat and rehabilitating degraded habitat for wildlife. In addition, riparian restoration at Buckner Homestead hayfield and pasture lower hayfield and pasture and Lower Field would also contribute to beneficial effects. Birds, insects, and mammals would benefit from the reestablished vegetation, soils, and diverse habitat offered by restored riparian and floodplain ecosystems. More of the Stehekin River channel migration zone would be available for fish, insect, bird, and mammal use. Natural river processes would continue to allow for fish spawning, rearing, resting, and foraging. Amphibians and reptiles would gain high-value habitat in the restored floodplain / channel migration zone and riparian areas. Although there would be short- and long-term moderate adverse impacts on wildlife from the road reroute, restoring high-value floodplain and riparian zones would also create moderate beneficial long-term impacts for fish and wildlife.

**Land Protection Plan Modifications**: With the potential development of additional home sites on 10 - 15 parcels for proposed exchange lands, and the subsequent rehabilitation or restoration of a similar area from exchanged or acquired lands, effects would be somewhat balanced. Because much of the acquisition and exchange would occur in more sensitive riparian wildlife habitats, and because most of the lands proposed for exchange are located in more common upland habitat types, there could be some long-term minor to moderate beneficial effects on some wildlife species. Removal of the Lower Field area from consideration for exchange would have a long-term localized moderate beneficial effect because there is currently no development on this large, diverse parcel of key importance to wildlife. Exchange would primarily result in NPS acquisition of wildlife habitats nearer to the Stehekin River in trade for areas farther away. As noted in the ―Soils and Vegetation" section above, covenants and other stipulations on the development of exchanged lands would result in additional protection of key characteristics important to wildlife, a long-term negligible to minor beneficial effect on wildlife.

Because the proposed land exchange parcels are larger than 1 acre (1.33 acres to 7.2 acres) and because most of the land on the larger parcels would likely remain undeveloped (as a result of Chelan County zoning and NPS covenants), development of portions of these 13 parcels would have adverse effects on wildlife habitat. These impacts include conversion of native landscape to developed area and potential invasion of nonnative species. With restoration of some developed areas, these adverse impacts would likely remain minor to moderate.

### Additional Impacts from Alternative 3

**Road Reroute**: The road reroute would affect approximately 1.7 miles of mostly undisturbed habitat (18 acres within an overall disturbance area of 28 acres). Because the road reroute would result in the removal of vegetation and the conversion of the area from native landscape to developed, adverse effects on wildlife from habitat loss would be the same as Alternative 2, based on the number of acres. Impacts would occur over most of the same areas, but would result from a shorter overall length of road. Effects from Alternative 3 would be long term and moderate to major.

**Erosion Protection Measures**: Instead of six to eight barbs and two logjams, as in Alternative 2, there would be four barbs and five logjams in Alternative 3. Overall adverse and beneficial impacts would be greater than in Alternative 2, but would be similar, including rehabilitating riverbanks with bioengineering, contributing long-term stable vegetation, and increasing the availability of pool habitat in the Stehekin River by 4,000 square feet. Approximately 0.6 acre would be affected by erosion protection measures, resulting in short- and long-term minor to moderate adverse effects, coupled with negligible to minor beneficial effects from bioengineering.

**Milepost 8.0 / Large Woody Debris / Land Protection Plan Modifications / Restoration**: Actions and impacts would be similar to Alternative 2 except that there would be less restoration of the former Stehekin Valley Road alignment bypassed by the reroute

**Recreational Facilities**

*Campgrounds*: There would be a small additional area affected by the construction of another campground near Company Creek but no area affected by addition of a raft takeout. When combined with impacts from other recreational facility improvements similar to Alternative 2, overall adverse effects on wildlife would be intermittent and negligible to moderate from noise and disturbance and long term and minor from habitat modification.

### Additional Impacts from Alternative 4

Some impacts would be similar to Alternatives 1 and 3. As in Alternative 1, the Stehekin Valley Road would be maintained in its current alignment and its grade would be raised. As in Alternative 3, there would be beneficial and adverse impacts from Milepost 8.0 actions and restoration and bioengineering.

**Road Grade Raise / Realignment**: Road grade raise and realignment actions and impacts would be the same as in Alternative 1. There would be short- and long-term minor to moderate adverse impacts on wildlife, including aquatic species, especially if new road fill was released during future flooding.

**Erosion Protection Measures**: Construction of 16 - 17 barbs would result in additional adverse impacts to riverbanks from hardening (1.2 acres) and would affect up to 17,000 square feet within the river by changes from riffle to pool habitat. Additional locations with barbs include Milepost 7.0 and Milepost 9.2. Other effects would be the same as described in Alternative 3. The barbs would have a long-term mostly moderate adverse effects on wildlife but would also have some negligible to minor beneficial effects from bank-erosion prevention and retention/restoration of plants along the riverbank, which would provide habitat for terrestrial and aquatic wildlife.

**Large Woody Debris**: Effects of the procurement and use of large woody debris would be greater than described in Alternatives 2 and 3 because it would occur over a much larger area, up to Bullion Raft Launch. There would be minor localized adverse effects on sedimentation, potentially affecting aquatic species and other wildlife (from disturbance), and there would be a negligible adverse impact on wildlife habitat for both terrestrial and aquatic species.

**Land Protection Plan Modifications**: Although priorities would be different, impacts would be similar to Alternatives 2 and 3 because the same lands would be available for exchange. Because there would continue to be lands within the channel migration zone that would be developed, potentially to protect the alignment of the Stehekin Valley Road, adverse impacts from development would be greater due to the overall greater sensitivity of lands, including lands within riparian areas, to be developed. Overall impacts on wildlife would be mixed, and would be long term, adverse, and minor to moderate, with fewer beneficial effects than Alternatives 2 and 3.

Measures to Avoid, Minimize, or Mitigate Impacts Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to wildlife would include the following:

- Scheduling construction activities with seasonal consideration of wildlife lifecycles to minimize impacts during sensitive periods (e.g., bird nesting and breeding seasons). The timing of the construction of rock barbs and other channel- or bank stabilization measures as well as extraction of large woody debris could be limited to avoid spawning and other sensitive periods for fish and aquatic wildlife.
- Minimizing the degree of habitat removal (vegetation clearing) by delineating construction limits.
- Limiting the effects of light and noise on wildlife habitat through controls on construction equipment and timing of construction activities, such as limiting construction to daylight hours.
- Maintaining escape routes for animals that might fall into excavated pits and trenches. If erosion control matting is used, only tightly woven fiber netting or nonbound materials (e.g., rice straw) would be used to ensure that small animals would not be trapped. No plastic netted materials would be used.
- Using spill-prevention measures to prevent inadvertent spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals that could affect wildlife.
- Discouraging construction personnel at work sites from providing a source of human food to wildlife, avoiding habituating of wildlife and increased human/wildlife conflicts. (Title 36, Code of Federal Regulations, Chapter 1, Section 2.10(d) prohibits anyone from leaving food unattended or stored improperly where it could attract or otherwise be available to wildlife. Title 36, CFR, Chapter 1, Section 2.14(a) prohibits the disposal of refuse in other than refuse receptacles. Title 36, CFR, Chapter 1, Section 2.2(a)(2) prohibits the feeding and molesting of wildlife.)
- Maintaining proper food storage, disposing of all food waste and food-related waste promptly in a bear-resistant receptacle, and removing all garbage off site at the end of each working day.
- Placing rock barbs from outside the wetted channel. Rock would be placed in the channel using heavy equipment from the road or bank above the ordinary high water mark.
- Conducting informal inspections for aquatic species prior to removal of large woody debris from the tops of logjams.
- Obtaining single pieces of large woody debris only from above the high water mark in a manner that would not destabilize the logjam.

**Cumulative Impacts**: Similar to other protected areas, the combined effects of development in the recreation area and in the surrounding area over time coupled with the purposeful eradication of predators through the mid-1900s have contributed to low-level or extirpated wildlife populations of some key species in the recreation area. The North Cascades region as a whole, however, contains most of its historic species, although in diminished numbers. Past and reasonably foreseeable development projects planned for the recreation area, such as additional construction of visitor and administrative facilities, would result in additional negligible to minor cumulative effects to wildlife. The effects of existing development and hunting continue to take a toll on wildlife. Development within the lower 12 miles of the Stehekin River has remained at a relatively low level. Because extensive wilderness areas surround Lake Chelan NRA on neighboring federal lands, the recreation area contributes to a large protected area of mostly intact habitat.

The existence and continued maintenance of the road and public and private developed areas under Alternatives 1 - 4 would continue to contribute to long-term minor to moderate cumulative adverse effects on wildlife, increasing some species while decreasing the presence of others. Other recreation area projects would also continue to have primarily short-term negligible to moderate impacts, with some minor to moderate long-term impacts, on wildlife where the new development occurs. Because the proposed action under Alternatives 1 and 4 would not result in major changes to the road location or width, these would contribute localized negligible to moderate short-term adverse effects from noise and activity, negligible to minor beneficial effects from habitat restoration (Alternative 4), and localized negligible to minor short- and long-term adverse effects from construction in undisturbed areas along the road or in areas that have recovered from the disturbance associated with original road construction. By contrast, Alternatives 2 and 3 would disturb a new area for the road reroutes and would have both greater adverse impacts from habitat modification and greater beneficial effects from restoration than Alternative 1. Restoration benefits would be similar among all action alternatives (2 - 4), primarily because of replacement and relocation of the housing and maintenance complex and actions at Lower Field and Buckner Homestead lower hayfield and pasture. These benefits would be greater under Alternatives 2 and 3 because more rerouted road would be restored; however, adverse effects from construction of the reroute(s) would also be greater under Alternatives 2 and 3.

Other past, present, or future actions have the potential to cause additional impacts to wildlife. In the Stehekin Valley, these impacts are mostly the result of construction-related activities (principally associated with roads in the project area) and from the Forest Fuels Reduction Program. The Forest Fuels Reduction Program would continue to have short- and long-term adverse impacts on wildlife, including from the presence of fire, smoke, and human activity. Wildlife is likely to avoid areas while fires are occurring, and some species may relocate permanently following habitat changes after fires. Long-term benefits of from the reintroduction of fire and selective thinning would include a reduction in tree diseases and insect infestation, prevention of crown (tree canopy) fires, understory growth enhancement by reducing shade, and improvement to the overall structure of the forest (i.e., maintaining a late successional stage forest). In the short term, habitat is changed, which can adversely impact some wildlife species, while benefitting others. In the long term, however, fire can create a more diverse vegetation pattern that supports greater wildlife diversity, and protects habitat stability by reducing the potential for a very hot and destructive fire.

The increase in the number of barbs and other erosion protection structures over time in the Stehekin River has contributed to minor to moderate localized adverse effects on the diversity, abundance, distribution, and quality of aquatic habitat in the Stehekin River. Negligible to minor adverse effects have been contributed by snowmelt culverts and side-channel culverts. Alternatives 2 - 4 would contribute localized negligible to minor beneficial and adverse effects on wildlife, with Alternative 4 having comparatively the greatest contribution to adverse impacts from the largest number of bank structures.

When added to the impacts of other development in the lower Stehekin Valley, Alternative 1 would contribute short- and long-term minor cumulative adverse effects on wildlife, primarily from habitat disturbance, while Alternatives 2 and 3 would contribute short- and long-term minor to moderate adverse effects, primarily from habitat removal due to the reroutes, and Alternative 4 would contribute short- and long-term minor to moderate cumulative adverse effects, again primarily due to habitat disturbance. Long-term minor to moderate beneficial effects would occur from the restoration of wildlife habitat in all alternatives.

**Conclusion**: Impacts on wildlife from Alternative 1 would be minor to moderate, short and long term, and both beneficial and adverse from rehabilitation of the Stehekin Valley Road, implementation of portions of the Road Improvement Project and construction of the Lower Valley Trail, and replacement and relocation of the maintenance facility and housing. In Alternative 2, adverse impacts would range from short term to long term and negligible, while beneficial impacts associated with removal of the road from the floodplain would be moderate and would somewhat balance impacts from the reroute. Alternative 2 would contribute localized moderate to major adverse cumulative impacts and localized minor beneficial impacts on wildlife. Alternative 3 impacts would be similar to those under Alternative 2, with negligible to major adverse impacts (primarily related to wildlife disturbance and habitat loss) and long-term negligible to moderate localized beneficial effects from restoration. Compared to Alternative 2, both adverse and beneficial effects would be somewhat less due to shorter reroute and less potential restoration at Lower Field. In Alternative 4, fewer overall beneficial effects would occur compared to Alternatives 2 and 3 because the road would be retained in the channel migration zone and it is likely that over time, additional erosion protection measures and/or eventual relocation would be needed that would cause long-term adverse effects on wildlife. Adverse effects from Alternative 4 would be short and long term and minor to moderate.

Although localized impacts would range to major in Alternatives 2 and 3 due to the disturbance of approximately 18 acres of wildlife habitat from the construction of the reroutes, no species loss would occur and displaced species could use other nearby intact areas and future restored areas for habitat. As a result, there would be no impairment of wildlife or its values from the implementation of Alternatives 1 - 4.

# 10. SPECIAL STATUS WILDLIFE IMPACTS

## a. Special Status Wildlife Methodology

Special status wildlife impact determinations are formally determined under the Endangered Species Act (Section 7). Analysis was based on the known or likely occurrence of the species in the vicinity of the project area and the potential loss or alteration of habitat and potential effects to the species.

**Context of Impact**: Special status wildlife impacts were considered in the lower Stehekin Valley within the nonwilderness portion of Lake Chelan NRA and within the region.

**Type of Impact**: Adverse impacts are those that would alter the range, location, number, or population of a species and/or its habitat. Beneficial impacts would expand, improve, or protect one or more of these characteristics.

**Intensity of Impact for Special Status Wildlife**

- **No Effect**: The project (or action) is located outside suitable habitat and there would be no disturbance or other direct or indirect impacts on the species. The action will not affect the listed species or its designated critical habitat.
- **May Affect, Not Likely to Adversely Affect**: The project (or action) occurs in suitable habitat or results in indirect impacts on the species, but the effect on the species is likely to be entirely beneficial, discountable, or insignificant. The action may pose effects on listed species or designated critical habitat but given circumstances or mitigation conditions, the effects may be discounted, insignificant, or completely beneficial. Insignificant effects would not result in take. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects or (2) expect discountable effects to occur.
- **May Affect, Likely to Adversely Affect**: The project (or action) would have an adverse effect on a listed species as a result of direct, indirect, interrelated, or interdependent actions. An adverse effect on a listed species may occur as a direct or indirect result of the proposed action or its

interrelated or interdependent actions and the effect is not: discountable, insignificant, or beneficial (USFWS 1998).

## b. Special Status Wildlife Impacts

### Impacts from Actions Common to Alternatives 1 - 4

Most special status wildlife would remain unaffected by proposed actions. Because there would be habitat loss, however, analysis has resulted in the following determinations of effect (in compliance with Section 7 of the ESA) for listed and proposed species for Alternatives 1 - 4. Some adverse impacts would be mitigated by restoration of riparian areas. Where impacts would be different among alternatives, these are noted below. In addition to specific effect analyses below, the general impacts identified in the ―Wildlife Impacts" section would also affect special status species and are the basis for the summary of impacts in this section.

**Federally Listed and Proposed Species**

**Gray Wolf**: Since wolves tend to avoid human activity areas and because habitat for gray wolves is common in the surrounding area, adverse impacts on gray wolves would be short term and negligible and related to noise and activity from construction. There would be no major increase in the amount or type of human activity following construction. Because no denning or foraging habitat would be removed, there would be no cumulative effects on gray wolves. Proposed actions under Alternatives 1 - 4 may affect, but would be not likely to adversely affect gray wolves.

**Grizzly Bear**: Adverse impacts to grizzly bears would be short term and negligible, since the area of disturbance is small and grizzly bears tend to use higher elevations in summer (during the period when construction is planned) and are less likely to be in the area at that time. There would be no major increase in the amount or type of human activity following construction. Proposed actions under Alternatives 1 - 4 may affect, but would be not likely to adversely affect grizzly bears.

**Canada Lynx**: Although project area lands generally do not comprise suitable habitat, Canada lynx may occur in the area, but would tend to avoid the area during construction. Since the area of disturbance is small compared to the available habitat beyond the project area in surrounding national forests and North Cascades National Park, adverse impacts would be minor. There would be no major increase in the amount or type of human activity following construction. Proposed actions under Alternatives 1 - 4 may affect, but would be not likely to adversely affect Canada lynx.

**Pacific Fisher**: Fishers have not been found in the Stehekin Valley since 1980. Prior to that, fishers were found in North Cascades National Park Service Complex in areas of Douglas-fir and grand fir above 1,800 feet amsl. Because the project area is entirely below the 1,640-foot contour in the lower Stehekin Valley, proposed actions in Alternatives 1 - 4 may affect, but would be not likely to adversely affect this species. Negligible beneficial effects would occur from removing a portion of the Stehekin Valley Road away from riparian habitat (including the channel migration zone) in Alternatives 2 and 3 and from long-term actions that could protect lands within McGregor Meadows if exchanges occurred. Long-term minor adverse effects coupled with long-term negligible beneficial effects would occur. Alternatives 1 and 4 would be more likely to contribute adverse effects and less likely to contribute beneficial effects due to the retention of the road.

**California Wolverine**: Similar to lynx, there have been unconfirmed observations of wolverines in the lower Stehekin Valley, but not since 1984. Data obtained from radio-collared wolverines show the Stehekin Watershed to be a part of at least three separate animals' home ranges (Raley, pers. comm., 2009; Rohrer et al. 2008). Wolverines likely move through the valley; however, they prefer more remote mountainous areas of higher elevation (the project area is entirely below the 1,640-foot wilderness contour in the lower Stehekin Valley). Proposed actions would affect a relatively small area under the Alternatives (1 - 4), compared to larger areas of better-quality wolverine habitat surrounding the Stehekin Valley. Proposed actions under Alternatives 1 - 4, may affect, but would be not likely to adversely affect wolverine.

**Bald Eagle**: Because most project actions would occur in summer, outside the eagle nesting period, and would occur more than 300 feet from known nesting areas near the head of Lake Chelan, there would be minor disturbance effects to nesting eagles and to eagles that forage along the Stehekin River during the late summer and early fall (when the construction and repair work would occur). Actions at Weaver Point and near the river mouth would have the greatest potential to affect bald eagles through noise and activity. Potential eagle disturbance could also occur anywhere along the Stehekin River where construction actions are proposed, including at Boulder Creek, Milepost 3.8 (Frog Island), and Milepost 5.3 (Wilson Creek) and along the Company Creek Road. Because there would be few large trees removed and because eagles are not known to nest in other areas along the river, there would be a potential for negligible to minor short-term adverse impacts on bald eagles. Proposed actions may affect, but would be not likely to adversely affect Bald Eagles.

**Northern Spotted Owl**: The proposed project area in all alternatives is within the activity area of a pair of northern spotted owls whose nest was first detected in 1998. This nest produced at least five young in 10 years. The nest activity area was occupied by barred owls during the 2008 and 2009 nesting seasons, but in spring 2010 a single male northern spotted owl was detected, but no nest or female owl were observed.

Construction of a portion of the proposed action under all alternatives would occur within the activity area where the most recent nesting activity occurred (in 2007). As a result, proposed actions affecting this area would be scheduled to occur outside of the nesting period (from March 1 to at least September 6) if nesting activity was found. If nesting activity is not found, work could begin as soon as July 1. Regardless, there would continue to be the potential to disturb foraging northern spotted owls before and after the nesting season. As a result, short-term adverse impacts from disturbing the birds during construction could occur at other times.

As part of the road rehabilitation design, no pullouts or tree removal would occur within the area along the road immediately adjacent to the current northern spotted owl activity area. This is to reduce the potential that recreation area visitors would notice the nesting owls (i.e., potentially harass the birds) or that the owls would be attracted to people or vehicles. No pullouts are to be located within the line of sight (0.25 miles) adjacent to the current spotted owl nest activity area.

Adverse effects would occur in Alternatives 1 and 4 with disturbance and some habitat modification of 7.5 acres of northern spotted owl habitat. Habitat modification in Alternatives 2 and 3 would affect approximately 18 acres of northern spotted owl habitat from the reroute.

The U.S. Fish and Wildlife Service (USFWS) estimates that spotted owls require an average minimum of 6,657 acres of suitable habitat per nesting pair. Suitable habitat surrounding the nest activity area is comprised of approximately 978 acres (a 1.82-mile radius), or 176 acres within the 0.7-mile-radius core area. As a result, the loss of from 7.5 acres (Alternatives 1 and 4) to 18 acres (Alternatives 2 and 3) and disturbance effects comprising a maximum of approximately 28 acres from proposed actions in Alternatives 2 and 3 may affect and would be likely to adversely affect this pair of northern spotted owls. Alternatives 2 and 3 would impact an estimated 1.7 percent of this suitable habitat in the area, including areas within 200 - 800 feet of the customary nest activity areas.

Some long-term negligible to minor beneficial effects on northern spotted owls could occur from creation of additional foraging area in restored riparian areas in Alternatives 2 - 4 and restored roadway in Alternatives 2 and 3. Most effects of the alternatives, however, would be long-term moderate to major adverse impacts associated with habitat removal and short-term negligible to moderate adverse impacts associated with noise and activity during construction. Edge effects would also likely favor barred owls over northern spotted owls.

Proposed actions under Alternatives 1 and 4 may affect and would be likely to adversely affect northern spotted owls. These two alternatives implement the Road Improvement Project actions previously analyzed in a Biological Opinion on the EA for that project (see mitigation measures included below). Although most vegetation removal would be associated with construction of pullouts and new side ditches along the edge of the existing Stehekin Valley Road, these activities would occur within existing northern spotted owl habitat, affecting 7.5 acres. Similarly, Alternatives 2 and 3 may affect and would be likely to adversely affect northern spotted owls due to the loss of or construction disturbance impacts on approximately 18 of 133 acres of northern spotted owl habitat from the reroutes. These impacts are in addition to habitat loss due to the construction of new pullouts and additional disturbance related to rehabilitation of the Stehekin Valley Road before and after the reroute.

**Bull Trout**: The proposed actions under Alternatives 1 - 4 would result in instream work to construct barbs and logjams. This would convert up to about 8,000 square feet of riffles to pool habitat in Alternative 2, 4,000 square feet in Alternative 3, and up to 17,000 square feet in Alternative 4. In addition, two logjams in Alternatives 2, 3, and 4 would have long-term minor to moderate adverse and minor beneficial effects on bull trout. Slope stabilization at Milepost 5.3 (Wilson Creek) and at Milepost 8.0 would occur above the ordinary high water mark. Work in or near water includes constructing bank barbs, logjams, slope stabilization, bioengineering, and riparian restoration. In addition to clearing and grading, these activities would have the potential to cause a short-term increase in the amount of sediment in the water. Increased sediment load and short-term turbidity can adversely affect fish, as described in the ―Wildlife" section above.

To reduce or eliminate impacts on bull trout, BMPs such as temporary erosion and sediment control, including silt fencing, would be used. Revegetation of disturbed areas would protect soils from erosion and reduce the potential for erosion of and long-term impacts to stream habitat. In addition, moving the Stehekin Valley Road away from the river in Alternatives 2 and 3 would have long-term beneficial effects by allowing additional area for natural river processes within the 100-year floodplain and channel migration zone, which could improve local habitat for fish. Because bull trout have not been found in the Stehekin River since the 1950s, and because their extirpation is not well documented, proposed actions under all alternatives may affect, but would be not likely to adversely affect bull trout. Future potential beneficial effects could be realized from proposals to restore native cutthroat and bull trout populations in part of their historic habitat within the Stehekin drainage.

**Other Federal Sensitive Species and State-listed, Proposed and Sensitive Species**

**Northern Goshawk**: Potential and occupied goshawk nesting sites would be adversely affected due to the removal of approximately 18 acres of presently undisturbed forest habitat from construction of a road reroute in Alternatives 2 and 3. This proposed action under these alternatives may affect, but would be not likely to adversely affect goshawks, because a large amount of suitable goshawk habitat would remain nearby. Removal of forested edge area adjacent to the Stehekin Valley Road in Alternatives 1 and 4 would have no effect on nesting goshawks, because goshawks nest within contiguous forest canopy areas. Goshawks flying through these areas to forage would, however, have fewer trees where these were removed for pullout construction or to realign parts of the road in McGregor Meadows under Alternatives 1 and 4.

**Western Gray Squirrel**: Western gray squirrels have been documented in the lower valley. The road reroute may affect their upland forest habitat; however the riparian zone restoration would add preferable mixed forest habitat in this area. While no specific adverse effects have been identified, the loss of additional vegetation from construction of new areas associated with road rehabilitation (Alternatives 1 - 4) and from reroute construction (Alternatives 2 and 3) as well as general loss of vegetation from construction of the housing and maintenance areas could affect squirrel habitat. In general, areas where they are found would likely be avoided by project impacts under all alternatives. Because some minor beneficial and adverse impacts are possible, project actions under all alternatives may affect, but would be not likely to adversely affect squirrels.

**Western Toad, Cascades Frog, and Columbia Spotted Frog**: Actions that would occur in water, including placement of barbs and logjams, would occur outside of the breeding season for these species; therefore, they would not be affected. Long-term beneficial effects, including a long-term potential improvement in frog and toad breeding habitat, could occur as a consequence of streambank revegetation. Construction of the in-water erosion protection structures would also have some beneficial effect on frogs and toads because it would create pool habitat and areas of slower-moving water. These would be greatest in Alternatives 3 and 4, moderate in Alternative 2, and least in Alternative 1. Overall, the alternatives would result in short-term negligible adverse effects from sedimentation and long-term beneficial effects from reduced erosion and may affect, but would be not likely to adversely affect proposed frogs.

**Other State-listed, Proposed, and Sensitive Species**: Proposed actions under Alternatives 1 - 4 would have no effect on the following species: Keen's myotis, sandhill crane, golden eagle, merlin, black swift, Vaux's swift, Lewis's woodpecker, black-backed woodpecker, pileated woodpecker, common loon, and western grebe.

Generally, the rehabilitation of the Stehekin Valley Road and construction of housing and the new maintenance area would not affect birds and bats during the nesting season because it would primarily occur during nonnesting or late nesting periods (in summer) (Alternatives 1 - 4). Removal of trees from the reroute area, however, would likely commence prior to the end of the nesting season for some species (Alternatives 2 and 3). As a result, depending on the species, there could be some adverse impacts. To avoid these impacts, forested reroute areas in these alternatives would be surveyed prior to tree removal to determine the presence of nesting behavior. In addition, there would be greater short-term disturbance from construction noise and human activities associated with construction in Alternatives 2 and 3 because of the reroute construction. Because the potential disturbance area is small relative to the availability of nearby foraging areas in adjacent undisturbed habitat, these impacts would be localized and minor to moderate. Restoration impacts, primarily under Alternatives 2 - 4, would include obliteration of some former roadway (more in Alternatives 2 and 3) and restoration of some former riparian areas (Lower Field and Buckner Homestead hayfield and pasture). These actions would result in long-term negligible to moderate beneficial effects on birds from the new trees and shrubs, providing new resting and nesting areas where habitats have been affected by human activities.

**Harlequin Duck**: Where construction would occur in or near the Stehekin River, there could be adverse effects on harlequin ducks. Construction-related impacts include increased noise, dust, and human activity and temporary disturbance to riverbank habitat. Most work, however, would occur outside the breeding and nesting season for harlequin ducks so that adverse effects during these sensitive times would be minimized. Slight adverse impacts on foraging harlequin ducks could occur; however, there is an abundant supply of foraging habitat for this species, and they tend to start leaving the area near the end of July to return to the coast. Beneficial effects would occur from the restoration of riparian habitat in Alternatives 2 - 4 and from bioengineering in Alternatives 1 - 4. Overall effects would be minor and localized and may affect, but would be not likely to adversely affect harlequin ducks.

### Measures to Avoid, Minimize, or Mitigate Impacts

The following conservation measures that would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts to related to northern spotted owls, bull trout, and other special status wildlife species:

- Determining whether northern spotted owls or another special status species are nesting, and then whether or not the proposed action will affect the active nest or disrupt reproductive behavior. If it is determined that the action will not affect an active nest or disrupt breeding behavior, work will proceed without any restriction or mitigation measure. If it is determined that construction activities will affect an active nest or disrupt reproductive behavior, then avoidance strategies will be implemented.
- If after protocol surveys have been completed by July 1 in the year work is planned and occupancy has not been documented at the site (as determined by NOCA wildlife biologist), work may begin after July 1 of that year. If the site is occupied and nesting is occurring, construction activities within a 0.7 mile radius of the active nest cannot be conducted from March 1 through September 6 or after at least 4 weeks have passed since young fledged. This construction start date will be recommended by the NOCA wildlife biologist and approved by NOCA Superintendent.
- Not locating pullouts within line-of-sight (0.25 miles) of the area along the road that is immediately adjacent to the current spotted owl nest activity area if one is identified.
- Placing rock barbs from outside the wetted channel. The rock will be placed in the channel using heavy equipment that will be on the road or bank above the ordinary high water line.
- Storing food and garbage in wildlife-resistant containers during the day and removing all garbage off-site from project work areas at the end of each working day.
- The following reasonable and prudent measures with respect to northern spotted owls (developed by the USFWS in the Road Improvement Project Biological Opinion[USFWS 2005]) would also be implemented as part of the project by NPS wildlife biologists:
- Monitoring project implementation to ensure compliance with the conservation measures listed above, especially the seasonal timing restrictions and the final placement of the road near the spotted owl nest and reporting the results of this monitoring to the USFWS. A North Cascades Complex biologist would monitor the spotted owl nest to determine if the spotted owls produce young during the year(s) of project implementation. (*Note: The biologist would also determine whether the spotted owl nest is occupied or has moved.*) If young are discovered, then the biologist would estimate the age of the fledgling(s) as part of the timing restrictions described above.
- Reporting progress of the proposed action and its impacts on federally threatened and endangered species, particularly northern spotted owls to the USFWS as specified in the incidental take statement in the biological opinion in accordance with 50 CFR §13.45 and §18.27.
- Reporting any dead or injured Federally-listed species found in the action area within 24 hours to a special agent of the USFWS, Division of Law Enforcement at (360) 753-7764, or to the USFWS Western Washington Fish and Wildlife office at (360) 753-9440.
- Notifying USFWS in writing within 3 working days of the accidental death of, or injury to, a northern spotted owl or of the finding of any dead or injured spotted owls during implementation of the proposed federal action. Notification must include the date, time, and location of the incident or discovery of a dead or injured spotted owl, as well as any pertinent information on

circumstances surround the incident or discovery. The USFWS contact for this written information is the Manager for the Western Washington Fish and Wildlife office.

**Cumulative Impacts**: Over time, long-term adverse effects to special status species have occurred throughout the Cascades and Washington State. Adverse impacts have been associated with development, predator control, unnaturally frequent wildland fire, and habitat fragmentation, primarily from transportation corridors. Effects from past, present, and future actions occurring within Lake Chelan and the surrounding national forests and the NPS complex would continue to be primarily from administrative and private development in areas in close proximity to where it has already occurred. Ongoing actions to repair and maintain recreation area administrative facilities, including roads, bridges, housing, and visitor and maintenance facilities, would continue to occur and would continue to have negligible to minor incremental adverse cumulative effects on special status species. As noted in the ―Impacts to Wildlife” section above, ongoing impacts from the Forest Fire Fuel Reduction Program would continue to have both general wildlife impacts as well as potential impacts on special status species. A biological opinion for the program guides its implementation with respect to these impacts, allowing for some adverse effects on northern spotted owls. Similarly, a biological opinion covered the actions that would be implemented by the Road Improvement Project as part of this plan; however, a separate biological opinion is under preparation for this plan and would be part of the final EIS.

NPS actions would continue to be modified, if possible pending identification of special status species through surveys and other analysis, unless potential adverse effects are outweighed by other moderate long-term beneficial effects. In the present action, removal of development from the floodplain and channel migration zone of the Stehekin River under Alternatives 2 and 3 would have a long-term beneficial effect on riparian habitat and habitat diversity.

Because they would modify nearly 18 acres of the known habitat of a currently listed species that is declining throughout its range, Alternatives 2 and 3 would have moderate to major adverse cumulative effects on northern spotted owls, particularly within the project area. Alternatives 1 and 4 would modify less than 10 acres and would therefore have moderate cumulative adverse effects on northern spotted owls. For other species, including other federally listed and proposed species, project actions would result in long-term minor cumulative adverse effects, primarily because these species would be indirectly affected by project actions; because a comparatively small amount of their overall habitat would be affected; or because they are not currently known from the project area. Exceptions would include bald eagles, northern goshawks, harlequin ducks, western gray squirrels, and riparian affiliate birds (such as the olive-sided flycatcher), where there would be some beneficial and some adverse effects. Some additional negligible to minor adverse and beneficial effects would also be contributed to cumulative effects on special status species, such as amphibians and fish, from actions which affect water flow within the Stehekin River.

Road improvements may actually result in fewer long-term impacts to some species, such as fish, frogs, and toads, particularly where the road is relocated away from the river. Where the road is outside the channel migration zone and/or the 100-year floodplain (particularly through rerouting in Alternatives 2 and 3), fewer road repairs and maintenance would occur in proximity to aquatic species habitat, and there would therefore be less potential for disturbance from human activity based on the proximity of the road to the habitat. In all alternatives, the installation of barbs and logjams would contribute short-term adverse impacts from construction and long-term moderate adverse impacts from changes in river processes coupled with long-term negligible to minor beneficial cumulative impacts from the creation of new habitat.

**Conclusion**: Alternatives 1 - 4 may affect, and would be likely to adversely affect, northern spotted owls. Alternatives 1 - 4 may affect, but would not be likely to adversely affect, the following listed, proposed, or candidate species: grizzly bears, gray wolves, Canada lynx, Pacific fishers, bull trout, Dolly Varden, Chinook salmon, westslope cutthroat trout, or Columbia spotted frogs. Similarly, the proposed actions may affect, but would not be likely to adversely affect, the following federal species of concern: *mammals*: California wolverine, western gray squirrel, Pacific Townsend’s big-eared bat, small-footed (Yuma) myotis, western long-eared myotis, fringed myotis, and long-legged myotis; *birds*: bald eagle, peregrine falcon, northern goshawk, olive-sided flycatcher, harlequin duck, and black swift; and *amphibians*: western toad, spotted frog, Cascades frog, and tailed frog.

As noted above, there would be no known effect on the following state-listed, proposed, and candidate species or species of special concern: golden eagle, merlin, Vaux’s swift, black-backed woodpecker, Lewis’s woodpecker, pileated woodpecker, common loon, and western grebe.

Because there would be limited major adverse impacts to threatened or endangered species or species of concern, there would be no significant impact to and no impairment of Lake Chelan NRA’s special status species resources or values. Northern spotted owls may have become displaced from their existing nest site by barred owls prior to project implementation, or the presence of a male in May 2010 may signal return to the nest activity area. Other northern spotted owl nest sites within the lower Stehekin Valley would likely continue to produce young. Visitors and residents would likely continue to have the opportunity to hear or to experience rare glimpses of this threatened species.

# 11. CULTURAL RESOURCES

**Introduction to Cultural Resources Section**: Potential impacts to cultural resources, including archeological resources, prehistoric or historic structures, cultural landscapes, and traditional cultural properties, either listed in or eligible for listing in the National Register of Historic Places were identified and evaluated. Analyses were in accordance with the Advisory Council on Historic Preservation’s (ACHP) regulations implementing Section 106 of the NHPA (36 CFR 800, Protection of Historic Properties). Analysis included (1) determining the APE, (2) identifying cultural resources present in the APE that are National Register-listed or eligible, (3) applying the criteria of “adverse effect to affected resources,” and (4) considering ways to avoid, minimize, or mitigate adverse effects.

The criteria for characterizing the severity or intensity of impacts to National Register-listed or eligible archeological resources, prehistoric or historic structures, cultural landscapes, and traditional cultural properties are the Section 106 determinations of effect: no historic properties affected, adverse effect, or no adverse effect. A Section 106 determination of effect is included in the conclusion section for each analysis of impacts to National Register-listed or eligible cultural resources.

# 12. ARCHEOLOGICAL RESOURCES IMPACTS

## a. Archeological Resources Methodology

Archeological resources are typically considered eligible for inclusion in the National Register of Historic Places because of the information they contain or may be likely to yield (36 CFR 60.4). Any change in the physical attributes of an archeological site is irreparable and considered adverse and of permanent duration. Adverse impacts to archeological resources most often occur as a result of earthmoving activities within an archeological site, soil compaction or increased erosion, unauthorized surface collection, or vandalism.

Archeological resources impacts were analyzed qualitatively, with respect to whether or not surveys have revealed archeological information in the project area (or APE).

**Context of Impact**: Archeological resources were considered within the lower Stehekin Valley below High Bridge within the nonwilderness portion of Lake Chelan NRA and within the North Cascades National Park Complex.

**Type of Impact**: Adverse impacts would include activities involving ground disturbance (including soil compaction) in the presence of an archeological site, or activities that would increase the potential for vandalism, illegal collecting of artifacts, or destruction of a site. Beneficial impacts to archeological resources can occur when patterns of visitor use or management action are changed near archeological resources such that an ongoing impact is reduced or eliminated. Direct impacts can occur as a result of grading, trenching, or other activities that damage the structure of an archeological site. Indirect impacts can occur as a result of increasing visitor activity or management action near an archeological site, leading to effects such as artifact collection, accelerated soil compaction, and erosion.

**Intensity of Impact**: The intensity of impacts to an archeological resource would depend upon the potential of the resource to yield important information, as well as the extent of the physical disturbance or degradation. For example, major earthmoving at an archeological site with low data potential might result in a minor adverse impact, whereas major impacts would involve archeological sites with high data potential.

### Intensity for Cultural Resources (Archeology, Historic Buildings and Structures, and Cultural Landscapes) (Section 106 definitions)

- **No effect**: A determination of no historic properties affected means that either there are no historic properties present or there are historic properties present in the area of potential effects (APE) but the undertaking will have no effect upon them (36 CFR 800.4(d)(1)).
- **No adverse effect**: A determination of no adverse effect means there is an effect, but the effect would not meet the criteria of an adverse effect [36 CFR Part 800.5(a) (1)], i.e. diminish the characteristics of the cultural resource that qualify it for inclusion in the National Register (36 CFR 800.5(b)). The undertaking is modified or conditions are imposed to avoid or minimize adverse effects. This category of effects may have effects that are considered beneficial under NEPA, such as restoration, stabilization, rehabilitation, and preservation projects.
- **Adverse effect**: An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register, e.g. diminishing the integrity (or the extent to which a resource retains its historic appearance) of its location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the alternatives that would occur later in time, be farther removed in distance or be cumulative (36 CFR 800.5(a) (1)). An adverse effect may be resolved in accordance with the 2008 Programmatic Agreement, or by developing a memorandum or program agreement in consultation with the SHPO, ACHP, American Indian tribes, other consulting parties, and the public to avoid, minimize, or mitigate the adverse effects (36 CFR Part 800.6(a)). If an impact to National Register historic property cannot be resolved by agreement among SHPO, ACHP, American Indian Tribes, other consulting parties and the public it would be considered significant.

**Introduction**: Numerous cultural resources surveys have been conducted within the proposed APE over nearly two decades. The surveys were conducted pursuant to several types of proposed NPS undertakings, including road storm damage repair, road realignment, road resurfacing, trail construction, and fire management activities. The most recent survey was conducted by Bob Mierendorf, park complex archeologist, and Ray DePuydt, Lake Roosevelt NRA archeologist, in July 2008. Consequently, proposed road actions have been surveyed for cultural resources (Mierendorf 2009).

## b. Archeological Resources Impacts

### Impacts from Alternative 1

None of the 12 pre-contact period sites identified to date within the project area are located in areas that are proposed for undertakings. No pre-contact archeological sites have been recorded in or near proposed Company Creek Road actions. As additional detailed plans and APEs for each undertaking are developed, however, the recreation area would ensure that no known prehistoric or historic archeological resources are affected and that it continues to comply with Section 106 of the NHPA in analyzing effects to cultural resources.

Routine, ongoing maintenance of the road prism (area affected by previous road construction activities) would not result in major changes to existing areas of disturbance. Future road failure related to flooding would have the potential to disturb previously unknown or undiscovered archeological resources, as would replacement or modification of culverts, expansion of existing developed areas, and other actions. Continued encroachment from parking in undeveloped pullouts would also have the potential to affect previously unidentified archeological resources as erosion of bare soil continued.

Approximately 5 to 8 acres of previously disturbed land near the airstrip would also undergo soil disturbance as part of the housing and maintenance area replacement and relocation out of the floodplain.

Because archeological resources have been surveyed for within the proposed project area, because archeological resources found were outside the project area, and because the discovery potential for buried archeological resources would employ mitigation measures noted below, there would be no historic properties affected.

### Impacts from Alternative 2

As in Alternative 1, none of the 12 pre-contact period archeological sites is within an area proposed to be affected by the implementation of this alternative. There are two historic period sites within the project area, the Weaver Point Historic Site (45CH452) and the Stehekin Wagon Road (45CH429).

The Weaver Point Historic Site (45CH452) is near proposed actions but would not be affected by the implementation of Alternative 2. It is located at Weaver Point well away from the shoreline of either Lake Chelan or the mouth of the Stehekin River. This site is being tested as part of the Chelan PUD relicensing for the Lake Chelan hydroelectric project. The results of testing will determine appropriate management action as part of the FERC relicensing agreement. In the erosion protection component of the license, the southwest-facing area would be treated with a logjam and rock wall along approximately 500 feet at Weaver Point to prevent shoreline erosion from occurring where the lake intersects the bank. Access to the area (from the water) to implement these actions would not affect the archeological site. Since neither access nor implementation of proposed actions would occur near the historic archeological site and would occur along the edge of the lake / mouth of the Stehekin River outside the site's boundary, there would be no historic properties affected.

Construction of the reroute would likely not affect three closely spaced rock wall segments built on the downhill side of an abandoned roadbed (Stehekin Wagon Road) where it traverses the sloping toe of a large boulder-strewn debris cone. These rock walls would be retained. This portion of the Stehekin Wagon Road affected by Alternative 2 has been determined to be ineligible for the National Register. Based on archeological analysis, the features appear to lack integrity of association and workmanship; their age and affiliation with an original or early Stehekin Valley Road cannot be demonstrated; and they do not represent the best example of early road design and construction techniques in the lower valley

(Mierendorf 2009). Nonetheless, as a historic archeological feature, they would be documented using Historic American Engineering Record (HAER) criteria if they would be affected by road construction, and concurrence from the State Historic Preservation Officer (SHPO) regarding their proposed disposition would be sought as required by the NPS programmatic agreement (NPS et al. 2008).

As noted above in Alternative 1, archeological surveys have been conducted in areas associated with proposed actions in Alternative 1 and/or would be conducted and/or soil-disturbance activities would be monitored. In addition, archeological surveys of the proposed land exchange properties were also conducted (Mierendorf 2009). With the exception of the McGregor Meadows actions, those actions identified above would also be part of Alternative 2. Therefore, in addition to those areas identified above, soil disturbance would occur in the following areas: below Boulder Creek; along the Stehekin Valley Road at Milepost 3.8 (Frog Island), Milepost 8.0, and Milepost 9.2; for the McGregor Meadows / Lower Field reroute and McGregor Meadows Access Road; at Purple Point, Rainbow Falls, and near Bullion Raft Launch; near the mouth of the Stehekin River; at Lower Field and Buckner Homestead hayfield and pasture; and on proposed land exchange properties. Approximately 5 acres of previously disturbed land near the airstrip would also undergo some soil disturbance as part of the housing and maintenance facility replacement and relocation out of the floodplain.

Because no known National Register eligible archeological resources are found in these areas, because known archeological resources are outside the proposed areas that would be affected by the implementation of this alternative, because mitigation measures to document the ineligible rock wall features found along the reroute areas would be employed, and because the discovery of potential buried archeological resources would employ mitigation measures noted below, there would be no (known eligible) historic properties affected.

### Impacts from Alternative 3

Although Alternative 3 would include one additional erosion protection measure (at Lower Field) and one additional camp, along with shorter reroute, effects on archeological resources would be the same as described in Alternative 2: no historic properties affected.

### Impacts from Alternative 4

Impacts from Alternative 4 on archeological resources would be the same as described in Alternative 1: no historic properties affected.

### Measures to Avoid, Minimize, or Mitigate Impacts

Based on the NPS *Programmatic Memorandum of Agreement with the Association of State Historic Preservation Officers and the Advisory Council* (NPS et al. 2008), the following measures would be included in the proposed project to minimize impacts to archeological resources:

- Documenting the rock walls along the reroute (Alternative 2) using HAER criteria if these would be affected by proposed road construction.
- Stopping work in the area of identification and nearby areas if archeological resources are discovered at any point during the project work (as directed by the park) until the find is evaluated and action taken to avoid or mitigate the impact.
- When it is necessary to stop work due to archeological resources discovery, the contractor would cease all activities in the area of discovery, allow the archeologist to complete investigations, and

take measures to protect the resources discovered as directed by the park. (During this time, work may proceed in unaffected areas.)

- Determining if a monitoring plan is needed pending final construction plans, the cultural material that might be encountered, important archeological questions that could be addressed, and identifying a range of treatment options (e.g., avoidance, data recovery) for any findings.
- Avoiding further impact by modifying project implementation as needed at the site if archeological resources are discovered during implementation. If this is not possible, as much information as possible would be collected about the site in accordance with applicable laws and regulations and additional consultation with applicable agencies and tribes would occur as specified in the implementing regulations for Section 106 of the NHPA.
- Monitoring ground-disturbing actions as appropriate during construction to ascertain presence/absence of archeological materials within the proposed construction zone. Monitoring would be focused where buried historical deposits might be present beneath existing development. The NPS archeologist would identify sites prior to construction. Evaluating the eligibility of the site under National Register of Historic Places criteria if monitoring results in the discovery of archeological materials.
- Following procedures outlined in the Native American Graves Protection and Repatriation Act in the unlikely event that human remains or any objects protected under Native American Graves Protection and Repatriation Act are exposed. This would include the potential need to stop work for a minimum of 30 calendar days. (During that time, work may resume in nonsensitive areas.)

**Cumulative Impacts**: Archeological resources in the lower Stehekin Valley and elsewhere in the recreation area and park complex have likely been adversely impacted to varying degrees from past construction-related disturbances (prior to the advent of archeological resources protection laws), visitor impacts, vandalism, and erosion and other natural processes. Because mitigation measures would be employed to minimize impacts to potentially unidentified cultural resources in other proposed and future recreation area projects, it is likely that these measures would protect archeological resources from additional impacts. There would be no construction-related contributions that would affect known eligible archeological resources and therefore no cumulative impacts from Alternatives 1 - 4. There is a slight possibility, however, that future proposed work would affect currently unidentified cultural resources. Because mitigation measures would be implemented as noted above, Alternatives 1 - 4 would not be expected to contribute to cumulative effects on archeological resources.

**Conclusion**: Alternatives 1 - 4 would have no effect on known eligible archeological resources. Because there would be no historic properties affected, there would be no impairment of National Register eligible archeological resources or values.

## 13. CULTURAL RESOURCES: CULTURAL LANDSCAPES IMPACTS

### a. Cultural Landscapes Methodology

Historic buildings and structures and cultural landscape impacts were analyzed qualitatively, in accordance with 36 CFR 800 criteria of effect, based on their presence in the project area and the modifications that would be made to character-defining features (features that qualify the structures or landscapes for inclusion in the National Register). Historic structures and landscapes for which a determination of eligibility has not been completed were considered eligible.

**Type of Impact**: Impacts to cultural landscapes result from physical changes to contributing characteristics of a resource or its setting. Adverse impacts result when effects of the proposed action diminish the characteristics which make the structure or landscape eligible for the National Register or which diminish the overall integrity of the landscape (see –Methodology” section for more information). Beneficial impacts can occur as a result of restoration or rehabilitation of resources or removal of incompatible or noncontributing facilities. Direct adverse impacts generally occur as a result of modifying a significant characteristic of a historic structure or landscape resource; removal of a significant structure or landscape resource; or addition of new, incompatible facilities in proximity to a historic site or structure. Indirect adverse impacts can also occur following project completion. These impacts are generally associated with changes in historic vegetation or continued deterioration of historic structures.

**Photo 31 – Lower Stehekin River Valley in 1921 before Water Level of Lake Chelan was Raised (Note historic Field Hotel near left-center of the image)**

**Duration of Impact**: Impacts to historic structures and cultural landscapes are considered short term if they involve activities such as temporary removal of vegetation or other contributing resources, road closures, or prescribed burns, where the impacts are noticeable for a period of 1 to 5 years. Other short-term impacts to historic structures include constructing scaffolding surrounding a building during rehabilitation work, or minor deterioration in historic fabric that is repairable as part of routine maintenance and upkeep. Long-term impacts usually last longer than 5 years but may include reversible changes to a contributing characteristic of a historic structure or landscape, such as alteration of historic appearance. Long-term adverse impacts to a historic structure or landscape resource include reversible and irreversible changes in contributing characteristics, such as loss or removal of historic fabric; other changes to the historic character of a property; demolition of a historic structure; construction of an incompatible addition or adjacent facility; or removal of a structure from its historic setting.

**Intensity of Impact**: See –Intensity of Impact” Cultural Resources in –a. Archeological Resources Methodology.”

## b. Cultural Landscape Impacts

### Impacts from Alternative 1

None of the three cultural landscapes within the project area—the Golden West Lodge Historic District, Buckner Homestead Historic District, and High Bridge Ranger Station Historic District—would be affected by actions proposed in Alternative 1 (no historic properties affected).

### Impacts from Actions Common to Alternatives 2 - 4

The Buckner Homestead Historic District would be affected by proposed actions in Alternatives 2 - 4 to restore natural riparian conditions at the Buckner Homestead lower hayfield and pasture.

Of the following characteristics associated with cultural landscapes: spatial organization, circulation, topography, vegetation, structures, and buildings (see Chapter IV: Environmental Consequences—Cultural Landscapes), only vegetation would be affected by proposed actions in Alternatives 2 - 4. There would be no effect on spatial organization, circulation, topography, structures, or buildings. Vegetation restoration, however, would result in long-term beneficial effects from slowing erosion at Buckner Homestead Historic District. This action would help to retain not only the hayfield and pasture, but also other features associated with the site, including the homestead.

To prevent additional erosion of the Stehekin River bank adjacent to the hayfield and pasture, under Alternatives 2 - 4 approximately 500 feet of bank, for a width of about 30 feet (0.34 acre), would be planted with native riparian plants. This would have a long-term minor beneficial effect on the cultural landscape associated with the Buckner Homestead Historic District because the riparian edge that formerly existed along the hayfield and pasture has been lost due to erosion of the Stehekin River bank. Restoration would help to retain land that is protecting other features associated with the cultural landscape. As a result, Alternatives 2 - 4 would have no adverse effect on the Buckner Homestead Historic District.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to cultural landscapes would include the following:

- Implementing appropriate measures under “Cultural Resources: Archeological Resources.”
- Ensuring that access to the Buckner Homestead hayfield and pasture would be via existing roads and paths.

**Cumulative Effects**: Although over time, portions of the recreation area’s cultural landscapes have likely been lost, such as some historic homes, NPS actions to identify and to designate these areas has had a long-term beneficial effect on preserving the intact characteristics associated with them. For each of the cultural landscapes, a cultural landscape inventory has identified remaining features and whether they continue to contribute to the historic significance of the area. As a result, preservation techniques have become focused on those character-defining features which contribute to the area’s significance. Although all three cultural landscapes are historically based, some of their components are related to prehistoric resources. In time, additional cultural landscapes may be designated within the lower Stehekin Valley and/or the park complex as more information is acquired and lands are evaluated, a long-term beneficial effect. Actions in Alternative 1 would have no contribution to cumulative effects on cultural landscapes. Alternatives 2 - 4 would contribute long-term beneficial effects (no adverse effect).

**Conclusion**: Under Alternative 1, there would be no historic properties affected. Alternatives 2 - 4 would have long-term beneficial effects (no adverse effect) on rehabilitation of the cultural landscape at Buckner Homestead Historic District from vegetation restoration of the riparian edge along the pasture and hayfield. Vegetation restoration of the riparian area would have no adverse effect on the Buckner Homestead Historic District. Because there would be no adverse effect on cultural landscapes, there would be no impairment of resources or values associated with cultural landscapes from the implementation of Alternatives 1 - 4.

# 14. VISITOR EXPERIENCE

## Visitor Experience Methodology Overview

Impacts on visitor experience have been assessed using professional judgment to analyze the effects of actions on the activities of different visitor populations and different aspects of visitor use.

**Type of Impact**: Impacts on visitor experience may occur as a result of changes in road circulation, interpretation, interpretive media, campgrounds, trails, and other facilities and resources that contribute to the type and quality of visitor experience in Lake Chelan NRA. Impacts may also occur from direct actions altering the availability of a specific experience or activity. Visitor experience is also directly affected by actions influencing natural resources, such as air quality, scenic resources, and cultural resources. For example, the experience of a scenic view that is lost on a cloudy or hazy day may diminish the overall experience of a visit to an area that focuses on the view, such as from a wayside exhibit or a vista point. The extent of enhancement or degradation of natural and cultural resources, including air and water quality, the presence of vegetation (such as flowers in spring) or wildlife, and other resources (such as the experience of an excavated and interpreted archeological site or intact historic structure), also enhances or degrades the quality of the visitor experience. Beneficial impacts would enhance visitor participation and visitors' ability to connect with recreation area resources, the quality of visitor experience, and the kinds of opportunities available for recreation area visitors, including scenic resources and safety. Adverse impacts would reduce the number and quality of these experiences.

**Intensity of Impact**: This is identified separately below for each of the following categories of visitor experience: access and transportation, interpretation and education, visitor use opportunities, safety, and scenic resources.

# 15. VISITOR EXPERIENCE: ACCESS AND TRANSPORTATION IMPACTS

## a. Access and Transportation Methodology

Methodology would be the same as ―Visitor Experience."

**Type of Impact**: Same as ―Visitor Experience."

### Intensity of Impact

- **Negligible**: Impacts would be imperceptible or not detectable.
- **Minor**: Impacts would be slightly detectable or localized within a relatively small area.
- **Moderate**: Impacts would be readily apparent over a large area.

- **Major**: Impacts would be substantial, highly noticeable changes in ease of access and transportation.

## b. Access and Transportation Impacts

### Impacts of Alternatives 1 - 4

**Transportation of Materials and Supplies**: There would be negligible to minor short-term adverse impacts on visitor and resident access and transportation in the lower valley from transportation of materials and supplies for proposed projects under all alternatives. Under all alternatives, particularly Alternatives 1 and 4, there would be an increase in the number of barge loads for several years following approval of proposed actions. These would include transportation of people and construction materials for the maintenance and housing areas and surfacing materials for the road. In Alternatives 1 and 4 these would also include large amounts of imported fill for the road grade raise in McGregor Meadows that would take 300 - 500 truck trips from the Landing.

In general, it is likely that most visitors would be unaffected by the increase in barge and truck traffic, especially because it would occur over time as the proposed projects were implemented. Visitors and residents would be impacted by truck traffic on the road during weekday business hours and at other times as approved by the superintendent. Road construction would generally occur in summer and fall over two years. This would be followed by two to three years of work to relocate the housing and maintenance area. Residents, because they frequently come and go, would notice the increase in traffic more. In the first one to two years following approval, depending on the selected alternative, work would be concentrated on the road improvements and erosion protection measures, while afterwards, work would be concentrated on recreational improvements, building construction, and restoration.

Both residents and visitors would experience localized minor to moderate short-term adverse impacts from traffic delays related to construction, particularly from road rehabilitation actions during construction. Residents and visitors would notice a substantial increase in the number of dump truck loads of materials traveling on the Stehekin Valley Road, especially under Alternative 1. Because of the number of dump truck loads that would be required to transport fill materials for the grade raise, these impacts would likely be greatest under Alternatives 1 and 4; however, impacts of construction from the removal of fill from Wilson Creek (all alternatives) and Milepost 8.0 (Alternatives 2 - 4) would also result in impacts and traffic delays.

As a result of the road rehabilitation, residents and visitors would encounter one-lane road closures with construction delays of up to 20 minutes during the week. On weekends and holidays, construction would cease, except if it was associated with the reroute (off the main road) or unless approval for work on these days was granted by the superintendent. The proposed road rehabilitation under Alternatives 1 and 4 would take approximately one construction season to complete and would likely begin the year following approval of the plan. Road work under Alternatives 2 and 3 would likely take two or more seasons to complete. Work that would affect key visitor use areas would be scheduled before or after the main visitor use season to avoid impacts to the greatest number of people. Recreation area visitors would be informed of construction delays through various means, including press releases to local media, Stehekin Community e-mails, notification at visitor and information centers and local businesses, and signs posted on bulletin boards in the recreation area, at the boat dock, and on the boat.

**Road Improvements**: The rehabilitation of the road would affect visitor access through a variety of means, including constructing smoother roadways, providing clearer signs, and creating more pullouts. Long-term minor to moderate beneficial impacts on visitor and resident travel on the Stehekin Valley Road under the alternatives would include the following:

- Improvements in sight distance along the road (all alternatives)
- Safer passing from adding pullouts to facilitate traffic movement (all alternatives)
- Improvements in the road that would make it less susceptible to temporary closures and flood damage (improvements associated primarily with the reroutes in Alternatives 2 and 3, from the grade raise in Alternatives 1 and 4, and from erosion protection measures in all alternatives)
- Reduced probability of complete slope failure by reducing the grade of the slope below the road and improving stability of the riverbank (at Milepost 5.3, Wilson Creek) (all alternatives)
- Fewer rock falls from laying back the steepest upper part of the slope, rock scaling, and revegetation at Milepost 8.0 (Alternatives 2 - 4)
- Diminished dust and potholes and a smoother travel surface from surfacing most of the road (all alternatives)
- Improved conditions from revegetation of disturbed and abandoned sections of road (all alternatives) and where reroutes were constructed (Alternatives 2 and 3).

These actions would also have short-term minor to moderate adverse impacts from traffic delays and construction noise and activity.

**Company Creek Road and McGregor Meadows**: Access to and through these areas would continue to be problematic because of periodic flooding under all alternatives. Because the Company Creek Road would not be rerouted and would therefore continue to remain directly adjacent to the right bank of the Stehekin River, across from McGregor Meadows, there would continue to be long-term adverse impacts to visitors and residents living in and traveling through this area because of the potential increased magnitude and frequency of flooding. Most flooding occurs during nonpeak visitation periods, and few visitors use the upper Company Creek Road. Actions taken after the 2003 and 2006 floods, including installation of three grade-control structures and four rock barbs, have stabilized the area.

Under Alternatives 1 and 4, less flooding of the road would occur in the McGregor Meadows area due to the grade raise; however, the area would continue to experience periodic flooding that would preclude transportation to and through the area. If past trends in rapid gravel deposition in the main channel continue, flooding and erosion of the road would get worse.

**McGregor Meadows Access Road**: Alternatives 2 - 3 would improve conditions for most visitors and some residents because of the reroutes; however, the McGregor Meadows Access Road would continue to be flooded and subsequent temporary closures during road repairs would be necessary. Recent improvements, including grade-control structures, above this area would continue to be maintained under all alternatives to reduce the potential for the river to cut a new channel down the road from the river bed at Milepost 6.8. Under Alternatives 2 and 3, residents who live in McGregor Meadows and visitors to these areas could also experience more difficulty in access by motor vehicle, due to the reduced road maintenance, particularly in the winter. Motor-vehicle access to the river in this area would also become slightly more difficult because the road would end at the last private parcel and visitors would no longer be able to drive to some parts of the Stehekin River shoreline. Construction of the Lower Valley Trail along the roadbed would enable continued pedestrian access to the area and provide the minor benefit of a more serene visitor experience along the river, which could include fishing and hiking. Because of a lack of through access, residents and visitors continuing up would have to double-back at the end of the access road and retrace their path to the rerouted main Stehekin Valley Road. As a result, reduced motor-vehicle access into the vicinity of McGregor Meadows could have negligible to minor adverse impacts on some visitors. Other visitors would experience beneficial effects from reduced motor-vehicle use and the opportunity to hike in an area of former roadway. Over time, some impacts would diminish as visitors and residents adjusted to the changed road location.

**Rafting**: Barbs would continue to be submerged during high flow periods in spring and early summer when floating the river is most popular. During late summer and winter, the upper parts of barbs would likely protrude above the water surface near the bank, but would minimally affect the rafting experience nearby, similar to other natural river obstacles (NPS 1997:34). The number of raft trips decreases substantially as river flows drop in late summer. In addition, eddies and pools on the downstream side of the barbs could serve as resting areas during raft trips. These effects would be moderate in Alternative 4, which has the most barbs, and minor in Alternatives 2 and 3, with less than half as many barbs. Because logjams could be a hazard to boaters, final designs for these would be approved in consultation with a consortium of river rafting guides modeled after a process used by King County. Construction of a new raft takeout in Alternatives 2 and 4 would result in a minor to moderate long-term benefit to access for recreational users of the Lower River and head of Lake Chelan.

**Lower Valley Trail**: In addition to the trail itself, a variety of new access opportunities would be provided by the trail. Access across the river would be shorter and more direct to Weaver Point and the River Trail from Stehekin Landing. From the Landing, it is approximately 1 mile on the River Trail to Weaver Point, where a walk-in/boat-in campground is available. The footbridge crossing would also make it feasible for visitors to hike a loop that included portions of the River Trail and the proposed Lower Valley Trail (approximately 12.5 miles long). The Lower Valley Trail’s connection with the Stehekin River Trail would also allow for a new loop trail opportunity and would enhance access by providing a bridge across the river at Boulder Creek. This would shorten the trail distance from the Landing to Weaver Point Campground and provide a minor to moderate long-term beneficial effect for some people.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to visitor and resident access and transportation, interpretation and education, visitor use opportunities, scenic resources, and safety would include the following:

- Allowing construction delays and one-lane closures to be no longer than 20 minutes per passage through the project (longer delays could be approved in advance).
- Avoiding evening, weekend, and holiday work by requiring approval in advance. Longer construction delays or total road closures would also be approved in advance.
- Distributing press releases to local media, locating signs in the recreation area, and providing information on the boat to inform visitors about road conditions in the lower Stehekin Valley during the project.
- Using a public information program to warn of construction-related road closures, delays, and road hazards.
- Keeping a McGregor Meadows and Lower Field route open during reroute construction (Alternatives 2 and 3).
- Providing notice to equestrians (e.g., Stehekin Valley Ranch) regarding conditions that could make the road temporarily impassable for horse crossing.
- Managing vehicle traffic and contractor hauling of materials, supplies, and equipment within the construction zone to minimize disruptions in visitor traffic.

- Developing a safety plan prior to the initiation of construction to ensure the safety of recreation area visitors, workers, residents, and park staff.
- Minimizing dust during construction on public roadways (by minimizing soil disturbance, spraying water [no chemicals] over disturbed soil areas during dry periods, and revegetating disturbed soil areas as soon as practical following construction).

**Cumulative Impacts**: Over the long term, visitors and residents have experienced moderate to major adverse impacts on access and transportation from the closure of the upper portion of the Stehekin Valley Road (above Car Wash Falls). Closure of the road after the 2003 flood initially resulted in a decrease in the number of visitors to this area, over time the number of visitors has risen and is now essentially the same as it was in the past, based on recent visitor use statistics. Other impacts have occurred from periodic closure of the road in the lower valley below High Bridge during and after floods. Alternative 1 and, to a lesser degree, Alternative 4 would continue to contribute minor adverse impacts to access because flooding damage could result in more frequent road closures, primarily during fall floods in McGregor Meadows. Although the road through portions of McGregor Meadows would be raised in Alternatives 1 and 4, large floods could erode road fill or wash out other sections of roadway, resulting in the need for repairs before access could occur. Alternative 4 would contribute fewer adverse impacts because erosion protection measures and realignments would help to minimize the areas of future road washouts. Access along Company Creek Road would not change and would continue to be affected by periodic flooding. Extensive rock barbs, bioengineering, and three grade-control structures already in place on the upper Company Creek Road would continue to require maintenance.

Alternatives 2 and 3 would contribute long-term minor to moderate beneficial impacts from dependable road access past McGregor Meadows, while Alternative 2 would also contribute long-term dependable road access to above the Lower Field area. With erosion protection measures, Alternatives 2 - 4 would likely result in better access than Alternative 1 from bank stabilization. Drainage improvements at Milepost 9.2 should eliminate a problem caused by a debris flow in 2009. Slope stabilization at Milepost 8.0 would improve safety and access from reducing rock fall hazards.

All alternatives would contribute short-term minor to moderate adverse effects on transportation during construction that would generally affect residents more than visitors. These include traffic delays from transport of fill and construction materials and other road construction activities. Similarly, long-term negligible to minor beneficial effects on transportation would be contributed under Alternatives 1 - 4 from rehabilitation of the road (Alternatives 1 - 4) or construction of new segments of road (Alternatives 2 and 3) and from improved driving conditions, signage, and safety improvements such as increased sight distance and pullouts. Elimination of dust from the road surface would have a long-term minor to moderate beneficial impact above Harlequin Bridge.

**Conclusion**: Alternatives 1 - 4 would have short-term negligible to moderate adverse and negligible to moderate beneficial impacts. Additional moderate adverse effects would occur in Alternatives 1 and 4 related to transportation of fill and flooding of access routes. Alternatives 2 - 4 would add long-term minor to moderate beneficial effects from actions at Milepost 8.0 and from stabilization of the road, whether in place or with a reroute. Additional minor adverse impacts would occur from erosion protection measures.

# 16. VISITOR EXPERIENCE: INTERPRETATION AND EDUCATION IMPACTS

## a. Interpretation and Education Methodology

Methodology would be the same as ―Visitor Experience.”

**Type of Impact**: Same as ―Visitor Experience.”

### Intensity of Impact

- **Negligible**: Impacts would be imperceptible or not detectable.
- **Minor**: Impacts would be slightly detectable or localized within a relatively small area.
- **Moderate**: Impacts would be readily apparent.
- **Major**: Impacts would be substantial, highly noticeable, and/or result in changing the nature and extent of programming.

## b. Interpretation and Education Impacts

### Impacts from Alternative 1

There would be ongoing minor to moderate beneficial impacts from existing interpretive and educational programs. As called for by the GMP, the Lower Valley Trail would provide several new interpretive opportunities. One would include opportunities for better interpretation of the Stehekin Wagon Road and its extant historic features in the lower valley and the other would include the old Skinny Wilson homestead near Wilson Creek, which is potentially eligible for the National Register of Historic Places. It would also provide opportunities to interpret numerous natural features in the lower valley. A relocated Bullion Campground would provide some limited additional opportunities to learn about recreation area resources from information signs in the camp. Effects on interpretation and education as a result of the implementation of Alternative 1 would be negligible to minor and beneficial.

### Impacts from Actions Common to Alternatives 2 - 4

Alternatives 2 - 4 would result in a variety of minor to moderate long-term beneficial effects on interpretation and education. Visitors and residents could learn more about the changes in the Stehekin River wrought by the increased frequency and magnitude of flooding and how this likely may relate to a changing environment. As in Alternative 1, there would be increased opportunities to learn about the Stehekin Wagon Road and Skinny Wilson’s homestead from construction of the Lower Valley Trail. New campsites at Rainbow Falls and Purple Point Horse Camp, a relocated Bullion Campground (in Alternatives 1 - 4) and a new Company Creek Campground (in Alternatives 3 and 4) would provide some limited additional opportunities to learn about recreation area resources from information signs placed at these locations in association with the camps.

The enhancement of interpretive and educational programming for the general public, local residents, and the media would include an emphasis on the value of large woody debris in the river environment, the role of flooding in river ecosystems, and on the value of allowing floodwaters to occupy the floodplain / channel migration zone by minimizing human impacts to river processes. These programs would continue to include river hazard-related visitor and resident safety messages to ensure meaningful, satisfying, and safe recreation area experiences.

### Measures to Avoid, Minimize, or Mitigate Impacts

Same as Access and Transportation Impacts.

**Cumulative Impacts**: Over time, the recreation area has changed both the number of programs and the diversity of interpretive and educational programming and targeted specific programs for different audiences. Alternatives 1 - 4 would have minor beneficial effects on interpretation and education. New interpretive opportunities would also increase in Alternatives 2 - 4 because of more access opportunities to learn about the river environment. Combined with Alternative 1, these impacts would be negligible to minor and localized.

**Conclusion**: Alternatives 1 - 4 would have minor to moderate beneficial effects, with slightly more beneficial effects in Alternatives 2 - 4.

# 17. VISITOR EXPERIENCE: VISITOR USE OPPORTUNITIES IMPACTS

## a. Visitor Use Opportunities Methodology

Methodology would be the same as ―Visitor Experience."

**Type of Impact**: Same as ―Visitor Experience."

### Intensity of Impact

- **Negligible**: Visitors would not be affected or changes in visitor use opportunities would be below or at the level of detection. Any effects would be short term. Visitors and residents would likely be unaware of the effects associated with the alternative.
- **Minor**: Changes in visitor use opportunities would be detectable, although the changes would be slight and likely short term. Visitors and residents would be aware of the effects associated with the alternative, but the effects would be slight.
- **Moderate**: Changes in visitor use opportunities would be readily apparent and likely long term. Visitors and residents would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes.
- **Major**: Changes in visitor use opportunities would be readily apparent and would have substantial long-term consequences. Visitors and residents would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.

## b. Visitor Use Opportunities Impacts

### Impacts from Alternative 1

Alternative 1 would primarily continue to offer the current range of visitor use opportunities, including hiking, bicycling, horseback riding, rafting, skiing, hunting, fishing, and wildlife viewing. Interpretive and education programs interactions with Stehekin residents, staff, and other visitors, and participation in wilderness experiences (solitude and primitive recreation experiences) would also continue. These would continue to provide long-term minor to moderate beneficial impacts.

The implementation of proposed actions in this alternative, however, would result in additional moderate long-term beneficial effects, including hiking and horseback riding opportunities from the construction of the Lower Valley Trail. Other benefits would include a new loop trail experience on the Stehekin River

Trail and a safer driving experience on the road, with improved access to pullouts and an improved driving and bicycling surface. New parking and a formal, safe winter turnaround area would also benefit visitors. Surfacing the roadway would eliminate dust and decrease dust irritation to motorists and recreational users, particularly bikes and pedestrians. Overall impacts would be beneficial from maintaining access, increasing driver safety, and surfacing the road. There would be more sustainable opportunities to camp at the relocated Bullion Campground.

During and immediately following construction, wildlife viewing opportunities would likely diminish in the project areas, a short-term negligible to minor adverse effect on visitor use opportunities. During this time, there would be fewer opportunities to encounter natural conditions in the construction areas. Over time, as construction activities subsided, these impacts would diminish and most wildlife would return to the areas and opportunities would return or even increase, because of the increase in edge habitat in some areas.

### Impacts from Actions Common to Alternatives 2 - 4

Compared to Alternative 1, Alternatives 2 - 4 would offer the same kinds of visitor use opportunities; however, these would be expanded, a moderate mostly beneficial long-term impact. There would be more opportunities for visitors to learn about the Stehekin River through expanded interpretive programs and new interpretive signs at camps and along trails. There would be more camping opportunities from the establishment of campgrounds at Purple Point Horse Camp and Rainbow Falls, as well as more sustainable opportunities to camp at the relocated Bullion Camp. Alternatives 3 and 4 would also include another campground at Company Creek, offering expanded camping opportunities off the main road. Although not all visitors would take advantage of all the expanded opportunities, effects would be mostly beneficial, but would also result in some negligible to minor adverse impacts on the experience of those visitors and residents who would prefer fewer formal camps, recreation facilities, and trails in the valley. It is likely that backpackers and groups visiting Stehekin, in particular, would benefit from expanded camping opportunities. There would be minor beneficial effects on fishing from creation of pool habitat and restoring riparian vegetation by constructing logjams and rock barbs along the Stehekin River.

In addition, there would be a raft takeout on public land near the mouth of the river in Alternatives 2 and 4. To the recreating public, this facility would represent a long-term minor to moderate beneficial impact by providing a convenient access point at the end of a journey down the river or the beginning of a journey to the head of the lake. Moving the entrance to the access road off private land would create a long-term minor to moderate beneficial impact for nearby landowners and the public. (The current road passes within 10 feet of a cabin.)

Impacts associated with the Lower Valley Trail would be similar to those in Alternative 1; however, in Alternatives 2 and 3, the trail would take advantage of more existing road and trail and would require fewer constructed miles than in either Alternative 1 or Alternative 4. In both cases, however, the trail would be approximately the same length.

The road reroutes in Alternatives 2 and 3 would add to the diversity of the driving experience along the Stehekin Valley Road in a way that would be preferred by some visitors and residents and disliked by others. Compared to Alternatives 1 and 4, the driving experience would be well away from the Stehekin River for 1.9 or 1.7 miles, depending on which reroute was implemented. Both would result in about 40 percent of this part of the road (within the project area) moving into a forested area, rather than a combination of open and forested landscape. Although visitor use opportunities to see some wildlife species could diminish, opportunities to see other species would increase. As noted below in the ―Visitor Experience: Scenic Resources" section, there would be changes in the visual character of the road that would affect the visitor experience of scenic views and vistas along this same section of the road

(Alternatives 2 and 3). Whether this would be a beneficial or adverse impact would depend on the viewer. Rafters and anglers might prefer the removal of the road from next to the river, and although access would be via a flat, 0.5-mile-long trail to the east bank, the west bank is accessible from Company Creek Road. Alternative 2 would also contribute some enhanced wildlife viewing opportunities in the Lower Field area, since there would be less human disturbance in the field along the river, access would continue via the Lower Valley Trail, and wildlife sightings could increase.

All alternatives would result in the same kinds of short-term construction-related impacts to visitor use described above under Access and Transportation Impacts and in this section under Alternative 1, as well as those related to wildlife viewing described in Alternative 1. There would be fewer overall impacts from traffic delays related to the construction of the reroutes (Alternatives 2 and 3) because the road through McGregor Meadows would remain open. There could be some delays on this route related to materials movement and deliveries until the reroute was complete (both alternatives would retain a 0.8-mile portion of the old road as the McGregor Meadows Access Road). Most of the adverse impacts to visitor use would occur between Company Creek Pit to McGregor Meadows due to construction and would result in minor adverse impacts on visitor use by causing increased levels of noise and dust, degraded views, and delays in accessing the upper or lower Stehekin Valley via the road. Increased noise and changes in visual quality could have short-term negligible adverse impacts on visitors in the wilderness area.

Since much of the current visitor use would occur well away from the proposed reroute and maintenance and housing replacement and relocation project areas, it would not be added to that of the reroute disturbance. Most other actions, however, would occur in the vicinity of visitor and residential use, and some residences are near the reroute alignment and the construction site for the new raft takeout in Alternatives 2 and 4. Those residents and visitors near the road and the reroute construction areas would therefore experience short-term moderate adverse impacts from noise and activity related to road construction. The same would be true of residents and visitors along lower Company Creek Road and near the Stehekin airstrip, where a moderate amount of activity related to relocating the existing and constructing the new maintenance facility and housing would occur. Trucks crossing Harlequin Bridge would result in short-term disruptions at Harlequin Camp and on access to the Stehekin River Trail. Temporary inconveniences related to construction would also occur to visitors and residents not being able to take advantage of some opportunities due to road construction delays.

### Measures to Avoid, Minimize, or Mitigate Impacts

Same as Access and Transportation.

**Cumulative Impacts**: Resident and visitor use opportunities have increased gradually over time within Lake Chelan from the development of visitor facilities. Effects from the Forest Fuel Reduction Program have also likely contributed to increased wildlife viewing opportunities from the opening of thickly forested areas surrounding the road and from the creation of edge habitat from fuel-reduction activities, including from the ability to see into adjacent forested areas. Most erosion protection projects implemented over the last 15 years have not resulted in increases or decreases in resident and visitor use opportunities. Some projects, however, have altered the visitor experience on the road (such as the extensive Coon Run reroute). Although visitor use activities would remain largely unchanged under Alternative 1, this alternative would have long-term minor to moderate beneficial impacts on visitor use opportunities from the construction of the Lower Valley Trail and its linkage to the Stehekin River Trail and from improved driving conditions on a surfaced road. Negligible to minor short-term adverse effects would be contributed from construction activities, which would diminish wildlife presence in construction areas. Alternatives 2 - 4 would have the same effects as Alternative 1 plus would contribute an increasing series of minor to moderate long-term beneficial effects from establishing additional or improved camps and in Alternatives 2 and 4, a raft takeout. Views and vistas would change on the Stehekin Valley Road in

Alternatives 2 and 3, with more of the road traversing a drier forested area, a minor long-term adverse or beneficial effect, depending on the viewer.

**Conclusion**: There would be few new opportunities in Alternative 1; however there would be improvements in existing opportunities. Compared to the negligible to moderate beneficial effects in Alternative 1, Alternatives 2 - 4would have both more opportunities and more improvements (minor to beneficial effects) than Alternative 1.

# 18. VISITOR EXPERIENCE: SAFETY IMPACTS

## a. Safety Methodology

Visitor and employee safety impacts were assessed qualitatively based on past studies which identified specific problems in the project area.

**Type of Impact**: See ―Visitor Experience."

### Intensity of Impact

- **Negligible**: Visitors would not be affected or changes in visitor safety would be below or at the level of detection.
- **Minor**: Changes in visitor use safety would be detectable, although the changes would be slight and likely short term.
- **Moderate**: Changes in visitor safety would be readily apparent and likely long term.
- **Major**: Changes in visitor safety would be readily apparent and would have substantial long-term consequences.

## b. Safety Impacts

### Impacts from Actions Common to Alternatives 1 - 4

The following specific actions called for by these alternatives would have negligible to moderate improvements (beneficial effects) on visitor, resident, and/or employee safety. These would include actions that involve the following:

**Negligible Beneficial Impacts**

- There would be ongoing grading of unsurfaced sections of road or access road (Alternatives 1 - 4).

**Minor Beneficial Impacts**

- Surfacing the road would reduce the potential for pothole formation and defensive driving methods required when they form (Alternatives 1 - 4).
- Surfacing the road would likely reduce visitor, staff, and resident bicycle accidents caused by riding on a gravel surface.
- Constructing a designated winter turnaround area with parking would improve operations and visitor experience (Alternatives 1 - 4).

**Moderate Beneficial Impacts**

- Improving sight distance along portions of the road, either by slight realignments or by adding pullouts (Alternatives 1 - 4), would improve driving conditions.
- Relocating the maintenance area from the Stehekin River floodplain / channel migration zone would reduce the amount of employee time spent in this area and residents' needs to go there to for solid waste disposal as well as allowing access to emergency equipment when needed during flooding (Alternatives 1 - 4).
- Surfacing of the road would eliminate dust and improve air quality for residents, visitors (particularly bicyclists), and NPS employees (Alternatives 1 - 4).
- There would be reduced employee exposure to cramped conditions and hazardous materials, including asbestos, lead-based paint, and rodent infestations from constructing new, buildings designed for the maintenance area (Alternatives 1 - 4).
- There would be increased ability to pass safely by more pullouts both on the main road (Alternatives 1 - 4) and from adding pullouts to the reroutes (Alternatives 2 and 3).
- Using barbs or logjams would protect vulnerable sections of the Stehekin Valley Road along steep riverbanks (Alternatives 2 - 4).
- Rock fall hazard would be reduced at Milepost 8.0 (Alternatives 2 - 4).
- Rerouting portions of the road away from the Stehekin River (Alternatives 2 and 3) would increase fire protection and emergency access.
- Changing LPP priorities regarding land acquisition and exchange (Alternatives 2 - 4) would allow residents in flood-affected areas to relocate to other parts of the lower Stehekin Valley, if desired.

**Adverse Impacts**

Long-term negligible to moderate adverse effects associated with all alternatives would remain from retaining sections of the Stehekin Valley Road in the floodplain / channel migration zone near the head of Lake Chelan and from the road's proximity to rock fall hazards along the lake shore, at Harlequin Bridge, and at Frog Island. In Alternatives 1 and 4, an additional 1.8 miles of road would remain vulnerable to floods in McGregor Meadows. In Alternatives 2 and 3, there would be long-term negligible to moderate adverse effects from relocating the road where it would cross several debris cones formed by small, steep, tributary streams. Debris cones are formed, in part, by snow avalanches, debris flows, and flood deposits. None of these debris cones along the reroute area has had a recent debris flow; however, a snow avalanche occurred in 2008.

All alternatives would continue to maintain access for emergency services such as emergency medical services, search and rescue, and fire suppression. This includes the McGregor Meadows access road in Alternative 2, although this section could be temporarily closed by floods and flood damage. These services would be more consistent in Alternatives 2 - 4 because the Stehekin Valley Road would be rehabilitated or rerouted and available for use during flooding. Comparatively more locations could continue to wash out in Alternative 1 and, to a lesser extent, Alternative 4. Regardless, maintaining access would continue to be a high priority. Parts of Company Creek Road would continue to be closed by periodic flooding.

## Measures to Avoid, Minimize, or Mitigate Impacts

Same as b. Access and Transportation.

**Cumulative Impacts**: Alternatives 1 - 4 would contribute a variety of negligible to minor beneficial impacts on visitor, resident, and employee safety. Road improvements under all alternatives would contribute the greatest number of these effects, while construction of the new maintenance area would result in improved operations efficiency and safety from the improved condition of facilities and working conditions. While Alternatives 1 and 4 provide minor safety improvements, Alternatives 2 and 3 would result in long-term moderate beneficial impacts from improving safety conditions related to rerouting the road; as a result, Alternative 2 would have slightly greater benefits.

**Conclusion**: Alternatives 1 and 4 would contribute negligible to minor beneficial impacts on safety, while Alternatives 2 and 3 would have moderate beneficial impacts because of the reroute and changes in LPP priorities. There would also continue to be negligible to moderate adverse effects from retaining sections of the road in the floodplain / channel migration zone where it cannot be moved (Alternatives 2 and 3) or to retain the existing road alignment (Alternatives 1 and 4).

## 19. VISITOR EXPERIENCE: SCENIC RESOURCES IMPACTS

### a. Scenic Resources Methodology

Scenic resources impacts were assessed qualitatively based on how the proposed actions would change the appearance of scenery.

**Type of Impact**: Adverse impacts were considered those that would focus viewing on human-constructed modifications, rather than natural scenery; beneficial impacts would enhance a natural scenic view.

#### Intensity of Impact

- **Negligible**: Impacts would be imperceptible or not detectable.
- **Minor**: Impacts would be slightly detectable or localized within a portion of the project area.
- **Moderate**: Impacts would be readily apparent.
- **Major**: Impacts would be substantial, highly noticeable changes to the character of the landscape.

### b. Scenic Resources Impacts

#### Impacts from Actions Common to Alternatives 1 and 4

The scenic driving experience on the Stehekin Valley Road would not undergo major changes as a result of the implementation of Alternative 1. The road would continue to be a narrow, curvy, forested roadway, with close views of both the forest and the Stehekin River. During construction there would be negligible short-term effects on views along the road due to the presence of construction equipment in the project area, particularly staging areas, such as the Lower Field. Afterward, because construction would include removal of vegetation along the roadside related to ditch construction / reconstruction and pullout construction, there would be long-term adverse and beneficial effects. Initially, visitors would perceive that a change had occurred and would perhaps notice previously obscured views opened by the removal of some trees. Later, as plants began to fill in the open spaces, the road edges would revert to an array of vegetation similar to that now present.

The Stehekin Valley Road has been in place for decades, although minor reroutes have been common throughout the past 40 years at a number of sites. The road itself interrupts the scenic values of the recreation area, it also provides access and a vantage point. By the same token, NPS and private development in the valley both facilitate and impede the visitor experience of scenic resources. Actions proposed in Alternatives 1 and 4 would not relocate or expand the main alignment of the Stehekin Valley Road, but would continue to maintain a park-like setting for the road. In addition, where recreation area maintenance facilities are currently impeding the floodplain / channel migration zone of the Stehekin River near Harlequin Bridge, these would be removed and the area restored, allowing more natural river processes to occur, a minor to moderate long-term beneficial impact on scenic resources.

Alternatives 1 and 4 would also have long-term negligible to moderate beneficial effects from reducing noise and dust along the Stehekin Valley Road by surfacing the road. The extensive amount of roadside vegetation covered with dust during the peak visitor use / summer dry season would be eliminated. Where new construction would result in loss of vegetation, including from constructing pullouts and the winter turnaround, as well as in removal of the eyebrow area in McGregor Meadows in Alternatives 1 - 4, there would be variable short- to long-term minor on moderate adverse impacts to visual quality from the loss of vegetation and from disturbance. Over time these impacts would diminish as revegetation and natural plant establishment occurred on the stabilized slopes.

Bioengineering associated with barb placement would eventually restore the riparian edge between the road and the Stehekin River in some places, possibly obscuring views. This effect would be greatest in Alternative 4, where 16 - 17 new barbs are proposed, and least in Alternative 1, where no new barbs are currently proposed. Because expansive views of the river are available from numerous locations along the road (downvalley from the Stehekin School, Frog Island, Harlequin Bridge, Company Creek, Milepost 8.0, and above Coon Creek), these adverse impacts on scenic resources would be negligible.

Construction of the Lower Valley Trail would open up nonroaded views of the Stehekin River from numerous observation points, a long-term minor beneficial effect on scenic resources.

Under Alternative 1, the ongoing impacts from land acquisition and exchange in the lower Stehekin Valley by both private residents and the NPS would continue to result in periodic modifications of the scenic qualities within the project area. New homes and outbuildings would be developed where none were present before, with some houses clustered in areas outside the channel migration zone. Others would be removed as lands with undesirable development were acquired. Covenants to protect scenic qualities and scenic easements established through the 1995 LPP would continue to limit impacts to scenic resources.

### Impacts from Actions Common to Alternatives 2 and 3 and Additional Impacts from Alternative 4

Although many of the same beneficial and adverse impacts to scenic qualities from Alternative 1 would occur in Alternatives 2 - 4, there would be a series of additional beneficial and adverse impacts. These would include moderate adverse and beneficial effects from more bioengineering associated with barb placement (greatest in Alternatives 3 and 4) and additional long-term moderate beneficial and negligible short-term adverse effects from riparian restoration.

Reroute construction would result in moderate short- to long-term adverse effects (Alternatives 2 and 3) due to the major change from a forested plant community to a highly disturbed area with road cuts and fills, ranging from disturbing areas just larger than the road width (16 feet) to between 40 and 100 feet beyond the road. There would be changes in elevation no greater than 6 percent as the road ascended to the reroute area and then descended back to the valley floor. In Alternative 3, the steep descent into the Lower Field would be on top of an estimated 8 - 10 feet of fill. This fill section of roadway would not appear natural and would not blend into the open landscape of the Lower Field. Rather, it would be visible from approaches from the west on the Stehekin Valley Road and from the Lower Field.

Alternative 3 would therefore have moderate long-term adverse effects on scenic resources. Overall, the road reroute area (approximately 40 percent of the road within the project area) in Alternatives 2 and 3 would not have views of the Stehekin River, but would traverse a forested landscape. This would be offset by improvements in views toward McGregor Meadows associated with road removal. Where the road was moved farther away from the river, views toward the river would contain a more natural appearance, with riparian vegetation providing screening and a vegetated, rather than bare, corridor alongside the river or a series of cutoff roads as it was gradually relocated. In addition, as in Alternatives 1 and 4, construction of the Lower Valley Trail would open up numerous nonroaded views of the Stehekin River, wildlife, and surrounding landscapes, a long-term minor beneficial effect on scenic resources.

Compared to Alternative 1, there would be similar impacts from land acquisition and exchange because many of the key provisions that protect scenic qualities in the current LPP process would be retained in the modified priorities that would be implemented in Alternatives 2 - 4. It is likely, however, that potentially fewer lands in Alternative 4 would be acquired within the channel migration zone because the current development pattern would continue. In Alternatives 2 and 3, development of potential exchange lands would result in clustering of some development in the Company and Boulder creek areas, a long-term minor to moderate adverse impact on scenic resources for the road. Emphasis on removal of cabins in the channel migration zone would improve scenic views along the river, a moderate long-term beneficial effect.

### Measures to Avoid, Minimize, or Mitigate Impacts

Same as Access and Transportation.

**Cumulative Impacts**: The effects of past, present, and future actions have resulted in long-term beneficial and adverse effects on views and vistas from the Stehekin Valley Road. Past reroutes of the Stehekin Valley Road at Coon Run and 7.5 Mile have generally lead to fewer river views of the river from the road. Existing covenants and conditions for development of exchanged and adjacent lands resulted from the implementation of the 1995 LPP. When combined with these conditions, Alternative 1 would continue to contribute long-term negligible to moderate beneficial effects. Short-term adverse effects would continue to occur periodically from construction activities, response to flood damage of road, and from prescribed burns. Alternatives 2 - 3 would contribute the same adverse and beneficial effects as Alternative 1, plus long-term adverse and beneficial effects from relocating a portion of the road from a riparian area near the river to a drier forested area away from the river. While there would be fewer opportunities for views and vistas of the Stehekin River from the rerouted section of the road, there would be new opportunities to observe upland forest species, and to view the river from a trail instead of the road. Long-term beneficial effects noted in Alternative 1 associated with the LPP would continue, but would vary slightly since the emphasis in Alternatives 2 and 3 would be on acquiring lands within the channel migration zone. Scenic resources qualities along the road, though they would remain important, would be of lower priority. Similarly, Alternatives 1 and 4 would contribute additional long-term negligible to minor adverse effects from the effort to maintain the Stehekin Valley Road, as well as the Company Creek Road, in essentially their existing alignments, contributing both minor adverse and minor beneficial effects on scenic resources from maintaining views while altering natural topography and vegetation.

**Conclusion**: Alternatives 1 and 4 would continue to have long-term negligible to moderate and short-term negligible to minor adverse effects on scenic resources, and long-term beneficial impacts from reducing dust, improving visibility, and removing NPS facilities from the floodplain. Alternatives 2 and 3 would contribute to the diversity of the Stehekin Valley Road driving experience, a long-term minor to moderate beneficial or adverse effect, depending on the viewer.

Because there would be no significant impacts to scenic resources, there would be no impairment of scenic resources or values from the implementation of Alternatives 1 - 4.

# 20. WILD AND SCENIC RIVERS IMPACTS

## a. Wild and Scenic Rivers Methodology

The Stehekin River has been determined eligible as a Wild and Scenic River. The portion within the project area has been determined eligible for its recreational characteristics; above High Bridge it is eligible for its scenic characteristics; and farther upvalley, near Cottonwood Camp, it is eligible for its wild characteristics. (See Chapter III: Affected Environment, ―Wild and Scenic Rivers" for definitions of these.)

The Wild and Scenic Rivers analysis assesses potential effects of the proposed alternatives on the characteristics of the Stehekin River that contribute to the river's eligibility for listing as a component of the National System. Those characteristics include the free-flowing nature of the river and the outstanding remarkable values provided by the river and its immediately surrounding lands. The outstandingly remarkable values for the Stehekin River are prehistoric and historic resources, geology, scenic resources, wildlife/fish, and recreation.

**Context of Impact**: Wild and Scenic Rivers impacts were considered within the project area and associated with the Stehekin River as a whole.

**Type of Impact**: Beneficial impacts would improve wild and scenic river characteristics compared to existing conditions, while adverse impacts would reduce eligibility characteristics.

### Intensity of Impact

- **Negligible**: The effect on the values for which the river segment was determined eligible for listing as a Wild and Scenic River would be at the lowest levels of detection, barely measurable, with no perceptible consequences, either adverse or beneficial.
- **Minor**: A perceptible effect would occur to one or more of the values for which the river segment was determined eligible for listing as a Wild and Scenic River, but the effect would be localized to relatively small areas. Little, if any, loss of value or integrity would occur.
- **Moderate**: A readily apparent effect would occur to the values for which the river segment was determined eligible for listing as a Wild and Scenic River. The effect would diminish some of the values, but not enough to threaten the river's listing in the National Wild and Scenic Rivers System.
- **Major**: A readily apparent effect would occur to the values for which the river segment was determined eligible for listing as a wild and scenic river. The effect would be severe enough to threaten segment 1's eligibility for inclusion in the National Wild and Scenic Rivers System.

## b. Wild and Scenic Rivers Impacts

### Impacts from Actions Common to Alternatives 1 - 4

As noted in Chapter III: Environmental Consequences, the proposed project area under all alternatives is within Segment 1 of the Stehekin River, an area proposed for its recreational values, primarily because of existing disturbance to the riverbank, including the presence of roads, houses, businesses, power lines, and other human development. Segment 1 begins at the mouth of the river on Lake Chelan and extends up to High Bridge. As a result, the following discussion is limited to potential effects that would occur related to the eligibility of Segment 1 for Wild and Scenic River status. At the time Segment 1 was determined eligible for this status, it contained an estimated 80 erosion protection structures, including cabled logs, rip-rap, and rock barbs or a combination of these structures at approximately 35 sites, as well as one major bridge and other minor bridges over tributaries (NPS 2005). According to the analysis, these channel modifications or restriction were considered ―generally unobtrusive and of short length.”

**Free-flowing**: In Alternative 1, additional riverbank modifications would occur at Milepost 5.3 (Wilson Creek). Alternative 2 would include additional actions at Milepost 5.3, plus there would be modifications to areas near the river mouth, at Frog Island, and at Boulder Creek. Alternatives 3 and 4 would include these same areas but would add additional modifications at the Lower Field at Weaver Point, while Alternative 4 would also include modifications (barbs) at Milepost 7.0 and Milepost 9.2. At Wilson Creek and Frog Island, the barbs and logjams would be at the edge of the channel migration zone, where their impact on the free-flowing nature of the river would be relatively minor. As noted above, these modifications would be the same as (barbs) or similar to (logjams) those mentioned in the Wild and Scenic River eligibility report. Both the barbs and the logjams would locally redirect streamflow, change bank and sediment erosion and channel avulsion processes, and increase the amount of pool vs. riffle habitat. Alternatives 2 - 4 would also remove some rip-rap at the Stehekin River mouth, while adding other beneficial features, such as riparian restoration and the bioengineering component associated with rock barbs and logjams. In Alternatives 2 and 3, relocating the road away from the eroding riverbank would have a minor to moderate beneficial effect by eliminating the need for additional erosion protection structures and allowing natural river processes, such as the river's free-flowing characteristics, to be enhanced.

Compared to Alternative 1, Alternatives 2 and 3 would have negligible to moderate beneficial effects from relocating part of the road away from the river and from restoration, as well as minor adverse effects from rock barbs. Rock barbs would have minimal effects on river recreation. Both beneficial effects and adverse effects would be fewer in Alternative 3 from less relocation of the road and from less restoration and more logjams. Alternative 4 would have even fewer beneficial effects (no reroute), and there would be additional minor to moderate adverse effects from more barbs than in other alternatives.

**Prehistoric and Historic Resources**: As noted above in cultural resources, there would be no effect on known prehistoric or historic resources from the implementation of Alternative 1. Alternatives 2 - 4 would have no effect on prehistoric resources. Alternatives 2 and 3 would have no adverse effect on historic resources. A portion of the Stehekin Wagon Road, which has been determined to be ineligible for the National Register, could be affected by the proposed 1. 9-mile reroute through McGregor Meadows and the Lower Field. Alternatives 2 - 4 would have beneficial effects on the Buckner Homestead Historic District from the restoration of the riparian area alongside the Stehekin River. Since this restoration would also have no adverse effect on historic resources and because vegetation is not considered a contributing outstandingly remarkable value of the Stehekin River, there would be a negligible beneficial effect combined with minor adverse effects on the continued contribution of historic resources to the eligibility of the Stehekin River as a Wild and Scenic River in Segment 1 in Alternatives 2 and 3 and a negligible beneficial effect in Alternatives 1 and 4.

**Geology**: Because there would be no effects from the proposed project on glaciers, ice fields, cirques, spires, hanging valleys, or bedrock box canyons, there would be no effect on the glacial features which contributed to the identification of geology as a contributing outstandingly remarkable value on Segment 1 of the Stehekin River. Instead, effects would be limited to local surficial landforms that would be excavated or otherwise modified for shoreline stabilization measures and road-related infrastructure improvements at Milepost 5.3, Wilson Creek (Alternatives 1 - 4), and Milepost 8.0 (Alternatives 2 - 4), as well as for the proposed maintenance and housing areas (Alternatives 1 - 4) and the reroutes (Alternatives 2 and 3). The spatial scale of these adverse impacts would be negligible compared to the overall scale of the geologic values that would remain unaffected by the proposed actions in the alternatives. Further, landforms at those sites are relatively young.

**Scenic Resources**: The scenic resources called out in the eligibility report for the Stehekin River include the landscape dominated by dramatic, glacially sculpted landforms, diverse vegetation, and exceptionally clear, flowing water. As noted in the report, human impacts are few and unobtrusive and allow visitors to experience the grandeur of the wilderness and its landscapes.

As noted above, the glacially sculpted landforms characteristic of this outstandingly remarkable value would not be compromised by the proposed project under Alternatives 1 - 4. Although both water and vegetation would be affected by the proposed project under all alternatives, the changes to these characteristics would not have long-term adverse effects on landforms or the diversity of vegetation.

The proposed project actions would locally affect the quantity of vegetation in road reroute areas in Alternatives 2 and 3. There would not be other than short-term localized effects on the clarity of flowing water. Beneficial vegetation effects would be realized from riparian restoration noted above at Weaver Point, the Stehekin River mouth, Buckner Homestead hayfield and pasture, Frog Island, and Lower Field in Alternatives 2 - 4. Beneficial impacts would also occur in Alternatives 1 - 4 from restoration of the former maintenance area, which is within 0.25 mile of the river. There would be negligible adverse and beneficial effects from installation of barbs and accompanying bioengineering in Alternatives 2 - 4, particularly at sites on the edge of the channel migration zone. Vegetation effects would be moderate and short to long term associated with the reroutes in Alternatives 2 and 3, but effects over this area would not affect the eligibility of the Stehekin River as a Wild and Scenic River because they would be located more than 0.25 mile from the river, outside the potential area of eligibility noted in the report.

Overall, there would be a variety of short-term effects on scenic resources from the implementation of the alternatives. A variety of landscape elements would include long-term alteration, including from clearing vegetation, and moving the road farther from the river. Foreground and background views from the road would change under all alternatives (related to the winter turnaround and pullouts in Alternatives 1 - 4) and would be primarily associated with the road reroutes in Alternatives 2 and 3. While these would have additional effects on scenic resources, they would not affect the scenic resources characteristics called out by the eligibility report because of their distance from the river.

As a result, the proposed project under Alternatives 1 - 4 would have negligible to minor short-term adverse effects, combined with similar beneficial effects, on scenic resources associated with the scenic resources outstandingly remarkable value noted in the Stehekin River eligibility report. The adverse effects would be primarily short-term adverse impacts to water quality and the beneficial effects would be associated with riparian restoration and bioengineering. Potential adverse effects would be present in all alternatives (Alternatives 1 - 4), with effects increasing from Alternative 1 to 4, while beneficial effects would be greatest in Alternative 2, followed by Alternatives 3, 4, and 1.

**Wildlife/Fish**: Alternatives 1 - 4 would have primarily short-term adverse impacts associated with construction on some fish and wildlife. Wildlife would be more likely to avoid the construction areas during, and potentially for a short time after, construction. There would be several benefits to fish by creating pool habitat, which is more scarce than other habitat types (such as riffle habitat), and providing additional riparian vegetation along the riverbank (such as willow layering to provide shade and woody debris) (NPS 2005) in Alternatives 2 - 4. Once the road was surfaced there would be less sediment eroding from the road, and slope-stabilization measures (Alternatives 2 - 4) would also help to reduce the amount of eroded sediment entering the river. Thus, overall water quality and habitat for fish would be improved.

These impacts would not affect the diversity of game and nongame wildlife and fish and/or threatened and endangered species called out as an outstandingly remarkable value and identified in the Stehekin River Wild and Scenic River eligibility report. Despite short-term impacts and long-term loss of minor portions of upland forested habitat, the diversity of wildlife and fish species present in and near the Stehekin River would remain. Species would continue to depend on the Stehekin River for all or part of their lifecycle, and the river would remain an important habitat component and migration route despite short- and long-term adverse impacts identified here. There would be no effect on the diversity of wildlife and fish species related to the proposed project under Alternatives 1 - 4. As a result, this outstandingly remarkable value would remain a valuable component of the Stehekin River’s eligibility in Segment 1.

**Recreation**: Recreational values in Segment 1 would remain similar in Alternative 1, with some enhancement within 0.25 mile of the Stehekin River, including a crossing of the proposed Lower Valley Trail connecting to the Stehekin River Trail near Boulder Creek. This would have a negligible to moderate beneficial effect on recreation as an outstandingly remarkable value called out by the Stehekin Wild and Scenic River eligibility report. Construction of a foot-bridge could result in minor to moderate impacts to the river. In Alternatives 2 and 4, a moderate long-term benefit would occur from construction of the raft launch. There would also be negligible to minor adverse effects on recreation from the potential need for installation of some additional erosion protection structures at the bridge crossing. During most of the year, rock barbs would constitute a minor hazard to river rafters by creating an obstruction in the channel. The obstruction would be topped during high-flow periods in the spring and early summer, when floating the river is most popular. Later in the summer, however, part of the structure would protrude above the water surface, although the effects would likely have no greater impact to recreation than other obstacles along the river (Allen, pers. comm., 2005 in NPS 2005). Rock barbs would be unobtrusive because to be effective, they would be installed generally below the high water mark of the river. This makes them compatible with river runners and undetectable to most visitors. Consultation with river rafters would occur regarding the placement of logjams. Other features, such as grade-control structures, would be hidden (below grade), while logjams would appear natural. Bullion camp within the 0.25 mile affected area would be considered a minor beneficial effect that would improve the recreation qualities associated with the Stehekin River.

Alternatives 2 - 4 call for additional enhancement of Stehekin River recreational features within the 0.25-mile affected area, including some additional camps adjacent to the river (Rainbow and Bullion camps in all three action alternatives [Alternatives 2 - 4] and Company Creek Camp in Alternatives 3 and 4). Along with the raft take-out in Alternatives 2 and 4, the camps would be considered minor to moderate beneficial effects that would improve the recreational qualities associated with the Stehekin River. There would be no adverse effect on the desire of visitors from outside the region to visit the Stehekin River, the key characteristic of the recreation outstandingly remarkable value called out in the eligibility report for the river. Therefore, improvements under Alternatives 1 - 4 would result in enhancement of this value, and there would be no adverse effects on it.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to Wild and Scenic Rivers would include mitigation measures listed in the “Water Resources,” “Vegetation,” “Wildlife,” and “Visitor Experience: Scenic Resources” sections.

**Cumulative Impacts**: Since the eligibility report was written, there have been about 10 new sites with erosion protection features along the river in Segment 1. While these have resulted in slight modifications to the free-flowing nature of the river, the designation of this segment of the river under recreation allows for their continued persistence and additions that remain unobtrusive. Because rock barbs and other features associated with protecting the riverbanks from erosion either appear natural or would be below the ordinary high water mark, they would continue to be unobtrusive. Although additional future measures would likely be added, primarily under Alternatives 1 and 4, where the road is essentially retained in place, and would be maintained under all Alternatives (1 - 4), these alternatives would continue to contribute negligible to minor long-term adverse cumulative impacts. These impacts, however, would not affect the eligibility of the river to be nominated as a Wild and Scenic River in Segment 1 for recreation and would have no effect on potential designation in segments 2 and 3 as scenic or wild, respectively.

Effects in Segment 1 would continue to be minimal because the same kinds of erosion protection measures as currently existing would be added (Alternatives 1 - 4) and because additional portions of the river would be released to natural conditions (because of reroutes in Alternatives 2 and 3). As a result, Alternatives 1 and 4 along with past projects would contribute long-term moderate adverse effects. Alternatives 2 and 3 would also contribute some moderate beneficial impacts, in addition to negligible beneficial effects in Alternatives 1 and 4. Removal of private cabins from within the channel migration zone would have a long-term moderate beneficial effect on Wild and Scenic River values. It is likely more cabins would be removed in Alternatives 2 and 3 due to the LPP focus in the channel migration zone. Alternatives 2 and 3 add new bank protection structures at 4 sites (Alternative 2) and 6 sites (Alternative 3).

If the Stehekin River were designated as a National Wild and Scenic River, a 0.25-mile corridor on either side of the river would be designated to preserve its wild and scenic values. Because the river was found eligible with existing developments in place and because it also contained over 80 erosion protection and bank modifications (as noted in the report), there would be no effect on the status of the Stehekin River as a Wild and Scenic River from the additional modification of the river or the withdrawal of development from its floodplain as described in the action alternatives. All of the outstandingly remarkable values, including fish/wildlife, prehistoric resources, historic resources, geology, scenic resources, and recreation resources, of the Stehekin River would be maintained regardless of the implementation of Alternatives 1 - 4.

**Conclusion**: There would be no adverse effect on the following outstandingly remarkable values in Alternative 1: prehistoric and historic resources, geology, scenic resources, wildlife, or fish. Minor beneficial effects would occur from the creation of the Lower Valley Trail and its connection to the Stehekin River Trail. Although there would be additional erosion protection measures at Wilson Creek in Alternative 1, these would continue to be ―unobtrusive and of short length” and would not affect the ability of the Segment 1 portion of the Stehekin River to be designated as a Wild and Scenic River for recreation.

Alternative 2 would have no effect on prehistoric resources, geology, scenic resources, wildlife, or fish outstandingly remarkable values associated with the Stehekin River. There would be negligible to minor beneficial effects on historic resources from riparian restoration along the Buckner Homestead hayfield and pasture adjacent to the river. Similarly, there would be minor beneficial effects on recreation from the designation of some additional camps and a raft takeout, along with negligible to minor adverse effects from additional barbs or logjams near steep sections (at Frog Island, Wilson Creek, and the river mouth), as well as some impacts near Boulder Creek. As in Alternative 1, the effects in Alternative 2 would not affect the ability of the Segment 1 portion of the Stehekin River to be designated as a Wild and Scenic River for recreation. The river would continue to be free flowing, with short, unobtrusive impediments to river flow, and would continue to possess more than one outstandingly remarkable value.

Alternatives 3 and 4 would have effects similar effects to Alternative 2, except that there would be additional barbs and/or logjams constructed within the Stehekin River. Alternative 4 (and eventually Alternative 1) would add erosion management structures at eight sites within the potential 0.25-mile eligibility zone for the river. Alternative 4 would not have the same degree of beneficial effects due to maintenance of the road in the same location. In addition, there would be one more camp (Company Creek) to enhance recreational use in Alternatives 3 and 4. For the same reasons noted in Alternative 2, the river would continue to be free flowing, with short, unobtrusive impediments to flow, and would continue to possess more than one outstandingly remarkable value. There would be no effect on the eligibility of the Stehekin River in Segment 1 to be designated a Wild and Scenic River for recreation. There would therefore be no impairment of Wild and Scenic River resources or values from the implementation of Alternatives 1 - 4.

# 21. PARK OPERATIONS IMPACTS

## a. Park Operations Methodology

Impacts for each action alternative were evaluated by identifying changes to operations outlined in each of the action alternatives. These effects were compared to existing operations, staffing, and funding.

**Context of Impact**: Park operations impacts were considered within the project area and for the North Cascades NPS Complex.

Impacts on park operations would result from the need for additional staffing or changes in duties for current staff, changes in funding levels, changes in facilities, and from cost-saving measures associated with new facilities. Planning and implementing projects requires staff time, expertise, and assistance, which must be taken from daily duties such as visitor contacts, interpretation, resource protection, and safety.

**Type of Impact**: Adverse impacts would increase staffing, operating costs or fuel consumption. Beneficial impacts would decrease these. With beneficial impacts, the efficiency of park operations would also be improved and may lower the overall cost of operation. The discussions of impacts are for those operations that would be new, undergo major operational change, or show susceptibility to increases or decreases in operational activity. For example, old facilities would require additional staff time to operate or maintain, whereas replacement of facilities would likely use existing staffing levels. Impacts on park operations would result from the need for additional staffing or changes in duties for current staff, changes in funding levels, and from cost-saving measures associated with new facilities.

### Intensity of Impact

- **Negligible**: Park operations would not be affected, or the effects would be at low levels of detection and would not have an appreciable effect on park operations.
- **Minor**: The effects on park operations would be detectable and would be of a magnitude that would not have an appreciable effect on park operations.
- **Moderate**: The effects on park operations would be readily apparent and would result in a substantial change in park operations in a manner noticeable to staff and the public.
- **Major**: The effects on park operations would be readily apparent, would result in a substantial change in park operations in a manner noticeable to staff and the public, and would be markedly different from existing operations.

## b. Park Operations Impacts

### Impacts from Actions Common to Alternatives 1 - 4

**Road Rehabilitation**: Typical construction impacts would include temporary delays for recreation area staff and related activities such as tour buses moving through the construction area. These produce short-term, minor adverse impacts on park operations. Some actions associated with road rehabilitation would be common to all alternatives, including pullout and winter turnaround construction, culvert installation and repair or replacement, and surfacing. These actions would result in short-term negligible to minor adverse impacts on park operations (staffing) from maintaining construction oversight, including contract monitoring. After construction, long-term negligible to minor beneficial impacts would occur from a decreased workload associated with maintaining new road facilities in good condition.

Rerouting the road to higher ground (Alternatives 2 and 3) or raising the road height (Alternatives 1 and 4), stabilizing portions of the Stehekin River banks, directing the erosive force of the Stehekin River away from the road, and laying back slopes to prevent material from sloughing onto the road would reduce the potential for road closures, temporary delays, maintenance activity, and other access problems for park staff and recreation area activities. The effectiveness of the road would also be improved by surfacing the road, increasing sight distance, and providing pullouts to facilitate traffic movement. Surfacing the road would also make snowplowing operations more efficient and reduce the potential for damaging the snowplow. Once these improvements were completed it is likely that less staff time and recreation area resources would be required to maintain operations on the Stehekin Valley Road.

**Maintenance Facility Replacement and Relocation**: Construction of the replacement maintenance facility would have a series of beneficial and adverse impacts on park operations. Overall impacts from construction of the new facilities would be major and beneficial. Individual impacts would vary from negligible to moderate. There would be short-term minor to moderate increases in staff responsibilities for construction planning and design oversight, as well as long-term negligible to minor changes in operations related to managing the new facilities. Construction of the new facility would initially result in fewer maintenance needs associated with the new structures in good condition, a long-term moderate beneficial effect. Over time, however, age and deterioration would increase maintenance needs, but would not approach the current level because the new facilities, unlike the old, would be designed for their designated uses and location (including tolerance for weather conditions, such as snowload).

Long-term economic benefits would be realized from the new maintenance facility, which is expected to save the recreation area approximately $6,000 per year in utility costs alone and more than $71,600 in annual maintenance costs. These cost savings would be realized from having the buildings and structures consolidated in one area and would result from savings attributed to snow removal and maintenance in addition to utility costs. Replacement and relocation would also avoid the potential for more severe damages to the facility from flooding.

Because the new facilities would be centrally located and would consist of a new, more functional arrangement of structures, there would be long-term negligible to minor beneficial effects from consolidated, efficient operations. Because the new buildings would be designed to be energy efficient, there would be long-term minor to moderate cost savings associated with improved efficiency and reduced energy consumption. Employees would have regular access to break / restroom facilities within appropriate structures and would have some diminished responsibilities in maintaining the new facilities, for example because roof pitches would be designed to shed snow load and would not need to be shoveled.

The new maintenance area would have minimal duplication in heating mechanisms. Instead of stocking parts related to several different kinds of heating devices (wood, pellet, propane, and diesel devices, depending on the building), these would be of the same types and would use the same kinds of parts, resulting in operations cost savings.

There would be short-term increases in staffing or contract oversight to remove the former maintenance facility and to relocate, salvage, or deconstruct useable portions of it. Long-term beneficial effects would be realized from relocating it out of the floodplain. These beneficial effects would be most apparent during future flooding of the area, when the new maintenance area would remain functional rather than being located partially within the flooding of the Stehekin River. Instead of equipment access and use being hampered by flooding, needed equipment would be readily available for use during emergencies, requiring less time to respond to staff, resident, and facility problems.

**Housing Area**: As with the maintenance area, construction of new housing would initially result in fewer maintenance needs; however, over time maintenance of these facilities would increase as age and deterioration occurred. There would be initial moderate long-term beneficial effects from the use of new structures outside the floodplain or channel migration zone for housing coupled with short-term negligible to minor adverse effects over time. Similar benefits would be realized associated with the design and maintenance of the new housing, including cost savings associated with reduced energy use, etc. There would also be minor to moderate long-term beneficial effects from the expansion of housing for seasonal and concession staff.

**Other Actions**: There would be negligible to minor short-term adverse effects on park operations from the implementation of additional measures from the Road Improvement Project, including rehabilitation of the Stehekin Valley Road near Wilson Creek, installation or replacement of culverts, surfacing of the road, and other actions. Long-term beneficial effects would occur from repair of these areas, minimizing the need for repeated, more costly maintenance actions, such as fixing portions of the road after each major storm. Ongoing maintenance of the road would be similar to existing conditions, with a variety of actions performed, depending on the season (see Chapter III: Affected Environment).

### Additional Impacts from Alternative 1

Most actions within Alternative 1 would be a continuation of current management. In addition to those actions that would be common to all alternatives; however, Alternative 1 would include retention of / improvements to the Stehekin Valley Road in McGregor Meadows and in other places within the floodplain / channel migration zone of the Stehekin River; ongoing implementation of the 1995 LPP; and other actions that would affect park operations.

**Road Grade Raise / Rehabilitation**: Initially, there would be oversight and consultation with FHWA to procure a contractor to execute road improvements, including the raising of the road and other improvements within McGregor Meadows, as well as for other actions associated with the rehabilitation of other portions of the roadway noted above. Later there would be park staff impacts from oversight related to implementation of the proposed road project. These would constitute short-term minor to moderate adverse impacts and long-term minor beneficial impacts.

Under this alternative, the NPS would continually need to make major repairs to the Stehekin Valley Road, particularly near McGregor Meadows. These actions would cause moderate adverse impacts on park operations, because staff time and park resources would be needed to respond to the flood damage. Responding to flood damage would affect park operations at both a local and regional level. These circumstances would continue to diminish the ability of the NPS to conduct other operational activities.

Reaction to flooding on a case-by-case basis would cause a much greater impact to park operations when compared to the comprehensive and integrated strategies presented for each of the action Alternatives 2 - 4. There would be an ongoing need to make emergency road repairs following flooding to keep the road in use. These additional locations where erosion protection measures would be needed have not yet been identified, but would likely be similar to Alternative 4. Over time as more portions of the road were hardened or moved away from the Stehekin River, the need to harden banks would likely diminish. Until then, there would continue to be long-term minor to moderate adverse effects on park operations from repeated interruptions due to flood damage impacts and assessment of those impacts and then from constructing repairs.

**1995 Land Protection Plan Implementation**: Ongoing implementation of the 1995 LPP (NPS 1995b) would continue to require park staff to write future EAs for land exchanges and to exercise oversight of the land protection program. The program would also continue to require regional office staff oversight to work with landowners to orchestrate actions in conjunction with the program and to determine the need for appraisals and covenants and to facilitate transfers under real estate law and policy, while protecting the resources of the recreation area. These would be both short- and long-term negligible to moderate impacts, periodically taking up most of the work of some staff for up to a few months at a time.

**Research and Monitoring**: Ongoing monitoring provides a framework for understanding the Stehekin River and has been important to understanding how often large floods occur (flow gauge monitoring), a long-term moderate beneficial effect. There would be ongoing negligible to moderate impacts to park operations to conduct and fund monitoring programs.

**Other Actions**: Numerous other actions called for by Alternative 1 would have short-term negligible to moderate impacts on park operations to deal with increased responsibilities for some staff related to project planning, implementation, and oversight. Among these would include construction of the Lower Valley Trail, implementation of erosion protection measures at Wilson Creek, and ongoing park operations related to maintaining the Company Creek Road in addition to the Stehekin Valley Road. Upon completion these actions would have long-term negligible to moderate beneficial effects from establishing or returning the road to good condition, thus minimizing future needs for repairs. For many actions, repairs would become cyclic, rather than routine, after improvements were made.

### Additional Impacts from Actions Common to Alternatives 2 and 3

**Road Reroute**: Negligible to minor short-term adverse impacts, coupled with long-term moderate beneficial effects, on park operations would occur from rerouting a portion of the Stehekin Valley Road around McGregor Meadows and Lower Field in Alternative 2 or from a reroute around McGregor Meadows in Alternative 3. While the longer reroute in Alternative 2 would have more beneficial effects from bypassing both portions most subject to future impacts from flooding, and erosion, the shorter reroute would also have beneficial effects because it would be coupled with additional erosion protection measures at the Lower Field. The short-term adverse impacts would be related to delays of park staff and additional responsibilities related to construction oversight and monitoring, while the beneficial effects would be from the realignment of the road that would reduce the long-term need to maintain and/or to reconstruct this portion(s) following flood impacts.

There would be minor to moderate adverse effects from the need to maintain a McGregor Meadows Access Road under Alternatives 2 and 3. Efforts to maintain this access road to a standard that permits resident and visitor access and emergency and utility system access would be required on a regular basis and would also require restoring access / repairing this section of the road following flooding. Because the road is proposed to be 0.8 mile long, rather than approximately 2 miles long, impacts associated with maintaining the road would be more limited than those that occur now after flooding and that would continue to occur in Alternatives 1 and 4 from maintaining the primary road all the way through these areas.

**Erosion Protection Measures**: To the extent that park staff is involved in the construction of erosion protection measures, there would be effects on staffing and funding as well as effects from potential road delays related to these. Short-term effects would be minor to moderate, while long-term beneficial effects from the measures working to retain the road (therefore minimizing additional staff time related to repairs) would be minor to moderate.

**Land Protection Plan Modifications**: While priorities would be different than in Alternative 1, the duties would remain similar. Initially, however, there would be an increase in impacts on park operations until park and regional staff became familiar with the revisions and their implementation became routine. Effects would remain intermittent and would be minor to moderate.

**Research and Monitoring**: Impacts from Alternative 1 would continue and additional negligible to moderate impacts on park staffing and funding would continue to implement additional monitoring programs called for by this alternative.

### Additional Impacts from Alternative 4

**Road Grade Raise / Rehabilitation**: Impacts from Alternative 4 would be similar to Alternative 1. Because there would be a similar array of erosion protection measures as in Alternative 3 (plus two additional sites), retention of / improvements to the Stehekin Valley Road would be more secure in Alternative 4 compared to Alternative 1. Decisions about where to locate erosion protection measures have been made in Alternative 4, compared to Alternative 1. Still, because flooding could result in additional damage and failure of the road, particularly in vulnerable sections of the Company Creek Road where the road was not rerouted, impacts on park staffing and funding to ascertain and repair flood-related damage would continue to occur and would range from minor to moderate, depending on future flood damage.

**Erosion Protection Measures**: There would be more impacts from constructing 16 - 17 rock barbs. Overall impacts would be adverse and both short- and long-term, while beneficial effects would range from minor to moderate.

**Land Protection Plan Modifications**: As in Alternative 1 and Alternatives 2 and 3, impacts would be intermittent and minor to moderate.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to park operations would include the following:

- Providing and maintaining emergency vehicle access through the project area during construction.
- Coordinating work between NPS and FHWA park liaison to minimize disruption to normal park activities.
- Monitoring construction activities to ensure adherence to mitigation measures.
- Monitoring construction activities to provide recommendations to minimize impacts on park resources.

- Conducting legal boundary surveys prior to scheduling work that may have the potential to affect private property. If necessary, easements would be negotiated.
- Designing new building construction to be silver or greater LEED certified.
- Using functional, energy-efficient appliances and heating and cooling systems in new buildings.
- Designing efficient circulation spaces for new maintenance and housing areas.
- Using contractors and term employees to facilitate short-term workload increases.
- Providing emergency vehicle access through the project area during construction. Coordinating work with park staff to reduce disruption to normal activities.
- Informing construction workers about the special sensitivity of park resources and values and regulations.
- Providing orientation on park resources for the contractor(s).
- Encouraging park resource specialists to be involved in inspections and monitoring and providing recommendations during the road rehabilitation and facility construction work.

**Cumulative Impacts**: Over time, there have been a series of cumulative impacts on park operations from ongoing use of a cluster of old buildings in the floodplain for a maintenance facility, and from continued maintenance of the Stehekin Valley Road within the floodplain / channel migration zone of the Stehekin River. These impacts on park operations have ranged from poor response time to incidents during flooding from trying to reach vehicles in flooded areas to ongoing use of buildings that were not designed for their current functions. Alternatives 1 - 4 would improve these impacts because they propose replacement and relocation of the current maintenance facility and implementation of erosion protection measures and/or a series of changes to the Stehekin Valley Road to help better maintain it.

Road reroutes and raising the road grade have been used to move the road farther away from the river and/or to protect the road from flooding. Future projects would have similar goals, which typically provide long-term beneficial effects on park operations. Alternative 1 would continue to contribute a minor to moderate degree of cumulative impacts to park operations because it would continue to respond to most flood-related damage on a case-by-case basis, improving only the retention of the road through McGregor Meadows (by raising the road). Alternative 2 would contribute negligible to minor adverse cumulative impacts and long-term minor beneficial effects by relocating a portion of the Stehekin Valley Road and by improving the ability to retain other parts of the road (including near the mouth of the Stehekin River and at Boulder Creek, Frog Island, Wilson Creek, Milepost 8.0, and Milepost 9.2). Alternative 3 would contribute the same range of negligible to minor adverse impacts by relocating a shorter portion of the road and by instituting additional erosion protection measures (instead of a reroute) at Lower Field. Alternative 4 would institute similar erosion protection measures as Alternative 3, plus additional rock barbs at Mileposts 7.0 and 9.2, but would retain the road similar to Alternative 1. Therefore, it would have negligible beneficial effects on park operations because it is likely that future measures would continue to be needed, although not to the degree that they would in Alternative 1.

**Conclusion**: Alternatives 1 - 4 would have some short-term adverse impacts (related to construction) and a series of long-term moderate to major beneficial effects on park operations from construction of the new energy-efficient, well-designed maintenance facility and housing areas. There would also be a series of minor to moderate adverse impacts associated with all alternatives from continued implementation of the 1995 LPP or from modifying it.

Impacts that would be different among alternatives on park operations would primarily have to do with the changes to the Stehekin Valley Road and from those related to implementation of erosion protection measures. Among the alternatives, Alternative 2 would have the greatest long-term beneficial effects, followed by Alternative 3, Alternative 4, and then Alternative 1. These beneficial effects would primarily be related to the ability of the recreation area to maintain the road, with the longer reroute and specific erosion protection measures in Alternative 2 contributing to fewer routine and more cyclic maintenance operations. Alternative 1 and 4 would have moderate to major adverse impacts on park operation by maintain the Stehekin Valley Road through the floodplain at McGregor Meadows. Although Alternatives 3 and 4 would have the same array of erosion protection measures, moving the road away from the river in Alternative 3 would have greater long-term beneficial effects on park operations by relocating the road from an area of repeated maintenance needs to one of fewer needs over time. Alternative 4 would have fewer long-term impacts on park operations than Alternative 1, because there would be a variety of locations where erosion protection measures designed for keeping the road in place would be implemented. Although these would likely also occur eventually in Alternative 1, they are not planned and would therefore continue to need to undergo separate environmental analysis to implement, an impact that would affect future staff time.

# 22. SOCIOECONOMICS IMPACTS

## a. Socioeconomics Methodology

Economic or social impacts for each action alternative were evaluated by identifying changes that would potentially affect the socioeconomic environment, related to the local and regional economy, including private landowners in the Stehekin Valley.

**Context of Impact**: Socioeconomics impacts were considered within Lake Chelan NRA and Chelan County.

**Type of Impact**: Adverse impacts would decrease economic benefits. Beneficial impacts would increase these.

### Intensity of Impact

- **Negligible**: There would be no measurable effect on the socioeconomic environment.
- **Minor**: Only a small sector of the local or regional economy would be affected and this effect would not be readily apparent.
- **Moderate**: A small sector of the local or regional economy would be affected and this effect would be measurable but would not alter basic socioeconomic structure or functions.
- **Major**: Changes in the local or regional economy would occur and would be readily apparent in shifts in the key economic functions and structure. New economic sectors could be created or eliminated.

## b. Socioeconomics Impacts

### Impacts from Alternative 1

Alternative 1 housing and maintenance area and Lower Valley Trail construction would cost approximately $20.47 million. Actions in Alternative 1 would have moderate short-term and minor long-term beneficial effects on income and expenditures for recreation area employees and Chelan County residents. The construction of a new maintenance area and new recreation area housing as well as road surfacing would provide short-term minor to moderate economic benefits as workers were secured and materials, supplies, and services were obtained from the local area. Depending on how much of the project was implemented at one time, what percentage of employees, materials, and supplies were procured locally, and what other projects were being undertaken in the county at the same time, Chelan County could see some slight growth in the construction industry economic sector.

Minor to moderate short-term beneficial effects would occur from the road rehabilitation project, with primarily contractor-hired construction staff and procurement of supplies and materials from both within Chelan County and from outside areas. It is likely that road rehabilitation under Alternative 1 would take approximately one to two construction seasons.

Additional negligible effects would result from ongoing changes in population related to the acquisition of private land in Stehekin. Continued implementation of the 1995 LPP would continue to result in incremental changes in the amount of federal and private land in Stehekin and therefore Chelan County. These effects would be measurable associated with property tax rolls in Chelan County, but overall, would contribute mixed long-term beneficial or adverse effects, depending on when they occurred and the nature of the exchanges or purchases. With exchanges, however, it is likely that property owners would accrue additional acreage if their existing exchanged property was developed because of the need to balance the exchange (either with additional land or payments). Development of this property, away from the river would be more sustainable. As a result, there would be a net, albeit minor, increase in property for landowners pursuing exchanges, a long-term negligible to minor beneficial effect on Chelan County socioeconomics.

### Impacts from Actions Common to Alternatives 2 and 3

Alternative 2 would cost approximately $27.80 million and Alternative 3 would cost approximately $28.46 million. Impacts from actions in Alternative 2 would be similar to Alternative 1; however, there would be some additional negligible beneficial effects from the construction of some new visitor facilities, such as the Lower Valley Trail and additional camping opportunities, and these would provide more recreational experiences for visitors who would otherwise have walked the road, resulting in a small number of repeat visitors to the recreation area during the peak season. Based on boat transportation figures, visitation over the past 10 years has been relatively flat, showing only a slight increasing trend.

**Photo 32 – Stehekin Community at the Buckner Homestead Hayfield and Pasture Harvest Fest 2009**

Impacts associated with the maintenance and housing areas would be the same as described in Alternative 1. Although there would be increased expenditures associated with the reroutes combined with road rehabilitation in these alternatives, the level of impacts would remain minor to moderate and would continue to be short term. Instead of the approximate 1 - 2 seasons to implement the road rehabilitation project in Alternative 1, however, the combined reroute/rehabilitation project in Alternatives 2 - 3 would likely take at least 2 years (two or more construction seasons). Erosion protection measures would be implemented over several years.

Although there would be changes in the implementation of the proposed LPP, the same kinds of effects from land acquisition and purchases would occur. It is unlikely that LPP actions would have a major increase or decrease on the population of the Stehekin Community, although there would eventually likely be some changes in the location of federal and private property due to opportunities for land exchanges. Alternatives 2 and 3 may increase some revenue associated with travel to Stehekin because the certainty of visits during the spring and fall, when flooding currently precludes some travel on the Stehekin Valley Road, would increase. This could result in additional visitors who would book lodging and take advantage of other services provided by the Stehekin Community at these times, since travel would be on a rerouted facility away from the danger of flood closures. This would have a negligible to minor beneficial effect.

### Impacts from Alternative 4

Alternative 4 would cost approximately $25.79 million. Alternative 4 would have the same negligible to minor adverse effects as Alternative 1 and the similar negligible to moderate beneficial effects as Alternatives 2 and 3; however, the beneficial effects in Alternative 4 would be less related to road conditions because, as in Alternative 1, the road would be retained in its existing location.

### Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to the socioeconomic environment would include the following:

- Where possible, projects would be combined or phased to allow for cost-saving measures related to staging remaining in place, rather than setting up and taking down for sequential implementation actions.
- New buildings would be constructed to silver or greater LEED standards to minimize long-term operations costs.
- New buildings and facilities and other improvements would use recycled or reused materials to the extent possible.

**Cumulative Impacts**: The presence of the recreation area would continue to generate economic benefits to the local and regional economy, including jobs and income. The most recent figures for Lake Chelan in fiscal year 2005 (October 2004 - September 2005) show that the recreation area generated 28 jobs, $412,000 in income, and $1,176,000 in spending. Local contracts in 2007 were worth approximately $400,000.

While the Alternatives 1 - 4 would likely contribute some measurable economic benefits from the construction of new maintenance and housing areas, most impacts would be short term, occurring only during construction activities. However, because of reroutes of the road away from the river, Alternatives 2 and 3 would contribute some long-term negligible economic benefits by minimizing future closures of the road related to flooding and thus allowing visitors more access to area amenities. Similarly there would be negligible, but slightly increasing, economic benefits from a variety of erosion protection measures from Alternative 1 to Alternative 4. Although Alternative 1 would not result in the implementation of as many erosion protection measures as Alternatives 2 - 4, it is likely that as flood damage continued to affect the road, these measures would continue to be proposed, resulting in a different array of realignment, reroutes and bank stabilization measures implemented over a longer period of time. There would be long-term minor economic benefits would occur from the implementation of Alternatives 1 - 4 from cost savings associated with the construction of the new maintenance and housing areas. Other short-term beneficial and adverse impacts would occur from the actions associated with changes in the LPP in Alternatives 2 - 4 and from continued implementation of the 1995 LPP.

**Conclusion**: Alternative 1 would result in negligible to minor adverse effects and negligible to moderate beneficial effects and it is likely that these would be spread out over more years than in Alternatives 2 - 4. Alternatives 2 and 3 would result in negligible to minor adverse effects and negligible to moderate beneficial effects. Slightly more beneficial effects would occur in Alternatives 2 and 3 than in Alternative 1 because of the additional incremental number of construction actions and because greater certainty associated with road conditions during flooding. Alternative 4 would have the same negligible to minor adverse effects as Alternative 1 and the similar negligible to moderate beneficial effects as Alternatives 2 and 3; however, the beneficial effects in Alternative 4 would be less related to road conditions.

# 23. HAZARDOUS MATERIALS IMPACTS

## a. Hazardous Materials Methodology

The extent to which hazardous materials are present and would be exposed to visitors, personnel, and the environment under each alternative during site preparation, site management, or from any residual concentrations of hazardous substances was considered. Areas within the proposed project area that could require additional assessment and characterization for potential sources of environmental contamination were also identified.

**Type of Impact**: Generally, the addition of facilities and infrastructure that require hazardous materials that have a potential to expose people to greater levels of risk was considered adverse. Specifically, the type of impact would be considered adverse if it increased the quantity or type of hazardous materials used on the site or if it increased the frequency of use or number of people required to use these materials. Beneficial impacts would have a reduction in the presence or use of hazardous materials.

### Intensity

- **Negligible**: Impacts would be imperceptible or not detectable. There would be no or minimal exposure to hazardous materials.
- **Minor**: Impacts would be perceptible but localized in a small portion of the project area, without the potential to expand if left alone. Exposure to hazardous materials would occur only for those used to working with these materials.
- **Moderate**: The potential for hazardous materials would be widespread throughout the project area or within a specific portion of the project area. Hazardous materials surveys would be required before the extent of impacts was known. Professionals would be required to remediate potential contamination.
- **Major**: The potential for hazardous materials would be widespread throughout the project area. Hazardous materials surveys have identified serious problems. Professionals would be required to remediate potential contamination.

## b. Impacts from Hazardous Materials

### Impacts from Actions Common to Alternative 1 - 4

Some older buildings that would be demolished as a result of removing structures from the former maintenance area and flood-affected structures may contain hazardous building materials. The most common hazardous materials found in older buildings are asbestos, polychlorinated biphenyls (PCBs), and lead-based paint. Other hazards would result from septic system drain fields and tanks. Potential hazards of these materials stem from improper handling or disposal. If any unidentified hazardous building materials were to remain in existing buildings, these materials could cause adverse health impacts if human exposure were permitted during renovation. Construction workers and future employees or visitors could be exposed to contaminants in buildings to be renovated, or they could inadvertently expose the public or the environment to those contaminants. Hazardous materials could also be inappropriately released to the environment as hazardous waste or contamination.

In addition to impacts from hazardous materials associated with buildings, additional impacts associated with the removal of the former maintenance area have the potential to occur in Alternatives 1 - 4. Although recent practices regarding fuel spills and disposal of other hazardous materials have been improved, past practices may have contributed to the presence of hazardous materials near buildings and structures in the maintenance area, a long-term localized negligible to moderate adverse effect. Removal of fuel-storage facilities from within the 500-year floodplain would have a major beneficial effect. Additional hazardous materials would likely be present from the removal of the shooting range in Alternative 2. Potential impacts from hazardous materials would be dealt with according to existing law and policy, which govern the need to survey and treat these areas and for personal protective equipment to protect NPS and contract employees from exposure hazards.

**Different Impacts from Alternative 2**

Because the existing shooting range would need to be removed in Alternative 2, there could be additional potential short-term minor adverse impacts from removal and long-term moderate beneficial impacts from mitigation of hazardous materials. These impacts would include the removal of potentially contaminated soil from within the shooting range to an appropriate disposal location outside the recreation area. During the removal, workers would potentially be exposed to soil contaminated with lead and potentially other materials, a minor adverse impact if precautions are taken. There would be long-term minor beneficial effects on the recreation area and long-term minor adverse effects at the disposal site from the removal of contaminated soil.

## Measures to Avoid, Minimize, or Mitigate Impacts

Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts from hazardous materials would include the following BMPs:

- Conducting formal surveys of the existing maintenance area, including contacting staff to determine if any unanticipated spill or disposal areas are present before removal of buildings or structures and associated development.
- Wearing proper personal protective equipment for the nature of the hazardous materials identified in the surveys during all work in the affected area.
- Refueling vehicles and equipment at least 100 feet from the river and its tributaries or other bodies of water.
- Identifying areas where refueling or maintenance of equipment would occur and providing containment devices, such as temporary earth berms, surrounding these areas.
- Ensuring that spill cleanup materials, such as absorbent pads, are present on site where needed.
- Requiring restrictions on the location of fueling sites, requirements for spill containment, and other measures to safeguard aquatic and terrestrial habitat from construction-related contaminants in contracts.
- Locating fuel storage tanks outside of the floodplain / channel migration zone floodplains and other sensitive areas.

**Cumulative Impacts**: Hazardous materials have the potential to contaminate soil or groundwater or expose workers to certain health hazards. Past, present, and future activities in the project area, such as storage, use, or generation of hazardous materials and hazardous wastes, could have produced soil contamination. This is particularly true in Alternatives 1 - 4 in the maintenance area and in Alternative 2 at the shooting range. There may also be areas where the fill and underlying groundwater require additional assessment and characterization for potential sources of environmental contamination. These sources would include contamination to soil or groundwater that could expose construction workers and others to certain health hazards. Unknown locations of underground storage tanks may also be present in the project vicinity. Residual contamination in the project area could pose health threats to workers or future users of the property, and could pose constraints to development. There would be no additional long-term contribution to cumulative effects from Alternatives 1 - 4. Contributions would be long-term and beneficial from removal of potential areas of hazardous materials in the former maintenance area (Alternatives 1 - 4) and at the shooting range (Alternative 2).

**Conclusion**: Alternatives 1 - 4 have the potential to release hazardous materials from construction and removal of facilities from the floodplain. There would be negligible to moderate localized short-term adverse impacts from these activities. Hazardous materials may be present in proposed buildings and structures deconstructed or removed in the maintenance area and within the floodplain and other materials used in the proposed projects. Over the long term, removal of hazardous materials from the floodplain would have a major long-term beneficial effect.

## 24. UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are defined as moderate to major impacts that cannot be fully mitigated or avoided.

### Impacts from Actions Common to All Alternatives

The presence of development in the lower Stehekin Valley floodplain is an ongoing cumulative unavoidable major adverse impact. Under Alternative 1, conditions associated with this development in the floodplain of the Stehekin River would improve, primarily associated with NPS administrative structures and with the removal of the maintenance area from the floodplain. Nonetheless, private development and portions of the Stehekin Valley Road and Company Creek Roads would continue to remain within the floodplain / channel migration zone. Although private lands would continue to be exchanged and or purchased and some of these acquisitions or exchanges would remove development from the floodplain / channel migration zone of the Stehekin River, it is likely that some development could continue to remain within the floodplain / channel migration zone. Aside from the development in the floodplain, private development is fully consistent with the intent of the Lake Chelan NRA legislation, with the Stehekin Community providing valuable services for visitors to the recreation area.

#### Alternative 1

Ongoing to major moderate adverse impacts associated with the location of the Stehekin Valley Road in the floodplain / channel migration zone of the Stehekin River would remain under Alternative 1. In addition, there would be some additional filling of the floodplain from raising the height of a portion of the Stehekin Valley Road through McGregor Meadows. Other unavoidable moderate adverse impacts would continue to result from the location of existing erosion protection measures, including both riverbank and instream structures currently affecting approximately 6.5 percent of the Stehekin River bank. Implementation of Alternative 1 would increase this to 6.82 percent.

#### Alternatives 2 and 3

Moderate to major adverse effects on the floodplain / channel migration zone of the Stehekin River associated with the cumulative effects of development in the lower Stehekin Valley as described under Alternative 1 would continue. Under Alternatives 2 and 3, there would be some additional potential for removal of private development from the floodplain / channel migration zone from the revised LPP priorities; however, it is likely that some development would remain since exchanges and acquisitions would continue to be on a voluntary basis, based on the desire of private landowners to remove their existing homes from the future threat of flooding in the floodplain / channel migration zone. In addition, the NPS does not have enough suitable land for exchange to remove all private development from the 100-year floodplain by this process.

Ongoing moderate adverse impacts associated with the location of the Stehekin Valley Road in the floodplain / channel migration zone would also continue under Alternatives 2 and 3, albeit to a lesser extent than in Alternative 1 and 4 because portions of the road (different) would be rerouted. In Alternative 3, more of the road (including the area adjacent to the Lower Field) would also remain close to the river. Erosion protection measures in Alternative 2 would affect an additional 1.22 percent of the Stehekin River bank, while in Alternative 3 they would affect an additional 1.6 percent.

### Alternative 4

Major adverse effects associated with development in Alternative 1 would continue. Alternative 4, like Alternatives 2 and 3, would offer some potential for improvement for private development to be removed from the floodplain based on new LPP priorities, however, in Alternative 4, the LPP priorities would be affected by retention of the Stehekin Valley Road in its current alignment and using erosion protection measures along the Stehekin River. Compared to Alternative 1, these would affect an additional 2.6 percent of the Stehekin River bank. It is likely that fewer private properties within the floodplain / channel migration zone would be exchanged under this alternative.

**Conclusion**: Alternatives 1 - 4 would continue to have moderate to major adverse impacts from development remaining within the floodplain / channel migration zone, including private homes, roads and the Company Creek levee. Alternatives 2 - 3 would improve conditions by removing a portion of the Stehekin Valley Road from the floodplain / channel migration zone and Alternatives 2 - 4 would also allow removal of private development from the floodplain / channel migration zone through a revised emphasis in the LPP. Ongoing minor to moderate adverse effects would continue from existing (Alternatives 1 - 4) and new (Alternatives 2 - 4) erosion protection measures along the banks of the Stehekin.

# 25. RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

## Impacts from Actions Common to Alternatives 1 and 4

Major development actions in Alternatives 1 and 4 consist of modifications to the Stehekin Valley Road and construction of a replacement maintenance area and new housing area. Impacts from the road modifications, while they would affect some additional undeveloped areas (to construct the winter turnaround and pullouts), would have negligible impacts on long-term productivity within the lower Stehekin Valley. Most lands within Lake Chelan NRA would remain open and unaltered as a result of the proposed projects. Even development of the replacement maintenance and housing area would have overall minor effects since these impacts would occur in an area that has already lost much of its former productivity by being converted to now unused golf course fairways, where the area was graded and its native vegetation removed, and under the terms of the transfer maintained as an open area. Although the area is now in recovery, its long-term productivity would not be improved without active restoration. Because the former maintenance area would be restored in combination with the development of the replacement maintenance area and because the existing maintenance area is located within a more productive habitat (floodplain area), there would be long-term beneficial effects on long-term productivity from the removal of the maintenance area from its current location and its replacement in another, less sensitive, environment.

### Impacts from Actions Common to Alternatives 2 and 3

In addition to the major development actions identified above as part of Alternatives 1 and 4, major development actions in Alternatives 2 and 3 include the construction of the road reroutes, although these are different in each alternative. Development of the road reroutes would have direct effects on another 13 acres and indirect effects on up to 27 - 28 acres of now forested land in Alternatives 2 and 3 but would allow the restoration of riparian area now covered by road surface, a long-term moderate beneficial effect on productivity since this habitat is located close to the river and has a naturally higher level of productivity than upland forest habitat, which is far more abundant in the national recreation area. Although the development effects would be removed from these more sensitive riparian habitats, it would not compensate for the loss of additional intact forested habitat. As a result, this use of forested habitat would result in negligible to minor long-term diminished productivity in the affected area over time, but would increase due to beneficial impacts from edge effects introducing an increased diversity of species into the area. In addition, there would be additional restoration of 6 acres of degraded riparian area at the former maintenance area, Buckner Homestead hayfield and pasture, the Lower Field, and other areas in these alternatives, as well as in Alternative 4.

**Conclusion**: New development would affect about 8 acres in Alternative 1, 22 acres in Alternative 2, 23 acres in Alternative 3, and 10 acres in Alternative 4. In addition, some portion of the 37 acres of available exchange lands in Alternative 1 and some portion of the 24 acres of available exchange lands in Alternatives 2 - 4 could be developed. Most of this land has been affected by human activities or is forested (reroutes). Restoration of more productive riparian areas would compensate for some of this loss, accounting for about 5.0 acres in Alternative 1, 7.88 acres in Alternative 2, 7.42 acres in Alternative 3, and 6.42 acres in Alternative 4.

## 26. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitments of resources are actions that result in the loss of resources that cannot be reversed. Irretrievable commitments are actions that result in the loss of resources but only for a limited time.

### Impacts from Actions Common to Alternatives 1 - 4

While development effects would be long-term, effects from development are to some degree reversible and could, if desired, be removed, and the areas returned to natural landscape. It is likely that effects, however, would remain visible on the landscape for decades. Old roads and trails that have been left are often still visible for more than 50 years. If active restoration, however, is conducted and contours are restored, it is possible to diminish the effects of development; however, when this occurs in a forest of old trees, then the effects remain visible as a younger band of trees for decades.

Actions taken that would ―use up” resources in a way that could not be reversed, include the removal of mature trees from the forested landscape (for road rehabilitation actions in Alternatives 1 - 4 and for the reroutes in Alternatives 2 and 3) and for building materials procured elsewhere. Fill materials would not be balanced in Alternatives 1 or 4 and would therefore require the importation of approximately 5,600 cubic yards of fill for the road grade raise. Fill materials would be balanced in Alternatives 2 and 3, but because of this would disturb a larger area for the reroutes. Depending on the source of materials procured for Alternatives 1 and 4, impacts from their procurement could be considered irreversible since the materials would be taken from one area and moved to another area. Additionally, materials use for all the alternatives for building construction and outfitting would also result in the loss of materials from one area and their movement to another. To the degree that nonrenewable resources, including minerals and metals, were used, such use would preclude other uses and would be an irreversible commitment of resources.

**Conclusion**: Because development of the road and new facilities area currently affect only a very small percentage of the lower Stehekin Valley (see ―Land Use Impacts" in this chapter), are small in comparison to development occurring outside the area, and would not undergo major changes as a result of the implementation of Alternatives 1 - 4, irreversible and irretrievable commitments would be minor in all alternatives.

**Table IV-16: Impact Comparison Chart**

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Land Use<br>Impacts from Actions Common to All Alternatives: Relocating maintenance and housing: Long-term localized moderate adverse effects on 5 - 8 acres near the airstrip and moderate to major beneficial effects from restoration of riparian and upland areas (5 acres) and creation of more sustainable land use patterns outside CMZ.<br>Winter Turnaround, pullouts, and erosion protection at Wilson Creek: Minor adverse effects.</td></tr>
<tr><td>New development on 10 acres.<br>Road rehabilitation: Long-term minor adverse effects from improvements to existing road.<br>LPP: Long-term minor to major adverse and moderate beneficial effects from potential exchange of 37 acres.<br>Erosion protection: Long-term minor adverse effects.<br>Restoration: Additional negligible beneficial effects.</td><td>New development on 28 acres.<br>Road rehabilitation: Same as Alternative 1 with fewer impacts from less road rehabilitated.<br>Reroute construction: Long-term major adverse effects from development of 18 acres from 1.9 mile reroute.<br>LPP: Long-term minor to moderate adverse and major beneficial effects from potential exchange of 24 acres.<br>Erosion protection: Long-term minor to moderate localized from 6 - 8 barbs and 2 logjams.<br>Restoration: Additional moderate beneficial effects from restoration of Lower Field and Buckner.</td><td>New development on 28 acres.<br>Impacts similar to Alternative 2 with fewer adverse impacts from shorter reroute (1.6 miles) and more from more erosion protection measures (6 sites, 4 barbs and 6 logjams).</td><td>New development on 11 acres.<br>Road rehabilitation: Impacts same as Alternative 1.<br>LPP: Impacts similar to Alternatives 2 and 3 with less land exchanged from channel migration zone (moderate to major beneficial).<br>Erosion protection: Similar to Alternatives 2 and 3 with more minor to moderate adverse impacts from many more erosion protection measures (8 sites, 16 - 17 barbs and 3 logjams).<br>Restoration: Similar to Alternative 2.</td></tr>
<tr><td colspan="4">Cumulative Impacts: Alternatives 1 and 4 would contribute the fewest changes in land use (locally minor to moderate adverse effects on land use) since they would result in the least amount of additional development, however they would continue to have the potential to have the greatest impact on sustainability of road access and land use in the channel migration zone. The road reroutes in Alternatives 2 and 3 would contribute greater cumulative effects on development (minor to major adverse effects) from the relocation of the road from adjacent to the river to a currently forested area and the fewest impacts on the movement of the river channel.<br>Conclusion: The greatest direct effects on land use would occur in Alternatives 2 and 3 because they would relocate the road (with its existing adverse changes in the channel migration zone) to higher ground and disturb new areas (approximately 18 acres). At the same time, relocating the road would have long-term beneficial impacts on the sustainability of the Stehekin Valley Road and provide for restoration. Because Alternatives 1 and 4 would retain the road (including these adverse effects in the channel migration zone) there would be fewer impacts on undisturbed lands (approximately 10 and 11 acres, respectively); however, Alternatives 1 and 4 would continue to result in a continuation of unsustainable land use and affect the channel migration zone by leaving more of the road within it. Compared to the area that would be retained and protected within the lower Stehekin Valley, depending on the alternative selected, new development would occur on a very small percentage of the land within Lake Chelan NRA.<br>Because nearly all of Lake Chelan NRA would be retained in public ownership, reroute impacts in Alternatives 2 and 3 would occur in a common forest community type, and the Stehekin Community would remain, there would be no significant adverse effects on land use as a result of the implementation of Alternatives 1 - 4.</td></tr>
</table>

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Air Quality**<br>*Impacts from Actions Common to All Alternatives*: Localized short-term negligible to moderate adverse effects from soil moving activities, surfacing, transport of materials, evaporative emissions, and traffic delays associated with construction of housing and maintenance areas, road rehabilitation and construction of the Lower Valley Trail. Localized, long-term minor to moderate beneficial effects from surfacing (reducing dust), energy efficient design, LEED certification, and restoration of former maintenance area. | | | |
| *Road grade raise / erosion protection*: Additional minor to moderate short-term localized adverse impacts from transport of fill for McGregor Meadows and rip-rap / log-cribbing for Wilson Creek. | *Road reroute*: Additional short-term minor to moderate impacts from forest clearing, cuts and fills, and construction of road reroute.<br>*Erosion protection / recreational facilities*: Additional localized short-term negligible to minor adverse effects from construction.<br>*Restoration*: Additional long-term negligible beneficial effects from more restoration. | Similar additional negligible to moderate impacts related to the same actions in Alternative 2, with fewer construction impacts from recreational facilities and more from erosion protection measures.<br>*Restoration*: Fewer negligible beneficial effects than Alternative 2 from less restoration. | *Road grade raise*: Same as Alternative 1<br>*Erosion protection / recreational facilities*: Additional short-term minor to adverse impacts from more construction.<br>*Restoration*: Similar to Alternative 3 with less road restoration. |
| *Cumulative Impacts*: There would be no long-term contributions to particulate or other emissions from Alternatives 1 - 4. Alternatives 1 - 3 would contribute short-term negligible to minor cumulative impacts from particulate, exhaust, and evaporative emissions during construction and long-term minor to moderate beneficial effects from energy efficient building use and surfacing.<br>*Conclusion*: Alternatives 1 - 4 would have mostly localized, short-term, negligible to moderate adverse impacts lasting only during construction activities. Alternative 1 would have additional impacts from the grade raise. Alternatives 2 and 3 would have additional particulate and exhaust emissions due to greater excavation for the reroutes. Alternative 4 would have additional emissions from more importation of rock for barbs and soil for the grade raise. Beneficial impacts from restoration and bioengineering would be greatest in Alternative 2, followed by Alternatives 3, 4, and 1. All alternatives would have long-term localized minor to moderate beneficial effects from reducing gravel use from the Company Creek Pit and from dust reduction on the main road.<br>There would be no major adverse impacts to and no impairment of air quality or air quality-related values from the proposed actions under the alternatives. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Soils and Vegetation**<br>*Impacts from Actions Common to All Alternatives*: Long-term minor to moderate adverse effects from construction of the maintenance and housing area and localized negligible to major beneficial effects from upland and riparian restoration of the former maintenance area. Short-term negligible to moderate adverse effects from ongoing road maintenance and from rehabilitation, including construction of winter turnaround and pullouts. Minor short- and long-term adverse effects from road realignment at Wilson Creek, relocation of campsites and docks at Weaver Point, and minor to moderate adverse effects from construction of the Lower Valley Trail. Additional minor beneficial effects from dust reduction and vegetation restoration following disturbance. | | | |
| *Road grade raise*: Additional short- and long-term negligible to minor adverse effects.<br>*Road realignment*: Additional minor adverse and beneficial effects.<br>*Erosion protection*: Additional minor adverse impacts on soils from rip-rap and log cribbing at Wilson Creek.<br>Large woody debris: No effects.<br>*LPP*: Long-term minor to moderate adverse and beneficial effects from ongoing implementation. | *Road reroute*: Short- and long-term moderate adverse impacts on soils and moderate to major adverse impacts on vegetation from construction. Loss of approximately 238 trees per acre in 18 acres. Negligible to moderate beneficial effects from revegetation.<br>*Access road / recreation*: Long-term minor adverse effects from ongoing maintenance of 0.8 miles of road in floodplain / channel migration zone and construction of recreation facilities.<br>*Erosion protection*: Short- and long-term minor to moderate localized adverse effects from construction and negligible to minor beneficial effects from bioengineering.<br>*Milepost 8.0 / 9.2*: Localized minor adverse and minor beneficial effects.<br>Large woody debris: Short-term minor adverse and long-term minor beneficial effects.<br>*Restoration*: Long-term minor to major beneficial effects from restoration of Buckner, Lower Field, old road, other erosion protection areas, and bioengineering.<br>*LPP*: Long-term minor to moderate adverse effects from development of 10 - 15 exchanged parcels and long-term moderate to major beneficial effects from acquisition or exchange in riparian areas. | Impacts same as Alternative 2 from access road, Milepost 8.0, 9.2, large woody debris, and LPP.<br>Road reroute: Similar to Alternative 2, with fewer adverse effects from shorter reroute.<br>*Recreation*: Similar to Alternative 2, with impacts from one more camp, no raft takeout and retention of shooting range.<br>*Erosion protection*: Similar to Alternative 2, with fewer barbs and more logjams in two more sites.<br>*Restoration*: Similar to Alternative 2, with less road restoration and more bioengineering. | Impacts same as Alternative 1 for road grade raise / realignment and same as Alternatives 2 and 3 for Mileposts 8.0 and 9.2 actions.<br>*Recreation*: Similar to Alternative 2, but with negligible impacts from one more camp and retention of shooting range.<br>*Erosion protection*: Similar to Alternative 3 but with additional minor to moderate adverse and negligible beneficial effects from more barbs in more locations.<br>*Restoration*: Similar to Alternative 3, but with no road restoration.<br>*Large woody debris*: Additional minor adverse and beneficial impacts from larger procurement area.<br>*LPP*: Similar to Alternatives 2 and 3, but with less exchange targeted in channel migration zone. |

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Cumulative Impacts: Alternative 1 would contribute localized negligible to moderate adverse effects and localized minor to moderate beneficial effects. Alternatives 2 and 3 would contribute localized negligible to moderate adverse impacts and localized minor to moderate beneficial effects. Alternative 4 would contribute localized minor to moderate adverse effects and minor to moderate beneficial effects.<br>Conclusion: Alternative 1 would have negligible to moderate adverse and negligible to major beneficial effects. Alternative 2 would have negligible to major adverse effects and negligible to major beneficial effects. Alternative 3 would have impacts similar to Alternative 2, with adverse and beneficial effects both somewhat less from shorter reroute, less restoration, and more erosion protection measures. Alternative 4 would contribute negligible to moderate adverse effects and minor to major beneficial effects.<br>Because there would be no widespread major adverse impacts on vegetation, and no major widespread adverse impacts to soils or effects on rare vegetation or soils, there would be no impairment of park resources or values.</td></tr>
</table>

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Geologic Hazards<br>Impacts from Actions Common to All Alternatives: Ongoing long-term minor to moderate potential for injury or damage from geologic hazards.</td></tr>
<tr><td>Ongoing long-term minor to moderate exposure to flood hazards on the Stehekin Valley and Company Creek roads.</td><td colspan="2">Reduced impacts from rock fall hazard at Milepost 8.0 (minor beneficial) and with most flood hazards on the Stehekin Valley Road (moderate beneficial). The potential for injury or damage would remain minor to moderate. Minor new risks would be associated with relocated recreational facilities and minor to moderate from the debris flow or snow avalanche hazards on the reroute.</td><td>Same as Alternative 1 except reduction of hazards at Milepost 8.0 and minor additional hazards from recreational facilities as in Alternatives 2 and 3.</td></tr>
<tr><td colspan="4">Cumulative Impacts: A variety of potential hazards would continue to exist. The contribution of additional impacts from Alternatives 1 - 4 would be negligible to minor.<br>Conclusion: Alternatives 1 - 4 would have minor increase in exposure to geologic hazards. Alternatives 2 - 3 would reduce roadway flood hazards along reroute sections. Alternatives 2 - 4 would have long-term minor beneficial impacts from stabilizing the slope at Milepost 8.0</td></tr>
</table>

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Water Resources: Hydraulics and Streamflow Characteristics<br>Impacts from Actions Common to All Alternatives: Ongoing long-term minor to major adverse effects from maintaining the Company Creek Road and levee. Major adverse impacts would occur from retaining the Stehekin Valley Road (Alternatives 1 and 4) or moderate impacts from retention of the McGregor Meadows Access Road (Alternatives 2 and 3). Minor to moderate adverse effects from road rehabilitation actions coupled with minor long-term beneficial effects from surfacing from less erosion of fill. Long-term minor adverse and beneficial effects from drainage modifications. Long-term moderate beneficial effects from maintenance facility and housing replacement and relocation. Long-term negligible to moderate adverse effects from construction of Lower Valley Trail. Long-term negligible to moderate beneficial effects from removal of structures and from restoration and bioengineering.</td></tr>
<tr><td>Road grade raise: Long-term localized moderate to major adverse effect on floodwater level and flow.<br>Erosion protection: Long-term moderate adverse effects from rip-rap and log-cribbing at Wilson Creek.<br>LPP: Ongoing long-term minor to moderate, occasionally moderate to major, adverse impacts from development in floodplain / channel migration zone. Ongoing minor beneficial effects from effort to remove development from floodplain.</td><td>Road reroute: Long-term moderate to major beneficial effects from allowing floodwater, wood, and gravel storage and lateral migration of channel.<br>Access road: Minor short-term adverse impacts from potential release of road sediments and on floodwater elevation and flow.<br>Milepost 8.0: Short-term minor adverse and long-term moderate beneficial effects from slope stabilization.<br>Erosion protection: Minor adverse impacts from new structures on the edge of the channel migration zone and moderate impacts from those within it. Minor to moderate beneficial effects from restoring more natural rates of erosion. Minor to moderate increase in hardening of additional 1.4% more of riverbank.<br>Localized long-term moderate adverse impacts in Reach 1, minor to moderate in Reach 2 and Reach 3 from increased area of hardened riverbank.<br>Restoration and bioengineering: Long-term localized minor to moderate beneficial effect from increase in stream bank cover.<br>LPP: Same as Alternative 1 plus long-term minor to major beneficial impacts.</td><td>Road reroute: Long-term moderate adverse impacts from retention of some of the road in the channel migration zone. Moderate beneficial effects.<br>Erosion protection: Similar to Alternative 2, but with additional localized minor to moderate adverse impacts from two more sites with actions (1.7% more of riverbank).<br>Localized moderate to major adverse impact in Reach 1, minor to moderate in Reaches 2 and 3, and moderate in Reach 4.<br>Access road / Milepost 8.0 / Restoration / LPP: Same as Alternative 2 with slightly less road restoration.</td><td>Road grade raise: Same as Alternative 1.<br>Erosion protection: Same as Alternative3 plus actions at two more sites, a moderate to major adverse impact.<br>Localized long-term major impact in Reach 1, minor to moderate in Reaches 2 and 3 (same as Alternative 2), and moderate in Reach 4 and an undesignated reach near Milepost 9.2.<br>LPP: Same as Alternative 1 plus long-term minor to major beneficial impacts.</td></tr>
</table>

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4"> Cumulative Impacts: All alternatives would contribute minor to moderate cumulative impacts from increasing the amount of hardened streambank. Measures in Alternative 4 would add the most to cumulative effects, while Alternative 1 would likely equal these over time. Alternative 2 would have the fewest additions to cumulative adverse effects. All alternatives would also contribute long-term minor beneficial effects from relocating the housing and maintenance areas. Conclusion: Alternative 2 would have the fewest effects, followed by Alternatives 3, 4, and 1. Alternative 1 would have long-term minor to major adverse effects and minor beneficial effects. Alternative 2 would have long-term minor to moderate adverse effects and long-term minor to major beneficial effects. Alternative 3 would have long-term minor to moderate and localized major adverse effects and long-term minor to major beneficial effects. Alternative 4 would have minor to major adverse effects and minor to major beneficial effects. Since there would be no significant adverse impacts to streamflow characteristics or channel-forming processes, there would be no impairment of park resources or values. </td></tr>
</table>

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Water Resources: Water Quality**<br>*Impacts from Actions Common to All Alternatives*: Localized negligible to moderate long-term adverse effects from existing development and operations. Short-term negligible to minor adverse effects from runoff and long-term minor to moderate beneficial effects from surfacing. Short-term localized negligible to minor adverse effects from culvert work and Lower Valley Trail. Short-term minor to moderate localized adverse impacts from construction. Minor to moderate adverse impacts from removal of structures coupled with long-term moderate to major beneficial effects. Negligible to moderate beneficial effects from replacement and relocation of maintenance area. | | | |
| *Road grade raise*: Short-term moderate to major localized adverse impacts from potential release of fill.<br>*Erosion protection*: Short-term minor adverse and long-term beneficial effects at Wilson Creek.<br>*Large woody debris*: No effects.<br>*LPP*: Short-term negligible to moderate adverse and long-term minor to moderate beneficial effects. | *Road reroute*: Short- and long-term minor impacts from runoff.<br>*Erosion protection*: Short-term minor to moderate localized adverse impacts from placement of barbs and logjams and long-term negligible to moderate beneficial impacts from reducing erosion.<br>*Milepost 8.0 and 9.2*: Minor to moderate beneficial impacts from slope retention / decreasing erosion.<br>*Large woody debris*: Short-term negligible to minor adverse effects from access.<br>*Recreation*: Short-term negligible to minor adverse effects from construction. Potential beneficial impacts from restoration of shooting range.<br>*LPP*: Potential long-term moderate to major beneficial and short-term minor to major adverse effects. | *Road reroute*: Similar to Alternative 2 with short-term minor adverse impacts.<br>*Erosion protection*: Similar to Alternative 2 with additional impacts from a different array of structures.<br>*Milepost 8.0 / 9.2 / Large Woody Debris / LPP*: Same as Alternative 2. | *Road grade raise*: Same as Alternative 1.<br>*Erosion protection*: Similar to Alternative 2 with more structures at more sites.<br>*Large woody debris*: Additional short-term minor impacts from additional procurement area.<br>*LPP*: Long-term minor to major beneficial impacts from removal of structures combined with potential short-term adverse similar to Alternatives 2 and 3. |
| *Cumulative Impacts*: Alternatives 1 - 4 would contribute minor localized cumulative adverse impacts from construction of new maintenance and housing, negligible to minor long-term beneficial effects from road rehabilitation, and minor to moderate adverse and beneficial effects from LPP actions. Alternatives 2 and 3 would contribute additional minor adverse and long-term beneficial effects from the reroutes and Alternatives 2 - 4 would contribute additional moderate beneficial effects from LPP actions.<br>*Conclusion*: Alternative 1 would have short-term negligible to major localized adverse effects and long-term minor to moderate beneficial effects. Alternatives 2, 3, and 4 would have short-term minor to major localized adverse effects and long-term minor to major beneficial effects.<br>There would be no significant impacts to and no impairment of water quality or its values under Alternatives 1 - 4. | | | |

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Water Resources: Wetlands<br>Impacts from Actions Common to All Alternatives: Short-term negligible to minor adverse effects on wetlands from construction and negligible to moderate or major beneficial impacts from restoration. There would be short-term minor adverse effects from replacement of intermittent and perennial stream culverts and long-term negligible to minor effects from maintaining these and snowmelt drainage culverts. Long-term beneficial effects from restoration of 1.5 acres of palustrine forested wetlands in the current maintenance area. Ongoing beneficial impacts from acquisition of lands within the floodplain.</td></tr>
<tr><td>Road grade raise: Long-term localized moderate adverse impacts from elevated road.</td><td>Road reroute: Long-term minor to moderate beneficial effects from removing road from floodplain / channel migration zone.<br>Erosion protection: Short-term minor to moderate adverse effects from construction of barbs and logjams, particularly from actions within or adjacent to water coupled with long-term minor beneficial effects from revegetation and riparian restoration.<br>Large woody debris: Negligible to minor short-term adverse effects from access for procurement.<br>Restoration: Long-term beneficial effects from restoration of Buckner and Lower Field riparian areas and from other restoration associated with erosion protection measures.<br>LPP: Long-term minor to moderate beneficial effects from acquisition of riparian areas or exchange of uplands for riparian areas.</td><td>Road reroute / Large woody debris: Same as Alternative 2.<br>Erosion protection: Similar to Alternative 2 with additional minor and moderate adverse effects from additional measures within and adjacent to channel migration zone (minor to moderate adverse).<br>Restoration: Similar to Alternative 2, with less restoration of riparian area in old road alignment (moderate beneficial) and ongoing impacts from continued location of road next to Lower Field riparian area (moderate adverse).</td><td>Road grade raise: Same as Alternative 1.<br>LPP: Additional minor to moderate beneficial impacts from opportunities to acquire lands within channel migration zone.<br>Erosion protection: Impacts similar to Alternatives 2 and 3, but with more moderate adverse effects from more structures within and on the edge of the river.<br>Restoration: Similar to Alternatives 2 and 3, but without road restoration in McGregor Meadows and Lower Field.</td></tr>
<tr><td colspan="4">Cumulative Impacts: All alternatives would contribute long-term moderate beneficial effects from restoration of the maintenance area and long-term minor adverse and negligible to minor beneficial effects from erosion protection measures and replacement / construction of culverts. Alternatives 2 and 3 would have similar beneficial and adverse contributions, with more adverse and fewer beneficial effects in Alternative 3 because of ongoing impacts adjacent to Lower Field. Alternatives 2 - 4 would contribute slightly more beneficial effects from restoration than Alternative 1.<br>Conclusion: There would be short- and long-term adverse effects from impacts to wetlands of less than one acre in Alternatives 1 - 3. Long-term beneficial impacts would occur from approximately 1.5 acres of restoration in Alternative 1, 4.1 in Alternative 2, 3.9 in Alternative 3, and 2.9 in Alternative. Jurisdictional wetland impacts would include erosion protection measures (barbs and logjams above) plus impacts from culvert modifications. Only Alternative 4 would require a wetlands statement of findings and formal mitigation of adverse impacts.<br>Because there would be no widespread major adverse impacts on wetlands there would be no impairment of park resources or values from the implementation of Alternatives 1 - 4.</td></tr>
</table>

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Water Resources: Floodplains**<br>*Impacts from Actions Common to All Alternatives*: Ongoing moderate to major adverse impacts from retaining Stehekin Valley Road floodplain channel migration zone in McGregor Meadows and from the Bakery to Lake Chelan and from Company Creek Road near Harlequin Bridge and above Company Creek. Ongoing negligible to minor adverse effects from maintaining recreational facilities in floodplains. Long-term minor to moderate adverse effects from not retaining the Stehekin Valley Road in its current alignment near Milepost 3.8 (Frog Island), Milepost 5.3 (Wilson Creek), Milepost 8.0 and 8.5. Long-term moderate to major beneficial effects from relocating housing and maintenance areas (including fuel storage area) outside of regulatory floodplains. Long-term minor to moderate beneficial effects from allowing floods to overtop riverbanks. Long-term minor to moderate adverse impacts from existing erosion protection measures. | | | |
| *Road grade raise*: Localized moderate to major adverse impacts from placement of 5,600 cubic yards fill. | *Road reroute*: Long-term moderate to major beneficial effects from restoring floodplain values and functions.<br>*Access road*: Long-term localized minor to moderate adverse impacts.<br>*Erosion protection*: Minor to moderate adverse impacts from three structures on the edge of the channel migration zone and one within it.<br>*Restoration and bioengineering*: Long-term minor beneficial effects from slowed bank erosion.<br>*LPP*: Potential for long-term moderate to major beneficial effects by removal of private development. | *Access road / Restoration and bioengineering / Removal of structures / LPP*: Same as Alternative 2.<br>*Reroute*: Long-term minor to moderate beneficial impacts and ongoing minor to moderate adverse effects from 1.2 acres remaining within channel migration zone.<br>*Erosion protection*: Similar to Alternative 2 with additional long-term minor to moderate adverse effects from more structures within or on the edge of the channel migration zone. | *Road grade raise*: Same as Alternative 1.<br>*Restoration and bioengineering*: Same as Alternative 2.<br>*Erosion protection*: Similar to Alternative 3, with additional long-term minor to major adverse impacts from more structures within channel migration zone.<br>*LPP*: Potential long-term minor to moderate beneficial effects on floodplains. |
| *Cumulative Impacts*: Alternatives 1 and 4 would contribute moderate adverse impacts from fill used for the road grade raise. Alternatives 2 and 3 would contribute minor effects from retaining the Access Road in the floodplain. Long-term negligible benefits would be contributed in all but Alternative 1 from the changed priorities for land acquisition and exchange, though these would be greater in Alternatives 2 and 3 from prioritizing lands primarily to remove development from not just the floodplain, but also the channel migration zone. All action alternatives would move toward less development within the floodplain, a long-term minor to major beneficial effect, depending on the alternative.<br>*Conclusion*: The combined effects of the actions in Alternative 1 would result in a series of localized, long-term negligible to major adverse effects coupled with some long-term moderate to major beneficial effects. Alternative 2 would result in similar negligible to moderate adverse effects, while it would have more long-term moderate to major beneficial effects. Alternative 3 would have effects similar to Alternative 2, including a range of negligible to moderate adverse and beneficial impacts from many of the same actions. These would include fewer beneficial effects from shorter reroute and from the implementation of additional erosion protection measures in areas where the road is within the floodplain / channel migration zone. Alternative 4 would essentially combine the effects of retaining the Stehekin Valley Road in its current alignment as in Alternative 1, a long-term moderate to major adverse effect with the erosion protection and restoration measures in Alternatives 2 and 3, resulting in some long-term negligible to moderate beneficial effects.<br>There would be no significant impacts to and no impairment of floodplain values or functions from the implementation of Alternatives 1 - 4. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Wildlife**<br>*Impacts from Actions Common to All Alternatives*: Short-term localized negligible to minor disturbance from noise and construction activity and long-term minor to moderate disturbance from new developed areas. Ongoing negligible to minor impacts from vehicle-wildlife collisions. Long-term minor to moderate habitat loss from road rehabilitation and facility construction. Potential minor short-term impacts from sedimentation attributed to earth moving activities and localized minor adverse effects from work at Wilson Creek. Minor adverse effects from contamination from runoff after surfacing. Long-term negligible to moderate localized beneficial impacts from habitat restoration. Short- and long-term negligible to moderate localized impacts from other construction activities. Localized short-term minor to moderate adverse impacts from construction of Lower Valley Trail. Long-term moderate beneficial impacts from habitat restoration of former maintenance area. | | | |
| *Road grade raise / realignment*:: Negligible to moderate adverse effects from reduction in habitat and potential for sedimentation due grade raise / realignment.<br>*Erosion protection*: Long-term localized moderate impacts to aquatic habitat from rip-rap and log-cribbing at Wilson Creek.<br>*Large woody debris*: Ongoing negligible to minor adverse impacts on fish and aquatic species.<br>*LPP*: Ongoing long-term negligible to moderate beneficial and minor to moderate adverse effects. | *Road reroute*: Short-to long-term localized moderate to major adverse effects from habitat loss. Negligible to minor beneficial effects from edge habitat creation and restoration over time of cuts and fills.<br>*Erosion protection*: Short-term minor to moderate adverse and long-term minor to moderate beneficial effects on bank stabilization and habitat loss and creation.<br>*Milepost 8.0 and 9.2*: Negligible to minor adverse impacts from habitat modification and disturbance and long-term minor beneficial effects from revegetation and stabilization.<br>*Large woody debris*: Short-term minor adverse impacts during procurement and long-term minor beneficial impacts from use of wood over rock.<br>*Recreation*: Short- and long-term negligible to moderate adverse effects from construction and use and long-term negligible to minor effects from habitat modification.<br>*Restoration*: Long-term beneficial impacts from restoration.<br>*LPP*: Long-term minor to moderate adverse effects from development and minor to moderate beneficial effects from potential acquisition of important riparian habitat areas. | *Road reroute*: Same as Alternative 2 except for shorter distance with fewer impacts.<br>*Erosion protection*: Similar to Alternative 2 with more adverse and more beneficial impacts.<br>*Restoration*: Same as Alternative 2 except with less road restoration from shorter reroute.<br>*LPP*: Same as Alternative 2.<br>*Recreation*: Fewer adverse impacts from no raft takeout and one additional camp. | *Road grade raise*: Same as Alternative 1.<br>*Erosion protection*: Similar to Alternative 3 with short-term minor to moderate adverse and negligible to minor beneficial impacts.<br>*Large woody debris*: Negligible to minor adverse effects, including potential for more dispersed impacts from wider area used.<br>*LPP*: Similar to Alternatives 2 and 3, with fewer beneficial impacts from revised LPP from retaining the Stehekin Valley Road alignment. |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| *Cumulative Impacts*: Alternative 1 would contribute long-term negligible to minor cumulative adverse and beneficial effects from habitat disturbance and loss. Alternatives 2 and 3 would contribute localized minor to moderate adverse cumulative impacts and localized minor beneficial impacts on wildlife. Alternative 4 would contribute localized minor to moderate adverse effects from both disturbance and loss.<br>*Conclusion*: Alternative 1 would have negligible to moderate short- and long-term adverse and long-term beneficial impacts. Alternative 2 would have negligible to major adverse and negligible to moderate beneficial impacts. Alternative 3 impacts would be similar to Alternative 2, with short- to long-term negligible to major adverse impacts and long-term negligible to moderate localized beneficial effects from restoration. Compared to Alternative 2, Alternative 3 would have both adverse and beneficial effects would be somewhat less from shorter reroute, less potential restoration at Lower Field, and more erosion protection measures. Alternative 4 would have negligible to moderate adverse and beneficial effects. In Alternative 4, fewer overall beneficial effects would occur compared to Alternatives 2 and 3, because the road would be retained in the channel migration zone and more erosion measures would also be within that zone.<br>Although localized impacts could range to major in Alternatives 2 and 3 due to the disturbance of approximately 18 acres of wildlife habitat, within a total disturbed area of about 28 acres from the construction of the reroutes, no species loss would occur and displaced species could use other nearby intact areas and future restored areas for habitat. As a result, there would be no impairment of wildlife or its values. | | | |

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Special Status Wildlife<br>Impacts from Actions Common to All Alternatives: Impacts would be not likely to adversely affect most special status species because they would primarily be associated with short-term construction impacts. Impacts would be short-term and negligible on gray wolves and grizzly bears; short-term and minor for lynx and wolverine; short- and long-term minor on fishers (with some negligible beneficial effects from restoration of riparian areas); and short-term negligible to minor on bald eagles.<br>Most effects on aquatic species, including fish, frogs, and toads would be avoided by work outside the breeding season.</td></tr>
<tr><td>Road rehabilitation: Approximately 7.5 acres of northern spotted owl suitable habitat could be affected by noise and disturbance, a short- to long-term minor to moderate adverse effect, primarily associated with road rehabilitation.</td><td>Impacts would be the same as in Alternative 1 for all special status species except northern spotted owls, goshawks and aquatic species.<br>Road reroute: Impacts on northern spotted owls would be long-term and moderate to major associated with both noise and disturbance and habitat removal. Long-term negligible to minor beneficial impacts could occur from changes to foraging areas.<br>Removal of forested habitat for the reroutes would also have moderate adverse effects on goshawks.<br>Erosion protection: There would be short- and long-term minor to moderate adverse and minor beneficial impacts from work in or near water. Some long-term negligible to minor beneficial effects could occur from creation of pool habitat for fish, frogs and toads.</td><td>Same as Alternative 2.</td><td>Same as Alternative 1 with increased effects from creating pool habitat.</td></tr>
<tr><td colspan="4">Cumulative Impacts: Alternatives 1 - 4 would contribute long-term, cumulative negligible to minor beneficial impacts along with similar short-term adverse impacts from construction. Cumulative effects in Alternatives 2 and 3 would be greater associated with direct adverse impacts to northern spotted owl habitat.<br>Conclusion: Alternatives 1 - 4 may affect and would be likely to adversely affect northern spotted owls. Alternatives 1 - 4 may affect, but would not be likely to adversely affect the following listed, proposed or candidate species: grizzly bears, gray wolves, Canada lynx, Pacific fisher, bull trout, dolly varden, Chinook salmon, westslope cutthroat trout, or Columbia spotted frog. Similarly, the proposed actions may affect, but would not be likely to adversely affect the following mammal, bird, and amphibian federal species of concern: mammals: California wolverine and western gray squirrel; birds: bald eagle, Pacific Townsend‟s big-eared bat, small-footed (Yuma) myotis, western long-eared myotis, fringed myotis or long-legged myotis, peregrine falcon, northern goshawk, olive-sided flycatcher, and black swift; and amphibians: western toad, spotted frog, Cascades frog, and tailed frog.<br>Because there would be limited major adverse impacts to threatened or endangered species or species of concern there would be no impairment of the park‟s special status species‟ resources or values. Northern spotted owls may have become extirpated from their existing nest site prior to project implementation by barred owls, or may return to nest activity area. Other northern spotted owl nest sites within the lower Stehekin Valley would likely continue to produce young. Visitors and residents would likely continue to have the opportunity to experience rare glimpses of this threatened species and it would continue to occur in the lower Stehekin Valley.</td></tr>
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| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Archeological Resources** | | | |
| Because archeological resources have been surveyed for within the proposed project area; because archeological resources found were outside of the project area; and because the discovery potential for buried archeological resources would employ mitigation measures noted below there would be no adverse effect on known archeological resources. | | | |
| *Cumulative Impacts*: There would be no construction-related contributions that would affect known eligible archeological resources and therefore no cumulative impacts from Alternatives 1 - 4. There is a slight possibility; however, that future proposed work could affect currently unidentified cultural resources. Because mitigation measures would be implemented as noted above, Alternatives 1 - 4 would not be expected to contribute to cumulative effects on archeological resources.<br>*Conclusion*: Alternatives 1 - 4 would have no adverse effect on known archeological resources.<br>There would be no adverse effects on and no impairment of known National Register eligible archeological resources or values. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Cultural Landscapes** | | | |
| No effect on cultural landscapes. | Minor long-term beneficial effects on rehabilitation of the cultural landscape at Buckner Homestead Historic District from vegetation restoration of the riparian edge along the pasture and hayfield. Vegetation restoration of the riparian area would have no adverse effect on the Buckner Homestead Historic District. | Same as Alternative 2 | Same as Alternative 2 |
| *Cumulative Impacts*: Actions in Alternative 1 would have no contribution to cumulative effects on cultural landscapes. Alternatives 2 - 4 would contribute minor long-term beneficial effects.<br>*Conclusion*: Alternative 1 would have no effect on cultural landscapes. Alternatives 2 - 4 would have long-term beneficial effects (no adverse effect) on rehabilitation of the cultural landscape at Buckner Homestead Historic District from vegetation restoration of the riparian edge along the pasture and hayfield. Vegetation restoration of the riparian area would have no adverse effect on the Buckner Homestead Historic District.<br>There would be no impairment of resources or values associated with cultural landscapes. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Visitor Experience: Access and Transportation**<br>*Impacts from Actions Common to All Alternatives*: Negligible to moderate adverse short-term adverse impacts from transportation of materials and supplies for projects, causing an increase in barge loads and truck traffic as well as delays on road (such as one lane closures). Long-term minor to moderate beneficial impacts from surfacing, a safer roadway, more pullouts and better signage. Minor to moderate beneficial effects from construction of Lower Valley Trail. | | | |
| *Road grade raise*: Additional short-term moderate adverse impacts from importing and transporting fill.<br>*Retaining road*: Ongoing long-term moderate impacts from difficult access in McGregor Meadows section during flooding. | *Road reroute*: Short-term minor to moderate adverse impacts from transportation of materials (fewer than Alternatives 1 and 4 because most within area of reroute) and moderate long-term beneficial impacts from increased reliability of access.<br>*Access Road*: Ongoing long-term minor to moderate difficulty of access during flooding and minor adverse impacts from backtracking on the access road.<br>*Erosion protection*: Negligible to minor adverse impacts from potentially protruding barbs during raft trips.<br>*Milepost 8.0*: Long-term beneficial impacts from reduced potential for road closures due to rock fall.<br>*Raft takeout*: Long-term minor to moderate beneficial effects. | Same as Alternative 2 except for impacts associated with raft takeout.<br>*Erosion protection*: There would be fewer potential impacts on rafting from barbs, but more from logjams. | *Road grade raise / Stehekin Valley Road retention*: Same as Alternative 1.<br>*Erosion protection*: Minor to moderate adverse effects from potentially protruding barbs during raft trips.<br>*Milepost 8.0 / Raft takeout*: Same as Alternative 2. |
| *Cumulative Impacts*: Alternatives 2 and 3 would contribute long-term minor to moderate beneficial impacts from dependable road access around McGregor Meadows, while Alternative 2 would also contribute long-term dependable road access to above the Lower Field area. With erosion protection measures, Alternatives 2, 3 and 4 would likely result in better access than Alternative 1 from bank stabilization and from work at Milepost 9.2 and from slope stabilization at Milepost 8.0. All alternatives would contribute short-term minor to moderate adverse effects on transportation that would generally affect residents more than visitors. These include traffic delays from transport of fill and construction materials and other road construction activities. Similarly long-term negligible to minor beneficial effects on transportation would be contributed under Alternatives 1 - 4 from rehabilitation of the road (Alternatives 1 - 4) or construction of new segments of road (Alternatives 2 and 3) from improved driving conditions, signage, and safety improvements such as sight distance and pullouts.<br>*Conclusion*: Alternatives 1 - 4 would have short-term negligible to moderate adverse and negligible to minor beneficial impacts. Additional moderate adverse effects would occur in Alternatives 1 and 4 related to transportation of fill and flooding access. Alternatives 2 - 4 would add long-term minor to moderate beneficial effects from actions at Milepost 8.0 and from stabilization of the road, whether in place or with a reroute, though these would be greater in Alternatives 2 and 3 from increased reliability of access. Additional minor adverse impacts would occur from erosion protection measures. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Visitor Experience: Interpretation and Education**<br>*Impacts from Actions Common to All Alternatives*: Ongoing minor to moderate beneficial impacts from existing interpretive and educational programs. Minor long-term beneficial effects from opportunities for interpretation / education on Lower Valley Trail. Short-term minor beneficial impacts from informal interpretive opportunities during construction. | | | |
| Same as Actions Common to All Alternatives. | Long-term minor to moderate long-term beneficial effects from other new interpretive opportunities associated with new recreational facilities.<br>Long-term minor beneficial effects from enhancement of interpretive and educational programming related to the implementation plan. | Same as Alternative 2 | Same as Alternative 2 |
| *Cumulative Effects*: Alternatives 1 - 4 would contribute minor beneficial effects.<br>*Conclusion*: Alternatives 1 - 4 would have minor to moderate beneficial effects, with slightly more beneficial effects in Alternatives 2 - 4. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Visitor Experience: Visitor Use Opportunities**<br>*Impacts from Actions Common to All Alternatives*: Long-term minor to moderate beneficial impacts from ongoing visitor use opportunities. Long-term moderate to major beneficial impacts from improved driving conditions on a surfaced road, new experiences on Lower Valley Trail, an improved winter turnaround, and reduced dust on the road for motorists and recreationists. Negligible to minor, short-term minor to moderate adverse effects from noise and activity and reduced wildlife presence due to road rehabilitation and construction of housing and maintenance areas. | | | |
| Same as “Actions Common to All Alternatives.” | *Road reroute*: There would be long-term minor effects from the increased diversity of the driving experience and from changes in views and vistas that would be negligible to minor beneficial or adverse depending on individual preferences. Long-term negligible beneficial effects from increased wildlife sightings in the Lower Field area.<br>*Recreation*: Negligible to minor adverse and minor to moderate long-term beneficial effects from establishing additional or improved camps and raft takeout. Minor beneficial effects on fishing from creation of pool habitat and riparian restoration. | *Recreation*: Similar to Alternative 2 except fewer beneficial and adverse impacts form no raft takeout and one additional camp. | Same as Alternative 2, but with additional beneficial impacts from one additional camp. |
| *Cumulative Effects*: Alternative 1 would contribute minor to moderate beneficial impacts and negligible to minor short-term adverse effects. Alternatives 2 - 4 would be the same as Alternative 1 plus would have additional minor beneficial effects from new visitor facilities. Depending on the viewer, changes to the driving experience would be viewed (in Alternatives 2 and 3) as minor and beneficial or adverse.<br>*Conclusion*: There would be few new opportunities in Alternative 1; however there would be improvements in existing opportunities. Compared to the negligible to minor beneficial effects in Alternative 1, Alternatives 2 - 4 would have both more opportunities and more improvements (minor to moderate beneficial effects) than Alternative 1. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Visitor Experience: Safety**<br>*Impacts from Actions Common to All Alternatives*: All alternatives would contribute a series of long-term negligible to moderate beneficial effects on safety primarily associated with road improvements (pullouts, surfacing, etc.) and maintenance area replacement and relocation. Negligible to moderate adverse effects from retaining sections of the road within the floodplain. | | | |
| *Road grade raise / road retention*: Minor to moderate long-term adverse effects from maintaining more road vulnerable to flooding. | *Road reroute*: Long-term moderate beneficial effects from rerouting the road away from the river. Long-term negligible to moderate adverse effects from relocation of the road.<br>*LPP*: Moderate beneficial effects from removing additional development from the floodplain. | Same as Alternative 2. | Same as Alternative 1 plus additional minor to moderate beneficial effects from revised LPP. |
| *Cumulative Effects*: While Alternatives 1 and 4 provide minor safety improvements, Alternatives 2 and 3 would result in long-term moderate beneficial impacts from improving safety conditions related to rerouting the road; as a result Alternative 2 would have slightly greater benefits.<br>*Conclusion*: Alternatives 1 and 4 would contribute negligible to moderate beneficial impacts on safety, while Alternatives 2 and 3 would also have additional moderate beneficial impacts because of the reroute and changes in LPP priorities. There would also continue to be negligible to moderate adverse effects from retaining sections of the road in the floodplain / channel migration zone where it cannot be moved (Alternatives 2 and 3) or to retain the existing road alignment (Alternatives 1 and 4). | | | |

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Visitor Experience: Scenic Resources<br>Impacts from Actions Common to All Alternatives: Negligible short-term effects from construction. Long-term negligible to moderate adverse and beneficial effects from new actions, including from surfacing and restoration.</td></tr>
<tr><td>Road retention: No effect.<br>LPP: Ongoing minor beneficial effects from protecting scenic resources from acquisition and exchange along the Stehekin Valley Road.</td><td>Road reroute: Long-term minor to moderate beneficial or adverse effects, depending on the viewer.<br>Erosion protection: Long-term minor beneficial and adverse impacts.<br>Restoration: Long-term minor to moderate beneficial effects.<br>LPP: Minor to moderate beneficial impacts from revised LPP.</td><td>Same as Alternative 2 with slightly less restoration and more erosion protection measures.</td><td>Same as Alternative 1 plus: Additional beneficial and adverse impacts from erosion protection measures and from revised LPP.</td></tr>
<tr><td colspan="4">Cumulative Impacts: Alternative 1 would continue to contribute long-term negligible to minor beneficial effects and ongoing short-term adverse effects from construction activities / prescribed burns. Alternatives 2 - 4 would contribute the same adverse and beneficial effects as Alternative 1, plus long-term adverse and beneficial effects from road reroute. Long-term beneficial effects noted in Alternative 1 associated with the LPP would continue but there would be less emphasis on these. Similarly, Alternatives 1 and 4 would contribute additional long-term negligible to minor adverse effects from maintaining roads in their existing alignments, contributing both minor adverse and minor beneficial effects on scenic resources from maintaining views while altering natural processes.<br>Conclusion: Alternatives 1 - 4 would continue to have long-term negligible to minor beneficial and short-term negligible to minor adverse effects on scenic resources, while Alternatives 2 and 3 would contribute to the diversity of the Stehekin Valley Road driving experience, a long-term minor to moderate beneficial or adverse effect depending on the viewer.</td></tr>
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<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Wild and Scenic Rivers<br>Impacts from Actions Common to All Alternatives: Minor beneficial effects would occur from the creation of the Lower Valley Trail and its connection to the Stehekin River Trail. No effect on the following outstandingly remarkable values: prehistoric resources, geology, scenic resources, wildlife, or fish.</td></tr>
<tr><td></td><td>Negligible to minor beneficial effects on historic resources. Minor beneficial effects on recreation from the designation of some additional camps and a raft takeout. Negligible to minor adverse effects from additional barbs or logjams where the road needs to be maintained near steep sections.</td><td>Additional negligible to minor adverse and beneficial effects on recreation from additional erosion protection measures and new recreational facilities.</td><td>Same as Alternative 3, with a different array of erosion protection measures.</td></tr>
<tr><td colspan="4">Cumulative Impacts: No effect on eligibility of Stehekin River Segment 1 to be designated as a wild and scenic river for recreation. Minor beneficial effects on recreation in Alternative 1. Minor beneficial effects on historic resources, recreation and negligible to minor adverse effects from erosion protection measures in Alternatives 2 - 4. Removal of private cabins from along the river would contribute long-term moderate beneficial effects.<br>Conclusion: There would be no effect on the ability of the Segment 1 portion of the Stehekin River to be designated as a wild and scenic river for recreation. The river would continue to be free flowing with unobtrusive and short impediments to river flow and would continue to possess more than one outstandingly remarkable value.<br>There would be no impairment of wild and scenic river resources or values from the implementation of Alternatives 1 - 4.</td></tr>
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| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Park Operations**<br>*Impacts from Actions Common to All Alternatives*: Short-term minor adverse effects from additional staff time and delays associated with planning, road construction, facility improvements and other actions. Long-term negligible to moderate beneficial effects from maintaining new and old facilities in good condition, with fewer needs for repair and fewer adverse effects during seasonal and catastrophic flooding. Long-term major beneficial effects from more functional maintenance facilities and from location not impacted by flooding. Long-term beneficial effects from cost-savings from new maintenance facility and housing. | | | |
| *Road grade raise*: Short-term minor to moderate adverse and long-term minor beneficial effects.<br>*LPP*: Short- and long-term negligible to moderate beneficial impacts.<br>*New facility construction*: Short-term negligible to moderate adverse impacts from oversight and management. | *Road reroute*: Negligible to minor short-term adverse effects plus long-term moderate beneficial effects.<br>*Access Road*: Minor to moderate adverse effects.<br>*Erosion protection*: Negligible to moderate adverse and long-term beneficial effects.<br>*LPP*: Minor to moderate beneficial effects. | Same as Alternative 2 | Same Alternative 1 with additional minor impacts from revised LPP and from erosion protection measures. |

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th><th>Alternative 3</th><th>Alternative 4</th></tr>
<tr><td colspan="4">Socioeconomics<br>Impacts from Actions Common to All Alternatives: Ongoing long-term minor to moderate beneficial effects from recreation area presence. Short-term minor to moderate beneficial effects from slight growth in construction during maintenance and housing and Lower Valley Trail project implementation.</td></tr>
<tr><td>Road rehabilitation: Short-term minor to moderate beneficial effects from construction.<br>LPP: Long-term negligible to minor beneficial effects.</td><td>Road reroute: Short-term minor to moderate beneficial effects from construction.<br>LPP: Long-term negligible to minor beneficial effects.</td><td>Same as Alternative 2</td><td>Same as Alternative 1 with additional beneficial impacts from LPP.</td></tr>
<tr><td colspan="4">Cumulative Impacts: Alternatives 1 - 4 would contribute long-term minor beneficial effects from cost savings associated with construction of new maintenance and housing. Alternatives 2 - 4 would contribute negligible long-term economic benefits from reduced closures of the Stehekin Valley Road related to flooding.<br>Conclusion: Alternative 1 would have negligible to minor adverse effects and negligible to moderate beneficial effects. Alternatives 2 and 3 would have negligible to minor adverse effects and negligible to moderate beneficial effects, more than Alternative 1 because of more construction and road remaining open more. Alternative 4 would have the same negligible to minor adverse effects as Alternative 1 and the similar negligible to moderate beneficial effects as Alternatives 2 and 3, however, the beneficial effects in Alternative 4 would be less related to road conditions.</td></tr>
</table>

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Hazardous Materials**<br>*Impacts from Actions Common to All Alternatives*: Potential short-term minor to moderate adverse effects from removing maintenance area and flood-affected structures and long-term moderate to major beneficial effects from removing hazardous materials from the floodplain. | | | |
| Same as Actions Common to All Alternatives | Short-term minor to moderate adverse effects from potential clean-up actions associated with former shooting range. | Same as Actions Common to All Alternatives | Same as Actions Common to All Alternatives |
| *Cumulative Impacts*: There would be no additional long-term contribution to adverse cumulative effects from Alternatives 1 - 4. Impacts would be minor to moderate, long-term and beneficial from removal of potential areas of hazardous materials in the former maintenance area and at the shooting range.<br>*Conclusion*: Alternatives 1 - 4 would have minor to moderate adverse and moderate to major long-term beneficial effects from removing hazardous materials from the floodplain. There would be additional minor adverse and moderate beneficial impacts in Alternative 2 from removing the shooting range. | | | |

| Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| **Unavoidable Adverse Impacts**<br>*Impacts from Actions Common to All Alternatives*: Moderate to major adverse impacts from presence of development remaining within floodplain / channel migration zone, including on Company Creek Road, portions of the Stehekin Valley Road, erosion protection structures and on private lands. | | | |
| Ongoing moderate adverse effects partially mitigated by long-term minor to moderate beneficial effects from potentially reducing development in floodplain / channel migration zone. | Additional mitigation of ongoing adverse effects from removing a portion of the Stehekin Valley Road from floodplain / channel migration zone and from potentially reducing development in floodplain / channel migration zone. | Slightly less mitigation than Alternative 2 from shorter road reroute and same LPP revisions. | Slightly more mitigation than Alternative 1 from LPP revisions. |
| *Conclusion*: Alternatives 1 - 4 would continue to have moderate to major adverse impacts from development remaining within the floodplain / channel migration zone, including private homes, roads and the Company Creek levee. Alternatives 2 - 3 would improve conditions by removing a portion of the Stehekin Valley Road from the floodplain / channel migration zone and Alternatives 2 - 4 would also allow removal of private development from the floodplain / channel migration zone through a revised emphasis in the LPP. Ongoing minor to moderate adverse effects would continue from existing (Alternatives 1 - 4) and new (Alternatives 2 - 4) erosion protection structures along the banks of the Stehekin. | | | |
| *Relationship Between Short-term Use of the Environment and Maintenance and Enhancement of Long-term Productivity*<br>*Impacts from Actions Common to All Alternatives*: Long-term minor to moderate beneficial and adverse effects from restoration of former maintenance area and development of new areas. | | | |
| Same as Actions Common to All Alternatives | Same as common to all alternatives plus: Additional moderate adverse effects from developing the road reroute areas and additional minor adverse and beneficial effects from erosion protection and restoration | Same as Alternative 2 | Additional minor adverse and beneficial effects from erosion protection and recreation. |
| *Conclusion*: New development in Alternatives 1 - 4 would affect about 8 acres in Alternatives 1 and 4 and 22 acres in Alternatives 2 and 3 plus some portion of the 37 acres of available exchange lands in Alternative 1 and some portion of the 24 acres of available exchange lands in Alternatives 2 - 4. Most of this land has been affected by human activities or is forested (reroutes). Restoration of more productive riparian areas would compensate for some of this loss, accounting for about 5.0 acres in Alt1, 7.88 acres in Alternative 2, 7.42 acres in Alternative 3 and 6.42 acres in Alternative 4. | | | |
| **Irreversible and Irretrievable Commitments of Resources**<br>*Impacts from Actions Common to All Alternatives*: Short-term minor adverse impacts from use of building materials, particularly nonrenewable resources such as metals and minerals that taken from one area to another that could not be reused. Potential for removal of development and restoration in all alternatives but with impacts visible for many years in forested areas. | | | |
| *Conclusion*: Because development of the road and new facilities area currently affect only a very small percentage of the lower Stehekin Valley (see “Land Use Impacts” in this chapter) and would not undergo major changes as a result of the implementation of Alternatives 1 - 4, irreversible and irretrievable commitments would be minor in all alternatives. | | | |

Note: LPP = Land Protection Plan

# CHAPTER V:

## Consultation and Coordination

# CHAPTER V: CONSULTATION AND COORDINATION

## A. HISTORY OF PUBLIC INVOLVEMENT

### Public Scoping (General)

A press release and newsletter describing the intent to begin the public involvement process through comments on the proposed project was issued on January 7, 2008. The newsletter was distributed to approximately 350 people on the recreation area's mailing list and was available in park visitor centers. The proposed project was also entered into the National Park Service (NPS) Planning, Environment, and Public Comment (PEPC) website/database.

The formal public scoping period for the *Stehekin River Corridor Implementation Management Plan Environmental Impact Statement* began on January 22, 2008 and ended on March 31, 2008. During this time, Lake Chelan National Recreation Area held three open house public meetings in Stehekin (January 22, 2008), Wenatchee (January 23, 2008) and Seattle (January 24, 2008). All parties wishing to express concerns or provide information about management issues which should be addressed in the forthcoming conservation planning and environmental impact analysis process were strongly encouraged to submit written comments.

Professional staff was available to introduce the project, give presentations on scientific data, answer questions, and to accept comments. The public was encouraged to provide comments during the meetings and/or to submit written comments. In total, approximately 73 people attended the public meetings and approximately 226 comments were recorded on flip charts at the meetings (see Chapter II). Later, 21 public comment letters were also received, including letters from individuals, nonprofit organizations (the Wilderness Society, National Parks Conservation Association, and North Cascades Conservation Council), and one business. With the exception of concerns outside the scope of the plan, these comments were used to inform the preparation of the preliminary alternatives.

After the public comments were analyzed, a postcard announcing the public comment summary was posted on the recreation area and PEPC website. Individuals, agencies, organizations, and businesses were invited to view the public comments online beginning June 9, 2008 at http://parkplanning.nps.gov/noca and were notified that the process of developing alternative management strategies was beginning.

### Public Scoping (Alternatives)

A second newsletter was prepared and sent out in summer 2008 describing the results of public scoping in more detail and identifying a range of preliminary alternatives. It was sent to the project mailing list, including the same individuals and organizations from the original mailing, plus the addition of individuals, organizations, and businesses who commented during public scoping.

Upon publication of the second (alternatives) newsletter, additional public scoping took place, focusing on these preliminary alternatives. Three public open houses were held: two in Stehekin (August 26 - 27, 2008) and one in Seattle (August 28, 2008). Afterwards, 17 additional comment letters were received from individuals; nonprofit organizations (National Parks and Conservation Association, Western Lands Project, and Stehekin Heritage); the Stehekin School District, Chelan County and two businesses (Island Resources, Ltd., and Stehekin River Resort). These letters contained approximately 65 comments, which were incorporated into the revised alternatives.

### Public Notification

The formal notice of intent to prepare an EIS was published in the Federal Register on February 27, 2008.

News releases mailed in advance of the public scoping and alternatives scoping periods were sent to the following news media: Seattle Times, Seattle Post Intelligencer, Chelan Mirror, Wenatchee World, Associated Press, Everett Herald, River Post, Argus, Spokane Chronicle, Bellingham Herald, Skagit Valley Herald, and Lynden Tribune.

Public notification also included the two newsletters and postcard mentioned above, sent in January, June and August 2008.

A project website (www.nps.gov/noca/srcip) was created in January 2008 and is periodically updated with new information.

During both the public scoping (general and alternatives) processes, comments were submitted directly to the park at the following address: North Cascades National Park Service Complex, Attn: SRCIP-EIS, 810 State Route 20, Sedro-Woolley, WA 98284. Comments were also submitted via the NPS PEPC website at *http://parkplanning.nps.gov/NOCA* or sent via e-mail to the superintendent, project manager, or *NOCA_planning@nps.gov*. Information about the planning process was regularly updated and posted on the park's website: *www.nps.gov/noca and on PEPC.*

## B. AGENCY CONSULTATION AND COORDINATION

A variety of agencies have an interest in the outcome of the Environmental Impact Statement (EIS). The following discussion documents the consultation and coordination process undertaken by the NPS and Federal Highway Administration (FHWA) during the preparation of the Draft Stehekin River Corridor Implementation Plan / Draft Environmental Impact Statement (Draft SRCIP/EIS). All local governments, tribal governments, and federal and state agencies with resource management responsibilities or interests in Lake Chelan National Recreation Area were invited and encouraged to participate in the development of the Draft SRCIP/EIS. Representatives of the planning team, including the North Cascades National Park Service Complex NOCA superintendent and SRCIP project manager made several presentations for key stakeholders, congressional officials, and NPS regional office management staff. Information from these contacts and correspondence is on file.

### U.S. Department of Transportation, Federal Highway Administration

As noted in the beginning of this EIS, the lead agency for the preparation is the U.S. Department of the Interior, National Park Service at North Cascades National Park Service Complex (Lake Chelan National Recreation Area) and the cooperating agency is the Federal Highway Administration (U.S. Department of Transportation).

### U.S. Environmental Protection Agency

The EPA submitted comments following their review of the notice of intent.

### U.S. Fish and Wildlife Service

The Endangered Species Act of 1973 as amended authorizes federal agencies to enter into early consultation with the U.S. Fish and Wildlife Service (USFWS) to ensure that federal actions would not jeopardize the existence of any listed or proposed species or habitat. Consultation with the USFWS under

Section 7 of the Endangered Species Act was initiated in January 2008 and updated in June 2008 and January 2009. Preparation of a biological assessment based on the impact analysis in this Draft EIS (see Chapters III and IV ―Special Status Species" sections), as well as on more detailed species-specific information, is currently ongoing.

## Native American Tribe Consultation

Consultation with Native American tribes under Section 106 of the National Historic Preservation Act occurred. Native American tribes within the vicinity of the recreation area were contacted. During public scoping the following tribes were informed of the Draft SRCIP/EIS process: Yakama Nation, Skagit System Cooperative, Nlakapamux National Tribal Council, Sauk-Suiattle Indian Tribe, Nooksack Tribal Office, and Colville Confederated Tribes. The North Cascades National Park Service Complex NOCA Cultural Resources Branch Chief, archeologist, and superintendent offered representatives of these tribes several opportunities further information and to provide comments and recommendations on the plan.

## Washington State Historic Preservation Officer / Advisory Council on Historic Preservation Consultation

The State Historic Preservation Officer and the Advisory Council are consulted regarding any proposals that might affect a cultural property listed on or eligible for the National Register of Historic Places. The NPS initiated consultation during the public scoping period. Upon the release of the Draft SRCIP/EIS, individual letters will be sent to the State Historic Preservation Officer and Advisory Council with a copy of the Draft, further informing them of the release and requesting additional informal consultation.

## Washington State Natural Resources Agencies

In addition to consultation with federal agencies, the NPS contacted the Washington Department of Fish and Wildlife, and the Washington State Department of Natural Resources (Washington Natural Heritage Program) to gather species information and additional concerns regarding the planning process. In addition, ongoing consultation with the Washington Department of Ecology also informed the process.

## Stehekin River Corridor Implementation Plan Technical Committee

In addition to individual agency contacts regarding the development of the Draft SRCIP/EIS, a technical committee was formed.

**Mission**: To provide technical and regulatory information related to long-term river and floodplain management in the lower 10 miles of the Stehekin Valley, Chelan County, Washington.

**Nature of Involvement**: The committee will meet regularly during the 2-year planning and EIS preparation process. The schedule will include working committee meetings and public meetings for scoping and alternative development. Meetings will focus on review of technical information and proposed management alternatives, as well as other functions described below. The SRCIP technical committee is not a decision-making body.

**Functions**

1. Help define the nature and scope of river and floodplain management issues;
2. Technical assessment of alternatives for mitigating erosion and flooding;
3. Assist with public education;
4. Assessment of the suitability of NPS exchange property;

5. Review NPS technical reports on sediment yield and channel change; and
6. Assist with development of a new regulatory floodplain map for lower Stehekin River valley.

The technical committee met on the following dates: December 7, 2007 (Chelan), April 18, 2008 (Wenatchee), July 28 - 29, 2008 (Stehekin), and April 28, 2009 (Seattle).

**Membership**: The following individuals from the identified agencies/organizations served on the Technical Committee and provided comments on initial proposals associated with the alternatives:

National Park Service: Jon Riedel
Chelan County: Mike Kaputa
Chelan Public Utilities District: Bill Christman
Geomax PC: Don Reichmuth
Washington Department of Fish and Wildlife: Gina McCoy
Washington Department of Ecology: Patricia Olson
U.S. Army Corps of Engineers: Paul Komoroske, Doug Weber, and Les Soule
U.S. Fish and Wildlife Service: David Morgan

## C. LIST OF PREPARERS / LIST OF PERSONS AND AGENCIES CONSULTED

### U.S. Department of the Interior, National Park Service

**North Cascades National Park Service Complex**
Main: 810 State Route 20, Sedro Woolley, WA 98284
Resource Division: 7280 Ranger Station Road, Marblemount, WA 98267

**Project Team**
Chip Jenkins, Superintendent
Jon Riedel, Geologist / Hydrologist (Project Manager, preparer)
Mignonne Bivin, Plant Ecologist (preparer)
Vicki Gempko, Stehekin District Resource Management Specialist (preparer)
Jesse Kennedy, Chief, Cultural Resources Branch (preparer)
Bob Kuntz, Wildlife Ecologist (preparer)
Jack Oelfke, Chief, Natural Resources (preparer)
Kerry Olson, Stehekin District Interpretive Specialist
Paul Slinde, Chief of Maintenance (former Stehekin Foreman)
Roy Zipp, Environmental Protection Specialist (preparer)

**Other Staff**
Charles Beall, Chief of Interpretation
Nicole Bowerman, Physical Science Technician
Anne Braaten, Geographic Information System Specialist (preparer)
Sharon Brady, Physical Science Technician (preparer)
Roger Christopherson, Wildlife Biologist (preparer)
Reed Glesne, Aquatic Ecologist
Shelley Kluz, Management Assistant
Karen Kopper, Fire Ecologist
Tom Langley, Maintenance Mechanic
Bob Mierendorf, Archeologist (preparer)
Stan Zyskowski, Biological Technician (Fisheries) (preparer)

## Pacific West Regional Office

**Seattle**
Main: 909 First Avenue, Seattle, WA 98304
Land Resources: 168 South Jackson Street, Seattle, WA 98104

Keith Dunbar, Chief, Division of Planning and Environmental Compliance
Wayne Hill, Realty Specialist (project team)
Amanda Kaplan, Environmental Planner (project team)
Rose Rumball-Petre, Environmental Protection Specialist (project team, preparer)
Anna Tamura, Landscape Architect / Planner
Karen Vaage, Landscape Architect (project team)
Rick Wagner, Chief, Division of Land Resources (project team)

**Oakland**
1111 Jackson Street, Suite 700, Oakland, California 94607

Justin DeSantis, Landscape Architect, Federal Highway Program Liaison
Alan Schmierer, Regional Environmental Coordinator

## Denver Service Center

12795 W. Alameda Pkwy., Denver, Colorado 80225

Jan Burton, Landscape Architect (Project Manager)
Mark Pritchett, Section Chief, Park Roads and Parkways
George Tait, Branch Chief of Roads
Karen Vaage, Landscape Architect
Bob Welch, Branch Chief, Transportation Division
Sarah Wynn, Revegetation Technical Specialist

## U.S. Army Corps of Engineers

Seattle District, PO Box C-3755, Seattle, WA 98124-2255

Paul Komoroske
Les Soule
Doug Weber, Levee Safety Program Manager
Amy Gibbons

## U.S. Environmental Protection Agency

Region 10, 1200 Sixth Avenue, Seattle, WA 98101

Elaine L. Somers, NEPA Review Unit

## U.S. Department of Transportation

**Federal Highway Administration, Western Federal Lands Highway Division**
610 East 5th Street, Vancouver, WA 98661

Juan Aguirre, former Civil Engineering Technician
Betty Chon, Highway Engineer (Project Manager)
Jennifer Corwin, Environmental Protection Specialist
Sven Leon, Hydraulics Engineer
Grant Lindsey, Civil Engineering Technician, Designer

Craig Sanders, Construction Operations Engineer
Curtis Scott, former Construction Operations Engineer
Malcolm Ulrich, Engineering Geologist

### U.S. Fish and Wildlife Service

Central Washington Field Office, 215 Melody Lane, Suite 119, Wenatchee, WA 98801

David Morgan, Biologist

### Washington Department of Fish and Wildlife

Region 3 Office, 1701 S. 24th Avenue, Yakima, WA 98902

Gina McCoy, Central Washington Technical Assistance Engineer

### Washington Department of Ecology

Shorelines and Environmental Assistance Division, Ecology Headquarters Building, 30300 Desmond Drive SE, Lacey, WA 98503

Patricia Olson, Senior Hydrogeologist

### Chelan County

316 Washington Street, Suite 401, Wenatchee, WA 98801

Mike Kaputa, Director, Chelan County Natural Resource Department

### Chelan County Public Utility District

327 N. Wenatchee Ave, Wenatchee, WA 98801

Bill Christman, Hydro Engineering Manager

### Geomax

1023 West 30th Avenue, Spokane, WA 99203-1324

Don Reichmuth, Private Consultant for Geomax

## D. LIST OF AGENCIES, ORGANIZATIONS, AND BUSINESSES THAT RECEIVED THE DRAFT SRCIP/EIS

| Groups/Agencies | Contact Name |
|---|---|
| American Rivers | |
| American Whitewater | Thomas O'Keefe |
| Army Corps of Engineers | |
| Blue Water Network | |
| Chelan Airways | |
| Chelan County Commissioner | Doug England |
| Chelan County Dept. Of Natural Resources | Michael Kaputa |

| Groups/Agencies | Contact Name |
|---|---|
| Chelan County PUD | Richard Riazzi |
| Chelan County PUD | Bill Christman |
| Chelan County, Port of | |
| Chelan Public Library | |
| Chelan Ranger District | Robert Sheehan, District Ranger |
| City of Chelan | |
| Colville Confederated Tribes | Camille Pleasants |
| Colville Confederated Tribes | Michael E. Marchand |
| Congressman Doc Hastings | |
| Congressman Doc Hastings | Tara Ord, Legislative Director |
| Conservation Northwest | |
| Defenders of Wildlife | |
| Earth Justice Legal Defense Fund | Stephan Volker |
| Friends of the Earth | |
| Geomax | Don Reichmuth |
| Lake Chelan Boat Company | Jack Raines |
| Methow Conservancy | |
| Mt Baker-Snoqualmie NF | Forest Supervisor |
| National Parks & Conservation Association | Sean Smith |
| North Cascades Conservation Council | Marc Bardsley |
| North Cascades Institute | |
| North Central Washington Audubon Society | Jon Soest |
| NPCA | |
| Okanogan-Wenatchee National Forest | Rebecca Heath, Forest Supervisor |
| Pacific Crest Trail Association | Mike Dawson |
| Pacific Crest Trail Association | |
| Port of Chelan County | Mike Mackey |
| Representative Cary Condotta | Cary Condotta |
| Representative Cary Condotta | Cary Condotta |
| Representative Mike Armstrong | 426A Legislative Building |
| Sauk-Suiattle Indian Tribe | Janice Mabee |
| Sauk-Suiattle Indian Tribe | Richard Wolten |

| Groups/Agencies | Contact Name |
|---|---|
| Seattle Public Library | |
| Senator Maria Cantwell | |
| Senator Maria Cantwell | |
| Senator Maria Cantwell | Central WA Outreach Director |
| Senator Patty Murray | 2988 Jackson Federal Building |
| Senator Patty Murray | |
| Senator Patty Murray | Eastern WA Director  Judy Olsen |
| Senator Linda Evans-Parlette | 316 Legislative Building |
| Senator Linda Evans-Parlette | |
| Sierra Club - Cascades Chapter | |
| Stehekin Valley Ranch | Clifford Courtney |
| Student Conservation Assn. Inc. | |
| The Henry M. Jackson Foundation | |
| The Mountaineers | |
| The Nature Conservancy | |
| The Wilderness Society | |
| Upper Skagit Indian Tribe | Scott Schuyler |
| Upper Skagit Indian Tribe | Jennifer Washington |
| US Army Corps of Engineers | Deborah Knaub |
| US Army Corps of Engineers | Doug Weber |
| US DOT, Fed. Hwy Administration | Betty Chon |
| US DOT, Fed. Hwy Administration | Betty Chon |
| WA Department of Ecology | Patricia Olsen |
| Washington DNR | Sandy Swope Moody |
| Washington DNR-Rivers District | Cindy Peston |
| WA Dept of Fish & Wildlife | Bob Steele |
| Washington Fish and Wildlife Service | David Morgan |
| Washington Fish and Wildlife Service | Gina McCoy |
| WA State Parks & Recreation Commission | |
| WA Trails Association | |
| Washington Recreational River Runners | |
| Washington State DOT, Aviation Division | William Hamilton |

| Groups/Agencies | Contact Name |
|---|---|
| Washington Wilderness Coalition | |
| Washington's National Park Fund | |
| Wenatchee Public Library | |
| Western Lands Project | Janine Blaeloch |
| Wilderness Watch | |
| Yakima Nation Tribe | Johnson Meninick |

# E. LIST OF FEDERAL PERMITS

## Clean Water Act Section 401 and Section 404

Actions identified in Alternatives 1 - 4 (rock barbs) would require Clean Water Act, Section 404 permits. These permits will either fall under existing nationwide permits, or could require individual permits.

It is also likely that these actions will require a Section 401 consistency determination from the Washington State agency that implements Section 401 of the Clean Water Act: the Washington Department of Ecology.

It is also likely that the project will require at least one nonpoint source discharge (NPDES) permit.

Hydraulic Project Approval permits may also be required as part of Washington State's implementation of the Clean Water Act.

## Endangered Species Act Section 7

The USFWS has stated that it is currently unlikely that an incidental take permit would be required for adverse effects to northern spotted owls.

## Code of Federal Regulations Rule Change

Under Alternative 2, closure of the Shooting Range would require a change in a Code of Federal Regulations Part 7 regulation. Although this would not require a federal permit, it would require publication of a regulation change in the Federal Register and a change in the Superintendent's Compendium.

The current compendium states ―Stehekin Shooting Range, as described in 36 CFR 7.62(c), is closed to the discharge of firearms from March 15th to June 15th." This closure is in effect because of potentially nesting northern spotted owls. No alternate site is mentioned as being available for use during this time period; the compendium simply closes the existing site.

# CHAPTER VI:
## References

# CHAPTER VI: REFERENCES


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# CHAPTER VI:
## Glossary and Acronyms

# CHAPTER VII: GLOSSARY AND ACRONYMS

## A. GLOSSARY DEFINITIONS

**Adfluvial**: A fish that lives in lakes and migrates into rivers or streams to spawn.

**Affected Environment**: Existing natural, cultural, social, and recreational conditions of an area, potentially subject to change indirectly or directly as a result of human action.

**Alternatives**: Sets of management elements that represent a range of options for how, or whether to proceed with a proposed action. An environmental assessment or environmental impact statement analyzes the potential environmental impacts of the range of alternatives, as required under National Environmental Policy Act (NEPA).

**Alluvial Fan**: An outspread, gently sloping mass of alluvium deposited by a stream. Viewed from above, it has the shape of a fan, the apex being at the valley mouth.

**Area of Potential Effect**: The geographic area or areas where an undertaking has the potential to affect historic properties. The APE consider physical, visual, auditory, and atmospheric effects as well as potential changes in land or building use, change in the setting, and potential for neglect.

**Archeological Resources**: Historic and prehistoric deposits, sites, structures, and other remains from a human culture from an archeological site.

**Asphalt Pulverizing**: Pulverizing is the process of breaking apart existing road asphalt into an aggregate (gravel-like) mixture, sometimes blending the recycled aggregate with new aggregate and reusing it as subgrade for newly laid asphalt. Pulverizing is a cost effective and environmentally appropriate way to reconstruct existing pavement. The process eliminates the expensive and environmentally damaging excavation and trucking of the existing asphalt and it creates a stronger base course.

**Avulsion**: A major change in the location of a river channel.

**Bankfull**: When a river is at maximum carrying capacity and its waters come up to the height of the bank.

**Bankfull Stage**: The elevation of the water surface of a stream flowing at channel capacity.

**Batholith**: A large mass of igneous rock that formed when magma was emplaced at depth and was subsequently exposed by erosion.

**Berm**: A shaped mound of earth. It is intended to direct traffic or flow away from an area.

**Best Management Practices**: Effective, feasible (including technological, economic and institutional considerations) conservation practices and land and water management measures that avoid or minimize impacts to natural and cultural resources. Best management practices may be physical, organizational, prohibitions, or management practices.

**Bioengineering**: Bioengineering is the use of plants to stabilize riverbanks and slopes. In Stehekin, National Park Service (NPS) favors use of a layering technique with long whips of willow, dogwood, and coconut fabric, which decomposes over time. First, as plants grow and roots develop, the structure gets stronger with time. Second, native shrubs grow quickly, and do not add weight to the bank.

Bioengineering provides several benefits. First, the plants provide shade and woody debris, an important component of aquatic habitat. They also provide habitat for birds, small mammals, and amphibians (NPS 2005: 25).

**Borrow Pit**: An excavated area where material has been dug for use at another location (e.g., sand, rock, and gravel).

**Candidate Species**: Those species being considered by the U.S. Fish and Wildlife Service for listing as threatened or endangered as published in the Federal Register.

**Council on Environmental Quality (CEQ) Regulations**: The CEQ was established by the NEPA and given the responsibility of developing federal environmental policy and overseeing the implementation of NEPA by federal agencies.

**Channel Migration Zone (CMZ)**: The historic area within which the Stehekin River has migrated over time (does not include tributary migration area).

**Chipseal**: A road-surfacing treatment composed of asphalt emulsion covered with crushed aggregate (gravel chips).

**Cirque**: A deep, steep-walled basin on a mountain, usually forming a blunt end of a valley.

**Compatibility Criteria**: The basis for determining which land uses are consistent with the recreation, scenic, scientific, natural, and historic values of Lake Chelan National Recreation Area.

**Crushed Aggregate**: Gravel.

**Cultural Landscape**: Cultural landscapes are defined as areas that reflect human adaptation and use of natural resources during one period or over time, as expressed in the way that land is organized and divided into patterns of settlement, land use, circulation systems, and structures. Cultural landscapes may be comprised of a series of historic districts or may be the landscape associated with one district.

**Culvert**: Plastic, PVC, or corrugated metal pipe used to convey water under a road.

**Cumulative Effect or Impact**: —The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.” (40 CFR 1508.6)

**Cut Slope**: The upslope, the hill sloping up from the roadbed.

**Debris Cone**: A mass of loose, unstable material constructed in part by mass movement (debris flows, debris torrents). Debris cones are typically associated with small, steep streams and have slopes greater than ten degrees.

**Debris Fence** (U.S. Army Corps of Engineers (ACOE) Advanced Flood Protection Measure): A debris fence may be constructed from a chain-link fence, continuous row of gabion baskets, logs chained or cabled to standing trees, or spaced gabion baskets. Debris fences prevent debris flow toward a structure.

**Decibel**: A unit of measure for sound intensity.

**Deposition / Storage Zone**: Areas of channel stability where the gradient of the river is relatively low and massive amounts of gravel and large wood are stored by the river. These are located near McGregor Meadows, Frog Island, and where the river meets Lake Chelan.

**Direct Effect or Impact**: Effects that are ―…caused by the action and occur at the same time and place" (40 CFR 1508.8[a]).

**Ecosystem**: A geographically identifiable area that encompasses unique physical and biological characteristics. It includes the plant community, animal community and environment in a particular region or habitat.

**Effect (or Impact)**: ―Effects are synonymous with impacts" (40 CFR 1508.8[b]).

**Endangered Species**: A species listed by the U.S. Fish and Wildlife Service (USFWS) as in danger of extinction throughout all or a part of its range due to current or planned activity.

**Engineered Logjam**: As used by the NPS along the Stehekin River, an engineered logjam consists of several dozen large logs cabled together and anchored to the bank of the river. Some of the logs may be buried within the bank.

**Environmental Assessment (EA)**: A public document, required under NEPA that identifies and analyzes actions that might affect the human environment, including natural, cultural and social resources. An Environmental Assessment provides sufficient evidence and analysis to determine whether an Environmental Impact Statement (EIS) is necessary. An EA facilitates compliance with NEPA when no EIS is necessary and facilitates preparation of an EIS if one is necessary.

**Environmental Impact Statement (EIS)**: A public document, required under NEPA that identifies alternatives and analyzes their effects on the human environment.

**Environmentally Preferable Alternative**: The alternative in an EA or EIS that best promotes the goals of NEPA and meets the identified CEQ criteria. In general, this is the alternative that causes the least damage to the environment and best protects natural, cultural, and social resources.

**Exotic**: See nonnative.

**Facilities**: Buildings and the associated supported infrastructure, including roads, trails, and utilities.

**Finding of No Significant Impact (FONSI)**: The decision document for an environmental assessment.

**Fill slope**: Downslope; the hill sloping down from the roadbed where fill from the construction of the road was cast.

**Floodplain**: The area surrounding a stream subject to flooding on some interval (10, 20, 50, 100, 500 years).

**Flow Deflector** (ACOE Advanced Flood Protection Measure): A barrier intended to divert, but not stop, flow toward a structure. Flow deflectors are located at an angle, a minimum of 20 feet from a structure.

**Gabion Basket** (ACOE Advanced Flood Protection Measure): A gabion basket is made of steel mesh and contains various sizes of rocks that lock together well. Typical baskets are 3 feet wide by 3 feet tall by 6 feet long and may be wired together to achieve any desired length.

**Glide**: An expanse of shallow bottom extending across a streambed, over which the water flows smoothly.

**Grade Control** (ACOE Advanced Flood Protection Measure): Grade-control structures slow the progression of head cutting in areas where there is water flowing down a slope. Grade-control structures are trenches dug approximately 6 feet deep and filled with rip-rap.

**Gradient**: Degree of inclination of the part of the earth's surface; steepness of slope. May be expressed as a fraction, ratio, percentage, or angle.

**Guardwall**: A wall intended to keep cars on the road in case of loss of control.

**Headwall**: A vertical support structure at a culvert inlet or outlet.

**Historic or Cultural Resources**: Under NEPA/CEQ, these are culturally valued pieces of real property that are not historic properties and nontangible values such as cultural use of the biophysical and built environment, and sociocultural attributes such as social cohesion, social institutions, lifeways, religious practice, and other institutions.

**Historic Property**: Under the National Historic Preservation Act and NEPA/CEQ, a historic property is a district, site, building, structure, or object that is included in or eligible for listing in the National Register of Historic Places, and/or which includes resources of cultural and religious significance for American Indians (traditional cultural properties; see National Register Bulletin 38).

**Human Environment**: The natural and physical (e.g., built) environment and the relationships of people to that environment, i.e., social and cultural aspects and the relationships between natural and cultural. Culturally valued aspects of the environment generally include National Register historic properties, and other culturally valued pieces of real property, cultural use of the biophysical environment, and intangible sociocultural attributes as social cohesion, social institutions, lifeways, religious practices, and other cultural institutions.

**Igneous**: A type of rock formed as a result of volcanic processes.

**Impact (or Effect)**: ―Effects are synonymous with impacts" (40 CFR 1508.8[b]).

**Impairment**: Impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including opportunities that would otherwise be present for the enjoyment of those resources or values.

**Indirect Effect or Impact**: Effects that are caused by the action that occur later in time or at a distance from the action.

**Inlet**: The place where water enters a culvert or other drainage feature.

**Invasive Species**: A nonnative species of plant or wildlife that not only exists away from its natural habitat but also employs habits that allow it to take over the habitat, displacing native species. Often (in the case of plants) becomes a monoculture.

**Lacustrine**: Pertaining to wetlands and deepwater habitats produced by or formed in a lake.

**Land Protection Techniques**: Land use protection techniques detailed in the Land Protection Plan include agreements (cooperative and overlay district), zoning and public review, and regulations.

**Land Acquisition Methods**:

> *Donation*: Landowners may donate property or interests in land to achieve conservation objectives. Tax benefits are also available for donations.
>
> *Exchange*: The NPS will consider some federal lands within the authorized boundary as potential for exchange to strengthen historic development patterns, consolidate new developments into the most suitable areas, and protect other significant areas.
>
> *Purchase*: Acquisition by purchase requires appropriated funds from Congress or donated from private sources.
>
> *Purchase and Sellback*: Land is purchased in fee, appropriate restrictions are attached to the deed, and the deed-restricted land is then sold or leased to another owner.

**Lateral Moraine**: A low ridge-like moraine carried on, or deposited at, the side of a mountain glacier. It is composed chiefly of rock fragments loosened from the valley walls by glacial abrasion and plucking, or fallen on the ice from the bordering slopes.

**Left Bank**: The left side of a river when facing downstream.

**Main Channel**: The channel currently occupied by the main body of a river.

**Metamorphic**: A type of rock formed under tremendous heat and pressure.

**Mitigation**: Activities that avoid, reduce the severity of, or eliminate an adverse environmental impact.

**National Environmental Policy Act (NEPA)**: The federal act requiring the development of an environmental assessment or environmental impact statement for federal actions having an effect on the human environment.

**National Register of Historic Places**: The National Register of Historic Places is the official list of American cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. Properties listed on or “determined eligible” for listing on the National Register must be given consideration for preservation in the planning for federal or federally assisted projects.

**Native**: Indigenous; pertains to plant and animal species that occur naturally in a particular area. Not introduced by humans or as a result of human activity.

**No Action Alternative**: The alternative that is proposed to continue current management actions and direction. “No Action” means the proposed activity would not take place. The No Action Alternative sets the standards for comparing the action alternatives.

**Nonnative**: Exotic; pertains to plant or animal species that do not occur naturally in a particular area and were introduced by humans or human activity. These species may interfere with natural biological systems or ecosystems. Some nonnative species are also invasive. See invasive species.

**Organic Act (NPS)**: 1916: The NPS Organic Act established the NPS to “promote and regulate the use of the parks” and defined their purpose as “to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

**Outlet**: The location where water exits a culvert or other drainage feature.

**Palustrine**: Pertaining to freshwater wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses and lichens. Also includes wetlands lacking such vegetation, but with the following three characteristics: area less than 20 acres; active wave-formed or bedrock shoreline features lacking; and maximum water depth less than 2 meters at low water.

**Planning**: An interdisciplinary process for developing short- and long-term goals and alternatives for visitor experience, resource conditions, projects, facility type and placement, and other proposed actions.

**Pool**: Deep sections of a river channel, usually between riffles, with gradients usually under 1 percent; critical habitat for river life during storm events.

**Preferred Alternative**: The alternative in an EA or EIS that the agency believes would best fulfill the purpose and need for action.

**Public Comment Process**: A formalized process required by NEPA in which the action agency publishes a notice in the Federal Register that provides notice that the agency is preparing an EIS. Public meetings are a required part of the EIS process. For EAs, the public comments process is less formal, with notification of the public by press release and optional public meetings.

**Pullout (Turnout)**: A widened section of roadway that allows vehicles to pull off the road for viewpoints, access to terrain or emergencies. Pullouts may be formal (paved or graveled) or user-designated (created by visitor use over time).

**Reach**: The length of a stream channel that is uniform with respect to discharge, depth, area, and slope; also the length of a stream between two defined stations.

**Redd**: The depression a female fish creates when laying eggs that males then fill in with gravel.

**Retaining Wall**: A wall intended to hold the fill slope at a steep angle.

**Riffle**: An expanse of shallow bottom extending across a streambed, where water flows over submerged obstructions; a shallow rapids of comparatively little fall. Gradients are usually between 1 and 3.5 percent.

**Right Bank**: The right side of a river when facing downstream.

**Ring Dike** (ACOE Advanced Flood Protection Measure): An arc or circular structure made of sandbags constructed approximately 8 feet away from the structure to be protected. Ring dikes protect against a 1-foot rise in standing water and may be used in combination with pumping water out of the ring. Ring dikes are not suitable for use with moving water.

**Riparian Area or Zone**: The land area and associated vegetation bordering a stream or river.

**Rip-rap**: A layer of durable broken rocks or formed concrete selected and graded (in the same size), put together irregularly or fitted to prevent water erosion; often placed at the end of a constructed water flow zone, such as a culvert.

**Riverine**: Freshwater wetlands and deepwater habitats contained within a stream channel.

**Road Prism**: The area affected by original construction, from cut slope to fill slope.

**Rock Barb**: A structure that protrudes into the river at an angle upstream of perpendicular to the bank. Rock barbs are individually placed to redirect and dissipate the force of the river to create eddies, thereby eliminating bank erosion. Rock barbs are designed to move the main channel to the ends of the barbs away from the banks.

**Setback**: A line some distance from a specific site or area where areas beyond the line would be suitable for development or another activity.

**Scoping**: Public involvement is a key component of the NEPA process. In this part of the process, the general public, federal, state, local agencies and organizations are provided an opportunity to identify concerns and issues regarding the potential effects of proposed federal actions. The opportunity to provide input is called ―scoping.”.

**Scour Protection** (ACOE Advanced Flood Protection Measure): Scour protection structures consist of a long, narrow mound of rock and soil called a berm. Berms are used where water rises and flows across the property toward structures and where there is not a great deal of debris expected.

**Section 7 Consultation**: Section 7 of the Endangered Species Act requires federal agencies, when proposing a federal action to obtain a species list for the project area from, and to consult with the USFWS regarding potential impacts to listed species from the proposed action.

**Side Channel**: Channels peripheral to the main channel that may or may not have flowing water in them at all times. Can also be old, abandoned main channels.

**Sinuosity**: A quantifiable value to measure the degree to which a river channel meanders.

**Storage Zone**: See Deposition Zone.

**Substrate**: The substance or nutrient on or in which an organism lives and grows, or the surface to which a fixed organism is attached.

**Threatened or Endangered Species**: Plants or animals that receive special protection under federal or state laws, including the Endangered Species Act. Species may be listed threatened or endangered in the state, but not by the federal government (USFWS), or vice versa. Some USFWS regional offices also maintain a list of those species of special concern, either nationally or locally, which may be being or may have been previously considered for listing as threatened or endangered.

**Threatened Species**: Any species that is likely to become endangered within the foreseeable future throughout all or a part of its range, as listed by the USFWS in the Federal Register.

**Traditional Cultural Resource**: Any site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

**Traditional Cultural Property**: Traditional cultural resources eligible for or listed on the National Register of Historic Places. They are resources to which American Indian tribes attach cultural or religious significance and may include structures, objects, districts, geological and geographical features, and archeology.

**Transport Zone**: Reaches of the lower Stehekin River that have relatively straight, stable channels that move large wood and gravel between deposition reaches. They are generally located where the river flows against gravel deposited by the tributaries of Company, Boulder, and Rainbow Creeks.

**Turbidity**: A measure of the optical clarity of a liquid (water). Optical clarity in water is affected by the scattering and absorption of light by suspended material, such as clay, silt, sand, and organic and inorganic particulates and plankton.

**Turnout**: See Pullout.

**U.S. Fish and Wildlife Service (USFWS)**: The federal agency responsible for implementing the provisions of the Endangered Species Act, including listing species, developing recovery plans, etc.

**Viewshed**: The visible areas seen from identified viewpoints.

**Visitor Experience**: The perceptions, feelings, reactions, and activities of a park visitor in relationship to the surrounding environment.

**Visitor Use**: The types of recreation activities engaged in by visitors, including the type of activity, visitor behavior, timing, and distribution of use.

**Wetland**: As defined by the ACOE – an area inundated or saturated with surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

# B. ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACHP | Advisory Council on Historic Preservation |
| ACOE | U.S. Army Corps of Engineers |
| AFMZ | Alluvial Fan Migration Zone |
| amsl | above mean sea level |
| APE | area of potential effects |
| ARPA | Archeological Resources Protection Act |
| | |
| BLM | Bureau of Land Management |
| BMP | best management practice |
| | |
| CAA | Clean Air Act |
| CCRs | Conditions, Covenants, and Deed Restrictions |
| CEQ | President's Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| Chelan PUD | Chelan County Public Utility District |
| CMZ | Channel Migration Zone |
| Complex | North Cascades National Park Service Complex (North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area) |
| CTA | Common to All |
| CWA | Clean Water Act |
| | |
| dbh | Diameter-at-Breast-Height (a standard measure of tree size) |
| DCA | Designated Conservation Area |
| DEIS | draft environmental impact statement |
| | |
| EA | environmental assessment |
| EIS | environmental impact statement |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| | |
| $ft^2$ | square feet |
| $ft^3$ | cubic feet |
| FEIS | Final Environmental Impact Statement |
| FEMA | Federal Disaster Assistance Administration |
| FERC | Federal Energy Regulatory Commission |
| FHWA | Federal Highway Administration |
| FONSI | Finding of No Significant Impact |
| | |
| GMP | General Management Plan |
| | |
| HAER | Historic American Engineering Record |
| | |
| $km^2$ | square kilometers |
| | |
| Lake Chelan NRA | Lake Chelan National Recreation Area |
| LEED | Leadership in Energy and Environmental Design |
| LPP | Land Protection Plan |

| | |
|---|---|
| nd | no date |
| N/A | Not applicable |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| NOAA Fisheries | National Oceanic and Atmospheric Administration, National Marine Fisheries Service |
| NOCA | North Cascades National Park |
| NPS | National Park Service |
| NR | National Register (of Historic Places) Number |
| NRA | National Recreation Area |
| PEPC | NPS Planning Environment and Public Comment website |
| PL | Public Law |
| SHPO | State Historic Preservation Office or Officer |
| USC | United States Code |
| USDA | United States Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USFS | USDA Forest Service |
| USGS | United States Geological Survey |
| VOC | Volatile Organic Compound |
| WDFW | Washington Department of Fish and Wildlife |
| WSRA | Wild and Scenic River Act |
| $yd^3$ | cubic yard |

**Photo 33 – The Stehekin River near High Bridge**

# Appendices

# APPENDIX 1: LAKE CHELAN NATIONAL RECREATION AREA ENABLING LEGISLATION (PUBLIC LAW 90-544)

**North Cascades Complex**

An Act to establish the North Cascades National Park and Ross Lake and Lake Chelan National Recreation Areas, to designate the Pasayten Wilderness and to modify the Glacier Peak Wilderness, in the State of Washington, and for other purposes. (82 Stat. 926)

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

**TITLE I - NORTH CASCADES NATIONAL PARK**

SEC. 101. In order to preserve for the benefit, use, and inspiration of present and future generations certain majestic mountain scenery, snowfields, glaciers, alpine meadows, and other unique natural features in the North Cascade Mountains of the State of Washington, there is hereby established, subject to valid existing rights, the North Cascades National Park (hereinafter referred to in this Act as the "park"). The park shall consist of the lands, waters, and interests therein within the area designated "national park" on the map entitled "Proposed Management Units, North Cascades, Washington," numbered NP-CAS-7002, and dated October 1967. The map shall be on file and available for public inspection in the office of the Director, National Park Service, Department of the Interior, and in the office of the Chief, Forest Service, Department of Agriculture.

**TITLE II - ROSS LAKE AND LAKE CHELAN NATIONAL RECREATION AREAS**

Sec. 201. In order to provide for the public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge Lakes, together with the surrounding lands, and for the conservation of the scenic, scientific, historic, and other values contributing to public enjoyment of such lands and waters, there is hereby established, subject to valid existing rights, the Ross Lake National Recreation Area (hereinafter referred to in this Act as the "recreation area"). The recreation area shall consist of the lands and waters within the area designated "Ross Lake National Recreation Area" on the map referred to in section 101 of this Act.

SEC. 202. In order to provide for the public outdoor recreation use and enjoyment of portions of the Stehekin River and Lake Chelan, together with the surrounding lands, and for time conservation of the scenic, scientific, historic, and other values contributing to public enjoyment of such lands and waters, there is hereby established, subject to valid existing rights, the Lake Chelan National Recreation Area (hereinafter referred to in this Act as the "recreation area"). The recreation area shall consist of the lands and waters within the area designated "Lake Chelan National Recreation Area" on the map referred to in section 101 of this Act.

**TITLE III - LAND ACQUISITION**

SEC. 301. Within the boundaries of the park and recreation areas, the Secretary of the Interior (hereinafter referred to in this Act as the "Secretary") may acquire lands, waters, and interests therein by donation, purchase with donated or appropriated funds, or exchange, except that he may not acquire any such interests within the recreation areas without the consent of the owner, so long as the lands are devoted to uses compatible with the purposes of this Act. Lands owned by the State of Washington or any political subdivision thereof may be acquired only by donation. Federal property within the boundaries of the park and recreation areas is hereby transferred to the administrative jurisdiction of the Secretary for administration by him as part of the park and recreation areas. The national forest land within such boundaries is hereby eliminated from the national forests within which it was heretofore located.

SEC. 302. In exercising his authority to acquire property by exchange, the Secretary may accept title to any non-Federal property within the boundaries of the park and recreation areas and in exchange therefor he may convey to the grantor of such property any federally owned property under his jurisdiction in the State of Washington which he classifies as suitable for exchange or other disposal. The values of the properties so exchanged either shall be approximately equal, or if they are not approximately equal the values shall be equalized by the payment of cash to the grantor or to the Secretary as the circumstances require.

SEC. 303. Any owner of property acquired by the Secretary which on the date of acquisition is used for agricultural or single-family residential purposes, or for commercial purposes which he finds are compatible with the use and development of the park or the recreation areas, may, as a condition of such acquisition, retain the right of use and occupancy of the property for the same purposes for which it was used on such date, for a period ending at the death of the owner or the death of his spouse, whichever occurs later, or for a fixed term of not to exceed twenty-five years, whichever the owner may elect. Any right so retained may during its existence be transferred or assigned. Any right so retained may be terminated by the Secretary at any time after the date upon which any use of the property occurs which he finds is a use other than one which existed on the date of acquisition. In the event the Secretary terminates a right of use and occupancy under this section, he shall pay to the owner of the right the fair market value of the portion of said right which remains unexpired on the date of termination.

## TITLE IV - ADMINISTRATIVE PROVISIONS

SEC. 401. The Secretary shall administer the park in accordance with the Act, of August 25, 1916 (39 Stat. 535; 16 U.S.C. 1-4), as amended and supplemented.

Sec. 402. (a) The Secretary shall administer the recreation areas in a manner which in his judgment will best provide for (1) public outdoor recreation benefits; (2) conservation of scenic, scientific, historic, and other values contributing to public enjoyment: and (3) such management, utilization, and disposal of renewable natural resources and the continuation of such existing uses and developments as will promote or are compatible with, or do not significantly impair, public recreation and conservation of the scenic, scientific, historic, or other values contributing to public enjoyment. In administering the recreation areas, the Secretary may utilize such statutory authorities pertaining to the administration of the national park system, and such statutory authorities otherwise available to him for the conservation and management of natural resources as he deems appropriate for recreation and preservation purposes and for resource development compatible therewith.

(b) The lands within the recreation areas, subject to valid existing rights, are hereby withdrawn from location, entry, and patent under the United States mining laws. The Secretary, under such reasonable regulations as he deems appropriate, may permit the removal of the nonleasable minerals from lands or interest in lands within the recreation areas in the manner prescribed by section 10 of the Act of August 4, 1939, as amended (53 Stat. 1196; 43 U.S.C. 387), and he may permit the removal of leasable minerals from lands or interests in lands within the recreation areas in accordance with the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181 et seq.), or the Acquired Lands Mineral Leasing Act of August 7,1947 (30 U.S.C. 351 et seq.), if he finds that such disposition would not have significant adverse effects on the administration of the recreation areas.

(c) All receipts derived from permits and leases issued on lands or interests in lands within the recreation areas under the Mineral Leasing Act of February 25, 1920, as amended, or the Acquired Lands Mineral Leasing Act of August 7, 1947, shall be disposed of as provided in the applicable Act; and receipts from the disposition of nonleasable minerals within the recreation areas shall be disposed of in the same manner as moneys received from the sale of public lands.

(d) The Secretary shall permit hunting and fishing on lands and waters under his jurisdiction within the boundaries of the recreation areas in accordance with applicable laws of the United States and of the State of Washington, except that the Secretary may designate zones where, and establish periods when, no hunting or fishing shall be permitted for reasons of public safety, administration, fish and wildlife management, or public use and enjoyment. Except in emergencies, any regulations of the Secretary pursuant to this section shall be put into effect only after consultation with the Department of Game of the State of Washington.

(e) The Secretary shall not permit the construction or use of any road within the park which would provide vehicular access from the North Cross State Highway to the Stehekin Road. Neither shall he permit the construction or use of any permanent road which would provide vehicular access between May Creek and Hozomeen along the east side of Ross Lake.

## TITLE V - SPECIAL PROVISIONS

SEC. 501. The distributive shares of the respective counties of receipts from the national forests from which the national park and recreation areas are created, as paid under the provisions of the Act of May 23, 1908 (35 Stat. 260), as amended (16 U.S.C. 500), shall not be effected by the elimination of lands from such national forests by the enactment of this Act.

SEC. 502. Where any Federal lands included in the park or recreation areas are legally occupied or utilized on the effective date of this Act for any purpose, pursuant to a contract, lease, permit, or license issued or authorized by any department establishment, or agency of the United States, the Secretary shall permit the persons holding such privileges to continue in the exercise thereof, subject to the terms and conditions thereof, for the remainder of the term of the contract, lease, permit, or license or for such longer period of time as the Secretary deems appropriate.

SEC. 503. Nothing in this Act shall be construed to affect adversely or to authorize any Federal agency to take any action that would affect adversely any rights or privileges of the State of Washington in property within the Ross Lake National Recreation Area which is being utilized for the North Cross State Highway.

SEC. 504. Within two years from the date of enactment of this Act, the Secretary of the Interior and the Secretary of Agriculture shall agree on the designation of areas within the park or recreation areas or within national forests adjacent to the park and recreation areas needed for public use facilities and for administrative purposes by the Secretary of Agriculture or the Secretary of the Interior, respectively. The areas so designated shall be administered in a manner that is mutually agreeable to the two Secretaries, and such public use facilities, including interpretive centers, visitor contact stations, lodges, campsites, and ski lifts, shall be constructed according to a plan agreed upon by the two Secretaries.

SEC. 505. Nothing in this Act shall be construed to supersede, repeal, modify, or impair the jurisdiction of the Federal Power Commission under the Federal Power Act (41 Stat. 1063), as amended (16 U.S.C. 791a et seq.), in the recreation areas.

SEC. 506. There are hereby authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act, but not more than $3,500,000 shall be appropriated for the acquisition of lands or interest in lands.

## TITLE VI - WILDERNESS

SEC. 601. (a) In order to further the purposes of the Wilderness Act, there is hereby designated, subject to valid existing rights, the Pasayten Wilderness within and as a part of the Okanogan National Forest and the Mount Baker National Forest, comprising an area of about five hundred thousand acres lying east of Ross Lake, as generally depicted in the area designated as "Pasayten Wilderness" on the map referred to in section 101 of this Act.

(b) The previous classification of the North Cascades Primitive Area is hereby abolished.

SEC. 602. The boundaries of the Glacier Peak Wilderness, an area classified as such more than thirty days before the effective date of the Wilderness Act and being within and a part of the Wenatchee National Forest and the Mount Baker National Forest, subject to valid existing rights, are hereby extended to include portions of the Suiattle River corridor and the White Chuck River corridor on the western side thereof, comprising areas totaling about ten thousand acres, as depicted in the area designated as "Additions to Glacier Peak Wilderness" on the map referred to in section 101 of this Act.

SEC. 603. (a) As soon as practicable after this Act takes effect, the Secretary of Agriculture shall file a map and legal description of the Pasayten Wilderness and of the Glacier Peak Wilderness, as hereby modified, with the Interior and Insular Affairs Committees of the United States Senate and House of Representatives, and such descriptions shall have the same force and effect as if included in this Act: *Provided, however,* That correction of clerical or typographical errors in such legal descriptions and maps may be made.

(b) Upon the filing of the legal descriptions and maps as provided for in subsection (a) of this section the Pasayten Wilderness and the additions to the Glacier Peak Wilderness shall be administered by the Secretary of Agriculture in accordance with the provisions of the Wilderness Act and thereafter shall be subject to the provisions of the Wilderness Act governing areas designated by that Act as wilderness areas, except that any reference in such provisions to the effective date of the Wilderness Act shall be deemed to be a reference to the effective date of this Act.

SEC. 604. Within two years from the date of enactment of this Act, the Secretary of the Interior shall review the area within the North Cascades National Park, including the Picket Range area and the Eldorado Peaks area and shall report to the president, in accordance with subsections 3(c) and 3(d) of the Wilderness Act (78 Stat. 890; 16 U.S.C. 1132 (c) and (d)), his recommendation as to the suitability or nonsuitability of any area within the park for preservation as wilderness, and any designation of any such area as a wilderness area shall be accomplished in accordance with said subsections of the Wilderness Act.

# APPENDIX 2: MANAGEMENT OBJECTIVES AND ACTIONS IN THE LAKE CHELAN NRA GMP APPLICABLE TO THE SRCIP

The following information is taken from the proposed action section in the Final Lake Chelan NRA GMP.

Among the applicable overall Management Objectives identified in the GMP (NPS 1995a: 19-49) under *Natural Resources* are those which pertain to the Stehekin River; wetland, floodplain, shoreline and riparian areas; geohazards and scenic resources. Other Management Objectives pertain to *Cultural Resource Management*, *Visitor Experience*, *Interpretation and Information*, *Land Use and Development* (transportation and land protection plan elements), and *Park Operations*. Because this plan focuses on the Stehekin River, that section is included in its entirety. Otherwise, only applicable management objectives and actions are cited below.

## NATURAL RESOURCES

**Fish Management Objective**: Preserve existing native fish populations and strive to restore viable native fish populations to levels where all endemic species are represented in Lake Chelan NRA; preserve or restore the opportunity for anglers to fish for native fish species and to enjoy and learn about the natural aquatic environment (NPS 1995a: 20).

**Stehekin River Management Objective**: Preserve and restore the free-flowing character and natural processes of the Stehekin River and its tributaries with consideration for protecting the public road system.

**Management Actions**: The National Park Service would not manipulate the Stehekin River to protect federal property except roads and bridges according to the following criteria. Existing public roads would be protected in erosion / river conflict zones only if (1) there are no feasible alternatives, (2) funds are available, (3) proposed actions would have lesser impacts than other alternatives, and (4) the proposed actions are permitted by the county, state, and other federal agencies. No new road construction would be proposed in active river / erosion conflict zones.

Previously manipulated sites that do not meet the above criteria for future manipulation would be restored to approximate natural conditions.

The Park Service would not manipulate the river to protect private property. No action would be taken to prevent private owners from manipulating the river on their land to protect their property unless such actions would significantly harm recreation area resources or were in violation of local, state, or federal ordinances, regulations, or laws. Such actions would not be encouraged, however.

NPS structures that could be threatened by river processes would be relocated.

The National Park Service would manipulate woody debris in the Stehekin River or its tributaries only to protect public roads and bridges according to the criteria above. Woody debris could also be trimmed or turned in the lower 9 miles of the Stehekin River to allow safer recreational use of the river for rafting, kayaking, and canoeing if it did not alter the function or stability of woody debris accumulations and was permitted by the appropriate regulatory agency. Woody debris would not be removed from the river system in any case. The Park Service would not remove or manipulate woody debris on public land or water to protect private property, and it would take no action to prevent private landowners from removing or manipulating woody debris on their land to protect their property, unless these actions would significantly harm recreation area resources or were in violation of local, state or federal ordinances, regulations or laws. Such actions would not be encouraged.

The National Park Service would work with the county to encourage private property owners to protect natural river processes. Private alteration of river processes would be opposed through cooperation with county, state and federal agencies that have appropriate authorization to take action. The highest priority would be placed on acquiring lands, through exchange or purchase that area threatened by or where development threatened natural river processes.

River processes would be inventoried, researched and monitored to evaluate and mitigate impacts of recreation and other land uses.

The suitability of the Stehekin River would be studied for designation as a wild and scenic river.

## WETLAND, FLOODPLAIN, SHORELINE AND RIPARIAN AREAS

**Management Objective**: Preserve or restore ecological processes and conditions in wetland, floodplain, shoreline and riparian areas (NPS 1995a:23).

**Management Actions**: Existing NPS development on public wetland, appropriate regulatory floodplain, shoreline, and riparian areas (except significant cultural resources) would be relocated to suitable sites and the disturbed sites restored to natural conditions… Campgrounds in regulatory floodplains would be brought into compliance with floodplain guidelines.

Property owners would be encouraged to minimize impacts on wetland, floodplain, shoreline or riparian areas. The National Park Service would take appropriate measures where actions threatened to cause significant impacts on wetland, floodplain, shoreline, or riparian areas.

## SAND, ROCK AND GRAVEL PLAN ELEMENTS

**Management Objective**: Allow mining of sand, rock, and gravel in Stehekin Valley but restrict mining to the Company Creek borrow pit for NPS maintenance and public use and minor reconstruction only; allow for importing of material from outside the valley for new construction (NPS 1995a: 23).

**Actions**: …No sand, rock or gravel would be removed from the 100-year floodplain of the Stehekin River or its tributaries.

## GEOHAZARDS

**Management Objective**: Recognize and avoid hazards of natural geological processes, such as snow avalanches, debris torrents and rockfalls (NPS 1995a: 23).

**Management Actions**: New NPS developments and recreational facilities would be sited to avoid geohazards, and existing NPS / concession facilities would be relocated away from geohazards.

The National Park Service, through cooperative efforts with state and local agencies, would oppose private commercial visitor facilities in geohazard areas…

## THREATENED, ENDANGERED AND RARE SPECIES / NONNATIVE SPECIES

**Management Objective**: Preserve and restore, where feasible, species and ecological relationships that would exist were it not for human impacts including control of nonnative species, and comply with federal, state, and local laws and guidelines (NPS 1995a: 27).

**Management Actions**: The NPS would monitor and attempt to protect incoming gravel, soil and firewood from nonnative plants and would control selected nonnative species that threaten to spread and adversely affect national recreation area resources. The NPS would educate and cooperate with private landowners and other agencies to encourage use of native species.

The NPS would work with the USFWS and other agencies to define and properly management important habitats in an ecosystem context. The NPS would pursue resource inventory, monitoring and research programs to enhance knowledge of biological communities and natural processes to evaluate trends.

Human-disturbed sites would be actively revegetated, or natural revegetation with native species would be allowed to occur on a case-by-case basis. Species recovery plans would be implemented as approved.

## SCENIC RESOURCES

**Management Objective**: Maintain existing levels of natural scenic quality and views and restore cultural scenes (NPS 1995a: 27-28).

**Management Actions**: The current character of the road from the Landing to Harlequin Bridge and from 9-Mile to High Bridge would be maintained. Between them a hardened, single lane road with pullouts would be provided from Harlequin Bridge to 9-Mile.

The natural character of the lake and river edge on public lands (includes areas within 200 feet of the lake and river shoreline) would be restored…

…Design guidelines would identify a crafted, step-back-in-time image… Where feasible, structures would be relocated away from environmentally sensitive areas.

In cooperation with Chelan County PUD and in compliance with state and federal requirements, power lines would be buried where feasible.

## VISITOR EXPERIENCE

**Management Objective**: Emphasize selected opportunities that focus on natural, cultural, and recreational values, through both structured and unstructured ways and both solitary and social means. Visitors encounter facilities and services in a rural community context where needs are balanced with preservation of a nearly pristine natural environment.

**Circulation Management Actions**: …The Stehekin Valley Road would be paved from the Landing to 9-Mile, gravel between 9-Mile and High Bridge… (NPS 1995a: 30).

Overnight Uses Management Actions: …The National Park Service would provide camping areas (NPS 1995a: 30).

River Management Actions: The Stehekin River would be managed as a dynamic natural system…Opportunities for visitors to appreciate the power and intricacy of the river as a natural system would be enhanced (NPS 1995a: 30).

## LAND USE AND DEVELOPMENT

**Transportation Plan Elements Management Objective**: Provide transportation and access to, from and within the national recreation area to accomplish a quality visitor experience, fulfill resource management objectives, and meet local Stehekin Community needs (NPS 1995a: 32).

**Transportation Plan Elements Actions**: The airstrip would be retained and operated under a special use permit with the Washington State Department of Transportation, Aeronautics Division, for noncommercial public use on a "use at your own risk" basis (NPS 1995a: 33).

…Abandoned vehicles would be removed from public lands.

Roads and trails – the road system would not be expanded. Unnecessary roads would be eliminated and the areas restored to natural conditions.

Company Creek Road would be maintained in its current alignment and condition. According to the Lake Chelan GMP, rerouting the Company Creek Road was inappropriate because it would destroy one acre of riparian habitat and would require building numerous bridges over existing flood channels. As a result, the Record of Decision for the Lake Chelan GMP states: "Company Creek road will be maintained in its current alignment, and will be protected from river erosion at two locations." As noted in the Company Creek EA (NPS 1997: 8) this references the flood prone areas at road mile 2.1 and 2.2.

An 11-mile pedestrian and horseback trail would be developed from the Landing to High Bridge…A pedestrian and horseback riding trail system that connects key lower valley features to the Stehekin Valley Road would also be developed.

**Land Protection Plan Elements Management Objective**: Make sure that land uses on public and private lands are compatible with the purposes of the Lake Chelan NRA, emphasizing those uses that protect natural and cultural resources and natural processes, and provide for safe visitor facilities and services (NPS 1995a: 40).

In addition to this overall objective, there are six management objectives and thirteen guidelines related to land protection within Lake Chelan NRA as well as five high value resources. Three subsequent sections identify the need to cooperate with Local Zoning/Land Use Regulations (Chelan County); to establish a Stehekin Valley Overlay District; and to establish NPS Land Use Compatibility Criteria (NPS 1995a: 41-47).

**Stehekin Maintenance Facility and Phase I Housing Development Concept Plan/Environmental Assessment Management Objective**: The project will replace the existing maintenance facility and employee housing located in the floodplain at Lake Chelan National Recreation Area in accordance with the direction of the 1995 General Management Plan. The project will specifically provide for design and construction of a new maintenance facility, to include an equipment repair shop, fuel storage and dispensing facility, a search and rescue/fire cache building, storage building, solid waste compaction and recycling building, helipad and associated infrastructure. The project will also include the design and construction of the first phase of housing, to include a 10 person fire dorm and one three-bedroom single family residence. The project is to include removal of the existing facilities, and site restoration. The site-specific planning for this project will begin in fall 2010 and include production of a Development Concept Plan and Environmental Assessment.

## PARK OPERATIONS

**Cooperative Relationships with Others Management Objective**: Strengthen working relationships with others, defining shared objectives and developing strategies that lead to cooperative agreements for the management of natural, scenic, cultural, and recreational resources of Lake Chelan NRA (NPS 1995a: 48).

**Cooperative Relationships with Others Actions**: The National Park Service would work with county, state, and federal agencies for enforcement of existing ordinances and regulations.

The National Park Service would build cooperative relationships with county, state, and federal agencies; the private sector; and the public through constant communication to involve them in all efforts to facilitate resource protection and visitor enjoyment…

# APPENDIX 3: LAKE CHELAN NATIONAL RECREATION AREA LAND PROTECTION PLAN MANAGEMENT GOALS / OBJECTIVES AND GUIDELINES

## Management Goal / Objectives (NPS 1995a: 40-41, 1995c: 2-3)

The goal is to ensure that land uses on public and private lands are compatible with the purposes of Lake Chelan National Recreation Area (NRA), emphasizing those uses that protect area natural and cultural resources and natural processes, and provide for safe visitor facilities and services.

The six principal management objectives are as follows:

- Protect Lake Chelan NRA from land uses and developments that are incompatible with the purposes of the recreation area.
- Actively support local government in their regulation of nonfederal land within the Stehekin Valley, which places primary reliance on adopted Chelan County zoning ordinances, subdivision, and other applicable ordinances and regulations that ensure that the public health and safety of Stehekin Valley residents and visitors are maintained and enhanced.
- Provide a formal process by which Stehekin Valley residents can actively participate in and provide meaningful input to the Chelan County land use decision process regarding the regulation of private lands.
- Ensure that applicable laws and policies of the state of Washington, including health and safety regulations and Washington Growth Management Act provisions, are followed.
- Provide a basis for meaningful and constructive NPS review of proposals for land use change on private land within the Stehekin Valley in order to ensure that all uses and land developments are compatible with the purposes of Lake Chelan NRA.
- Maintain an effective NPS capability to acquire or exchange for full or partial interests in private lands, conducted on a willing buyer / willing seller basis, to augment the protection measures provided by county land use authority and compatibility determinations.

## Guidelines (NPS 1995: 3-4)

Based on the land protection goal and objectives, the following guidelines form the basis for this *Land Protection Plan*:

- Place emphasis on local zoning and other land use authorities of county and state government to regulate private land uses within the Stehekin Valley.
- Provide opportunities for local review of Stehekin Valley land use proposals, and an appropriate forum to provide this input to Chelan County government.
- Accept new residential and other private land uses that are compatible with the purposes of Lake Chelan NRA.
- Accept new commercial uses on private lands that provide visitor and resident services and that are compatible with the purposes of Lake Chelan NRA.

- Accept new industrial uses on private lands that are typical of and compatible with historical industrial uses within the Stehekin Valley and that are compatible with the purposes of Lake Chelan NRA.
- Encourage land uses that consume a low level of resources, and that conserve both renewable and nonrenewable resources.
- Encourage new construction and conversion of existing facilities that adhere to sustainable design principles.
- Identify those properties with areas that have a high priority for resource protection, and where a public interest in land is necessary to protect recreation area resources, based on resource sensitivity and values, or to provide for compatible visitor use and public community needs consistent with the purposes of Lake Chelan NRA and other legislated mandates. Resources that have a high priority protection are wetland, high flood influence, riparian, and high visual sensitivity areas.
- Continue willing buyer / willing seller acquisitions for properties with areas that have a high priority for resource protection, or for which public needs have been identified, when appropriated funds are available for such purposes or appropriate lands are available for exchange. The National Park Service will consider other factors on a case-by-case basis in making final determinations to purchase tracts. Private lands consisting primarily of areas with a low priority for protection are considered lowest priority for acquisition; willing seller opportunities would be considered when funds are available.
- Unless specifically authorized by Congress, for all proposed NPS acquisitions of land, or interests in lands (e.g., easements), including exchanges, the National Park Service will provide advance written notification to both U.S. senators for Washington and the U.S. congressional representative(s) for the congressional district(s) containing the affected lands. A copy of the notification will also be sent to the Chelan County Commissioners. If specifically requested in writing by any of the congressional delegation, the National Park Service will enter into further consultation regarding the proposed action.
- Use land exchanges, as natural, cultural, and scenic conditions allow, within Lake Chelan NRA by offering to exchange private lands having resources with high priority for protection for public land from previously acquired private tracts having resources with a low priority for protection.
- Emphasize, where appropriate, with the cooperation of the landowner, opportunities for easement purchases and other less-than-fee (e.g., conservation easements) interests for resource protection and public use. This will allow greater flexibility in the protection of high priority resources, including scenic areas, and could provide an alternative method of achieving public nonmotorized recreational trail access to lakes, rivers, and streams, and other sites within Lake Chelan NRA.
- Exercise the use of eminent domain procedures only to prevent resource degradation of national recreation area values by incompatible uses on private land, and only as a last resort where other prudent and reasonable measures to protection national recreation area resources by eliminating or mitigating the resource degradation have been exhausted.

This *Land Protection Plan* further defines specific land protection strategies that are to be employed relative to private property within the Stehekin Valley. It also provides a tract by tract listing of landownerships, identifying the approximate percentage of each tract that has a high priority for resource protection (see the “Recommendations” section).

# APPENDIX 4: STEHEKIN RIVER REACH ANALYSIS

## STREAM CHANNEL GEOMETRY, HYDRAULICS, AND STABILITY

The lower Stehekin Valley is an alluvial valley with varying levels of confinement. It is characterized by a wide floodplain and gravel-dominated channel containing an island-bar pattern (Schumm 1977). The river has this pattern because of the heavy coarse-textured bed load it carries, its large-scale transport and storage of woody debris, and the effective resistance provided by dense stream-bank vegetation, including willow and red osier dogwood. The Stehekin is not a braided glacially dominated system like the large rivers at Mount Rainier and in Alaska.

Figures 1 and 2: Stehekin River Channel Changes 1962-2006 (above and below Harlequin Bridge) illustrate the island-bar pattern of the river in several reaches. Two sites in the lower valley, however, have more of a single, straight channel, including the reach above Harlequin Bridge and the reach near the mouth of Boulder Creek. As discussed above, these single-thread, relatively straight channel reaches have functioned as large wood and sediment transport zones. They have been stable features of the floodplain for most of the last century.

Areas standing above the floodplain, and limiting channel migration, include a large lateral moraine on the northeast side of the valley and the extensive alluvial fans of Company, Rainbow, and Boulder Creeks. Over the past several hundred years, the Stehekin River has meandered across most of the valley floor between these landforms.

Channel geometry varies considerably within the two types of lower valley reaches. In the narrow straight reaches, bank-full width is as low as 50 feet, but increases to more than 250 feet in other reaches. Channel sinuosity is generally near 1.3, but in areas of recent sediment deposition, such as McGregor Meadows, it is 1.8. Three relatively large meander loops have formed downstream from Harlequin Bridge, where sinuosity increases to 2.5. The first meander is located near Frog Island (river kilometer 6), where the channel has migrated into the left bank. A second meander is below Buckner Homestead hayfield and pasture. This unusually large meander formed in-part because a right bank side channel was blocked by Chelan Public Utility District (PUD) in the 1930s to prevent water from bypassing the downstream gauge. Growth of this meander was exacerbated by removal of native vegetation and the presence of weak sand and silt soils (ancient river delta) on the left bank below the mouth of Rainbow Creek. Another large meander has formed just above the mouth of the river and is discussed below.

Channel hydraulic conditions in the two different reaches were assessed by the NPS (1992a) with a HEC-2 hydraulic model. Channel velocity generally decreases down valley, while width depth ratio and sinuosity increase. Superimposed on this general pattern, within three narrower straighter sediment transport zones adjacent to alluvial fans and above McGregor Meadows, 100-year flood channel velocities are on the order of 9-12 feet per second (fps). Within the sediment storage zones between the big fans and at McGregor meadows, 100-year flood velocities are typically 6-7 fps, but more variable due to the presence of multiple side channels. Flow depth, flood-prone width, entrenchment, width-depth ratio, and stream power also vary systematically between these zones. Overbank velocities during 100-year flood events vary between 2 - 4 feet, with flood depths of 6 feet or more in many side channels.

Manning's hydraulic roughness values for the Stehekin River channel have been estimated at 0.045 by the USGS (1987) and NPS (1992a). This is a measure of how many obstacles the water encounters as it flows downstream. Overbank flooding areas in the deposition zones, with dense forests and large wood accumulations, have 'n' values as high as 0.125. The high degree of roughness in most overbank areas reduces flood velocities in floodplains.

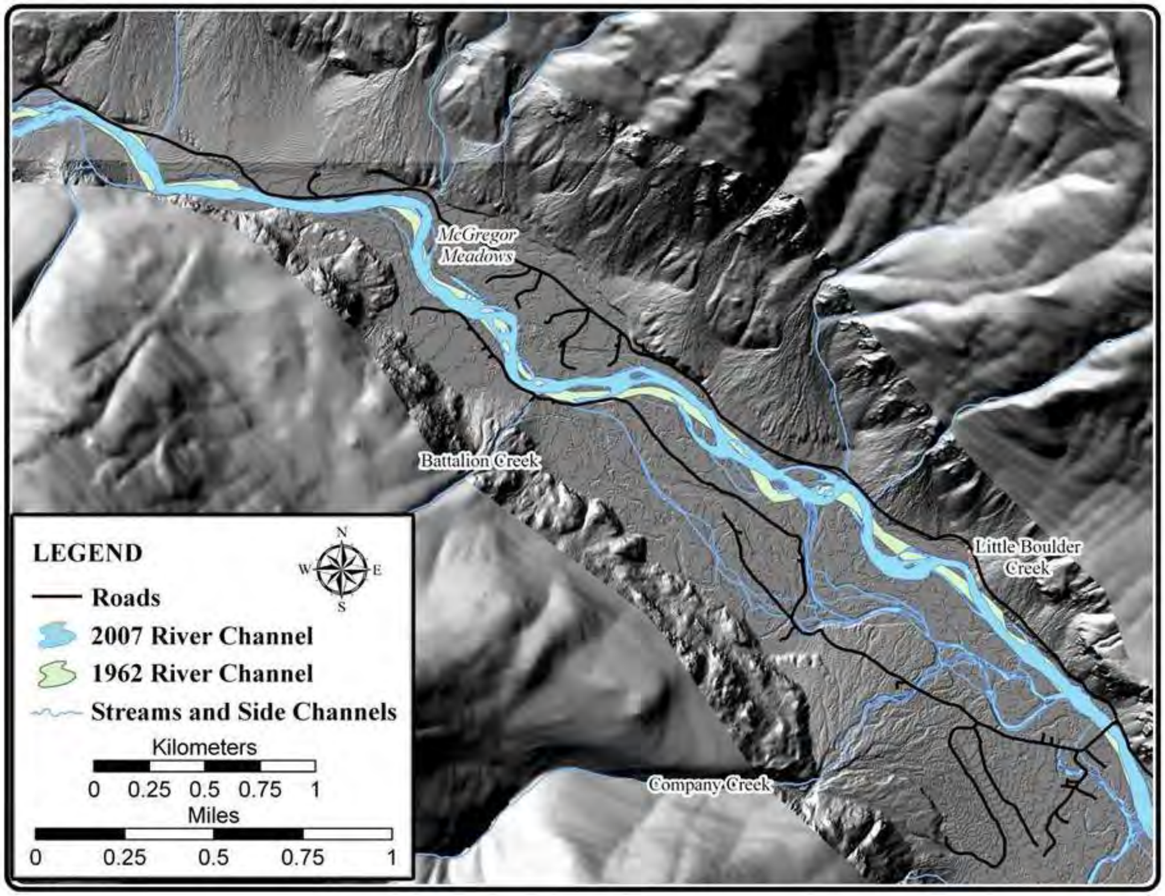



**FIGURE 1: STEHEKIN RIVER CHANNEL CHANGES 1962-2006**
*(above Harlequin Bridge)*

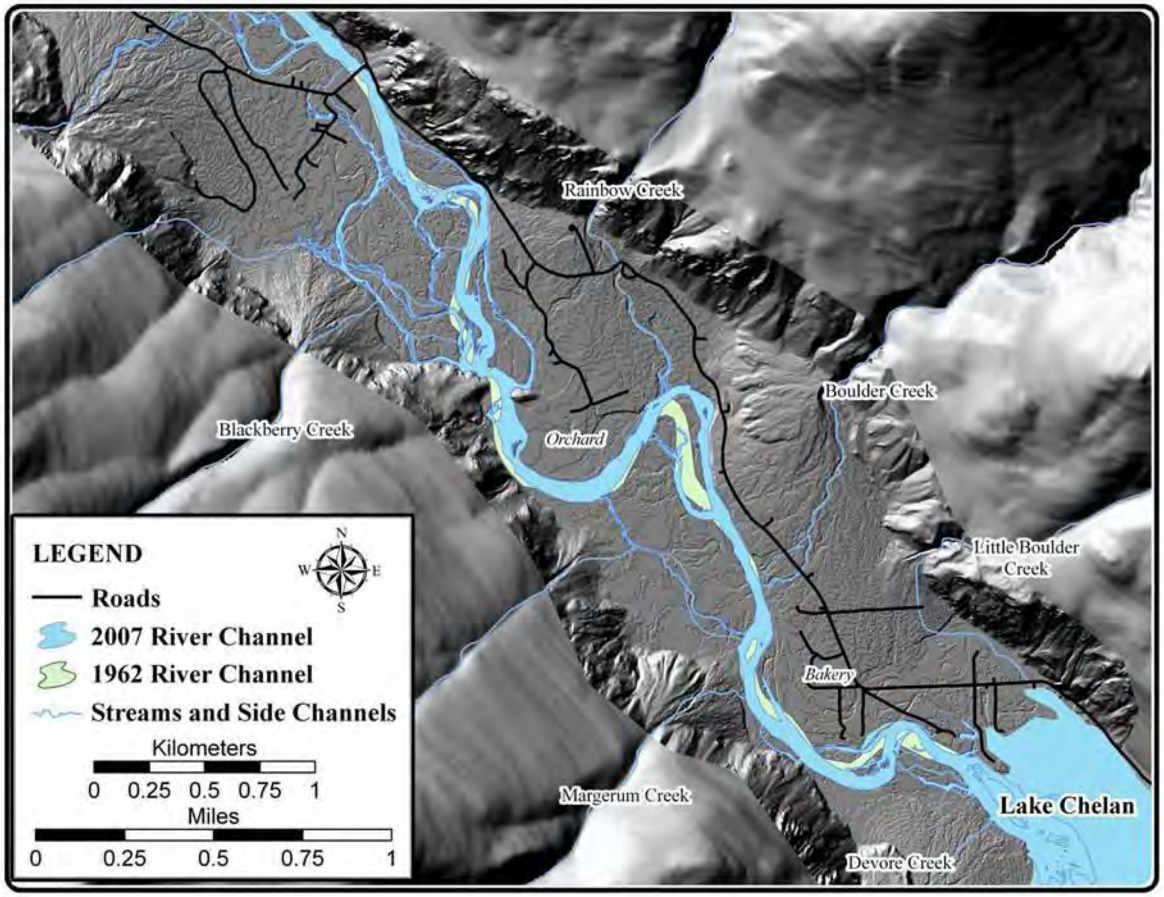



**FIGURE 2: STEHEKIN RIVER CHANNEL CHANGES 1962-2006**
*(below Harlequin Bridge)*

The position of the Stehekin River channel has been examined based on an old map made in 1902 and from aerial photos taken in 1957, 1962, 1978, 2004, and 2007. The 1902 channel location is suspect due to mapping scale and a lack of landmarks; however, in several areas there are old river channels where the map placed the river. Furthermore, it is interesting that the channel appears to have been straighter in 1902, and its sinuosity (curvature) has generally increased since 1962.

Until passage of the recent large floods, evidence indicates that the Stehekin Rivers channel geometry was fairly well adjusted to a spring mean bank-full discharge of about 9,000 cfs (Wolma and Leopold 1957; Ackers and Charlton 1970; Southerland 2002). Deposition of massive amounts of gravel and channel widening in different reaches during the recent fall floods is leading to channel changes on the lower Stehekin River.

Channel changes observed at three locations by the NPS in the past 50 years have been remarkably gradual, given the recent flood events. Qualitative observations indicate that the process begins with deposition of large amounts of gravel in the main channel during floods, which reduces channel capacity and results in accelerated bank erosion and over-bank flooding. Over-bank flooding exploits weaknesses in the floodplain, but generally follows and enlarges former river channels. The process of channel migration is complicated by the presence of large wood, which can block side channels and initiate new channel formation in unexpected locations.

Pronounced changes in channel configuration and associated rapid bank erosion can be found at and downstream of McGregor Meadows, below the orchard, and at the mouth of the river. At several other locations, including the Lower Field, McGregor Meadows, and near the mouth of Wilson Creek, the river has jumped from one side of its channel to the other with deposition of gravel during large floods.

Due to changes in valley width, stream gradient, and obstructions, there are three main areas of stream bank instability in the lower Stehekin valley. One is where the river loses its gradient upon entering Lake Chelan. Another is where the river is joined by Company Creek above Harlequin Bridge. The third is at McGregor Meadows, where the valley width increases three-fold. In the McGregor Meadows reach, the increase in valley width is accompanied by a drop in valley gradient, which in turn results in the loss of stream power and massive deposition of sand, gravel, and large wood.

## CHANNEL HABITAT

In the lower valley, the Stehekin River is characterized primarily by alternating riffles and pools, with occasional cascades and glides. In a 2000 survey, approximately four pool units covered 32,000 square meters, compared to 39,000 square meters in four riffles, with small pools associated with accumulations of large wood (Table 1: Stream Reach Large Woody Debris). It is not currently known how the distribution and character of the riffle and pool habitat may have changed with the passage of the 2003 and 2006 floods (Riedel 2007).

**TABLE 1: STREAM REACH LARGE WOODY DEBRIS (1984, 1999/2000, AND 2007)**

| Reach | 1984 Logjams Large Woody Debris (LWD) (cubic yards) | 1999 / 2000 Logjams LWD (cubic yards) | 2007 Logjams LWD (cubic yards) | Habitat (acres) |
|---|---|---|---|---|
| **Reach 1** | Logjams:21<br>LWD: 2,607 | Logjams:12<br>LWD: 22,682 | Logjams:17<br>LWD: 110,348 | Pool: 4.4<br>Riffle: 7.6<br>Glide: 5.8 |
| **Reach 2** | Logjams:11<br>LWD: 1,111 | Logjams: 15<br>LWD: 2,987 | Logjams: 16<br>LWD: 3,083 | Pool: 0.6<br>Riffle: 12.2<br>Run:2.9 |
| **Reach 3** | Logjams: 16<br>LWD: about 2,300 | Logjams: 15<br>LWD: 9,133 | Logjams: 17<br>LWD: 21,398 | Pool: 3.6<br>Riffle: 14.8<br>Run: 0.5 |
| **Reach 4** | Logjams: 9<br>LWD: about 4,200 | Logjams: 19<br>LWD: 16,705 | Logjams: 26<br>LWD:48,371 | Pool: 5.4<br>Riffle: 15.1<br>Cascade: 4.7 |

## SELECTED STREAM REACH CONDITIONS IN THE PROJECT AREA

This section describes the characteristics of four stream reaches on the Stehekin River within the project area. A similar section was included in the Stehekin Valley Road Improvement Project (NPS 2005). These reach analyses help to sort out effects of existing erosion protection structures and the accumulation of large woody debris over time in the Stehekin River.

Descriptions of each reach include average depths and widths, flood prone areas, channel gradient, sinuosity, large wood accumulation, and distribution and amount of stream habitat such as riffle, pool, glide, and of side channel types (Table 1: Stream Reach Large Woody Debris and Table 2: Stream Reach Physical Characteristics). Reaches were selected for analysis based on their proximity to proposed erosion protection measures.

**TABLE 2: STREAM REACH PHYSICAL CHARACTERISTICS**

| | Reach 1 | Reach 2 | Reach 3 | Reach 4 |
|---|---|---|---|---|
| **River (kilometer)** | 0-1.5 | 4.8-6 | 7-8.5 | 9-11 |
| **Length (feet)** | 4,600 | 5,000 | 6,000 | 3,400 |
| **Bankfull Width (feet)** | 450 | 160 | 200 | 160 |
| **Width/Depth Ratio** | 40:1 | 24:1 | 37:1 | 20:1 |
| **Max. Bankfull Depth (feet)** | 11.1 | 6.6 | 5.4 | 7.9 |
| **Flood Prone Area Width (feet)** | 1400 | 1780 | 1600 | 1200 |
| **Channel Gradient (5)** | 0.5 | 1.6 | 0.8 | 0.8 |
| **Sinuosity** | 1.3 | 1.3 | 1.2 | 1.3 |
| **Maximum Diameter (inches)** | 7.9 | 5.5 | 9.4 | 11.8 |

The lower Stehekin River flows through a wide and deep glacially carved valley into Lake Chelan. Glacial deposits are important in defining the river channel pattern in the lower Stehekin. In the lower valley towards the lake, alluvial fans, debris cones, fan terraces, and steep valley walls mark the edge of the channel migration zone (Reaches 1-2) (Figure 3: Overall Layout of the Reaches on the Stehekin River). A large glacial moraine runs along the northeast side of the valley and generally defines the limit of channel migration on the left bank for a large portion of the lower valley (Reaches 3-4) (Figure 3: Overall Layout of the Reaches on the Stehekin River). Steep first and second order streams contribute large amounts of sediment. At the bottom of Reach 1 is Lake Chelan, while bedrock at the lower end of Reach 2 controls the bottom of Reaches 2 - 4.

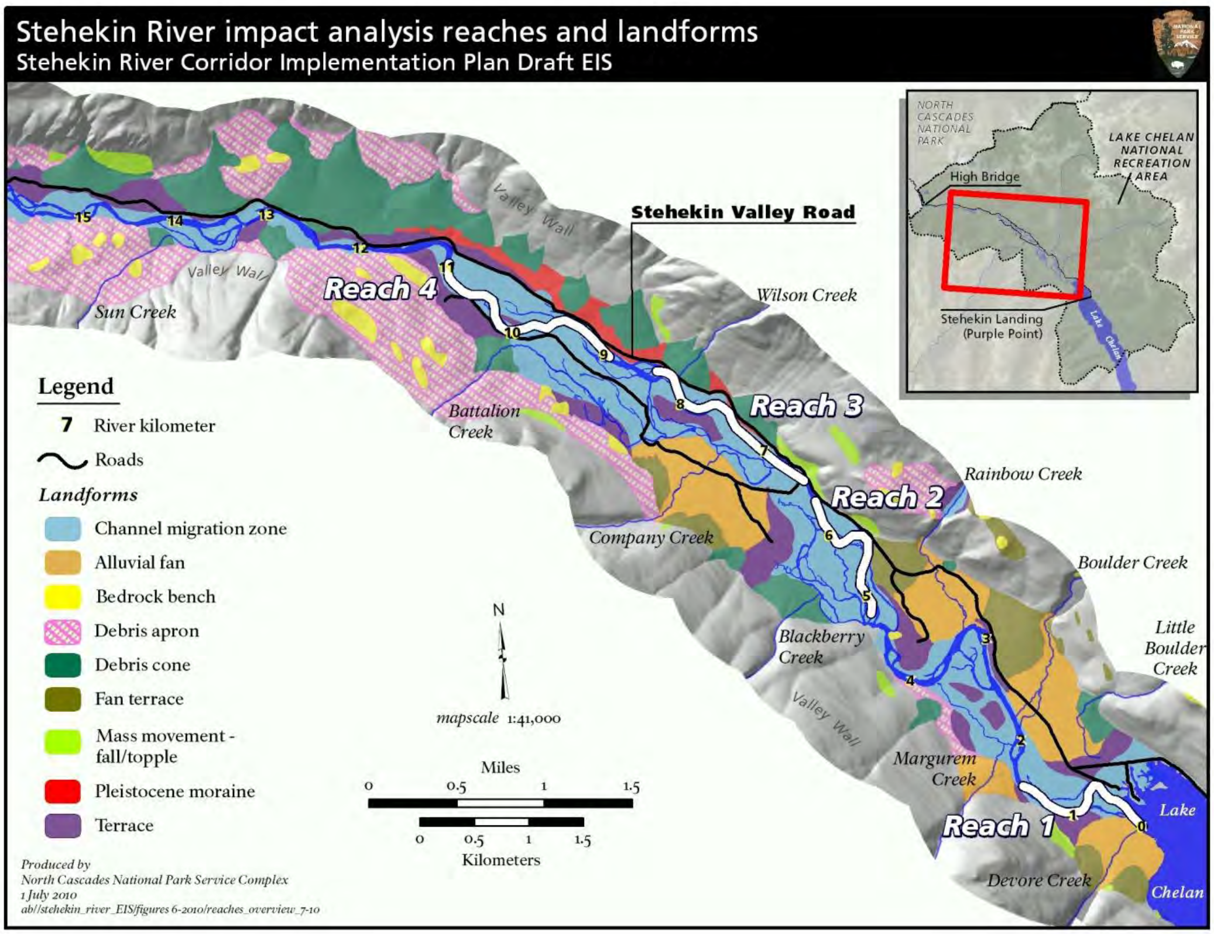



**FIGURE 3: OVERALL LAYOUT OF THE STREAM REACHES ANALYZED ON THE STEHEKIN RIVER**

Note the Pleistocene moraine (red) along the left bank and the alluvial fans (orange) along the lower valley, which generally defines the channel migration zone.

Within the approximately four miles containing Reaches 1-4, the longitudinal profile of the Stehekin River undergoes several significant changes. These changes define the riffle-pool sequence along the river; determine relative channel stability, large wood accumulation and stability, and other habitat factors. The U.S. Army Corps of Engineers conducted removal of large woody debris from the lower five kilometers of the Stehekin River in the early 1970s. Surveys of woody debris were conducted on the Stehekin River in 1984, 2000, and 2007 (Table 1: Stream Reach Large Woody Debris). Information about large woody debris within each reach from all three surveys has been included, as have cross-sections from each reach.

## Reach 1

Reach 1 of the Stehekin River encompasses the river mouth to the edge of the Lake Chelan backwater zone (Figure 4: Location of Reach 1). When Lake Chelan is at full pool and river discharge approaches 20,000 cfs (i.e., a 100-year flood), the backwater effect of the lake extends about 0.25 mile upstream (Chelan PUD 2001). The backwater effect also extends several hundred feet further upstream for smaller floods that occur at full pool. Reach 1 ends near the edge of this backwater zone, which has a strong effect on gravel and wood deposition and channel stability in this section of the river. The lower valley is underlain by a thick silt and clay layer that represents the former bed of Lake Chelan. This material outcrops intermittently on the right bank of Reach 1. The presence of this layer along with the water level in Lake Chelan probably slows channel migration in this area.

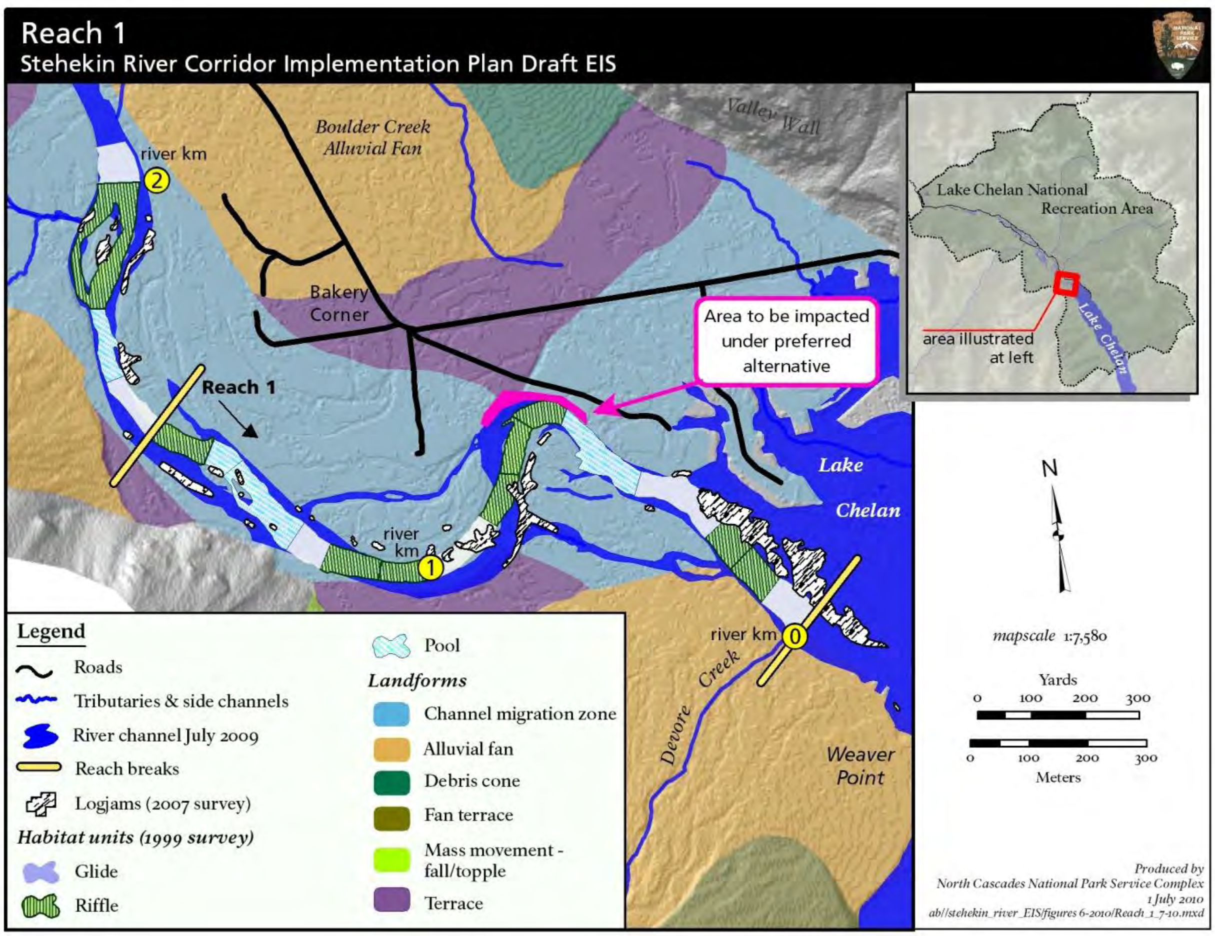



**FIGURE 4: LOCATION OF REACH 1, WITH ASSOCIATED LANDFORMS, LOGJAMS, AND HABITAT UNITS**

Proposed bank stabilization work will extend downstream 280 feet near river kilometer 1.

**Topography**: The valley wall confines this section of the river on the right bank at the upper end of Reach 1. Downstream the river meanders across a wide floodplain with terraces on either side. The alluvial fans of Margerum and Devore Creeks on the right bank and the Boulder Creek alluvial fan on the left bank also limit channel migration. The width of the valley averages 0.7 miles in this reach. The Stehekin River meanders through gravel bars and logjams, dropping its remaining load as it approaches Lake Chelan. This is a net sediment deposition zone with massive logjams in multiple side channels. Based on a continual decrease in grain size as the river approaches the lake, only pebble gravel and finer material is transported through the lower valley and deposited in the lake. The largest diameter sediment cataloged in this reach was only 7.9 inches. The maximum depth for this reach is artificially high at 11.1 feet, since it is at a 50-foot recession bank next to a levee.

**Large Woody Debris**: The effect of the lake backwater is to raise the 100-year flood elevation about 0.5 feet, and to cause sediment deposition and accumulation of large woody debris in Reach 1. This reach is one of the largest net deposition zones for large woody debris on the river. In the 1984 the lower 4,600 feet of the Stehekin River contained 21 logjams, totaling 2,607 cubic yards of wood. The number of logjams dropped to 12 in 1999, but the volume increased to 22,682 cubic yards. In summer 2007, a large logjam was removed from the head of a side channel near river kilometer 1 on the right bank of Reach 1. Almost all of the logs were repositioned downstream of the channel mouth below the ordinary high water mark. This project represented the first large scale manipulation of wood on the Stehekin River in more than 35 years. The 2007 survey done in the fall showed the number of logjams to be 17, with 110,348 cubic yards of wood. There are four major logjams at the mouth of the Stehekin River, the largest totaling 861 logs.

**Stream Habitat**: Habitat in Reach 1 was last surveyed in 2000. It is characterized by a mix of riffle and glide sequences, along with an occasional pool. Riffles and glides are intermixed in this reach, with riffles accounting for 7.2 acres of habitat and 4.4 acres for glides. A majority of the glides are at the very mouth of the river, where it meets Lake Chelan. Pool habitat consists of two large pool features covering approximately 3.3 acres of habitat. Side channels are also a significant habitat feature in this reach, especially adjacent to Lake Chelan were they are strongly affected by changes in the lake level.

**Erosion Protection Measures**: In this reach there is currently a total of 1,000 feet of modified bank. Private landowners installed two rock barbs, effecting about 200 feet of the left bank in the 1990s. Rip-rap, covers 800 feet of the left bank immediately downstream near the mouth of the Stehekin River and was installed in 1983, including a few hundred feet on NPS land. In addition to stopping bank erosion where they were placed, the primary effect observed was development of scour holes on the channel bed within 200 feet downstream of the barbs. The effect of the rock barbs is also limited in time and in parts of the channel prone to gravel deposition. There are no other bank modifications in Reach 1.

## Reach 2

The Stehekin River within Reach 2 has a wide flood prone area averaging 1,780 feet in width due to the lack of confining landforms (Figure 5: Location of Reach 2). Located just down valley from the Company Creek alluvial fan, is a major gravel and wood deposition zone, Frog Island on the left bank marks the beginning of this reach. Highly unstable in this section, the Stehekin River reaches a sinuosity of 1.3, spreading over many side channels. Gradient in this reach appears to be controlled by a bedrock ledge at Buckner Rock. Right bank side channels represent the lowest part of the floodplain, and one cut 4-5 feet below the main channel, which is clogged with logs and gravel. While some of the right bank side channels are cut off at Harlequin Bridge, recent new channels have formed across from Frog Island.

**Topography**: At one time, the river travelled across the right side of its floodplain, but for at least the past 50 years it has been moving into the left bank. The channel is truncating the former alluvial fan of Rainbow Creek. As the river moved east the point bar on the opposite bank has grown proportionally. A cross-section through Frog Island reveals numerous side channels (Figure 6: Cross-Section N2-N2’for

Reach 2). The channel gradient in Reach 2 is 0.02 percent and is influenced by Buckner rock. Gravel, only as large as 5.5 inches, was cataloged in this reach.

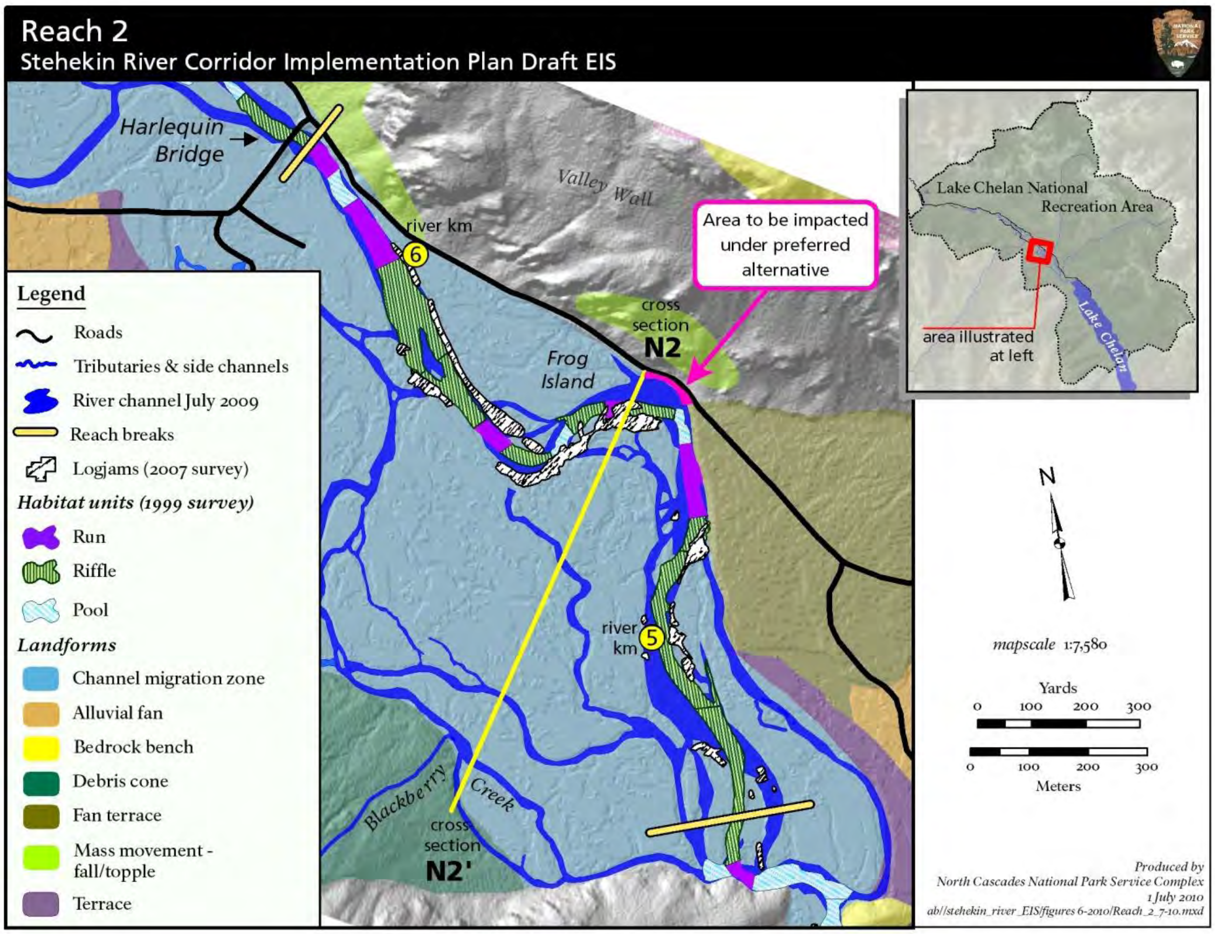



**FIGURE 5: LOCATION OF REACH 2, WITH ASSOCIATED LANDFORMS, LOGJAMS, AND HABITAT UNITS**

Proposed rock barbs just downstream of 'N2' where the river is encroaching on the road. Gravel was removed from a gravel bar on the left bank across from upper Frog Island.

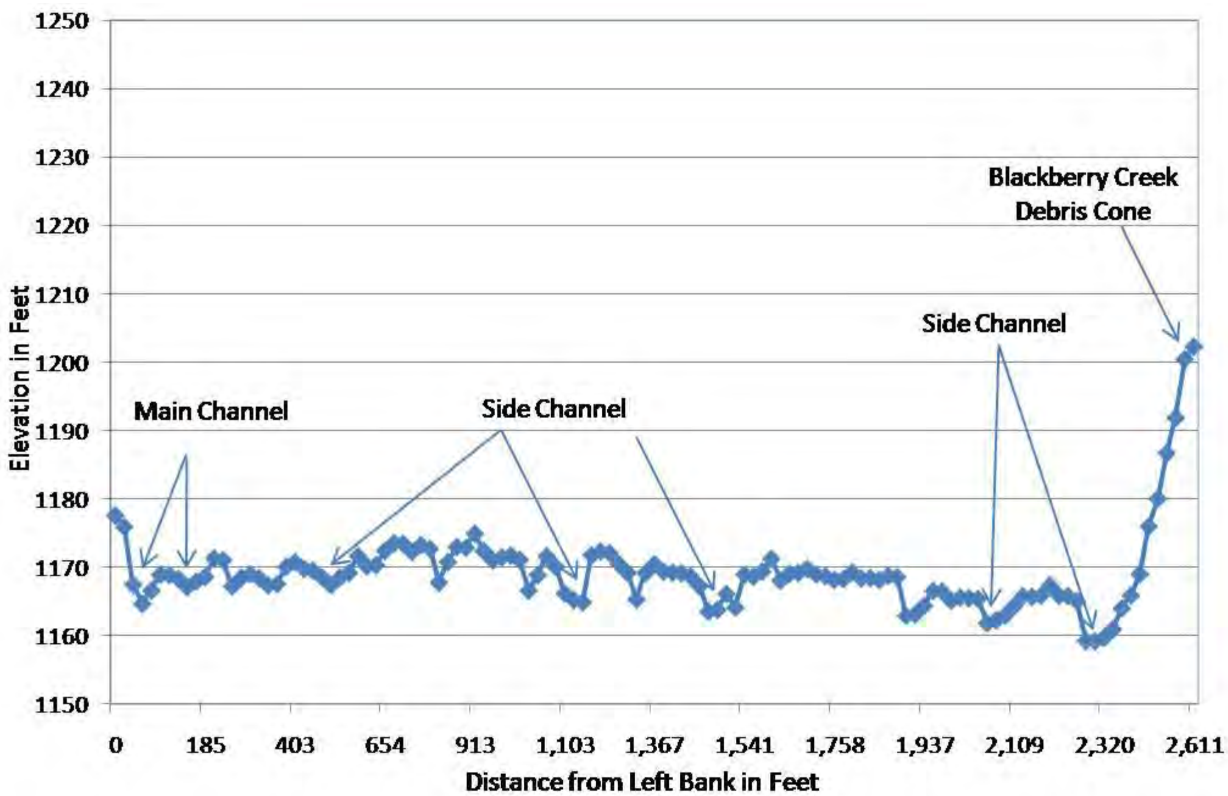



**Figure 6: Cross-section N2 to N2' for Reach 2**

**Large Woody Debris**: When the channel in this reach was first surveyed in 1984, 1,111 cubic yards of woody debris was present. In the 1999 woody debris survey, 15 individual logjams were identified, totaling 2,987 cubic yards of wood. When surveying was completed in 2007, 16 logjams were present, with the overall size had increased to 3,083 cubic yards of wood.

Minor amounts of rock were placed at this site in the past, but there are no other erosion management structures in this reach. The rock and natural accumulation of boulders from adjacent cliffs effect about 300 feet of riverbank.

**Erosion Protection Measures**: Gravel was removed in small quantities from the right bank but ceased in the late 1970s. Harlequin Bridge upstream has a strong influence on river process. The potential action site on this reach includes the bend in the river just downriver of Frog Island, which is cutting laterally into the main Stehekin Valley Road. Proposed rock barbs would be on the edge of the channel migration zone, where the river flows against the valley wall.

**Stream Habitat**: The habitat within Reach 2 is characterized by a series of riffles, with only two pools present. The riffles account for 94 percent of the habitat area. The pools total only 0.4 acres and are located at the downstream end of Frog Island. Bank erosion at the site of the proposed barbs measures 240 feet since 1962, with approximately 90,300 cubic yards of gravel introduced into the channel downstream.

## Reach 3

**Topography**: The upper part of this reach is at the end of a major gravel and wood deposition zone. At about River Kilometer 8, the river transitions to a transport zone. In Reach 3 the Stehekin River has alternated over time between two channels located on opposite sides of the floodplain. Channel migration is limited on the left bank by a large glacial lateral moraine, while on the right bank it is limited by the extensive alluvial fan of Company Creek (Figure 7: Location of Reach 3). The main channel of the river is paralleled by an abandoned channel on the floodplain of the right bank, which appears to have been the active channel in the early 1900s (Figure 7: Location of Reach 3 and Figure 8:Cross-section T to T' for Reach 3). Avulsion of this abandoned channel and occupation of the present alignment probably occurred sometime before 1953, most likely during the 1948 flood.

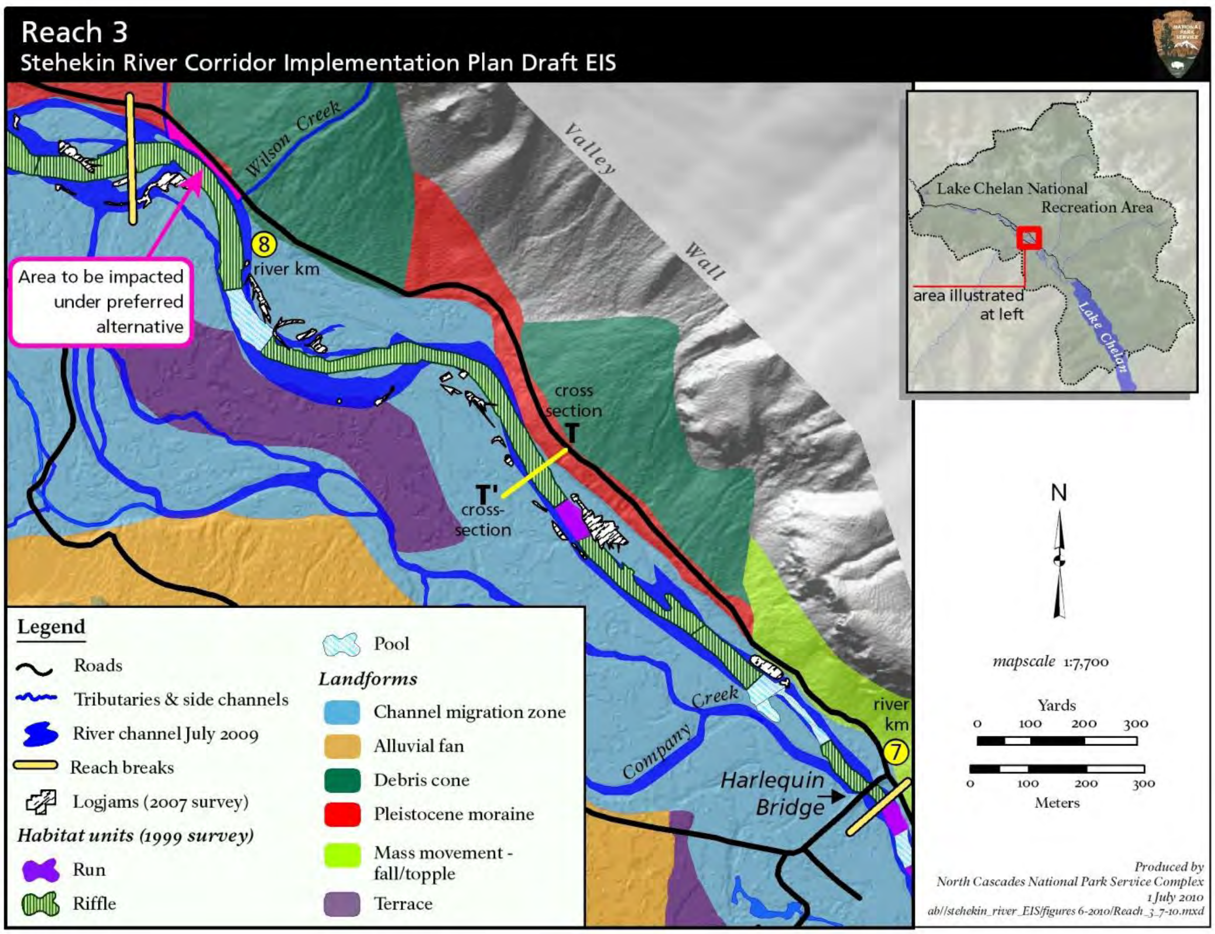



**FIGURE 7: LOCATION OF REACH 3, WITH ASSOCIATED LANDFORMS, LOGJAMS, AND HABITAT UNITS.**

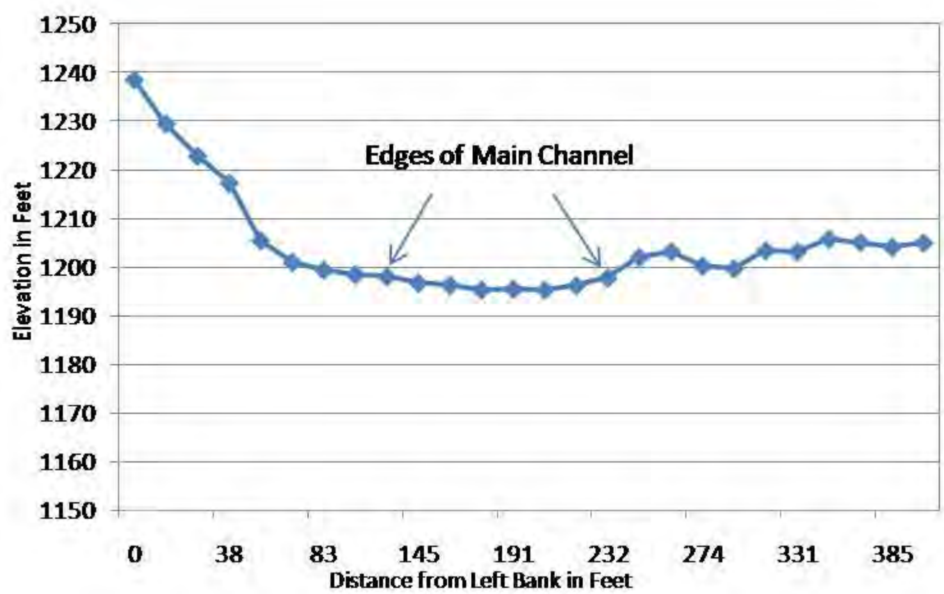



**FIGURE 8: CROSS-SECTION T TO T' FOR REACH 3**

Stream gradient in Reach 3 varies significantly. In the upper part of the reach the gradient is 0.0089 percent, while in the lower part of the reach the gradient drops to 0.0039 percent. The substrate in this reach ranges from cobble and boulder to gravel with the maximum diameter pebble at 9.4 inches. Main channel flood velocities in this reach are on the order of 5-6 cubic feet per second (cfs). Bankfull width, bankfull depth, and width to depth ratios all reflect the broad alluvial nature of this reach.

**Large Woody Debris**: Reach 3 represents a significant storage zone for large woody debris. In a 2000 survey approximately 9,133 cubic yards of large wood in 15 logjams was inventoried in this reach, representing a 400 percent increase from a 1984 large wood survey. The results from the 2007 survey reveal 17 logjams that total a volume of 21,398 cubic yards in wood, reflecting further substantial increases during the large 2003 and 2006 floods.

Sinuosity is calculated at 1.2 in this reach, although it is higher in the upper parts of this reach. Associated with increased sinuosity is growth of gravel bars and bank erosion. Bank erosion since 1962 at one site measured 315 feet, with an average rate of 7feet/year. Bank erosion at these sites introduced 87,000 cubic yards of gravel to the channel downstream in the past half century.

**Erosion Protection Measures**: There are currently no erosion control structures within this reach, except for rip-rap at Harlequin Bridge.

**Stream Habitat**: Habitat in Reach 3 is characterized by riffle pool sequences. Seven long riffles dominate the reach, accounting for 87 percent of all main channel stream habitats (approximately 6.0 acres). Side channels are also a significant habitat feature in this reach (12.5 acres), and have half as much habitat as the main channel. The system of abandoned channels on the right bank of the river's floodplain accounts for most of the side channel habitat. Pool habitat is limited in Reach 3 to two pool features covering approximately 0.7 acres of habitat.

## Reach 4

**Topography**: The Stehekin River channel in Reach 4 migrates across a broad alluvial floodplain between a glacial moraine on the north and a valley wall to the south (Figure 9: Location of Reach 4). The most significant change in valley geomorphology within the lower Stehekin River above the head of Lake Chelan occurs at Reach 4, where valley width increases from a width of 500 feet to a half-mile. Flood prone area and bankfull width (Figure 9: Location of Reach 4) also increase significantly in this reach (Table 2: Stream Reach Physical Characteristics). This change coincides with a drop-in stream gradient from 0.015 percent to 0.008 percent. Flood velocity in the main channel is estimated at 9 cfs. The main channel in the upper part of this reach is boulder and cobble gravel, with a $D_{Max}$ of 11.8 inches.

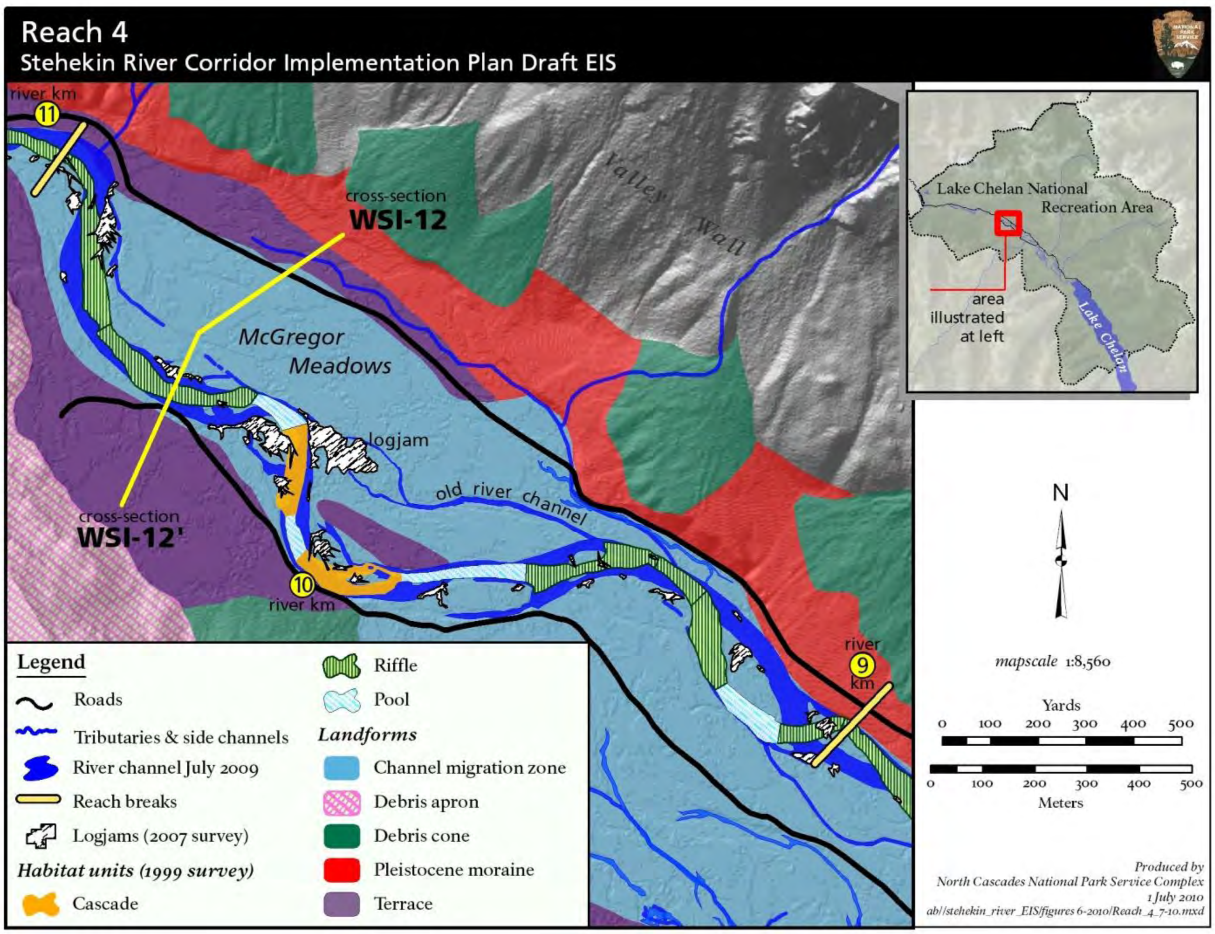



**FIGURE 9: LOCATION OF REACH 4, WITH ASSOCIATED LANDFORMS, LOGJAMS, AND HABITAT UNITS**

Due to these physical changes in valley width and stream gradient, Reach 4 is located in an area where the Stehekin River channel is very unstable. Gravel deposition in this reach since the mid 1980s is estimated at 50,000 cubic yards. Most gravel deposited in this reach has been upstream of the large logjam shown in Figure 9. Downstream of the jam, repeat channel surveys indicate that the river has incised 2-3 feet into 1995 and earlier flood deposits.

A major stream avulsion has been underway in Reach 4 that will likely reroute the main channel through McGregor Meadows down No Name Creek on the left bank (labeled "Old River Channel" on Figure

9). Sinuosity in Reach 4 is as high as Reach 1, another very unstable section of the river (Table 2: Stream Reach Physical Characteristics), and has been increasing steadily since the 1950s. The increase in sinuosity is associated with rapid point bar growth and bank erosion. In the October 2003 flood, bank erosion of more than 50 feet was recorded on the right bank at the lower end of Reach 4. In response to bank erosion issues, the NPS and private landowners have installed rock barbs and three grade-control structures in this reach covering a liner distance of 1,565 feet at three locations. Most of these structures are in the middle of the channel migration zone, where their impact on river migration is large. However, four of the rock barbs are now buried in sediment deposited in the 2003 and 2006 floods.

Bankfull width in Reach 4 is 500 feet, while maximum bankfull depth is 7.9 feet (Table 2: Stream Reach Physical Characteristics). Repeat surveys of the river channel in this reach indicate that bankfull width is increasing, while bankfull depth has decreased. These changes are associated with the ongoing channel avulsion described above and are directly related to deposition of sediment as main channel conveyance is decreased.

**Large Woody Debris**: Reach 4 is located in an area that changes from a net large wood transport zone upstream to a storage zone downstream. Reach 4 contains 23 logjams in2007, totaling 48,371 cubic yards of wood. Large wood accumulated rapidly in this area between surveys in 1984 and 2000 (16,705 cubic yards), with an approximately 1,800 percent increase in large wood volume. Large woody debris accumulations have played a major role in channel stability and pattern in Reach 4. For many years a rapidly growing logjam prevented the river from following No Name Creek and reoccupying an old river channel (Figure 10: Cross-section WSI-WSI′ for Reach 4). However, the record October 2003 flood punched a hole in the logjam, thereby rapidly increasing conveyance down the avulsion route and decreasing flow down the main channel. The 2006 event re-plugged this route and the logjam grew to cover 5 acres on both sides of the main channel that contains more than 3,000 individual logs stacked as high as 20 feet.

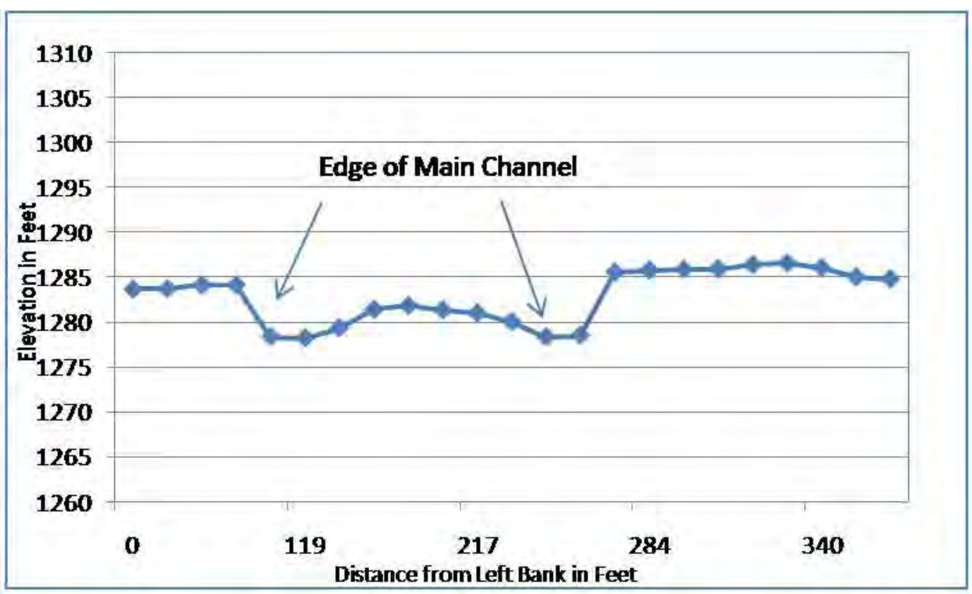



**FIGURE 10: CROSS-SECTION WSI-12 TO WSI-12' FOR REACH 4**

**Erosion Protection Measures**: There are currently 14 erosion management structures within this reach, affecting about 4,000 feet of the river bank. Structures include 13 rock barbs on both banks, cabled logs, and two levees. A 300 foot long by 3 foot tall levee was built in the floodplain on the left bank in 2008.

About 0.4 miles downstream, the NPS constructed a 400 foot long levee and log cribbing in the 1980s. Eleven of the 13 rock barbs are on the right bank to protect Company Creek Road.

In response to channel instability in upper Reach 4, the NPS and private landowners cooperated to manage ever-worsening flood damage. A 1998 plan coordinated installation of about a dozen small grade control structures on public and private land. These sills of rock buried beneath the surface are designed to slow channel formation and maintain sheet flow in McGregor Meadows (aka avulsion sill).

The 2003 and 2006 floods deposited massive quantities of gravel in upper Reach 4, resulting in unprecedented erosion and flooding of the left bank. In response, private landowners and the NPS cooperated on installation of three long grade control structures. The NPS also installed one long grade control structure and two smaller ones beneath the Stehekin Valley Road near Milepost 6.6 - 6.8.

**Stream Habitat**: Stream habitat in this reach is confined primarily to the main channel, until halfway through the reach, with a noticeable absence of pool and side-channel habitat. All habitats were classified as riffle in upper McGregor Meadows, covering an area of approximately 3.4 acres. Through lower McGregor Meadows, downstream of the logjam, pools dominate riffles, totaling 2.5 acres of habitat with numerous side channels along the river. Two cascades are present, signaling gradients over 3.5 percent just below the major logjam in McGregor Meadows.

# APPENDIX 5: CUMULATIVE IMPACTS PROJECT LIST

See also Chapter I: Purpose of and Need for Management Action and Chapter IV: Environmental Consequences (Methodology section).

## COMPANY CREEK ROAD (CCR)

**CCR Mile 1.9:** Maintain levee (1981), bank barbs and riparian vegetation (1997) to protect Company Creek Road from inundation.

For several decades, prior to the 1970s, there was repeated flood damage to the Company Creek Road, including deep scouring and loss of surface gravel. In 1976 a 290-foot long log-crib was constructed to protect the Company Creek Road (NPS 1997). By 1981, that log cribbing was extended 110 feet for a total length of 400 feet (NPS 1997) and was raised by approximately 2 feet (one row of logs) and an earthen levee from loose pit run material was built on top of the log-crib (NPS 1997). The levee is currently approximately 6 feet high and has not recently been topped by floodwaters along 90 percent of its length. Two rock barbs protect the river side of the levee.

A flood in the spring of 1982 substantially damaged the cribbing/levee and the adjacent road. In this flood, the last remnant of land between the river and the log-crib structure (formerly 8 feet from the river) washed away. The flood inundated the area around the levee on both the upstream and downstream sides and flowed down the Company Creek Road, washing off the gravel surfacing (NPS 1997). The cribbing was repaired and expanded and was further damaged in subsequent floods (NPS 2007:3). These repairs to the road required over 3,000 cubic yards of rock and gravel (NPS 1997).

In 1995, a flood undermined the cribbing and eroded the lower end of the levee again (NPS 2007:3). By 1997, the height of the levee was 4.8 feet above the cribbing. As noted in the *Erosion Control on Company Creek Road, Stehekin Valley Environmental Assessment* (NPS 1997):

> Although the log cribbing was constructed to protect the road from erosion by the river, it has locally accelerated the water velocity, creating a large scour hole at the base of the structure, undermining the crib. This allows some of the rock and soil in the crib and levee to wash out through the bottom. The cribbing now sags several feet in the middle. At present there is no protection for the downstream end of the crib, which has suffered from erosion damage and floats during high water events.

Therefore, in 1997 two rock barbs were constructed at the toe of the levee and a dense cover of native riparian vegetation was planted on top of the levee. The road was then protected from erosion and a section of road downstream from levee elevated to redirect overbank flow off the road into existing natural flood channels (NPS 1997). In the spring 1999 flood, the river channel along the levee was blocked by a natural logjam and is now covered in alders. The poorly constructed levee remains stable, with a dense cover of surface vegetation.

Although the levee is currently in fair to good condition, it is anticipated that over time additional repairs to maintain it will need to be made. These repairs would likely consist of measures similar to those described above, such as reconstruction of rock barbs, replacement of portions of the levee structure, and additional bioengineering or riparian restoration.

**CCR Mile 2.1:** Maintain three remaining rock barbs and bioengineering from installation of six barbs and bioengineering constructed in 1997 to implement the *Erosion Control on Company Creek Road Environmental Assessment* (NPS 1997).

In 1997, four bank barbs and bioengineering were placed at Milepost 2.1 to protect the Company Creek Road from Stehekin River flood-related erosion. One of these barbs has since been buried, while three remain. Over time it is anticipated that these barbs will also be buried, necessitating their reconstruction as the riverbed continues to aggrade (increase in height). A fifth barb, placed on private land, has also been largely buried.

**CCR Mile 2.2:** Maintain hump in road to allow water to run off the road, rather than down the road.

In 2004, a road hump was placed within the Company Creek Road as part of the emergency repairs that followed the flooding in 2003. This road drainage feature allows water to run off into natural flood channels off the edge of the Company Creek Road. Over time, it may require replacement or repair.

**CCR Mile 2.2 - 2.4:** Maintain three grade-control structures in road constructed as an action which implemented the *Minimize Erosion on Upper Company Creek Road Environmental Assessment* (NPS 2007).

In 2007, three grade-control structures were constructed adjacent to the Company Creek Road to prevent head-cutting along the bank of the Stehekin River from affecting the Company Creek Road. Additional changes in the bank of the Stehekin River could necessitate the repair or reconstruction of these grade-control structures, which are designed to allow floodwater to pass through the floodplain without cutting large channels.

## STEHEKIN VALLEY ROAD (SVR)

Numerous erosion management and one major flood control measure have been implemented by the NPS along the Stehekin Valley Road, beginning in the 1930s. Under all alternatives (1-4) these measures would continue to be maintained and would be enhanced if necessary.

**SVR Mile 2.8:** Maintain four rock barbs and bioengineering constructed in 1997 as part of the Company Creek Road Environmental Assessment (EA).

Using an easement, a 400-foot long rock toe (using approximately 4,000 cubic yards of rock), four rock barbs and bioengineering were installed on public and private land. The barbs and bioengineering were installed after a pile of rocks fell into the river and 100 feet of bank was lost in one day. In the fall of 2008, cabled logs were added behind the first barb to prevent the continued formation of a scour hole and 20 cubic yards of rock were used to repair three barbs. Although there is not a strong flow at this location, seeps are contributing to the ongoing erosion of the sandy bank. The rock toe armor was done as an emergency action, while the rock barbs and bioengineering were installed in 1998 and repaired in 2000 and 2008.

Approximately 8,000 linear feet of streambank has been affected, with approximately 400 feet $\times$ 20 (8,000 linear feet) of bioengineering. Over time, additional maintenance of the rock barbs, including potential reconstruction, would be needed as the Stehekin River continues to fill with sediment.

**SVR Mile 5.5:** If the need for additional erosion protection impacts private property downstream, work with the landowner to identify mitigation and/or compensation for impacts.

There is little NPS land and little room to work between the slope of the road and the Stehekin River.

**SVR Mile 7.0:** As part of the Stehekin Valley Road Improvement Project implementation of the Milepost 7.0 and 7.5 reroutes, grade-control structures were constructed to inhibit the Stehekin River from flowing down the road.

Three grade-control structures and reroutes (7.0 - 7.2 and 7.5 - 7.9) would continue to be maintained and the road would be repaired as needed following flooding. The largest grade-control structure (at Milepost 7.0) is 300 feet long and 6 feet wide (1,800 square feet or 0.04 acres) (beneath the road). The other two are slightly wider than the road (12-14 feet), approximately 16 feet by 6 feet (96 square feet) (0.004 acres) and spread 50 yards apart downstream.

**The Environmental Assessment:** Protection of the Stehekin Valley Road in the Vicinity of McGregor Meadows, Lake Chelan National Recreation Area Finding of No Significant Impact (FONSI) cleared the way for construction of several grade control structures in McGregor Meadows and placed a hump in the Stehekin Valley Road to reduce the potential for river avulsion through the area (NPS 2004a).

**SVR Mile 8.0:** Maintain streambank revetment (1993 and 2007), two rock barbs and bioengineering (1993), and four additional rock barbs and bioengineering (2007) constructed as part of the *Stehekin Valley Road Improvement Project*.

Approximately 800 linear feet of streambank has been affected, with approximately 12,000 square feet (800 feet $\times$ 15 feet) (0.28 acre) of bioengineering. Over time, additional maintenance of the rock barbs, including potential reconstruction, would be needed as the Stehekin River continues to fill with sediment.

**SVR Mile 9.2:** Continue to monitor threats to Stehekin Valley Road and maintain existing grade-control structures that limit the potential for water to create a channel in the road corridor (see also proposed actions at this site in Alternatives 2 - 4).

Following rapid bank erosion just upstream during the 2006 flood, two grade-control structures were installed where the road meets the river.

**SVR Mile 9.1 - 10.2**: Restore Stehekin Valley Road access at Coon Run, Mile 9.1 to 10.2 (NPS 2005b) Maintain existing culverts, bioengineering, and cabled logs (2005).

In 2003, catastrophic loss of the Stehekin Valley Road occurred in this area and an upper road reroute was selected from among the alternatives described in the EA that evaluated options for this portion of the road. Because the road reroute continues to traverse the edge of the floodplain, there is a potential that future additional repairs or modifications to the road and/or associated erosion control structures could be needed.

## STEHEKIN RIVER 1948 CHANNEL

Prior to a large logjam being deposited during a significant flood in 1948, the Stehekin River had access to an overflow flood channel near the Stehekin River Resort. The channel permitted overflow from the right bank of the river (toward Silver Bay). At the logjam, where the channel is blocked, the main Stehekin River channel flows past the 1948 channel toward the left bank and then makes a large bend toward its right bank. Armoring along the left bank has been in place for many years. The unarmored portion of the bend is eroding rapidly and is exhibiting bank undercutting. At this location, where the erosion and undercutting is occurring, there is another low-lying channel that would allow the river to jump the left bank and flood the land and homes near it (toward the Stehekin Valley Road) during floods. It was postulated that this flow pattern caused the destruction of the Weaver Point docks (Chelan County 2007).

In this project, the 1948 channel was opened up to allow water from the Stehekin to pass by the area of erosion and undercutting toward the head of Lake Chelan. The purpose of the project was to allow high water to travel in a way that would protect the eroding bank, potentially alleviating flooding nearby, and reducing the force of floodwater exiting into upper Silver Bay (Chelan County 2007).

This project was completed in the fall of 2007 on private land, through applicable permitting from state and federal agencies. In the fall of 2008, the 1948 channel closed again and after additional maintenance, was reopened in the fall of 2009.

### Upper Stehekin Valley Road, Flat Creek to Cottonwood Camp Environmental Assessment (NPS 1997)

The November 1995 flood severely damaged portions of the Stehekin Valley Road between Flat Creek and Cottonwood Camp. During the flood, the Stehekin River changed course and occupied approximately 3,000 feet of the road, making it impassable. Following public review and comment the NPS decided to temporarily close the road and to reevaluate the damaged area every year for possible reconstruction. Since then, the river has continued to occupy the roadbed and the road remained closed at what is referred to as the “Glory” turnaround until the Upper Stehekin Valley Road EA (NPS 2006) closed the road at Car Wash Falls, just above High Bridge.

### Stehekin Ferry Landing Improvement Project Environmental Assessment (FONSI approved 05/07/2010)

The purpose of this proposed action is to improve passenger safety and experience by providing year-round Americans with Disabilities Act (ADA)-compliant universal access at the Stehekin Ferry Landing for all passengers traveling via the commercial ferry system. An important but secondary purpose is to improve passenger circulation and freight handling.

This action is needed because for at least eight months out of the year the current docking facilities at the Stehekin Ferry Landing do not meet guidelines provided by the Architectural Barriers Act Accessibility Standards (ABAAS) or ADA. Once the lake level drops more than two feet below full elevation, the angle of the passenger gangway from the ferry to the shoreline exceeds the ADA-mandated maximum 1:12 slope and can reach angles of 4:12 before ferry docking is shifted to the boat launch. Docking along the boat launch forces passengers to navigate an expanse of uneven terrain. There is no accessible route between primary transportation to or from Stehekin and additional transportation or facilities within Stehekin. The lack of accessibility is a notable problem since approximately 25 percent of commercial ferry passengers are over the age of 60 and/or have limited mobility.

### Future Proposed Environmental Assessments

**Title**: Maintenance and Housing Facilities, including Solid Waste Treatment and Fire Cache Environmental Assessment

**Title**: Reestablish Private Access From the Stehekin Valley or Company Creek Roads

One or more environmental assessments could be needed if catastrophic loss of access to private property occurred as a result of flooding. As noted in the SRCIP, a set of criteria, to be identified, would be used to determine how to reestablish access.

**Title**: “TBD Owner” Land Exchange

One or more environmental assessments would be needed to implement future potential land exchanges between the National Park Service and private landowners in Stehekin.

# APPENDIX 6: SUMMARY OF MITIGATION MEASURES

## MEASURES TO AVOID, MINIMIZE, OR MITIGATE IMPACTS

**Land Use**: Measures included in the proposed project (as appropriate depending on the alternative) to minimize impacts to land use would be:

- Clearly identifying the construction limits, to prevent expansion of construction operations into undisturbed areas.
- Work with Chelan County on zoning and land use planning.
- Minimizing disturbance from reroutes by incorporating toe walls at fill locations where feasible.
- Retaining some sensitive lands previously proposed for exchange.
- Reducing the number of acres within the lower valley offered for exchange.
- Concentrating the maintenance and housing area developments.
- Combining maintenance functions in buildings where possible.
- Restoring the former maintenance and housing areas.
- Limiting circulation space associated with new housing and maintenance areas to functional needs.
- Minimizing clearing of vegetation associated with the road rehabilitation.
- Continuing to acquire private lands in the floodplain and/or channel migration zone as identified by Land Protection Plan priorities.
- Restoring some riparian areas to natural conditions.
- Continuing to use conditions, covenants and deed restrictions (CCRs) on exchanged public lands when private development is proposed.

**Air Quality**: Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to air quality would be:

- Chipping or mulching vegetation on site rather than disposing of it offsite or burning it.
- Spraying water over exposed soil, particularly during dry conditions to minimize fugitive dust on main roadway.
- Covering trucks when transporting materials outside the project area to reduce or eliminate particle release during transport.
- Encouraging contractor employees and National Park Service (NPS) employees to travel in groups to and from the project site (rather than in multiple separate vehicles).
- Revegetating bare and staging areas as soon as possible (upon final grading or when staging area is no longer in use).
- Minimizing the extent of vegetation removal associated with road rehabilitation.
- Encouraging the use of local labor sources and large-volume material delivery to minimize trip generation during construction activity.

- Not locating wood-burning stoves or fireplaces in buildings.
- Using propane and solar devices for heating.
- Using low VOC paints, solvents and other chemicals in building construction.
- Encouraging idling of construction vehicles and equipment for periods of no longer than 15 minutes when not in use.
- Encouraging use of a biodiesel mix fuel rather than traditional diesel fuel.

**Soils**: Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to soils include:

- Locating staging areas where they will minimize new disturbance of area soils and vegetation.
- Minimizing ground disturbance to the extent practicable.
- Minimizing construction along water courses during periods of heavy precipitation.
- Minimizing driving over or compacting root-zones.
- Using mats or plywood to minimize soil compaction impacts in sensitive areas or fine-grained soils.
- Salvaging topsoil and duff from excavated areas for use in re-covering source area or other project areas.
- Windrowing topsoil at a height that will help to preserve soil microorganisms (less than three feet).
- Covering salvaged topsoil with a breathable, water repellent fabric and anchoring perimeter to limit erosion.
- Not leaving excavated soil alongside trees, and providing tree protection if needed for specimen trees.
- Reusing excavated materials where possible in the project area.
- Revegetating project areas through native seeding or planting.
- Importing weed-free clean fill and topsoil.
- Identifying clearing limits to minimize the amount of vegetation loss.
- Clearing and grubbing only those areas where construction would occur.
- Reusing topsoil from the reroute areas, to the extent practicable, to obliterate and revegetate abandoned road sections.
- Preparing and approving a hazardous spill plan before construction begins.
- Encouraging the use of vegetable oil in place of hydraulic fluid in heavy equipment.

**Vegetation**: Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to vegetation include:

- Minimizing construction limits and areas to be cleared, where possible.
- Clearly identifying the construction limits, to prevent expansion of construction operations into undisturbed areas.
- Rehabilitating or restoring road reroute clearing areas not occupied by the roadway.
- Retaining specimen trees where possible adjacent to erosion protection sites and along the reroute/realignment areas (as identified by park staff).
- Salvaging plant material, prior to construction, from areas to be disturbed.
- Replanting salvaged plants on reroute side slopes and obliterated areas to accelerate site recovery and to reduce the opportunity for exotic species to establish (Alternatives 2 and 3).
- Continuing to use CCRs associated with the development of exchanged lands to address clearing of vegetation; location and design of access roads and utilities; density, height, design and color of visible development; and access for management of natural and cultural resources.
- Restoring staging and other temporarily impacted areas following construction.
- Obliterating and revegetating abandoned road segments and areas disturbed by construction with native plant species.
- Using bioengineering techniques such as willow layering to stabilize river banks.
- Minimizing actions that affect endangered, threatened, or sensitive plant species in the project area.
- Keeping fill slopes as steep as possible where fill is proposed to raise the road to minimize the disturbance footprint.
- Minimizing clearing of vegetation associated with reroutes by incorporating toe walls at appropriate locations (Alternatives 2 and 3).

**Noxious Weeds**: Mitigation measures for preventing the spread of noxious weeds include:

- Only importing freshly exposed subsurface materials.
- Avoiding the use of stockpiled materials from the Company Creek Pit unless designated for the project.
- Covering trucks when transporting materials outside the project area to reduce or eliminate particle release during transport.
- Imported topsoil, fill and other construction materials capable of harboring seeds would be weed free, and would include certification if applicable.
- Washing all vehicles having contact with soil or materials that may contain noxious weed seed prior to working in weed free areas or transporting weed free materials.
- Covering stored soil and rock to prevent exposure to noxious weed seed.
- Separating contaminated soil from weed free soil and using it for subsurface fill.

- Conducting annual monitoring for potential weed infestation.
- Identifying and controlling exotic plant species infestations prior to construction (especially associated with the airstrip and old roads).

**Water Resources**: Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to water resources (including hydraulics and streamflow characteristics, water quality, wetlands, and floodplains) include:

- Locating staging and stockpiling areas located away from the Stehekin River.
- Delineating staging areas to prevent incremental expansion of the staging area.
- Covering stockpiled fine-grained soil and rock near surface water and if overwintered with a breathable, water repellent fabric, such as silt fence, anchored around the perimeter.
- Using temporary sediment control devices such as filter fabric fences, sediment traps, or check dams as needed during culvert replacement.
- Identifying the area to be cleared to define extent and clearing only those areas necessary for construction.
- Minimizing the amount of disturbed earth area and the duration of soil exposure to rainfall.
- Using bioengineering to stabilize riverbanks where erosion protection measures are employed.
- Minimizing soil disturbance and re-seeding or revegetating disturbed areas as soon as practical.
- Using topsoil and duff from the reroute areas to rehabilitate (re-create habitat) the obliterated road segments and road shoulders where reroutes occur.
- Scarifying slopes, if necessary, to slow erosion.
- Stabilizing disturbed areas until seeding and/or revegetation takes hold.
- Constructing temporary diversion devices such as swales, trenches, culverts, or drains to divert storm water runoff away from disturbed areas, including exposed slopes.
- Using native duff and topsoil to cover exposed soil as soon as practical.
- Installing protective construction fencing around, adjacent to, or near wetland and/or riparian areas that are to be protected or other erosion control measures to protect water resources in the project area.
- Avoiding machinery use below the wetted perimeter of water bodies (work would be done from the bank) where possible.
- For rock barbs, equipment (excavator) would be used from the bank to place rock below ordinary high water mark to reduce the potential for introducing pollutants, including possible leaks of hydraulic fluid or other substances from heavy equipment.
- Using vegetable based hydraulic fluid in heavy equipment.
- Limiting the duration of the instream work as much as possible.
- Timing instream work to occur at lower flow periods (i.e., work would not occur during heavy river flows).

- Minimizing creation of impervious surface.
- Using a Storm Water Pollution Prevention Plan (SWPPP) for construction activities to control surface run-off, reduce erosion, and prevent sedimentation from entering water bodies during construction.
- Developing and implementing a comprehensive spill prevention/response plan that complies with federal and state regulations and addresses all aspects of spill prevention, notification, emergency spill response strategies for spills occurring on land and water, reporting requirements, monitoring requirements, personnel responsibilities, response equipment type and location, and drills and training requirements. Using an oil and hazardous materials spill prevention, control, and countermeasure plan to address hazardous materials storage, spill prevention, and responses.

**Prevention of Fuel Spills**: The following best management practices to control adverse impacts of fuel spills would also be used:

- Refueling activities would be done at least 100 feet from the river and its tributaries or other surface water.
- Areas where refueling or maintenance of equipment would occur would be identified and have containment devices such as temporary earth berms.
- Absorbent pads would be available to clean up spills.
- Restrictions on the location of fueling sites, requirements for spill containment, and other measures to safeguard aquatic and terrestrial habitat from construction-related contaminants would be identified.

**Wildlife**: Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to wildlife would include:

- Scheduling construction activities with seasonal consideration of wildlife lifecycles to minimize impacts during sensitive periods (e.g., bird nesting and breeding seasons). The timing of the construction of rock barbs and other channel or bank stabilization measures, as well as extraction of large woody debris, could be limited to avoid spawning and other sensitive periods for fish and aquatic wildlife.
- Minimizing the degree of habitat removal (vegetation clearing) by delineating construction limits.
- Limiting the effects of light and noise on wildlife habitat through controls on construction equipment and timing of construction activities, such as limiting construction to daylight hours.
- Requiring all equipment and motor vehicles to have working mufflers and/or sound attenuation devices.
- Use of un-muffled engine brakes or Jake Brakes is prohibited in the park unless required for safety.
- Use of air horns within the park would be limited to emergencies only.
- Maintaining routes of escape for animals that might fall into excavated pits and trenches. If erosion control matting is used, only tightly woven fiber netting or nonbound materials (e.g.,

rice straw) would be used to ensure that small animals would not be trapped. No plastic netted materials would be used.

- Using spill prevention measures to prevent inadvertent spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals that could affect wildlife.
- Discouraging construction personnel at work sites from providing a source of human food to wildlife, avoiding conditioning of wildlife and in human/wildlife conflicts. Title 36, Code of Federal Regulations (CFR), Chapter 1, Section 2.10(d) prohibits anyone from leaving food unattended or stored improperly where it could attract or otherwise be available to wildlife. Title 36, CFR, Chapter 1, Section 2.14(a) prohibits the disposal of refuse in other than refuse receptacles. Title 36, CFR, Chapter 1, Section 2.2(a)(2) prohibits the feeding and molesting of wildlife.
- Maintaining proper food storage, disposing of all food waste and food-related waste promptly, in a bear-resistant receptacle and removing all garbage off-site at the end of each working day.
- Placing rock barbs from outside the wetted channel. Rock would be placed in the channel using heavy equipment from the road or bank above the ordinary high water mark.
- Conducting informal inspections for aquatic species prior to removal of large woody debris from the tops of logjams.
- Obtaining single pieces of large woody debris only from above the high water mark in a manner that would not destabilize the logjam.

**Special Status Species**: The following conservation measures would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts related to northern spotted owls, bull trout, and other wildlife species were taken from the Biological Opinion (BO) produced by the U.S. Fish and Wildlife Service (USFWS 2005) for the Road Improvement Project (NPS 2005):

- Determining whether northern spotted owls or another special status species are nesting, and then whether or not the proposed action will affect the active nest or disrupt reproductive behavior. If it is determined that the action will not affect an active nest or disrupt breeding behavior, work will proceed without any restriction or mitigation measure. If it is determined that construction activities will affect an active nest or disrupt reproductive behavior, then avoidance strategies will be implemented.
- If nesting is occurring, not conducting construction activities within a 0.7 mile radius of the nest site between March 1 (the beginning of the spotted owl nesting season) and September 6, depending on the age of the fledgling spotted owls, as follows: work can begin on or after September 6 or after four weeks have passed since fledging of the spotted owl(s), if any. This determination will be done by the North Cascades National Park Complex wildlife biologist. Without nesting, work can begin after July 1.
- Not locating pullouts within line-of-sight of the area along the road that is immediately adjacent to the current spotted owl nest activity area if one is identified.
- Placing rock barbs from outside the wetted channel. The rock will be placed in the channel using heavy equipment that will be on the road or bank above the ordinary high water line.
- Storing food and garbage in wildlife-resistant containers during the day and removing all garbage off-site from project work areas at the end of each working day.

The following reasonable and prudent measures with respect to northern spotted owls (developed by the USFWS in the Road Improvement Project Biological Opinion) would also be implemented as part of the project by NPS wildlife biologists:

- Monitoring project implementation to ensure compliance with the conservation measures listed above, especially the seasonal timing restrictions and the final placement of the road near the spotted owl nest and reporting the results of this monitoring to the USFWS. A North Cascades Complex biologist would monitor the spotted owl nest to determine if the spotted owls produce young during the year(s) of project implementation. (*Note: The biologist would also determine whether the spotted owl nest is occupied or has moved.*) If young are discovered, then the biologist would estimate the age of the fledgling(s) as part of the timing restrictions described above.
- Reporting progress of the proposed action and its impacts on federally threatened and endangered species, particularly northern spotted owls to the USFWS as specified in the incidental take statement in the BO in accordance with 50 CFR §13.45 and §18.27.
- Reporting any dead or injured federally-listed species found in the action area within 24 hours to a special agent of the USFWS, Division of Law Enforcement at (360) 753-7764, or to the USFWS Western Washington Fish and Wildlife office at (360) 753-9440.
- Notifying USFWS in writing within 3 working days of the accidental death of, or injury to, a northern spotted owl or of the finding of any dead or injured spotted owls during implementation of the proposed federal action. Notification must include the date, time, and location of the incident or discovery of a dead or injured spotted owl, as well as any pertinent information on circumstances surround the incident or discovery. The USFWS contact for this written information is the Manager for the Western Washington Fish and Wildlife office.

**Archeological Resources**: Based on the NPS Programmatic Memorandum of Agreement with the Association of State Historic Preservation Officers and the Advisory Council (NPS 2008), the following measures would be included in the proposed project to minimize impacts to archeological resources:

- Documenting the rock walls along the reroute (Alternative 2) using Historic American Engineering Record (HAER) criteria if these would be affected by proposed road construction.
- Stopping work in the area of identification and nearby areas if archeological resources are discovered at any point during the project work (as directed by the park) until the find is evaluated and action taken to avoid or mitigate the impact.
- When it is necessary to stop work due to archeological resources discovery, the contractor would cease all activities in the area of discovery; allow the archeologist to complete investigations; and take measures to protect the resources discovered as directed by the park. (During this time, work may proceed in unaffected areas.)
- Avoiding further impact by modifying project implementation as needed at the site if archeological resources are discovered during implementation. If this is not possible, as much information as possible would be collected about the site in accordance with applicable laws and regulations and additional consultation with applicable agencies and tribes would occur as specified in the implementing regulations for Section 106 of the NHPA.
- Determining if a monitoring plan is needed pending final construction plans, the cultural material that might be encountered, important archeological questions that could be

addressed, and identifying a range of treatment options (e.g., avoidance, data recovery) for any findings.

- Monitoring ground disturbing actions as appropriate during construction to ascertain presence/absence of archeological materials within the proposed construction zone. Monitoring would be focused where buried historical deposits might be present beneath existing development. The NPS archeologist would identify sites prior to construction. Evaluating the eligibility of the site under National Register of Historic Places criteria if monitoring results in the discovery of archeological materials.
- Following procedures outlined in the Native American Graves Protection and Repatriation Act (NAGPRA) in the unlikely event that human remains or any objects protected under NAGPRA are exposed. This would include the potential need to stop work for a minimum of 30 calendar days. (During that time, work may resume in nonsensitive areas.)

**Cultural Landscapes**: The following measures would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts to cultural landscapes:

- Appropriate measures under archeological resources.
- Ensuring that access to the Buckner Homestead hayfield and pasture would be via existing roads and paths.

**Visitor Experience**: The following measures would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts to visitor and resident access and transportation, interpretation and education, resident and visitor use opportunities, scenic resources, and visitor, resident, and employee safety:

- Allowing construction delays and one-lane closures to be no longer than 20 minutes per passage through the project (longer delays could be approved in advance).
- Avoiding evening, weekend, and holiday work by requiring approval in advance. Longer construction delays or total road closures would also be approved in advance.
- Distributing press releases to local media, locating signs in the recreation area and providing information on the boat to inform visitors about road conditions in the Lower Stehekin Valley during the project.
- Using a public information program to warn of construction related road closures, delays, and road hazards.
- Keeping a McGregor Meadows and Lower Field route open during re-route construction (Alternatives 2 and 3).
- Providing notice to equestrians (e.g., Stehekin Valley Ranch) regarding conditions that could make the road temporarily impassable for horse crossing.
- Managing vehicle traffic and contractor hauling of materials, supplies, and equipment within the construction zone to minimize disruptions in visitor traffic.
- Developing a safety plan prior to the initiation of construction to ensure the safety of recreation area visitors, workers, residents, and park staff.
- Minimizing dust during construction on public roadways (by minimizing soil disturbance, spraying water but no chemicals over disturbed soil areas during dry periods and revegetating disturbed soil areas as soon as practical following construction).

**Wild and Scenic River Values**: The following measures would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts to wild and scenic rivers. Mitigation measures would include those listed in the water resources, vegetation, wildlife, and visitor experience – scenic resources sections.

**Park Operations**: Measures included in the proposed project (as appropriate to the alternative actions) to minimize impacts to park operations would include:

- Providing and maintaining emergency vehicle access through the project area during construction.
- Coordinating work with park liaison to minimize disruption to normal park activities.
- Monitoring construction activities to ensure adherence to mitigation measures.
- Monitoring construction activities to provide recommendations to minimize impacts on park resources.
- Conducting legal boundary surveys prior to scheduling work that may have the potential to affect private property. If necessary, easements would be negotiated.
- Designing new building construction to be silver or greater Leadership in Energy and Environmental Design (LEED) certified.
- Using functional, energy efficient appliances, and heating and cooling systems in new buildings.
- Designing efficient circulation spaces for new maintenance and housing areas.
- Using contractors and term employees to facilitate short-term workload increases.
- Providing emergency vehicle access through the project area during construction. Coordinating work with park staff to reduce disruption to normal activities.
- Informing construction workers about the special sensitivity of park resources and values and regulations.
- Providing an orientation to park resources for the contractor.
- Encouraging park resource specialists to be involved in inspections and monitoring and providing recommendations during the road rehabilitation and facility construction work.

**Socioeconomics**: The following measures would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts to the socioeconomic environment:

- Where possible projects would be combined or phased to allow for cost-savings measures related to staging remaining in place rather than setting up and taking down for sequential implementation actions.
- New buildings would be constructed to silver or greater LEED standards to minimize long-term operations costs.
- New buildings, facilities, and other improvements would use recycled or reused materials to the extent possible.

**Hazardous Materials**: The following best management practices would be included in the proposed project (as appropriate to the alternative actions) to minimize impacts from hazardous materials:

- Conducting formal surveys of the existing maintenance area, including contacts with staff to determine if any unanticipated spill or disposal areas are present before removal of buildings or structures and associated development.
- Wearing proper personal protective equipment for the nature of the hazardous materials identified in the surveys during all work in the affected area.
- Refueling vehicles and equipment at least 100 feet from the river and its tributaries or other bodies of water.
- Identifying areas where refueling or maintenance of equipment would occur and providing containment devices, such as temporary earth berms surrounding these areas.
- Ensuring that spill clean-up materials, such as absorbent pads, are present onsite where needed.
- Identifying the locations of fueling sites, requirements for spill containment, and other measures to safeguard aquatic and terrestrial habitat from construction-related contaminants.
- Locating fuel storage tank outside of the floodplain / channel migration zone floodplains and other sensitive areas.

# APPENDIX 7: ARMY CORPS OF ENGINEERS (ACOE) ADVANCED FLOOD PROTECTION MEASURES

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO ATTENTION OF

Planning Branch

Residents of Stehekin
Chelan County

Dear Residents:

As you may know we completed our Advanced Measures investigation and report in late August. Due to the high complexity and degree of uncertainty of the riverine system we determined the best course of action for the short term would be flood protection on individual landowner properties. In order to assist you in the planning or construction of these different flood protection measures, we have prepared the enclosed packet of information.

The enclosed packet contains generic drawings of several measures that can be implemented in suitable locations on individual properties. Each drawing or technique is supported by a fact sheet that explains the uses, risks, benefits, constructability, materials, etc. in constructing such a measure. The drawings are non-site specific and may be modified according to the individual characteristics of the property. Please be reminded that all flood protection measures are temporary and provide a limited level of protection.

To assist you in designing applicable measures on your property, a team of technical experts will be visiting the community the week of September 27. They will meet with individual and interested landowners at their property. Some materials will be provided to assist in the construction of these measures – more details will be provided at the public meeting. If you are interested and available, I recommend you take advantage of this opportunity.

On behalf of the Seattle District Army Corps of Engineers Advanced Measures Team, it has been a pleasure meeting with you and working towards a flood management solution. Your input and suggestions have been appreciated.

We hope you will find the contents of this package helpful in addition to the technical advice and assistance we can offer. If you have any questions please contact me (206) 764-5522, or alicia.m.austinjohnson@usace.army.mil.

Sincerely,

Alicia M. Austin Johnson

Alicia M. Austin Johnson, Program Manager

Encl.

# Flow Deflector Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

- **Uses**: A Flow Deflector is a barrier that is intended to divert, but not stop, flow toward a structure. A typical situation where a flow deflector would be beneficial would be on a minimal to moderate slope that gets flow of a few inches or more of water and debris directed toward a home or structure.

- **Location and Form in Relation to Home or Property:** Flow deflectors should be placed a minimum of 20 feet from a structure. One or more flow deflectors can be used, depending on the situation.

  They should be placed at an angle that will divert water away from a structure. If more than one is necessary, then they should be angled and staggered apart.

  Another configuration is a classic "V". Where the point of the "V" is aimed upstream to catch and deflect flow and debris away from the home, the flow deflector should be at least 20 feet from the property the "V" should be further.

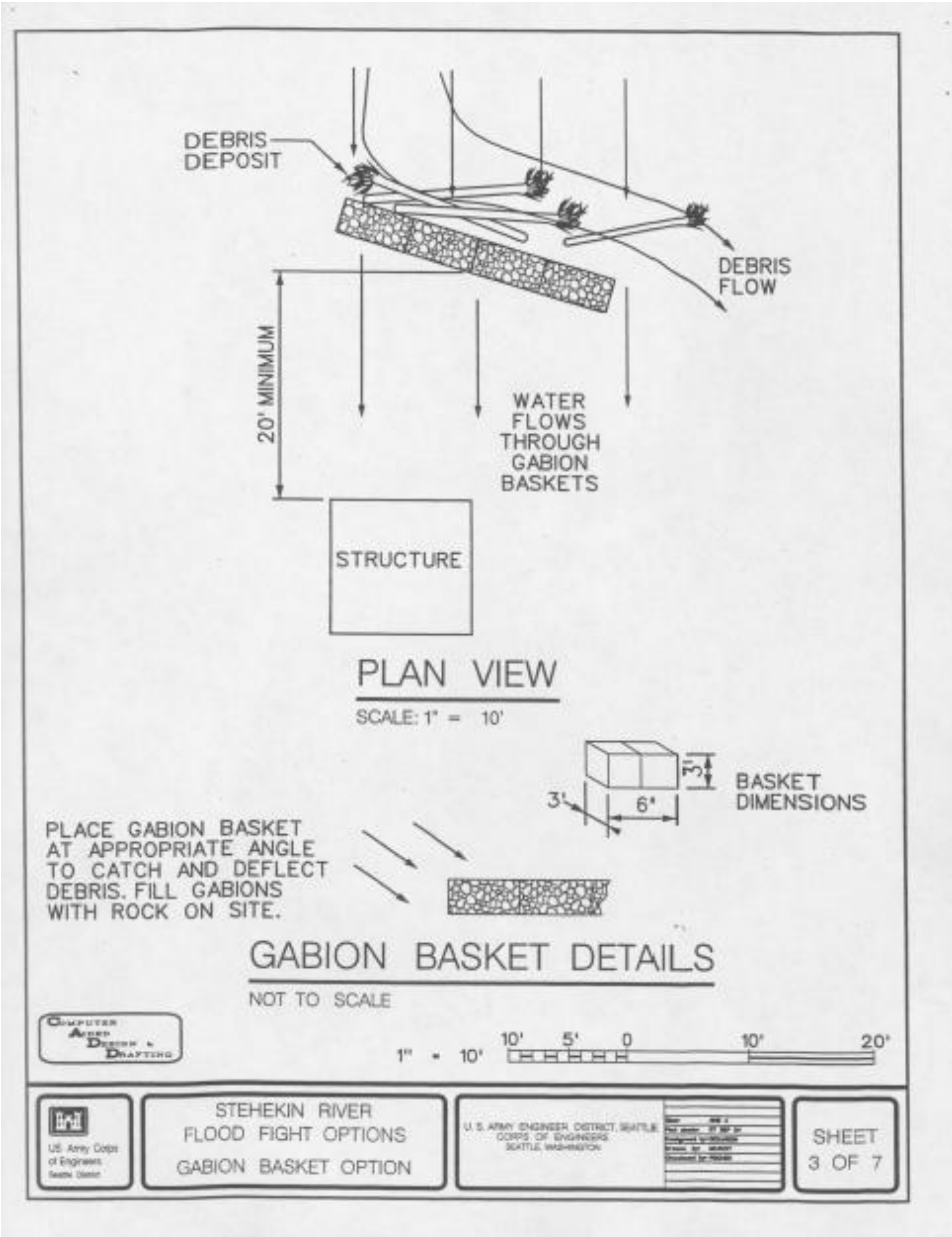
- **Typical Materials used to Construct:** A flow deflector could be constructed of one or more gabion baskets filled with various sizes of rock that lock together well. This will slow the amount of water that flows through the structure, and divert it away. A combination of gabion baskets and logs would also work. The baskets are made of steel mesh. They are 3 feet wide X 3 feet tall X 6 feet long. They can be wired together to make any desired length

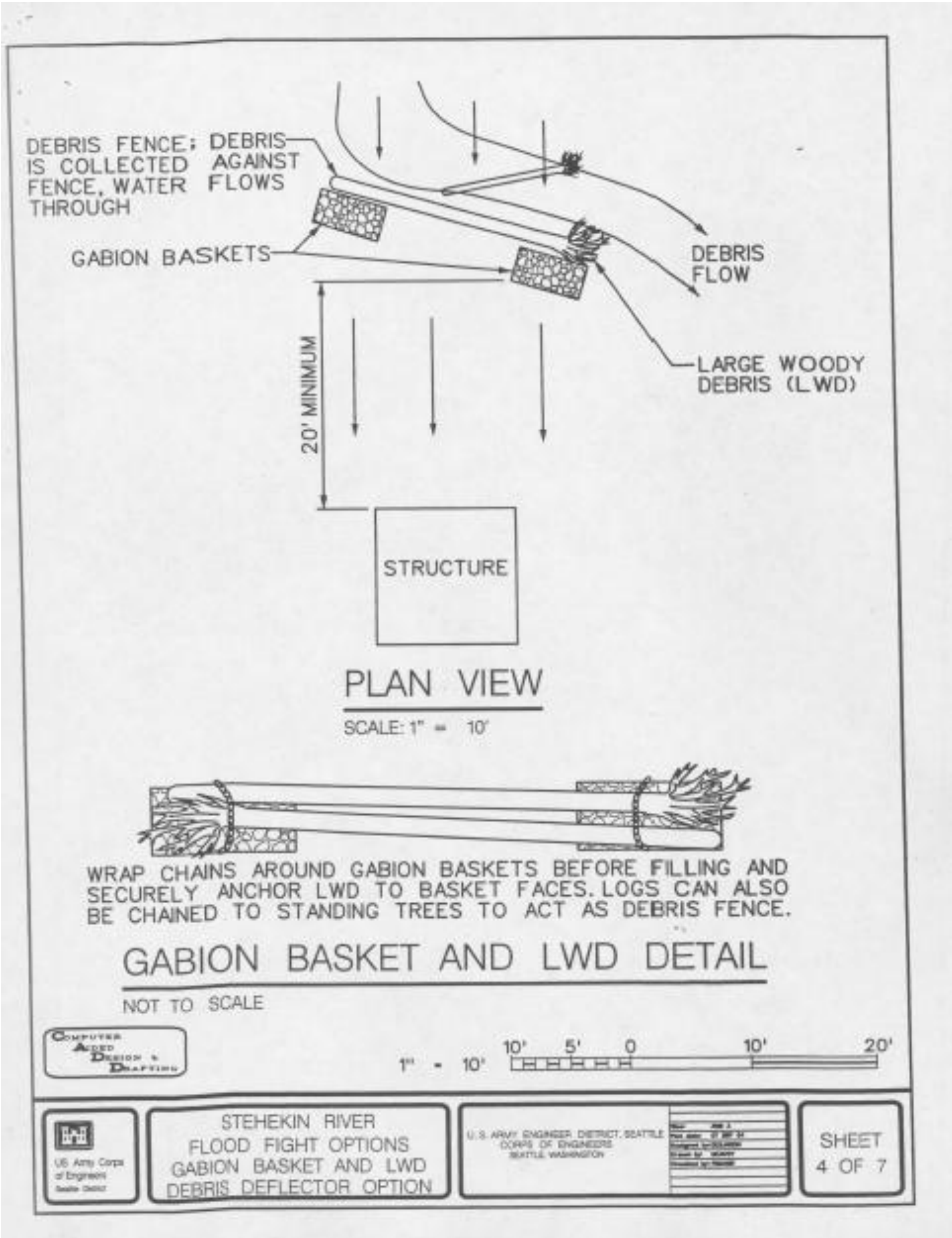
- **Construction Methods:** If using logs and gabion baskets, place chain underneath the basket before filling with rock. Choose a length of chain long enough to run under the basket and anchor the logs to the baskets. The logs should be placed on the outside face, the direction the flow will come from. The logs should fit well enough to the ground surface so the flow will be diverted when it hits the logs.

  The logs could also be chained to standing trees of sufficient girth to withstand uprooting. The log should be as long or longer than the distance between the trees. Place the log on the side of the trees the flow will be coming from, and make sure that the logs fit well to the ground surface.

- **Typical Lifespan:** Gabion basket structure should last for years, log structures can be expected to rot after a few years.

- **Risks**: There is the risk with the gabion basket deflectors, gabion basket/log deflectors, and the log/tree deflectors that they could possibly fail and cause material and water to flow toward a structure.


DEBRIS DEPOSIT
DEBRIS FLOW
20' MINIMUM
WATER FLOWS THROUGH GABION BASKETS
STRUCTURE
PLAN VIEW
SCALE: 1" = 10'
3'
3'
6'
BASKET DIMENSIONS
PLACE GABION BASKET AT APPROPRIATE ANGLE TO CATCH AND DEFLECT DEBRIS. FILL GABIONS WITH ROCK ON SITE.
GABION BASKET DETAILS
NOT TO SCALE
1" = 10'
10' 5' 0 10' 20'
US Army Corps of Engineers
STEHEKIN RIVER
FLOOD FIGHT OPTIONS
GABION BASKET OPTION
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
SHEET 3 OF 7


DEBRIS FENCE; DEBRIS IS COLLECTED AGAINST FENCE, WATER FLOWS THROUGH
GABION BASKETS
DEBRIS FLOW
LARGE WOODY DEBRIS (LWD)
20' MINIMUM
STRUCTURE
PLAN VIEW
SCALE: 1" = 10'
WRAP CHAINS AROUND GABION BASKETS BEFORE FILLING AND SECURELY ANCHOR LWD TO BASKET FACES. LOGS CAN ALSO BE CHAINED TO STANDING TREES TO ACT AS DEBRIS FENCE.
GABION BASKET AND LWD DETAIL
NOT TO SCALE
COMPUTER AIDED DESIGN & DRAFTING
1" - 10'
10' 5' 0 10' 20'
US Army Corps of Engineers
STEHEKIN RIVER
FLOOD FIGHT OPTIONS
GABION BASKET AND LWD
DEBRIS DEFLECTOR OPTION
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
SHEET
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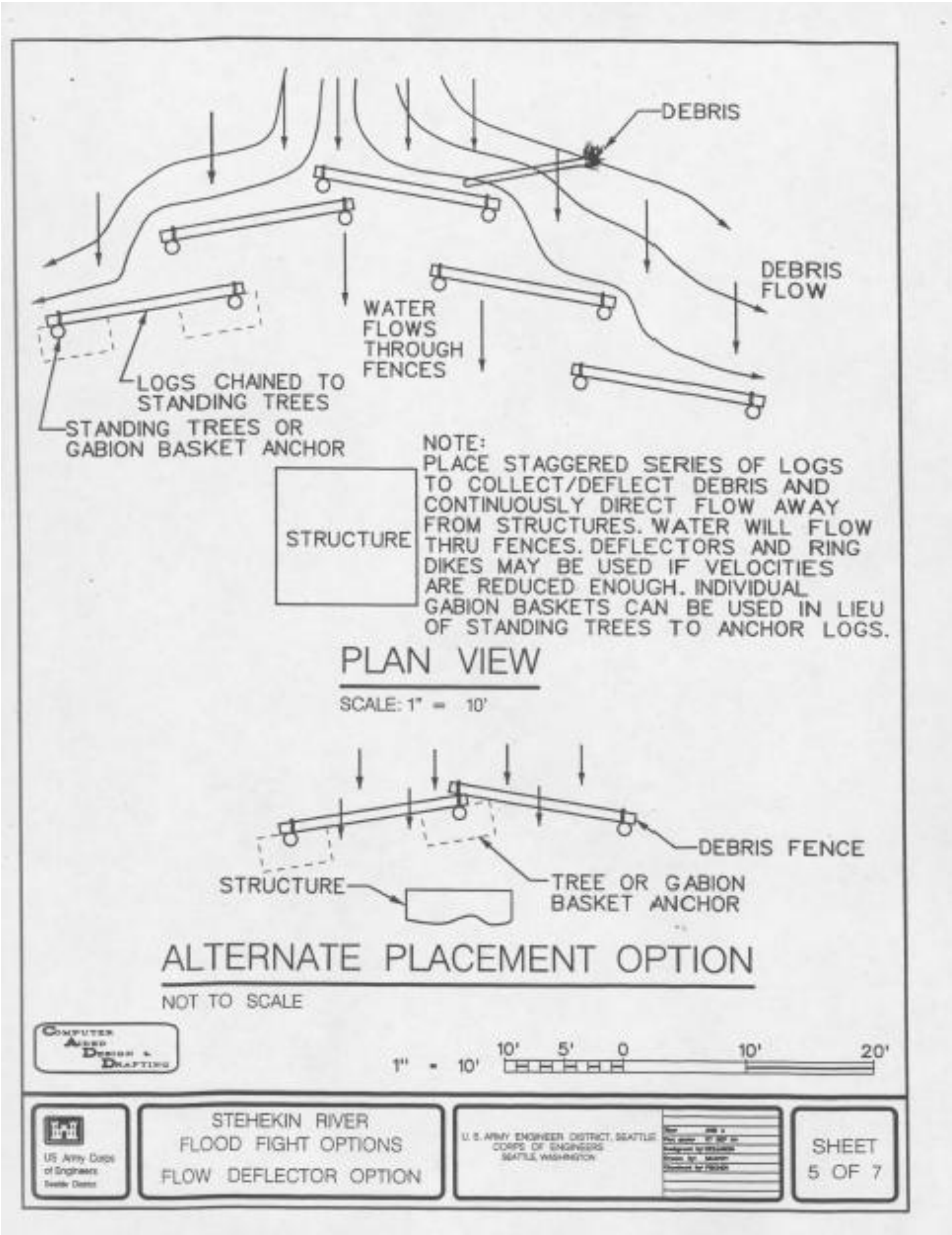
DEBRIS
DEBRIS FLOW
WATER FLOWS THROUGH FENCES
LOGS CHAINED TO STANDING TREES
STANDING TREES OR GABION BASKET ANCHOR
STRUCTURE
NOTE:
PLACE STAGGERED SERIES OF LOGS TO COLLECT/DEFLECT DEBRIS AND CONTINUOUSLY DIRECT FLOW AWAY FROM STRUCTURES. WATER WILL FLOW THRU FENCES. DEFLECTORS AND RING DIKES MAY BE USED IF VELOCITIES ARE REDUCED ENOUGH. INDIVIDUAL GABION BASKETS CAN BE USED IN LIEU OF STANDING TREES TO ANCHOR LOGS.
PLAN VIEW
SCALE: 1" = 10'
DEBRIS FENCE
STRUCTURE
TREE OR GABION BASKET ANCHOR
ALTERNATE PLACEMENT OPTION
NOT TO SCALE
COMPUTER AIDED DESIGN & DRAFTING
1" = 10'
10' 5' 0 10' 20'
US Army Corps of Engineers Seattle District
STEHEKIN RIVER
FLOOD FIGHT OPTIONS
FLOW DEFLECTOR OPTION
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
SHEET
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## Ring Dike Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

- **Description of Feature:** A ring dike is an arc or circular structure made of sandbags.
- **Uses: To keep flood waters out of structures.**
- **Location and Form in relation to Home or Property**: The ring dike should be constructed approximately 8 feet away from the structure to be protected if pumping is planned. The ring dike should be constructed in a circular shape.

  If pumping isn't planned, then sandbags can be placed against or near the structure to be protected. If there is high ground to tie into on each side, then an arc shaped structure can be used.
- **Typical Materials used to Construct**: Typically, ring dikes are made of sandbags; treated burlap bags 14 inches by 24 inches and filled with sand ½ to 2/3 full (approximately 40 lbs.).
- **Construction Methods:** This is the preferred construction method for a ring dike and will withstand up to a one-foot rise in water. If pumping out the ring dike, the ring dike should be constructed about 8' from the structure to be protected. Fill in the low spots with sandbags before starting to build the ring dike. The sandbags should be placed in a pyramid structure with three bags across the base, 2 bags on the second layer and one bag on top. The seams of the sandbags should be staggered so they aren't placed over the layer above, below or beside each other.
- **Typical Lifespan:** A ring dike will typically last a few months until the sandbags begin to decompose.
- **Risks:** There is a possibility that the ring dike will overtop if not built high enough. It is a great deal of work to raise the dike any significant height. For instance, to protect against 2 feet of water, 2,100 sandbags would be required for a 100 foot long ring dike where only 600 bags would be required for a one foot height.

**Note: Ring dikes will leak, and if the intention is to keep the area dry, pumping will be necessary. Plan ahead and place the pump in a low spot. Pump downstream away from other structures. Ring dikes should be used only in areas where there is standing water. They are not appropriate to use with moving water. Use this sandbag method where water won't rise above one foot.*

## Debris Fence Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

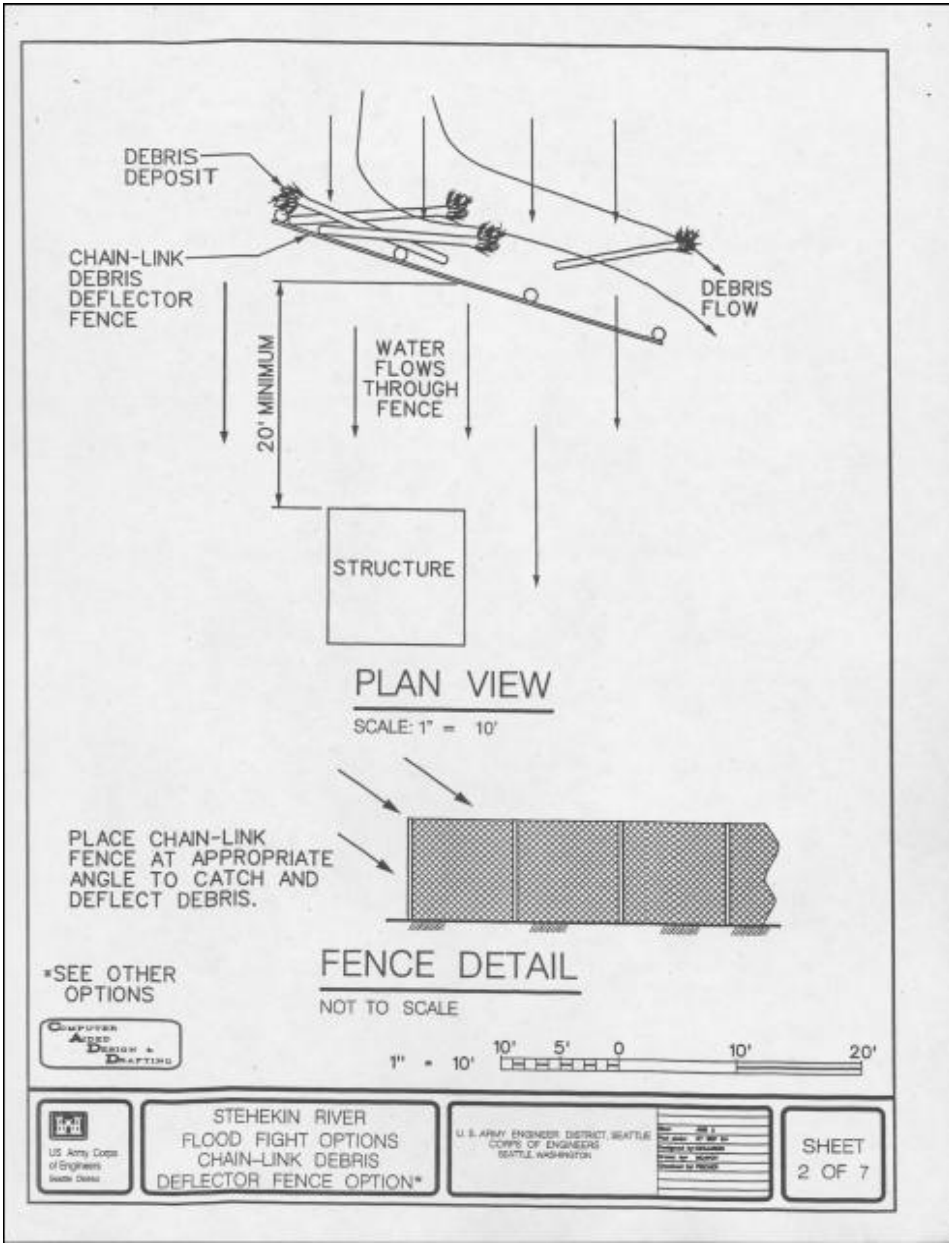
- **Physical Description of Feature:** Chain link fence, continuous row of gabion baskets, logs chained or cabled to standing trees or spaced gabion baskets.
- **USES:** A Debris Fence prevents debris flow toward a structure.
- **Location and Form in Relation to Home or Property:** The fence should be placed a minimum of 20 feet from structure at an angle to deflect debris away from the structure and toward a swale or channel. A debris fence should be placed where debris is expected to be carried by floodwaters.
- **Typical Materials Used to Construct:** materials include chain link fence, gabion baskets, a combination of gabion baskets and logs, or possibly logs anchored to large standing live trees.
- **Construction Methods:** A gabion basket is a steel mesh basket used to hold rock. The rock used should be material found on site. Downed logs with diameters of 12" to 24" can be chained between gabion baskets or standing timber to restrain the debris.

  Assemble baskets and place on a relatively flat surface, fill with rock from site. If anchoring logs to baskets, place chain underneath the basket before filling. Choose a length of chain long enough to run under the basket and anchor the logs to the baskets. The logs should be placed on the outside face, the direction the debris flow will come from.

  If using logs chained to standing trees of sufficient girth to withstand uprooting, place the logs on the outside face and anchor between trees.

  Install chain link fence at an angle to deflect debris.
- **Typical Lifespan:** The chain link fence and gabion baskets should last for years, with regular maintenance to clear trapped debris and sediment, unless destroyed by large debris volume.
- **Risks:** There is a possibility of catastrophic failure if a large debris flow takes out the debris fence. The resulting flow could destroy the structure it was intended to protect.
- **Applicability to Stehekin River Site Locations:** The debris fences can be used at McGreagor Meadows.

**Note: debris fences will deflect debris, but not necessarily slow the flow of water unless constructed as a flow and debris deflector.*


DEBRIS DEPOSIT
CHAIN-LINK DEBRIS DEFLECTOR FENCE
DEBRIS FLOW
20' MINIMUM
WATER FLOWS THROUGH FENCE
STRUCTURE
PLAN VIEW
SCALE: 1" = 10'
PLACE CHAIN-LINK FENCE AT APPROPRIATE ANGLE TO CATCH AND DEFLECT DEBRIS.
FENCE DETAIL
NOT TO SCALE
*SEE OTHER OPTIONS
COMPUTER AIDED DESIGN & DRAFTING
1" = 10'
10' 5' 0 10' 20'
US Army Corps of Engineers
STEHEKIN RIVER
FLOOD FIGHT OPTIONS
CHAIN-LINK DEBRIS
DEFLECTOR FENCE OPTION*
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
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# Grade Control Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

- **Uses:** Grade control will help slow the progression of head cutting in an area where there is water flowing down a slope. The control will consist of digging a trench and filling it with riprap. These would be used if a home or structure were threatened by erosion.

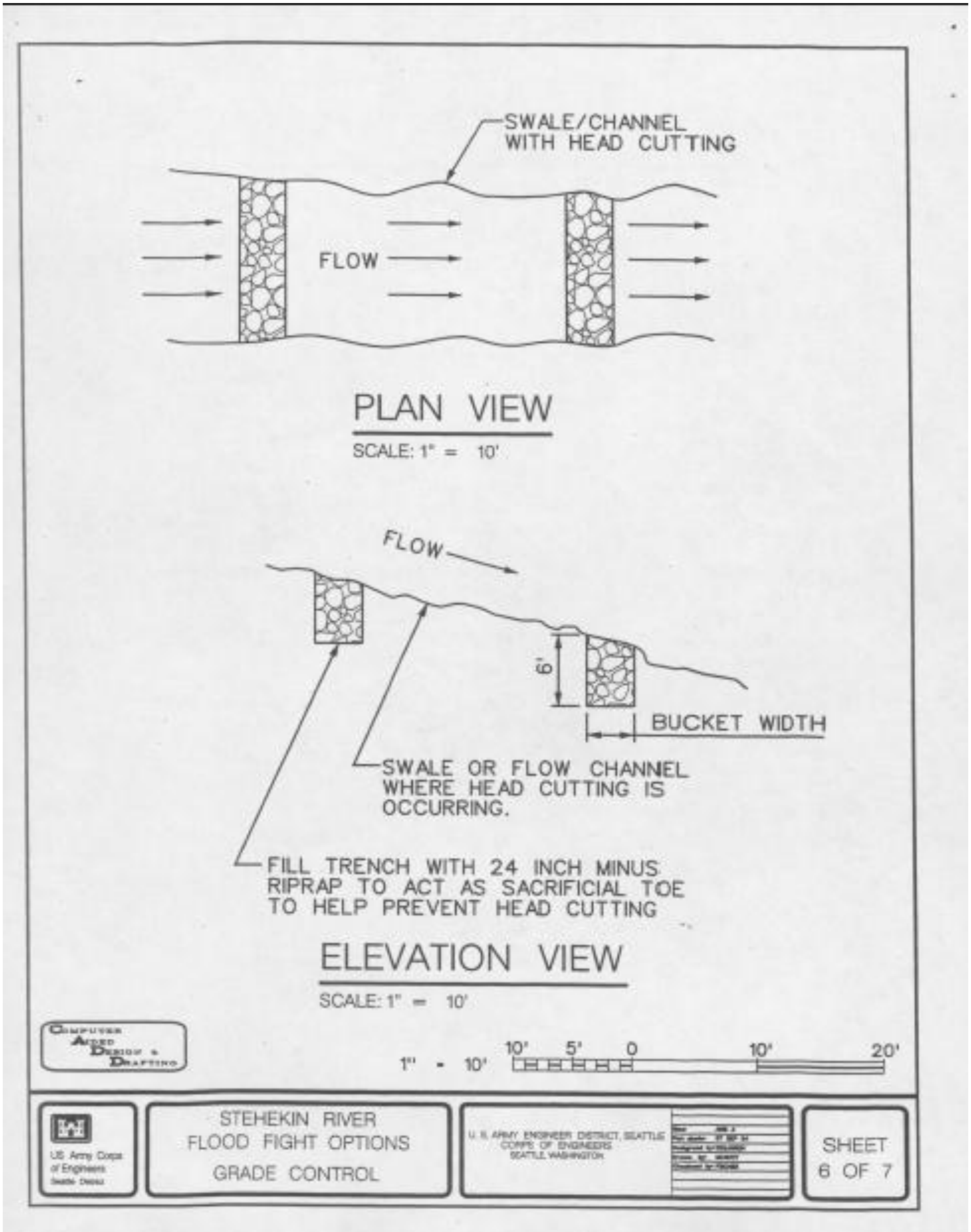
- **Location and Form in Relation to Home or Property:** This form of prevention will be used where erosion occurs and creates flow that resembles a creek and causes erosion that keeps cutting back and eroding deeper taking more soil.

- **Typical Materials used to Construct/ Construction Methods:** Typically an excavator or backhoe can be used to dig a trench approximately 6 feet deep, a bucket wide, and as long as necessary. The trench is then filled with riprap to act as a hardened structure. As the material in front of the rock erodes away, the riprap will fall to that elevation and slow the progression of head cutting.

  The number of trenches necessary will depend on the amount of flow and the angle of the slope.

- **Typical Life Span**: These trenches could possibly last a few years before having to be supplemented or replaced.

- **Risks:** There is always a possibility that there will be a great deal of concentrated flow that will erode away the slope. There is also a possibility that flow will divert around the hardened structure and make a new channel.


SWALE/CHANNEL
WITH HEAD CUTTING
FLOW
PLAN VIEW
SCALE: 1" = 10'
FLOW
6'
BUCKET WIDTH
SWALE OR FLOW CHANNEL
WHERE HEAD CUTTING IS
OCCURRING.
FILL TRENCH WITH 24 INCH MINUS
RIPRAP TO ACT AS SACRIFICIAL TOE
TO HELP PREVENT HEAD CUTTING
ELEVATION VIEW
SCALE: 1" = 10'
COMPUTER AIDED DESIGN & DRAFTING
1" - 10'
10' 5' 0 10' 20'
US Army Corps of Engineers
Seattle District
STEHEKIN RIVER
FLOOD FIGHT OPTIONS
GRADE CONTROL
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
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# Scour Protection Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is any threat of imminent failure.

- **Physical Description of Feature:** A long narrow mound of rock and soil called a berm.

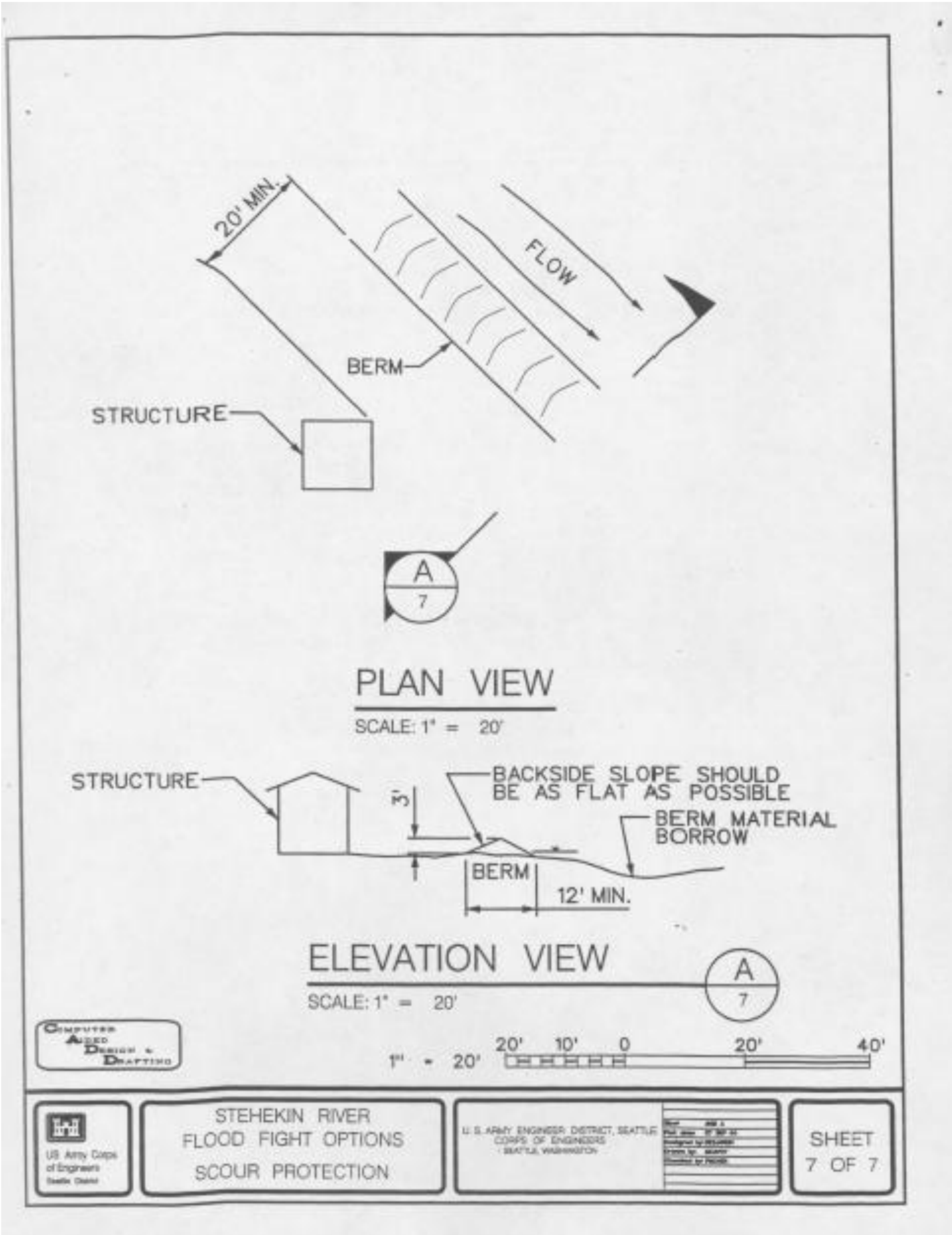
- **Location and Form in relation to Home or Property:** The berm would generally be placed parallel to the direction of downstream flow. A berm could also be used as an overflow channel. This would keep the water flowing downstream away from the home or structures to be protected.

- **Uses:** Berms would be appropriate in areas where water rises and flows across the property toward structures, and where there isn't a great deal of debris expected.

- **Construction Methods:** A berm used for scour protection would be constructed using a bulldozer to push up native material into a mound or narrow strip a minimum of 12 feet wide (footprint) at the base, 3 feet high and the length necessary to prevent water flow from damaging the property. Typically, the bulldozer would push material up from the outside of the berm, or the side that would be facing the water. The transition between the slope and the bottom would be gentle, and the side slopes of the berm would not be steep, this should help prevent scour.

- **Typical Lifespan:** A berm constructed of native material consisting of a mix of rock and soil with vegetation such as grass on the slopes and top should last indefinitely. It would be considered a permanent feature.

  A berm made of a single type of material may not hold up well. One made of a mixture of rock, soil and sand should hold up against scour quite well. If the berm overtops, it is important the backslope (the side nearest the home or structure) is not steeper than 3 horizontal (H) to 1 vertical (V). A slope of 5 to 1 would be ideal; otherwise water coming over the top will erode away the berm and the ground between the house and berm. These flatter slopes will require a much larger berm footprint. If it fails, it could channel water to flow directly at the home or structure.


20' MIN.
FLOW
BERM
STRUCTURE
A
7
PLAN VIEW
SCALE: 1" = 20'
STRUCTURE
3'
BACKSIDE SLOPE SHOULD BE AS FLAT AS POSSIBLE
BERM MATERIAL BORROW
BERM
12' MIN.
ELEVATION VIEW
SCALE: 1" = 20'
A
7
COMPUTER AIDED DESIGN & DRAFTING
1" = 20'
20' 10' 0 20' 40'
US Army Corps of Engineers Seattle District
STEHEKIN RIVER
FLOOD FIGHT OPTIONS
SCOUR PROTECTION
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
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# APPENDIX 8: VASCULAR PLANTS OBSERVED WITHIN PROPOSED PROJECT AREAS

## KEY

Abundance codes represent relative abundance of individual plant species within the area.

- R-Rare is a few plants less than five individuals for the area surveyed.
- U-Uncommon is a species which is greater than five plants but is only occasionally observed.
- C-Common, species are found throughout the area surveyed.
- A-Abundant, species that are found throughout the area surveyed and are a dominate species.

## PROPOSED LAND EXCHANGE PARCELS

| Stehekin Valley Ranch Area | Abundance |
|---|---|
| *Acer macrophyllum* | A |
| *Achillea millefolium* | C |
| *Adenocaulon bicolor* | U |
| *Agoseris sp.* | U |
| *Agrostis stolonifera* | C |
| *Alnus rubra* | C |
| *Amelanchier alnifolia* | U |
| *Anaphalis margaritacea* | U |
| *Angelica sp.* | U |
| *Apocynum androsaemifolium* | U |
| *Arctostaphylos uva-ursi* | U |
| *Artemesia sp.* | U |
| *Aster engelmannii* | C |
| *Aster sp.* | U |
| *Bromus inermus* | C |
| *Calamagrostis rubescens* | U |
| *Carex mertensii* | U |
| *Castilleja miniata* | U |
| *Centaurea sp.* | U |
| *Chamerion angustifolium* | U |
| *Chimaphila umbellata* | U |
| *Cirsium edule* | U |
| *Collomia heterophylla* | U |
| *Cornus sericea* | C |
| *Dactylus glomerata* | A |
| *Disporum hookeri* | U |
| *Elymus glaucus* | U |
| *Equisitem arvense* | U |
| *Erigeron foliosus* | U |
| *Festuca sp.* | U |
| *Galium triflorum* | U |
| *Goodyera oblongifolia* | U |
| *Hieracium albiflorum* | U |
| *Hieracium gracile* | U |
| *Lomatium brandegii* | U |
| *Lonicera ciliosa* | U |
| *Lonicera involucrata* | U |

| | |
|---|---|
| *Lunia nardosmia* | U |
| *Lupinus latifolia* | C |
| *Madia sp.* | U |
| *Madia exugia* | U |
| *Mahonia nervosa* | U |
| *Microseris sp.* | U |
| *Moehringia macrophylla* | C |
| *Mycalis muralis* | C |
| *Osmorhiza chilense* | C |
| *Paxistima myrsinites* | U |
| *Penstemon serrulatus* | U |
| *Phacelia hastata* | U |
| *Philadelphus lewisii* | C |
| *Pinus ponderosa* | C |
| *Plantago lanceolata* | C |
| *Platanthera sp.* | U |
| *Poa bulbosa* | A |
| *Poa pratensis* | A |
| *Populus balsamifera* | C |
| *Prunella vugalare* | U |
| *Pseudotsuga menziesii* | A |
| *Pseudoregneria spicatum* | A |
| *Pteridium aquilinum* | C |
| *Ribes sanguineum* | U |
| *Rosa gymnocarpa* | U |
| *Rumex acetosa* | C |
| *Sambucus racemosa* | C |
| *Sanicula crassicaulis* | U |
| *Sanicula bipinnata* | U |
| *Smilacina racemosa* | U |
| *Solidago sp.* | U |
| *Spirea betula* | U |
| *Stipa lemmonii* | U |
| *Symphoricarpos albus* | C |
| *Taraxacum officinale* | C |
| *Taxux brevifolia* | U |
| *Tragopogon sp.* | U |
| *Trifolium pratense* | C |
| *Trifolium repens* | C |
| *Vaccinium membranaceum* | U |
| *Verbascum thapsus* | U |
| *Viola sp.* | U |

| **McGregor Meadows** | **Abundance** |
|---|---|
| *Acer douglasii* | C |
| *Acer macrophyllum* | C |
| *Adenocaulon bicolor* | U |
| *Agoseris sp.* | U |
| *Amelanchier alnifolia* | C |
| *Apocynum androsaemifolium* | C |
| *Arnica cordifolia* | C |
| *Asarum caudatum* | U |
| *Aster engelmannii* | C |
| *Athyrium filix-femina* | U |
| *Balsamorhiza sagittata* | U |

| | |
|---|---|
| *Calamagrostis rubescens* | C |
| *Carex rossii* | U |
| *Collinsia sparsiflora* | U |
| *Cornus nuttallii* | A |
| *Delphinium nuttallianum* | U |
| *Disporum hookeri* | U |
| *Elymus glaucus* | C |
| *Festuca idahoensis* | A |
| *Galium triflorum* | U |
| *Goodyera oblongifolia* | U |
| *Hieracium albiflorum* | U |
| *Lupinus latifolia* | U |
| *Mahonia nervosa* | C |
| *Moehringia macrophylla* | C |
| *Mycelis muralis* | A |
| *Orthilia secunda* | U |
| *Osmorhiza chilense* | U |
| *Paxistima myrsinites* | U |
| *Penstemon serrulatus* | U |
| *Philadelphus lewisii* | C |
| *Pinus ponderosa* | C |
| *Polystichum munitum* | U |
| *Pseudotsuga menziesii* | A |
| *Pteridium aquilinum* | C |
| *Rosa gymnocarpa* | U |
| *Rubus ursinus* | U |
| *Sanicula bipinnatifida* | U |
| *Silene seelyi* | U |
| *Spirea betula* | C |
| *Symphoricarpos albus* | C |

| **North Parcel - 3 parcels** |
|---|
| *Acer macrophyllum* |
| *Achillea millefolium* |
| *Amelanchier alnifolia* |
| *Apocynum androsaemifolium* |
| *Apodosis densa* |
| *Athyrium filix-femina* |
| *Bromus tectorum* |
| *Carex rossii* |
| *Chamerion angustifolium* |
| *Collomia sp.* |
| *Cornus nuttallii* |
| *Cryptogramma crispa* |
| *Dactylus glomerata* |
| *Elymus glaucus* |
| *Hieracium sp.* |
| *Holodiscus discolor* |
| *Juncus sp.* |
| *Lomatium brandegii* |
| *Mahonia nervosa* |
| *Moehringia macrophylla* |
| *Paxistima myrsinites* |
| *Pinus ponderosa* |
| *Plantago lanceolata* |

| | |
|---|---|
| *Poa bulbosa* | *Sambucus racemosa* |
| *Poa pratensis* | ***SANCRA*** |
| *Pseudoregneria spicatum* | *Tragopogon dubius* |
| *Pseudotsuga menziesii* | *Taraxacum officinale* |
| *Rubus ursinus* | *Vaccinium membranaceum* |

| McGregor Meadows | Abundance |
|---|---|
| *Acer douglasii* | C |
| *Acer macrophyllum* | C |
| *Adenocaulon bicolor* | U |
| *Agoseris sp.* | U |
| *Amelanchier alnifolia* | C |
| *Apocynum androsaemifolium* | C |
| *Arnica cordifolia* | C |
| *Asarum caudatum* | U |
| *Aster engelmannii* | C |
| *Athyrium filix-femina* | U |
| *Balsamorhiza sagittata* | U |
| *Calamagrostis rubescens* | C |
| *Carex rossii* | U |
| *Collinsia sparsiflora* | U |
| *Cornus nuttallii* | A |
| *Delphinium nuttallianum* | U |
| *Disporum hookeri* | U |
| *Elymus glaucus* | C |
| *Festuca idahoensis* | A |
| *Galium triflorum* | U |
| *Goodyera oblongifolia* | U |
| *Hieracium albiflorum* | U |
| *Lupinus latifolia* | U |
| *Mahonia nervosa* | C |
| *Moehringia macrophylla* | C |
| *Mycelis muralis* | A |
| *Orthilia secunda* | U |
| *Osmorhiza chilense* | U |
| *Paxistima myrsinites* | U |
| *Penstemon serrulatus* | U |
| *Philadelphus lewisii* | C |
| *Pinus ponderosa* | C |
| *Polystichum munitum* | U |
| *Pseudotsuga menziesii* | A |
| *Pteridium aquilinum* | C |
| *Rosa gymnocarpa* | U |
| *Rubus ursinus* | U |
| *Sanicula bipinnatifida* | U |
| *Silene seelyi* | U |
| *Spirea betula* | C |
| *Symphoricarpos albus* | C |

| Skinny Wilson's | Abundance |
|---|---|
| *Acer circinatum* | C |
| *Acer macrophyllum* | C |
| *Adenocaulon bicolor* | U |
| *Agrostis capillaris* | C |
| *Amelanchier alnifolia* | U |
| *Apocynum androsaemifolium* | U |
| *Iris sp.* | C |
| *Calamagrostis rubescens* | C |
| *Chimaphila umbellata* | U |
| *Convallaria sp.* | C |
| *Cornus nuttallii* | U |
| *Cytisus scoparius* | C |
| *Dactylus glomerata* | A |
| *Dianthus barbatus* | C |
| *Disporum hookeri* | U |
| *Elymus glaucus* | C |
| *Galium triflorum* | U |
| *Hieracium albiflorum* | U |
| *Lathyrus latifolius* | C |
| *Linaria sp.* | U |
| *Lonicera ciliosa* | U |
| *Lupinus latifolia* | U |
| *Mahonia nervosa* | C |
| *Osmorhiza chilense* | U |
| *Paxistima myrsinites* | U |
| *Phleum pratense* | C |
| *Prunus emarginata* | C |
| *Pseudotsuga menziesii* | A |
| *Pteridium aquilinum* | C |
| *Rosa gymnocarpa* | U |
| *Rubus parviflorus* | U |
| *Rubus ursinus* | U |
| *Sambucus racemosa* | C |
| *Smilacina racemosa* | U |
| *Spirea betula* | C |
| *Taraxacum officinale* | C |
| *Thuja plicata* | C |
| *Trifolium pratense* | C |
| *Trifolium repens* | C |
| *Vinca major* | A |
| *Viola sp.* | U |

| Getty/Griffin/Dineen Properties | Abundance |
|---|---|
| *Acer macrophyllum* | C |
| *Achillea millefolium* | C |
| *Agropyron repens* | C |
| *Amelanchier alnifolia* | U |
| *Arctostaphylos nevadensis* | U |
| *Aspidotis densa* | R |
| *Aster engelmannii* | C |
| *Bromus hordeaceus* | U |
| *Bromus tectorum* | C |
| *Calamagrostis rubescens* | U |
| *Carex rossii* | R |

| | |
|---|---|
| *Centaurea sp.* | U |
| *Collinsia sparsiflora* | R |
| *Collomia grandiflora* | R |
| *Collomia linearis* | R |
| *Dactylus glomerata* | C |
| *Elymus glaucus* | C |
| *Equisetum sp.* | R |
| *Festuca idahoensis* | U |
| *Hieracium albiflorum* | U |
| *Hieracium scouleri* | U |
| *Holodiscus discolor* | U |
| *Koeleria cristata* | U |
| *Lathyrus latifolius* | U |
| *Syringa vulgaris* | U |
| *Lomatium brandegii* | U |
| *Moehringia macrophylla* | C |
| *Mahonia nervosa* | U |
| *Melilotus alba* | U |
| *Meticago sativa* | U |
| *Montia parviflora* | U |
| *Osmorhiza chilense* | U |
| *Paxistima myrsinites* | U |
| *Penstemon serrulatus* | U |
| *Pinus ponderosa* | C |
| *Poa bulbosa* | C |
| *Prunus emarginata* | U |
| *Pseudotsuga menziesii* | C |
| *Pteridium aquilinum* | U |
| *Rubus discolor* | U |
| *Rubus luecodermis* | U |
| *Rumex acetosa* | C |
| *Sambucus racemosa* | U |
| *Symphorocarpus alba* | U |
| *Trifolium repens* | C |
| *Vinca major* | C |
| *Vulpia sp.* | U |

| Riverside Park | Abundance |
|---|---|
| *Acer circinatum* | A |
| *Adenocaulon bicolor* | U |
| *Artemesia sp.* | U |
| *Asarum caudatum* | U |
| *Calypso bulbosa* | U |
| *Chimaphila umbellata* | U |
| *Disporum hookeri* | U |
| *Festuca sp.* | U |
| *Galium triflorum* | U |
| *Goodyera oblongifolia* | U |
| *Hieracium albiflorum* | U |
| *Lonicera ciliosa* | U |
| *Philadelphus lewisii* | C |
| *Populus balsamifera* | C |
| *Pteridium aquilinum* | C |

| | |
|---|---|
| Rosa gymnocarpa | U |
| Rubus parviflorus | C |
| Smilacina racemosa | U |
| Trillium ovatum | U |
| Trisetum cernuum | U |
| dense Acer circinatum thickets | |

| **Behind school** | **Abundance** |
|---|---|
| *Acer macrophyllum* | C |
| *Achillea millefolium* | U |
| *Acnatherum lemmonii* | U |
| *Agoseris sp.* | U |
| *Antenaria sp.* | U |
| *Arctostaphylos nevadensis* | U |
| *Brodiaea sp.* | U |
| *Calamagrostis rubescens* | U |
| *Carex rossii* | U |
| *Cheilanthes gracillima* | U |
| *Collinsia sp.* | U |
| *Collomis linearis* | U |
| *Cytisus scoparius* | U |
| *Dactylus glomerata* | C |
| *Elymus glaucus* | U |
| *Festuca idahoensis* | U |
| *Hieracium scouleri* | U |
| *Koeleria cristata* | U |
| *Mahonia nervosa* | U |
| *Moehringia macrophylla* | U |
| *Penstemon serrulatus* | U |
| *Poa pratensis* | C |
| *Polystichum munitum* | U |
| *Pseudoregneria spicatum* | U |
| *Pseudotsuga menziesii* | A |
| *Pteridium aquilinum* | U |
| *Spirea betula* | U |
| *Taraxacum officinale* | U |
| *Vulpia bromoides* | A |

| ***Keller Park / Castle*** | **Abundance** |
|---|---|
| *Abies grandis* | A |
| *Acer circinatum* | A |
| *Acer macrophyllum* | A |
| *Achillea millefolium* | U |
| *Adenocaulon bicolor* | U |
| *Agoseris sp.* | U |
| *Amelanchier alnifolia* | U |
| *Anaphalis margaritacea* | U |
| *Artemesia sp.* | U |
| *Aster engelmannii* | C |
| *Bromus tectorum* | A |
| *Ceanothus sanguineus* | C |
| *Collomia linearis* | R |

| | |
|---|---|
| *Cornus nuttallii* | U |
| *Dactylus glomerata* | A |
| *Elymus glaucus* | A |
| *Festuca idahoensis* | A |
| *Festuca scabrella* | A |
| *Galium triflorum* | U |
| *Goodyera oblongifolia* | U |
| *Hieracium albiflorum* | U |
| *Hieracium scouleri* | C |
| *Holodiscus discolor* | C |
| *Lonicera ciliosa* | C |
| *Mahonia nervosa* | C |
| *Moehringia macrophylla* | C |
| *Oryzopsis exigua* | R |
| *Osmorhiza chilense* | U |
| *Paxistima myrsinites* | U |
| *Penstemon sp.* | U |
| *Philadelphus lewisii* | U |
| *Pinus ponderosa* | C |
| *Poa commutata* | C |
| *Poa pratensis* | C |
| *Polystichum munitum* | U |
| *Pseudoregneria spicatum* | C |
| *Pseudotsuga menziesii* | A |
| *Pteridium aquilinum* | U |
| *Rosa gymnocarpa* | U |
| *Rubus luecodermis* | U |
| *Rubus ursinus* | U |
| *Smilacina sp.* | U |
| *Spirea betula* | C |
| *Symphorocarpus alba* | C |
| *Tragopogon dubius* | U |
| *Taraxacum officinale* | U |
| *Trifolium pratense* | C |

| Peterson Property | Abundance | Origin |
|---|---|---|
| **Trees** | | |
| *Abies grandis* | C | N |
| *Acer macrophyllum* | A | N |
| *Cornus nuttallii* | U | N |
| *Pinus ponderosa* | U | N |
| *Populus balsamifera ssp. trichocarpa* | C | N |
| *Pseudotsuga menziesii var. menziesii* | A | N |
| **Shrubs** | | |
| *Acer circinatum* | C | N |
| *Amelanchier alnifolia* | U | N |
| *Berberis aquifolium* | C | N |
| *Berberis repens* | R | N |
| *Cornus sericea ssp. sericea* | U | N |
| *Holodiscus discolor* | C | N |
| *Paxistima myrsinites* | C | N |
| *Philadelphus lewisii* | C | N |
| *Rosa gymnocarpa* | C | N |
| *Rubus parviflorus var. parviflorus* | U | N |
| *Rubus ursinus ssp. macropetalus* | A | N |

| | | |
|---|---|---|
| *Sambucus cerulea var. cerulea* | U | N |
| *Spiraea betulifolia var. lucida* | U | N |
| *Symphoricarpos albus var. laevigatus* | C | N |
| Graminoids | | |
| *Bromus mollis* | C | E |
| *Bromus tectorum* | U | E |
| *Calamagrostis rubescens* | U | N |
| *Carex geyeri* | U | N |
| *Dactylis glomerata* | C | E |
| *Elymus glaucus ssp. glaucus* | C | N |
| *Elymus repens* | A | E |
| *Festuca idahoensis var. idahoensis* | U | N |
| *Festuca rubra ssp. rubra* | U | E |
| *Melica subulata var. subulata* | U | N |
| *Poa pratensis* | C | E |
| *Stipa occidentalis var. minor* | R | N |
| *Trisetum canescens* | R | N |
| Ferns/Allies | | |
| *Pteridium aquilinum var. pubescens* | A | N |
| Herbs | | |
| *Achillea millefolium* | U | N |
| *Adenocaulon bicolor* | U | N |
| *Agoseris heterophylla var. heterophylla* | U | N |
| *Chimaphila umbellata var. occidentalis* | U | N |
| *Corallorrhiza maculata var. maculata* | R | N |
| *Cryptantha sp.* | R | N |

| | | |
|---|---|---|
| *Disporum hookeri* | U | N |
| *Eucephalus engelmannii* | C | N |
| *Fragaria vesca* | U | N |
| *Galium triflorum* | U | N |
| *Gnaphalium microcephalum var. thermale* | U | N |
| *Habenaria sp.* | R | N |
| *Hieracium albiflorum* | C | N |
| *Hieracium scouleri* | U | N |
| *Holosteum umbellatum* | U | N |
| *Lactuca muralis* | U | E |
| *Linaria vulgaris* | U | E |
| *Maianthemum racemosum ssp. racemosum* | U | N |
| *Microsteris gracilis* | U | N |
| *Microsteris gracilis var. humilior* | U | N |
| *Moehringia macrophylla* | U | N |
| *Osmorhiza chilensis* | C | N |
| *Plantago lanceolata* | C | E |
| *Rumex acetosella* | C | E |
| *Sanicula sp.* | R | N |
| *Taraxacum officinale* | U | E |
| *Thalictrum occidentale* | U | N |
| *Tragopogon dubius* | U | E |
| *Trifolium pratense* | U | E |
| *Trifolium repens* | U | E |
| *Veronica arvensis* | U | N |

| Ward Property | Abundance | Origin |
|---|---|---|
| **Trees** | | |
| *Abies grandis* | C | N |
| *Acer macrophyllum* | C | N |
| *Cornus nuttallii* | A | N |
| *Pinus ponderosa* | R | N |
| *Pseudotsuga menziesii var. menziesii* | A | N |
| **Shrubs** | | |
| *Amelanchier alnifolia* | C | N |
| *Arctostaphylos nevadensis* | U | N |
| *Arctostaphylos uva-ursi* | U | N |
| *Berberis aquifolium* | C | N |
| *Berberis repens* | R | N |
| *Ceanothus velutinus* | U | N |
| *Paxistima myrsinites* | U | N |
| *Philadelphus lewisii* | U | N |
| *Rosa gymnocarpa* | U | N |
| *Rubus leucodermis* | U | N |
| *Spiraea betulifolia var. lucida* | U | N |
| *Symphoricarpos albus var. laevigatus* | C | N |
| Graminoids | | |
| *Bromus tectorum* | U | E |
| *Calamagrostis rubescens* | C | N |
| *Carex geyeri* | C | N |
| *Deschammpsia elongata* | R | N |
| *Elymus glaucus ssp. glaucus* | C | N |
| *Festuca occidentalis* | U | N |
| *Mellica subulata var. subulata* | U | N |
| *Poa pratensis* | U | E |
| *Pseudoroegneria spicata* | U | N |
| *Stipa occidentalis var. minor* | U | N |
| **Ferns &Allies** | | |
| *Pteridium aquilinum* | C | N |
| **Herbs & Forbs** | | |
| *Achillea millefolium* | U | N |
| *Adenocaulon bicolor* | U | N |
| *Apocynum androsaemifolium* | C | N |
| *Arenaria macrophylla* | U | N |
| *Asarum caudatum* | U | N |
| *Collinsia parviflora* | U | N |
| *Collomia grandiflora* | U | N |
| *Galium triflorum* | U | N |
| *Gnaphalium microcephalum var. thermale* | U | N |
| *Goodyera oblongifolia* | U | N |
| *Hieracium albiflorum* | C | N |
| *Hieracium scouleri* | C | N |
| *Holosteum umbellatum* | U | N |
| *Lomatium brandegeei* | U | N |
| *Lomatium triternatum ssp. platycarpum* | U | N |
| *Lonicera ciliosa* | C | N |
| *Osmorhiza chilensis* | C | N |
| *Rumex acetosella* | U | E |
| *Taraxacum officinale* | U | E |
| *Viola glabella* | R | N |

## CAMPS

| Purple Point Horse Camp | Abundance |
|---|---|
| *Achillea millefolium* | U |
| *Amelanchier alnifolia* | U |
| *Calamagrostis rubescens* | A |
| *Elymus glaucus* | A |
| *Festuca sp.* | A |
| *Hieracium scouleri* | U |
| *Lonicera ciliosa* | U |
| *Moehringia macrophylla* | U |
| *Pinus ponderosa* | A |
| *Poa pratensis* | A |
| *Pseudotsuga menziesii* | A |
| *Symphorocarpus alba* | U |

| Bullion Camp | Abundance |
|---|---|
| *Acer macrophyllum* | A |
| *Achillea millefolium* | U |
| *Amelanchier alnifolia* | A |
| *Arctostaphylos nevadensis* | U |
| *Aster engelmannii* | C |
| *Calamagrostis rubescens* | C |
| *Carex rossii* | U |
| *Castilleja miniata* | U |
| *Ceanothus sanguineus* | C |
| *Chamerion angustifolium* | C |
| *Collomis linearis* | U |
| *Collinsia sparsiflora* | U |
| *Comandra umbellatum* | C |
| *Elymus glaucus* | A |
| *Epilobium minutum* | U |
| *Goodyera oblongifolia* | U |
| *Hieracium scouleri* | U |
| *Holodiscus discolor* | C |
| *Lomatium brandegii* | U |
| *Lupinus latifolia* | C |
| *Mahonia nervosa* | U |
| *Paxistima myrsinites* | C |
| *Pinus ponderosa* | A |
| *Poa pratensis* | A |
| *Pseudotsuga menziesii* | A |
| *Rumex acetocella* | C |
| *Sambucus racemosa* | U |
| *Spirea betula* | U |

| Proposed Rainbow Falls Camp | Abundance |
|---|---|
| *Achillea millefolium* | U |
| *Amelanchier alnifolia* | U |
| *Apocynum androsaemifolium* | U |
| *Arctostaphylos uva-ursi* | C |
| *Aspidotis densa* | U |
| *Bromus tectorum* | A |
| *Calamagrostis rubescens* | C |

| | |
|---|---|
| *Carex rossii* | U |
| *Collomia heterophylla* | U |
| *Hieracium albiflorum* | U |
| *Hieracium scouleri* | U |
| *Holodiscus discolor* | C |
| *Paxistima myrsinites* | C |
| *Penstemon serrulatus* | U |
| *Pinus ponderosa* | A |
| *Poa pratensis* | A |
| *Polystichum munitum* | U |
| *Pseudoregneria spicatum* | C |
| *Pseudotsuga menziesii* | A |
| *Spirea betula* | C |
| *Vulpia bromoides* | C |

| **Purple Point Overflow** | **Abundance** |
|---|---|
| *Achillea millefolium* | U |
| *Amelanchier alnifolia* | U |
| *Calamagrostis rubescens* | C |
| *Elymus glaucus* | C |
| *Festuca sp.* | C |
| *Hieracium scouleri* | U |
| *Lonicera ciliosa* | U |
| *Pinus ponderosa* | A |
| *Poa pratensis* | A |
| *Pseudotsuga menziesii* | A |
| *Symphorocarpus alba* | C |

| **Proposed Company Creek Camp** | **Abundance** |
|---|---|
| *Abies grandis* | U |
| *Acer circinatum* | A |
| *Acer glabrum* | A |
| *Achillea millefolium* | C |
| *Adenocaulon bicolor* | U |
| *Alnus rubra* | A |
| *Amelanchier alnifolia* | C |
| *Apocynum androsaemifolium* | C |
| *Arctostaphylos nevadensis* | U |
| *Arnica cordifolia* | C |
| *Arnica latifolia* | C |
| *Asarum caudatum* | U |
| *Aster sp.* | U |
| *Athyrium filix-femina* | R |
| *Calamagrostis rubescens* | U |
| *Carex rossii* | R |
| *Chimaphila umbellata* | U |
| *Clintonia uliflora* | U |
| *Cornus nuttallii* | C |
| *Cornus sericea* | C |
| *Disporum hookeri* | U |
| *Elymus glaucus* | A |
| *Festuca idahoensis* | A |
| *Galium aparine* | U |
| *Goodyera oblongifolia* | U |

| | |
|---|---|
| *Hieracium albiflorum* | U |
| *Holodiscus discolor* | C |
| *Lilium sp.* | R |
| *Lonicera hispidula* | U |
| *Mahonia nervosa* | U |
| *Oplopanax horridus* | C |
| *Orthilia secunda* | U |
| *Osmorhiza chilense* | C |
| *Paxistima myrsinites* | C |
| *Pinus monticola* | R |
| *Pinus ponderosa* | U |
| *Populus balsamifera* | U |
| *Pseudoregneria spicatum* | C |
| *Pseudotsuga menziesii* | C |
| *Pteridium aquilinum* | U |
| *Pyrola asarifolia* | U |
| *Pyrola picta* | U |
| *Rhamnus purshiana* | U |
| *Ribes sanguineum* | U |
| *Rosa gymnocarpa* | U |
| *Rubus parviflorus* | U |
| *Rubus ursinus* | U |
| *Salix scouleri* | U |
| *Sambucus racemosa* | U |
| *Streptopus sp.* | R |
| *Symphoricarpos albus* | C |
| *Thuja plicata* | C |
| *Trillium ovatum* | U |
| *Trisetum cernuum* | R |
| *Viola sempervirens* | R |

| **Company Creek Camp** | **Abundance** |
|---|---|
| *Acer macrophyllum* | C |
| *Achillea millefolium* | C |
| *Acnatherum lemmonii* | U |
| *Agoseris sp.* | R |
| *Amelanchier alnifolia* | U |
| *Anaphalis margaritacea* | U |
| *Antennaria sp.* | U |
| *Arctostaphylos uva-ursi* | C |
| *Bromus tectorum* | A |
| *Cares rossii* | U |
| *Carex sp.* | U |
| *Centaurea sp.* | U |
| *Collinsia sparsiflora* | U |
| *Collomia linearis* | U |
| *Dactylus glomerata* | A |
| *Elymus repens* | A |
| *Hieracium scouleri* | C |
| *Holodiscus discolor* | U |
| *Luina media* | U |
| *Mahonia nervosa* | U |
| *Moehringia macrophylla* | C |
| *Philadelphus lewisii* | C |
| *Plantago lanceolata* | C |

| | |
|---|---|
| *Poa bulbosa* | A |
| *Poa pratensis* | A |
| *Pseudoregneria spicatum* | A |
| *Pseudotsuga menziesii* | C |
| *Rosa gymnocarpa* | U |
| *Rubus ursinus* | U |
| *Rumex acetosa* | C |
| *Salix sp.* | U |
| *Spirea betula* | U |
| *Taraxacum officinale* | C |
| *Tragopogon dubius* | C |
| *Vulpia bromoides* | A |

## RAFT LAUNCH

| Stehekin River Mouth | Abundance |
|---|---|
| *Abies grandis* | A |
| *Acer circinatum* | A |
| *Acer macrophyllum* | A |
| *Adenocaulon bicolor* | U |
| *Asarum caudatum* | R |
| *Athyrium filix-femina* | R |
| *Carex deweyana* | C |
| *Cornus nuttallii* | C |
| *Disporum hookeri* | U |
| *Equisetum sp.* | A |
| *Galium triflorum* | U |
| *Goodyera oblongifolia* | U |
| *Lonicera ciliosa* | U |
| *Philadelphus lewisii* | U |
| *Populus balsamifera* | A |
| *Rosa sp.* | U |
| *Rubus parviflorus* | C |
| *Rubus ursinus* | U |
| *Rumex sp.* | C |
| *Smilacina sp.* | U |
| *Symphorocarpus alba* | U |
| *Thuja plicata* | A |
| *Trillium ovatum* | U |
| *Viola sp.* | U |

# APPENDIX 9: PROPOSED CONDITIONS, COVENANTS AND DEED RESTRICTIONS (CCRS)

- All site development and building construction plans would be reviewed and approved by the National Park Service.
- The primary residential building would not exceed 30 feet in height and accessory buildings would not exceed 25 feet in height.
- Cottage craft uses would be limited to hand manufactured art objects and personal use products.
- Proposed new construction could be of a contemporary design, construction, and color that blends with other structures in the Valley. New construction would be in harmony and continuity with the Valley's traditional character and style, scale and orientation, color, and texture of exterior surface.
- Structures would be screened to be unobtrusive from public use roads, trails, and viewpoints, including from the Stehekin Valley Road.
- Energy efficient standards would be incorporated to the extent possible.
- No building would be served by aerial (overhead) electric or utility lines.
- All construction would comply with local, state, and federal ordinances and regulations.
- Native noninvasive species would be used for any plantings and any invasive nonnative species would be eliminated.
- No mobile homes, travel trailers, or similar would be used even temporarily unless approved by the National Park Service.
- No rubbish, junked or salvaged equipment, vehicles, or other materials would be disposed of or accumulate on the property.
- The location of radio antenna towers taller than the roof peak of the primary building on the site or of dish antennas would require approval by the National Park Service.
- Except as needed for approved construction, there would be no cutting, destroying, or removing of trees, live or dead, 12 inches in diameter or larger, at 4.5 feet (diameter breast high), unless approved by the National Park Service.
- Pesticides, herbicides, and other chemicals for weed and pest control for other than household uses would be prohibited.
- State and local laws, ordinances, and regulations would be enforceable on these premises and would apply to all parties using the premises.
- The property could not be subdivided.
- The National Park Service could enter the property, with prior notification, to inspect for compliance with deed restrictions.
- Property would be used primarily for residential purposes, including cottage craft uses.

- Residential development would consist of one single-family residence with a footprint not to exceed 2,500 square feet (excluding basement).
- Residential uses may include gardening.
- Additional conditions covenants and restrictions would be determined on a case-by-case basis by the National Park Service.

# APPENDIX 10: 1995 LAND PROTECTION PLAN RANKING OF PRIVATE LANDS

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 01-100 | Wall | 23.3 | High |
| 01-101 | Barnhart | 7.21 | High |
| 01-102 | McKellar | 5.5 | High |
| 01-103 | Lewman | 30.8 | High |
| 02-102 | Brewster Hgts | 0.7 | Medium |
| 02-104 | Blue Grade Par. | 6.65 | High |
| 02-105 | Pinnow | 17.9 | High |
| 02-106 | Kinman, et ux | 0.3 | Medium |
| 02-107 | Blue Grade Par. | 2.49 | High |
| 02-108 | Blue Grade Par. | 2.35 | High |
| 02-109 | Blue Grade Par. | 6.28 | High |
| 03-100 | Stifter | 40.07 | High |
| 03-108 | Stevens | 0.11 | Low |
| 03-125 | Clayson | 1 | High |
| 03-131 | Purple Cr. | 0.16 | Low |
| 04-100 | Hegge | 1.73 | High |
| 04-101 | Hegge | 1.73 | High |
| 04-102 | Flint | 1.74 | High |
| 04-103 | Thompson | 5 | High |
| 04-104 | Darvill | 4.24 | High |
| 04-105 | Williams | 0.37 | Low |
| 04-106 | Bell | 4.24 | High |
| 04-108 | Waddell | 0.59 | Low |
| 04-110 | Peterson | 0.5 | Low |
| 04-112 | Blomberg | 4.09 | High |
| 04-114 | Clark | 10 | High |
| 04-116 | Ste. R. Resort | 10.28 | High |
| 04-117 | Moriarity | 0.14 | Low |
| 04-120 | Blackburn | 0.69 | Low |
| 04-124 | McLean | 0.58 | Low |
| 04-127 | Bluhm | 0.2 | Low |
| 04-128 | Bridges | 0.34 | Low |
| 04-130 | Pearl | 0.36 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 04-131 | Parks | 0.21 | Low |
| 04-136 | Carleton | 0.2 | Low |
| 04-137 | Katz | 0.18 | Low |
| 04-139 | Glenn | 0.71 | Medium |
| 04-143 | Behie | 0.33 | Low |
| 04-144 | Pritt | 0.28 | Low |
| 04-145 | Freeman | 0.22 | Low |
| 04-147 | Hubbard | 0.2 | Low |
| 04-148 | Dinwiddie | 0.62 | Low |
| 04-149 | Harvey | 0.24 | Low |
| 04-150 | Dinwiddie | 0.24 | Low |
| 04-153 | The Cedar Company | 0.2 | Low |
| 04-154 | Buehler | 0.53 | Medium |
| 04-155 | Bohn | 0.32 | Medium |
| 04-156 | Williams | 0.64 | Medium |
| 04-157 | Stehekin Chapel | 0.55 | Medium |
| 04-158 | Higgins | 0.48 | Medium |
| 04-162 | Morehead | 0.55 | Medium |
| 04-163 | Hayes | 0.71 | Medium |
| 04-164 | Glenn | 0.2 | Medium |
| 04-165 | Loynes | 0.52 | Low |
| 04-166 | Blackburn | 0.66 | Low |
| 04-172 | Parks | 0.72 | Low |
| 04-173 | Blackburn | 0.75 | Low |
| 04-177 | Graham | 0.48 | Low |
| 04-178 | Calvin | 0.48 | Low |
| 04-179 | Gaukroger | 1.1 | High |
| 04-181 | Parks | 0.03 | Low |
| 04-184 | Mathews | 0.48 | Low |
| 04-186 | Harvey | 0.21 | Low |
| 04-187 | Holcomb | 0.35 | Low |
| 04-188 | Parks | 3.65 | High |
| 04-189 | Dinwiddie | 0.22 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 04-190 | Courtney | 0.18 | Low |
| 04-191 | Libby | 0.38 | Low |
| 04-192 | Karapostoles | 0.38 | Low |
| 04-193 | Parsons | 1.24 | Medium |
| 04-194 | Lesmeister | 0.48 | Low |
| 04-195 | Theubet | 0.48 | Low |
| 04-196 | Clayson | 0.25 | Low |
| 04-197 | Kelly | 0.48 | Low |
| 04-198 | Baker | 0.48 | Low |
| 04-199 | Robson | 0.48 | Low |
| 05-102 | Kelly | 1.68 | High |
| 05-104 | Gans | 2 | Medium |
| 05-107 | Sherer | 27 | High |
| 05-108 | Bowles | 1.52 | High |
| 05-109 | Spirk | 0.76 | Low |
| 05-110 | Malone | 0.76 | Low |
| 05-111 | Mathews | 0.76 | Low |
| 05-112 | Jacobson | 0.76 | Low |
| 05-113 | Weagant | 0.76 | Low |
| 05-119 | Hammett | 0.7 | Low |
| 05-120 | Scutt | 0.76 | Low |
| 05-121 | Courtney | 5.46 | High |
| 05-124 | Morehead | 0.21 | Low |
| 05-125 | Caffell | 0.41 | Low |
| 05-126 | Denning | 0.85 | Low |
| 05-127 | Torcaso | 0.85 | Low |
| 05-128 | Stewart | 0.85 | Low |
| 05-130 | Courtney | 0.43 | Low |
| 05-133 | Staley | 0.85 | Low |
| 05-135 | Beuhler | 27.65 | High |
| 05-136 | Saul | 0.36 | Medium |
| 05-140 | Hayes | 2.13 | High |
| 05-141 | Sargo | 2.17 | High |
| 05-142 | Gans | 2.48 | High |
| 05-144 | Morehead | 0.21 | Low |
| 05-145 | Hutson | 0.65 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 05-147 | Morehead | 0.42 | Low |
| 05-148 | Stone | 0.77 | High |
| 05-150 | Courtney | 0.58 | Low |
| 05-157 | Hammett | 2.99 | High |
| 05-158 | Breeze | 3.03 | High |
| 05-159 | Warner | 1.21 | High |
| 05-160 | Breeze | 1.65 | High |
| 06-102 | Fultz | 4.06 | High |
| 06-106 | McConnell | 2.9 | Medium |
| 06-111 | Boyd | 0.21 | Low |
| 06-113 | Miles | 0.18 | Low |
| 06-114 | Stevens | 0.24 | Low |
| 06-116 | Bardin | 0.7 | Low |
| 06-119 | Peterson | 6.7 | High |
| 06-120 | Gianulis | 0.32 | Low |
| 07-100 | McConnell | 4.36 | Medium |
| 07-105 | Blomberg | 0.59 | Low |
| 07-107 | Courtney | 1.12 | High |
| 07-109 | McKinley | 0.71 | Low |
| 07-110 | Webb | 0.68 | Low |
| 07-112 | Avery | 0.66 | Low |
| 07-114 | Wilsey | 4 | High |
| 07-116 | Neuzil | 1.6 | High |
| 07-121 | Williams | 0.41 | Low |
| 07-122 | Williams | 2.32 | High |
| 07-124 | Ralphs | 1.18 | High |
| 07-125 | Stegeman | 2.07 | High |
| 07-127 | Winkel | 2.18 | High |
| 07-130 | Linston | 2 | High |
| 07-131 | Bingham | 0.97 | Low |
| 07-133 | Winkel | 6.89 | High |
| 07-138 | Scutt | 2 | High |
| 07-142 | Scherer | 9.95 | High |
| 07-145 | Pitts | 0.97 | Low |
| 07-147 | Pitts | 0.71 | Low |
| 07-149 | Jenkins | 0.61 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 07-150 | Barnhart | 1.01 | High |
| 07-153 | Fellows | 0.9 | Low |
| 07-157 | Leader | 28.7 | High |
| 07-161 | Quoidbach | 0.63 | Low |
| 07-166 | Taylor | 0.32 | Low |
| 07-168 | Pitts | 0.47 | Low |
| 07-172 | Dickerson | 1.24 | High |
| 07-176 | Baker | 2.48 | High |
| 07-177 | Otto | 0.64 | Low |
| 07-179 | Nawalinski | 0.9 | Low |
| 07-184 | Quoidbach | 0.8 | Low |
| 07-185 | Byerly | 0.97 | Low |
| 07-186 | Mitchell | 3.53 | High |
| 07-187 | O'Neal | 0.1 | Low |
| 07-188 | Unknown | 0.61 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 07-189 | Ralphs | 0.58 | Low |
| 07-190 | Morrison | 0.53 | Low |
| 07-191 | Garfoot | 2.99 | High |
| 07-192 | Robbins | 1.42 | High |
| 07-193 | Courtney | 1.98 | High |
| 07-194 | Courtney | 2.02 | High |
| 07-195 | Courtney | 2.01 | High |
| 07-196 | Courtney | 2.01 | High |
| 07-197 | Courtney | 2.02 | High |
| 07-198 | Courtney | 2.02 | High |
| 07-199 | Danielson | 4.97 | High |
| 07-200 | Bowles | 1.74 | Medium |
| 07-201 | Ramos | 3 | Medium |
| 08-101 | Courtney | 20 | High |

# APPENDIX 11: ALTERNATIVES 2 AND 3 PROPOSED RANKING OF PRIVATE LANDS FOR THE REVISED LAND PROTECTION PLAN

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 01-101 | Barnhart, Michael J. et ux | 8.38 | High |
| 01-102 | McKellar, Richard V., et al | 6.39 | High |
| 01-103 | Lewman, Darrel, et al | 30.72 | High |
| 02-102 | C& M I, LLC | 0.70 | Low |
| 02-104 | Kaminski, Perry | 6.65 | High |
| 02-105 | Pinnow, Edward M., et al | 17.90 | High |
| 02-106 | Kinman, David, F., et us | 0.30 | Medium |
| 02-107 | Kaminski, Perry | 2.49 | Medium |
| 02-108 | Britt, James M., et us | 2.35 | High |
| 02-109 | McMurry, John, et ux | 6.28 | Medium |
| 03-100 | Stifter, William F., et ux | 12.95 | Medium |
| 03-108 | Stevens, John T., et ux | 0.11 | Medium |
| 03-125 | Courtney, Thomas H., et ux, trustees | 1.00 | High |
| 03-131 | Purple Creek Corp. | 0.16 | Medium |
| 04-100 | Hegge, Gary L., et ux | 1.73 | Medium |
| 04-101 | Hegge, Gary L., Trustee | 1.73 | Medium |
| 04-102 | Bouslaugh, Tom A., et ux | 1.74 | Medium |
| 04-104 | Darvill, Fred T., Jr. | 4.31 | High |
| 04-105 | Ellis, James L., et ux | 0.37 | Medium |
| 04-106 | Bell, Lloyd | 3.65 | High |
| 04-108 | Bishop, James L., et ux | 0.59 | Medium |
| 04-110 | Petersen, Gregory H., et al | 0.50 | Medium |
| 04-112 | McGinness, Collin | 4.09 | High |
| 04-114 | Clark, James D. | 1.69 | Medium |
| 04-115 | Weavtel LLC | 1.69 | Medium |
| 04-116 | Morse Resort Inc. | 11.67 | High |
| 04-117 | Fesler, Rick L., et ux | 0.14 | Medium |
| 04-120 | Blackburn, Ovidia L., et al | 0.69 | High |
| 04-121 | Clark, Judith | 6.62 | High |
| 04-124 | McLean, Mark A | 0.58 | High |
| 04-127 | Griffiths, William S., et al | 0.20 | Medium |
| 04-128 | Bridges, Ardee M., et al | 0.16 | High |
| 04-130 | Pearl, Warren L. | 0.36 | Medium |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 04-131 | Parks, Terry V. | 0.21 | Low |
| 04-136 | Davis, Lewis V., et ux | 0.20 | Medium |
| 04-137 | Stewart, Mark P. | 0.18 | Medium |
| 04-139 | Glenn, Nicholas A. | 0.91 | Medium |
| 04-143 | Sherman, Angela C. | 0.33 | Medium |
| 04-144 | Breeze, William E. | 0.28 | High |
| 04-145 | Freeman, Lillian A., et al | 0.22 | High |
| 04-147 | Hubbard, Duane L., et ux | 0.20 | High |
| 04-148 | Dinwiddie, Randall R. | 0.70 | High |
| 04-149 | Harvey, Curtis S., et al | 0.24 | High |
| 04-150 | Dinwiddie, Randall R., et ux | 0.24 | High |
| 04-153 | Libbey, Caroline L. | 0.20 | Medium |
| 04-154 | Buehler, Walter E., et al, Trustees | 0.53 | High |
| 04-155 | Bohn, Willis C., et al, Trustees | 0.32 | High |
| 04-156 | Liberty, Janet L., et al | 0.64 | High |
| 04-157 | First United Methodist Church | 0.55 | High |
| 04-158 | Higgins, Ben C., et al | 0.48 | High |
| 04-162 | Morehead, Harriet O., Trustee | 0.55 | Medium |
| 04-163 | Hazell, Marjorie J. | 0.71 | Medium |
| 04-165 | Cook, Melanie J., et al | 0.56 | Medium |
| 04-166 | Blackburn, Ovidia L., et al | 0.66 | Medium |
| 04-169 | Parks, Terry | 0.42 | Medium |
| 04-172 | Parks, Terry | 0.72 | Medium |
| 04-173 | Blackburn, Ovidia L., et al | 0.75 | Medium |
| 04-177 | Kelly, Patrick J., et al | 0.48 | Medium |
| 04-178 | Goodwin, Richard H., Jr., et al | 0.48 | Medium |
| 04-179 | Gaukroger, James G. | 0.55 | Medium |
| 04-180 | Gaukroger, Robin R. | 0.55 | Medium |
| 04-181 | Parks, Terry | 0.03 | Medium |
| 04-183 | Griffith, Jimmy E., et al | 0.18 | High |
| 04-184 | Gordon, Carole B., Custodian | 0.48 | High |
| 04-186 | Skidz LLC | 0.21 | Medium |
| 04-187 | Davis, Lewis V., et ux | 0.35 | High |
| 04-188 | Parks, Terry | 3.65 | High |
| 04-189 | Noble, Daniel, et ux | 0.22 | High |
| 04-190 | Courtney, Cragg, et ux, Trustees | 0.18 | Medium |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 04-191 | Libbey, Caroline | 0.38 | Medium |
| 04-192 | Karapostoles, Caitlin, et al | 1.00 | Medium |
| 04-193 | Parsons, Jeffrey L., et ux | 1.18 | Medium |
| 04-194 | Courtney, Mistaya M. (CP) | 0.48 | Medium |
| 04-195 | Theubet, James H., Trustee | 0.48 | Medium |
| 04-197 | Kelly, William L., et ux, Trustees | 0.48 | Medium |
| 04-198 | Seemiller, Joseph | 0.48 | Medium |
| 04-199 | Griffith, Frederick L., et al | 0.48 | Medium |
| 05-102 | Kelly, William L., et ux, Trustees | 1.68 | Medium |
| 05-104 | Gans, William C., Jr., et al | 2.00 | Medium |
| 05-107 | Sherer, Wesley, M., et ux | 4.05 | High |
| 05-109 | Raymond, Charles F., et ux | 0.76 | Medium |
| 05-110 | Raymond, Charles F., et ux | 0.76 | Medium |
| 05-111 | Mathews, Don D., et ux | 0.76 | Medium |
| 05-112 | Jacobson, Neal, et ux | 0.76 | Medium |
| 05-113 | Weagent, Rodney W., et al | 0.76 | High |
| 05-119 | Story, Michael J., et ux | 0.70 | Medium |
| 05-120 | Scutt, Ronald W., et ux, Trustees | 0.76 | High |
| 05-121 | Courtney, Cragg, et ux, Trustees | 6.76 | High |
| 05-123 | Sherer, Wesley, M., et ux | 22.15 | High |
| 05-124 | Morehead, Dwight T., et ux | 0.21 | Medium |
| 05-125 | Courtney, Reed | 0.41 | Medium |
| 05-126 | Denning, Michael | 0.85 | Low |
| 05-127 | Hudak, Renee Y., et al | 0.85 | Medium |
| 05-128 | Ward (Stewart), Norma V. | 0.85 | Medium |
| 05-130 | Courtney, Thomas H., et ux, trustees | 0.43 | Medium |
| 05-132 | Courtney, Cragg, et ux, Trustees | 7.15 | Medium |
| 05-133 | Staley, James E., et al | 0.85 | High |
| 05-135 | Buehler, Thomas M., et al | 27.65 | Medium |
| 05-136 | Nielsen, Robert C., et ux | 0.34 | Medium |
| 05-140 | Hayes, Adrienne, et al | 2.13 | Medium |
| 05-141 | Sargo, Herbert J., et al | 2.17 | High |
| 05-142 | Gans, William C., Jr., et al | 2.48 | High |
| 05-144 | Morehead, Lawrence E., et ux | 0.21 | Medium |
| 05-145 | Story, Michael J., et ux | 0.65 | Medium |
| 05-147 | Morehead, Kenneth, et ux | 0.42 | Medium |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 05-150 | Courtney, Thomas H., et ux, trustees | 0.58 | Medium |
| 05-157 | Goodwin, Richard H., Jr., et al | 2.99 | Medium |
| 05-158 | Gaskill, Karl B. | 3.03 | Medium |
| 05-159 | Gaskill, Karl B. | 1.21 | Medium |
| 05-160 | Gaskill, Karl B. | 1.65 | Medium |
| 06-102 | Fultz, Elizabeth R. | 4.06 | High |
| 06-106 | Ward, Vince, et ux | 2.90 | Medium |
| 06-111 | Boyd, Gail C. | 0.21 | Medium |
| 06-113 | Miles, Michael, R. | 0.18 | High |
| 06-114 | Stevens, John T., et ux | 0.24 | Medium |
| 06-116 | Gempko, Vicki et vir | 0.70 | High |
| 06-119 | Peterson, B. Jean | 6.70 | High |
| 06-120 | Gianulis, Deborah A., et al | 0.32 | Medium |
| 07-100 | McConnell, Carolyn A. | 4.36 | High |
| 07-105 | Blomberg, John | 0.50 | Medium |
| 07-107 | Courtney, James O., Trustee | 1.12 | High |
| 07-109 | Mundal, Anne S., et al | 0.71 | High |
| 07-110 | Walker, Allan E., III, et al, Trustees | 0.68 | High |
| 07-114 | Duke, Loretta | 2.15 | High |
| 07-115 | Thompson, Laura J., et al | 2.15 | Medium |
| 07-116 | Neuzil Family Trust | 1.60 | High |
| 07-121 | Robbins, Jeffrey C., et ux | 0.41 | Medium |
| 07-122 | Saulsbury, David, et ux | 2.32 | High |
| 07-124 | Goold, Jeffrey B., et al | 1.18 | Medium |
| 07-125 | Evans, Linda R., et al | 2.48 | High |
| 07-127 | Winkel, Walter G. | 2.18 | High |
| 07-130 | Burhen, William S. | 2.00 | High |
| 07-131 | Bingham, John R., et ux | 0.97 | Medium |
| 07-133 | Winkel, Walter G. | 6.19 | High |
| 07-134 | Winkel, Alvy, et ux | 0.70 | Medium |
| 07-138 | Scutt, Ronald W., et ux, Trustees | 2.00 | High |
| 07-142 | Scherer, Jonathan, et ux | 9.95 | High |
| 07-145 | Pitts, Edward D., et ux | 0.97 | Medium |
| 07-147 | Pitts, Edward D., et ux | 0.71 | Medium |
| 07-149 | Barnhart, Michael J. | 0.61 | Medium |
| 07-150 | Barnhart, Michael J. | 1.01 | Medium |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 07-153 | Schmid, Walter D. | 0.90 | Medium |
| 07-157 | Leader, Thomas W., et al | 28.70 | High |
| 07-166 | Pitts, Edward D., et ux | 0.32 | Medium |
| 07-168 | Pitts, Edward D., et ux | 0.47 | Medium |
| 07-176 | Leaf, Christopher C. | 2.48 | High |
| 07-177 | Thompson Family Trust | 0.64 | High |
| 07-179 | Nawalinski, Thomas E., et ux | 0.90 | Medium |
| 07-184 | Woodward, Douglas L. | 0.80 | Medium |
| 07-185 | Lehman, Robert A., et ux, Trustees | 0.97 | High |
| 07-186 | Mitchell, Robert D., Jr., et al | 3.53 | Medium |
| 07-187 | Parlette, Linda O'Neal, et al | 0.10 | Medium |
| 07-188 | Unknown (Company Creek Road) | 0.61 | Medium |
| 07-189 | Kurth, David W., et ux | 0.58 | Medium |
| 07-190 | Morrison, Randy C. | 0.53 | Medium |
| 07-191 | Garfoot, Phillip L., et ux | 3.00 | High |
| 07-192 | Robbins, Jeffrey C., et ux | 1.40 | High |
| 07-193 | Courtney, James O. | 2.99 | Low |
| 07-195 | Courtney, Thomas H., et ux, trustees | 3.02 | Medium |
| 07-196 | Courtney, Mark L. | 2.01 | Medium |
| 07-197 | Courtney, Clifford G. | 2.02 | Medium |
| 07-198 | Courtney, Clifford G. | 2.02 | Medium |
| 07-199 | Danielson Stehekin Cabin Mgt, LLC | 4.97 | High |
| 07-200 | Bowles, Stephen B., et ux, Trustees | 1.74 | High |
| 07-201 | Ramos, Myra | 3.00 | High |
| 07-202 | Blomberg, John | 0.09 | Medium |
| 08-101 | Ray and Esther Courtney Family, LLC, et al | 20.00 | High |
| 08-105 | Courtney, Clifford G. | 5.60 | Medium |

# APPENDIX 12: ALTERNATIVE 4 PROPOSED RANKING OF PRIVATE LANDS

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 01-101 | Barnhart, Michael J. et ux | 8.38 | High |
| 01-102 | McKellar, Richard V., et al | 6.39 | High |
| 01-103 | Lewman, Darrel, et al | 30.72 | High |
| 02-102 | C& M I, LLC | 0.70 | Low |
| 02-104 | Kaminski, Perry | 6.65 | High |
| 02-105 | Pinnow, Edward M., et al | 17.90 | High |
| 02-106 | Kinman, David, F., et us | 0.30 | Low |
| 02-107 | Kaminski, Perry | 2.49 | Medium |
| 02-108 | Britt, James M., et us | 2.35 | High |
| 02-109 | McMurry, John, et ux | 6.28 | Medium |
| 03-100 | Stifter, William F., et ux | 12.95 | Low |
| 03-108 | Stevens, John T., et ux | 0.11 | Low |
| 03-125 | Courtney, Thomas H., et ux, trustees | 1.00 | Low |
| 03-131 | Purple Creek Corp. | 0.16 | Low |
| 04-100 | Hegge, Gary L., et ux | 1.73 | Medium |
| 04-101 | Hegge, Gary L., Trustee | 1.73 | Medium |
| 04-102 | Bouslaugh, Tom A., et ux | 1.74 | Low |
| 04-104 | Darvill, Fred T., Jr. | 4.31 | Medium |
| 04-105 | Ellis, James L., et ux | 0.37 | Low |
| 04-106 | Bell, Lloyd | 3.65 | Medium |
| 04-108 | Bishop, James L., et ux | 0.59 | Low |
| 04-110 | Petersen, Gregory H., et al | 0.50 | Low |
| 04-112 | McGinness, Collin | 4.09 | Medium |
| 04-114 | Clark, James D. | 1.69 | Medium |
| 04-115 | Weavtel LLC | 1.69 | Medium |
| 04-116 | Morse Resort Inc. | 11.67 | Medium |
| 04-117 | Fesler, Rick L., et ux | 0.14 | Low |
| 04-120 | Blackburn, Ovidia L., et al | 0.69 | Medium |
| 04-121 | Clark, Judith | 6.62 | High |
| 04-124 | McLean, Mark A | 0.58 | Medium |
| 04-127 | Griffiths, William S., et al | 0.20 | Low |
| 04-128 | Bridges, Ardee M., et al | 0.16 | Medium |
| 04-130 | Pearl, Warren L. | 0.36 | Medium |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 04-131 | Parks, Terry V. | 0.21 | Low |
| 04-136 | Davis, Lewis V., et ux | 0.20 | Low |
| 04-137 | Stewart, Mark P. | 0.18 | Low |
| 04-139 | Glenn, Nicholas A. | 0.91 | Low |
| 04-143 | Sherman, Angela C. | 0.33 | Low |
| 04-144 | Breeze, William E. | 0.28 | Medium |
| 04-145 | Freeman, Lillian A., et al | 0.22 | Medium |
| 04-147 | Hubbard, Duane L., et ux | 0.20 | Medium |
| 04-148 | Dinwiddie, Randall R. | 0.70 | High |
| 04-149 | Harvey, Curtis S., et al | 0.24 | Medium |
| 04-150 | Dinwiddie, Randall R., et ux | 0.24 | Medium |
| 04-153 | Libbey, Caroline L. | 0.20 | Low |
| 04-154 | Buehler, Walter E., et al, Trustees | 0.53 | Medium |
| 04-155 | Bohn, Willis C., et al, Trustees | 0.32 | Medium |
| 04-156 | Liberty, Janet L., et al | 0.64 | Medium |
| 04-157 | First United Methodist Church | 0.55 | Medium |
| 04-158 | Higgins, Ben C., et al | 0.48 | Medium |
| 04-162 | Morehead, Harriet O., Trustee | 0.55 | Low |
| 04-163 | Hazell, Marjorie J. | 0.71 | Low |
| 04-165 | Cook, Melanie J., et al | 0.56 | Medium |
| 04-166 | Blackburn, Ovidia L., et al | 0.66 | Low |
| 04-169 | Parks, Terry | 0.42 | Low |
| 04-172 | Parks, Terry | 0.72 | Low |
| 04-173 | Blackburn, Ovidia L., et al | 0.75 | Low |
| 04-177 | Kelly, Patrick J., et al | 0.48 | Low |
| 04-178 | Goodwin, Richard H., Jr., et al | 0.48 | Low |
| 04-179 | Gaukroger, James G. | 0.55 | Low |
| 04-180 | Gaukroger, Robin R. | 0.55 | Low |
| 04-181 | Parks, Terry | 0.03 | Low |
| 04-183 | Griffith, Jimmy E., et al | 0.18 | Low |
| 04-184 | Gordon, Carole B., Custodian | 0.48 | Medium |
| 04-186 | Skidz LLC | 0.21 | Medium |
| 04-187 | Davis, Lewis V., et ux | 0.35 | High |
| 04-188 | Parks, Terry | 3.65 | High |
| 04-189 | Noble, Daniel, et ux | 0.22 | Medium |
| 04-190 | Courtney, Cragg, et ux, Trustees | 0.18 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 04-191 | Libbey, Caroline | 0.38 | Low |
| 04-192 | Karapostoles, Caitlin, et al | 1.00 | Low |
| 04-193 | Parsons, Jeffrey L., et ux | 1.18 | Low |
| 04-194 | Courtney, Mistaya M. (CP) | 0.48 | Low |
| 04-195 | Theubet, James H., Trustee | 0.48 | Low |
| 04-197 | Kelly, William L., et ux, Trustees | 0.48 | Low |
| 04-198 | Seemiller, Joseph | 0.48 | Low |
| 04-199 | Griffith, Frederick L., et al | 0.48 | Low |
| 05-102 | Kelly, William L., et ux, Trustees | 1.68 | Medium |
| 05-104 | Gans, William C., Jr., et al | 2.00 | Medium |
| 05-107 | Sherer, Wesley, M., et ux | 4.05 | Medium |
| 05-109 | Raymond, Charles F., et ux | 0.76 | Medium |
| 05-110 | Raymond, Charles F., et ux | 0.76 | Low |
| 05-111 | Mathews, Don D., et ux | 0.76 | Low |
| 05-112 | Jacobson, Neal, et ux | 0.76 | Low |
| 05-113 | Weagent, Rodney W., et al | 0.76 | Medium |
| 05-119 | Story, Michael J., et ux | 0.70 | Low |
| 05-120 | Scutt, Ronald W., et ux, Trustees | 0.76 | Medium |
| 05-121 | Courtney, Cragg, et ux, Trustees | 6.76 | Medium |
| 05-123 | Sherer, Wesley, M., et ux | 22.15 | Medium |
| 05-124 | Morehead, Dwight T., et ux | 0.21 | Low |
| 05-125 | Courtney, Reed | 0.41 | Low |
| 05-126 | Denning, Michael | 0.85 | Low |
| 05-127 | Hudak, Renee Y., et al | 0.85 | Low |
| 05-128 | Ward (Stewart), Norma V. | 0.85 | Medium |
| 05-130 | Courtney, Thomas H., et ux, trustees | 0.43 | Low |
| 05-132 | Courtney, Cragg, et ux, Trustees | 7.15 | Medium |
| 05-133 | Staley, James E., et al | 0.85 | Medium |
| 05-135 | Buehler, Thomas M., et al | 27.65 | Medium |
| 05-136 | Nielsen, Robert C., et ux | 0.34 | Low |
| 05-140 | Hayes, Adrienne, et al | 2.13 | Medium |
| 05-141 | Sargo, Herbert J., et al | 2.17 | Medium |
| 05-142 | Gans, William C., Jr., et al | 2.48 | Medium |
| 05-144 | Morehead, Lawrence E., et ux | 0.21 | Low |
| 05-145 | Story, Michael J., et ux | 0.65 | Low |
| 05-147 | Morehead, Kenneth, et ux | 0.42 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 05-150 | Courtney, Thomas H., et ux, trustees | 0.58 | Low |
| 05-157 | Goodwin, Richard H., Jr., et al | 2.99 | Low |
| 05-158 | Gaskill, Karl B. | 3.03 | Low |
| 05-159 | Gaskill, Karl B. | 1.21 | Medium |
| 05-160 | Gaskill, Karl B. | 1.65 | Low |
| 06-102 | Fultz, Elizabeth R. | 4.06 | Medium |
| 06-106 | Ward, Vince, et ux | 2.90 | Medium |
| 06-111 | Boyd, Gail C. | 0.21 | Medium |
| 06-113 | Miles, Michael, R. | 0.18 | Medium |
| 06-114 | Stevens, John T., et ux | 0.24 | Low |
| 06-116 | Gempko, Vicki et vir | 0.70 | Medium |
| 06-119 | Peterson, B. Jean | 6.70 | Medium |
| 06-120 | Gianulis, Deborah A., et al | 0.32 | Low |
| 07-100 | McConnell, Carolyn A. | 4.36 | Medium |
| 07-105 | Blomberg, John | 0.50 | Low |
| 07-107 | Courtney, James O., Trustee | 1.12 | Medium |
| 07-109 | Mundal, Anne S., et al | 0.71 | Medium |
| 07-110 | Walker, Allan E., III, et al, Trustees | 0.68 | Medium |
| 07-114 | Duke, Loretta | 2.15 | Low |
| 07-115 | Thompson, Laura J., et al | 2.15 | Medium |
| 07-116 | Neuzil Family Trust | 1.60 | Medium |
| 07-121 | Robbins, Jeffrey C., et ux | 0.41 | Low |
| 07-122 | Saulsbury, David, et ux | 2.32 | Medium |
| 07-124 | Goold, Jeffrey B., et al | 1.18 | Low |
| 07-125 | Evans, Linda R., et al | 2.48 | Medium |
| 07-127 | Winkel, Walter G. | 2.18 | Medium |
| 07-130 | Burhen, William S. | 2.00 | Medium |
| 07-131 | Bingham, John R., et ux | 0.97 | Low |
| 07-133 | Winkel, Walter G. | 6.19 | High |
| 07-134 | Winkel, Alvy, et ux | 0.70 | High |
| 07-138 | Scutt, Ronald W., et ux, Trustees | 2.00 | High |
| 07-142 | Scherer, Jonathan, et ux | 9.95 | High |
| 07-145 | Pitts, Edward D., et ux | 0.97 | Low |
| 07-147 | Pitts, Edward D., et ux | 0.71 | Low |
| 07-149 | Barnhart, Michael J. | 0.61 | Low |
| 07-150 | Barnhart, Michael J. | 1.01 | Low |

| Tract | Name | Acres | Priority |
|---|---|---|---|
| 07-153 | Schmid, Walter D. | 0.90 | Low |
| 07-157 | Leader, Thomas W., et al | 28.70 | Medium |
| 07-166 | Pitts, Edward D., et ux | 0.32 | Low |
| 07-168 | Pitts, Edward D., et ux | 0.47 | Low |
| 07-176 | Leaf, Christopher C. | 2.48 | Medium |
| 07-177 | Thompson Family Trust | 0.64 | Medium |
| 07-179 | Nawalinski, Thomas E., et ux | 0.90 | Low |
| 07-184 | Woodward, Douglas L. | 0.80 | Low |
| 07-185 | Lehman, Robert A., et ux, Trustees | 0.97 | Medium |
| 07-186 | Mitchell, Robert D., Jr., et al | 3.53 | Low |
| 07-187 | Parlette, Linda O'Neal, et al | 0.10 | Low |
| 07-188 | Unknown (Company Creek Road) | 0.61 | Low |
| 07-189 | Kurth, David W., et ux | 0.58 | Low |
| 07-190 | Morrison, Randy C. | 0.53 | Low |
| 07-191 | Garfoot, Phillip L., et ux | 3.00 | Medium |
| 07-192 | Robbins, Jeffrey C., et ux | 1.40 | Medium |
| 07-193 | Courtney, James O. | 2.99 | Low |
| 07-195 | Courtney, Thomas H., et ux, trustees | 3.02 | Low |
| 07-196 | Courtney, Mark L. | 2.01 | Low |
| 07-197 | Courtney, Clifford G. | 2.02 | Low |
| 07-198 | Courtney, Clifford G. | 2.02 | Low |
| 07-199 | Danielson Stehekin Cabin Mgt, LLC | 4.97 | Medium |
| 07-200 | Bowles, Stephen B., et ux, Trustees | 1.74 | Medium |
| 07-201 | Ramos, Myra | 3.00 | Medium |
| 07-202 | Blomberg, John | 0.09 | Medium |
| 08-101 | Ray and Esther Courtney Family, LLC, et al | 20.00 | Medium |
| 08-105 | Courtney, Clifford G. | 5.60 | Medium |

# APPENDIX 13: REVISED LAND PROTECTION PLAN (DETACHED)

## APPENDIX 14: CARBON EMISSION ESTIMATES AND CALCULATIONS

Note: Fuel efficiency assumptions are as follows: 6 gallons/hour for excavator and roller use; 5 miles per gallon for dump trucks and asphalt truck with 40 cubic yards transported per trip (round-trip assumed to be 15 miles); 200 gallons of fuel per barge trip; and 22.2 pounds of carbon are burned per 1 gallon of diesel fuel (EPA 2009).

**TABLE 1: ALTERNATIVE 1 EMISSIONS**

| | Alternative 1 |
|---|---|
| Road Rehabilitation and/or Reroutes | 9,887 cubic yards of fill: 741.5 gallons of diesel fuel<br>1,439 cubic yards of asphalt: 108 gallons of diesel fuel<br>600 hours of excavator use: 3,600 gallons of diesel fuel<br>350 hours of roller use: 2,100 gallons of diesel fuel<br>62 trips on the barge: 12,400 gallons of diesel fuel<br>Total of 18,950 gallon of diesel fuel<br>22.2 pounds of carbon burned per gallon of fuel (EPA 2009)<br>210 tons of carbon total |
| Erosion Protection Measures | 4,317 cubic yards of asphalt: 108 gallons of diesel fuel<br>400 hours of roller use: 2,400 gallons of diesel fuel<br>20 trips on the barge: 4,000 gallons of diesel fuel<br>Total of 6,724 gallons of diesel fuel<br>74 tons of carbon total |
| Construction of New Maintenance Building, Housing, and Helipad | 774 cubic yards of concrete: 58 gallons of diesel fuel<br>20 trips on the barge: 4,000 gallons of diesel fuel<br>Total of 4,058 gallons of diesel fuel<br>45 tons of carbon total |
| Recreational Improvements | Negligible |
| Totals | 330 |

**TABLE 2: ALTERNATIVE 2 EMISSIONS**

| | Alternative 2 |
|---|---|
| Road Rehabilitation and/or Reroutes | 3,571 cubic yards of fill: 268 gallons of diesel fuel<br>2,054 cubic yards of asphalt: 154 gallons of diesel fuel<br>1,134 hours of excavator use: 3,600 gallons of diesel fuel<br>150 hours of roller use: 900 gallons of diesel fuel<br>76 trips on the barge: 15,200 gallons of diesel fuel<br>Total of 517,834 gallon of diesel fuel<br>22.2 pounds of carbon burned per gallon of fuel (EPA 2009)<br>259 tons of carbon total |
| Erosion Protection Measures | 580 cubic yards of fill: 44 gallons of diesel fuel<br>30 trips on the barge: 6,000 gallons of diesel fuel<br>40 hours of excavator use: 240 gallons of diesel fuel<br>4317 cubic yards of asphalt: 324 gallons of diesel fuel<br>400 hours of roller use: 2,400 gallons of diesel fuel<br>Total of 199,978 gallons of diesel fuel<br>100 tons of carbon total |
| Construction of New Maintenance Building, Housing, and Helipad | 774 cubic yards of concrete: 58 gallons of diesel fuel<br>20 trips on the barge: 4,000 gallons of diesel fuel<br>Total of 4,058 gallons of diesel fuel<br>45 tons of carbon total |
| Recreational Improvements | Negligible |
| Totals | 404 tons of carbon |

**TABLE 3: ALTERNATIVE 3 EMISSIONS**

| | Alternative 3 |
|---|---|
| Road Rehabilitation and/or Reroutes | 3,285 cubic yards of fill: 246 gallons of diesel fuel<br>2,054 cubic yards of asphalt: 154 gallons of diesel fuel<br>1,050 hours of excavator use: 6,300 gallons of diesel fuel<br>100 hours of roller use: 600 gallons of diesel fuel<br>69 trips on the barge: 13800 gallons of diesel fuel<br>Total of 468,420 gallon of diesel fuel<br>22.2 pounds of carbon burned per gallon of fuel (EPA 2009)<br>234 tons of carbon total |
| Erosion Protection Measures | 580 cubic yards of fill: 44 gallons of diesel fuel<br>35 trips on the barge: 7,000 gallons of diesel fuel<br>60 hours of excavator use: 360 gallons of diesel fuel<br>4,317 cubic yards of asphalt: 324 gallons of diesel fuel<br>400 hours of roller use: 2,400 gallons of diesel fuel<br>Total of 146,682 gallons of diesel fuel<br>112 tons of carbon total |
| Construction of New Maintenance Building, Housing, and Helipad | 774 cubic yards of concrete: 58 gallons of diesel fuel<br>20 trips on the barge: 4,000 gallons of diesel fuel<br>Total of 4,058 gallons of diesel fuel<br>45 tons of carbon total |
| Recreational Improvements | Negligible |
| Totals | 391 |

**TABLE 4: ALTERNATIVE 4 EMISSIONS**

| | Alternative 4 |
|---|---|
| Road Rehabilitation and/or Reroutes | 9,887 cubic yards of fill: 741.5 gallons of diesel fuel<br>1,439 cubic yards of asphalt: 108 gallons of diesel fuel<br>600 hours of excavator use: 3,600 gallons of diesel fuel<br>350 hours of roller use: 2,100 gallons of diesel fuel<br>62 trips on the barge: 12,400 gallons of diesel fuel<br>Total of 18,950 gallon of diesel fuel<br>22.2 pounds of carbon burned per gallon of fuel (EPA 2009)<br>210 tons of carbon total |
| Erosion Protection Measures | 4,317 cubic yards of asphalt: 108 gallons of diesel fuel<br>400 hours of roller use: 2,400 gallons of diesel fuel<br>48 trips on the barge: 9,600 gallons of diesel fuel<br>1,480 of cubic yards fill: 111 gallons of diesel fuel<br>40 excavator hours: 240 gallons of diesel fuel<br>Total of 12,459 gallons of diesel fuel<br>138 tons of carbon total |
| Construction of New Maintenance Building, Housing, and Helipad | 774 cubic yards of concrete: 58 gallons of diesel fuel<br>20 trips on the barge: 4,000 gallons of diesel fuel<br>Total of 4,058 gallons of diesel fuel<br>45 tons of carbon total |
| Recreational Improvements | Negligible |
| Totals | 393 |

# APPENDIX 15: LAWS, REGULATIONS, AND POLICIES WHITEPAPER

## Select Laws, Regulations and Policies Concerning Flood Control and Erosion Prevention in the Lower Stehekin Valley, Lake Chelan National Recreation Area

Stehekin River in vicinity of Lake Chelan NRA

## Introduction

The Lower Stehekin Valley is located at the head of Lake Chelan in Chelan County Washington. Land ownership in the Lower Stehekin Valley includes a patchwork of public land managed by the National Park Service (NPS) as part of Lake Chelan National Recreation Area, and approximately 460 acres of private lands referred to as the Community of Stehekin. The Stehekin Community is an unincorporated settlement of year-round and summer homes and scattered tourism-related businesses. The Stehekin Community was founded in the late 1800's, and some of the residents who live there today are descendents of the original homesteaders to the area.

One common thread that binds the valley is the Stehekin River, a beautiful, free-flowing river that drains into upper Lake Chelan. The Stehekin River has meandered throughout the Lower Stehekin Valley over time immemorial, routinely changing its course in response to the dynamic conditions of the surrounding landscape it flows through. Those who first homesteaded in the area often settled in the floodplain because it was only flat, relatively fertile ground. This pattern of development continued for many years because there were relatively few notable floods and there was a general lack of regulatory oversight in the area.

In the early to middle 20$^{th}$ century the river channel was modified using available technology in order to mine gravel, remove logjams and to attempt to reduce the impacts of flooding and erosion on private property and government facilities. These efforts continued through the early years following designation of the area as a unit of the National Park Service. Since then, federal and state laws, regulations and policies have changed—generally moving away from permitting river manipulation toward encouraging greater protection of natural resources and recognizing the long-term fiscal impacts of ongoing manipulation. Since the creation of Lake Chelan NRA other significant legislation has been enacted by Congress and Washington State, further contributing to the complex body of federal, state and local laws, regulations and policies affecting Lake Chelan National Recreation Area and the private lands within the unit.

In the last 15 years, the Stehekin Valley has experienced a sustained increase in the magnitude and frequency of flooding. Houses have been damaged and destroyed, and areas that never flooded or eroded in the past are now threatened--even during relatively modest flows such as those that accompany spring snowmelt. These conditions present a considerable challenge to landowners and residents who live in the floodplain and are seeking solutions to protect their property. These circumstances also present a considerable challenge to the National Park Service, which must protect and manage an infrastructure of roads and facilities that are impacted by this dynamic river.

Any flood protection and erosion control work in or near water involves a complicated regulatory framework. The National Park Service, in consultation with various the various regulatory agencies, has compiled this whitepaper in an effort to inform all stakeholders about the laws, regulations and policies that may directly or indirect affect actions along the river. This whitepaper is by no means a treatise on all relevant laws and policies. Rather, it is a starting point for fostering a collective discussion, understanding and awareness of the regulatory constraints governing flood protection and erosion control.

## Enabling Legislation for Lake Chelan National Recreation Area

The Enabling Legislation for Lake Chelan National Recreation Area states:

> In order to provide for the public outdoor recreation use and enjoyment of portions of the Stehekin River and Lake Chelan, together with surrounding lands, and for the

> conservation of the scenic, scientific, historic, and other values contributing to public enjoyment of such lands and waters··· (Sec. 202, Public Law 90-544, October 2, 1968).

### Relevance to Lake Chelan and Stehekin River

The enabling legislation for Lake Chelan NRA does not speak specifically to issues regarding flooding on the Stehekin River. Rather, it designates the National Park Service as the federal land management agency with administrative jurisdiction over the federal lands within the area, and it directs the NPS to··· "utilize such statutory authorities pertaining to the administration of the national park system, and such statutory authorities otherwise available to him for the conservation and management of natural resources as he deems appropriate for recreation and preservation purposes and for resource development compatible therewith." (Title IV, Administrative Provisions).

Title III, Section 301 of the Enabling Legislation authorizes the NPS to acquire lands by donation, purchase, or exchange as follows:

> Within the boundaries of the park and recreation areas, the Secretary of the Interior…may acquire lands, waters, and interests therein by donation, purchase with donated or appropriated funds, or exchange, except that he may not acquire any such interests within the recreation areas without the consent of the owner, so long as the lands are devoted to uses compatible with the purposes of this Act.

The NPS has used this authority, in part, to acquire private lands adjacent to the Stehekin River in order to protect the river and its floodplain.

Section 301 of the Enabling Legislation also protects the rights of the private landowner by prohibiting the NPS from acquiring land "so long as the lands are devoted to uses compatible with the purposes of the enabling Act." There is no statutory definition of a "compatible use" in the Enabling Legislation. Instead, the issue of compatibility is specifically addressed in the Land Protection Plan Elements of the 1995 General Management Plan for Lake Chelan NRA. These elements outline the criteria the NPS would consider to ensure private land uses are compatible with the purposes for which Lake Chelan NRA was established. The criteria are not intended to duplicate county zoning standards or other applicable land use practices that are the proper purview of Chelan County. Rather, the criteria are intended to guide park management and private landowners in determining which land use proposals and practices are incompatible with the purposes of Lake Chelan NRA. If incompatible uses are indentified, they could subject the property to potential acquisition via the use of federal eminent domain powers—but only when all other prudent and reasonable attempts to remove or mitigate the incompatibility have failed.

The NPS has never exercised eminent domain powers in Stehekin. However, the NPS does have the authority to do so if, for example, adverse flood protection and/or erosion control measures on private land substantially threaten the resources and values of Lake Chelan NRA, including the Stehekin River. Again, the NPS would only exercise such authority if all other prudent and reasonable attempts to remove or mitigate the incompatible use have failed.

## National Park Service Organic Act of 1916

This law (and subsequent amendments) created the National Park Service and authorized it to manage lands under its jurisdiction as follows:

> [The National Park Service] shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified… by such

> means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Since 1916, Congress has established hundreds of areas of land and water as units of the National Park System. Today the system includes National Parks, National Monuments, National Seashores, National Lakeshores, National Historic Parks, Parkways, and National Recreation Areas, and National Recreation Areas, including Lake Chelan National Recreation Area.

Congress amended this Act on March 27, 1978 (the act expanding Redwoods National Park) with the addition:

> The authorization of activities shall be construed in light of the high public value and integrity of the National Park System and shall not be exercised in degradation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress. (16 USC 1a-1)

The NPS Organic Act, as amended in 1978 (10 year after creation of Lake Chelan NRA) is significant to Lake Chelan NRA because Congress made it clear that all units of the system, including Lake Chelan NRA, are equally protected by law without regard to the various titles (e.g., National Park versus National Recreation Area). It further emphasized that while each unit of the System is to be managed according to its specific enabling legislation, each unit is also subject to the purposes and mandates established by the Organic Act to the extent that those mandates do not conflict with the provisions of the units enabling legislation.

### Relevance to Lake Chelan and Stehekin River

The NPS Organic Act and subsequent laws related to the Nation Park System further clarify that the NPS does not have the discretion to authorize activities that are incompatible with, or would otherwise impair, the recreational, scenic, scientific, historic, and other values of Lake Chelan NRA, including Lake Chelan and the Stehekin River.

## Appropriations Bill for the Department of Interior, H.R. 1977, Title I, Section 117

Congress, in response to the identified need in the Lake Chelan GMP/EIS for legislation to authorize the NPS to maintain the Company Creek Road, provided the following authorization:

> Notwithstanding Public Law 90-544, as amended, the National Park Service is authorized to expend appropriated funds for maintenance and repair of the Company Creek Road in the Lake Chelan National Recreation Area: Provided that appropriated funds shall not be expended for the purpose of improving the property of private individuals unless specifically authorized by law.

### Relevance to Lake Chelan and Stehekin River

This law authorizes, but does not mandate, the NPS to maintain the Company Creek and repair it in the event of flood damage. The law specifically prohibits the NPS from spending money to “improve” private property; this includes spending NPS funds to protect private property from impacts caused by flooding.

The current General Management Plan for Lake Chelan NRA provides the following criteria for determining whether or not the NPS would take action to protect public roads from flooding:

1. There are no feasible alternatives;
2. Funds are available;
3. The actions will have less impacts than other alternatives;
4. The actions are permitted by county, state, and other federal agencies.

To date the NPS has successfully worked within these criteria to repair and maintain roads in the Lower Stehekin Valley, including the Upper Company Creek Road. But given the consistent increase in flood frequency and intensity experienced in the past decade, foreseeable circumstances could arise (e.g., lack of funds or severe flood damage) in which these criteria could no longer be met and the NPS would be forced to abandon maintaining the Upper Company Creek Road.

## National Park Service Management Policies 2006

Management of Lake Chelan National Recreation area must be guided by the Constitution, public laws, proclamations, Executive Orders, regulations and directives of the Secretary of the Interior. This collective legal and regulatory framework has various ambiguities and details not addressed by Congress, the President and/or the Secretary of the Interior. Therefore, like other federal state and local agencies the NPS develops policy to interpret ambiguities and provide an objective, consistent framework for all management decisions. The NPS Management Policies are periodically updated, and *NPS Management Policies* 2006 is the latest version. Completed after extensive public and agency review and comment, this document applies to all units in the national park system, including Lake Chelan National Recreation Area. The following service wide policies regarding § 4.6 Water Resources Management, apply to potential erosion and flood control measures in Lake Chelan NRA:

## Water Quality, §4.6.3

The pollution of surface waters and groundwaters by both point and nonpoint sources can impair the natural functioning of aquatic and terrestrial ecosystems and diminish the utility of park waters for visitor use and enjoyment. The Service will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the parks. The Service will:

- work with appropriate governmental bodies to obtain the highest possible standards available under the Clean Water Act for the protection for park waters;
- take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks, consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations; and
- enter into agreements with other agencies and governing bodies, as appropriate, to secure their cooperation in maintaining or restoring the quality of park water resources.

## Floodplains, §4.6.4

In managing floodplains on park lands, the National Park Service will (1) manage for the preservation of floodplain values; (2) minimize potentially hazardous conditions associated with flooding; and (3) comply with the NPS Organic Act and all other federal laws and executive orders related to the management of activities in flood-prone areas, including Executive Order 11988 (Floodplain Management), the National Environmental Policy Act, applicable provisions of the Clean Water Act, and the Rivers and Harbors Appropriation Act of 1899. Specifically, the Service will:

- protect, preserve, and restore the natural resources and functions of floodplains;
- avoid the long- and short-term environmental effects associated with the occupancy and modification of floodplains; and
- avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks.

When it is not practicable to locate or relocate development or inappropriate human activities to a site outside and not affecting the floodplain, the Service will:

- prepare and approve a statement of findings, in accordance with procedures described in Director's Order 77-2 (Floodplain Management);
- use nonstructural measures as much as practicable to reduce hazards to human life and property while minimizing the impact to the natural resources of floodplains;
- ensure that structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60).

## Wetlands, §4.6.5

The Service will manage wetlands in compliance with NPS mandates and the requirements of Executive Order 11990 (Protection of Wetlands), the Clean Water Act, the Rivers and Harbors Appropriation Act of 1899, and the procedures described in Director's Order 77-1 (Wetland Protection). The Service will (1) provide leadership and take action to prevent the destruction, loss, or degradation of wetlands; (2) preserve and enhance the natural and beneficial values of wetlands; and (3) avoid direct and indirect support of new construction in wetlands unless there are no practicable alternatives and the proposed action includes all practicable measures to minimize harm to wetlands. The Service will implement a "no net loss of wetlands" policy. In addition, the Service will strive to achieve a longer term goal of net gain of wetlands across the national park system through restoration of previously degraded or destroyed wetlands.

When natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human actions, the Service will, to the extent practicable, restore them to predisturbance conditions. The Service will conduct or obtain parkwide wetland inventories to help ensure proper planning with respect to the management and protection of wetland resources. Additional, more detailed wetland inventories will be conducted in areas that are proposed for development or are otherwise susceptible to degradation or loss due to human activities.

In managing floodplains on park lands, the National Park Service will (1) manage for the preservation of floodplain values; (2) minimize potentially hazardous conditions associated with flooding ; and (3) comply with the NPS Organic Act and all other federal laws related to the management of activities in flood-prone areas. Specifically, the Service will:

- protect, preserve, and restore the natural resources and functions of floodplains;
- avoid the long- and short-term environmental effects associated with the occupancy and modification of floodplains; and
- avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks.

When it is not practicable to locate or relocate development or inappropriate human activities in a site outside and not affecting the floodplain, the Service will:

- prepare and approve a statement of findings…
- use nonstructural measures as much as practicable to reduce hazards to human life and property while minimizing the impact to the natural resources of floodplains;
- ensure that structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60).

When practicable, the Service will not simply protect but will seek to enhance natural wetland values by using them for educational, recreational, scientific, and similar purposes that do not disrupt natural wetland functions. For proposed new development or other new activities, plans, or programs that are either located in or otherwise could have adverse impacts on wetlands, the Service will employ the following sequence:

- Avoid adverse wetland impacts to the extent practicable.
- Minimize impacts that cannot be avoided.
- Compensate for remaining unavoidable adverse wetland impacts by restoring wetlands that have been previously destroyed or degraded.

Compensation for wetland impacts or losses will require that at least 1 acre of wetlands be restored for each acre destroyed or degraded.

Actions proposed by the Park Service that have the potential to cause adverse impacts on wetlands must be addressed in an environmental assessment or an environmental impact statement. If the preferred alternative will result in adverse impacts on wetlands, a statement of findings must be prepared and approved in accordance with Director's Order #77-1: Wetland Protection.

## Watershed and Stream Processes, §4.6.6

The Service will manage watersheds as complete hydrologic systems and minimize human-caused disturbance to the natural upland processes that deliver water, sediment, and woody debris to streams. These processes include runoff, erosion and disturbance to vegetation and soil caused by fire, insects, meteorological events, and mass movements.

The Service will manage streams to protect stream processes that create habitat features such as floodplains, riparian systems, woody debris accumulations, terraces, gravel bars, riffles, and pools. Stream processes include flooding, stream migration, and associated erosion and deposition.

The Service will protect watershed and stream features primarily by avoiding impacts on watershed and riparian vegetation and by allowing natural fluvial processes to proceed unimpeded. When conflicts between infrastructure (such as bridges and pipeline crossings) and stream processes are unavoidable, NPS managers will first consider relocating or redesigning facilities rather than manipulating streams. Where stream manipulation is unavoidable, managers will use techniques that are visually nonobtrusive and that protect natural processes to the greatest extent practicable.

## General Management Plan, Lake Chelan National Recreation Area (NPS 1995)

The 1995 General Management Plan for Lake Chelan National Recreation Area (NPS, 1995) provides the most site-specific policy guidance to the NPS for administration of Lake Chelan NRA. The General Management Plan (GMP) provides guidance on managing visitor use, natural and cultural resources, development and operation of Lake Chelan NRA according to the previously cited enabling legislation for Lake Chelan NRA, the Organic Act, and other laws and regulations affecting management of the NRA. The following sections of the 1995 GMP and its associated Implementation Plans provide the policy guidance relevant to flood and erosion control measures (page numbers provided for reference):

- The Park Service would not manipulate the Stehekin River to protect federal property except roads and bridges according to the following criteria. Existing public roads would be protected in erosion/river conflict zones only if (1) there are no feasible alternatives, (2) funds are available, (3) proposed actions would have lesser impacts than other alternatives, and (4) the proposed actions are permitted by the county, state, and other federal agencies. No new road construction would be proposed in active river/erosion conflict zones (p. 20).
- The Park Service would not manipulate the river to protect private property. No actions would be taken to prevent private owners from manipulating the river on their land to protect private property unless such actions would significantly harm recreation area resources or were in violation of local, state, or federal ordinances, regulations or laws (p.20).
- The National Park Service would manipulate woody debris in the Stehekin River or its tributaries only to protect public roads and bridges…Woody debris would not be removed from the river system in any case. The Park Service would not remove or manipulate woody debris on public land or water to protect private property (p. 23)
- The Company Creek Road would be maintained in its current alignment and condition. Three erosion control systems along the upper Company Creek road would be removed and replaced. The structures would be designed to keep the road from eroding during frequently recurring flood events (i.e., 10- to 25-year recurrence interval), and they would be made from rock, soil, and native vegetation (p.34).
- **Sand, Rock, and Gravel Plan**: Sand, rock, and gravel will be conserved and recycled whenever possible…To ensure conservation of sand, rock, and gravel, the National Park Service proposes to limit the use of in-park material to 1,400 cubic yards per year: 1,200 cubic yards for NPS use and 200 cubic yards per year for private use over a proposed 10-year excavation cycle…In the event of a large flood, the remaining 10-year stockpile could be used in one year… The superintendent will have the option to exceed the established limit in the event of an emergency such as a major flood (pp.3, 10, 11).

- **Transportation Plan**: Erosion control systems along the Upper Company Creek Road will be removed and replaced, designed to keep the road from eroding during frequently recurring flood events (i.e., 10- to 25-year recurrence interval), and will be made from rock, soil, and native vegetation…public roads will be protected in active river erosion zones only if (1) there are no feasible alternatives; (2) funds are available; (3) the actions will have less impacts than other alternatives; and (4) the actions are permitted by county, state, and other federal agencies (p.9).
- **Stehekin Landing and Valley Development Concept Plan**: The natural character of the lake and river edge on public lands (which includes areas within 200 feet of the lake and river shoreline) will be restored (p.1).

## Clean Water Act, as Amended

The "Clean Water Act" refers to several pieces of legislation including the Water Pollution Control Act Amendments of 1972 (Public Law 92-500), the Clean Water Act Amendments of 1977, and the Water Quality Act (Clean Water Act) of 1987. The goal of the Clean Water Act is to make Nation's waters fishable, swimmable and drinkable by restoring and maintaining the chemical, physical and biological integrity of the waters of the United States. The Clean Water Act is far reaching. This discussion focuses specifically on Sections 404 and 401 of the Clean Water Act, since those sections would partially govern actions on the Stehekin River, its tributaries or adjacent wetlands.

## Section 404 of the Clean Water Act

Section 404 of the Clean Water Act authorizes the Secretary of the Army, acting through the Army Corps of Engineers, to issue permits for the discharge of dredged or fill materials into waters of the U.S. The Corps must base its permit decisions on guidelines developed by the Environmental Protection Agency in conjunction with the Corps. EPA has the authority to veto any permit granted by the corps. The Corps issues either General (or "Nationwide") Permits or Individual permits, depending upon the nature of the proposed work. Nationwide permits are issued for smaller projects involving less potential for impact to waters of the United States than individual permits.

## Section 401 Water Quality Certification

Authority for administration of Section 401 in Washington State is delegated to the Department of Ecology. A water quality certification is required for any activities that (a) might result in a discharge of dredge or fill material into water or non-isolated wetlands; or (b) involve excavation in water or non-isolated wetlands and require a federal permit or license. The 401 Certification can cover both the construction and operation of the proposed project. Issuance of a 401 Certificate means that the Department of Ecology anticipates that the applicant's project will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority. Conditions of the 401 Certification become conditions of the permit issued by the Corps.

The Department of Ecology has already reviewed and approved, denied or partially denied the various Nationwide permits issued by the Corps. If a specific nationwide permit has already been approved, no further 401 Certification review by Ecology is required. If a nationwide permit has been partially denied, then an individual certification or Letter of Verification from Ecology may be required. If a nationwide permit has been denied, then an individual certification is required for all activities under that nationwide permit.

### Relevance to Stehekin River and Lake Chelan

Lake Chelan, the Stehekin River and its tributaries, and adjacent wetlands are all waters of the United States and thus regulated in part under Section 404 of the Clean Water Act. Proposals for flood protection and/or erosion control that may affect these waters must obtain a 404 permit and/or 401 water quality certification before proceeding. In Washington State, a Joint Aquatic Resources Permit Application (JARPA) initiates the Corps' review under Section 404, and Ecology's review for shoreline, floodplain and 401 certification requirements. Both the Corps and Ecology can place conditions on permit applications as they relate to these programs.

### Contacts

U.S. Army Corps of Engineers Regulatory Branch, Seattle District
Post Office Box 3755
Seattle, WA 98124-2255
Telephone (206) 764-3495

Department of Ecology, Office of Regulatory Assistance
Environmental Permitting Service
300 Desmond Drive
PO Box 47600
Olympia, WA 98504-7600

Regional Contact:
Gary Graff, Washington Department of Ecology
Central Regional Office
15 West Yakima Ave., Suite 200
Yakima, WA 98902-3401
gagr461@ecy.wa.gov
(509) 454-4260

### Internet Links

More information on Nationwide permits can be obtained online at:
http://www.usace.army.mil/cw/cecwo/reg/nationwide_permits.htm

## Wild and Scenic Rivers Act

The National Wild and Scenic Rivers Act of 1968 established a national policy that certain selected rivers of the nation and their immediate environments shall be preserved and protected for the benefit and enjoyment of present and future generations. The Act specifically preserves designated rivers (or river segments) and their adjacent environments if they are free-flowing and "…possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values…" Rivers, or sections of rivers designated under the Act must be preserved in their "free-flowing condition" and cannot be dammed or otherwise modified in such a manner that would adversely affect the "outstandingly remarkable values" which contribute to designation.

The Act provides three levels of designation for rivers or river sections: wild rivers, scenic rivers and/or recreational rivers. Wild river areas are considered the most primitive and pristine; they must be unpolluted, free of impoundments and generally inaccessible (except by trail), with undeveloped watersheds and shorelines. Scenic rivers must also be free of impoundments and have largely primitive shorelines, but can be accessible in places by roads. Recreational rivers or sections of rivers can be readily accessible by road, may have some shoreline development, and may have undergone some impoundment or diversion in the past.

Rivers can be added to the national Wild and Scenic Rivers System in one of two ways.

The traditional way is for Congress to pass Wild and Scenic legislation that is signed into law by the President (similar to wilderness). The other way is for the Governor of a state to petition the Secretary of the Interior to add a river to the system.

Wild and Scenic designation does not affect a private landowners' ability to develop privately owned lands within the river corridor. On federally owned land, however, future development along a designated wild, scenic or recreational river is allowed as long as it is consistent with the river's classification, and does not harm the values which contributed to designation.

### Relevance to Stehekin River and Lake Chelan

The Stehekin River and its tributaries have never been designated as part of the Wild and Scenic Rivers System. In addition, neither the Stehekin River nor any of its tributaries are part of the Washington state Scenic Rivers System. Therefore, currently the only way the river could be included in the system is via affirmative congressional action, and no action is believed pending or contemplated by Congress as of this writing.

As an internal matter the NPS in 2002 evaluated the Stehekin River and its tributaries for its eligibility for inclusion in the National Wild and Scenic Rivers System, and determined the entire watershed of the Stehekin River is eligible for designation (Finlayson, 2002). The eligibility analysis was prompted by management guidance in the 1995 General Management Plan for Lake Chelan NRA, and the miscellaneous provisions of a 1991 Consent Decree[1] between the Secretary of the Interior and the North Cascades Conservation Council. A brief summary of the eligibility report follows, along with its implications for river-related management actions on the part of the NPS.

The eligibility analysis used two criteria to evaluate the river's eligibility in accordance with the Act: (1) the "Free-flowing" condition of the river; and (2) the river's "Outstandingly Remarkable Values" including fish, wildlife, vegetation, prehistoric and historic resources, geology, scenery and recreation. The "Free-flowing" criterion was evaluated by dividing the river into three segments in light of differences in human activity and development along its shoreline. Segment 1 extends from the mouth of the Stehekin River to High Bridge (the segment within Lake Chelan NRA); segment 2 extends from High bridge to Cottonwood Camp; and segment 3 from Cottonwood Campground to the headwaters. To evaluate the "outstandingly remarkable values" criterion, all three segments were considered collectively.

All three segments of the Stehekin River were determined to be eligible for inclusion in the Wild and Scenic Rivers System due to its generally free-flowing condition and outstandingly remarkable values, including wildlife, fish, prehistoric, historic, geologic, scenic and recreational resources. The river's

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[1] A judgment whereby the defendant agrees to stop the activity that was asserted to be illegal, without admitting wrongdoing or guilt.

vegetation, however, was found to be exceptional but not sufficiently unusual to contribute to eligibility. Segment 1 was classified as "Recreational" due to higher levels of development and road/bridge accessibility. Segment 2 was classified as "Scenic" in light of very limited road accessibility and shoreline development. Segment 3 was classified as "Wild" because except for a few trails it is completely undeveloped.

The Stehekin River Eligibility Report places the Stehekin River in the category of an "Agency Identified, 5(d)(1) Study River". This administrative determination carries no direct legal authority, but does lay the foundation for future designation of the river should the U.S. Congress choose to do so. The eligibility finding does, however, influence NPS management actions that could potentially affect the river's "Free-flowing" characteristics or the various "Outstandingly Remarkable Values" that contribute to its eligibility. In accordance with guidance from the Interagency Wild and Scenic Rivers Coordinating Council, and Section 4.3.4 of NPS Management Policies 2006, the NPS must avoid taking management actions that would adversely affect the "Free-flowing Condition" and "Outstandingly Remarkable Values" that qualify the river for inclusion in the National Wild and Scenic Rivers System.

## Rivers and Harbors Act

Various sections of the Rivers and Harbors Act of 1899 prevent unauthorized obstruction or alteration of any navigable water of the United States. The most frequently exercised authority is contained in Section 10 (33 U.S.C. 403) which covers construction, excavation, or deposition of materials in, over, or under such navigable waters, or any work which would affect the course, location, condition, or capacity of those waters.

The jurisdiction of the Rivers and Harbors Act of 1899 includes all navigable waters of the United States, defined in 33 CFR Part 329 as, "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce." Note: The Clean Water Act also uses the term "navigable waters"; however, the term "navigable waters" in section 404 of the Clean Water Act generally encompasses Section 10 waters plus their tributaries and adjacent wetlands and isolated waters where the use, degradation or destruction of such waters could affect interstate or foreign commerce.

The Secretary of the Army, acting through the Army Corps of Engineers, is authorized to issue Section 10 permits. The basic form of authorization used by Corps is the individual permit. In Washington, the process for obtaining a Section 10 permit begins with submittal of a Joint Aquatic Resources Permit Application. Once a complete application is received by the Corps, the formal review process begins. This process involves a public notice and evaluation of the impacts of the project and all comments received. The permit decision document includes a discussion of the environmental impacts of the project, the findings of the public interest review process, and any special evaluation required by the type of activity.

### Relevance to Stehekin River and Lake Chelan

The Corps has designated Lake Chelan as a navigable water, so a Section 10 Permit is required for any actions that could obstruct or otherwise affect navigation on Lake Chelan proper. The Corps has not designated the Stehekin River as a navigable river. Instead, the Corps considers the Stehekin River as a "traditional navigable water" (pers. comm. Debbie Knaub, ACOE, 8/30/07). As a "traditional navigable water", the Corps does not regulate the Stehekin River under Section 10 of the Rivers and Harbors Act. The Corps does, however, regulate the Stehekin River, its tributaries and adjacent wetlands under Section 404 of the Clean Water Act.

### Contact

U.S. Army Corps of Engineers Regulatory Branch, Seattle District
Post Office Box 3755
Seattle, WA 98124-2255
Telephone (206) 764-3495

## Endangered Species Act, as Amended

The purpose of the ESA is to protect and recover imperiled species and the ecosystems upon which they depend. It is administered by the Interior Department's U.S. Fish and Wildlife Service (FWS) and the Commerce Department's National Marine Fisheries Service (NMFS). The FWS has primary responsibility for terrestrial and freshwater organisms, while the responsibilities of NMFS are mainly marine species such as salmon and whales.

Under the ESA, species may be listed as either "endangered" or "threatened." Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. All species of plants and animals, except pest insects and non-native species, are eligible for listing as endangered or threatened.

The ESA protects listed species and their habitats by prohibiting the "take" of listed animals and the interstate or international trade in listed plants and animals, including their parts and products, except under federal permit. Such permits generally are available only for certain conservation and scientific purposes. Take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Through regulations, the term "harm" is defined as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." Listed plants are not protected from take, although it is illegal to collect or maliciously harm them on federal lands.

Section 7 of the ESA requires all federal agencies including the NPS to use their legal authorities to promote the conservation purposes of the law. This section also requires federal agencies to consult with the FWS or NMFS to ensure that actions they authorize, fund, or carry out will not jeopardize listed species.

Section 10 of the ESA provides relief to private landowners who want to develop land inhabited by listed species. Landowners can receive a permit for the take of a listed species that may occur incidental to otherwise legal activities, provided they have developed an approved habitat conservation plan (HCP). HCPs include an assessment of the likely impacts on the species from the proposed action, the steps that will be taken to minimize and mitigate those impacts, and the funding available to carry out those steps. When the FWS approves the HCP, the landowner can apply for an "incidental take" permit, which allows him/her to proceed with the proposed action. HCPs benefit not only the landowners but also the species by securing and managing important habitat.

## Washington State-Listed Species

Washington State has various administrative codes that are somewhat analogous to the U.S. Endangered Species Act. The state maintains a "Species of Concern List" that includes species native to Washington and listed as Endangered, Threatened, or Sensitive, or as Candidates. The designations of

Endangered, Threatened, and Sensitive species are legally established in Washington Administrative Code 232-12-297, Endangered, threatened, and sensitive wildlife species classification. Candidate species are established by WDFW policy. Washington Administrative Code 232-12-011 provides that wildlife classified as protected shall not be hunted or fished.

## Relevance to Stehekin River and Lake Chelan

Several federal and state-listed species are believed to be present in the Lower Stehekin Valley within Lake Chelan NRA (table I). NPS Management Policies require the agency to preserve state-listed species in a manner similar to that of federally listed species, so those species currently listed under the Washington State Species of Concern List are also provided in table I.

Bull trout (Threatened) are the only federally listed species of fish historically found within the Stehekin River; however, the last confirmed catch of bull trout was in 1957 (Brown 1984). Once a tremendous attraction for anglers, bull trout may be extirpated because they have not been documented for 50 years despite numerous surveys.

**TABLE I. WASHINGTON STATE AND FEDERAL ENDANGERED (E), THREATENED (T), CANDIDATE (C) AND OTHER SENSITIVE SPECIES FOR WHICH THERE IS SUITABLE HABITAT IN THE LOWER STEHEKIN VALLEY.**

| Common Name | Scientific Name | Status | |
|---|---|---|---|
| | | Federal | State |
| Gray Wolf* | Canus lupus | E | E |
| Grizzly Bear* | Ursus arctos | T | E |
| Canada Lynx* | Lynx canadensis | T | T |
| Pacific Fisher* | Martes pennanti pacifica | C | E |
| California Wolverine* | Gulo gulo luteus | | C |
| Western Gray Squirrel | Sciurus griseus griseus | | T |
| Townsend’s Big-eared Bat | Corynorhinus townsendii | | C |
| Bald Eagle | Haliaeetus leucocephalus | T | T |
| Northern Spotted Owl | Strix occidentalis caurina | T | E |
| Northern Goshawk | Accipiter gentilis | | C |
| Golden Eagle | Aquila chrysaetos | | C |
| Merlin | Falco columbarius | | C |
| Flammulated Owl* | Otus flammeolus | | C |
| Vaux’s Swift* | Chaetura vauxi | | C |
| Lewis’ Woodpecker* | Melanerpes lewis | | C |
| Black-backed Woodpecker* | Picoides albolarvatus | | C |
| Pileated Woodpecker | Dryocopus pileatus | | C |
| Bull Trout* | Salvelinus confluentus | T | |
| Western Toad | Bufo boreas | | C |
| Columbia Spotted Frog* | Rana luteiventris | C | C |

Species unlikely to be present (or extirpated) are noted with an asterisk; these species are not tolerant of human activity (e.g., residential development, motorized vehicle use) or they lack sufficient habitat.

In accordance with the Endangered Species Act, the NPS is required to consult with the U.S. Fish and Wildlife Service regarding any action that may affect a listed species. Private landowners are generally exempt from the Endangered Species Act unless their actions harm a listed species or require approval from a federal agency. For example, a private landowner may be required to develop a Biological Evaluation (i.e., an analysis of potential adverse effects to federally listed species) in conjunction with a 404 permit application depending upon the nature of the proposed action. This requirement is necessary because the Army Corps of Engineers cannot knowingly issue a permit that may violate the Endangered Species Act.

### Regional Contact:

David Morgan, Biologist
US Fish and Wildlife Service, Central WA Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801

509-665-3508 extension 24

### Internet Links

More information on the Endangered Species Act can be obtained online at:
http://www.fws.gov/endangered

## Washington State Hydraulic Code

A Hydraulic Project Approval (HPA) from the Department of Fish and Wildlife under 75.20 RCW is required if a project includes construction or other work, that will use, divert, obstruct, or change the natural flow or bed of any fresh or salt water of the state. The purpose of this law is to ensure that construction or other related activities are done in a manner to prevent damage to the state's fish, shellfish, and their habitat. By applying for and following the provisions of the HPA issued under Chapter 77.55 RCW, most construction activities that affect the bed or flow of state waters can be allowed with little or no adverse impact on fish or shellfish. More information is available online at:
http://www.wdfw.wa.gov/hab/hpapage.htm

### Relevance to Stehekin River and Lake Chelan

Generally speaking, work below the Ordinary High Water Mark in the Stehekin River (or its tributaries) requires an HPA. In some instances, this requirement extends to dry channels and upland areas adjacent to water if the action has the potential to affect fish or fish habitat. For example, felling of trees from the bank into the Stehekin River, or removing a logjam, typically require an HPA.

### Contact

Bob Steele, Area Habitat Biologist
WDFW, Region 2
3860 Chelan Hwy. N. Wenatchee, WA 98801
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## Washington State Floodplain Management Act

The Washington State Floodplain Management Act (Flood Plain Management Chapter 86.16 RCW; Chapter 173-158 Flood Plain Management WAC) governs development, including fills, grading, in stream restoration, bank stabilization and other structures that occur within Flood Plain and Shoreline jurisdictions. The state Flood Plain Management Code requires a permit, typically issued by the local government, for any development as well as filling or grading activities within the 100 year floodplain. Proposed projects are reviewed and conditions imposed on any permits issued to reduce the potential for damage from floodwater. Permits are required for any development as well as for filling or grading activities in the floodplain. State law requires that local entities have a local floodplain ordinance that meets or exceeds National Flood Insurance Program (NFIP) requirements. Ecology has approval authority over these ordinances.

In Washington, communities with designated floodways must restrict land uses in the floodways by prohibiting the construction or reconstruction of residential structures except for:

- Repairs, reconstruction, or improvements to a structure which do not increase the ground floor area;
- Repairs, reconstruction, or improvements to a structure the cost of which does not exceed fifty percent of the market value of the structure either
  - Before the repair, reconstruction, or improvement is started
  - If the structure has been damaged, and is being restored, before the damage occurred.
- Work done on structures to comply with existing health, sanitary, or safety codes which have been identified by the local code enforcement or building official and are the minimum necessary to assure safe living conditions shall not be included in the fifty percent determination.

A residential dwelling located partially within a designated floodway is considered totally within a designated floodway and must comply with floodplain management regulations. Exemptions to the prohibitions include existing farmhouses in designated floodways that meet the provisions of WAC 173-158-075, or to residential dwellings other than farmhouses that meet the depth and velocity and erosion analysis provisions of WAC 173-158-076, or to structures identified as historical places.

When a regulatory floodway for a stream has not been designated, the Stehekin Community may require that applicants for new construction and substantial improvements reasonably utilize the best available information from a federal, state, or other source to:

- Consider the cumulative effect of existing, proposed and anticipated future development.
- Determine that the increase in the water surface elevation of the base flood will not be more than one foot at any point in the Stehekin Community.

Building and development near streams without a designated floodway shall comply with the requirements of 44 CFR 60.3 (b)(3) and (4), and (c)(10) of the NFIP regulations

## Agencies and Responsibilities

The Department of Ecology is responsible for coordinating the flood plain management regulation requirements of the National Flood Insurance Program. Local governments participating in the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency (FEMA) are required to review proposed development projects to determine if they are in identified floodplains as shown on the FEMA maps. If a project is located in a mapped 100-year floodplain (A or V zone), the local government must require that a permit be obtained prior to development.

While the local government (in this case Chelan County) issues the permit, Ecology has the authority to examine, approve or reject designs and plans for any structure or works, public or private, to be erected, built, reconstructed or modified along the banks, over the channel, over or across the floodway of any stream or body of water in Washington. Also, any other development, including filling and grading, must be reviewed and permitted by the local government. Ecology may also review proposed actions that are initiated under the Shoreline Management Act.

Other Ecology responsibilities under the Flood Plain Management Code include:

- Provide guidance and assistance to local governments in development and amendment of their flood plain management ordinances;
- Provide technical assistance to local governments in the administration of their flood plain management ordinances;
- Provide assistance to local governments in enforcement actions against any individual or individuals performing activities within the flood plain that are not in compliance with local, state, or federal flood plain management requirements
- Establish minimum state requirements that equal minimum federal requirements for the national flood insurance program
- Assist counties, cities, and towns in identifying the location of the one hundred year flood plain, and petitioning the federal government to alter its designations of where the one hundred year flood plain is located if the federally recognized location of the one hundred year flood plain is found to be inaccurate
- Assist communities in developing effective flood hazard management plans that reduce flood hazards and minimize environmental degradation
- Support communities in implementing flood damage reduction projects
- Conduct community evaluation visits to monitor their floodplain management programs and assure compliance with federal and state regulations
- Provide training to communities in floodplain management methods and procedures
- Provide materials and methods to improve public awareness of flood hazards

- Evaluate flood characteristics to develop recommendations on repairing or replacing substantially damaged residential structures located in regulatory floodway. Replacement or repair can only be recommended where:
  - Flood depths cannot exceed more than three feet; flood velocities cannot exceed more than three feet per second.
  - No evidence of flood-related erosion. Flood erosion will be determined by location of the project site in relationship to channel migration boundaries adopted by the local government. Absent channel migration boundaries, flood erosion will be determined by evidence of existing overflow channels and bank erosion.
- At the request of local government, the department will prepare a report of findings and recommendations for local government concurrence on repair or replacement of substantially damaged residential structures located in the regulatory floodway. Without a recommendation from the department for the repair or replacement of a substantially damaged residential structure located in the regulatory floodway, no repair or replacement is allowed.

### Legal Authority

- Chapter 173-158 Flood Plain Management WAC
- Chapter 86.16 Flood Plain Management RCW
- Title 42, Ch 50, S 4001 et seq USC
- Title 44, Ch I, S 60.3 CFR

### Relevance to Lake Chelan and Stehekin River

Portions of Lake Chelan National Recreation Area and the Stehekin Community are within the 100-year floodplain of the Stehekin River. Chelan County has an Ecology-approved floodplain management ordinance administered under County Code Chapter 3.20, Flood Hazard Development. The Chapter prohibits encroachments, including fill and other development, unless hydrologic and hydraulic analysis done by a registered professional engineer shows the encroachment will not result in any increase in flood levels during a 100-year flood event. The Stehekin River FEMA-approved flood plain study included a floodway designation. Structures within the floodway with damage greater than 50 percent market value cannot be replaced.

Chelan County also regulates structures in frequently flooded overlay district, which they define as the 100-year floodplain (Chapter 11.84 Chelan County Code). This section restricts development within the floodway including:

> (a) New lots may be created within frequently flooded areas, provided:
>
> A designated buildable area in each lot is provided for outside the floodway and is identified on the face of the final plat, short plat or binding site plan mylar;
>
> All improvements, including parking areas, are located outside the floodway;
>
> Roads necessary to access permitted improvements may cross the floodway if no reasonable route exists outside the floodway;
>
> Open space lots may be located within the one hundred-year floodplain;
>
> (b) No residential structures may be built or placed within a designated floodway.

### Contact

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## Washington State Shoreline Management Act

Development within Shoreline jurisdiction may require shoreline development permits including conditional use, substantial development and variance. Each local government has development regulations in its Shoreline Master Program. The local government shoreline regulations identify the "conditional uses," i.e., uses that are not preferred but may be permitted when specified conditions are met. Shoreline Conditional Use Permits are sent to Ecology for approval or disapproval. Ecology may add its own conditions during its review process.

A Shoreline Substantial Development Permit is a written permit issued by local government for development on shorelines. All non-exempt developments and uses exceeding $5,718 fair market value as defined in RCW 90.58.030(3) and WAC 173-27-030(8) may require this permit. After completion of the local process the permits are sent to Ecology for filing but Ecology does not have authority to approve or deny them.

### Agencies and Responsibilities

The local government and Washington Department of Ecology are responsible for managing and regulating development along state shorelines. All permit applications start at the local level but some require Ecology approval also. The local government then supplies the information to the Washington Department of Ecology.

Shoreline Conditional Use and Variance Permits are sent to Ecology for approval or disapproval. Ecology may add its own conditions during its review process. The state Shoreline regulations (173-27-160 WAC) establish criteria for reviewing conditional use permits. Conditional uses may be authorized provided that the applicant demonstrates all of the following:

- That the proposed use is consistent with the policies of RCW 90.58.020 and the master program;
- That the proposed use will not interfere with the normal public use of public shorelines;
- That the proposed use of the site and design of the project is compatible with other authorized uses within the area and with uses planned for the area under the comprehensive plan and shoreline master program;
- That the proposed use will cause no significant adverse effects to the shoreline environment in which it is to be located;
- That the public interest suffers no substantial detrimental effect.
- The cumulative impact of additional requests for like actions in the area must be considered. For example, if conditional use permits were granted for other developments in the area where similar circumstances exist, the total of the conditional uses shall also remain

consistent with the policies of RCW 90.58.020 (Shoreline Management Act) and shall not produce substantial adverse effects to the shoreline environment.

- Other uses which are not classified or set forth in the applicable master program may be authorized as conditional uses provided the applicant can demonstrate consistency with the requirements of this section and the requirements for conditional uses contained in the master program.

### Internet Links

Chapter 173-27 WAC: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-27&full=true
Chapter 90.58 RCW: http://apps.leg.wa.gov/rcw/default.aspx?cite=90.58&full=true

Shoreline Management Act home page: http://www.ecy.wa.gov/programs/sea/SMA/index.html
Shorelines Hearings Board: http://www.eho.wa.gov/Boards/SHB.asp

### Relevance to Stehekin River and Lake Chelan

Under Chelan County's Shoreline Master Program, shoreline conditional use, substantial development and variance permits may be required for bank stabilization projects. Excavation of > 250 $yd^3$ within 200 yards of shorelines of state significance (e.g., Stehekin River and Lake Chelan) may require a substantial development permit.

The Stehekin River and upper Lake Chelan have Conservancy Environment shoreline designation. In Chelan County's Shoreline Master Program Conservancy is defined as:

7.2.280.5 CONSERVANCY ENVIRONMENT – An area characterized by a potential for diffuse outdoor recreation activities timber harvesting on a sustained yield basis, passive agricultural uses such as pasture and range lands, and other related development.

Activities permitted in the Conservancy designation under the Chelan County Shoreline Master Program are:

- Agriculture permitted in the Conservancy designation cannot involve major construction or other activities which substantially change the character of the environment (Section 12.3.1).
- Timber harvesting is subject to Washington Department of Natural Resources Forest Practices Regulation. Within Shorelines only selective commercial timber harvest, a maximum of 30 percent merchantable trees in any 10 year period may be permitted (Section 14.1.2). In the Conservancy Environment designation, roads must be maintained to minimize erosion, or be permanently closed, water barred, reforested, or planted and seeded with appropriate ground cover (Section 14.3.2).
- Mining operations may be permitted in conformance with WDFW Hydraulic Permit and WDNR mining regulations.
- Single family residences with lot size and height restrictions (Section 16.1.2, 16.3.2)
- Multi-family residences may be permitted as Planned Development with restrictions on height (35 feet), setback (common line from OHWM), and parking lots
- Only water-related and water-dependent commercial development may be permitted

- Shoreline protection and structures (e.g., bulkheads and docks) may be permitted provided they don't substantially change the character of the environment and are part of a project defined as water dependent or water related and project would be not be feasible without the structures.
- Channelization of streams is prohibited except as provided in RCW 90.58.030 (3) (e) (Shoreline Management Act). There is no provision under this section of the Act that would allow channelization of the Stehekin River.
- Land filling is prohibited (Section 22.3) except it may be permitted when:
  - Fill is landward of the OHWM and does not affect aquatic habitat or organisms and water quality.
  - Needed to provide a minimum single-family residence building site where there would be no ability to build even given variances, the property is not more than 70 percent below the OHWM, there is public sewer or adequate on-site sewage treatment area, the property landward of the OHWM is owned by the land owner, the residence is < 2000 square feet, the land fill waterward of the OHWM follows the natural shoreline contours and is the minimum necessary to provide a buildable site. This provision mostly applies to Lake Chelan where water levels fluctuate due to dam operations.
  - Water dependent use that is recreational in nature and could not occur except by land filling.
  - Dredging may be permitted to accommodate water dependent uses (Section 23.3) provided spoils are placed landward of OHWM and where they won't cause environmental harm (e.g., avoid wetlands).
  - Public roads and bridges may be permitted where it is necessary to cross water and roads are setback from OHWM (Section 26.3).
  - Low intensity recreational uses such as nature trails, unimproved beaches, semi-developed campgrounds allowing vehicle access (Section 28.3).

Chelan County Code also includes geologic hazards overlay district where a development permit may be denied based upon an evaluation of the inability of to reduce risks associated with the geologically hazardous areas which include channel erosion and migration. Performance standards to be utilized include:

> (1) Construction methods should be used which minimize risks to structures and do not increase the risk to the site, or to adjacent properties and their structures, from the geologic hazard. Development shall not increase instability or create a hazard to the site or adjacent properties, or result in a significant increase in sedimentation or erosion.
>
> (2) Site planning should minimize disruption of existing topography and vegetation, and should incorporate opportunities for phased clearing.

### Other important information

Chelan County has received grant money from Ecology to update their Shoreline Master Program. Under the revised Shoreline Management regulations, Chelan County is required to map channel migration zones (CMZ). Within the channel migration zone, development or structures are limited to those which won't interfere with channel migration and won't require future bank stabilization, dikes or other control structures. Channel migration regulations are mostly addressed under the flood hazard reduction provisions of the state Shoreline Management regulations:

- Flood hazard provisions:
  - WAC 173-26-221(3)(b): Establishing general principle that SMP should limit development and shoreline modifications that would result in interference with the process of channel migration that may cause significant adverse impacts to property or public improvements and or result in a net loss of ecological functions associated with the rivers and streams.
  - WAC 173-26-221(3)(b)(i) - (vii): Describes more specific flood hazard prevention principles, including encouragement to plan for and facilitate removal of artificial restrictions to natural channel migration.
  - WAC 173-26-221(3)(c)(i): Standard generally prohibiting new development in shoreline jurisdiction where it would require new dikes or levees within the channel migration zone. Includes list of specific developments that may be appropriate exceptions to the standard.
- Modifications and Use provisions:
  - WAC 173-26-231(3): Fills must protect shoreline ecological functions, including channel migration processes.
  - WAC 173-26-231(3)(f): Requiring conditional use permit for disposal of dredge material on shorelands or wetlands within CMZs.
  - WAC 173-26-241(3)(ii)(E): Requiring conditional use permit for mining within channel migration zone.

Since Ecology has provided funding for the Stehekin River flood management plan (FCAAP grant) and the Shoreline Master Program update (Shoreline grant), Ecology’s role in coordination between the two activities will be important and necessary.

## Regional Contacts

Shoreline Master Program and Update

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(509)457-7125

Shoreline Permit Review, Wetlands, Critical Areas

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gagr461@ecy.wa.gov
(509) 454-4260

## Washington State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) provides a way to identify possible environmental impacts that may result from governmental decisions. These decisions may be related to issuing permits for private projects, constructing public facilities, or adopting regulations, policies or plans. Information provided during the SEPA review process helps agency decision-makers, applicants, and the public understand how a proposal will affect the environment. This information can be used to change a proposal to reduce likely impacts, or to condition or deny a proposal when adverse environmental impacts are identified.

In most cases, one state or local agency will be designated as the "SEPA lead agency". This agency is responsible for evaluating the proposal and determining if the proposal is likely to impact the environment. For most private projects, the SEPA lead agency will be the city or county where the project is located.

Any proposal that requires a state or local agency decision to license, fund, or undertake a project, or the proposed adoption of a policy, plan, or program can trigger environmental review under SEPA (See WAC 197-11-704 for a complete definition of agency action). SEPA is a process, not a permit. A schematic describing the SEPA process is provided in attachment I of WAC 197-11-704. The SEPA lead agency will review the environmental checklist and may request additional information or special studies.

### Internet Links

The State Environmental Policy Act Home Page http://www.ecy.wa.gov/programs/sea/sepa/e-review.html

### Statewide Contact

Washington Department of Ecology, SEPA Unit
Headquarters
SEPA Unit
PO Box 47703
Olympia, WA 98504-7703
Website: http://www.ecy.wa.gov/programs/sea/sepa/e-review.html

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# APPENDIX 16: CURRENT KNOWLEDGE BASE WHITEPAPER (DETACHED)

# APPENDIX 17: DRAFT FLOODPLAINS STATEMENT OF FINDINGS

## Stehekin River Corridor Implementation Plan
## Environmental Impact Statement
## Lake Chelan National Recreation Area

## *Statement of Findings for Floodplains*

**North Cascades NPS Complex**
**Sedro Woolley, Washington**

**Recommended:**

| | |
|---|---|
| Superintendent, North Cascades NPS Complex | Date |

**Concurred:**

| | |
|---|---|
| Chief, Water Resources Division | Date |

**Concurred:**

| | |
|---|---|
| Regional Safety Officer | Date |

**Approved:**

| | |
|---|---|
| Pacific West Regional Director | Date |

## Introduction

This Statement of Findings (SOF) was proposed as part of the Stehekin River Corridor Implementation Plan Draft Environmental Impact Statement (SRCIP DEIS). The Stehekin River Valley is the focal point of the Lake Chelan National Recreation Area (NRA) (Figure 1). Executive Order 11988 (Floodplain Management) requires the NPS to evaluate likely impacts of actions in floodplains. NPS Director's Order #77-2 (Floodplain Management) provides policy and procedural guidance for complying with these orders. This SOF documents compliance with these orders.

This SOF pertains to the NPS preferred alternative, Alternative 2, of the SRCIP DEIS, which is focused on protecting resources and NPS administrative facilities (Figure 2). While all major actions in this plan follow NPS policy to enhance natural floodplain values, two types of actions in Alternative 2 (preferred alternative) would impact floodplain values. One is the installation of erosion protection measures at four locations along the Stehekin River to protect the main Stehekin Valley Road. Three of the four locations are at the edge of the channel migration zone where the road cannot be relocated without major slope modification or extensive new road construction and where impacts to floodplain values are relatively moderate (Figure 3). The fourth site is within the channel migration zone near the Stehekin River mouth, where continued bank erosion could threaten the Stehekin Valley Road and water quality.

The other main action proposed in the SRCIP DEIS that impacts floodplain values is to change management of large woody debris on the lower 0.25 mile of the Stehekin River, below the outlet of Boulder Creek. This area is within the backwater zone of Lake Chelan and has seen a large increase in the volume of large wood. Under emergency conditions, large logjams in this area could be manipulated in the floodplain to relieve flooding of the main valley road and septic drain fields in the densely developed river mouth. However, the wood taken from this area could only be used in the channel migration zone for erosion protection and/or riparian restoration projects. The NPS and private landowners could obtain large woody debris off the tops of large logjams in the backwater zone for erosion protection/restoration projects under a permit system and strict conditions to protect the integrity of jams.

The Stehekin Valley Road would be rerouted out of flood-prone McGregor Meadows, allowing the floodplain to utilize this section of the valley and the river to eventually create new riparian habitat. An access road would be maintained for private residents, but the road would be at grade and subject to periodic flooding. The access road would be about 0.8 mile long, with about 0.25 mile in the floodplain. It would end at the last parcel of private property in McGregor Meadows, and could be shortened if private parcels were acquired.

Several new recreation opportunities, including a lower valley trail and footbridge over the Stehekin River trail and raft takeout near the river mouth are also proposed. These actions will occur in or near the floodplain. In the case of the footbridge, existing concrete bridge abutments will be used, if possible, in this stable reach of the river.

If the proposed alternative were implemented, only two sections of the Stehekin Valley Road would remain in the floodplain; about 1 mile near the river mouth and several hundred feet at Frog Island. One other section of the road near the Stehekin Valley Ranch would also remain in the channel migration zone. Other road sections such as the upper two miles of the Company Creek Road and the access road to McGregor Meadows would also remain in the floodplain.

The NPS maintenance facility, fuel storage, and three housing units near Harlequin Bridge would be relocated out of the floodplain onto the adjacent alluvial fan of Company Creek. Numerous additional restoration projects within riparian areas of the floodplain are proposed under this alternative.

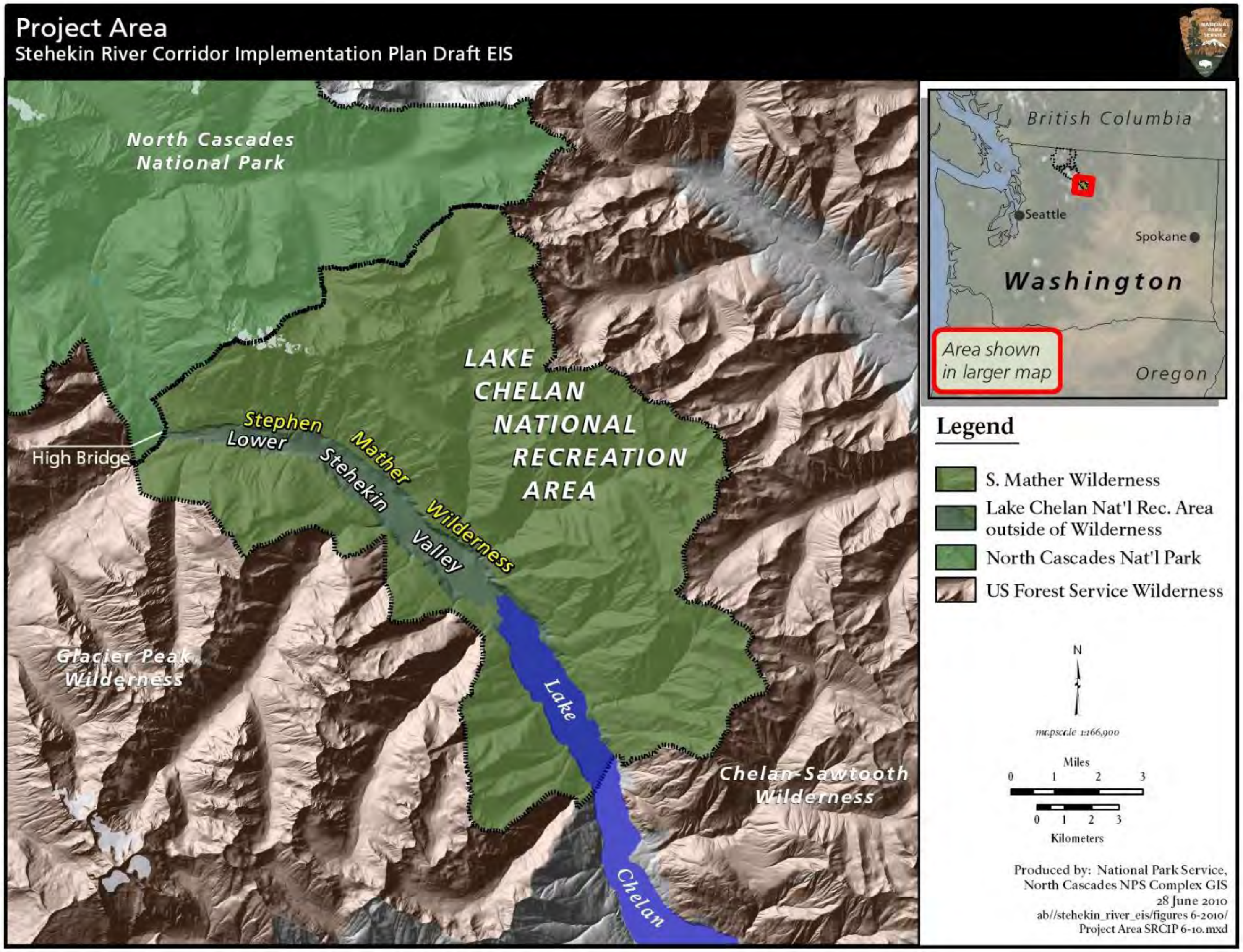


**FIGURE 1. LOCATION OF THE STEHEKIN RIVER WATERSHED AND THE SRCIP DEIS PROJECT AREA**

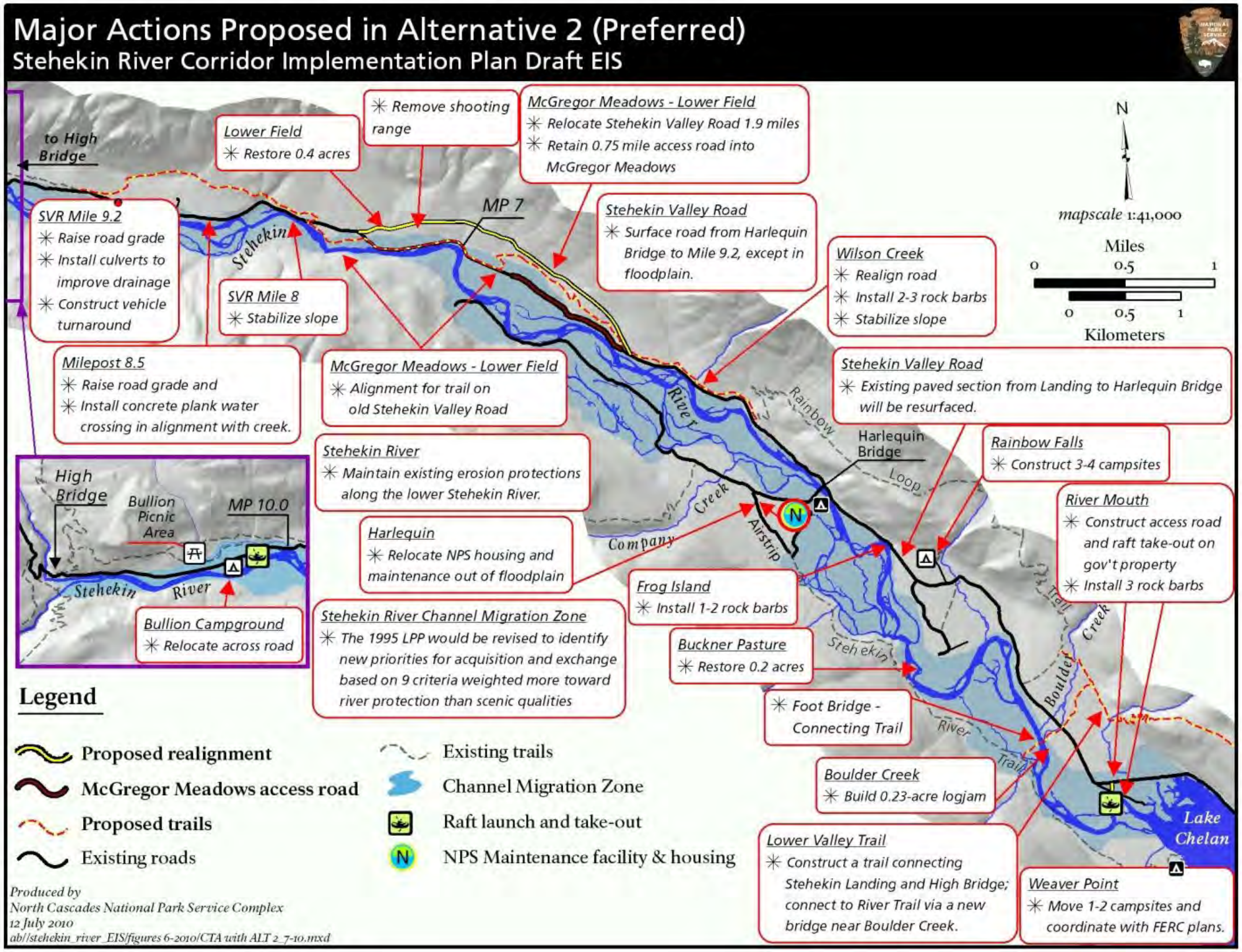


**FIGURE 2. MAJOR ACTIONS COMMON TO ALL ALTERNATIVES AND ALTERNATIVE 2**

## Proposed Actions

Under the preferred alternative the management actions that could negatively affect the Stehekin River floodplain are as follows.

**1. Erosion Protection Measures**: In Alternative 2, new erosion protection measures would be installed at four sites along the main river channel. These sites include the river mouth, Boulder Creek, Frog Island, and Wilson Creek (Figures 2 and 3). Impacts to floodplain values are relatively minor at three of the sites because they are located at the edge of the channel migration zone. Impacts to floodplains at the river mouth bank stabilization site, however, are moderate and long term because it is located within the channel migration zone. Work at this sites would involve construction of a small logjam, installation of 3 rock barbs, removal of about 100 feet of rip-rap, and dense replanting with native shrubs. This site is within the backwater influence of Lake Chelan. The six to eight rock barbs and two logjams proposed for these sites add to a growing number of structures along the lower Stehekin River in two main depositional zones.

**2. Large Woody Debris Management**: Changes to the management of large woody debris on the lower 0.25 mile of the Stehekin River are proposed in Alternative 2, within the backwater influence zone of Lake Chelan (Chelan Public Utilities District 2001). In this area, extensive accumulation of logs is influenced by unnatural manipulation of the Lake Chelan surface elevation. Proposed changes in management would allow for limited administrative and private use of large wood from the tops of logjams in the backwater zone below Boulder Creek. Conditions of use would include (1) wood taken only above ordinary high water mark, (2) removal could not destabilize logjams, and (3) all wood removed stays in the channel migration zone for restoration or erosion management.

The other change in management of large wood would also be focused on the lake backwater zone, and would allow for limited manipulation of a large logjam under certain conditions. These include (1) logjam manipulation would be at the minimum necessary to relieve threat to the Stehekin Valley Road or water quality from flooded septic systems and (2) all wood remains in the channel migration zone.

**3. Relocate Some Private Property from the Floodplain and onto Alluvial Fans**: The Lake Chelan National Recreation Area Land Protection Plan would be revised to encourage relocation of private property outside of the channel migration zone and away from the river using land exchange or land acquisition from willing sellers. Over the long term, removal of development from flood prone areas will greatly enhance floodplain values by precluding incorporation of septic systems and other debris into the river.

The NPS proposes to concentrate some future private development out of the Stehekin River channel migration zone onto alluvial fans and terraces. Twenty-four acres on these landforms are identified for exchange with private developed land in the floodplain near river. Occupation of alluvial fans, while not ideal, represents a more sustainable site, given the flood-prone nature of the Stehekin River and the decreased spring flood magnitude on east side tributaries with decreased snow fall in the past century. Potential exchange lands are not within the more active channel migration zones on the alluvial fans.

**4. Creation of Recreational Opportunities**: A new raft takeout would be provided near the Stehekin River mouth, which would require construction of 300-foot-long access road in the floodplain and a 30-foot-long ramp down a steep cut bank. The Lower Valley Trail would be constructed in a single complete project to connect Stehekin Landing with High Bridge using sections of existing trail (6.9 miles) and construction of new trail (6.3 miles) some of which would be in the channel migration zone. A 150-foot-long foot bridge over the Stehekin River would connect the Valley Trail to the existing river trail.

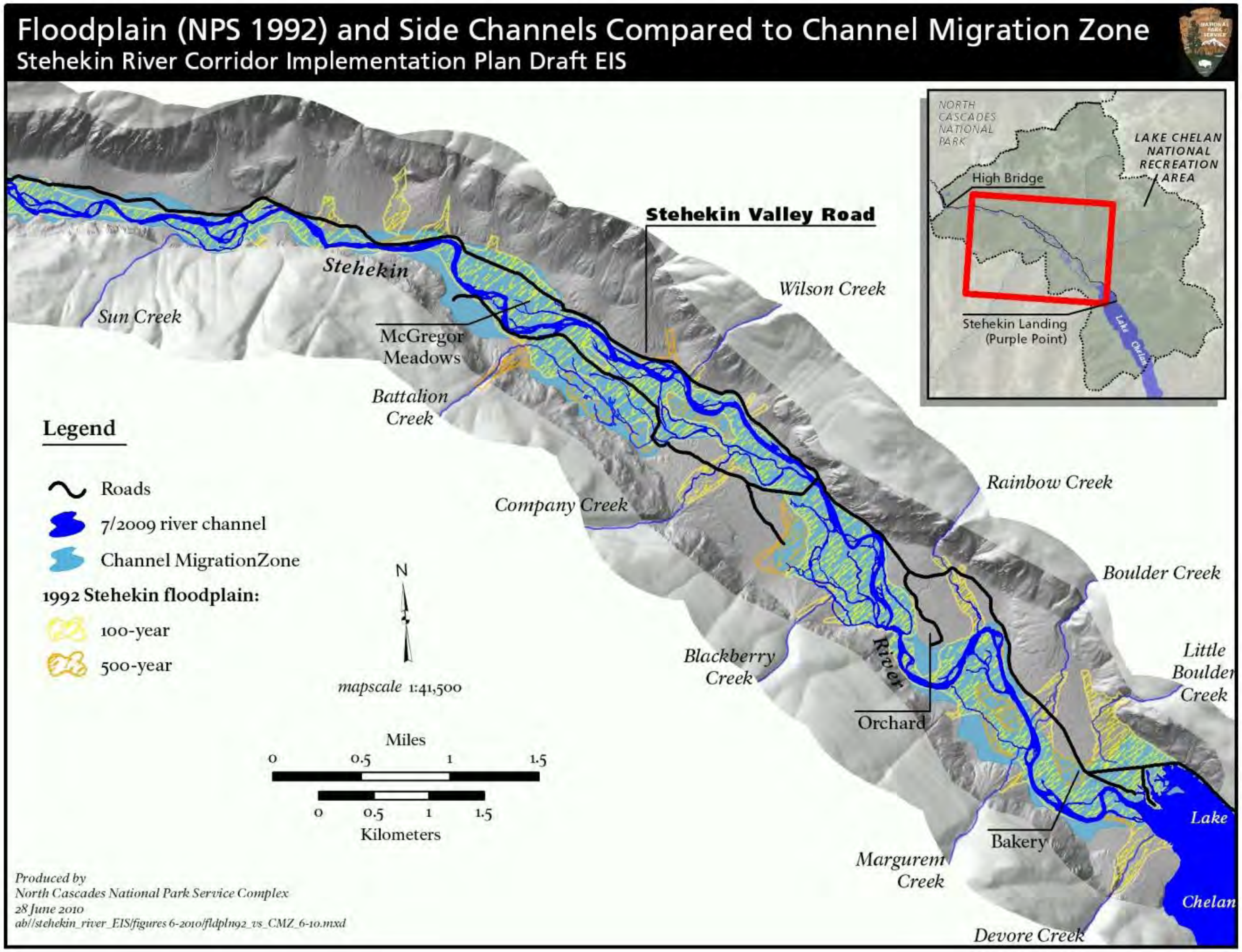


**FIGURE 3. CHANNEL MIGRATION ZONE IN THE LOWER STEHEKIN VALLEY**

Several actions in the plan would enhance floodplain values, and mitigate some of the impacts of retaining the road in the floodplain. These include focusing NPS planning on the Stehekin River channel migration zone rather than on static floodplain boundaries (geomorphically active), and maintenance of floodplain utilization as a management concept rather than unsustainable and ecologically damaging practices of dredging and levee construction. Specific actions include:

**1. Removal of the NPS Maintenance Facility, Fuel Storage, and Housing from the Floodplain**: Because the maintenance area and fuel storage facility are class I and class II actions, respectively, and are within regulatory floodplains, they continue to have adverse effects on floodplain values. Relocation of this five acre site would result in major beneficial effects from the restoration of a riparian wetland and adjacent floodplain, as well as reduce the potential for pollution from fuel storage and vehicles.

**2. Rerouting the Stehekin Valley Road**: A major section of the Stehekin Valley Road would be rerouted out of the floodplain around McGregor Meadows and the Lower Field (1.89 miles). An access road (0.75 miles long) would be retained into McGregor Meadows to the last parcel of private property (07-157). Beyond the access road, approximately one mile of road would be converted to become part of the Lower Valley Trail and another approximately 0.25 miles of the road would be used to maintain grade-control structures near Milepost 6.8.

**3. Restoration and Bioengineering**: Riparian restoration and/or bioengineering (layered planting associated with rock barbs or logjams) would also enhance riparian vegetation along the banks of the river, including at the Lower Field, Buckner Homestead hayfield and pasture, Wilson Creek, Frog Island and the river mouth.

## Site Description

The project area includes the Lower Stehekin Valley, from High Bridge to the head of Lake Chelan, including Weaver Point (Figures 1-3). Lake Chelan National Recreation Area (NRA) includes approximately 400 acres of private land, much of which lies within the floodplain and channel migration zone of the Stehekin River. All of the project area is outside designated wilderness.

## Change in Flood Frequency and Magnitude on the Stehekin River

The lower Stehekin River is flood-prone because of the circular shape of its watershed, steep slopes within the watershed, and the location of the headwaters on the wet Pacific Crest (Figure 1). Water delivered from three main tributaries merges in narrow bedrock box canyons above the lower valley. There is no storage of wood, gravel, or water within the canyons and some potential for the formation of temporary debris dams exists, which adds a hazardous element to flooding in the lower valley.

The Stehekin River is also flood-prone because it can flood at two times each year. The headwaters of the Agnes Creek tributary and the main Stehekin River are far enough to the west to be within a rain-on-snow zone. Heavy, warm November and December rainfall trigger rapid snowmelt and flooding on these tributaries. The entire watershed receives most of its precipitation in the winter as snow, and warm spring temperatures and rain can trigger rapid snowmelt and flooding. Unlike fall flood peaks, which typically pass within a few days, spring floods are smaller, but last for several weeks between May and June.

Prior to the late 20th century, the Stehekin River was dominated by spring snowmelt flooding, like most east-slope Cascade Rivers. Since the 1970s, however, the Stehekin River has become prone to large fall rain-on-snow floods, which rise quickly and occur from mid-October through December (Figure 4). Hydrologic data collected on the river since 1911 confirm the significance of this shift, as analyzed by the U.S. Geological Survey (USGS). The passage of large fall floods in 1995, 2003 and 2006 has led to significant changes in the Stehekin River channel, and redefined the boundaries for the 100-year floodplain. As a result, recreational and administrative facilities and developments once thought to be safe from the river are now threatened by flooding and bank erosion, while other sites in the floodplain have been compromised by larger, more frequent floods. Until now, the NPS has addressed problems on a case-by-case basis throughout the valley with the passage of each of these large floods.

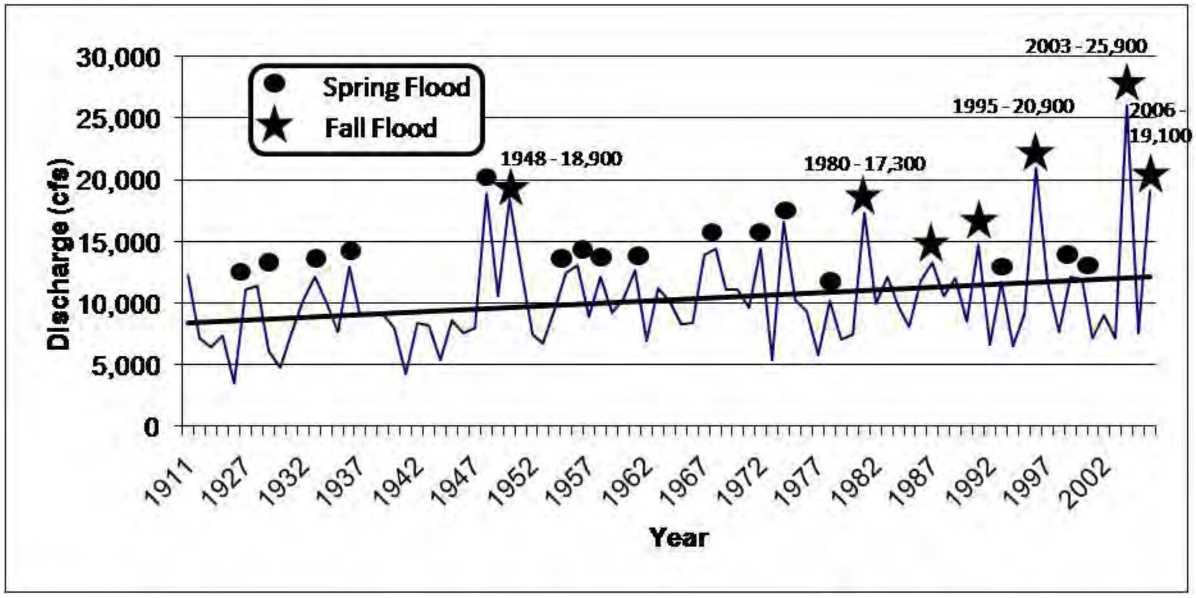


**FIGURE 4. MAGNITUDE AND TIMING OF THE ANNUAL PEAK FLOOD ON THE STEHEKIN RIVER**

In the past 15 years, the Stehekin River has had the three largest floods on record (Table 1). The November 1995 event was believed to have a 100-year recurrence interval, while the October 2003 event (25,000 cfs) has a recurrence interval estimated by the USGS at 100 - 500 years. In addition to these exceptionally large floods, significant fall events occurred in 1989 and 1990 and significant spring floods passed in 1997 and 1999.

**TABLE 1. LARGEST FLOODS ON RECORD FOR THE STEHEKIN RIVER.**

| Date | Discharge (cfs) |
|---|---|
| October 20, 2003 | 25,600 |
| November 29, 1995 | 21,000 |
| May 29, 1948 | 18,900 |
| June 20, 1950 | 18,400 |
| December 26, 1981 | 17,300 |
| June 16, 1974 | 16,600 |
| November 24, 1990 | 14,700 |
| June 2, 1969 | 14,400 |
| June 10, 1972 | 14,400 |

Small, steep, straight tributaries to the Stehekin River carry debris flows during large precipitation events. Debris flows occur about once every 25 years or so, and are often triggered by summer cloud-bursts, which are an unexpected but important contributor to flood hazards in the valley.

## Stehekin Valley Floodplain and Landforms

The Stehekin River floodplain is located along the floor of the Stehekin Valley in a deep glacial canyon, with peaks rising more than 7,000 feet above the river. The valley floor contains a long lateral moraine, debris cones from small tributaries, alluvial fans from three larger tributaries, and the Stehekin River and its floodplain. The terraces are composed of gravel, cobbles, and boulders and are crossed by numerous old flood channels. Debris cones have slopes steeper than 10 degrees and are covered with boulders, levees, and unstable channels at junctions with the Stehekin River floodplain.

Boulder, Rainbow, and Company Creeks deposited extensive alluvial fans on the Stehekin Valley floor. Parts of these landforms are above active parts of the fans, and are called fan terraces. Fan terraces represent stable sites above the floodplain and active alluvial fan surfaces. Due to the shift toward fall flooding, the alluvial fans have become less active because the headwaters for these tributaries are located in a more arid climate farther east of the Stehekin River headwaters.

Areas of sediment storage in the lower valley are marked by channel instability and wide floodplains. These deposition zones occur at McGregor Meadows where valley width increases three-fold, where the river meets the lake, and between the alluvial fans. Between deposition zones, the floodplain and river channel are relatively narrowed on the upstream edge of the three alluvial fans. Within these areas the channel is stable, and there is relatively little storage of wood, gravel, or water.

## Justification for Use of the Floodplain

### Why Proposed Actions are Located in Floodplains

Most of the proposed actions under this alternative would seek to remove current NPS facilities from the floodplain and channel migration zone. While private development would remain in the floodplain, the revised Land Protection Plan would provide a mechanism for removal of those most threatened. It is beyond the scope of this plan to remove all development from the floodplain. In addition to some private property, sections of the Company Creek Road and main Stehekin Valley Road would remain in the floodplain.

Actions that would occur in the floodplain include installation of erosion protection measures and rock barbs at three sites along the Stehekin Valley Road. In the case of these site locations, the road is between the river and the steep valley wall. Moving the road out of the floodplain and/or away from river conflicts would require blasting and/or heavy excavation work across cliffs or unstable slopes, or cause major impacts to undisturbed wetlands.

A major goal of the proposed plan is to allow large floods to occupy the floodplain (flood utilization), thereby reducing flood and erosion damage to all areas in the lower valley. The NPS has rejected alternatives involving large scale levee construction or channel dredging due to cost, sustainability, and impacts to floodplain values. The Boulder Creek logjam and grade control (avulsion sill) are designed to maintain sheet flow into the extensive floodplain and development down valley. More than a dozen similar structures have been installed on both sides of the river in McGregor Meadows since the 1995 flood.

A change in management of large wood debris in the river mouth area acknowledges the incredible build-up of wood in the last 25 years and the effect of lake level manipulation on wood accumulation. This shift in policy also recognizes the impact flooding can have on water quality in this area, and the value of using wood in restoration and erosion management projects.

There are recreation sites currently in, or proposed to be in, the floodplain. Harlequin Campground is the largest camp in the NRA and is located in the floodplain. The site is low relative to the river and typically floods in both the spring and fall. NPS relocated the vault toilet to high ground in 2009, but the camp sites remain in a regulatory floodplain. Flooding at the site occurs over a period of days or hours; flood conditions are summarized in Table 2.

**TABLE 2. SITE SPECIFIC 100–YEAR RECURRENCE INTERVAL FLOOD CONDITIONS FOR PARTS OF THE STEHEKIN RIVER FLOODPLAIN OCCUPIED BY NPS FACILITIES, VISITORS, OR PRIVATE RESIDENTS.**

| Site | Main Channel Depth and Velocity | Side Channel Depth and Velocity | Overbank Depth and Velocity |
|---|---|---|---|
| McGregor Meadows (left bank) | 8 feet<br>10 - 12 feet/second | 6 - 10 feet<br>4 - 6 feet/second | 3 feet<br>2 - 3 feet/second |
| Upper Company Creek Road (right bank) | 8 feet<br>10 - 12 feet/second | 2 - 4 feet<br>4 - 5 feet/second | 1 - 2 feet<br>1 - 4 feet/second |
| Harlequin Bridge and Camp (right bank) | 11 feet<br>10 - 11 feet/second | 5 - 6 feet<br>4 - 6 feet/second | 3 - 4 feet<br>2 - 3 feet/second |
| River Mouth near the Bakery (left bank) | 13 - 15 feet<br>6 - 8 feet/second | 4 - 6 feet<br>4 - 5 feet/second | 1 - 3 feet<br>4 - 6 feet/second |

It is not feasible to construct the raft take-out and access road out of the floodplain. The 300-foot-long access road will follow the route of an old road, and require removal of few trees. Construction of this raft take-out would give visitors a place to exit the river without disturbing private land owners or additional riparian areas in the floodplain. The takeout would provide an access point to the head of Lake Chelan for non-motorized boats.

Most of the Company Creek Road near Harlequin Bridge and above Company Creek alluvial fan is also within the 100-year floodplain. In the preferred alternative, floodwaters would be able to overtop riverbanks, except in the vicinity of the existing 400-foot long Company Creek levee. The current height of the levee along the Company Creek Road is four to six feet above the road. It continues to take pressure off the Company Creek Road by keeping floodwater from a small part of the floodplain. (The GMP calls for maintaining the Company Creek Road in its existing location.)

## Investigation of Alternative Sites

The NPS has considered and rejected numerous other alternatives in the preparation of the Draft Environmental Assessment Impact Statement (DEIS) for each of the action sites mentioned above.

At Frog Island and Wilson Creek, moving the road away from the eroding bank would require substantial blasting and/or heavy excavation work on steep valley walls, leading to potential slope instability and rock fall hazards. Therefore the road is proposed to remain in place and not be rerouted on the valley wall. Proposed actions at Boulder Creek are also located on the edge of the channel migration zone. At this site, the proposed grade control (avulsion sill) and extended logjam would be on the edge of the Boulder Creek alluvial fan. No other sites were considered because no other location offers the same advantages.

No other options exist for the location of the raft takeout on federal land. Dense private development and a lack of existing access roads eliminated other sites for consideration.

Use of large woody debris from other parts of the Stehekin River was considered in the SRCIP DEIS under Alternative 4, where woody debris could be manipulated (under the same conditions as the preferred alternative) and taken from areas below the Bullion raft launch, including at McGregor Meadows.

Relocation of private property to alluvial fans and alluvial fan terraces, while not ideal, is much less hazardous then leaving private property in the floodplain. This is especially true in McGregor Meadows where the potential exists for a major channel avulsion. Further, most of the valley floor is within the floodplain, and the NPS can only offer land for exchange that was once private. Alluvial fans and alluvial fan terraces represent one of the most stable landforms in the Lower Stehekin Valley, are out of the reach of the main river, and represent the best location for safe and sustainable development in the valley. No exchange properties are proposed in the most active parts of the alluvial fans.

Several options were considered for relocation of the Stehekin Valley Road out of the floodplain at McGregor Meadows. Rerouting the road along the Company Creek Road on the opposite side of the river was considered but rejected. Reasons included that major sections of the Company Creek Road are also within the floodplain and this would require a new bridge and approaches. The preferred reroute crosses several debris cones, which are prone to debris flows and snow avalanches.

## Description of Site-Specific Flood Risk

### Recurrence Interval of Flooding

Information on flood recurrence interval comes from USGS stream gauging data collected since 1911, recordings of flood heights from the 1995, 2003, and 2006 floods, a HEC2 floodplain model constructed by the NPS (Riedel, 1993), 2-D models constructed by the NPS Water Resources Division at two sites, and a study of paleo peak flows (Jarrett 1996). Results are summarized in Table 2.

The recurrence interval for flooding on the Stehekin River varies by the time of year and type of flood (Table 3). When spring and fall events are combined, as is typically done by federal agencies, the ‘100 year flood’ has a discharge of about 21,400 cfs. When the spring and fall flood populations are considered separately, the 100 year fall event discharge is 33,500 cfs, and the 20,000 cfs discharge occurs about once every 10 years.

**TABLE 3. COMPARISON OF TWO APPROACHES FOR DETERMINING FLOOD MAGNITUDE AND FREQUENCY ON THE STEHEKIN RIVER BY THE U.S. GEOLOGICAL SURVEY USING A LOG PEARSON III ANALYSIS.**

| Recurrence interval (probability in given year) | Discharge (cfs) for combined fall and spring floods (# events 85) | Discharge (cfs) for spring floods alone (# events = 70) | Discharge (cfs) for fall floods alone (#events = 16) |
|---|---|---|---|
| 10 - year (0.1) | 14,950 | 13,740 | 21,360 cfs |
| 20 -year (0.04) | 17,560 | 15,100 | 26,220 cfs |
| 50 - year (0.02) | 19,490 | 16,190 | 29,850 cfs |
| 100 - year (0.01) | 21,400 | 17,910 | 33,490 cfs |

### Hydraulics of Flooding at the Site (Depths, Velocities)

Information on flood flows and floodplain risk comes from recorded flood heights from the 1995, 2003, and 2006 floods, a HEC2 floodplain model constructed by the NPS (Riedel, 1993), 2-D models constructed by the NPS Water Resources Division at two sites, and a study of paleo peak flows (Jarrett, 1996). Results are summarized in Table 2.

Flood conditions in three main areas where NPS roads and visitor use facilities such as camps and trails will remain in the 100 year floodplain are summarized in Table 2. At Frog Island, where the Stehekin Valley Road is on the edge of the floodplain and erosion management structures are proposed, conditions during the 100-year flood would include water depths on the road of 1 - 3 feet, with velocity of approximately 2 - 3 feet/second.

Along the proposed reroute, severe rainfall could trigger debris flows that inundate parts of several debris cones with water, mud and boulders to depths of 5 feet or more. Debris flow events are thought to occur about once every 25 years on a given system, although flooding occurs more frequently.

### Time Required for Flooding to Occur (Amount of Warning Time Possible)

The amount of time required for warning of possible flooding in the lower Stehekin Valley ranges from a few hours to a day, depending on the nature of the flood hazard. The largest floods on the Stehekin River can take a week or more to build. During fall floods the Stehekin River can go from 10,000 to 20,000 cfs in a matter of hours, but the flood crest passes within one day. Most flood peaks occur at night or in the early morning, when most hazardous sites are unoccupied, but people are more unsuspecting. The National Weather Service has developed a flood warning system for the valley. Since the 2003 flood valley residents and visitors have the ability to view flood forecasts specifically for the Stehekin River on the internet. There is also a call-in system established by the NPS.

Spring floods take weeks to build, providing ample warning time for most events. Heavy spring rain, or high temperatures on a large, late, melting snow pack can bring peak events within days. River discharge for the largest spring events are 14 - 15,000 cfs.

There is the possibility that a natural log or landslide dam could form in the canyons in the upper Stehekin River, and release a large, somewhat unexpected flood event on the lower valley. Such an event has not been recorded in the last 100 years, nor has it been identified by deposits or landforms in the valley. Summer debris flows from small steep canyons can rise from intense thunderstorms in a few hours. These occur primarily on the north side of the valley where most development is located. On the steep debris flow canyons and debris cones along the proposed reroute, there may be only an hour or less or warning time.

## Opportunity for Evacuation of the Site in the Event of Flooding

Evacuations for the Stehekin River floodplain would involve the public, valley residents, NPS employees, and others from several sites. In McGregor Meadows, people would move about 0.5 mile down the access road to high ground on the Stehekin Valley Road. From here the road would provide access to the Landing, although it would pass through the floodplain near the river mouth. Along the upper Company Creek Road, there is a small piece of high ground across from the McGregor Meadows. The Company Creek alluvial fan terrace is above the highest flood levels, but would be isolated down valley by flooding at Harlequin Bridge. Flooding of the Stehekin Valley Road at the river mouth would temporarily cut-off the valley from the Stehekin Landing. During extensive flooding, the Stehekin Valley and Company Creek Roads would cross hazards at debris cones and bridges. Harlequin Bridge campground would be seasonally closed in during the fall and spring flood season.

## Geomorphic Considerations (Erosion, Sediment Deposition, Channel Adjustments)

Geomorphic considerations are outlined in a white paper prepared for the SRCIP DEIS (Riedel 2008). The Stehekin River is remarkable for the dramatic changes it undergoes in the lower valley. Above McGregor Meadows, the river transports small boulders, but within seven miles the river is stilled by the deep water of Lake Chelan. Superimposed on this pattern is a series of net wood and gravel transport and deposition zones.

Gradient is steep in reaches with straight, narrow channels where the river encounters large tributary alluvial fans of Company, Rainbow and Boulder Creeks. The relatively straight, steep reaches are net transport zones for sediment and large wood, and as a result are areas of relative channel stability. Wood and sediment storage zones between these reaches are characterized by the existence of massive log jams, multiple side channels, and channel instability. Within these unstable zones, erosion on the outside of river bends since 1962 ranges from 10 to more than 200 feet.

Dense private development occurs in two deposition zones. At McGregor Meadows, an increase in floodplain width and decrease in stream gradient led to massive gravel deposition in the 2003 flood. At the river mouth, gravel and wood deposition is influenced by the lake backwater zone. Bank erosion and increases in floodplain width are occurring at both sites.

Annual total sediment load of the Stehekin River is estimated at 32,000 $yd^3$/year; with about 17 percent or 5,600 $yd^3$/year, transported along the bed of the river as gravel. Larger quantities of sediment move in waves during large flood events causing aggradation and channel instability in deposition zones (Riedel 2008).

## Description and Explanation of Flood Mitigation Plans

This plan includes only a few specific measures to reduce hazards to human life and property because all action alternatives propose to remove NPS facilities from regulatory floodplains. Relocation of the main Stehekin Valley Road around McGregor Meadows and the Lower Field will, however, expose visitors along the road to debris flow and snow avalanche hazards. These events typically occur during the winter and fall, when visitation is low. NPS proposes to mitigate these hazards by placing interpretive and warning signs at selected pullouts. These signs will inform people about the nature of the hazards and what precautions to take during periods of heavy rainfall. These precautions would include avoidance of bridges and culverts, where small streams are likely to carry debris flows.

These signs are proposed to be located along the road and would have a negligible impact to the natural resources of the floodplain. Parts of the road, camps, and trails would remain within the floodplain, however.

Actions proposed in the preferred alternative at several sites would enhance floodplain values and reduce flood hazard. These include restoration of riparian zones at McGregor Meadows, Lower Field, and Buckner Homestead hayfield and pasture, and removal of the Stehekin Valley Road, fuel storage facilities, NPS Maintenance Shops, and three NPS housing units from regulatory floodplains.

In this plan the NPS structures and facilities will be removed from the channel migration zone. Roads, trails, and campgrounds that remain in the floodplain will be subject to periodic flooding. Chelan County enforces the National Flood Insurance Program on the more than 400 acres of private land in the NRA. Private structures and facilities will, however, remain within the regulatory floodplain, and standards and criteria of the National Flood Insurance Program (44 CFR 60) are administered by Chelan County.

## Summary

This statement of findings accompanies a DEIS for the Stehekin River floodplain for actions designed in the SRCIP.

Recent major floods and resultant channel changes on the lower Stehekin River have intensified flood and erosion threats to NPS facilities and natural resources within Lake Chelan National Recreation Area. The three largest recorded floods on the Stehekin River have occurred within the past 15 years, and in response the NPS has spent more than $3 million to protect public roads and facilities and to repair flood damage. Roads, visitor facilities and private homes once thought to be safe from the river are now threatened. Recognizing a shift to a large fall flood dominated flood regime and changes wrought by the recent floods, the NPS will use the more conservative approach of the channel migration zone to direct planning actions in the lower Stehekin Valley.

The proposed actions in the preferred alternative, Alternative 2, will reduce flood risk by removing NPS facilities and parts of the Stehekin Valley Road from the floodplain. The primary negative impacts to the floodplain in this alternative are impacts from keeping the 400-foot-long Company Creek levee, which inhibits floodplain utilization, erosion protection measures installed over time along the river, and from allowing the road to remain adjacent to the floodplain and/or channel migration zone where reroutes cannot be undertaken. In addition, large woody debris procurement in the Lake Chelan backwater zone would be allowed from the tops of large logjams (with NPS permitting approval) for erosion control projects. Logjam manipulation would be allowed under specific emergency circumstances in this backwater zone. New recreational opportunities proposed would also be within the channel migration zone.

Impacts to floodplain values are offset by several proposed management actions. These include (1) removal of the maintenance area from the floodplain, (2) rerouting the Stehekin Valley Road out of McGregor Meadows, (3) removal of private development from the floodplain through land exchange/purchase from willing owners to improve public safety and so that homes and septic systems do not become incorporated in logjams in future flood events, and (4) restoration of riparian areas in several locations in conjunction with the creation of new recreational opportunities

## Conclusion

Floodplain values are impacted by several actions proposed in the SRCIP DEIS, including placement of new erosion control structures, manipulation of large woody debris in the Lake Chelan backwater zone, and retention of some road segments and visitor use facilities in floodplains. For facilities that remain in floodplain, flood hazards are relatively minor (depth < 3 feet, velocity <3 ft/second) and advance warning of hours to days is likely.

These impacts are mitigated, to some extent, by several actions that enhance floodplain values. These include removal of NPS housing, maintenance buildings, and fuel storage from the floodplain, relocation of 1.8 miles of the main valley road from the floodplain, restoration of two riparian areas, and a re-vamped Land Protection Plan that proposes the removal of private development via willing seller land exchanges before it is claimed by the river.

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Jarrett. R.D. 1996. Paleoflood Investigation to Assess maximum Flooding in the Chelan River Basin, Washington. Unpublished study by Chelan Public Utility District. 36p.

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National Park Service, U.S. Department of the Interior. 1998. Director's Order #77-2; Floodplain Procedural Manual. Washington, D.C.

Riedel, J.L. 1993. Stehekin River Floodplain Mapping Project. Technical Report NPS/PNRNOCA/NRTR-93/011. 23p.

Riedel, J.L. 2008. Stehekin River Corridor Implementation Plan White Paper. National Park Service, North Cascades National Park Service Complex, January 18, 2008, 42p.

# APPENDIX 18: ESTIMATES OF GRAVEL ACCUMULATION IN TWO REACHES OF THE STEHEKIN RIVER

Estimates of gravel accumulations in two reaches of the Stehekin River were calculated in order to evaluate the basic cost of dredging the Stehekin River. The lower reach is defined as the river mouth (river kilometer 0) to river kilometer 1. Cross-sections from a survey done in 1999 by the Chelan County Public Utility District (PUD) were resurveyed in 2009. Four cross-sections were chosen as a basis of comparison of gravel accumulation in the lower kilometer of the river. Based on this data, in a ten year period it is estimated that 59,000 cubic yards of gravel accumulated in this lower reach. The upper reach is defined as just above the McGregor Meadows logjam to river kilometer 11. Gravel accumulation was estimated by comparing cross-sectional data done by the U.S. Geological Survey (USGS) in 1986 to a White Shield Inc. survey done in 2007. In a 21-year period it is estimated that 44,000 cubic yards of gravel accumulated in this reach.

This brings the total gravel accumulation to 103,000 cubic yards when these two sections of the river are combined. We note these are overall high estimates since incision was not accounted for in this study. Pebble counts done in 2007 estimated the mean grain size at 2.6 inches at river kilometer 1, 3.5 inches at river kilometer 10, and 5.9 inches at river kilometer 11. A potential gravel storage area is the Company Creek Gravel Pit, but current policy limits the footprint of the gravel pit to 2 acres, which is too small to accept 103,000 cubic yards of material. When this estimate of gravel was given to the Army Corps of Engineers, they calculated that the one-time cost of dredging the Stehekin River would cost around 12.5 million dollars. Therefore the maintenance of the dredging option on the decadal scale would cost millions of dollars to maintain and was thus not considered one of the preferred alternatives.

Below is a description of the data used in this study and the assumptions and calculations made in order to estimate gravel accumulation in the Stehekin River for these two reaches.

## Cross-section Data

The lower reach in this study is defined as the river mouth (kilometer 0) to 1 kilometer up river (figure 1). In this section of the river, surveys were conducted Chelan County PUD in October of 1999 and again in March of 2009. Both surveys are tied to the USGS Purple Point Gage, located in upper Lake Chelan. The vertical datum for both surveys is the USC and GS Datum at Lake Chelan (NAVD 88) and the horizontal datum is NAD 83. The locations of cross-sections in this lower reach are provided in figure 2 while the cross-sections follow in figures 3-6.

The upper reach of this study is defined as river kilometer 10 to 11, in the McGregor Meadows section of the Stehekin Valley (figure 1). Surveys were conducted by the USGS in 1986 and again in 2007 by White Shield Inc. The 1986 USGS survey used vertical datum NGVD 29, while the 2007 survey used the current vertical datum of NAVD 88. Thus an adjustment of 3.82 feet is added to each data point in the 1986 survey in order to compare it to the 2007 survey. This adjustment figure is based on calibrations done by White Shield Inc. relating to gage stations in the valley (White Shield Inc. 2007). Horizontal datum for both surveys is NAD 83. The locations of cross-sections in this upper reach are provided in figure 7 while the cross-sections follow in figures 8-11.


**FIGURE 1. THE LOCATION OF THE TWO REACHES EVALUATED FOR GRAVEL ACCUMULATION ON THE STEHEKIN RIVER**

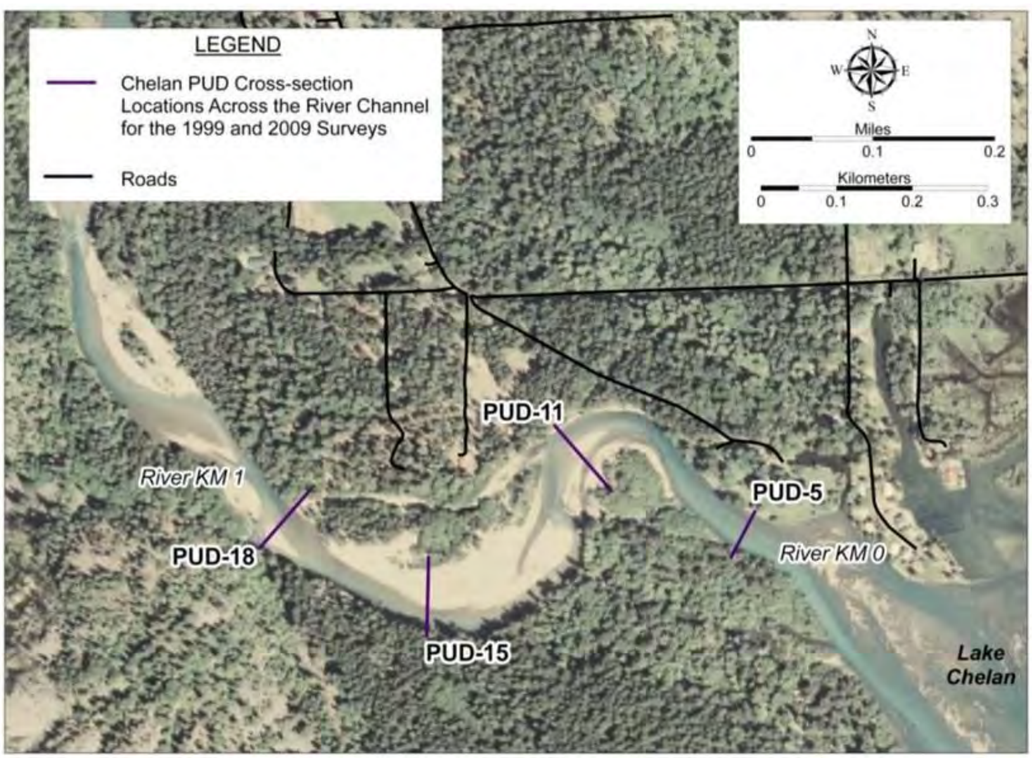


**FIGURE 2. THE LOCATIONS OF CROSS-SECTIONS IN THE LOWER KILOMETER OF THE STEHEKIN RIVER**

## Calculations of Gravel Accumulation

### Lower Reach

At the mouth of the river, PUD-5 shows an average increase of 1.5 feet of gravel over the ten-year period (figure 3). For PUD-11 incomplete data was provided for the 1999 survey, as shown in figure 4. The main channel has clearly incised close to the left bank since the 1999 survey with concomitant lateral growth of a "point" gravel bar. The average gravel accumulation was estimated at 2.3 feet across the channel. For PUD-15, slight erosion has occurred at the right bank of the river with minor deposition across the left bank gravel bar of 0.8 feet (figure 5). The final section of the lower reach is at PUD-18 (figure 6). The cross-section data clearly shows this section accumulated gravel in the last 10 years. The average accumulation across the channel was 3 feet.

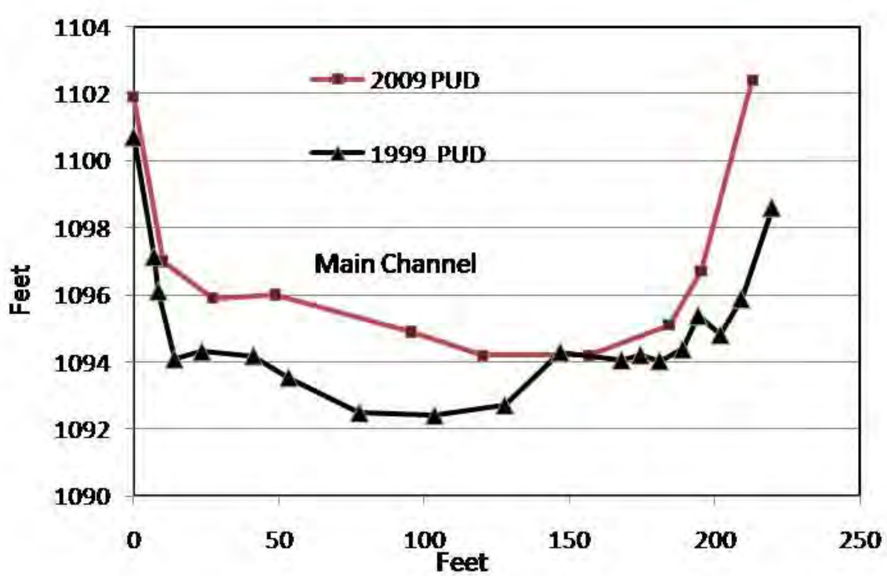


FIGURE 3. CROSS-SECTION PUD-5 IN THE 1999 AND 2009 SURVEYS

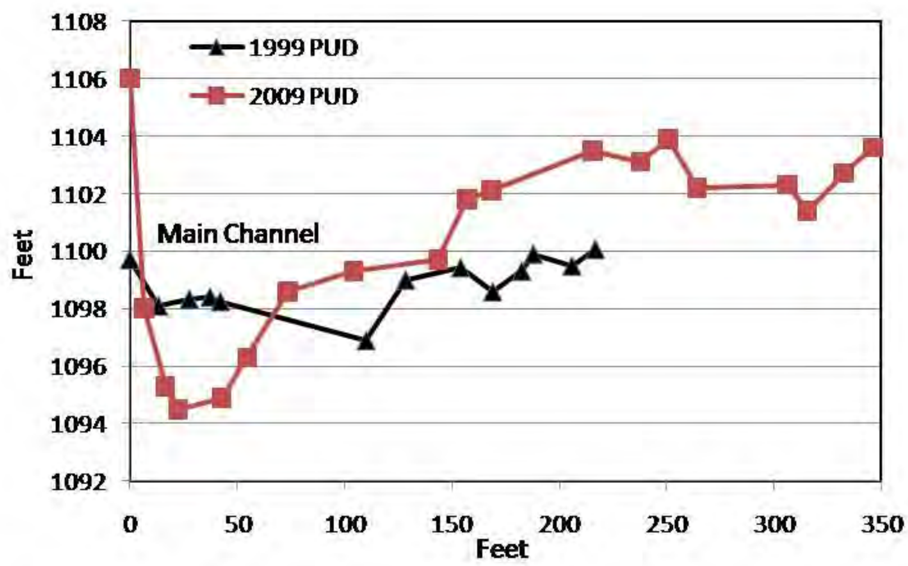


**FIGURE 4. CROSS-SECTION PUD-11 IN THE 1999 AND 2009 SURVEYS**

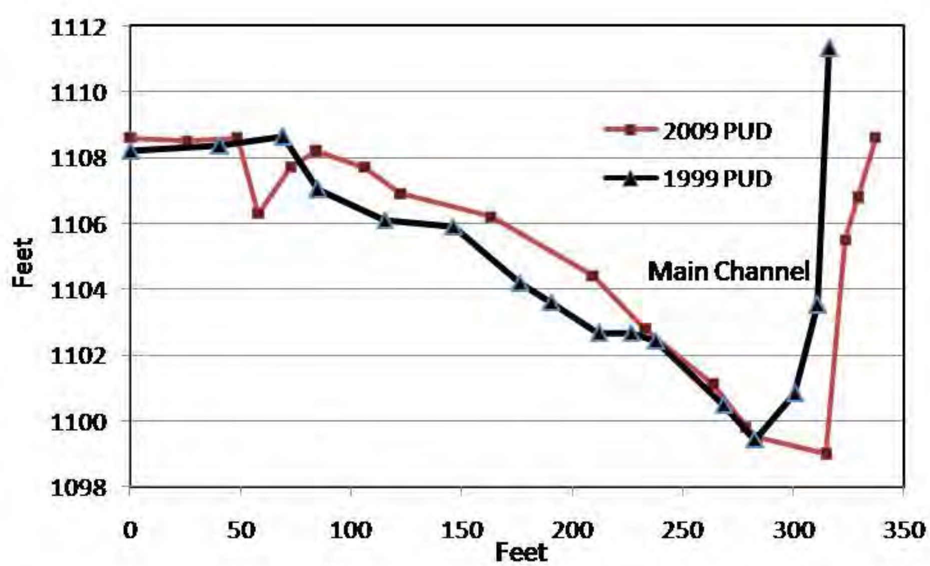


**FIGURE 5. CROSS-SECTION PUD-15 IN THE 1999 AND 2009 SURVEYS**

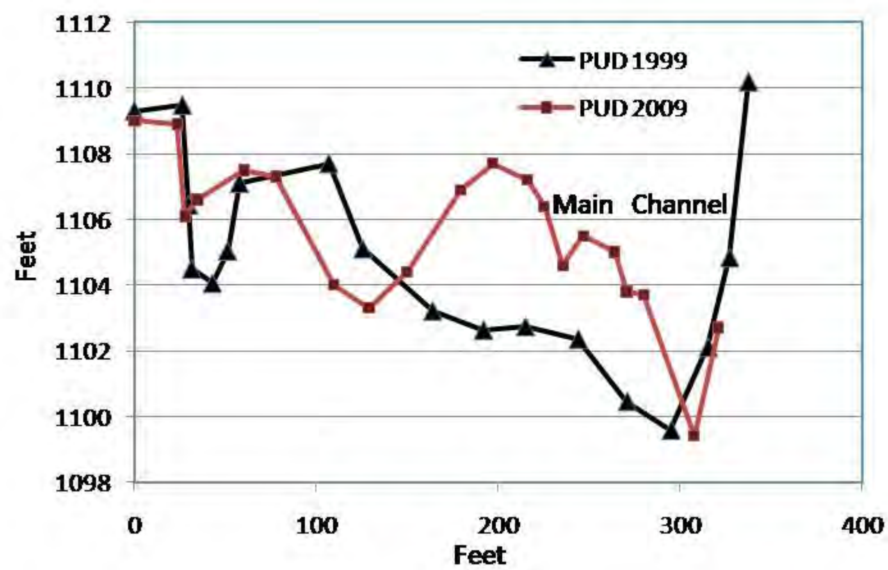


**FIGURE 6. CROSS-SECTION PUD-18 IN THE 1999 AND 2009 SURVEYS**

Between river kilometer 0 and 1, we will assume that that average gravel accumulation shown in the cross-sections, 1.9 feet, is constant over this 2,900 foot stretch of river. By approximating the area of the channel to be a trapezoid that consist of one rectangle 250 feet by 1.9 feet (main channel) and two triangles each 5 feet long (edges of channel), this section has an estimated volume of 59,000 cubic yards of gravel accumulated in the 21-year period. Pebble counts done in this section of the river in 2007 estimated the mean grain size to be 2.6 inches.

## Upper Reach

Gravel accumulation was more challenging to estimate in the upper reach in McGregor Meadows since the locations of comparing cross-sections in most cases are not identical (figure 7). Just above the major logjam in McGregor Meadows, cross-sections USGS-Z and WSI-10 are compared. Slight erosion is noted in the main channel and a large gravel bar has been deposited on the right bank (figure 8). It is also revealed that another channel has been scoured into the far right bank of the river. Further up-river of the logjam, there is again accumulation of gravel in the main channel, revealed by comparing cross-sections USGS-AA to WSI-12 (figure 9). USGS-AB and WSI-13 also reveal more accumulation in the main channel as the river has shifted closer to the right bank (figure 10). The final cross-section comparison, USGS-AC and WSI-16 reveals slight scour, but mostly deposition of gravel in the main channel (figure 11).

Between cross-section WSI-10 and USGS-AC, we will assume that that average gravel accumulation shown in the cross-sections, approximately 2 feet is constant over the 2,900 foot stretch of river. By approximating the area of the channel to be a trapezoid that consist of one rectangle 200 feet by 2 feet (main channel) and two triangles each 5 feet long (edges of channel), this section has an estimated volume of 44,000 cubic yards of gravel accumulated in the 21-year period. Pebble counts done in this section of the river in 2007 estimated the mean grain size to be 3.5 inches at river kilometer 10 and 5.9 inches at kilometer 11.

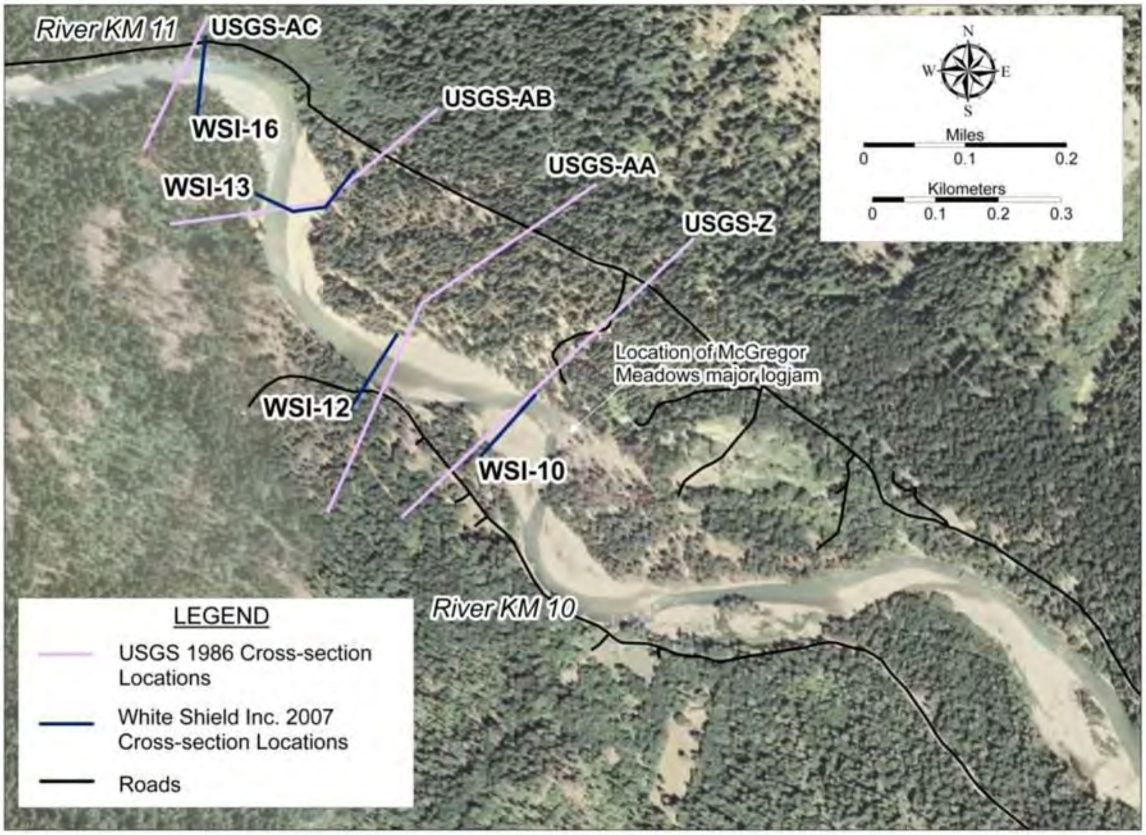


**FIGURE 7. THE LOCATIONS OF CROSS-SECTIONS IN THE MCGREGOR MEADOWS REACH OF THE STEHEKIN RIVER**

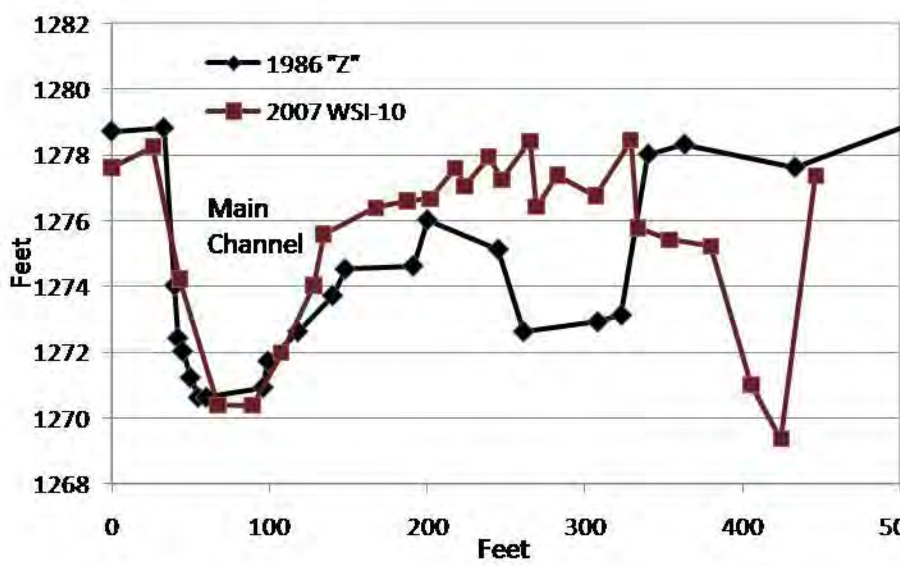


**FIGURE 8. CROSS-SECTION USGS-Z AND WSI-10 FROM THE 1986 AND 2007 SURVEYS**

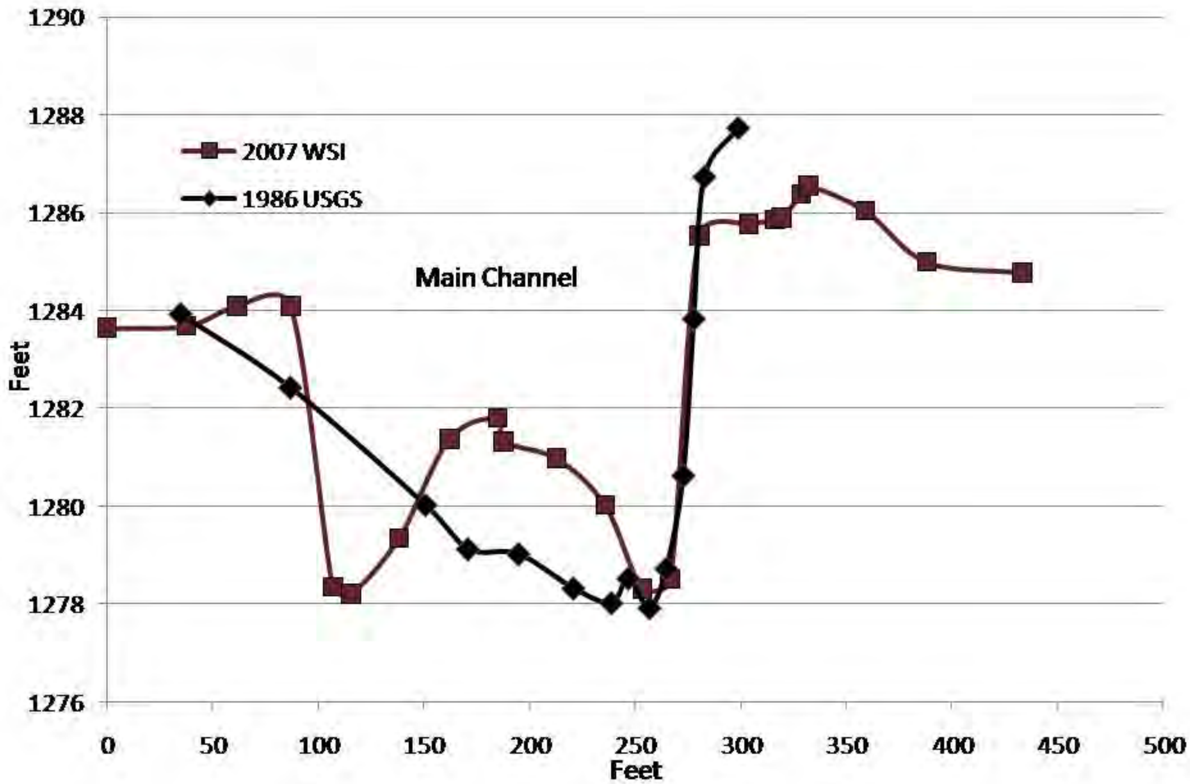


FIGURE 9. CROSS-SECTION USGS-AA AND WSI-12 FROM THE 1986 AND 2007 SURVEYS

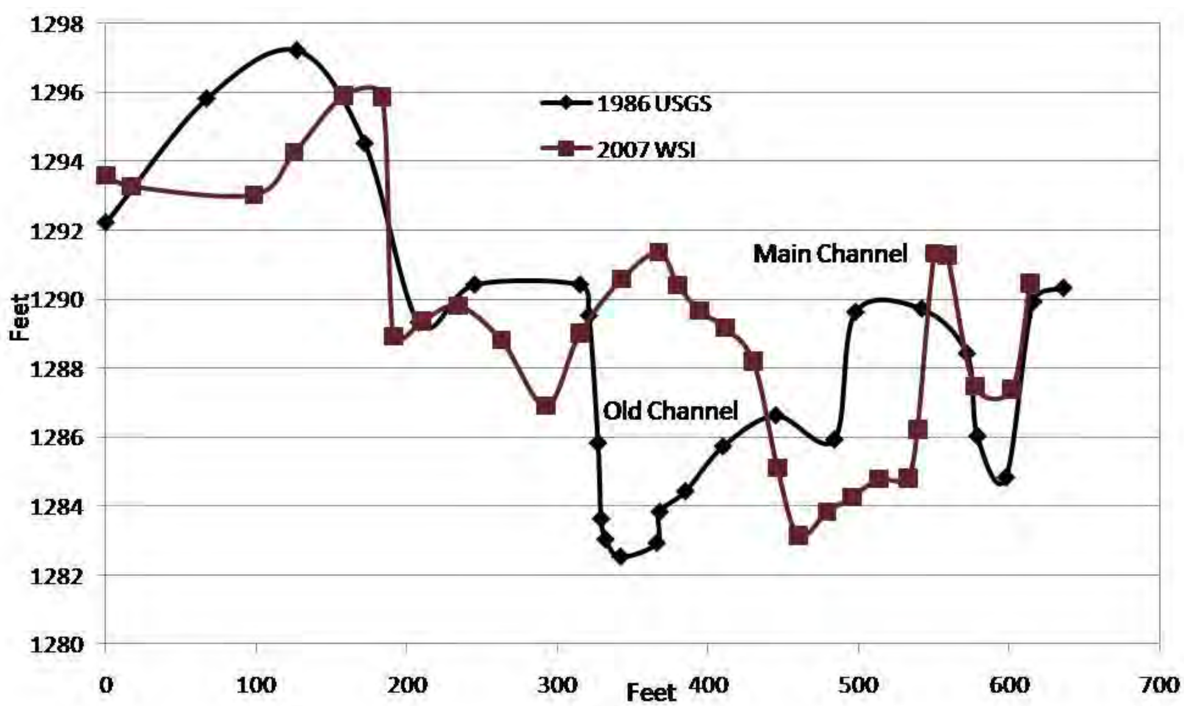


FIGURE 10. CROSS-SECTION USGS-AB AND WSI-13 FROM THE 1986 AND 2007 SURVEYS

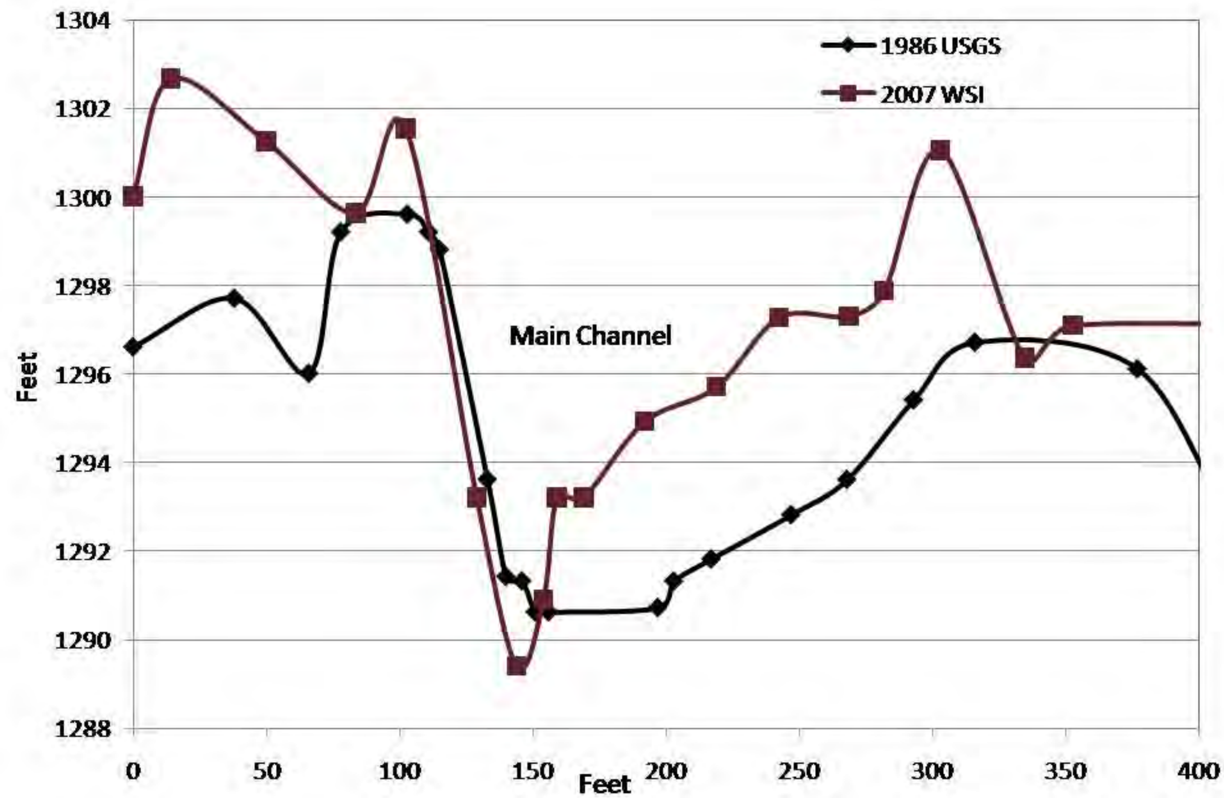


**FIGURE 11. CROSS-SECTION USGS-AC AND WSI-16 FROM THE 1986 AND 2007 SURVEYS**

## Potential Storage Site

Potential gravel storage areas in the lower Stehekin Valley are severely limited by current public and private land use, as well as the Stehekin River. The National Park Service currently operates one gravel pit in the valley, known as the Company Creek Gravel Pit. Current policy outlined in the 1995 General Management Plan for use of this material limits the footprint of the gravel pit to 2 acres, which is too small to accept 103,000 cubic yards of material. Nonetheless, the Company Creek Gravel Pit is the most attractive site for storage. It is located 3 miles from the upper reach and 3.5 miles from the lower reach analyzed in this study.

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

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