



OHANAPECOSH CAMPGROUND MOUNT RAINIER NATIONAL PARK

Rehabilitation Proposal and Design Guidelines

MAY 2018



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Ohanapecosh Campground, Mount Rainier National Park

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PART I: REHABILITATION PROPOSAL

Background

The Ohanapecosh Campground is located in the southeast corner of Mount Rainier National Park, on the banks of the Ohanapecosh River (figures 1–3). Consisting of eight loops and 188 sites, the low-elevation campground is the largest in the park and serves 40,000 to 50,000 visitors a year, from late May to mid-October (NPS 2016, 7; NPS 2017). The rushing river, towering old-growth conifers, and an array of geothermal springs have attracted humans to this area for millennia and are still enjoyed by visitors today. Many visitors return to the campground year after year, often staying in the same campsites. Campers range from backpackers and climbers spending one night before a long trip, to large family groups that gather for several days.

The campground area has a layered human history that can be organized into several key periods (described in more detail in part II of this document, the Design Guidelines). These periods include 1) pre-contact human history, 2) National Forest development (1906–1921), 3) the Ohanapecosh Hot Springs Resort (1921–1961), 4) National Park Service ownership (1931–present), 5) Civilian Conservation Corps development (1934–1939), and 6) Mission 66 development (1948–1972).

Early human use of the Ohanapecosh area has been identified dating as far back as 3,000 years ago, with some areas dating potentially as far back as 8,000 years ago (Ben Diaz pers. comm. 2018). Many pre-contact archeological sites have been formally documented in the campground. Human use of the area likely occurred due to the presence of the hot springs, the river corridor, and the documented 8,500 years of human foraging and habitation around Mount Rainier (NPS 2016, 8; Burtchard 2003). In the early 20th century, a one-room cabin and small campground stood on the site; this was followed in the 1920s by the development of the Ohanapecosh Hot Springs Resort, a privately owned tourist attraction that could be accessed from the town of Packwood (then Lewis), 13 miles to the south (figures 4–7).

Originally located within the Mount Rainier Forest Reserve (today Gifford Pinchot National Forest), the Ohanapecosh area was added to Mount Rainier National Park with the park's 1931 boundary expansion. The first investments in the campground under the NPS occurred in the 1930s, when the present-day loops A and C were constructed by the Depression-era Civilian Conservation Corps (CCC) program. While the loop alignments, Silver Falls Trail, and four rock and log comfort stations built by the CCC persist today, the majority of the campground's roadways, campsites, and facilities were built between 1957 and 1964 under the National Park Service's Mission 66 initiative (figures 8–11).

The campground's Mission 66-era facilities include a visitor center and 500-seat amphitheater. The campground is part of a larger Mission 66 development that also includes a ranger station, administrative and maintenance areas, and employee housing facilities (figures 16–18). The Ohanapecosh Developed Area retains exceptional integrity to Mission 66-era design and planning. The area is likely eligible for inclusion in the National Register of Historic Places as an historic district, however the determination of eligibility has not yet been completed (Lentz 2003, 6; NPS 2016, 7).

Current Status and Issues

There have been very few changes to the Ohanapecosh Campground since the conclusion of the Mission 66 developments in the early 1970s, although maintenance of existing campground sites occurs on a regular basis. A comparison of existing conditions with 1960 as-built construction drawings reveals that there has been a net loss of 41 campsites over time. This reduction is due not only to resource protection measures, but is also a result of changing site conditions resulting from flooding, erosion, hazard trees, and increased day use. The campground remains very popular and heavily used, and over the decades this has resulted in significant loss of understory vegetation due to trampling and soil compaction. Understory impacts in the campground area date to the 1930s or earlier: photographs of the CCC-era camp reveal an already significant reduction in forest floor vegetation (figure 8; NPS 2015b, 4). These issues would be formally identified as a problem in 1977, when a research associate in the Department of Forest Science at Oregon State University produced a rehabilitation study to aid park managers in improving forest health and understory conditions (Moehring and Franklin 1977). The situation described in the 1970s report has changed very little in the intervening decades. There is minimal definition or separation between campsites, vehicle parking areas are often poorly delineated, and numerous social trails continue to adversely impact the site's native plant communities (figures 24–25). Some campsite areas are not optimally configured to support their current use, and in certain locations it is challenging to find the right campsite and parking spot.

The park has additionally struggled to provide an adequate level of enforcement staff in the campground to help visitors understand the importance of parking and camping in designated areas. Park managers are concerned about resource impacts to riparian and wetland areas, as well as impacts to some of the campground's vulnerable old-growth Douglas-fir (*Pseudotsuga menziesii*) trees. As a result, some campsites have been closed. The park would like to continue to provide the same level of camping access and opportunity for visitors while balancing safety and resource protection needs.

Purpose, Need, and Objectives

The National Park Service is in the process of finalizing national guidelines for campground development. The Mount Rainier NP staff are closely tracking the progress of the national guidelines and when final, will draw on them to augment the design guidance herein. The purpose of this project is to improve the visitor experience and resource conditions within the Ohanapecosh Campground. The project seeks to maintain a variety of camping experiences, improve the campsite selection and reservation process, reduce impacts to vegetation and riparian areas, and provide design guidelines to ensure that maintenance and repairs are consistent with the campground's historic character-defining features. The project team recognizes that the tools provided by this plan will also require adequate enforcement and campground management to achieve the desired conditions described.

Maintain a variety of camping experiences

Ten Ohanapecosh campsites have recently been closed due to flooding, erosion, hazard trees, and wetland conditions (drawing 1). In addition, car camping opportunities at Mount Rainier National Park have decreased over the past few decades due to flood events, river aggradation, and debris flows. In view of this overall loss, park managers would like to continue to maintain as many camping opportunities as possible at Ohanapecosh, as well as within the rest of the park. Recreational practices within the campground have also evolved since the 1960s, as evidenced by the increasing popularity of

group camping and RV sites. To provide access for a diversity of visitors, the park would like to expand the variety of camping options it provides at the Ohanapecosh Campground, including increasing the number of accessible sites and accessible site elements.

Improve the campsite selection and reservation process

The campground's current reservation system, which can be accessed at Recreation.gov, presents outdated information, is difficult to navigate, and does not accurately correspond to all campsite conditions on the ground. The character, scale, amenities, and overall visitor experience varies from one area of the campground to the next, but this information is not clearly conveyed through the reservation website. It can therefore be challenging for campers to select a campsite that best meets their needs.

Once onsite, campers without reservations are forced to travel up into the campground's northern loops (G and H) to secure a first-come first-served campsite, creating circulation issues and congestion if they attempt to navigate narrow roads and bridges with large trailers and RVs. Signage and delineation of individual campsites and parking areas are confusing. In some cases, groups will reserve several individual campsites that are adjacent or nearby, potentially detracting from the experience of other campers who are not in the group.

Reduce impacts to vegetation and riparian areas

The campground is located on the banks of the Ohanapecosh River and cradled in an old-growth forest (figures 31–34). The visitor experience is thus defined by the river and its streams, as well as its towering trees. However, the campground's conifers, understory vegetation, and wetland and riparian areas are sensitive to impacts from visitor use, including trampling, erosion, and compaction. Some campsites have been sited in especially sensitive resource areas, resulting in adverse impacts to natural resources (figure 29). Campsites, parking areas, and trails are poorly defined, leading to an increase of social trails and large areas that have been completely denuded of vegetation. Without campsite and parking space delineation, campground rangers have trouble ensuring that campsites do not exceed capacity.

Provide design guidelines

Park staff regularly maintain and repair campsites. Currently, there is no guidance in place to supplement and preserve this institutional knowledge to ensure in the long term that work is undertaken in a manner compatible with the elements of the campground's Mission 66 and CCC-era cultural landscape. Without clearly articulated design guidance to complement enforcement, supervision, and implementation, these maintenance actions over time could lead to impairment of the campground's cultural resources.

OBJECTIVES

A successful project will:

- Provide a variety of camping experiences for visitors of all abilities
- Improve the clarity of the campsite reservation process, and make it easier for visitors to select the best campsite for their needs
- Improve wayfinding and circulation within the campground

- Locate new campsites in previously developed areas wherever possible and minimize ground disturbance and impacts to resources
- Protect riparian and wetland areas and vegetation through the closure of sites in particularly sensitive areas
- Improve soil health and the condition of the native understory vegetation by the delineation of campsites, parking areas, and trails
- Establish design guidelines to inform regular maintenance, repairs, and future development in the campground

Rehabilitation Proposal

The project team has developed a proposal to rehabilitate the Ohanapecosh Campground. This rehabilitation effort will ensure that Mount Rainier National Park continues to offer a variety of camping opportunities at Ohanapecosh. The proposal recommends the reconfiguration of key areas of the campground to better define use areas, reduce conflicting uses, respond to changing recreational practices, and increase accessibility. A small number of new campsites will be proposed to maintain visitor access to a diversity of camping options and to mitigate the loss of campsites closed for resource protection or closed due environmental damage such as landslides or flooding. The proposal is accompanied by several drawings that should be referred to in conjunction with the text. See drawings 1–3 for an illustration of existing conditions and actions included in the proposal.

Campsite types and sizes will be more clearly defined to protect resources and help visitors select and reserve the campsites that best meet their needs. Improved delineation of campsites, parking areas, and trails will protect vegetation communities, riparian and wetland areas, and the health of large trees, while ensuring that the campground’s Mission 66 spatial organization and features maintain integrity. Design guidelines have been developed to guide resource protection and preserve the visual unity and distinct character of the Ohanapecosh Campground, thereby enhancing its unique sense of place (see part II of this document).

The park currently reserves three campsites in the campground for tribal use, managed through a 2-year special use permit. These campsites are B-4, B-6, and B-7. This use is not projected to change in the near future, and therefore the rehabilitation proposal does not address any changes in use or configuration for these campsites. Campground capacity calculations on the pages that follow do not include the tribal use sites.

In developing the proposal, the project team evaluated alternative approaches to balancing visitor use and resource protection needs. While a net increase in camping capacity can be achieved through the addition of several new campsites and the reconfiguration of many existing campsites to serve larger groups, this approach does not take into account the campground’s sensitive environmental context and management objectives that include resource protection and safety. To balance visitor use and resource protection, the project team recommends the addition of a small number of new campsites and the reconfiguration of a small number of existing, crowded campsites to group sites. The project team also recommends reducing the concentration of visitor use in highly sensitive areas. To reduce impacts to riparian and wetland areas and vulnerable old-growth trees, the project team has developed a proposal

that reduces the footprint of campsites bordering streams and wetlands by reducing their capacity from six people to four and by delineating smaller use areas through edging and revegetation (see part II, Design Guidelines for Vegetation and Campsites). Although these changes would result in a net loss of campground capacity in terms of people (table 2), they would not reduce the overall number of campsites in the campground, and they would provide long-term protection of Ohanapecosh's unique sense of place.

The Ohanapecosh Campground Rehabilitation Proposal consists of the following main elements:

ZONING REVISIONS

- Convert B and D loops to first-come, first-served. Current first-come, first-served loops are G and H, which causes campers to drive into the northern loops to search for a site, resulting in congestion, stuck vehicles, etc. See drawings 1 and 2. Tribal campsites in B loop (B-4, B-6, and B-7) will be removed from the first-come, first-served sites and from campground maps. Signs will be erected to indicate that these sites are not part of the available first-come, first-served sites.
- Identify and implement a low-density zone in areas with sensitive resources, in particular in riparian or wetland areas, and areas with a high density of old-growth trees. The low-density zone would have small campsites with a capacity of four people instead of six people, and it would allow only one car instead of the one-to-two cars allowed in standard sites. RV sizes in low-density sites would be limited to 15 feet instead of 20 to 32 feet. See drawing 2.

INCREASE IN ACCESSIBLE CAMPSITES

- To increase the diversity of camping opportunities, the project team proposes increasing the number of accessible sites in the campground by converting existing campsites to sites with mobility features that comply with *Architectural Barriers Act Accessibility Standards*.
- For a campground the size of Ohanapecosh (in the range of 151 to 200 campsites), United States Access Board requirements call for a minimum of eight accessible campsites. This target does not need to be met immediately, but the addition of accessible campsites should be considered whenever campsites are altered or added, according to the quantities identified by the *Architectural Barriers Act Accessibility Standards*, "Camping Units With Mobility Features" (§F244.2). Implementing this proposal's recommendations for accessible campsite conversion will allow the park to exceed the goal of providing eight sites.
- Because the campground offers both tent and RV camping opportunities, accessible sites of each type should be provided proportionally. Moreover, accessible camping opportunities should be provided in diverse areas of the campground so that campers seeking an accessible site may have choices and experiences comparable to and integrated with those available to other campers. Some loops in the campground, such as G loop, are not suitable for accessible campsites due to the location of comfort stations atop steep slopes. In addition, walk-in sites in the campground require the negotiation of steep grades and may not be suitable for designated accessible sites, although incorporating universal design standards is encouraged for these sites so that they can serve as diverse a range of campers as possible.

- Existing accessible sites are located in D loop and include D-14, 20, and 21. Five additional campsites are proposed below in “Campsite Reconfigurations”: these sites are in A and H loops. As described in the design guidelines in part II of this document, the park will apply universal design standards to all campsites in the campground to the extent feasible.

CAMPSITE RECONFIGURATIONS

See tables 1 and 2 for an analysis of the capacity impacts of the proposal below.

- A loop (drawing 4):
 - A-54: Close this campsite and convert to day use, with a formal trail to the adjacent water station.
 - A-51, 52, and 53: Convert three standard sites into a large group site, with a capacity of 25. Preserve existing parking spaces.
 - A-49 and 50: Convert two standard sites into a small group site, with a capacity of 12 people. Expand the existing parking area so that it can accommodate two additional parking spaces to serve new walk-in sites.
 - New walk-in sites: Create two new walk-in sites in the level area previously used for seasonal employee housing. To avoid increasing the amount of wood smoke in the campground, do not include a fire pit in new campsites. See “Fire Pits” section in design guidelines, part II.
 - Accessible sites: Convert A-26, 30, 32, and the group site to accessible sites if topography and other considerations allow. For guidance, see the design guidelines in part II of this document and the *Architectural Barriers Act Accessibility Standards*.
- B loop: No changes.
- C loop (drawing 5):
 - C-16, 22, 24, 26: Convert four standard sites in the center of C loop into two small group sites, each with a capacity of 12.
 - Former walk-in sites and C-22 parking space: Former walk-in sites were recently converted to day use. Convert C-22 parking space to an accessible space and provide an outdoor recreation access route (ORAR) to accessible overlook. An ORAR is defined as the pedestrian route that connects accessible elements, spaces, and facilities within camping and picnic facilities and at viewing areas and trailheads. Consult the *Architectural Barriers Act Accessibility Standards* for guidance on ORARs.
 - Garbage enclosure: Explore relocating existing enclosure to the center of C loop.
 - C-27: Closed in 2017 for resource protection (proximity to stream).
- D loop: No changes.
- E loop (drawing 6):

- o E-6: Convert standard site to a small group site, with a capacity of 12 people. Formalize the existing social trail that connects to the Silver Falls Trail.
- o Silver Falls Trailhead: Formalize the trailhead and establish signage where the trail meets the road between E-9 and E-11.
- o Amphitheater accessibility: Convert the middle pathway to the amphitheater to an outdoor recreation access route (ORAR), and include access to comfort station. Accessible parking would need to be provided. For guidance, see the design guidelines in part II of this document and the *Architectural Barriers Act Accessibility Standards*.
- F loop (drawing 7):
 Due to its high density of old-growth Douglas-fir and nearby wetlands, F loop campsites would be designated as low-density (four-person capacity).
 - o New paths and raised boardwalks: A path through the center of F loop to the comfort station would be delineated or a raised boardwalk would be constructed to allow access to the comfort station while protecting the area's tree roots. Throughout the campground, raised boardwalks would be used wherever possible for trails to protect dense tree roots, riparian areas, archeological resources, and geological features where they exist.
 - o F-3, 5, and 6 have already been closed to reduce resource impacts. These sites border wetlands immediately northwest of the loop.
 - o F-15 was closed in 2018 due to the relocation of the campground's lift station from F-11 (F-11 will ultimately re-open).
- G loop (drawing 8):
 - o New walk-in sites: Create three new walk-in sites with parking area on the southern edge of G loop. To avoid increasing the amount of wood smoke in the campground, do not include a fire pit in new campsites. See "Fire Pits" section in design guidelines, part II.
- H loop (drawing 8):
 - o New standard site: Create one new standard campsite (6-person capacity) in previous campsite location south of H-19. To reduce the amount of wood smoke and improve air quality, not include a fire pit in new campsites. See "Fire Pits" section in design guidelines, part II.
 - o Accessible site: Convert H-3 to an accessible site if topography and other considerations allow. For guidance, see the design guidelines in part II of this document and the *Architectural Barriers Act Accessibility Standards*. As part of the accessibility conversion, drainage and stormwater management improvements should be implemented for this site to address water flowing across the parking area.

ANALYSIS OF CAMPGROUND CAPACITY IMPACTS: EXISTING CONDITIONS AND REHABILITATION PROPOSAL

Note that these calculations reflect campsites already closed: C-27, C walk-in sites (4), D-18, F-3, F-5, F-6, and F-15. * These 10 closures have resulted in a 60-person loss in capacity: original capacity was 1,214 persons and 196 sites. Note that the calculations below do not include or analyze capacity of the campsites reserved for tribal use (B-4, B-6, and B-7).

Table 1: EXISTING CONDITIONS/NO-ACTION ALTERNATIVE (drawing 1)

Site #	Campsite type	# in Campground	Capacity (persons)	Action	Total (persons)
multiple	Standard tent or RV	179	6	N/A	1,074
G 0-4	Walk-in (standard)	5	6	N/A	30
A and C loops	Group	2	25	N/A	50
TOTAL capacity		186 sites			1,154 people

Table 2: REHABILITATION PROPOSAL (drawings 2–8)

Site #	Campsite type	Capacity (persons)	Action	Loss or gain (persons)	Loss or gain (sites)
A-54	Standard tent or RV	6 x (1)	Convert to day use	-6	-1
A-51, 52, 53	Standard tent or RV	6 x (3)	Convert to large group site (25-person capacity)	+7	-2
A-49 and 50	Standard tent or RV	6 x (2)	Convert to small group site (12-person capacity)	0	-1
New A loop walk-in sites (2)	Walk-in (small)	4 x (2)	Create new small walk-in sites (4-person capacity)	+8	+2
A loop riparian sites	Standard tent or RV	6 x (5)	Convert to low-density sites (4-person capacity)	-10	0
C-16 and 22	Standard tent or RV	6 x (2)	Convert to small group site (12-person capacity)	0	-1

* Note that F-15 was closed beginning in spring 2018 due to the relocation of the lift station from below F-11.

Site #	Campsite type	Capacity (persons)	Action	Loss or gain (persons)	Loss or gain (sites)
C-24 and 26	Standard tent or RV	6 x (2)	Convert to small group site (12-person capacity)	0	-1
C loop riparian sites	Standard tent or RV	6 x (9)	Convert to low-density sites (4-person capacity)	-18	0
D loop riparian sites	Standard tent or RV	6 x (9)	Convert to low-density sites (4-person capacity)	-18	0
E-6	Standard tent or RV	6 x (1)	Create new small group site (12-person capacity)	+6	0
E loop riparian sites	Standard tent or RV	6 x (3)	Convert to low-density sites (4-person capacity)	-6	0
F loop riparian/sensitive sites	Standard tent or RV	6 x (14)	Convert to low-density sites (4-person capacity)	-28	0
New G loop walk-in sites (3)	Walk-in (small)	4 x (3)	Create new small walk-in sites (4-person capacity)	+12	3
G loop riparian sites	Standard tent or RV	6 x (2)	Convert to low-density sites (4-person capacity)	-4	0
New H loop campsite	Standard tent or RV	6 x (1)	Create new standard campsite (6-person capacity)	+6	1
H loop riparian sites	Standard tent or RV	6 x (4)	Convert to low-density sites (4-person capacity)	-8	0
Total addition				+ 39 people	+ 6 sites
Total loss				- 98 people	- 6 sites
TOTAL change				-59 people	0 sites
TOTAL capacity				1,095 people	186 sites

Operational Actions

The actions below were identified in internal scoping meetings during the development of this proposal. These actions can be implemented as part of the park's routine operational activities and do not require a planning process.

Several immediate signage needs are identified below. The design guidelines for signage (in part II of this document) should be considered during their implementation.

- New signage needs:
 - Add a one-way sign near B-4 to help prevent people from driving into the campsites designated for tribal use.
 - Erect signs at B loop sites reserved for tribal use (B-4, B-6, and B-7), indicating that these sites are not part of the available first-come, first-served sites.
 - Erect a sign in the B loop day-use parking area notifying people that RVs are prohibited.
 - Erect a sign before the bridge indicating that vehicles larger than a certain size won't fit in the upper loops.
 - Erect a new sign at the campground entrance that is larger and more legible.
 - Erect a sign at the campground entrance notifying people that they are entering a fee area.
 - Improve the clarity of walk-in campsite signage in loop G. It is currently difficult to understand which campsite is which.
 - Develop a wayfinding plan for the campground.
- Reduce the number of additional cars parking in the campground: This can be done now by enforcing the additional car fee that is currently in place. Campground staff can also require a park pass be visible within every car.
- Stockpile logs for barriers: Create a cache of disease-free logs that are readily accessible and relatively easy to move. Campground rangers can use these to create barriers in areas if there is an immediate need, for example over the weekend or at times when maintenance staff are absent. For guidance on selecting disease-free logs, see the "Vegetation" section and guidelines in part II.

Ideas Considered but Dismissed

INCREASED CAMPGROUND CAPACITY

To address the project's purpose, need, and objectives, the planning team considered options to maximize available camping opportunities. An increase in campground capacity could be achieved by maintaining the size of most existing campsites, adding new campsites, and reconfiguring a small number of other campsites to provide additional group camping opportunities. Many of the campsites

identified as suitable for conversion to group sites are located in F loop, however, and an interdisciplinary review team determined that the resource impacts caused by increasing F loop density would be too great, given the vulnerable condition of the old-growth trees in this area. Similarly, resource impacts in campsites bordering wetland and riparian areas were a driving consideration in reducing density in those sites. Although the rehabilitation proposal retains campsite reconfigurations and increased density recommendations in areas that are less sensitive to resource impacts, the proposal results in a decrease in overall campground capacity, as illustrated in table 2.

ADDITIONAL CAMPSITES EAST OF H AND E LOOPS

The planning team evaluated the potential development of new campsites to the east of H and E loops, but new campsites in this area were determined infeasible due to unacceptable resource impacts. The areas available for development are located along slopes that would require significant ground disturbance and disruption of natural drainage patterns. Moreover, the U.S. Forest Service Forest Health Protection report on the campground discourages development in the area east of H loop due to hazard tree concerns (USFS 2017, 9–10).

A potential new walk-in site adjacent and uphill from E-17 was closely examined as a potential new site, however, the project team determined that the addition of a single new site did not merit the amount of ground disturbance required for development.

REDUCED SIZE OF AMPHITHEATER

The park's interpretive staff have observed that the current footprint of the amphitheater is much larger than is needed for current programming, even during the busiest evenings. Reducing the size of the amphitheater by about one-third would allow space for other uses. The planning team considered this idea but has determined that further study is needed to evaluate whether or not this action could be achieved without unacceptable resource impacts. The amphitheater is an integral component of the campground's Mission 66 master plan and the reconfiguration of its footprint could possibly result in an adverse effect to the park's cultural resources.

POTENTIAL FUTURE ACTIONS

Several other ideas emerged during the planning process for the Ohanapecosh Campground. Some of these were identified as outside the scope of the current rehabilitation proposal, but the planning team considers them valuable potential alternatives for long-term campground management. Changes in recreational use patterns and climate-change associated impacts to environmental conditions may impact the future feasibility of these options, listed below.

Changes in loop development and management to address use conflicts and resource impacts

- Further reduce the density of low-density sites: reduce density in sensitive sites from four to two or three people.
- F loop: for protection of the site's old-growth trees, overnight use of F loop would be reduced in a phased approach. F loop would ultimately be converted to day use, with interpretive trails identified through subsequent interpretive and site planning.

- B loop: convert loop to day use to provide additional parking for visitors using the campground to access the visitor center and the Hot Springs and Silver Falls trails.
- A and C loops: convert both loops to first-come, first-served to discourage large vehicles from crossing the river and getting stuck in the narrow turnarounds of the northern loops.
- Addition of a new loop: if cultural and natural resource surveys determine it is feasible, develop a new camping loop in the area previously occupied by the Ohanapecosh Hot Springs Resort.
- Designate desired experiences for individual loops: evaluate the feasibility of designating some loops as tent-only, others for RVs, etc., in order to offer more secluded and primitive or more social camping options. The campground has a long history of mixing tent and RV use, and visitor use data is needed to determine 1) how many RV campers are accompanied by those in tents, and 2) whether visitors might be interested in more rigorous campground zoning.
- Overflow parking: provide an overflow parking lot near the Ohanapecosh Ranger Station to accommodate overflow campground parking as well as day-use parking. Providing an overflow lot will allow campground managers to reduce the allowed number of vehicles per campsite to one car in most cases. Day-use parking will reduce resource impacts and congestion by reducing the number of cars parked along road shoulders in the campground.
- Relocate dump station: the Ohanapecosh Ranger Station has been identified as a potential new location for the dump station that is currently in B loop.

Congestion management strategies

- Erect a sign before the campground's entrance on Route 123, indicating whether or not the campground is full.
- Provide advanced traveler information about day-use parking and campsite availability, through variable message signs, radio traffic information, websites, and social media.

Additional facilities to improve accessibility and reduce resource impacts

- Develop a trail providing visitors with access to the river and reducing informal, social trails. Safety and resource impact concerns would need to be addressed.
- Provide yurts or other minimal camping structures in some of the more heavily used areas (e.g., loops A and C) to offer more affordable and accessible camping options to visitors who may not have a lot of camping equipment and/or may not be able to sleep overnight in tents. This will also concentrate visitor use impacts into a smaller footprint that will make it easier to ensure the success of revegetation efforts.
- Provide all-terrain wheelchairs and carts to assist visitors in moving around the campground and transporting their possessions. While theft is currently a concern in the campground, increased law enforcement presence would allow the park to offer this amenity to campers.

Minimize air quality impacts from campfire smoke

- In the long term, begin to move away from providing campfires at individual campsites, instead offering larger, centralized fire pit areas.
- Remove fire pits from smaller, more primitive campsites, especially in loops E, F, G, and H.

Interpretation and visitor center exhibits

- Develop an interpretive program that educates visitors about opportunities and challenges associated with park campgrounds in dynamic forest and riparian habitats. Address topics such as old-growth succession, the natural role of decay organisms, and park restoration activities.
- Share “Keep Wildlife Wild” and “Leave No Trace” principles.
- Help educate visitors about the health and air quality benefits of limiting campfire use and wood smoke.

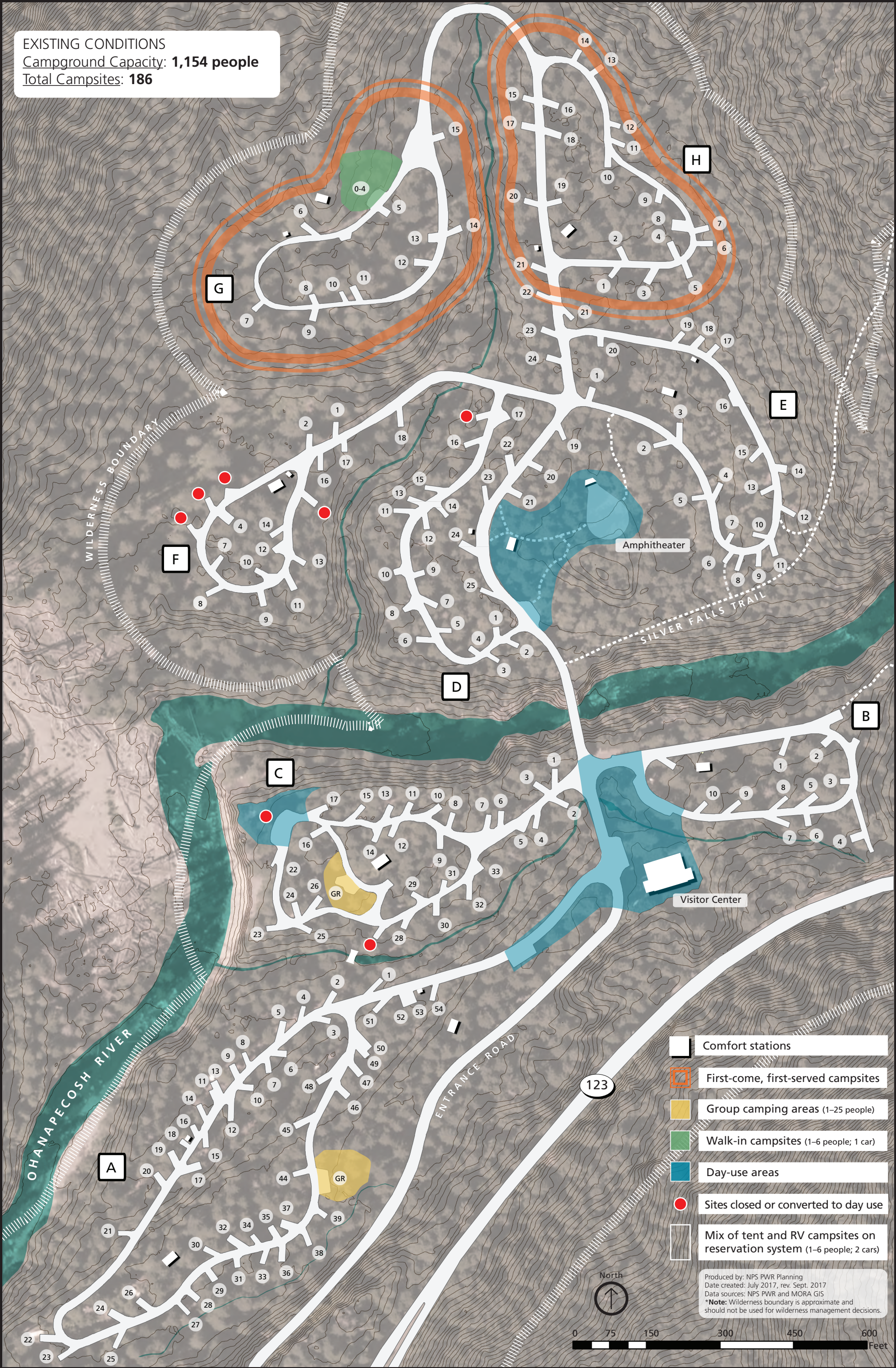
Drawing 1: Existing Conditions and Zones

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

National Park Service
U.S. Department of the Interior



EXISTING CONDITIONS
Campground Capacity: **1,154 people**
Total Campsites: **186**



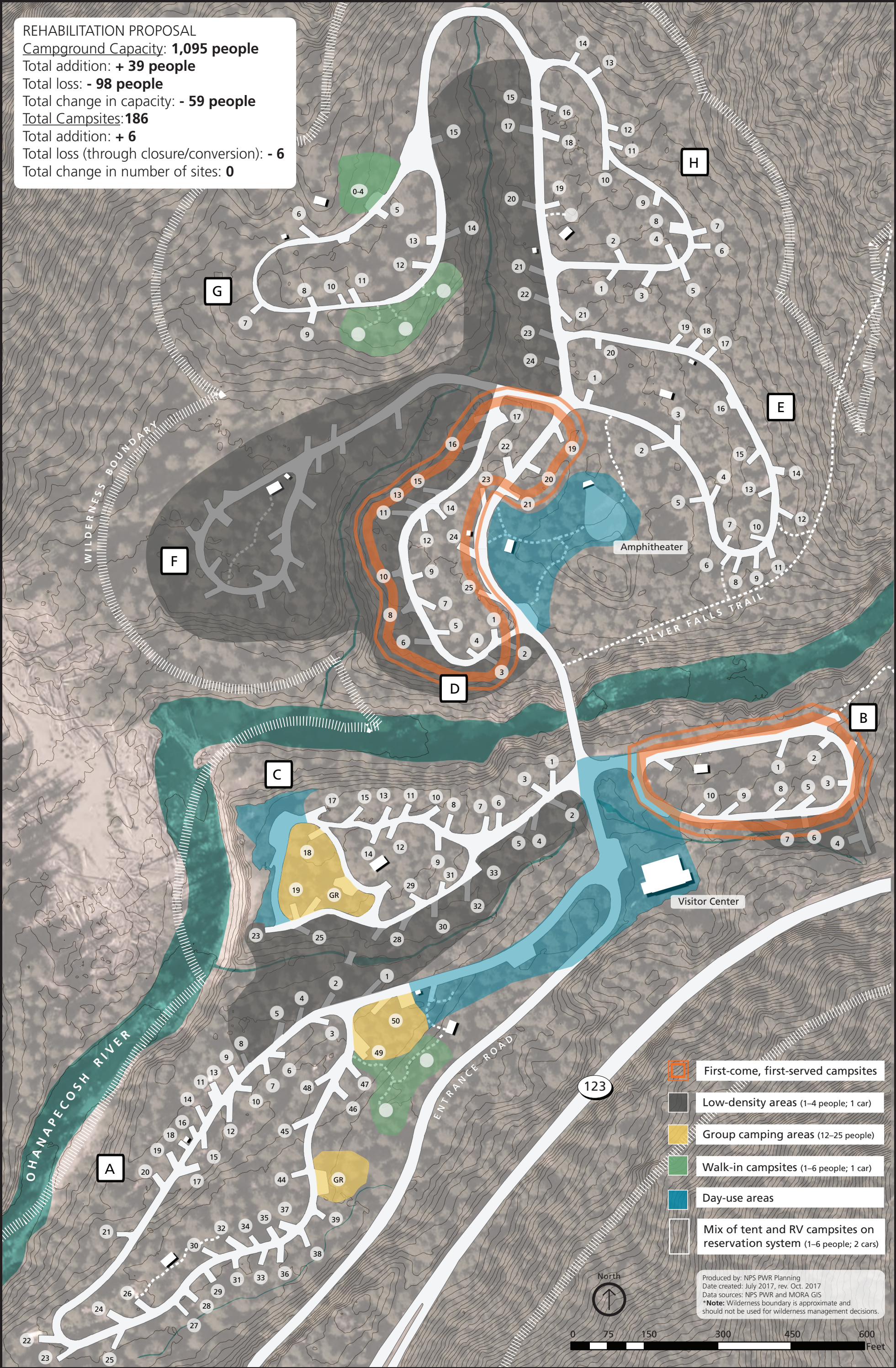
Drawing 2: Zones, Rehabilitation Proposal

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

National Park Service
U.S. Department of the Interior



REHABILITATION PROPOSAL
Campground Capacity: **1,095 people**
Total addition: **+ 39 people**
Total loss: **- 98 people**
Total change in capacity: **- 59 people**
Total Campsites: **186**
Total addition: **+ 6**
Total loss (through closure/conversion): **- 6**
Total change in number of sites: **0**



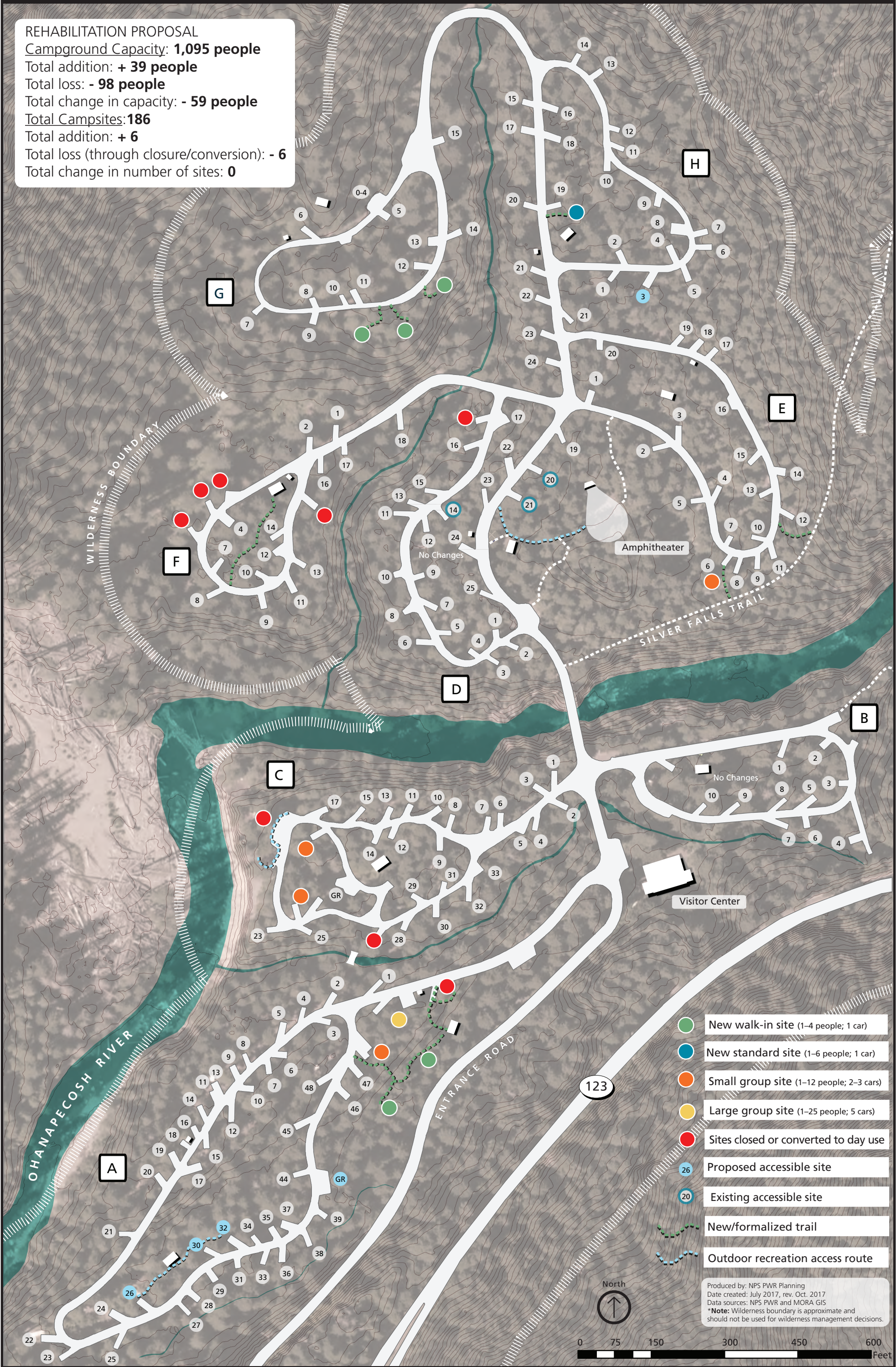
Drawing 3: Campsite Changes, Rehabilitation Proposal

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

National Park Service
U.S. Department of the Interior



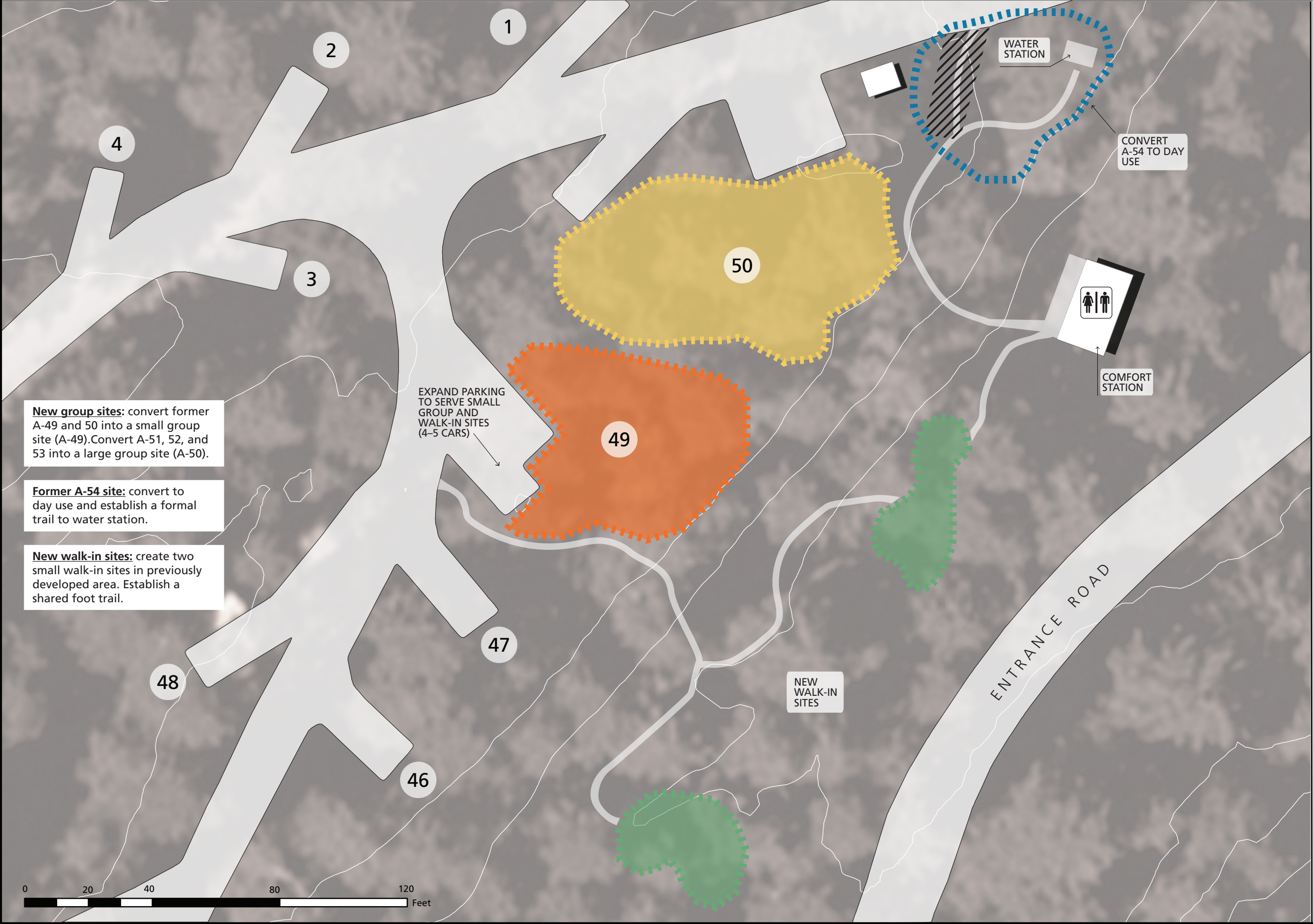
REHABILITATION PROPOSAL
Campground Capacity: **1,095 people**
Total addition: **+ 39 people**
Total loss: **- 98 people**
Total change in capacity: **- 59 people**
Total Campsites: **186**
Total addition: **+ 6**
Total loss (through closure/conversion): **- 6**
Total change in number of sites: **0**



Drawing 4: Loop A Campsite Changes, Rehabilitation Proposal

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

National Park Service
U.S. Department of the Interior



New group sites: convert former A-49 and 50 into a small group site (A-49). Convert A-51, 52, and 53 into a large group site (A-50).

Former A-54 site: convert to day use and establish a formal trail to water station.

New walk-in sites: create two small walk-in sites in previously developed area. Establish a shared foot trail.

- Large group site (25 people, 5 cars)
- Small group site (12 people, 2-3 cars)
- New walk-in site (1-4 people, 1 car)
- Day-use area
- Decommissioned parking area



Produced by: NPS PWR Planning
Date created: July 2017
Data sources: NPS PWR and MORA GIS

Drawing 5: Loop C Campsite Changes, Rehabilitation Proposal

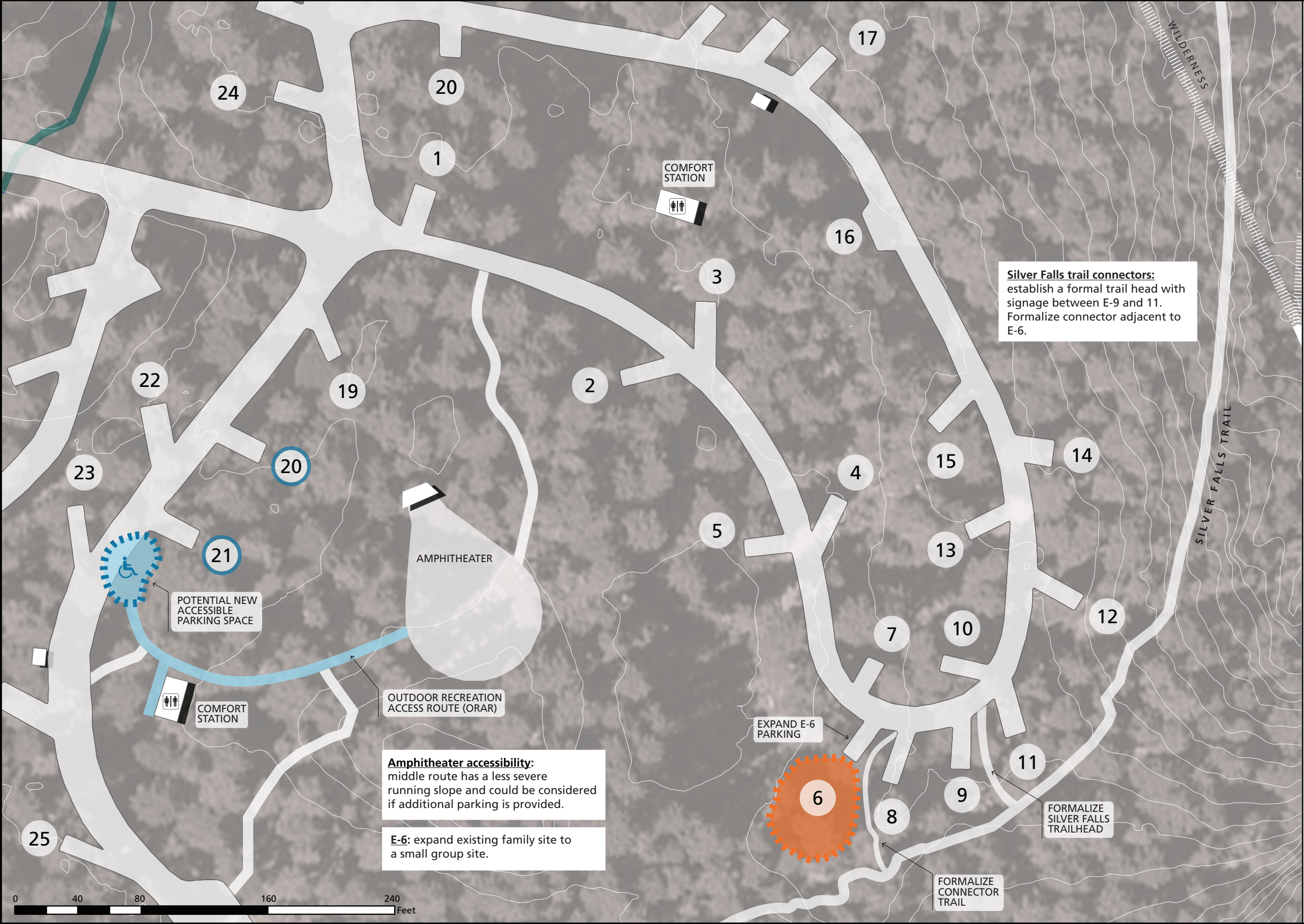
Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

National Park Service
U.S. Department of the Interior



Drawing 6: Loop E Campsite Changes, Rehabilitation Proposal

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan



Small group site
(12 people, 2–3 cars)

Proposed accessible
parking area

20 Existing accessible site

North
Produced by: NPS PWR Planning
Date created: July 2017
Data sources: NPS PWR +MORA GIS
*Note: Wilderness boundary is
approximate and should not be used for
wilderness management decisions.

Drawing 7: Loop F Campsite Changes, Rehabilitation Proposal

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

National Park Service
U.S. Department of the Interior



All sites: reduce capacity for all F-loop sites from 6 to 4 people per site.

Former F-3, 5, and 6: close campsites due to proximity to wetland areas.

Center of F loop: delineate path or construct raised boardwalk to comfort station.

Actively revegetate areas on either side of boardwalk and between campsites, according to Ohanapecosh Design Guidelines.

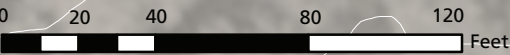
Former F-15: close campsite due to future lift station relocation.

F-11: lift station located at F-11 will be relocated in spring 2018.

 Closed campsite

North

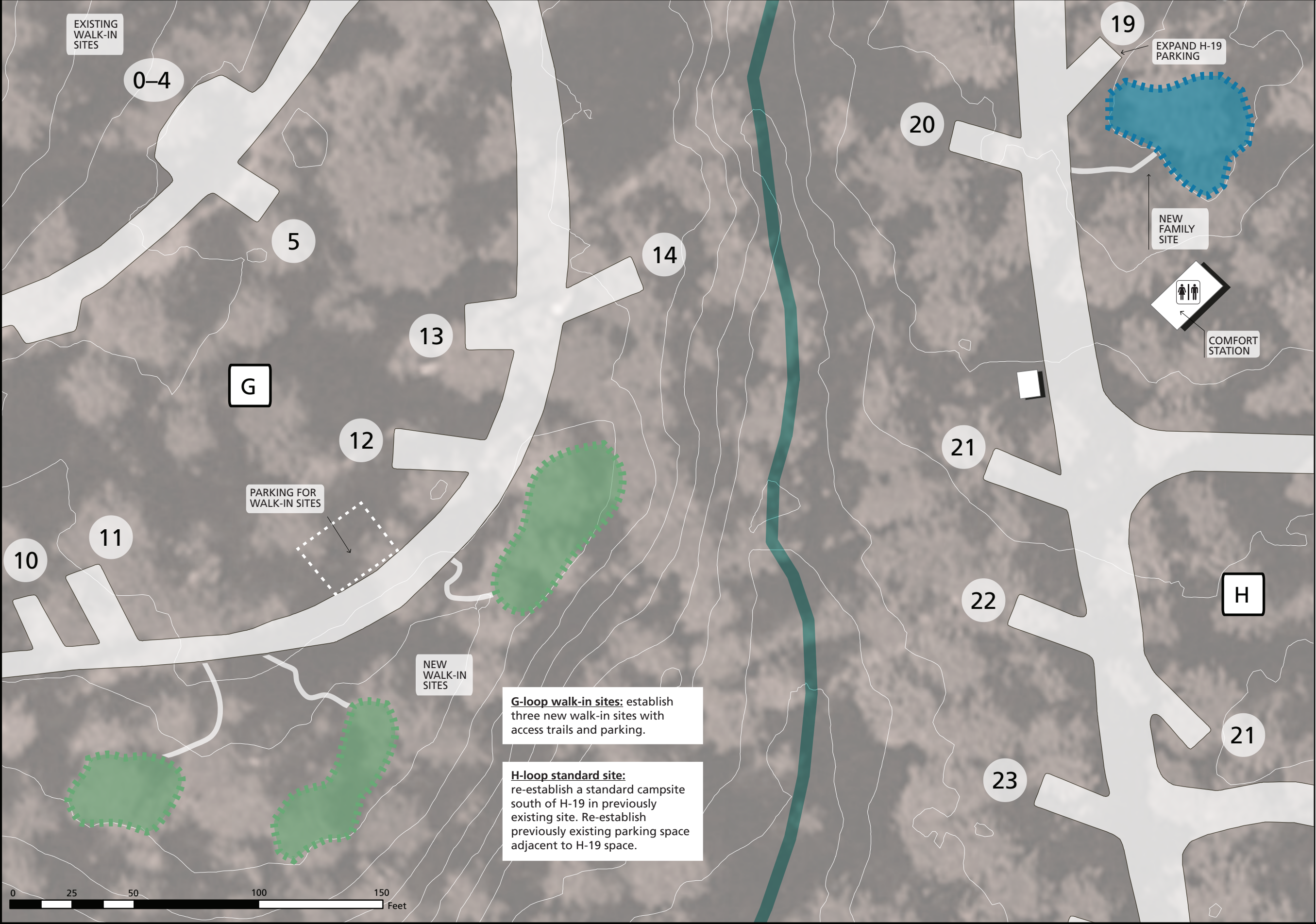

Produced by: NPS PWR Planning
Date created: rev. March 2018
Data sources: NPS PWR and MORA GIS
***Note:** Wilderness boundary is approximate and should not be used for wilderness management decisions.



Drawing 8: Loops G and H Campsite Changes, Rehabilitation Proposal

Mount Rainier National Park | Ohanapecosh Campground Rehabilitation Plan

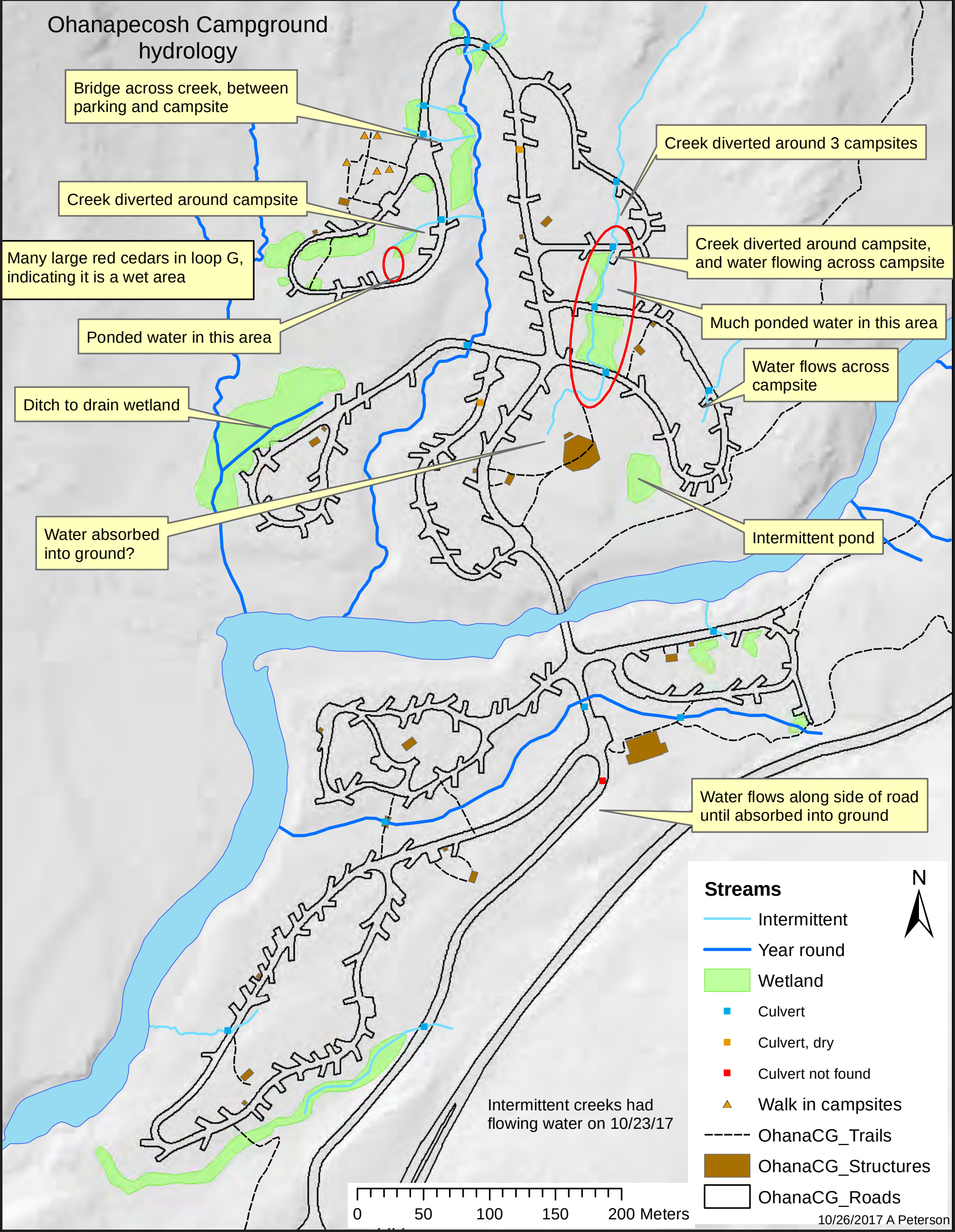
National Park Service
U.S. Department of the Interior



-  New standard site (6 people, 1 car)
-  New walk-in site (1-4 people, 1 car)

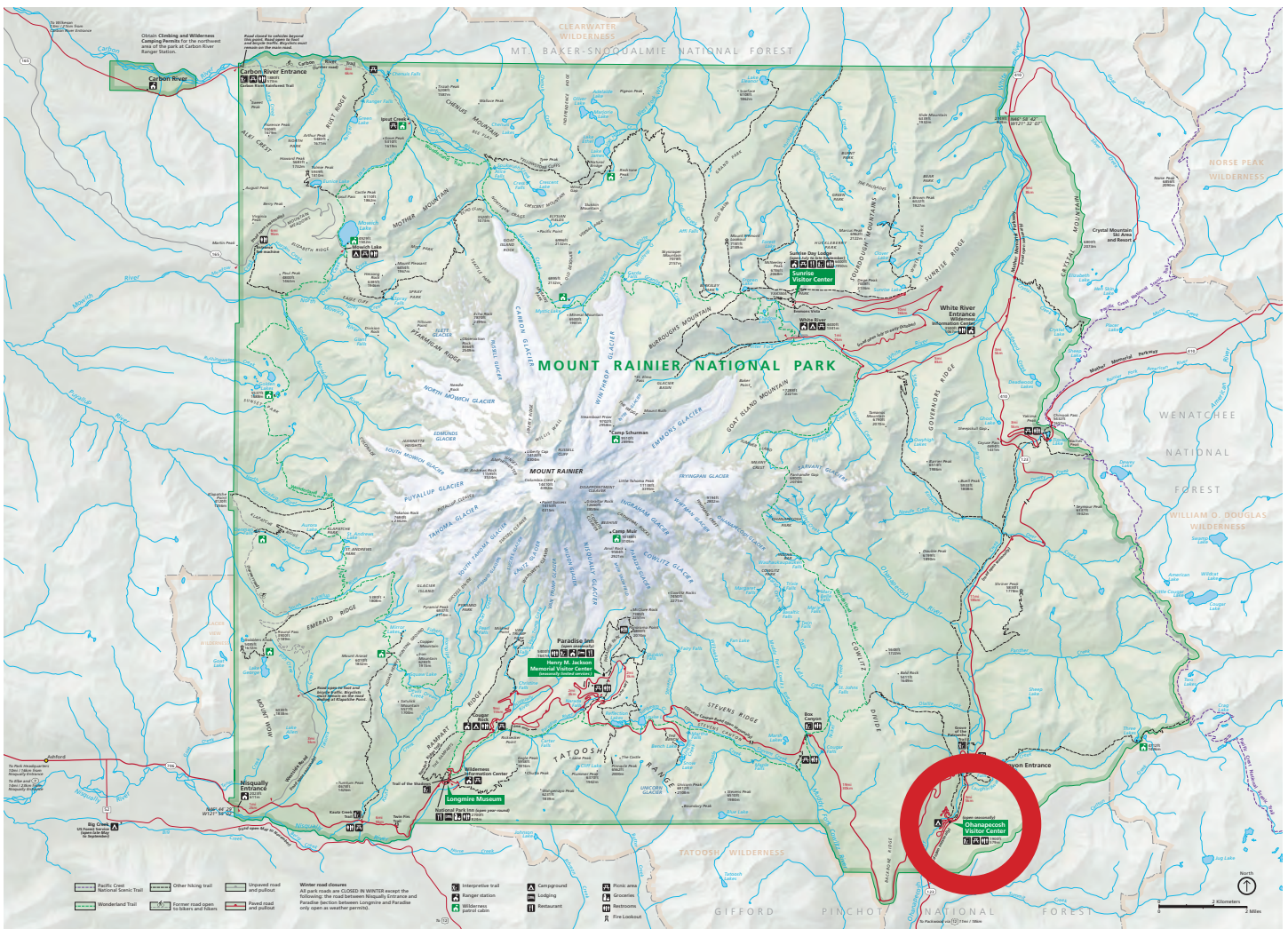
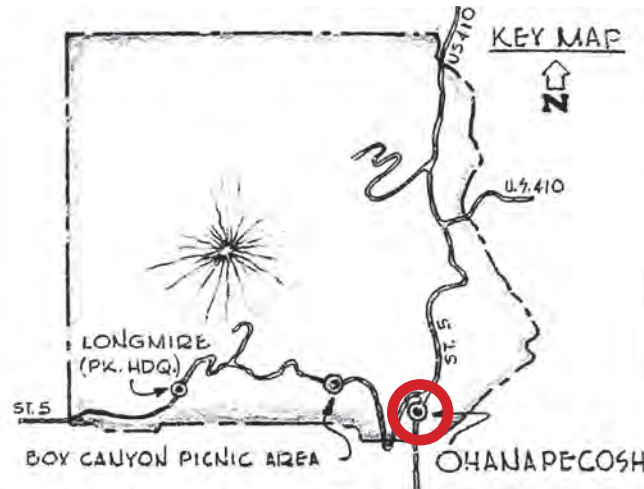
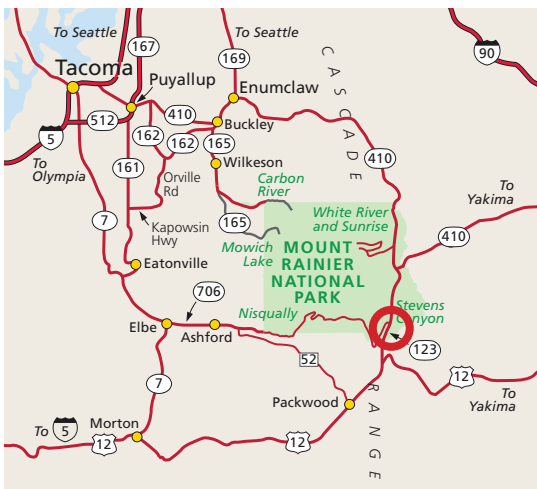


Produced by: NPS PWR Planning
Date created: July 2017
Data sources: NPS PWR and MORA GIS





REGIONAL CONTEXT AND PARK MAPS OHANAPECOSH CAMPGROUND, MOUNT RAINIER NATIONAL PARK



Figures 1–3. Park and regional context maps illustrating the location of the Ohanapecosh Campground. Source: NPS.

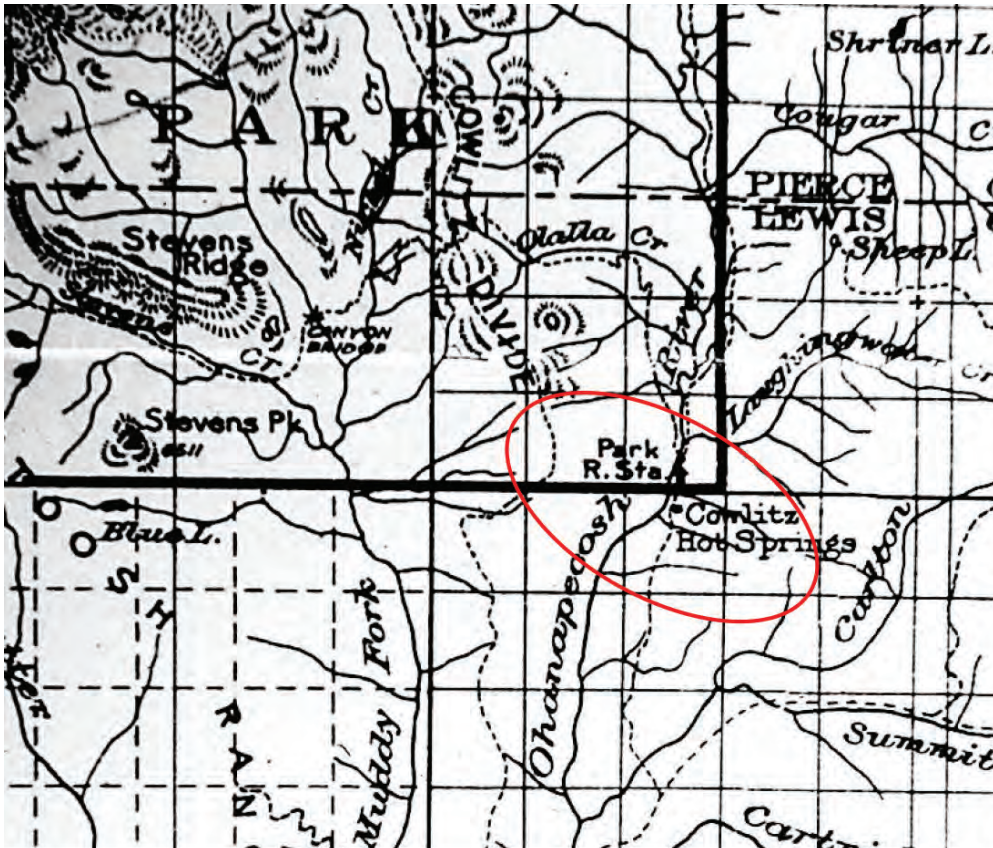


Figure 4. 1926 map detail showing the park ranger station inside the national park boundary and the “Cowlitz Hot Springs,” or Ohanapeosh Hot Springs, just south of the boundary. Source: NPS 2016.



Figure 5. The Ohanapeosh Hot Springs Resort Bath House Under Construction, 1927. Source: NPS 2016.

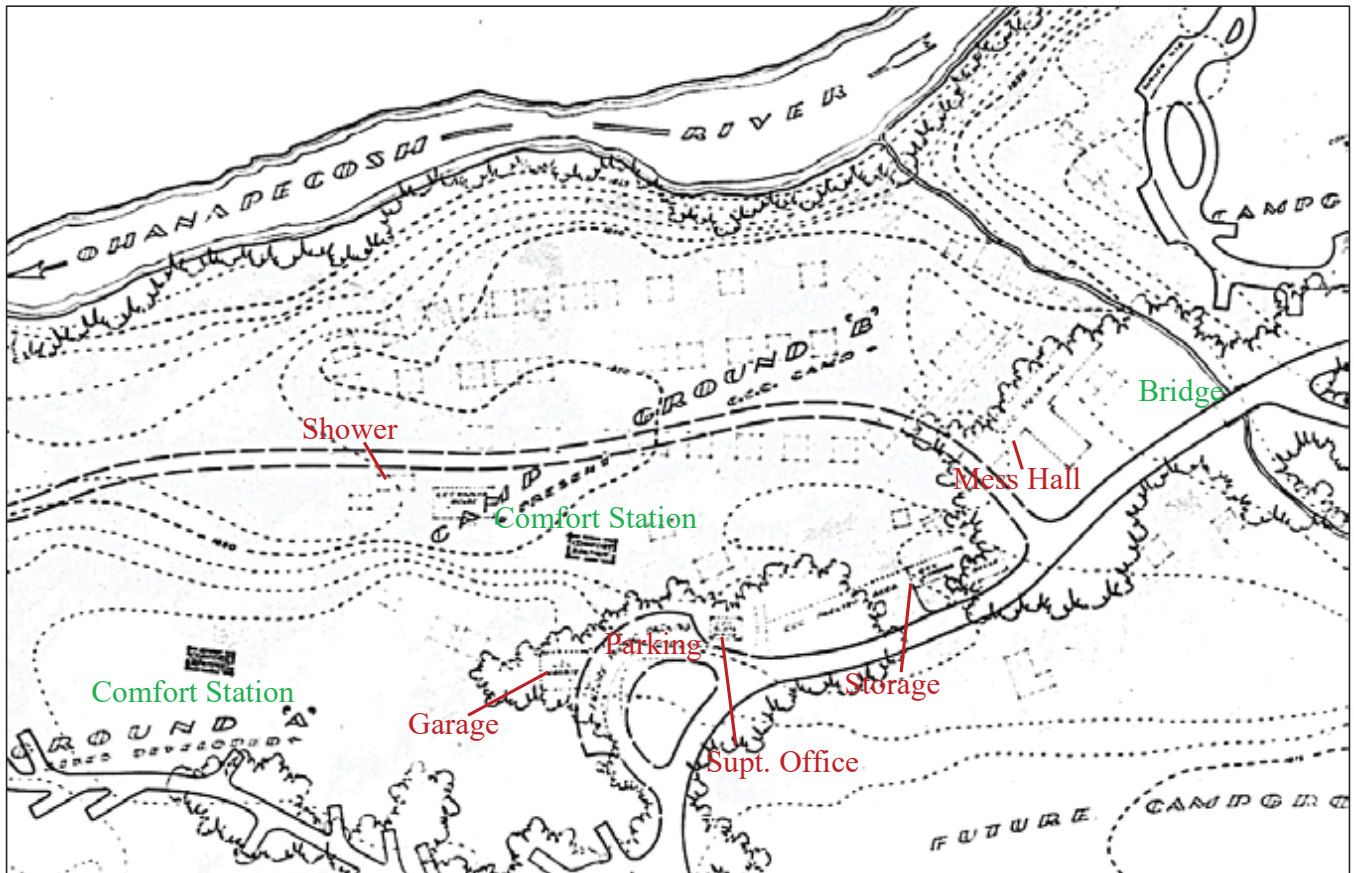


Figure 6. 1938 Ohanapecosh Hot Springs Development Plan, indicating CCC camp structures including comfort stations in loop A that persist today. Source: NPS 2016.



Figure 7. The Ohanapecosh Hot Springs Resort in its heyday, n.d.. Source: NPS 2016.



Figure 8. The Ohanapecosh CCC Camp, 1930s. Note the lack of understory vegetation. Source: NPS 2016.

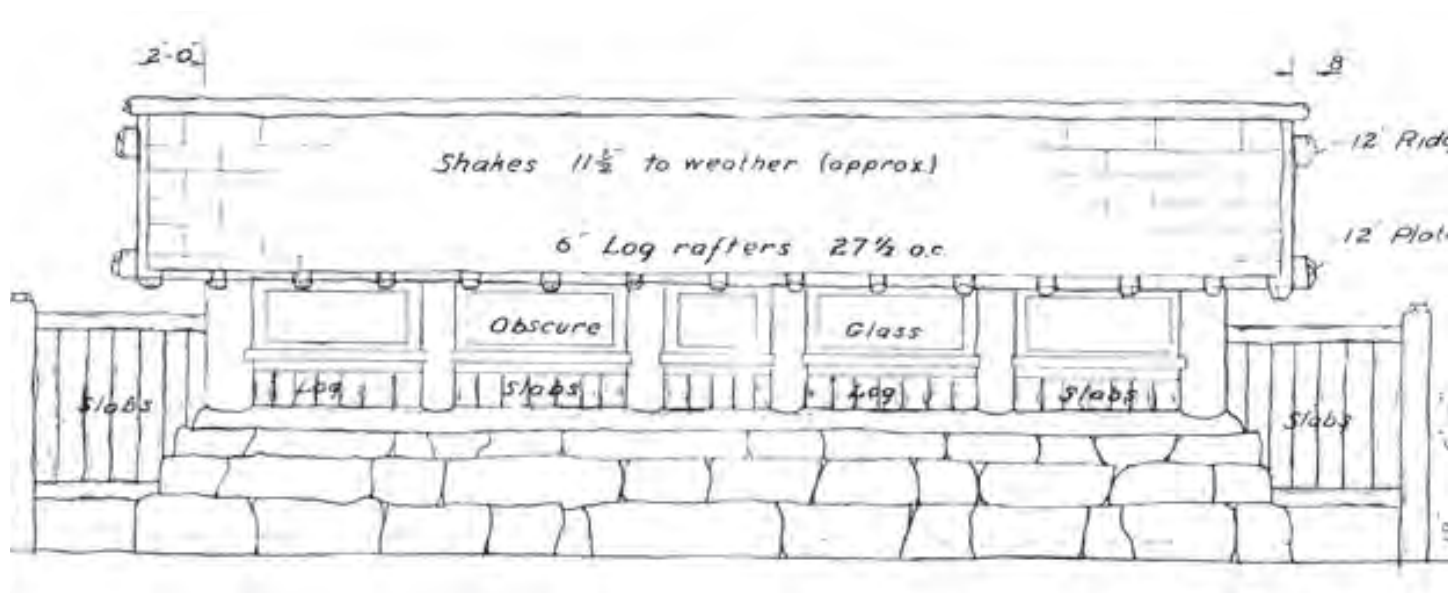


Figure 9. Elevation drawings for CCC-era comfort stations in the campground. Two are located in loop a, one in loop B, and one in loop C. Source: NPS 2016.



Figure 10. Construction of a comfort station at Ohanapecosh, 1934. Source: NPS 2016.



Figure 11. One of the comfort stations in A loop, 2017. Source: NPS.

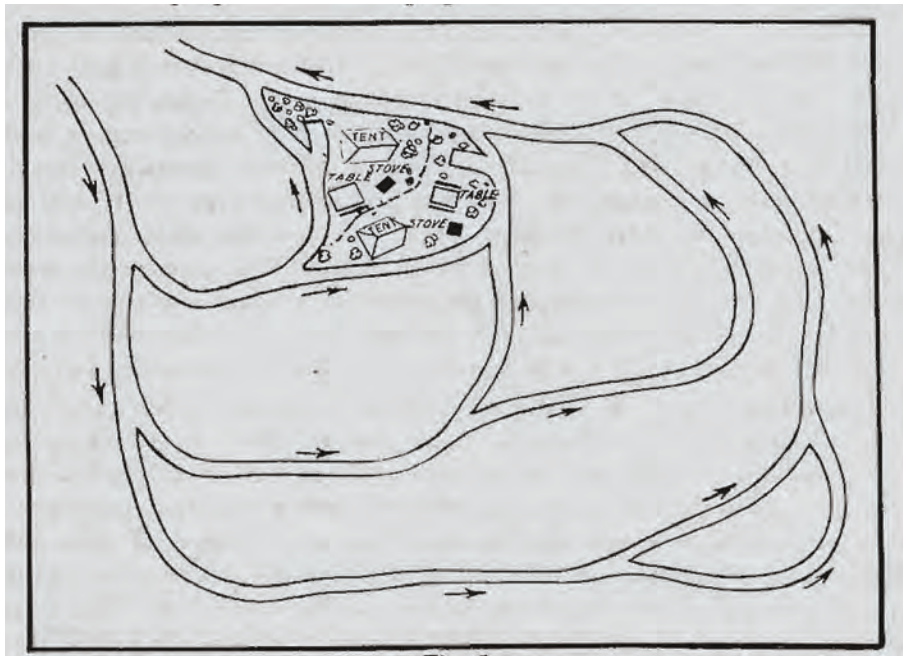


Figure 12. E. P. Meinecke proposal for a campground layout with one-way roads and parking spurs. Source: *A Camp Ground Policy*, 1932.



Figure 13. E. P. Meinecke proposal for individual campsites, with tents, tables, stoves, and "garage spurs" for parking. Source: *A Camp Ground Policy*, 1932.



Figure 14. Seasonal employee housing at Ohanapecosh, 1950s. This area has been identified as a location for new walk-in sites in the rehabilitation proposal. Source: NPS 2016.

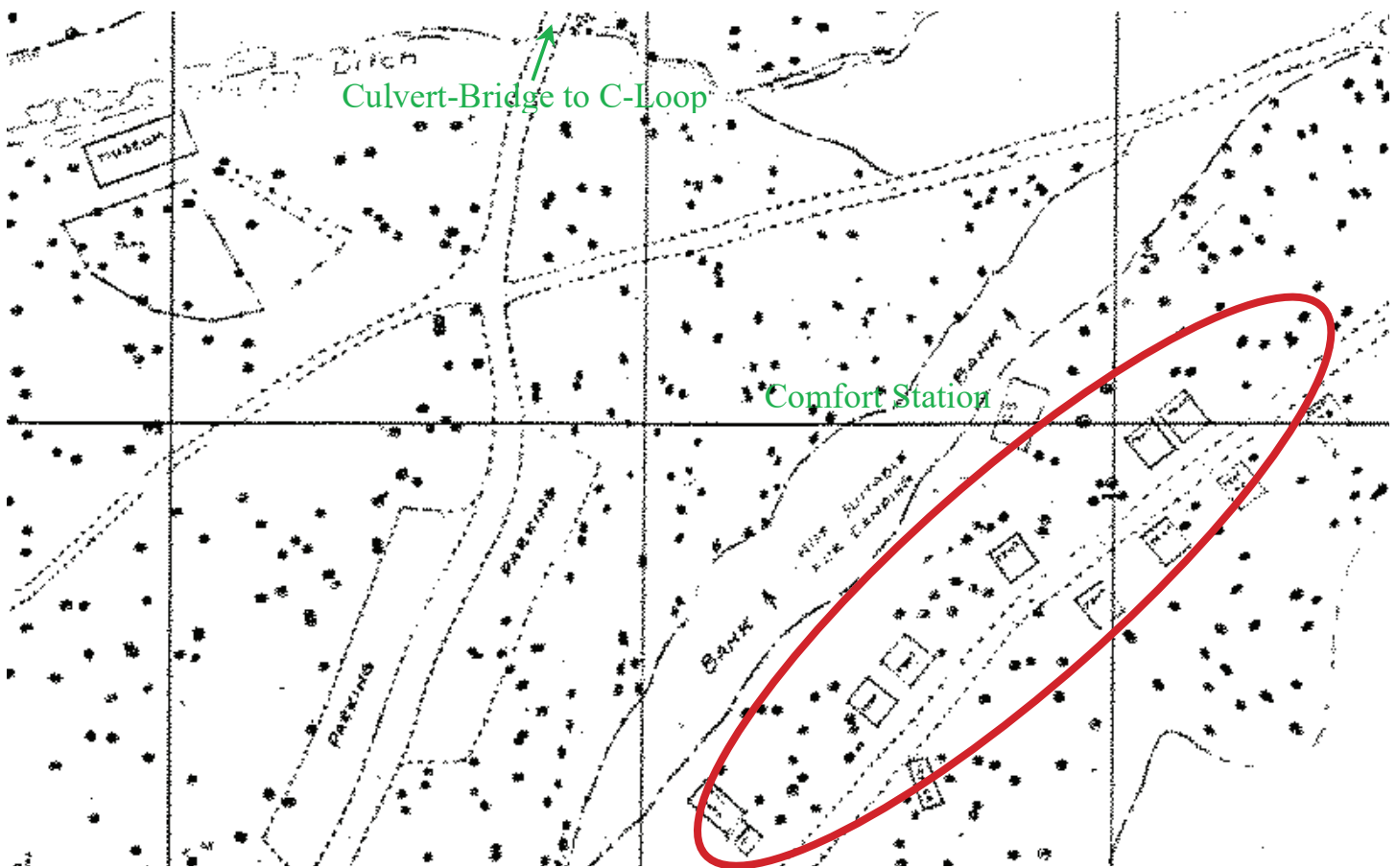


Figure 15. Map illustrating seasonal housing area in loop A, 1950s. Source: NPS 2016.

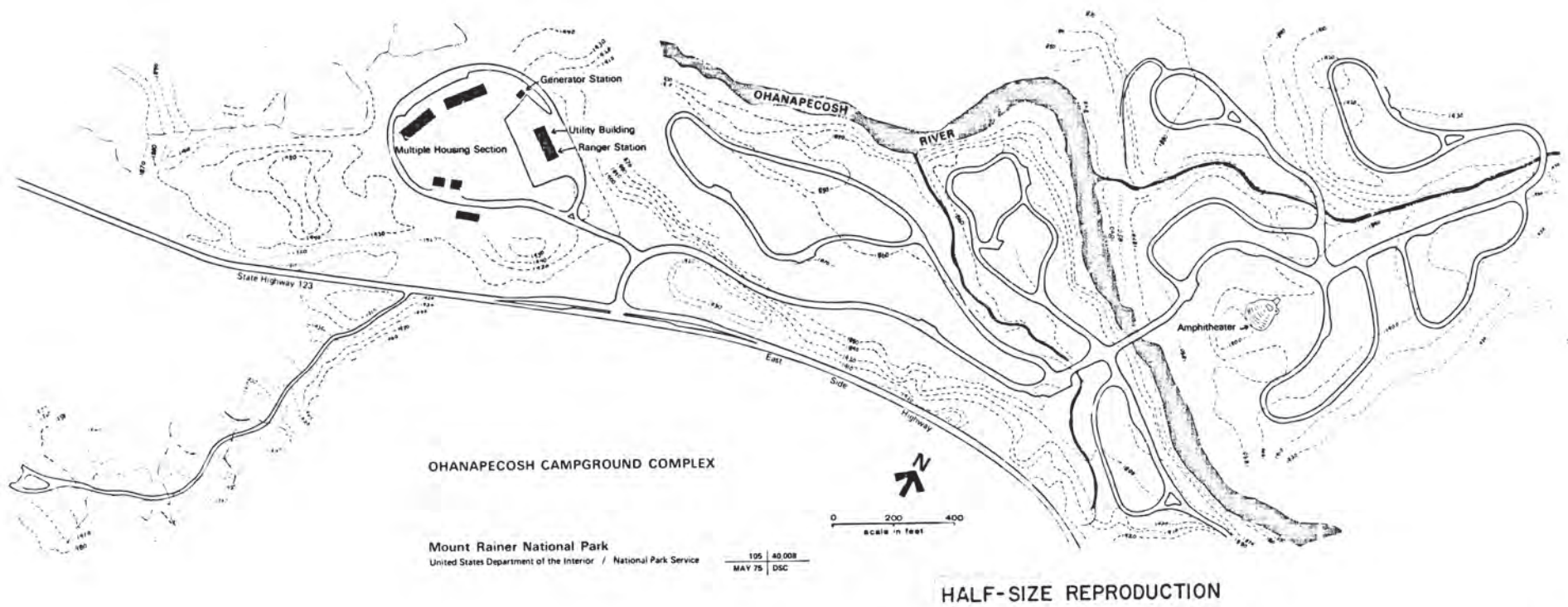


Figure 17. Ohanapecosh Campground, plan illustrating the administrative, maintenance, and employee housing areas, in addition to a campground loop configuration similar to what exists today. Note that the road leading from F loop and the small islands at the beginning of loops F and G do not exist. Source: Denver Service Center, National Park Service, 1975.



Figure 18. Ohanapecosh Visitor Center, 1966. The bare ground visible around the building is an artifact of its recent construction and not the optimal understory condition. Source: NPS 2016.



Figure 19. Ohanapecosh Visitor Center, 2009. Source: visitrainier.com.



Figure 20. Current conditions: there is a significant loss of understory vegetation in many areas in the campground, including this campsite in F loop, 2017. Source: NPS.



Figure 21. Parking area and campsite in E loop, 2017. Source: NPS.



Figure 22. Conditions in G loop, where there are fewer impacts to understory vegetation, 2017. Source: NPS.



Figure 23. An example of desired conditions between campsites or alongside parking areas, loop A, 2017. Source: NPS.



Figure 24. Loop A campsite conditions, 2017, illustrating a loss of understory and a confusing arrangement of multiple campsites. Note also the social trails leading up the hillside. Source: NPS.



Figure 25. An ill-defined parking area in loop A, 2017. Source: NPS.



Figure 26. Confusing, crowded campsite conditions inside the center of C loop, 2017. Source: NPS.



Figure 27. Desired edge conditions, C loop roadside, 2017. Source: NPS.



Figure 28. Desired conditions between campsites, 2017. Source: NPS.



Figure 29. Campsite C-27 adjacent to stream, with significant loss of vegetation. This campsite was closed shortly after this photo was taken, in 2017. Source: NPS.



Figure 30. Improved riparian conditions upstream of campsite C-27, 2017. Source: NPS.



Figure 31. The campground's forested setting, E loop, 2017. Source: NPS.



Figure 32. Forested conditions along the G loop road, 2017. Source: NPS.



Figure 33. Ohanapecosh River, looking east (upstream) from the bridge, 2017. Source: NPS.



Figure 34. Ohanapecosh River, looking west (downstream) from the bridge, 2017. Source: NPS.

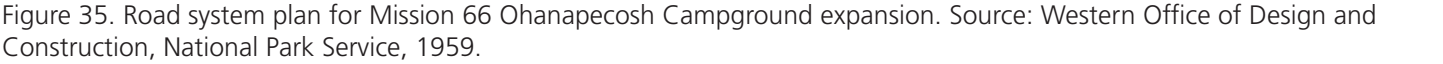


Figure 35. Road system plan for Mission 66 Ohanapecosh Campground expansion. Source: Western Office of Design and Construction, National Park Service, 1959.

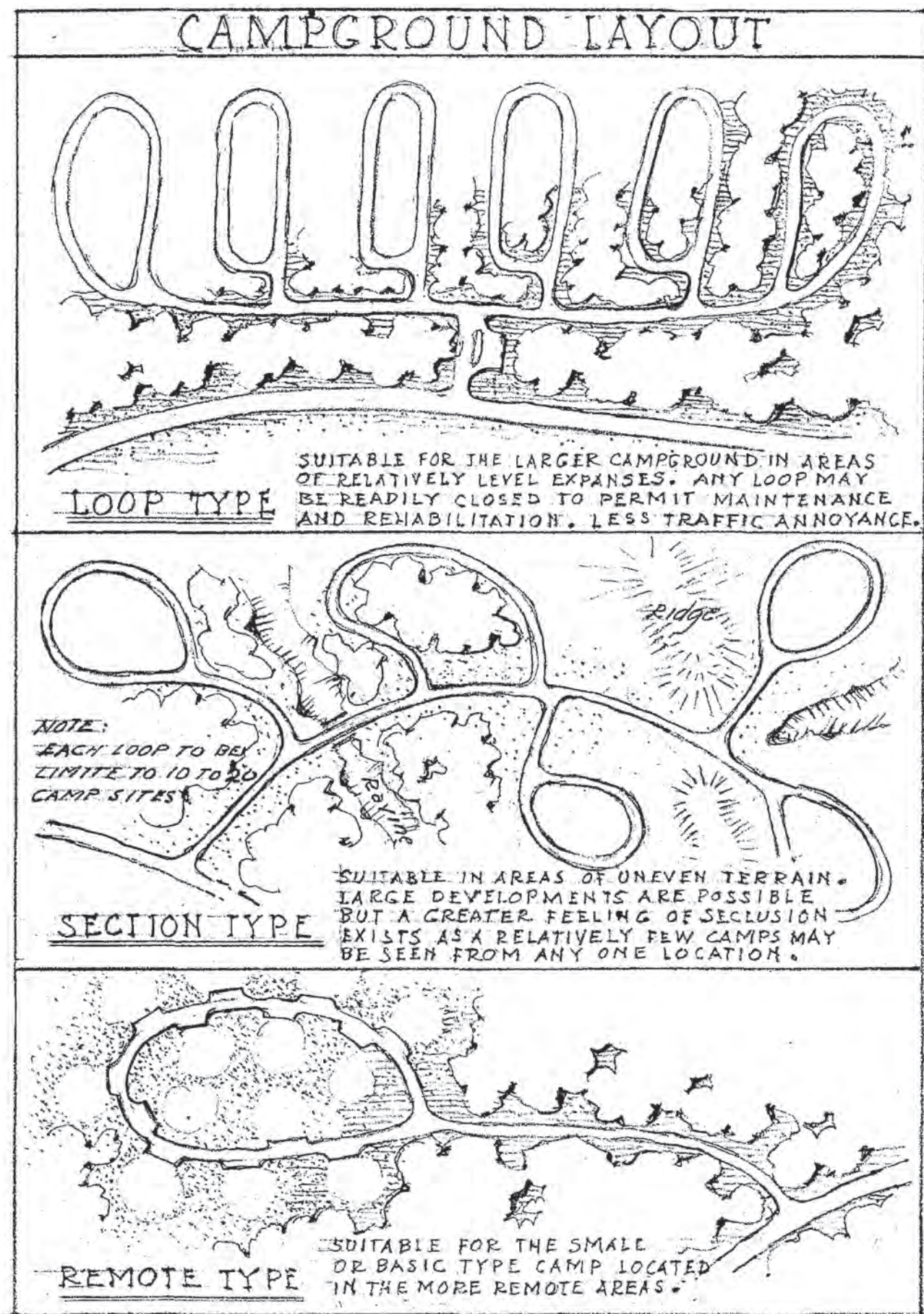


Figure 36. Mission 66 campground layout options proposed by the National Park Service Western Regional Office. Source: *Campground Study*, 1959.

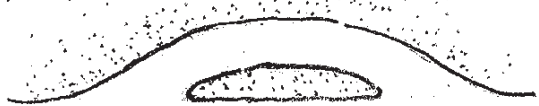
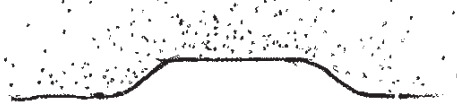
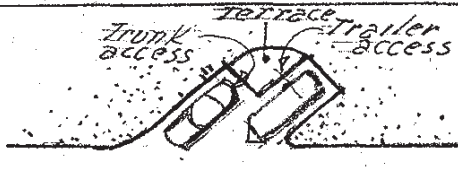
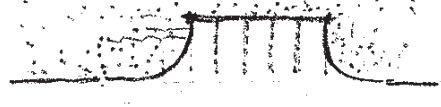
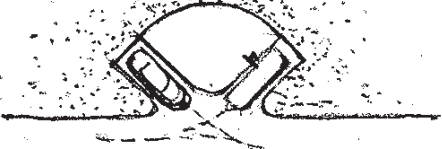
CAMPSITE PARKING	
 <u>LOOP</u> <i>Suitable for car or car and trailer use. Easy access. Island permits plant screening for privacy.</i>	 <u>PARALLEL</u> <i>For use in basic type camps or where natural features limit depth.</i>
 <u>ARC</u> <i>A variation of 'parallel' permits easier maintenance by equipment.</i>	 <u>SINGLE SPUR</u> <i>Suitable where trees or rocks restrict space.</i>
 <u>DOUBLE SPUR</u> <i>Suitable for trailer or two family use.</i>	 <u>MULTIPLE</u> <i>For group camp or for the 'walk in' type of camp.</i>
 <u>TRIANGLE</u> <i>permits parallel or diagonal parking from either direction.</i>	 <u>FAN</u> <i>For trailer use. Car and trailer form a screen for the stabilized soil terrace.</i>

PLATE NO. 5

Figure 37. Mission 66 parking designs proposed by the National Park Service Western Regional Office. Source: Campground Study, 1959.

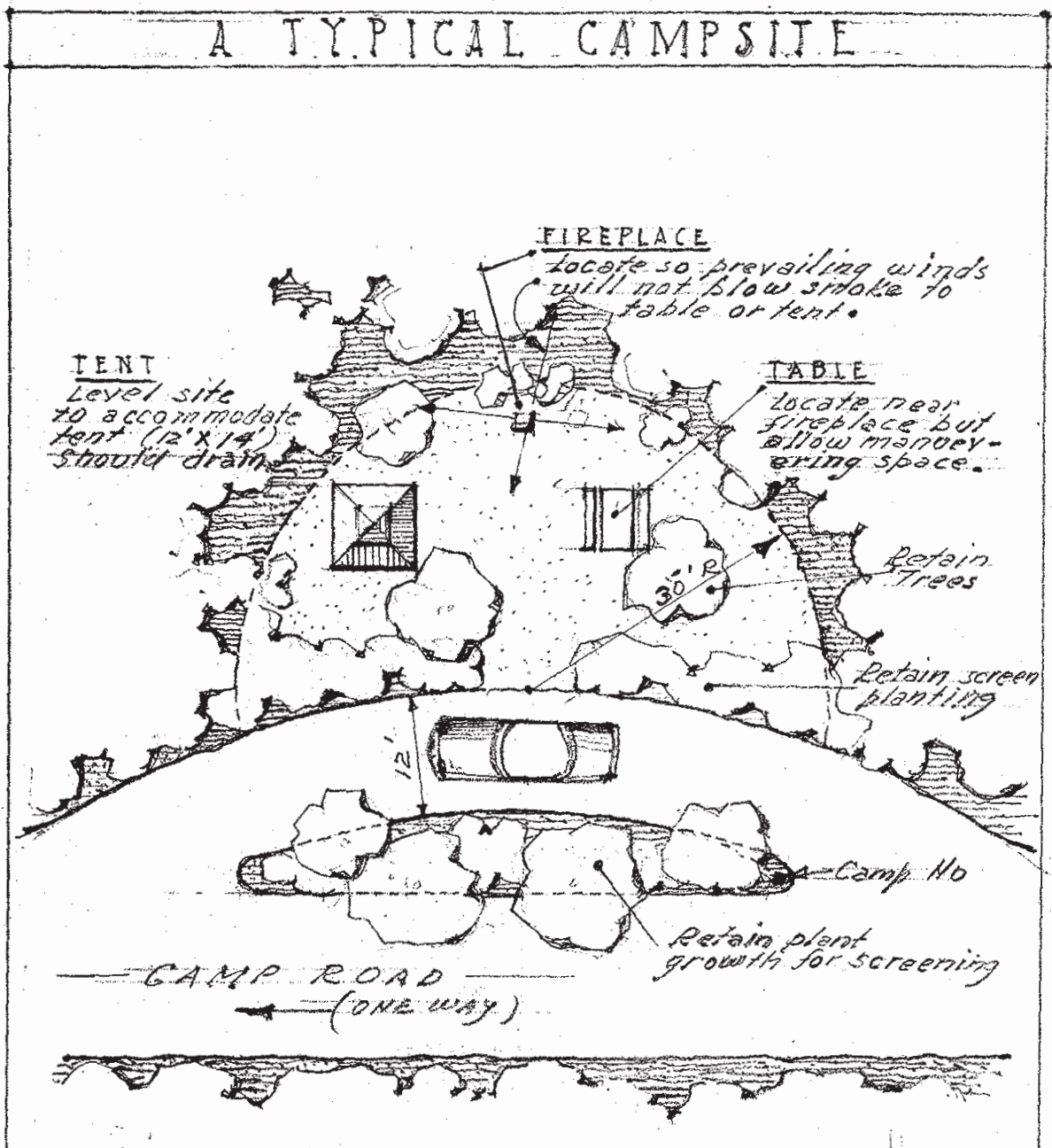


Figure 38. Mission 66 campsite design proposed by the National Park Service Western Regional Office.
Source: *Campground Study*, 1959.

Figure 39. Large woody debris in a "jackstraw" pattern, used to protect a stream bank and improve habitat. Source: fishbio.com.

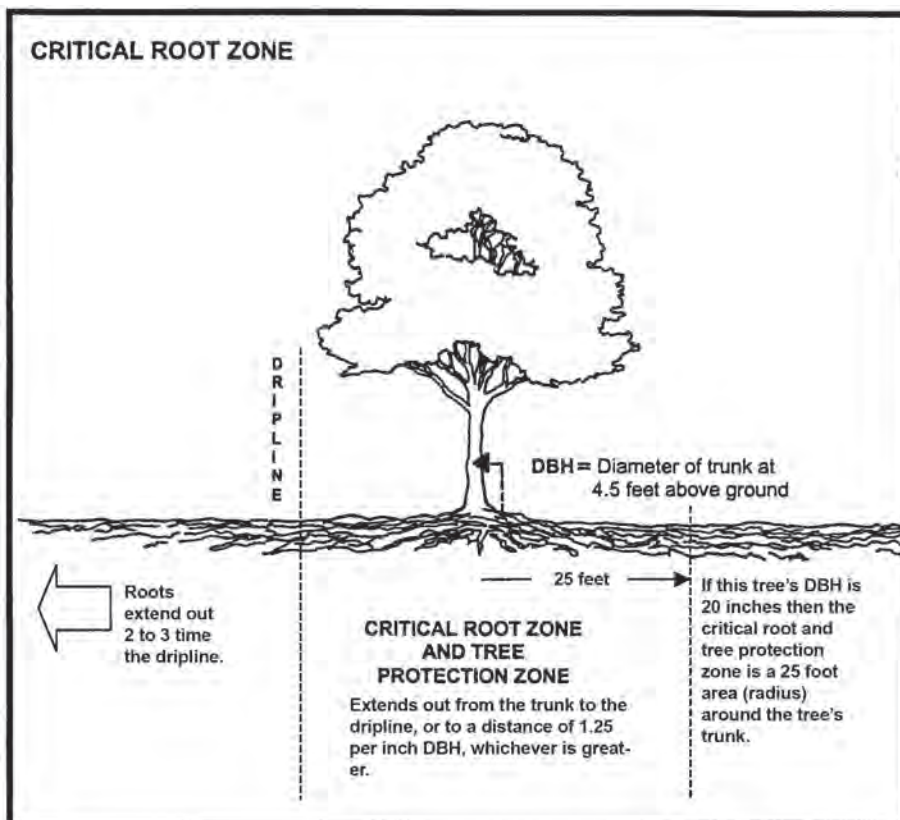


Figure 40. Critical root zone. Source: Athens/Clark County, Georgia. Unified Government standards for calculating Critical Root Zones.



Figure 41. Critical root radius (CRR). Source: T. Degerman, NPS.



Figure 42. Existing campsite without tree root protection, 2017. Source: NPS.

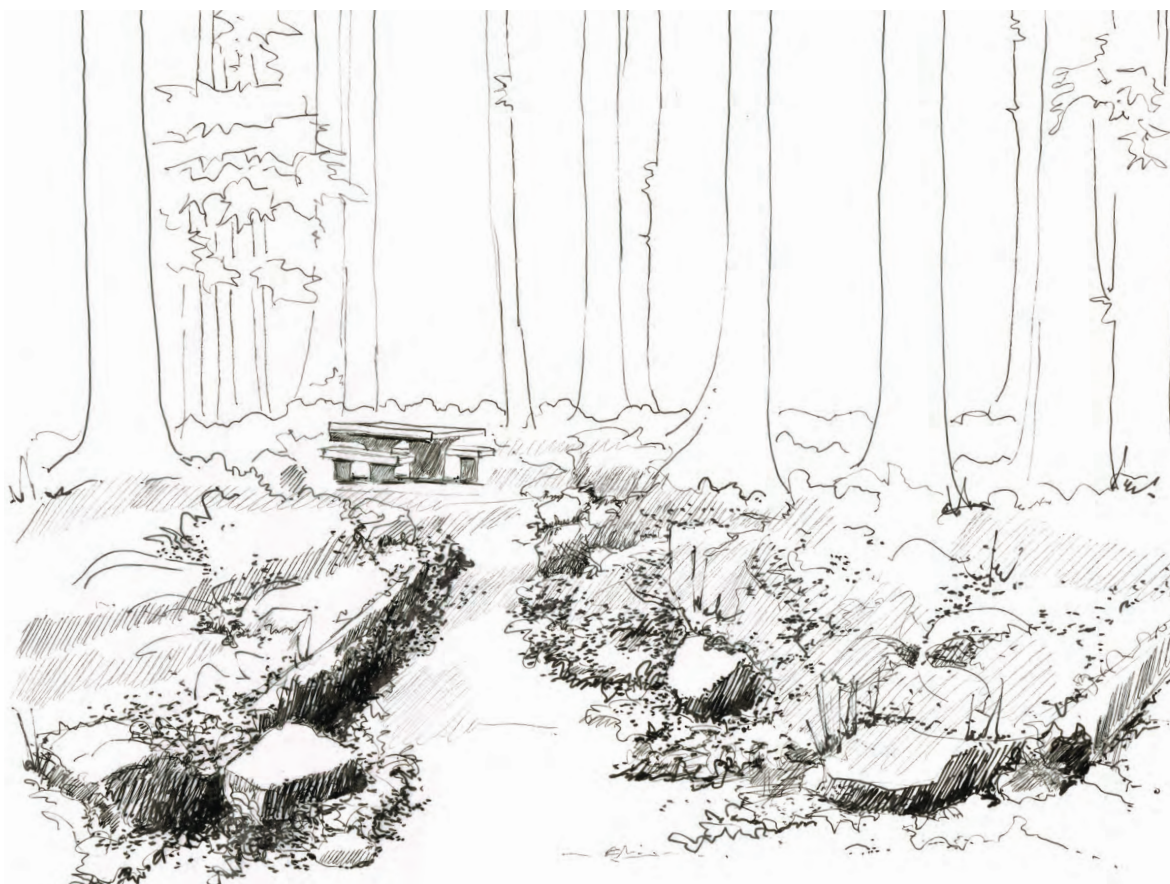


Figure 43. Campsite with critical root zones protected by boulder and log edging. Source: B. Anderson, NPS.



Figures 44 and 45. Vine maple paired with fallen logs provide optimal screening and definition between campsites. This exists in some areas of campground (seen here in 2017) and should be replicated elsewhere. Source: NPS.



Figure 46. Boulders used to delineate use areas, Cougar Rock Campground, Mount Rainier National Park. Source: Degerman 2015.

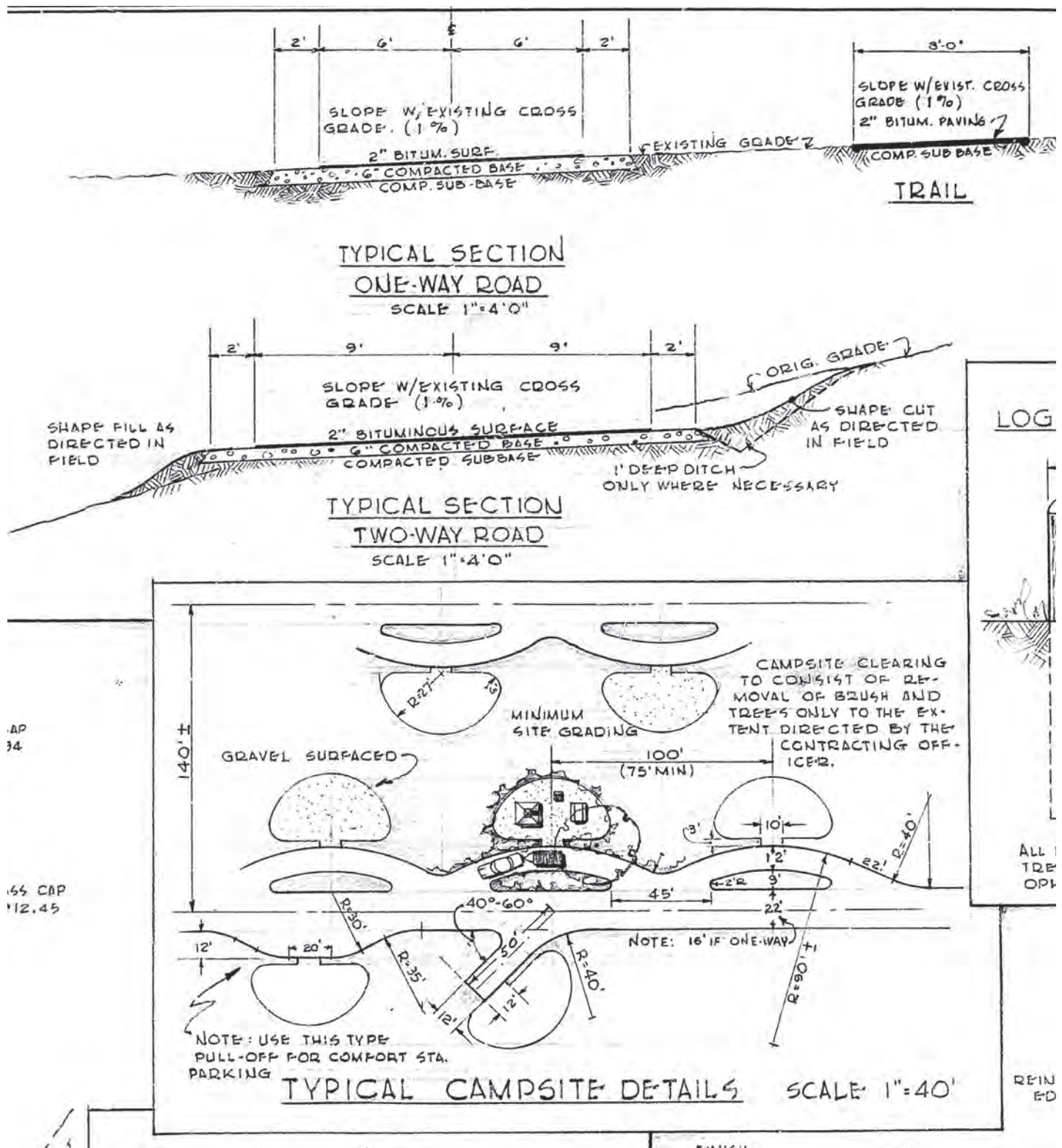


Figure 47. Details from road system plan, Ohanapecosh Campground. Source: Western Office of Design and Construction, National Park Service, 1959.

• BARRIERS •

THE CAMPGROUND BARRIER IS A 'NECESSARY EVIL' AND AN ATTEMPT SHOULD BE MADE TO KEEP THIS CONTROL FACILITY AS UNOBTUSIVE AS POSSIBLE. THE LOW HORIZONTAL TYPE SUCH AS IN A ROUNDED CURBING IS CONSIDERED LEAST OBJECTIONABLE.

The use of natural rock barriers is satisfactory if they are properly placed and are used in an area having natural rock outcroppings. An even toothy effect should be avoided.

NATURAL TYPE



POSTS

Effective as a barrier but should not be over used because of the resulting toothy effect.



VERTICAL TYPES



CONCRETE
OR LOG

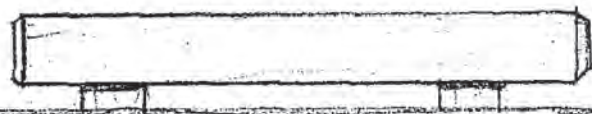


WOOD

The log and timber type is suitable for limited use. For barrier and bumper stop of parking spur especially on down grade.



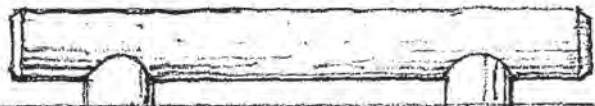
Sect.



DIM. TIMBER



Sect.



LOG

Bituminous concrete has been developed for curbing. A rounded section with backfill is worthy of further investigation. A study of this material is suggested.



Sect.



HORIZONTAL TYPE

Figure 48. Mission 66 barrier designs proposed by the National Park Service Western Regional Office.
Source: Campground Study, 1959.

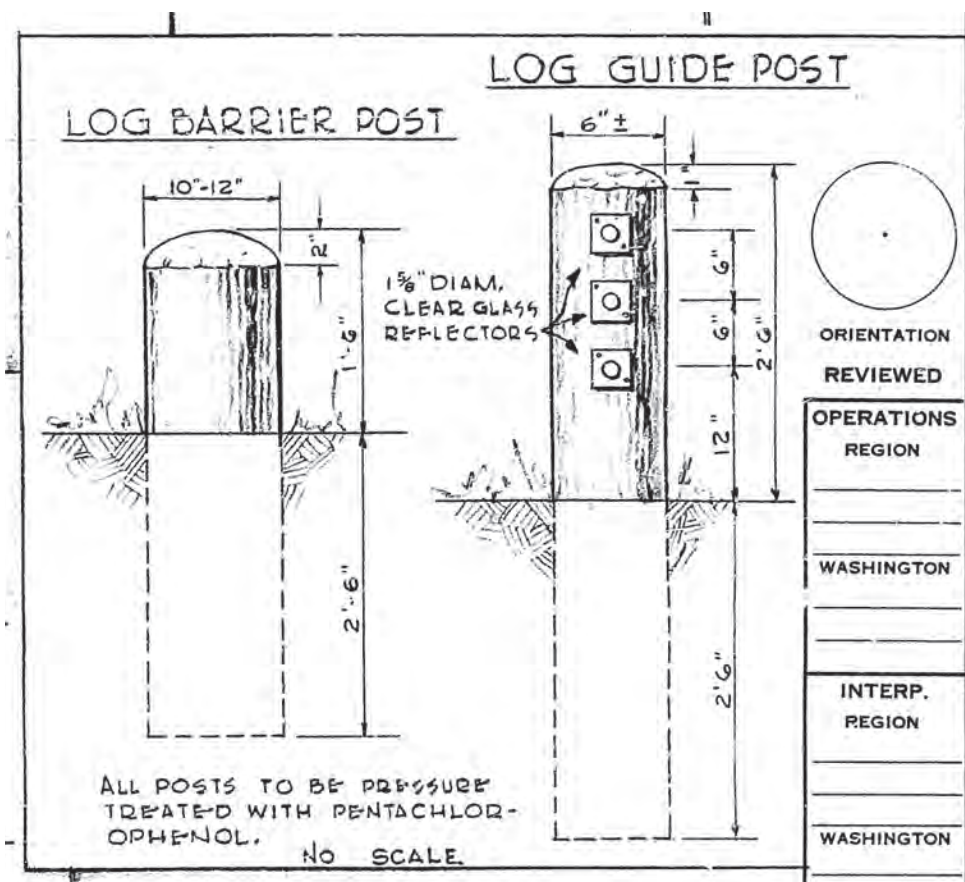


Figure 49. Barrier post details from road system plan, Ohanapecosh Campground. Source: Western Office of Design and Construction, National Park Service, 1959.



Figure 50. Existing parking area delineated by bollards, with ground surface denuded of vegetation, 2017. Source: NPS.



Figure 51. Existing parking area delineated by both fallen logs and bollards, E loop, 2017. Source: NPS.



Figure 52. Day-use parking area in A loop with log barriers and split-rail fencing, 2017. Source: NPS.



Figure 53. An ill-defined parking area in loop A, 2017. Source: NPS.

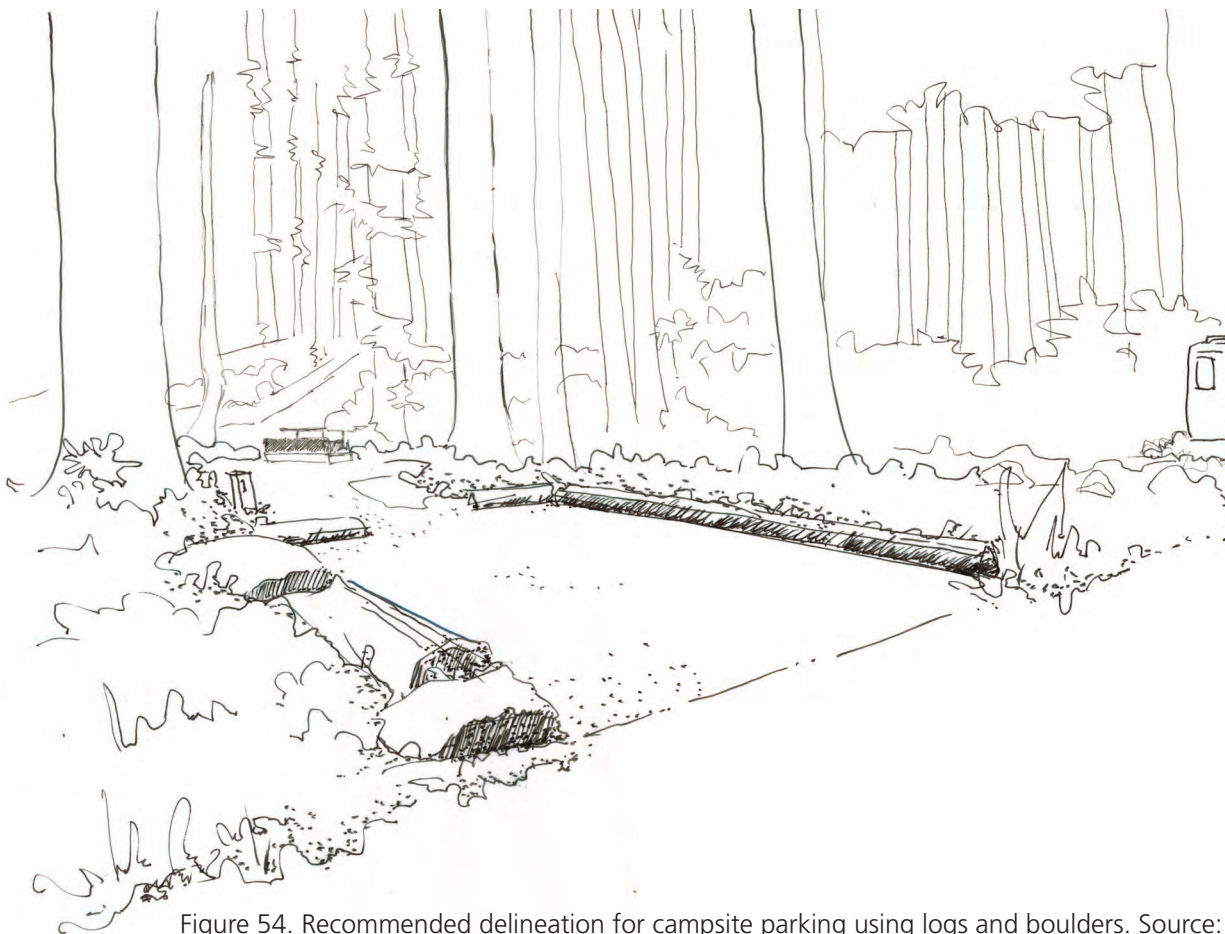


Figure 54. Recommended delineation for campsite parking using logs and boulders. Source: B. Anderson, NPS.



Figure 55. Asphalt path leading to amphitheater, 2017.
Source: NPS.



Figure 56. Newly resurfaced campsite, 2017; forest duff begins to accumulate in the compacted gravel. Source: NPS.



Figure 57. Stone-lined path leading to bridge between A and C loops, 2017. Note the partially buried stones. Source: NPS.



Figure 58. Boardwalk pathways such as those at the Grove of the Patriarchs (seen here) are a suitable option for areas with sensitive resources (e.g., old-growth trees and wetland/riparian areas). Source: visitrainier.com.



Figure 59. Care should be taken to select path and walkway surfaces that are not slippery in the campground's damp climate. The concrete aggregate around the visitor center (seen here) is very slippery. Source: NPS.



Figure 60. Split-rail fencing is an appropriate edging choice if a higher barrier is desired. Source: NPS.



Figure 61. Example of box steps created from milled lumber, Cataract Falls Trail. Source: eastbaytrails.com.



Figures 62 and 63. Existing stone steps in the Ohanapecosh Campground, loop A. Source (left): C. Moore, NPS; (right) NPS.

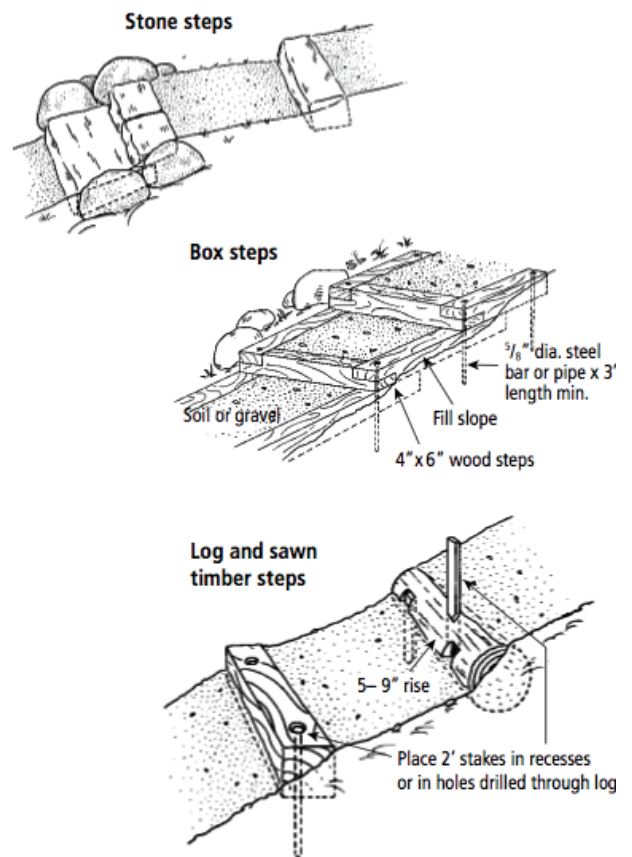


Figure 64. Example of steps built from logs, Skerwink Trail, Newfoundland. Note the scoring on the first tread to improve traction. Source: adventuresinnewfoundland.wordpress.com.

Figure 65. Techniques for stair construction. Source: Online Woodland Stewardship Resource Area.

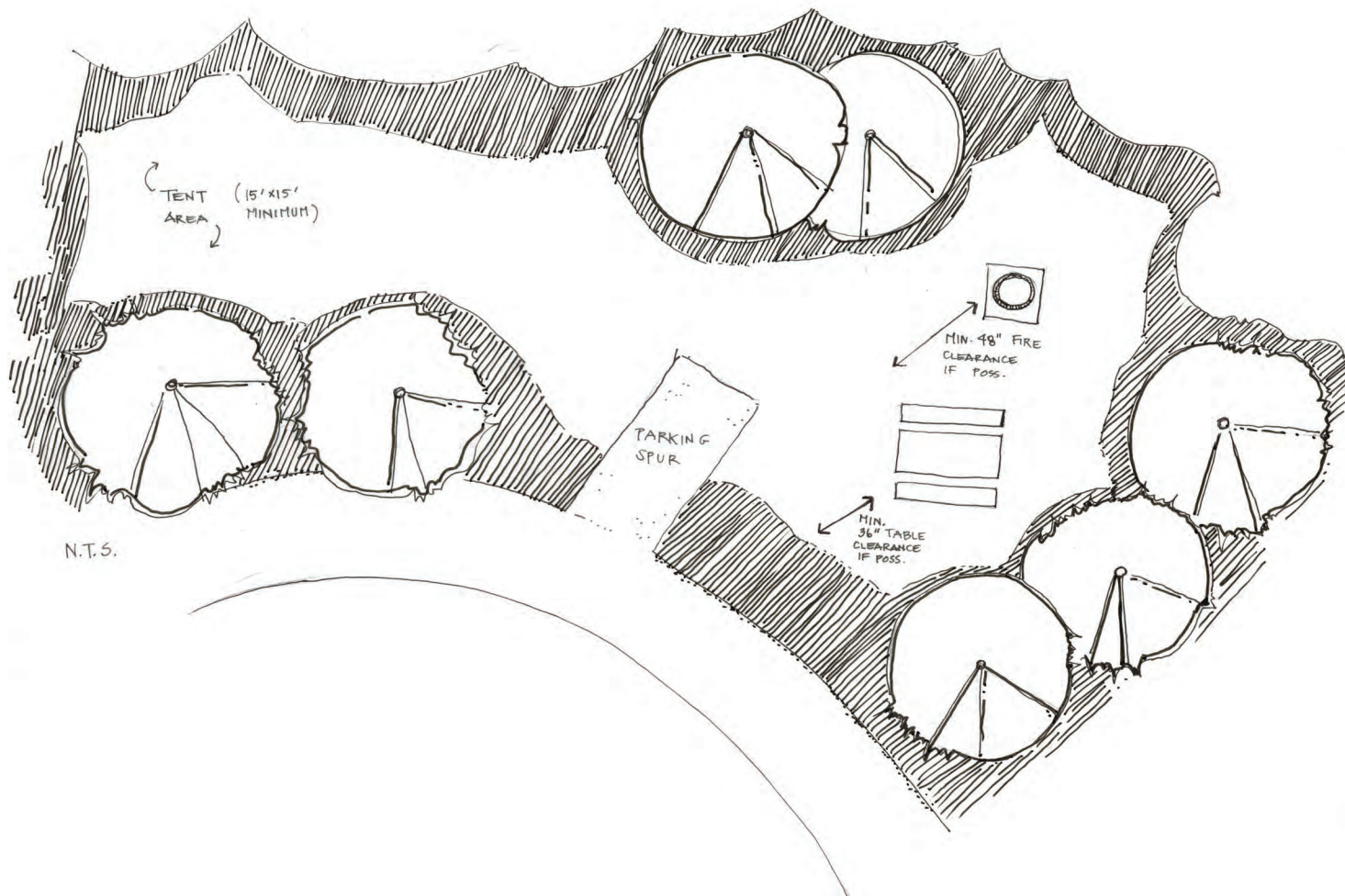
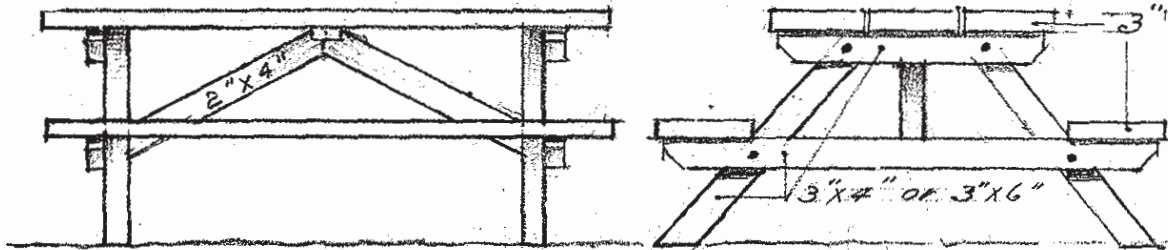


Figure 66. Conceptual campsite layout, illustrating protective edging and vegetation around tree roots and its relationship to use areas. Source: B. Anderson, NPS.

• CAMP TABLES •

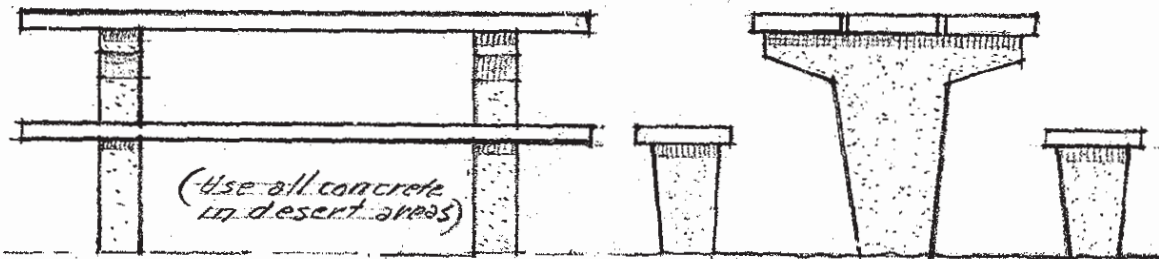
SEVERAL STANDARD TABLES ARE RECOMMENDED DUE TO THE VARIOUS CLIMATIC CONDITIONS EXISTING IN THE PARKS AND MONUMENTS. PRIME CONSIDERATION IS THAT ALL TYPES OF TABLES SHOULD BE NON-TIPPABLE, DURABLE, SIMPLE AND ECONOMICAL TO CONSTRUCT.

USE: In woodland areas where lumber is least costly. When locality has heavy snows use 3"x6" members.



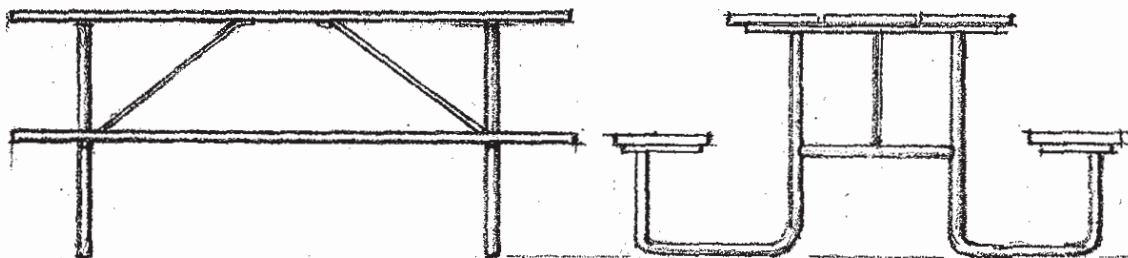
ALL WOOD TYPE

USE: In most areas where a durable table requiring a minimum maintenance is desired.



CONCRETE AND WOOD OR ALL CONCRETE TYPE

USE: In areas not having heavy snow but not in desert areas.

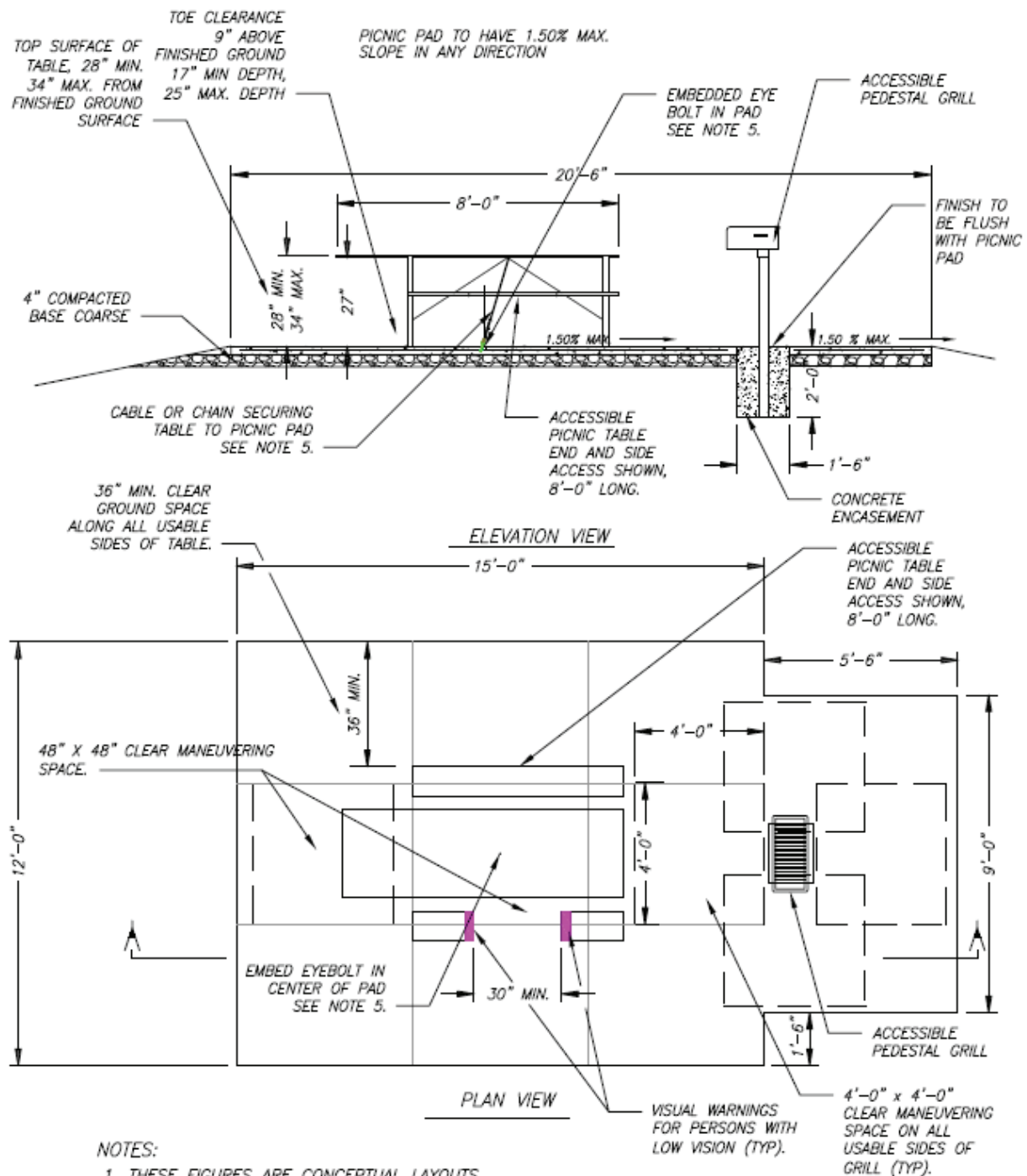


METAL AND WOOD TYPE

Figure 67. Mission 66 designs for picnic tables, proposed by the National Park Service Western Regional Office. Source: Campground Study, 1959.



Figures 68–71. Appropriate picnic table styles for the Ohanapecosh Campground. Source: NPS.



NOTES:

1. THESE FIGURES ARE CONCEPTUAL LAYOUTS
2. FIGURES ARE NOT TO SCALE
3. NOT TO BE USED AS CONSTRUCTION DRAWINGS
4. DESIGNER WILL CONFIRM COMPLIANCE WITH DESIGN CODES, ABAAS, AND ACCESSIBILITY COORDINATOR
5. WHEN SECURING TABLE TO PAD SECURE IN A FASHION THAT DOES NOT HINDER THE KNEE SPACE OF THE WHEELCHAIR OCCUPANT.

FIGURE B-12: ACCESSIBLE PICNIC SITE

Figure 72. Conceptual picnic site layout illustrating suggested dimensions for accessible picnic tables. Source: Bureau of Reclamation 2013.



Figure 73. Round-style fire pit in the campground, 2017.
Source: NPS.



Figure 74. Rectangular-style fire pit in the campground.
Source: NPS.

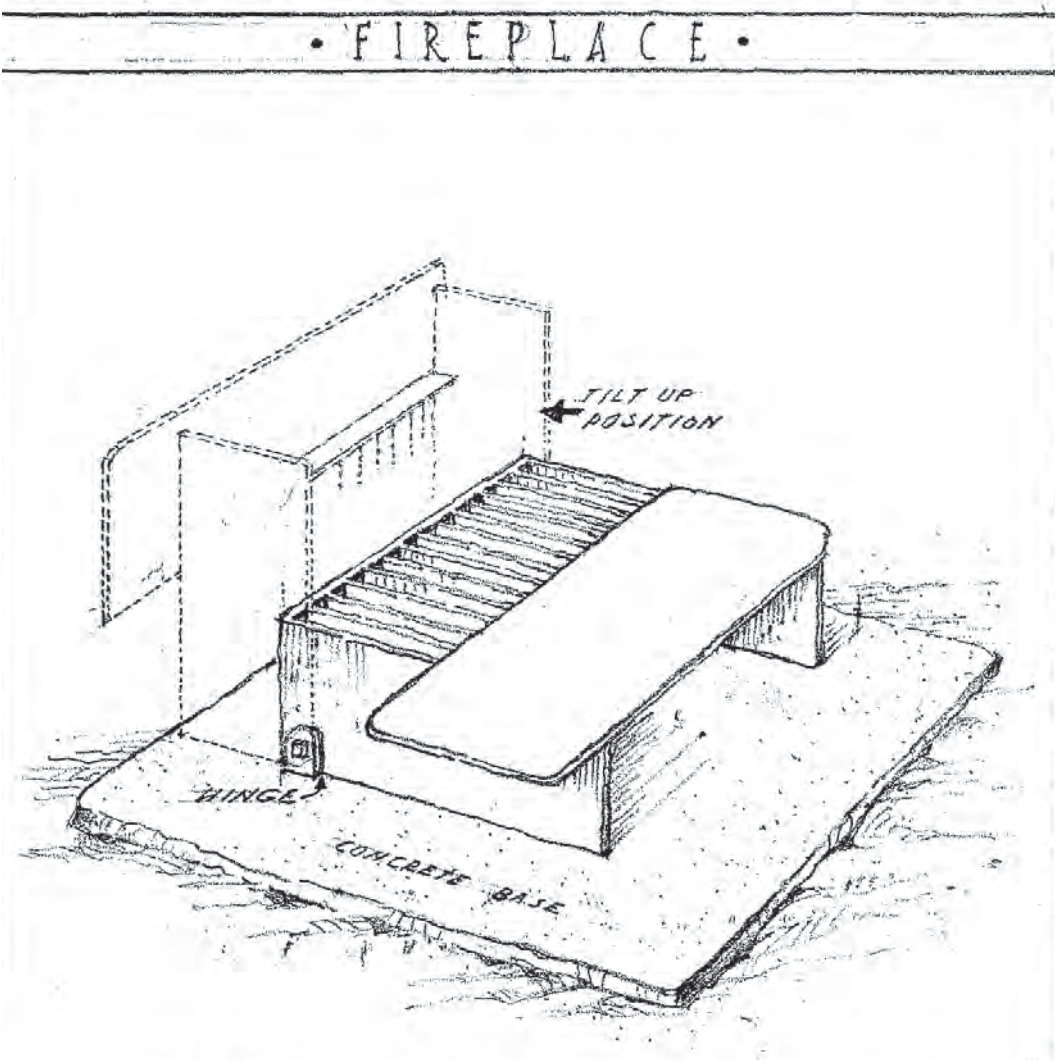
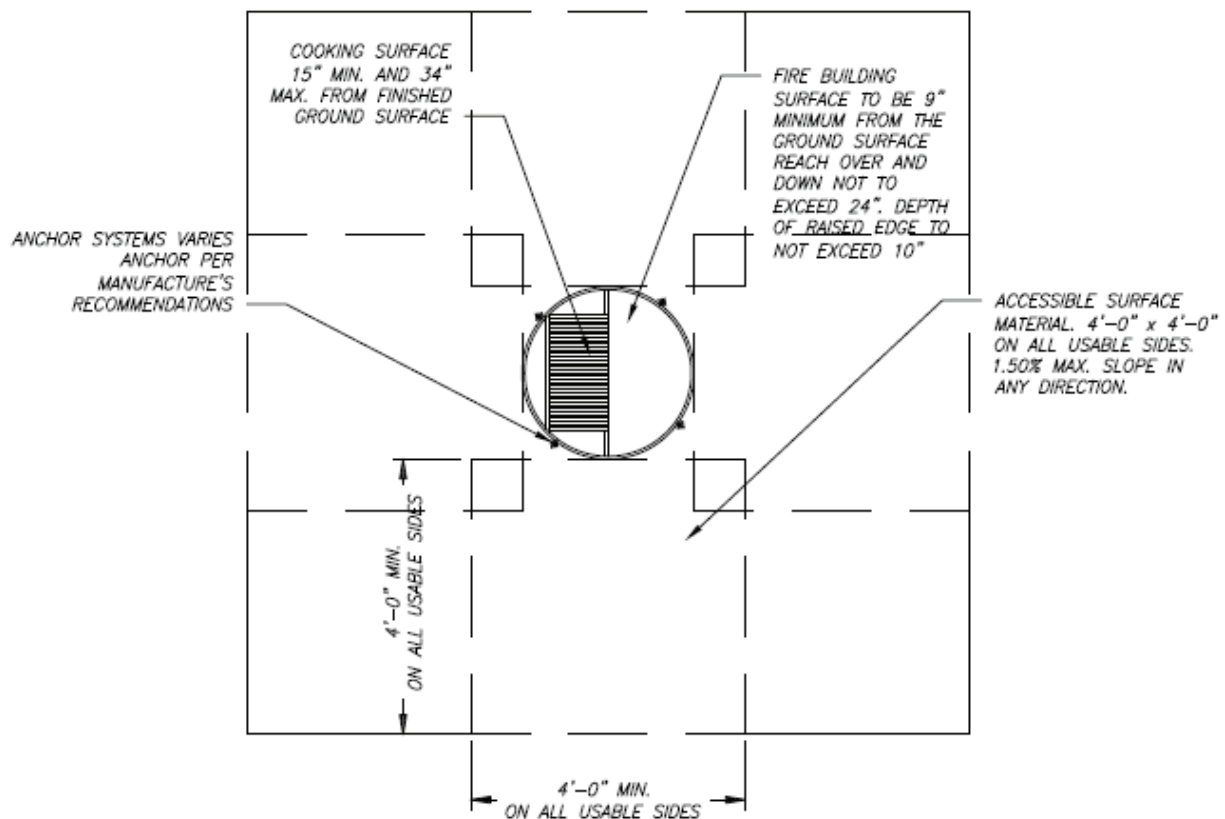


Figure 75. Mission 66 design recommendation for fire pit design, proposed by the National Park Service Western Regional Office. Source: *Campground Study*, 1959.



SEE FIGURE B-11a FOR ELEVATION VIEW OF ACCESSIBLE GRILL AND FIRE RING

NOTES:

1. THESE FIGURES ARE CONCEPTUAL LAYOUTS
2. FIGURES ARE NOT TO SCALE
3. NOT TO BE USED AS CONSTRUCTION DRAWINGS
4. DESIGNER WILL CONFIRM COMPLIANCE WITH DESIGN CODES, ABAAS, AND ACCESSIBILITY COORDINATOR

FIGURE B-11b: ACCESSIBLE FIRE RING – PLAN VIEW



Figure 77. Dark-stained wood informational sign identifying the campground registration station, 2017. Source: NPS.



Figure 78. Dark-stained wood wayfinding sign, C loop, 2017. Source: NPS.



Figure 79. Dark-stained wood informational sign for Nature Trail outside visitor center. Source: visitrainier.com



Figure 80. Aluminum informational/wayfinding sign, 2017. This sign is too small and not clearly legible for its intended purpose (to be seen by entering vehicles). Source: NPS.



Figure 81. Aluminum wayfinding sign, 2017. This style of wayfinding sign is suitable for signs intended to be seen from moving vehicles. Source: NPS.



Figure 82. Interpretive wayside in C loop, 2017. Source: NPS.



Figure 83. Existing campsite identification signs with sharp metal corners, 2017. Source: NPS.

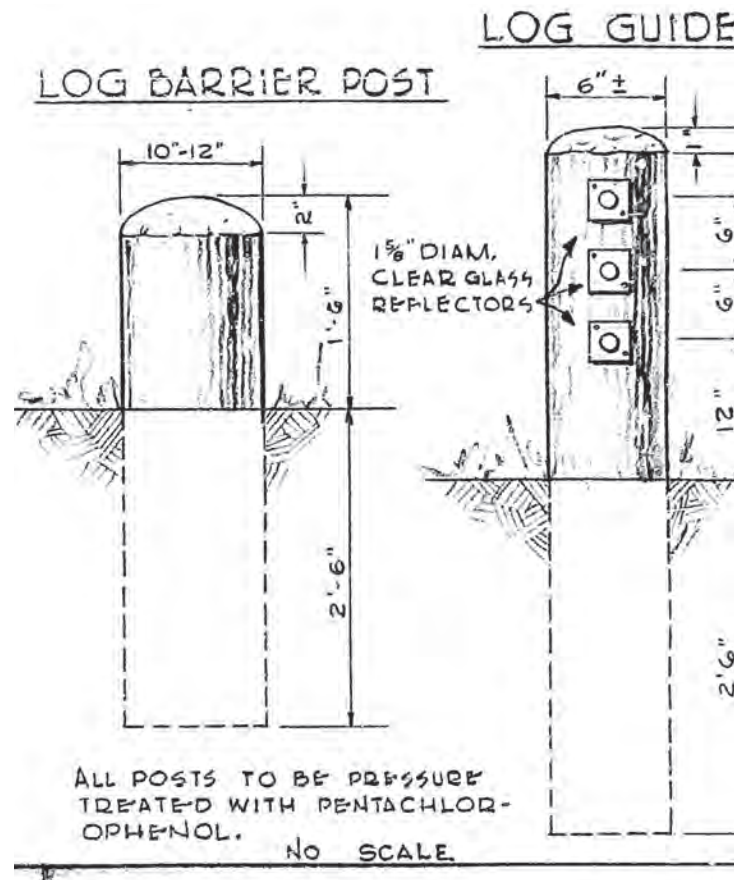


Figure 84. Design inspiration from Mission 66-era bollards. Source: Western Office of Design and Construction, NPS.

CAMP SITE MARKERS

EACH CAMPSITE SHOULD BE NUMBERED AND INDICATED ON A MARKER. A 3"X6" RED WOOD POST IS SUGGESTED. THE 6" WIDE FACE WILL ALLOW NUMBERS TO 3 DIGITS.

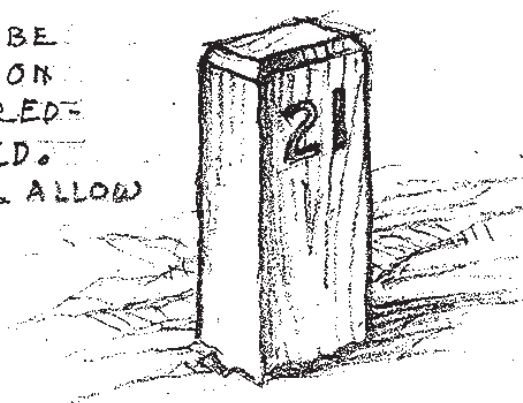
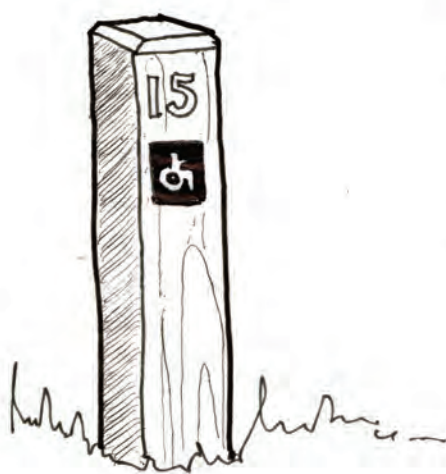


Figure 85. Mission 66 design recommendation for campsite markers. Source: *Campground Study*, 1959.



Figures 86–87. Log/bollard-style sign examples from the NPS Rustic era. Note that the design for campsite identification signs is still being developed with the park's sign shop. Source: Albert H. Good, *Park and Recreation Structures from the 1930s*.



NOTES

1. POSTS ARE 6" X 6"
CLEAR CEDAR
(IF AVAIL.)
2. 2 FEET ABOVE
GRADE

Figure 88. Example of a post campsite marker. Note that the design for campsite identification signs is still being developed with the park's sign shop. Source: B. Anderson, NPS.

PART II: DESIGN GUIDELINES

Introduction

Setting

The campground is situated in a lowland forest of old-growth Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and western red cedar (*Thuja plicata*), with an understory of bigleaf and vine maple (*Acer macrophyllum* and *A. circinatum*), Pacific dogwood (*Cornus nuttallii*), red alder (*Alnus rubra*), red huckleberry (*Vaccinium parviflorum*), devil's club (*Oplopanax horridus*), bunchberry dogwood (*Cornus canadensis*), maidenhair fern (*Adiantum aleuticum*), coltsfoot (*Petasites palmatus*), and mosses (Lentz 2003, 7). Development in the area has always been constrained by the narrow Ohanapecosh River valley, where slopes rise steeply beyond the river, limiting buildable terrain. Towering Douglas-fir dominate the experience of the campground, resulting in an abundance of shade and dappled sunlight. From many sites campers can enjoy the rushing sound of the Ohanapecosh River or the trickling of its tributary streams.

Purpose

These design guidelines articulate the appropriate character and desired conditions for campsites, roads, trails, vegetation, and signage within the Ohanapecosh Campground. They will inform day-to-day maintenance operations by park staff and will serve as a reference for any new site work or future campground alterations.

This guidance is timely, as park staff grapple with increasing visitation at this very popular campground. The natural qualities that have long attracted people to Ohanapecosh must be protected while still allowing for visitor use. Impacts to vulnerable old-growth trees and to riparian and wetland areas should be avoided by establishing protective buffers and clearly defining circulation routes and camping areas. Repairs, rehabilitation, and new campsites should be compatible with the campground's Mission 66 and CCC development history, as well as its riparian ecosystem and mature forest setting, which is influenced by dynamic natural processes including floods, erosion, and native pests that cause tree mortality.

Many visitors to Mount Rainier National Park experience the park's magnificent scenery through developed areas like the Ohanapecosh Campground. The quality of these built environments and their sensitivity to cultural and natural resources affect the quality of the visitor's experience of the park. These guidelines are provided to ensure that this visitor experience is positive and to assure the long-term protection of the campground's character-defining resources.

How to use these design guidelines

These design guidelines serve as an overarching reference to inform design, construction, and maintenance work in the Ohanapecosh Campground. By identifying the campground's character-defining features and resource sensitivities, the guidelines will support site-specific design and implementation, repairs, and regular maintenance.

Guidance for the treatment of buildings and other structures is not included in the scope of this document; however, design guidelines for the treatment and management of historic and new structures should be considered for inclusion in future iterations. See appendix A for a list of existing buildings and structures in the Ohanapecosh Campground.

This document is not intended as a substitute for management decisions or site-specific design work; rather, it is intended as a frame of reference that will help ensure that all actions in the campground help preserve the unity of its design and protect its resources, thereby enhancing its unique sense of place.

Agency Policies and Standards

National Park Service Management Policies

The National Park Service's *Management Policies 2006* provide the foundation for all management and resource protection activities that occur in national parks. The policies help the National Park Service fulfill the requirements of the 1916 Organic Act, which established the agency, by ensuring that the special places protected by the NPS are managed in a way that allows for public enjoyment both today and in perpetuity. As stated in the Organic Act,

[the National Park Service] shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations [. . .], which purpose is to conserve the scenery and the natural and historic objects and 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 (16 U. S. C. §1).

Plans and designs for developed areas within parks, such as campgrounds, must therefore be carefully conceived to avoid harming the park's "scenery and the natural and historic objects and wild life," as well as the opportunities to enjoy these resources. *Management Policies 2006* provides topic-specific guidance for NPS staff to assure that all management and development activities support this overarching mandate for stewardship. This is reflected in guidance for park facilities, excerpts of which are reproduced below:

The National Park Service will provide visitor and administrative facilities that are necessary, appropriate, and consistent with the conservation of park resources and values. Facilities will be harmonious with park resources, compatible with natural processes, esthetically pleasing, functional, energy- and water-efficient, cost-effective, universally designed, and as welcoming as possible to all segments of the population (*Management Policies 2006*, §1.9.5.2, 18).

[Facilities] will be integrated into the park landscape and environs with sustainable designs and systems to minimize environmental impact. Development will not compete with or dominate park features or interfere with natural processes. [. . .] If a cohesive design theme is desired, recommended, or required, the theme will reflect the purpose and character of the park, or in a large park the theme will reflect an individual developed area (*Management Policies 2006*, §9.1.1.2, 125).

Management Policies 2006 provide the foundation for the design guidelines that follow, and it is important that planning, design, and maintenance work in the campground is informed by their directives. All construction activities in the campground must also adhere to applicable codes and standards, and designers need to consult with NPS staff about the codes and other regulations that apply within the park.

Sustainability

In addition to guidance for resource protection in the development of park facilities, *Management Policies 2006* identifies principles for sustainable facility design and management. This includes “protection of the natural and cultural environments, resource conservation, energy conservation, pollution prevention, defensible space for fire safety, and fostering education about sustainable design and practices” (*Management Policies 2006*, §9.1.1, 124).

Sustainable design and maintenance practices should be incorporated into all work that takes place in the campground. For more information, consult the *Climate Friendly Parks: Mount Rainier National Park Action Plan* (NPS 2009), Executive Order 13514: *Federal Leadership in Environmental, Energy and Economic Performance* (2009), Executive Order 13123: *Greening the Government Through Efficient Energy Management* (1999), and *Guiding Principles of Sustainable Design* (NPS 1994).

Historic Buildings, Structures, and Landscapes

The treatment and management of buildings, structures, and landscapes that are on, or determined eligible for listing on, the National Register of Historic Places is addressed by NPS policy (Director’s Order 28), the National Historic Preservation Act of 1966, and *The Secretary of the Interior’s Standards for the Treatment of Historic Properties*. Planners and designers must be aware of the National Register status of any property as well as its significance and contributing features. Care must be taken in design and planning to avoid adverse impacts to historic properties.

A draft National Register nomination form was prepared for the Ohanapecosh Developed Area (Lentz 2003), however the determination of eligibility (DOE) for the property has not yet been completed. In the absence of the DOE, the park manages the campground as if it were already determined eligible.

Accessibility and Universal Design

The National Park Service and Mount Rainier National Park are committed to ensuring that park experiences are accessible to as wide an audience as possible. The NPS follows accessibility directives laid out in Section 504 of the Rehabilitation Act of 1973 and Director’s Order 42: *Accessibility for Park Visitors*, which states: “The NPS will design, construct, and operate all buildings and facilities so they are accessible to, and usable by, persons with disabilities to the greatest extent reasonable, in compliance with all applicable laws, regulations, and standards” (NPS 2000).

The park seeks to ensure that all facilities in the Ohanapecosh Campground meet the highest level of accessibility that is reasonable, rather than the minimum level required by law. Accessible elements are incorporated into campsite and facility design wherever possible, in addition to designated, fully accessible sites. Planners and designers working in the campground are encouraged to embrace the

implementation of “universal design” principles, or designing all facilities to be usable by all people to the extent possible, rather than separating facilities or programs.

For additional information about accessibility requirements, please consult the NPS project manager and the United States Access Board’s *Architectural Barriers Act (ABA) Accessibility Standards*.

Planning Context

These design guidelines and the accompanying campground rehabilitation proposal (part I) are informed by previous planning efforts.

The foundation document for Mount Rainier National Park, completed in 2015, provides basic guidance for all planning and management decisions in the park. The foundation document confirms the park’s purpose, significance, fundamental resources and values, and interpretive themes. It also identifies special mandates and administrative commitments that influence park operations, and it provides a list of high-priority planning and data needs to address the park’s most significant issues.

The park’s 2002 general management plan provides overarching guidance for the management of the Ohanapecosh Campground, located within the “Development Zone” of the park, a non-wilderness area (NPS 2002, 51). Under the plan’s preferred alternative, the existing visitor and administrative facilities are retained in the developed area. The plan’s focus on visitor use in the area is reflected in its guidance that the park increase available parking (NPS 2002, 82). Some of the actions identified in the preferred alternative are considered by park staff to be no longer relevant, for example the establishment of a staging area for pack stock groups and the opening of the campground for winter use (Ibid., 82, 85).

Previous planning efforts have addressed the rehabilitation of the Ohanapecosh Campground, specifically in an effort to improve forest health. These include the “Ohanapecosh Campground Rehabilitation Study” (Moehring and Franklin 1977), “Preliminary Rehabilitation and Revegetation Plan for Ohanapecosh Campground, Mount Rainier National Park,” (NPS 2015b), and “Ohanapecosh Hazard Tree Observations and Vegetation Management Plan Recommendations,” (USFS 2017; see appendix B). The detailed recommendations relating to vegetation protection and regeneration have been carried forward wherever feasible and are reflected in this document.

History of Development

The following summary is largely based on the detailed historical accounts provided in the draft “National Register of Historic Places Registration Form for Ohanapecosh Developed Area, Mount Rainier National Park” (Lentz 2003) and the draft historical and archeological study, “Ohanapecosh: From Prehistory to Mission 66” (NPS 2016).

The Ohanapecosh area is characterized by a richly layered human history. While the Mission 66-era developments are most prominent in the campground today, evidence remains of other periods of use.

PRE-CONTACT HUMAN USE

Formal documentation of pre-contact archeological sites has occurred in the campground, and park archeologists consider it likely that early humans made use of the area around the hot springs. In

Tahoma: Ethnography of Mount Rainier National Park (2006), Allan H. Smith describes several Taidnapam villages along the Upper Cowlitz River in the vicinity of Ohanapecosh. The village closest to the hot springs was located about 5 ½ miles south of today's campground, near where the Ohanapecosh River, Clear Fork, and Muddy Fork converge to become the Cowlitz. This was the site of a productive salmon fishery. Foraging for huckleberries and hunting of goats, deer, and bear also took place nearby (Smith 2006, 97). The Taidnapam are today enrolled in the Confederated Tribes and Bands of the Yakama Nation.

The Cowlitz River corridor would have facilitated travel between low-elevation villages and alpine and subalpine foraging grounds on Mount Rainier (NPS 2016). The mountain itself has and continues to play a significant role in the material, spiritual, and cultural lives of tribes, including the Muckleshoot Indian Tribe, the Puyallup Tribe of Indians, the Nisqually Indian Tribe, the Cowlitz Indian Tribe, the Squaxin Island Tribe, and the Confederated Tribes and Bands of the Yakama Nation. As Greg C. Burtchard writes:

Well before becoming a park and before its historical attraction to adventurers, scientists, miners and the rest, the mountain played an important role in the lives of indigenous people residing in its vicinity. Known as *Tahoma* during early historical times, the mountain's subalpine and alpine habitats provided huckleberries, game and other plant resources to Indian groups east and west of the Cascades. As *Tahoma* and probably a host of other names, the mountain also was integrated into the lives of Northwest hunter-gatherers for up to 8,500 years into the prehistoric past" (Burtchard 2003, 157).

NATIONAL FOREST DEVELOPMENT: 1906–1921

For the first decades of the 20th century, the Ohanapecosh hot springs were part of Mount Rainier Forest Reserve, 0.2 miles outside the park boundary. Although evidence points to the hot springs' long history of human use, historical written accounts date their "discovery" to around 1906, during railroad surveys of the area (NPS 2016, 15). Public use of the springs grew more and more popular over the years, and visitors regularly camped onsite, undeterred by the lack of facilities (Ibid., 15–20).

In the early years of Mount Rainier National Park, there was little traffic in the park's southeast corner. This changed in 1912, when records indicate that 175 visitors entered the park through Ohanapecosh, despite the rustic road conditions. The NPS responded by posting a ranger in this southeast district and constructing a one-room cabin within park boundaries. The cabin was regularly used by park staff until its removal in the late 1950s (NPS 2016, 21, 58).

OHANAPECOSH HOT SPRINGS RESORT: 1921–1961

In 1921, a local postmaster named N.D. Tower obtained a Special Use Permit from the Forest Service for the development of the Ohanapecosh Hot Springs Resort. Touting the health benefits of the springs, Tower and his partner, Dr. Albert W. Bridge, transformed the landscape by constructing two bath houses, nine cabins, two campgrounds, and a three-story hotel on a slope overlooking the Ohanapecosh River. The partners paid for the construction of a 6-mile road linking the hot springs to the Clear Fork Forest Camp (now La Wis Wis Campground), which opened in 1925. Portions of this road are still visible in the campground, running through A loop, crossing the footbridge into C loop, and

following B loop out to the hot springs (Ben Diaz pers. comm. 2018). Dr. Bridge assumed control of the Ohanapecosh Hot Springs Company in 1925, and would continue to develop the site (figures 5–7). By 1929, the Ohanapecosh Hot Springs Resort could accommodate 4,000 visitors annually (NPS 2016, 23–26).

NATIONAL PARK SERVICE OWNERSHIP: 1931–present

Visitation and capacity at Ohanapecosh continued to increase after the 1931 boundary adjustment that added 53.1 square miles to the park, including the hot springs area and the resort concession. Dr. Bridge expanded the road system, installed utilities, and by 1934 had increased resort facilities to include 27 cabins, tent frames, and a garage. Working together, in 1937 Bridge and NPS designers proposed an even more grandiose master plan for the Ohanapecosh Hot Springs, including a new hotel, gas station, a larger bath house, a lunch room, and other facilities (NPS 2016, 31–32).

Meanwhile, federal work crews arrived in the park, propelled by Depression-era programs such as the Civilian Conservation Corps (CCC), Civilian Works Administration (CWA), and the Works Progress Administration (WPA). These crews began work constructing public campground facilities and trails south of the resort (NPS 2016, 31).

Due to World War II, most of the resort improvements proposed in the late 1930s were never implemented. Dr. Bridge would sell the business in 1947, beginning a long period of decline before the concession contract was terminated by the NPS in 1961. Resort buildings were either demolished or moved offsite to nearby communities, where some still exist today (NPS 2016, 37). Remnants of the resort road system can still be detected onsite, east of the visitor center, in addition to the remains of resort utilities and a handful of former hot spring pools (Ibid., 69–70). Historic archeology from the resort and CCC eras has been surveyed and is documented in the 2016 draft report, “Ohanapecosh: From Prehistory to Mission 66” by Burtchard et al. (NPS 2016).

CIVILIAN CONSERVATION CORPS: 1934–1939

The 1931 expansion of the park boundary to include Ohanapecosh lands corresponded to a significant investment in the area’s infrastructure, fueled by New Deal work programs. Funded by the Public Works Administration (PWA), the construction of the East Side Road (State Route 123) began in 1931 and would continue until 1940. This north-south route would provide an important missing link in the park’s transportation system, allowing visitors to travel between Ohanapecosh and Yakima Park/Sunrise Ridge in the northeastern corner of the park (NPS 2016, 40). With the 1957 completion of the Stevens Canyon Road, Route 123 would ultimately allow access to Paradise, Longmire, and the Nisqually River entrance (Ibid.). At the outset of the East Side Road project, the Bureau of Public Roads and the PWA work crews established a road construction camp in a level area of land southwest of the Ohanapecosh Hot Springs Resort (Burtchard et al., 42).

Anticipating that the new road would increase visitation to the Ohanapecosh area, other Depression-era programs focused on increasing visitor facilities and infrastructure. To this end, the Civilian Conservation Corps (CCC) Camp 6 arrived at Ohanapecosh in 1934 and began to expand the campground into the relatively level landscape southeast of the river and southwest of the hot springs (figure 8). As its name

suggests, the CCC camp at Ohanapecosh was the sixth established in the park: five other camps were organized in 1933, when the CCC was created by Congress as part of its Emergency Conservation Work program. The six camps at Narada Falls, Tahoma Creek, Ipsut Creek, White River, St. Andrew's Creek, and Ohanapecosh would remain active in development and conservation projects in their respective districts until 1939 (NPS 2016, 44).

The development of present-day loops A and C in the Ohanapecosh Campground date from this period, which also saw the addition of four new comfort stations, an entrance station, a small museum/visitor center (known as the "Forest Museum"), and a utility area, as well as new trails, roads, and bridges (NPS 2016, 39–40). The CCC developments in the Ohanapecosh Campground, as elsewhere in the park, were influenced by NPS rustic architectural guidelines that emphasized a minimalist, naturalistic approach to building and landscape design. Proponents of the National Park Service rustic style, such as architectural consultant Albert H. Good, called for designs, materials, and construction techniques that would allow new park developments to blend as closely as possible into their surroundings:

through the use of native materials in proper scale, and through the avoidance of severely straight lines and over-sophistication, [the style] gives the feeling of having been executed by pioneer craftsmen with limited hand tools. It thus achieves sympathy with natural surroundings and with the past (Good 1990, 5).

Although the entrance station and small museum were removed by the NPS in the 1960s, the four comfort stations persist in loops A, B, and C and are listed on the National Register of Historic Places as significant structures within the campground (figures 9–11). The comfort stations' characteristic rustic features can still be appreciated by visitors: these include stepped or battered rock foundations, vertical log and half-log walls, exposed log purlins, wood shingled roofs, and pivoting wood windows (Lentz 2003, 14–15).

The CCC crews followed this service-wide design guidance, inspired by the NPS rustic style of landscape architecture so prevalent at Mount Rainier and in other national parks. In the 1920s and '30s, forest pathologist E. P. Meinecke was retained by the federal government to provide campground design rehabilitation guidance for campgrounds on federal lands. Heavy and unregulated visitor use—particularly the use of automobiles—was already leading to the degradation of vegetation and other natural resources in national forest and national park campgrounds. To offset these impacts and improve visitor experience, Meinecke proposed a system of one-way loop roads with angled parking spurs (figures 12–13). To constrain visitor impacts, individual campsites and parking areas were to be clearly delineated by sturdy vegetation, rocks, boulders, or logs (Meinecke 1935, 12). Meinecke believed that thoughtful campsite design and circulation would reduce the visitor's tendency to create social trails and expand campsites and parking areas beyond intended boundaries (Meinecke 1932, 10). He also stressed that the planning and siting of campsites should take into account soil types and vegetation that would prove more durable to visitor impacts, such as compaction (Ibid., 8–9).

The influence of Meinecke's design philosophy is still apparent in the spatial organization of loops A and C, although the CCC-era road that once led from loop A to loop C was closed around 1960 (Arnie

Peterson pers. comm. 2017). Other CCC-era features remaining in the campground include comfort station stone steps in loop A, a stone bridge and culvert connecting loops A and C, the Silver Falls Loop Trail, remnant stone retaining walls, and a storage shed near the campground entrance (NPS 2016, 52–55).

MISSION 66: 1948–1972

Development in the Ohanapecosh area slowed to a halt during World War II. In the 1950s, despite an increase in visitation, the campground lacked adequate facilities both to serve visitors and provide housing for staff. The campground had changed little since the CCC's departure in 1939. As late as 1958, seasonal staff lived in a tent complex with a bath house on the ridge above A loop, near the comfort station (NPS 2016, 58). The tent complex was dismantled in the mid-1960s (Dale Harvard pers. comm. 2018), but its previously disturbed, level location is still evident and has been identified for two proposed new walk-in sites in the 2017 Ohanapecosh Campground rehabilitation proposal (see part I and figures 14–15).

The Mission 66 program arose in response to situations like this throughout the National Park Service, where parks grappled both with increased post-war visitation and inadequate park infrastructure. The brainchild of NPS Director Conrad Wirth, the ten-year construction program was conceived in 1955 to provide critical support for much-needed facilities in anticipation of the National Park Service's 50th anniversary in 1966. In 1956, Congress approved the initiative, which “was intended to modernize, enlarge, and even reinvent the national park system by its 50th anniversary” (Carr et al. 2015, 3).

Mount Rainier was considered an ideal park to model the new Mission 66 guidance, given its proximity to urban populations and its issues with increased day-use visitors, circulation, impacts on sensitive resources, and increasing demands for campground and employee housing facilities (NPS 2016, 61; Lentz 2003, 27). The park therefore became the first national park to initiate Mission 66 planning and received national attention from agency leaders such as Wirth himself, who shared the earliest iteration of Mount Rainier's development plan with the press in March 1956 (Lentz 2003, 26).

The improvements at Ohanapecosh were only one part of the park-wide Mission 66 prospectus. However, the Mission 66 developments at Ohanapecosh stand out as an “exceptionally intact example of comprehensive Mission 66 planning and development,” according to the draft 2003 National Register registration form (Lentz 2003, 43). The draft registration form describes Ohanapecosh as the area in the park that was “most thoroughly transformed” by mid-century alterations (Ibid.). It is important to note that the comprehensive nature of the Mission 66 development at Ohanapecosh was the result both of its size and scope and NPS removal of all of the rustic architecture in the hot springs area (NPS 2016, 61).

Though various concepts were explored during the design and planning phases for the Mission 66 development, park managers and designers at the NPS Western Office of Design and Construction (WODC) agreed on a final proposal that would substantially increase visitor and staff facilities in the Ohanapecosh area. The master plan for the Ohanapecosh Campground, developed and refined between 1956 and 1959, called for expanding the campground with four new loops north of the river, constructing an amphitheater in the newly developed area, creating a new visitor center and day-use area near the campground entrance, and establishing a utility and employee housing area south of the

campground access road (figures 16–17; Lentz 2003, 28–31). Construction began in 1958 and would be largely complete by 1964, however development and refinement of individual campsites would continue until the early 1970s (Lentz 2003, 34; Susan Dolan pers. comm. 2017).

The Mission 66 program sought to introduce a modern architectural vocabulary to national park facilities. At Ohanapecosh, this goal is manifest in structures with clean and simple forms that are nonetheless responsive to the campground’s forested setting. As Lentz’s 2003 evaluation notes, the structures share a unifying design concept that is evident “in their careful siting, their unobtrusive low profiles, and their use of modern but naturally finished materials,” including cedar shake roofing and dark-colored siding (Lentz 2003, 10). These qualities are most apparent in the Visitor Center, designed by the Seattle architect John Morse (figures 18–19). Other Mission 66 structures include five comfort stations, an amphitheater stage and projection room, a combined utility building and ranger station, and a variety of employee residences.

Like the architectural additions, landscape developments in the campground were responsive to the site’s vegetation, topography, the river, and other naturally occurring features such as boulders, streams, and fallen logs. The Mission 66-era campground layout was strongly influenced by Meinecke’s earlier campground planning principles. NPS landscape architects continued to design one-way campground loops with individual campsites and parking spurs arranged on opposite sides of the road, although the amount of space allowed for vehicles was generally increased (figures 35–38). In addition, a new type of campsite known as a “walk-in” site was proposed during this period, allowing campers to park remotely and access a more primitive, private campsite on foot, sheltered from vehicle traffic by landform, boulders, and vegetation (Carr et al. 2015, 38).

Design Guidelines

Unifying Themes

These design guidelines are informed by several key unifying design themes that contribute to the Ohanapecosh Campground’s sense of place:

- Planning and design for the campground is undertaken holistically, with interdisciplinary consultation.
- A variety of camping experiences are provided for visitors of all abilities, ranging from large and small group sites for gatherings to more secluded, primitive sites.
- The campground is nestled in an old-growth forest and dominated by towering conifers that encourage an understory of fallen logs and a lush undergrowth of shade- and moisture-loving trees, shrubs, ferns, and mosses.
- The site’s topography and hydrology shape the location and configuration of campground developments. These natural systems are dynamic and require a proactive and flexible response from managers and planners to relocate facilities, if needed, for safety and resource protection.

- Campsites and parking areas are located on relatively level or gently sloping terrain to minimize ground disturbance. Limiting ground disturbance is critical to protecting archeological resources, vegetation, and hydrological patterns.
- Siting of new campsites and reconfiguration of existing campsites take advantage of previously disturbed areas, wherever possible.
- New campsites and the reconfiguration of existing campsites avoid wetland and drainage areas. Buffers are established between existing campground developments and riparian and wetland areas.
- Maximize opportunities to consolidate parking in order to reduce the impact of parking within the campground.
- Preserve the historic characteristics of Mission 66 master planning in the spatial arrangement of one-way campground loop roads, with a herringbone pattern of individual campsites and parking spurs on each side of the road.
- All buildings, structures, and site features are responsive to the forested character of the landscape and designed to harmonize with the natural setting, consistent with CCC and Mission 66 design principles as applied in the campground.

Natural Systems and Features

CLIMATE AND ENVIRONMENTAL CONTEXT

The Ohanapecosh Campground is located within a mesic forest, and its relatively flat expanse ranges in elevation from 1,850 to 1,950 feet. Two ridges flank the site on the west and east sides, reaching heights of 4,800 and 5,000 feet respectively. The Ohanapecosh River crosses through the middle of the campground and is edged throughout much of its length by steep cliffs (NPS 2015b, 3).

The area receives 74 inches of precipitation yearly; only 4.7 inches of this fall during the region's typically dry summer months of June through September. Maximum temperatures for the month of July average 77°F. Winters, on the other hand, are wet and cool, with average maximum temperatures of 36°F and 12 inches of precipitation. Although snowpack accumulation occurs periodically, much of the winter precipitation falls as rain (Western Regional Climate Center 2018).

Most of the campground is located within partial to deep shade, although some campsites to the south of the Ohanapecosh River receive afternoon and evening sun. The well-developed forest canopy is classified as early old-growth, with trees ranging in age from less than 150 to more than 350 years old. The 6-foot diameter trees in F-loop, for example, are older than 350 years, while the forest around the amphitheater is significantly younger (Arnie Peterson pers. comm. 2017). Late-successional forests such as this one cannot be treated as static systems: as trees age, these forests continually experience small-scale gap disturbances (i.e., tree mortality resulting in potential hazard trees) caused by native forest pathogens and insects (Betsy Goodrich pers. comm. 2017). This dynamic environment offers potential

habitat for species dependent on these unique conditions, including the Northern Spotted Owl (*Strix occidentalis caurina*) (NPS 2015b, 3).

The park's wilderness boundary is located outside the developed area of the campground.

SOUNDSCAPES, LIGHTSCAPES, AND AIR QUALITY

The soundscape is the component of the acoustic environment that can be perceived and comprehended by humans. Both natural and human-caused sounds may be desirable and appropriate in a soundscape, depending on the purposes and values of the park site. Although complete natural quiet occurs rarely in the Ohanapecosh Campground when it is open for visitor use, the campground's natural soundscape is one of its important character-defining features. The prevalent natural sounds of flowing water, wind, rain, and wildlife are sought-after aspects of the camping experience.

Human-caused noise in the campground originates from campers, generators, vehicles driving along loop roads, vehicle traffic along Washington State Route 123, park maintenance activities and equipment, and other sources. Quiet hours in the campground are between 9 pm and 7 am, and generator use is restricted to between 8 and 10 am, noon and 2 pm, and 5 and 7 pm. E loop is currently closed to generator use at all times.

The lightscape of the campground is characterized by rays of sunlight or dappled sunlight filtering through the trees. Where there are openings in the canopy, the absence of artificial light allows opportunities to experience the dark night sky.

The park is designated as a Class I air quality area and is afforded special protection under the federal Clean Air Act. Air quality and scenic resources in the park can be impacted by regional and local sources of air pollution such as power plants, agriculture, urban developments, vehicles and woodstoves/fireplaces. In addition, parks in the Pacific Northwest are exposed to trans-Pacific pollution from Asia. The air pollutants of concern include sulfur (S) and nitrogen (N) compounds, ground-level ozone, particulate matter (PM), and persistent bioaccumulative toxins (PBT), such as mercury and pesticides (Cummins 2014). Campfire smoke is the most significant air quality issue in the campground during the summer and fall. Excessive campfire smoke from many individual fires degrades air quality in and around the campground and is a frequent complaint of visitors and staff.

In response to visitor and employee complaints about wood smoke, particle monitoring (PM_{2.5}) was conducted in the Ohanapecosh campground at the park during summer through early fall of 2009, 2010, and 2013. While no exceedances of the 24-hour, EPA National Ambient Air Quality Standard for fine particulate matter (PM_{2.5}) were observed during the three summer monitoring seasons, high hourly peaks of particulate matter were consistently documented, particularly during the evening hours, between 8 and 11 pm (Lofgren and Samora 2010; Johnson and Lofgren 2013). In 2013, the number of campfires and weather conditions were correlated with PM_{2.5} levels. Results indicated concentrations of particulate matter in the Ohanapecosh area do not necessarily increase with an increase in campfire activity. High concentrations were found to be more related to the presence of campfires in combination with inversions occurring on clear nights and mornings in the Ohanapecosh valley (Johnson and Lofgren 2013).

Guidelines

- The design and construction of new facilities should respond to the climatic and topographical conditions of the site to allow passive climate-control strategies, including shade, ventilation, and insulation.
- Facility design and maintenance will take snow and ice management into account in planning for winter access, visitor safety, and structural integrity.
- The development of new facilities and maintenance of existing facilities will be undertaken in a manner that avoids impacts to state or federally listed threatened or endangered species.
- Take actions to monitor and minimize or prevent unnatural sounds that adversely affect park resources and values, including visitors' enjoyment.
- Minimize noise generated by NPS management activities. Consider noise in the procurement and use of equipment within the campground.
- Collaborate with visitors to find ways to prevent or minimize the intrusion of artificial light into the night scene, including encouraging night-sky friendly flashlights.
- Limit artificial outdoor lighting in the campground to basic safety requirements. Where possible, shield artificial lighting or change lamp types to reduce impacts.
- To avoid unnecessary extra campfire smoke, ensure that only dry, seasoned wood is burned for campfires, and ensure that visitors completely extinguish fires when finished.
- To improve summer air quality, reduce the number of individual campfire pits in the campground over time. Begin by removing fire pits from smaller, more primitive campsites. Plan in the long-term for fewer, more centralized campfire facilities.
- Conduct interpretive outreach to educate visitors about the health impacts associated with campfire smoke and encourage them to limit burn time or eliminate use of campfires altogether.

RIVER SYSTEMS

The Ohanapecosh River is one of nine major rivers that originate from Mount Rainier and is the largest river in the park whose headwaters do not solely begin on the mountain's flanks. Its source is the meltwater draining from the Ohanapecosh Glacier, on the mountain's southeastern slope, and multiple tributary streams located just east of Mount Rainier. Most tributary headwaters of the Ohanapecosh are not glacially sourced, which accounts for the river's sediment-limited character, due to its less extensive glacial deposits (Pringle 2008, 107, 191). From the Ohanapecosh glacier, the river travels approximately 16 miles, flowing through Indian Bar, tumbling over Wauhaukaupauken Falls and Silver Falls, and eventually emptying into the Cowlitz River to the south of the park, in Gifford Pinchot National Forest. The U.S. Forest Service has determined that the entire length of the river from the Ohanapecosh Glacier to the Cowlitz—15.7 miles in all—is eligible for Wild and Scenic River status (USFS n.d., E-91).

Favored for its clear waters, the Ohanapecosh drains a watershed of 41,400 acres, finely laced with a network of tributary streams.

The Ohanapecosh floodplain never develops a braided pattern and remains relatively constricted, which is anomalous when compared to the other major rivers at Mount Rainier. This is due to the small amount of glaciated volcanic cone that the Ohanapecosh drains; this represents less than 1% of the watershed compared to an average of approximately 12% for other watersheds at Mount Rainier. As a result, floodplains in the Ohanapecosh valley are narrow due to lack of glacial erosion and limited amounts of glacial, volcanic, and lahar debris (Riedel and Dorsch 2016).

Two perennial streams cross through the campground and feed into the Ohanapecosh River—one from the north and one from the south. Past surveys documented the presence of coastal cutthroat trout and tailed frogs in both streams (Samora et al. 2013). The river and its tributary streams profoundly influence the visitor experience of the campground. The site's hydrology continues to shape the overall configuration of the developed area, as well as the character of individual campsites. As discussed above, the river and streams contribute to the campground's natural soundscape, and several campsites are located along their banks.

Bank failure and flooding have occurred as a result of the shifting course of the Ohanapecosh River, and park staff have responded by closing campsites or converting them to day use. Heavy use of some of the campground's streambanks has led to erosion and loss of riparian vegetation. These conditions promote increased sedimentation that can clog the gravel spawning beds of native coastal cutthroat and other aquatic species of concern. Stream habitat is further diminished by the lack of riparian vegetation, which is needed to keep the water cool and provide woody debris to create pools, trap sediment, and introduce organic matter (Trout Unlimited 2006, 6–7, 12).

Guidelines

- Ensure that any new developments consider the potential migration of the Ohanapecosh River and its tributary streams.
- Ensure that all new developments do not adversely affect Wild and Scenic River values for the Ohanapecosh River.
- New development, maintenance, and repairs will not alter the course of natural drainages.
- Avoid alterations to surface water drainage, and if unavoidable, ensure that alterations will not result in erosion.
- New developments or repairs of paved or otherwise impervious surfaces (for example, roads and parking areas) will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- To protect aquatic resources, provide a vegetated buffer that is as wide as practically feasible adjacent to all riparian areas in the campground. Optimal buffer widths depend on stream, soil,

and vegetation type and range from 25 to 150 feet (figure 30). To determine appropriate buffer sizes, campsites should be evaluated on a case-by-case basis with the park's historical landscape architect, plant ecologist, and aquatic resources specialist.

- At streamside campsites, where the banks are heavily used, create established access points at key locations to concentrate visitor use. Select areas that are popular for existing features such as boulders or a gravel bank, and look for points that may already have a social trail leading to them. Create barriers at all other locations to encourage vegetation and discourage use. Barriers could consist of fallen logs or woody debris arranged in an overlapping, or "jackstraw," pattern (figure 39).
- The existing campground dump station will be decommissioned immediately.

WETLAND AREAS

Mount Rainier National Park protects at least 4,700 acres of wetland, according to the U.S. Fish & Wildlife Service National Wetlands Inventory maps. Approximately 3 acres of palustrine wetland and about 1.5 miles of riverine wetland habitat exist within the campground (Arnie Peterson pers. comm. 2017). There are several wetland areas within the development footprint (drawing 9; NPS 2015b, 3).

Guidelines

- To protect aquatic resources, the siting of all new development should avoid wetland areas. To determine appropriate wetland buffer sizes, any potential new development and adjacent wetland areas should be evaluated on a case-by-case basis with the park's historical landscape architect, plant ecologist, and aquatic resources specialist. See drawing 9 for the location of existing riparian and wetland areas in the campground. Development within this sensitive area would be extremely limited and would not occur without interdisciplinary evaluation.
- For existing campsites near wetland areas, provide a vegetated buffer that is as wide as practically feasible. Optimal buffer widths depend on wetland, soil, and vegetation type and range from 25 to 300 feet. To determine appropriate buffer sizes, campsites should be evaluated on a case-by-case basis with the park's historical landscape architect, plant ecologist, and aquatic resources specialist.

VEGETATION

Information about campground vegetation and recommendations for management are included in the "Preliminary Rehabilitation and Revegetation Plan for the Ohanapecosh Campground, Mount Rainier National Park," prepared by Traci Degerman in 2015 (NPS 2015b). Recommendations in this section are also guided by the "Ohanapecosh Campground Rehabilitation Study" (Moehring and Franklin 1977), the *Mount Rainier National Park Hazard Tree Management Plan and Environmental Assessment* (NPS 2010), and the "Ohanapecosh Campground Hazard Tree Observations and Vegetation Management Plan Recommendations" (USFS 2017; see appendix B).

Plant Communities

Located within the Western Hemlock forest zone, the campground's soaring conifers—ranging from 125 to more than 250 feet tall—create an atmosphere that has been likened to a cathedral. This effect is underscored by an understory primarily composed of mid- to low-height shrubs and forbs and only a small number of young, mid-canopy trees (NPS 2015b, 3).

The forest types of the Ohanapecosh Campground area are currently being classified and mapped. A preliminary draft of the vegetation map has tentatively identified the two main forest communities as Mesic Western Hemlock—Douglas-fir Forest and Wet Western Hemlock—Douglas-fir Forest. These types are dominated by three tree species: Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and western red cedar (*Thuja plicata*). The Douglas-fir trees are the oldest, tallest, and most dominant trees in the campground, while the western hemlock are co-dominant. Western red cedar are preferentially found in wetter areas of the campground. Western hemlock are shade-tolerant and are able to germinate under the canopy, where Douglas-fir cannot (Arnie Peterson pers. comm. 2017). While some undisturbed remnants remain of the campground's plant communities, trampling and compaction from visitor use has reduced or eliminated the presence of many indicator species (Degerman 2015, 9). The "Preliminary Rehabilitation and Revegetation Plan" for the campground has identified priority species from the campground and surrounding forest that should be included in revegetation planting efforts: see table 3 (NPS 2015b, 17–18).

Condition of Campground Vegetation

As described above (see Current Status and Issues), the health of understory vegetation and of the old-growth conifers has been significantly compromised over the years by human impacts. Trees and understory species damaged by trampling are unable to regenerate naturally due to severe soil compaction. In addition, the maturity of the forest in and around the campground means that campground trees have been exposed to native forest pathogens that cause disease and decay for long periods of time. Older trees in developed sites have likely been wounded over their long lifetimes and decay fungi can accumulate and spread in heartwood of wounded trees over time. Large, long-lived trees also allow plenty of time for decay to develop. An old-growth Douglas-fir forest on the west side of the Cascade Mountains has the tendency to experience tree failures caused by pathogens, creating space for regeneration that ultimately increases species and age/structure diversity. Although the pathogens are native to the forest and function naturally within its ecosystem, planning for visitor use within this context can be complex and challenging (USFS 2017, 4, 12).

Four types of root disease and butt rot have been identified in the Ohanapecosh Campground. These include laminated root rot, Armillaria root disease, Heterobasidion root disease, and Schweinitzii root and butt rot. The park's existing hazard tree and vegetation management recommendations call for regular monitoring of pathogen impacts and encouragement of less-susceptible species (see guidelines below). Minimizing tree wounding, especially damage to roots, as well as soil compaction is also critical to lessening the impacts of pathogens (NPS 2015b, 3–4, 18; USFS 2017, 8).

Guidelines

- Vegetation species within the campground should reflect the species composition of the surrounding forest (see table 3: Suggested Species for Revegetation).
- Campground vegetation should include the full forest complement of upper canopy trees, mid-canopy trees, mid-canopy shrubs, understory shrubs, and understory forbs (see table 3: Suggested Species for Revegetation).
- New facilities should be sited to avoid damage to existing healthy vegetation. New construction should be undertaken carefully to avoid disturbing trees and root systems. When possible, new facilities should avoid being placed in areas where previously unmanaged trees (trees not within falling distance of any existing facilities) must now be included in hazard tree monitoring.
- Wherever possible, ensure that at least 60% but optimally 100% of the critical root zone of all trees is protected by encroachment from visitor use.[†] The critical root zone corresponds to the greater value of 1 foot for every 1 inch of tree stem diameter or to the dripline of the tree's canopy and contains the most critical areas of its root system (figures 40–43). Avoid locating tents, picnic tables, fire rings, and parking spaces within this area. For large-diameter or other high-value trees, ensure that impacts are limited to less than 25% of the critical root area.
- Continue to survey campground on a regular schedule for hazard trees and regularly monitor for root and butt rot. For monitoring guidance, refer to “Ohanapecosh Campground Hazard Tree Observations and Vegetation Management Plan Recommendations” (USFS 2017), “Preliminary Rehabilitation and Revegetation Plan for the Ohanapecosh Campground, Mount Rainier National Park” (NPS 2015b), and the *Mount Rainier National Park Hazard Tree Management Plan and Environmental Assessment* (NPS 2010).
- Before any tree removal occurs, evaluate each tree for potential to be made into a habitat tree or snag feature for wildlife. Not all trees will be suitable for this treatment, therefore it is important to consult with the park's plant ecologist and ecologist. When safe and practicable, habitat trees and snag features can be created by leaving the bole standing and creating holes for cavity nesting birds, small mammals, fishers and bats or allowing them to colonize on their own.
- Trees removed for hazard mitigation should be replaced following guidance in the *Hazard Tree Management Plan*. In areas susceptible to pathogens, follow guidance below.

[†] This guidance mediates between the 60% recommended in NPS 2015b and more recent guidance from the U.S. Forest Service (USFS 2017).

- In areas where trees are infected with laminated root rot, in particular for loops G and F, plan for the long-term management of the disease by removing all Douglas-fir and shifting composition to more disease-tolerant species. Laminated root rot cannot be safely managed by removing trees only as they display symptoms, die, or fall. For loops F and G and the adjacent stream, do not attempt to protect or preserve old-growth specimen Douglas-fir. Species that are more resistant to laminated root rot include western red cedar, western hemlock, and hardwoods (Table 3).
- Schweinitzii root and butt rot should continue to be monitored by internal decay detection methods on large Douglas-fir trees throughout the campground, as trees do not have to be immediately removed if some decay is detected. In areas where Schweinitzii root and butt rot are observed, discourage the regrowth of Douglas-fir and select for and regenerate more disease-resistant species, including western red cedar, western hemlock, and hardwoods (see USFS 2017, 9).
- In areas where trees are infected with Heterobasidion root disease (HRD) and Armillaria root disease (ARD), encourage growth of resistant species such as Douglas-fir, western red cedar, and hardwood species. HRD and ARD have been detected in areas in C loop (sites C-10, C-26, C-33) and around the amphitheater.
- Avoid allowing freshly cut or fallen Douglas-fir logs to build up on the ground in a single season, as this increases the chance that Douglas-fir beetles will infest the logs and emerge the next season to attack live Douglas-fir trees. The following guidelines describe how to dispose of the fallen wood:
 - Fallen Douglas-fir logs can be used in riparian restoration projects throughout the park.
 - If it is impossible to remove fallen Douglas-fir from the campground in a timely fashion, de-bark the logs to reduce the risk of beetle infection.
 - Douglas-fir logs can also be burned in piles.
 - As a last resort, apply anti-aggregation pheromone packets (called MCH) around logs to prevent beetles from colonizing. This pheromone has been applied at Ohanapecosh in the past but requires funding and pesticide paperwork. For guidance on using MCH, please contact the U.S. Forest Service Wenatchee Service Center for Forest Health Protection.
- Windfall and felled trees that are not Douglas-fir, including western red cedar and western hemlock, could be repurposed for trail and campsite delineation or can be chipped to create berms. Berming can provide delineation and privacy between campsites and trails and will also result in long-term soil improvement. Any chipped

woody material that is used should come from within the campground or surrounding forest. Berm or mound construction should be supervised by the park's historical landscape architect, and placement should avoid the root zones of existing trees.

- Vegetated buffers and/or woody debris (as appropriate) should be maintained or established between campsites; alongside roads, trails, and paths; and adjacent to riparian and wetland areas. Buffers should be as wide as practically feasible. Ensure that woody debris is disease-free and sourced from within the campground or the surrounding forest.
- Plantings between campsites should provide screening and should include species such as vine maple (*Acer circinatum*) that are relatively tall and possess a dense growth habit (figures 44–45).
- Plantings alongside roadways and trails should be restricted to understory shrubs and forbs to maximize visibility and safe circulation.
- Fallen and/or decomposing logs, coarse woody debris, and/or boulders should be used to delineate trails and campsites and protect vegetated buffers. Consider the following factors when delineating trails, campsites, and vegetation:
 - Ensure that logs and woody debris are disease-free; avoid repurposing freshly cut or fallen Douglas-fir logs (see previous guidance).
 - Logs should have a minimum diameter of 2 feet. The decaying organic matter will additionally nourish new plantings and provide a seedbed for future plant regeneration.
 - In areas with tree roots, an unevenly spaced arrangement of boulders is preferable as it allows the roots to move and grow. Boulders are also suitable for areas requiring some slope retention, and they should be carefully arranged to avoid a regular pattern. Ensure that logs and boulders are partially buried for a more natural appearance (figures 43–46).
- Soil in areas identified for revegetation should be decompacted, or scarified, to allow for successful seedling establishment. Scarify soil with hand tools to reduce the risk of damage to tree roots. Small picks and spades should be used closer to the tree trunk; Pulaskis are only suitable for areas at the edge of the critical root zone.
- Protection from trampling and soil scarification may be enough to allow the natural regeneration of vegetation in some areas of the campground. In areas where soil has become especially compacted or in areas without sufficient seed rain, replanting is needed to restore understory health. Active replanting should also take place in the most accessible and heavily used areas of the campground.

- Before replanting, incorporate organic matter sourced from the campground or surrounding site into soil to improve soil structure, biodiversity, and fertility. Organic material mulched from fallen trees may be a good option.
- Groundcovers and understory species suitable for erosion control should be established on campground slopes to protect the soil. Depending on exposure and moisture, suitable species could include vine maple, thimbleberry, salal, Oregon grape, and sword fern (see table 3: Suggested Species for Revegetation).
- Building foundations should be softened by groupings of native understory and groundcover vegetation similar to that which is found in the surrounding forest.
- Campground vegetation should be monitored annually for exotic plant species, and control measures implemented if any are discovered.

Table 3: Suggested Species for Revegetation in the Ohanapecosh Campground

Species	Common Name	Growth Form
<i>Pseudotsuga menziesii</i>	Douglas-fir	upper canopy tree
<i>Tsuga heterophylla</i>	Western hemlock	upper canopy tree
<i>Thuja plicata</i>	Western red cedar	upper canopy tree
<i>Acer macrophyllum</i>	Big leaf maple	mid-canopy tree
<i>Alnus rubra</i>	Red alder	mid-canopy tree
<i>Acer circinatum</i>	Vine maple	mid-canopy shrub
<i>Vaccinium parvifolium</i>	Red huckleberry	mid-canopy shrub
<i>Rubus parviflorus</i>	Thimbleberry	mid-canopy shrub
<i>Oplopanax horridus</i>	Devil's club	mid-canopy shrub
<i>Gaultheria shallon</i>	Salal	understory shrub
<i>Berberis nervosa</i>	Dwarf Oregon grape	understory shrub
<i>Pteridium aquilinum</i>	Bracken fern	understory forb
<i>Polystichum munitum</i>	Sword fern	understory forb
<i>Rubus leucodermis</i>	Blackcap raspberry	understory forb
<i>Achlys triphylla</i>	Vanilla leaf	understory forb
<i>Linnaea borealis</i>	Twinflower	understory forb
<i>Cornus unalaschkensis</i>	Bunchberry	understory forb
<i>Tiarella trifoliata</i>	Foamflower	understory forb
<i>Galium triflorum</i>	Fragrant bedstraw	understory forb

Spatial Organization and Circulation

The landforms and natural systems at Ohanapecosh have shaped the spatial organization of the campground over time. The layout of the present-day campground loops began in the 1930s with CCC

improvements and continued north across the river as part of Mission 66 developments in the park. Spatial organization and circulation in the campground are closely connected, as the overall layout is primarily arranged around a system of campsite access roads. Designers took advantage of areas of relatively level terrain when designing loop roads and siting individual campsites. Road alignments and campsite locations were determined by site topography, the location of pre-existing natural features (such as streams and large trees and boulders), and spatial requirements for vehicles and camping facilities. On the south side of the river, the organization of present-day campground roadways also reflects the changing use of the area over time: the re-routing of roads in this area of Ohanapecosh followed earlier road alignments.

Spatial and circulation guidelines were articulated in servicewide design guidance by E. P. Meinecke in the 1930s, and again in 1959 by the San Francisco office of the National Park Service. The 1959 NPS “Campground Study” provides suggestions for campground layout, campsite parking configurations, the standardization of campsite types, standard campsite furnishings and amenities, the design of day-use areas and comfort stations, the use of trailers in campgrounds, and general campground management (figures 36–38, 48, 67, 75 and 85). While the 1959 study offers several approaches to campground design, the spatial organization at Ohanapecosh largely adheres to the “Section Type” layout and the “Single Spur” or “Double Spur” campsite parking configurations described in the plan. The organization of loops A and C similarly reflect Meinecke’s loop road and parking recommendations (figures 12–13).

The campground’s arrangement of one-way loops and herringbone spur parking is largely unchanged from the Mission 66 era, although in some places the boundaries of roads, campsites, and parking areas have lost delineation due to overuse and damage to vegetation. Evolving recreational practices—for example an increase in group camping and the increased size of recreational vehicles—have also led to larger, aggregated parking areas that diminish the integrity of the original Mission 66 and CCC-era designs.

In addition to this network of loop roads and parking spaces, the campground’s circulation system includes access paths to walk-in sites and comfort and water stations, as well as hiking trails such as the Silver Falls Trail.

ROADS

Roads in the campground consist of a quarter-mile entrance road, leading from State Route 123, as well as individual campground loop roads. The entrance road follows the alignment of the CCC-era road constructed to access the new highway from the Bureau of Public Roads construction camp and the Ohanapecosh Hot Springs Resort (NPS 2016, 42). The original CCC-era road was historically routed to present-day loop A and was re-routed to the visitor center during Mission 66. Today this entrance road leads into a north-south route that connects the southern and northern halves of the campground and serves as the backbone of its overall organization. Four day-use areas and the Ohanapecosh Visitor Center are located along or near this central spine, which connects to eight one-way loop roads. There are four bridge crossings in the road network, one spanning the Ohanapecosh River and the others crossing its tributary streams. The campground’s narrow roadways and bridges encourage slower

driving speeds and allow varied views of the campground's towering trees, waterways, and undulating landforms.

The average width of each loop road ranges from approximately 18 to 22 feet, which conforms to Mission 66 master plan drawings for the campground. The road surface treatment is asphalt, or bituminous concrete, as called for in the Mission 66 campground specifications (figure 47). Due to the nature of the material, the edge of the asphalt paving is rough, and road edging conditions vary throughout the campground. In some places a soft vegetative buffer spills onto the asphalt edge, and in others the edge of the asphalt meets bare, compacted soil (figures 25 and 27). In some areas of the campground, split rail fences, fallen logs, or boulders define the edge of the road and protect vegetation.

While it is unlikely that new roads will be needed in the campground, modifications or relocation of existing roads should conform to the NPS *Park Road Standards* (NPS 1984) and the following guidance.

Guidelines

- Retain historic land uses within the campground. These include camping and vehicle and pedestrian circulation.
- Retain the historic characteristics of the campground's CCC and Mission 66 spatial organization, in particular the layout of looped one-way campground roads with angled parking spurs.
- Ensure that the alignment of roads in the campground continues to respond to surrounding topography and natural features. In adjusting or relocating alignments, consider the driver's visual experience when traveling through the campground.
- Retain the visitor center as a key destination that provides a sense of arrival into the Ohanapecosh Developed Area. Retain the historic use of the visitor center for park and campground information and interpretation.
- Retain asphalt paving treatment for campground entrance and loop roads.
- Ensure that paving is installed to meet the existing grade of the surrounding landscape. In areas where the surrounding grade is significantly lower than the paved surface, grade the edge of the adjacent gravel or soil to ensure a smooth transition between the two materials.
- In areas where informal parking occurs on road shoulders, install log barriers, boulders, and/or sturdy plantings to protect adjacent vegetation and soils.
- Keep impervious paved surfaces to the minimum required for current use and cultural landscape preservation.

- New developments or repairs of paved road surfaces will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- Ensure that any work undertaken with bridges and culverts is approved and supervised by the park's historical landscape architect.
- Where campground roadways provide an accessible route between accessible campsites and comfort stations, ensure a firm and stable surface with a running slope no steeper than 1:20 (5%) and a cross slope no greater than 1:48 (2%).

PARKING

Automobiles have parked at Ohanapecosh since the early days of the hot springs resort. Campground planning in the 1930s and again in the 1950s carefully considered the emerging needs of cars and larger recreational vehicles, such as trailers. The legacy of early parking designs can still be detected in campground parking arrangements, although in some areas the clarity of the original design intent has been obscured by the removal or degradation of edging and vegetation. A variety of parking configurations exist in the campground: 1) individual or double campsite parking spaces, arranged in a herringbone pattern of angled spurs; 2) group or walk-in campsite parking areas that accommodate 4 cars on average; and 3) formalized day-use parking areas that are signed and striped.

Individual campsite spurs were designed to accommodate either cars or trailers and measure approximately 12 feet wide by 30 to 50 feet long (from the loop road centerline). These dimensions have not changed significantly at most campsites, although in many cases parking areas have expanded due to a lack of proper delineation and enforcement, and a tendency for visitors to park more cars than are allotted to a given campsite. Current edging treatments vary and range from a complete absence of edging, to fallen logs and clustered boulders, to spaced wooden bollards (figures 50–51). Logs, boulders, and posts or bollards were identified as suitable barriers both in general NPS guidance for Mission 66 campground design and in master plan drawings for Ohanapecosh (figures 48–49). While some parking areas are paved in asphalt, others are surfaced with compacted gravel and forest duff.

The Ohanapecosh area is a very popular day-use area in the park, given its visitor center and proximity to several scenic hiking trails. Day-use parking regularly exceeds the quantity of available parking areas in the campground. Current day-use parking facilities are available in front of the visitor center, near the entrance to loops A and B, and near the amphitheater in loop D. In 2015 the park converted a former walk-in parking area to day-use parking in loop C (see map 1).

Guidelines

- Retain historic parking spur arrangement along loop roads. Where new parking areas need to be added, preserve herringbone pattern of angled spurs to the extent possible. Avoid the creation of parallel or pull-over parking spaces.
- Individual campsite parking spurs should be defined and constrained to 12 feet wide for “single-spur” sites and 20 feet wide for accessible sites. “Double-spur” sites occur less frequently in the

campground, but where they exist they should measure approximately 24 feet wide and clearly reflect a staggered pattern (figure 37).

- Campsite parking areas should be signed and should clearly correspond to the appropriate campsite. See Signage: Campsite Identification section.
- Ensure that each group parking area is a minimum of 25 feet deep to allow 90 degree pull-in parking. For each group parking area, provide one 8-foot-wide accessible van site and 8-foot-wide aisle in addition to the other provided parking spaces. Provide signage and striping to indicate the location of the van accessible site and aisle.
- Day-use parking areas should be striped to ensure maximum parking efficiency. For all day-use parking areas, provide at minimum one 8-foot-wide accessible van site with 8-foot aisle.
- Parking spaces should have a firm and stable parking surface. Wherever possible, ensure cross slopes do not exceed 1:48 (2%). Accessible parking areas require a maximum 2% cross slope. Consult the *Architectural Barriers Act Accessibility Standards* for guidance on other accessibility requirements for parking spaces.
- Parking areas should be edged by large fallen logs or boulders. Existing wooden bollards should be removed and replaced with fallen logs or boulders (see figures 50, 53–54).
- New developments or repairs of impervious paving surfaces will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- The use of heavy equipment for construction or rehabilitation of parking areas should be limited due to impacts on the critical root zones of campground trees.
- In areas where informal parking occurs on road shoulders, such as in loop A, install log barriers to protect vegetation and soils. Provide signage indicating that shoulder parking is temporary (5- to 10-minute duration).

TRAILS AND PATHWAYS

Trails and pathways have existed in the Ohanapecosh area since the early years of national forest and national park development. Pedestrian routes in the campground offer a spectrum of different walking experiences. They include rugged hiking trails, narrow access paths through campsites, routes across bridges and up stairways, and smoothly paved walkways. Designed and constructed hiking trails, such as the Silver Falls Trail, were introduced in the 1930s as part of the park's CCC-era development. Asphalt paths were created during Mission 66 in high visitor-use areas including around the Visitor Center and amphitheater, and outside comfort stations.

Path edging conditions vary: some paths lack any kind of edging, other paths are defined by healthy vegetation, fallen logs, stone edging, split rail fencing, or spaced wooden bollards.

Guidelines

- Pathway width, material, and edging treatment should clearly identify pedestrian-only routes and should help visitors understand the hierarchy of pedestrian circulation in the campground, allowing for easy and logical wayfinding with a minimal number of directional signs.
- Retain the naturalistic characteristics of historic paths within the campground.
- Routes to and from all accessible facilities should be firm and stable. All other paths should be firm and stable wherever feasible.
- Wherever possible, paths should be designed to meet current accessibility standards. Accessibility standards apply to three different types of pathways in the campground: accessible routes, hiking trails, and outdoor recreation access routes (ORARs). Of these, ORARs are the most prevalent. An ORAR is defined as the pedestrian route that connects accessible elements, spaces, and facilities within camping and picnic facilities and at viewing areas and trailheads. Consult the *Architectural Barriers Act Accessibility Standards* for guidance on accessibility requirements, hiking trails, and ORARs.
- Path materials should vary according to the size, location, and purpose of the path. Depending on the path, appropriate surface materials might include asphalt, forest duff, or a pervious surface that can be compacted to meet accessibility standards. Boardwalks may be suitable especially for resource-sensitive areas near wetlands, streambanks, and tree roots (figures 55–58). Boardwalk design and construction should be undertaken in consultation with the park’s historical landscape architect and relevant resource specialists.
- Wherever feasible, use pervious, compacted granular material for path surfaces, installed on a compacted subgrade to encourage stormwater infiltration. In some areas it may be appropriate to incorporate an integral stabilizer to ensure accessibility. Before initiating a new surfacing project, consider creating a test plot to test color choice and durability.
- Avoid the installation of materials that may pose safety risks in the campground’s damp and shady environment. For example, exposed aggregate concrete collects debris and encourages the growth of moss, both of which can be slippery and potentially dangerous (figure 59).
- New developments or repairs of impervious path surfaces will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- Alignment of new trails and paths should follow contours, avoid large trees and thickly vegetated areas, and highlight views and other interesting natural features such as large boulders. Consider the purpose of the path when deciding whether to follow direct, existing desire lines or whether to provide a more meandering, relaxed route. The campground should incorporate a mixture of both types of trails.

- Discourage the formation and persistence of social trails by clearly defining existing trails and campsite boundaries. Establish barriers where necessary to prevent the use of unwanted social trails. Barriers can consist of fallen logs, vegetation, or arrangements of boulders. When logs are used, scattering them in an overlapping, or “jackstraw,” arrangement can create an effective and natural-looking impediment.
- Identify locations where trail and path edges need to be defined for resource protection, wayfinding, accessibility, or aesthetic reasons. If edge definition is necessary, select materials that are appropriate to the context. Logs and vegetation are suitable for most situations in the campground and echo the fallen logs that are characteristic of the forest setting. In areas with tree roots, an unevenly spaced arrangement of boulders is preferable as it allows the roots to move and grow. Boulders are also suitable for areas requiring some slope retention, and they should be carefully arranged to avoid a regular pattern. Ensure that logs and boulders are partially buried for a more natural appearance. Wooden split-rail or pierced-post fences may be appropriate in more developed areas or in areas that require a higher barrier for safety reasons. Smaller pathways leading to CCC-era features may be lined with rock. See figures 43–46, 48, 57, and 60 for examples.

STAIRS AND RAILINGS

Few staircases exist in the campground because of the relatively level nature of the site. Those that do exist are constructed of either stone or timber. At the west end of loop A, an existing flight of stone steps leads uphill to the CCC comfort station. Constructed of native stone, these stairs are a good example of rustic CCC-era trail steps that are suitable in the campground (figures 62–63). In steep areas, rock stairs can help stabilize slopes and create a more stable and comfortable path. Other steps in the campground are built of milled or rough-hewn lumber or logs. These are generally located in more rugged and informal areas.

At present, there are no railings in the campground except for those used along bridges. In the event that new staircases or railings are determined necessary, their design and construction should follow the guidance below.

Guidelines

- For safety and erosion control, install steps where pathway grades exceed 20%.
- Consider the location and size of the pathway when choosing staircase materials. Stone steps are most appropriate for heavily used trails and staircases in more developed areas of the campground, for example near comfort stations and other facilities. Timber stairs are useful for more lightly used or remote areas of the campground.
- Stone treads should be set with flattened faces up for safety reasons. Use the largest stones possible to ensure a more rustic appearance and reduce maintenance. The color and form of the stone selected should complement the rock types in the surrounding landscape.

- Timber steps should be created by anchoring logs or sawn timbers across the tread and backfilling with gravel and soil. In more heavily used areas, construct three-sided box steps with timbers anchored with steel rods and backfilled with gravel and soil (figure 65).
- Ensure a comfortable ratio between step rise and run. Wider treads are in general preferable (at minimum 11" wide), with riser heights between 4" and 7".
- Ensure slip-resistant surfaces for staircases by scoring or otherwise roughening stone or wood. Maintain naturalistic appearance of step surfaces. Steps should be installed to prevent the accumulation of water on the surface of treads.
- For longer staircases, provide landings at 5-foot intervals.
- Consider installing railings for heavily used staircases longer than three risers. Rail design should carefully take into account the style of the adjacent staircase, the historical character of the park, and code requirements for height and extension. Designs for any new railings should be developed in collaboration with the park's historical landscape architect and historical architect.

Campsites and Campsite Features

CAMPSITES

Campsites in the Ohanapecosh Campground reflect Mission 66 approaches to campsite design. These mid-century approaches evolved from E. P. Meinecke's influential campsite design guidance, created in the 1930s to prevent the further deterioration of campgrounds in forests on public lands (see "History of Development" in part I). Like Meinecke's recommendations, standard Mission 66 campground designs called for a typical suite of amenities for campgrounds and individual campsites, including comfort stations, picnic tables, tent pads, and grills. The relationship between various campsite features was carefully considered, likened to the arrangement of rooms in a home. For example, Meinecke highlights the importance of locating the fire pit/grill in close proximity to the picnic table, but not in an orientation that will cause prevailing winds to drive smoke toward the table or the tent (Meinecke 1932, 11).

Mission 66 campsite guidance largely retained these earlier recommendations, while providing for larger campsites and vehicle pull-in areas and specifying modern, standardized designs for campsite furnishings and other amenities. Plans from this era also identify a hierarchy of campsite types for campgrounds, ranging from sites designed for trailers, to tent sites for car campers, to more primitive walk-in sites. A 1959 "Campground Study," produced by the NPS, established campground design standards for parks in the western U.S. and describes three types of campgrounds (Standard, Basic, and Primitive or Back Country), each with differing campsite amenities (NPS 1959, 6-10).

Different campsite typologies are evident at Ohanapecosh and largely reflect the campground's development history. For example, previous to Mission 66, the area north of the river was managed as a "primitive" camping area and is identified this way as late as 1948 (McNett 2006, 88). Although this northern area would eventually be developed into loops D, E, F, G, and H, many of these upper loops

maintain a more secluded, primitive character than those south of the river. Campsites are smaller and accommodate fewer tents and vehicles, and walk-in sites are available. Sites in the southern loops (A, B, and C) tend to attract larger groups, many with larger vehicles and tents. In addition to picnic tables and fire pits with grills, all campsites are furnished with a wildlife/bear-resistant food storage locker and a numbered identification sign.

Although the campground was originally designed to provide separation and screening for individual campsites, much of the vegetation creating this privacy has declined over the years due to trampling and impacts from vehicles. Delineation between campsites is often poor; where it does exist, definition is provided by topographical changes or consists of fallen logs and vegetation. In some cases, social trails have been created through campsites to access campground amenities. Most campsites are lacking clearly defined use areas. This is in contrast to Meinecke's guidance that "Each camp site should so clearly appear as a unit at the first glance that there can be no doubt in the mind of the visitor newly arriving" (Meinecke 1932, 10)

The park plans to increase the number of accessible campsites in the campground, with a mix of tent and RV sites (see part I: rehabilitation proposal). In addition to converting existing campsites to designated accessible sites, park staff would like to apply universal design guidelines to all campsites to the extent feasible. In addition to the guidelines below, campsite design guidance is provided by the *Architectural Barriers Act Accessibility Standards*.

Guidelines

- Clearly identify campsite types for visitors and park managers to ensure that campers select the campsite that best meets their needs.
- Campsite types fall into the following categories: 1) Standard tent or RV (6-person capacity); 2) Small tent (4-person capacity); 3) Walk-in (4- to 6-person capacity); 4) Large group (25-person capacity); 5) Small group (12-person capacity). See table 4 for a description of spatial requirements for each site type.
- The park should strive to provide accessible camping options for every campsite type except walk-in sites. Accessible sites require a firm and stable surface, with a slope no greater than 1:48 (2%). For other design requirements for accessible campsites, refer to *Architectural Barriers Act Accessibility Standards*.
- Campsites should be located in relatively level areas (with less than 10% slope) that will require minimal ground disturbance to create space for campsite amenities such as tents and picnic tables.
- Finished grading of campsites should blend into the surrounding landform to the extent possible and should emulate natural drainage patterns.

- Due to the impacts on the critical root zones of campground trees, the use of heavy equipment for construction or rehabilitation of campsites should only be used when necessary and after all other options have been determined infeasible.
- New campsite and parking areas should be located in previously disturbed areas to the extent possible. New construction should be undertaken carefully to avoid disturbing trees and root systems.
- New campsites and the reconfiguration of existing campsites will avoid wetland and drainage areas and will also take into consideration age, species, and potential hazards of surrounding vegetation.
- The boundaries of individual campsites should be defined by topographical changes and the locations of large trees and boulders, allow sufficient space for vegetative buffers between sites and next to pathways, and accommodate required setbacks from riparian and wetland areas (see “Vegetation,” “River Systems,” and “Wetland Areas” guidelines for more detail).
- Define the edges of individual campsites to help campers find the right site, provide privacy, and reduce uncontrolled expansion of the campsite footprint. Edging can be created by fallen logs or groupings of boulders (figures 43–46).
- Wherever possible, ensure that at least 60% and optimally 100% of the critical root zone of all trees is protected by encroachment from visitor use.[‡] The critical root zone corresponds to the dripline of the tree’s canopy and contains the most critical areas of its root system (figures 40–41). Delineate a protected area around the tree’s root zone and avoid locating picnic tables, fire rings, and parking spaces within this area (see figure 66 for conceptual campsite layout).
- Use groupings of boulders or fallen logs to delineate protected areas around tree roots and vegetation. An unevenly spaced arrangement of boulders is recommended for areas with tree roots, as boulders allow space for roots to move and grow. Ensure that logs and boulders are partially buried for a more natural appearance; however, dig very carefully around roots to avoid damage. Wooden split-rail fences may be appropriate in areas that have suffered significant resource damage. See figures 43–46, 48, 57, and 60 for examples. Walk-in, tent-only campsites should be provided for campers seeking a more secluded, primitive experience. Walk-in sites should take advantage of topography and existing vegetation for maximum screening.
- Locate food storage lockers in areas where they are screened from view by topography and existing vegetation. Purchase lockers in earth tones to make them less conspicuous.

[‡] This guidance mediates between the 60% recommended in NPS 2015b and more recent guidance from the U.S. Forest Service (USFS 2017).

PICNIC TABLES

Three styles of picnic table can be found in the campground: all-wood, concrete-and-wood, and metal-and-wood (see figures 68, 69, and 70). The majority of picnic tables in the campground date from the Mission 66 era, with wooden components that have been replaced over the years. The 1959 NPS “Campground Study” called for “camp tables [that are] standardized more than they are at present, with perhaps three designs” (NPS 1959, 3). The three designs, illustrated in figure 67, correspond to the three styles of picnic table that exist in the campground.

Because of the park’s and the campground’s CCC-era histories, it may also be appropriate to introduce rustic style picnic tables that are crafted from natural materials and complement the Mission 66 site furnishings (figure 71).

Guidelines

- Retain Mission 66 picnic tables and replace deteriorating wooden components in kind, as necessary.
- For replacement picnic tables, select from the four styles illustrated in figures 68–71. Avoid the use of synthetic materials in picnic table construction.
- For visual cohesion, locate picnic tables of the same style in the same geographic area.
- Picnic tables at accessible sites and in day-use areas should conform to the requirements in the *Architectural Barriers Act Accessibility Standards*. This includes providing wheelchair seating spaces (see figure 72) and ensuring 36–48” of clear ground around each table. Ensure that the ground space has a firm and stable surface, with a maximum cross slope of 2%.
- For all other sites, where feasible provide 36” of clear ground space around each picnic table; ensure ground space has a firm and stable surface.

FIRE PITS

Two styles of steel fire pit are present in the campground: a round style and a rectangular style (figures 73–74). Mission 66 campground design guidance favored these no-frills metal fireboxes, which could be produced in large quantities and ensure uniform, low-maintenance performance (figure 75). Every campsite is equipped with a fire pit, and group sites possess several. The ability to build and enjoy a campfire is considered one the most quintessential aspects of the camping experience, however excessive fire from campfire smoke sometimes creates significant air quality issues in the Ohanapecosh district in the summer. Park managers are interested in exploring fire ring options that will allow this much-loved activity to continue in the campground while reducing the air quality impacts.

Guidelines

- Keep fire rings 10 to 20 feet away from any vegetation and a minimum of 20 feet away from tent areas to minimize the accidental spread of fire. Consider the prevailing wind direction and locate fire rings downwind of tent areas and picnic areas wherever possible.

- Ensure 48” of clear ground space around all usable sides of the fire ring, wherever possible. Consult with the park’s historical landscape architect if providing such clearance requires significant ground disturbance or removal of vegetation.
- For accessible sites, conform to guidance in the *Architectural Barriers Act Accessibility Standards*. This includes ensuring that the ground space around the fire ring is firm and stable with a slope that does not exceed 5% (2% max is optimal). See figure 76 for a conceptual layout for an accessible fire ring.
- To avoid unnecessary extra campfire smoke, ensure that only dry, seasoned wood is burned for campfires, and ensure that visitors completely extinguish fires when finished.
- To improve summer air quality, reduce the number of individual campfire pits in the campground over time. Begin by not including fire pits in the design of smaller, more primitive campsites (“small walk-in” sites: see table 4). In the long term, work with the park’s management team to plan for fewer, more centralized campfire facilities.
- Conduct interpretive outreach to educate visitors about the health impacts associated with campfire smoke and encourage them to limit burn time or eliminate use of campfires altogether.

Table 4: General Spatial Guidance for Campsites, Ohanapecosh Campground

Type	# of People	# of Vehicles	Parking space (in feet, per vehicle)	Additional requirements
Standard tent or RV	6	1–2	<u>Car</u>—back- in: 20’ long x 10’ wide; parallel: 24’ long by 13’ wide <u>RV</u>: 40’ long x 10’ wide[§] (length of existing RV spaces varies in the campground)	Provide universally accessible site elements wherever possible.
Accessible tent or RV	6	1–2	<u>Car</u>—back- in: 20’ long by 16’ wide <u>RV</u>: 40’ long by 20’ wide (length of existing RV spaces varies in the campground). A parking space for a second vehicle (non-RV) can be 16’ wide.	Provide clear ground space of 48” fire rings and picnic tables.

[§] This is an average length and covers the largest size RV the park currently allows in the campground. Recreation.gov and GPS data indicate that we have a variety of lengths on site; some shorter and some longer.

Type	# of People	# of Vehicles	Parking space (in feet, per vehicle)	Additional requirements
Small tent (low-density)	4	1	<u>Car</u>—back- in: 20' long x 10' wide; parallel: 24' long by 13' wide <u>RV</u>: limited to 15' long and 10' wide in small/low-density sites.**	Provide universally accessible site elements wherever possible.
Standard walk-in	6	1	<u>Car</u>—back- in: 20' long x 10' wide; parallel: 24' long by 13' wide	Provide universally accessible site elements wherever possible.
Small walk-in	4	1	<u>Car</u>—back- in: 20' long x 10' wide; parallel: 24' long by 13' wide	No fire pit provided. Provide universally accessible site elements wherever possible.
Group	25	5–6	<u>Car</u>—back in: 20' long x 10' wide; 18' long x 9' wide for multiple spaces Parallel sites are unlikely to occur, but follow guidance above if needed.	Provide universally accessible site elements wherever possible.
Small group	12	2–3	<u>Car</u>—back in: 20' long x 10' wide; 18' long x 9' wide for multiple spaces Parallel sites are unlikely to occur, but follow guidance above if needed.	Provide universally accessible site elements wherever possible.
Accessible group	25	5–6	<u>Car</u>—back- in: 20' long by 16' wide. Other spaces can be 9' wide. Designate and delineate the accessible parking space.	50% but no fewer than 2 of the picnic tables and fire pits should conform to ABA Accessibility Standards.

Sources: United States Access Board 2015; Harris and Dines 1998; Province of British Columbia 1998.

** The 15' length limit was recommended by Rene Ellis in spring 2018, based on the size of existing concrete pads in campsites in sensitive areas.

Signage

Signs are found throughout the Ohanapecosh Campground and vary in size and character. They serve as a critical means of communication between NPS staff and visitors, and they have the capacity to strongly influence the visitor's experience in the park. To support visitor use and resource protection within the campground, signs must be consistent, recognizable, easy to understand, and visually harmonious.

These guidelines articulate standards for sign design and placement within the campground, but signage must also be considered as part of the overall system of signs in the park as a whole. The draft "Mount Rainier National Park Sign Plan" (NPS 1990) describes the overarching vision for park signage and has informed the recommendations that follow. Future revisions or updates to the park's sign plan should be reflected as necessary in revised guidance for signs at Ohanapecosh. Guidance for campground signs is also based on servicewide policies and standards for signage, described in *NPS Management Policies 2006*, *NPS UniGuide Standards* (2005), and Director's Order 52C: *Park Signs*.

The park's draft sign plan identifies four functions of a successful sign: the sign should "1) fulfill a need, 2) command the attention of the user, 3) convey a clear, simple message, and 4) [be] sited to allow adequate time for proper response" (NPS 1990, 1).

In accordance with servicewide policies, the park will additionally keep the number of signs within the campground to a minimum. As stated in *NPS Management Policies 2006*:

Signs will be held to the minimum number, size, and wording required to serve their intended functions and to minimally intrude upon the natural and historic settings. They will be placed where they do not interfere with park visitors' enjoyment and appreciation of park resources. Roadside information signs are subject to the standards established in the National Park Service Sign Manual. Interpretive signs will be guided by sign and wayside exhibit plans (§9.3.1.1, 135).

Uniform standards guide the design and construction of park signs nationwide; however, Director's Order 52C: *Park Signs* allows for modifications within cultural landscapes and historic districts, as well as the continued use of historically significant signs (NPS 2003, 3). Given the campground's highly intact Mission 66 landscape, it is reasonable to expect that it will be determined eligible for listing on the National Register. Guidance for sign design within the campground therefore takes into account the historic character of the landscape, as well as the presence of historic signs.

Five types of signs currently exist in the campground:

- 1) **Informational** signs identify the campground entrance, visitor center, ranger station, and bulletin board with registration information. Most of these signs are made from dark brown-stained routed wood with white lettering (figures 77 and 79). Some are more recently constructed and feature aluminum panels with reflective white lettering on a brown background.

- 2) **Wayfinding** signs are directional, indicating the location of campground sites such as the ranger station, visitor center, amphitheater, trails, and individual loops. Some of these signs are aluminum with reflective white lettering on a brown vinyl background (figures 80–81). Others are dark brown-stained routed wood with white lettering. The hierarchy between informational and wayfinding signs is currently difficult to distinguish.
- 3) **Regulatory** signs indicate permitted or prohibited activities. Examples include no-parking areas, day-use parking areas, time-limited parking areas; also signs indicating maximum allowable vehicle lengths, one-way roads, etc. Regulatory signs are typically made from aluminum, with reflective white lettering on a brown background. Many regulatory signs are temporary signs—for example indicating the closure of a campsite.
- 4) **Interpretive waysides** are located in one area of the campground, near the Ohanapecosh River overlook in C loop. Waysides are constructed of weathering steel with inlaid information panels (figure 82).
- 5) **Campsite identification** signs are posted near the parking area for each campsite and identify each campsite loop and number (figure 83). Campsite identification signs are significantly smaller than other sign types and are fabricated from brushed aluminum and bolted to a length of square steel tube. These signs have sharp metal corners and can be difficult to notice, as they are easily obscured by dust or grime.

Guidelines

General guidance for sign design:

- Strive to minimize the number of signs in the campground, while still providing enough information to clearly identify loop names and numbers, vehicle size restrictions for narrow bridges and roads, and parking and day-use areas.
- Retain historic Mission 66 signage in the campground wherever possible.
- Establish a hierarchy of sign types that reinforces the hierarchy of circulation in the campground. Sign character for roadways should be distinguished from signage for pedestrian routes and campsites.
- Develop and keep updated a sign plan for the campground that is part of park-wide sign guidance.

Design guidance by sign type:

- 1) **Informational** signs should be dark brown-stained wood with white lettering. Use clear cedar whenever possible; the thickness of cedar board will depend on the overall size of the sign (consult with the park's lead sign designer to confirm thickness).

The dark brown stain used on the park's wooden signs is Sherwin Williams™ SW2014 Beatrix Brown. The white used for the lettering is currently not specified. Fonts used for wooden signs at Ohanapecosh should match the modified Gothic used for the campground's existing Mission 66-era signage (figures 77–79).

- 2) **Wayfinding** signs should be either reflective aluminum or dark brown-stained wood, depending on the location and purpose of the sign. Signs intended to be seen from moving vehicles should be made from aluminum, with a brown vinyl background and reflective white lettering that is clearly visible at night (figure 81). Signs should be mounted on a cor-ten steel post. Ensure that all aluminum signs have a brown backing to allow them to blend more seamlessly into their natural setting. Sign design for roadways should also conform to the Federal Highway Administration's *Manual on Uniform Traffic Control Devices* and the *NPS UniGuide Standards: Volume 2, Roadway Sign Design Standards* (2005).

Wayfinding signs that are intended to be viewed by pedestrians should be dark brown-stained wood. See guidance above under "Informational signs" for specifications.

- 3) **Regulatory** signs should be made from aluminum, with a brown vinyl background and reflective white lettering. Where they relate to vehicle circulation or parking, these signs should also conform to the Federal Highway Administration's *Manual on Uniform Traffic Control Devices* and the *NPS UniGuide Standards: Volume 2, Roadway Sign Design Standards* (2005).

Standard design guidelines for temporary regulatory signs should be developed in consultation with the park's sign shop, maintenance staff, and campground visitor use staff.

- 4) **Interpretive waysides.** The design of interpretive waysides will follow the guidelines articulated in the *NPS Visitor Information Sign System* and *Wayside Exhibits* guide. Low-profile, sled-based interpretive waysides are most appropriate for use within the campground. Sled-based signs are relatively portable and can be relocated to new areas to describe dynamic environmental processes impacting the campground.
- 5) **Campsite identification** signs. Existing signs should be replaced with a style similar to the routed wooden posts or wooden bollards illustrated in figures 86–88. Campsite signs could also indicate campsite type by incorporating the suggested campsite identification symbols illustrated in the *Design Guidelines Illustrated Field Reference* (Appendix C).

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APPENDIX A

Inventory of Sites, Structures, and Buildings: Ohanapecosh Developed Area, Mount Rainier National Park

The text below is excerpted from the draft National Register of Historic Places Registration Form (Lentz 2003).

SITES

- Ohanapecosh Hot Springs Site (1921–1965): former locations of hotel, bathhouse, cabins and tents; springs now restored to natural condition and all buildings removed; interpretive trail leads through open meadow and among springs.

STRUCTURES

Most structures and small-scale features at Ohanapecosh date to the Mission 66 period, with some exceptions. These elements are all of a kind—strategically placed, highly functional, designed to blend in with the forested setting.

Contributing

Roads and Trails

- Mission 66 roadways: utility-residential loop road (1958), main access road (1959), campground loop roads—Loops A and C (1934) and Loops B, D, E, F, G, H (1959)
- Hot Springs Resort road remnants (1920s/1930s)
- Silver Falls Loop Trail (1934)
- Hot Springs Nature Trail (1972)

Bridges

- Ohanapecosh River vehicular bridge (1960): steel and concrete with decorative steel railing
- Rock bridge and culvert, Loop A to Loop C (ca. 1934): prior to campground expansion northwest of the river, this bridge part of the main road through campground
- Wooden footbridge, Loop A to Loop C (1934): this CCC footbridge crossed Ohanapecosh River until moved here in 1960 to make way for vehicular bridge

Signage

- Campground signboards (1960s): kiosks, posting boards, and directional signage along main access road within campground; wood timbered construction with shake roofing

Other

- Amphitheater Complex (1961)
Design: Western Office of Design and Construction (WODC), San Francisco
Original cost: \$26,638

The amphitheater includes a wood enframed stage 9 feet in depth, with a 12 by 12-foot movie screen. A shed-roofed projection room with board and batten cladding backs the screen. Amphitheater seating consists of heavy plank benches to seat 500, arranged in three tiers in a teardrop configuration. There is a raised elliptical-shaped planting area in front of stage. Its low rock wall curves around the east side of the amphitheater framing a semi-circular campfire area. In the middle of this open space is a rock-faced campfire pit approximately 4 feet in diameter.

Non-Contributing

- Dump Station (early 1980s): installed for RV use when new sewer treatment system replaced original campground septic system; located at entrance to campground Loop C

BUILDINGS

With the exception of four Depression-era comfort stations, all buildings at Ohanapecosh were built during the Mission 66 period. As a group, they vary greatly in form and function. A unifying design concept is apparent, however, in their careful siting, their unobtrusive low profiles, and their use of modern but naturally finished materials. Design drawings called for all buildings to be roofed with shakes or cedar shingles—these have all since been replaced with metal of various types since the late 1980s. With the exception of two utility buildings, all the Mission 66 buildings are characterized by their dark-stained or dark-painted board and batten siding.

Contributing

Utility–Residential Area

- Utility Building/Ranger Station (1962-1964)
Architect: John Morse & Associates, Seattle
Contractor: Elling Halvorson Co., Seattle
Original cost: \$146, 655

Exterior

The utility building/ranger station stands in the middle of an asphalt yard near the entrance to the utility–residential loop. A spare structure with clean lines, the building achieves primary architectural interest in its asymmetrical massing, recessed entryway, and deep roof overhangs. The single-story, 4953-square-foot building has a steel frame infilled with 8-inch concrete masonry units. It measures approximately 41 x 131 feet in overall dimension with a roughly rectangular footprint.

The forward section of the building houses ranger offices, storage and supplies, and fire equipment under an asymmetrical gabled roofline. A second section, 5 feet higher in elevation, has a symmetrical gabled roof and contains the main garage and vehicle wash room. Both roofs are shallow-pitched and constructed of glu-lam beams clad with sheet metal and asphalt. Deep overhangs with projecting beams and purlins wrap around the building.

All exterior walls are of painted CMU block. The front, or east side of the building has paired aluminum sash windows, all original, with hopper openings. Recessed under the gable is a

doorway to the office complex, and a wooden overhead door and man door leading into the fire truck garage. The south elevation includes four similar overhead garage door bays, and the north elevation a single garage door plus a band of original aluminum windows giving light into the main garage.

Interior

The interior of the building is finished for utilitarian use, with painted CMU walls and concrete floors. Heavy glu-lam beams overhead are stained. The building has an oil-fired hot water heating system.

Original drawings show the east end of the building partitioned for an outer office, an area ranger's office, maintenance office, ranger and trail storage, general storage, boiler room, and restrooms. A central corridor separates these smaller spaces from the fire truck garage and a supplies and parts room, now used in part for the storage of drawings and plans. The west end of the building contains only the main garage and vehicle wash room.

No major alterations have been made to the utility building either inside or out since its completion.

- Generator House (1962)

Contractor: Swartz Electric Company, Moses Lake

Original Cost (electric generation and distribution system): \$53,976

Built to provide electrical power for the Ohanapecosh complex, the generator house stands at the far west end of the open utility yard. It is a simple gabled structure of painted CMU block, with metal roofing. Double entry doors have a glazed transom above to admit interior light. Ohanapecosh was linked to public power out of Packwood in the 1980s, so the generator house no longer provides power to the complex.

- Seasonal Multiple Housing (1964)

Design: WODC

Contractor: E.K. Henderson, Longview

Two identical 12-unit apartments for seasonal employees stand within the utility-residential loop at its far west end. Both buildings face outward toward the forest. A concrete sidewalk wraps around this portion of the loop. From it, five paths lead across open lawn to a verandah that spans the width of each facade. Mature landscaping is ranged around the perimeter.

Each apartment house is a two-story wood frame structure with a shallow pitched gable roof. Both measure approximately 30 x 128 feet, with a roughly rectangular footprint. The siding is a dark-stained board and batten, which contrasts with a crisp white trim. Windows consist of original wooden double-hung sash grouped singly, or in twos and threes. Both buildings are

fronted by a two-story verandah that serves as an exterior corridor to individual units. Projecting staircases at either end provide access to the second floor behind slatted partitions. Original railings with plywood panel detailing remain in place along the balcony. Wood shingle roofing has been replaced with seamed corrugated metal.

The interior of each apartment building contains 12 units, 6 on each floor. A flexible floor plan allows one or two bedrooms to be grouped with any one living and kitchen area. Two units on the ground floor are studios that flank the central laundry room and boiler rooms. Interior finishes are simple, including plasterboard walls and vinyl tile floors.

Except for carpeting and fixture replacement, no major alterations have been made to the seasonal multiple housing since its completion.

- Duplex (1964)
Design: WODC
Contractor: B.C. King Construction Co.

Situated within the utility-residential loop on its south end, the duplex is an unassuming residence designed for use by two year-round employees. A single-story structure with a rectangular footprint measuring 29 x 93 feet, the duplex has a shallow-pitched gabled roof with broad overhanging eaves. Wood shingle roofing has been replaced with corrugated seamed metal. Siding is a dark-stained board and batten. Original wooden, double-hung window sash have been replaced with aluminum sliders, all set within original openings.

Within the duplex, two garages are sandwiched at the center between the two living units. Each apartment features an open living room/dining area, an open kitchen, a utility room, bathroom, and two spacious bedrooms accessed off a hallway. In addition to wardrobe closets in the bedrooms, there are designated linen, broom, and coat closets, as well as two additional large storage closets in the hallway. Interior finishes are simple, but a step above those in the seasonal employees quarters, and include hardwood floors.

- Residence (1964)
Design: WODC
Contractor: B.C. King Construction Co.

The area ranger's residence stands at the east side of the utility-residential loop, secluded but relatively near to the utility building and campground. The site slopes to the south and east, allowing a partial basement that is accessed from the rear of the house. The house is sited close to the road across a narrow lawn, with mature conifers forming a backdrop at the rear.

The ranger's residence is a one-story dwelling, with a rectangular footprint, and a simple gabled roof. Overall dimensions are approximately 25 x 68 feet. A single-car garage with a concrete

drive occupies the south end. There is recessed main entry centered on the facade, and a back door is accessed via a short flight of wooden steps. Like other Mission 66 buildings, the house has stained board and batten siding. Original wooden windows sash have been replaced with aluminum sliders, and front bedroom window openings have been enlarged. Here, as elsewhere in the complex, metal roofing has replaced the original cedar shingles.

The interior has a large L-shaped living/dining room, a full kitchen, two bathrooms, and a full utility room. Three bedrooms are grouped at the north end of the house. Interior finishes include hardwood floors.

- Trails Maintenance Shed (ca.1940)

The trails maintenance shed stands at the utility-residential loop exit, at a site that was briefly considered for the area ranger's residence. Late 1950s site plans show three unidentified structures in this location; a 1963 site plan shows a "shed to be removed" with the approximate dimensions of the extant building. A small tool shed and an oil shed are shown at either side of this larger structure—both now demolished.

Design and materials further suggest that this building pre-dates the Mission 66 period. The shed is a simple gable roofed structure with exposed rafter tails and shaped log purlins projecting from either gable end. It has wide-gauge lapped siding and a recent metal roof. Paired, four-light sash occur in both gable ends. Double wooden garage doors on a track are centered on the front.

Campground Area

- Comfort Stations Loops A–C (ca. 1935)
Builder: Civilian Conservation Corps

Four campground comfort stations remain in use in the older campground loops southeast of the river. Two are located in Loop A, one in Loop B (along the old route to the hot springs resort), and one in Loop C. Built by the CCC in the mid-1930s, these buildings illustrate an important pre-Mission 66 phase of development at Ohanapecosh. The two Loop A restroom buildings retain rustic stone steps for access from lower-lying campsites.

Designed in the Park Service Rustic style, the four buildings have stepped rock foundations, vertical log and half-log walls, exposed log purlins, wood shingled roofs, and pivoting wood windows. Metal doors, lattice partitions, and water stations of CMU block represent Mission 66 updates.

- Comfort Stations—Loops D–H (1961)
Design: WODC
Contractor: Joe E. Venne

Original cost per building: \$12,271

Five new comfort stations built in conjunction with Mission 66 campground improvements stand in Loops D through H northwest of the Ohanapecosh River. Consistent site features of these buildings are water stations—low rectangular platforms of concrete and CMU facing with drinking fountains, taps for container filling, and drains.

The buildings are of wood-frame construction with gabled roofs originally clad with cedar shingles, now replaced with metal. Exterior siding is of dark-stained board and batten. A band of narrow, metal frame windows with pivot mechanisms ring the buildings just below the eaves line.

Interiors are partitioned into men's and women's restrooms with a narrow utility area between. Floors are of concrete.

Visitor Center Area

- Visitor Center, 1963-64
Architect: John Morse & Associates, Seattle
Contractor: Elling Halvorson Co., Seattle
Original Cost: \$137,683

Site

The visitor center stands at the lower end of the Ohanapecosh access road at the entrance to the campground loops. The building is well set back east of the road, just south of a small creek. Limited pullout parking is arranged along the road. Just south of the visitor center are a fire hydrant and hose "dog house," as well as propane tanks screened by recent fencing. Natural forest forms a close backdrop on the east and south sides of the building. Formal landscaping occurs on the west and north sides where visitors enter and exit to an outdoor terrace and trailhead.

Hardscape consists of a T-shaped concrete aggregate walkway from the parking area to the building entrance. The car park section of this walk is lined with a split rail fence, added in a 1979 landscape project. At the intersection of the T is an egg-shaped planting bed with a flagpole. Concrete aggregate paving, colored and scored, forms an apron that wraps around the west and north sides of the building under a deep roof overhang. At the northwest corner, the apron includes a roughly triangular flagstone section, installed in 1979. At the far northeast corner, this apron expands into a small polygonal terrace, where a cross-section of a large Douglas fir log is displayed. Log benches and black metal spotlights make the covered portions of the terrace usable in all weather.

Plant materials include ferns and sallal, huckleberries and bear grass, twinflower and Oregon grape – all arranged naturalistically around fallen logs. In a cluster off the north terrace, a Pacific yew tree, rhododendron, and mountain box are featured. The Hot Springs Nature Trail begins at the east end

of the terrace. Next to this a small stone bridge, added in 1979, leads over the creek to campground Loop D.

Exterior

The visitor center is a single-story wood-framed building with an irregular floor plan. Overall dimensions are 49 x 96 feet, although useable floor space is only 3,134 square feet. It has a concrete foundation and concrete slab floor.

One of the building's most distinctive architectural features is its double, offset shed roof configuration. Heavy glu-lam beams are a prominent visual feature inside and out. The lower of the two shed forms projects forward to encompass restrooms accessible from outside the building. The higher of the two shed forms features broad overhangs that create covered terraces around the west (front) and north sides of the building. Stylized upright logs support these overhangs. The offset in roof height results in a band of clerestory fenestration along the south side of the exhibit hall.

The original cedar shake roofing is now replaced with seamed corrugated metal. Exterior walls are of rough-cut board and batten, painted dark brown. The doors are solid wood, double-leafed and hinged, with mitered panels below and glazing above. All windows consist of wood sash in varying configurations. Some are fixed, others are operable hopper types. Door and window trim is painted a yellowish cream.

Interior

The interior of the visitor center has a ceramic tile and colored concrete floor, now covered in carpeting. The entire west wall is glazed, but solid wall surfaces elsewhere are clad with a smooth-grained, 5-inch vertical board finish, stained in a medium tone. The primary exhibit space is open to the roof, with dark stained beams, purlins, and tongue-in-groove decking between. Non-public rooms have gypsum board finished and dropped acoustical ceilings.

There are eight rooms in the visitor center, the largest being the open public lobby and exhibit area. Ranged along the south side of the building are the exterior restroom wing, a janitor's supply room, an interpreter's office, a naturalist's workshop, and a boiler room. An alcove of the main lobby/exhibit area, to the right of the entrance, was originally dedicated for use as the information counter. This alcove has now been enclosed for an additional office. To balance that loss of space, a freestanding L-shaped information counter has been installed just inside the front door, and a recessed bookshop has been opened up in the adjoining bay. The bookshop occupies what has once part of the naturalist's workshop.

In form and content, the Ohanapecosh visitor center furnishings and exhibits remain much as they appear in completion photos taken in the summer of 1964. Occupying the center of lobby is the model of Mt. Rainier created in 1940 for the former Ohanapecosh Forest Museum (now removed). A seating area with benches and low chairs occupies the corner overlooking the outdoor terrace. A

plaque on the wall notes that the building was “designed by the Western Office Division of Design and Construction, San Francisco” and attributes exhibit design and preparation to the “Western Museum Laboratory.” Around the corner past the exit to the terrace is an original diorama with animal specimens, now partially partitioned, featuring an audio and bench for better viewing. At the center of the exhibit space is a freestanding display case, also a later addition.

Mounted wall displays (believed original 1964 installations unless otherwise noted) include the following

Have you Been Here?

Ohanapecosh Hot Springs History (new in 1982)

Old Growth Forest of the Pacific Northwest (updated)

Pillars of the Forest (updated)

Western Hemlock

Western Red Cedar

Douglas Fir

Other Trees

Forest Succession

The Living Tree

Living Soil

Animal Ecology diorama

Alterations

Alterations to the visitor center have been few and far between. Some renovation took place in the late 1970s. According to maintenance records, the L-shaped information desk was installed in 1977. Sometime after 1980, the enclosure of the information room/counter for use as a second office space occurred. Very likely, the opening up of the bookstore bay (partitioned out of the naturalist’s workshop) occurred around the same time.

Design drawings and record photos suggest that the exterior site landscaping was updated with some new plant materials, wood fencing, and some flagstone paving sometime following the summer of 1980. At that time the Douglas fir cross-section was moved from its original location at the front of the visitor center to the rear terrace, in order to provide more light for picture-taking in front of it.

Recently, the visitor center’s oil heating system has been replaced with gas. Exact dates for the installation of carpeting, for the partial enclosure of the diorama, and for other exhibit updates have not been ascertained.

APPENDIX B:

	United States Department of Agriculture	Forest Service	Forest Health Protection Wenatchee Forest Insect & Disease Service Center	Forestry Sciences Lab 1133 N. Western Ave. Wenatchee WA 98801 Phone: (509) 664-1700 Fax: (509) 665-8362
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September 1, 2017

Mount Rainier National Park: Ohanapecosh Campground Hazard Tree Observations and Vegetation Management Plan Recommendations

During the week of July 17-21, 2017, Betsy Goodrich and Brennan Ferguson, forest pathologists with Forest Health Protection's Wenatchee Service Center, visited several campgrounds within Mount Rainier National Park (MORA) to assess hazard tree issues. One of these was Ohanapecosh Campground, where we had been asked for input on the following:

- Possible improvements in management and restoration treatments that may slow the rate of tree deterioration and death.
- Meet and communicate with Mount Rainier National Park and regional National Park Service staff, who are currently preparing long-term plans for the campground, to discuss management options related to hazard tree management and long-term maintenance of tree vigor.

The National Park Service is currently in the design and planning stages for modifying and restructuring some campsites and facilities within Ohanapecosh Campground. Specific goals are to rehabilitate and reconfigure key areas of the campground. A comprehensive report titled '*Preliminary Rehabilitation and Revegetation Plan for Ohanapecosh Campground, Mount Rainier National Park*' (Degerman 2015) discusses the need for rehabilitation and revegetation. It provides photos and data of current conditions, including vegetation composition, soils, geology, and visible extent of natural resource damage such as loss of vegetative cover and soil compaction. The report also provides preliminary goals and strategies for rehabilitation and revegetation.

We prepared for the visit by reviewing the hazard-tree data and maps collected and compiled by Traci Degerman (Hazard Tree Management Coordinator). Once on-site we did a preliminary walk-through of the campground with Arnie Peterson (Plant Ecologist) and Traci Degerman and discussed the relevant management objectives. These included:

- Maintain vigor of old-growth 'specimen' trees. (Note: 'specimen' trees in this context are defined as large, old-growth Douglas-fir)
- Maintain species composition of surrounding forests:
 - Restore and protect native understory vegetation.
 - Determine appropriate tree species for natural or artificial regeneration.
- Protection of desired resources:

- o Tree health and vigor.
 - o Stabilization of streams and riverbanks that run through the campground.
 - o Protection of specimen trees and tree root systems in highly disturbed areas.
- Move some campsites to less ecologically sensitive areas:
 - o Close sites that are impacting wetlands and riparian areas within and bordering the campground.
 - o Reduce ongoing soil compaction and degradation in areas where:
 - Tree vigor, including that of specimen trees, is likely being compromised.
 - Riparian corridor soils and vegetation are being impacted.
 - o Determine if portions of various loops within the campground are suitable for new campsite construction.
- Reduce footprint of current campsites, parking slips and stream access:
 - o Redesign campsite tent pads and parking slips.
 - o Provide barriers to reduce impacts of foot and vehicle traffic.
 - o Provide protection to understory plants and tree roots.
 - o Reduce soil denudation and compaction.
 - o Build trails with physical borders (such as fencing) and (or) elevated boardwalks to reduce streambank degradation by social trail network.
 - o Use logs and rocks to direct foot traffic and limit access to sensitive areas.
- Maintain the current number of campsites in campground. Build new campsites to make up for any that may need closure due to redesign.

After further walk-throughs and closer examinations of trees throughout the campground we made the following observations. We describe each bullet point in more detail below.

1. Implications of a campground within mature forest:
 - a. Stem decay, root diseases and butt rot pathogen accumulation in aging forests
 - b. Complexity in managing for visitor safety in aging forests in developed sites
2. Specimen tree pathogens that cause mortality and hazards:
 - a. Laminated root rot
 - b. Schweinitzii root and butt rot
 - c. Management and planning recommendations
3. Other (non-specimen) trees throughout campground identified with pathogens that cause root disease and butt rot and can lead to tree mortality and hazard-trees
 - a. Laminated root rot
 - b. Schweinitzii root and butt rot
 - c. Heterobasidion root and butt decay
 - d. Armillaria root disease
 - e. Management and planning recommendations.
4. Areas of Ohanapecosh suitable for new campsites (based on potential hazard-trees)

- a. H loop
 - b. G loop
 - c. E loop
- 5. Old-growth specimen trees inside Loop F
- 6. Educational outreach

1. Implications of a campground within mature forest

Stem decays and butt (lower stem) rots accumulate in forests over time due to higher proportions of heartwood being formed as trees grow, higher chances of wounds (infection points for decay) occurring, and longer times for decays to develop. For these reasons old forests have far more decay than young forests.

Successional changes via pathogens take longer and result in slower changes over time compared to stand replacing disturbances such as fire, bark beetles, or harvest, but their end result can be profound. Root disease pathogens, such as laminated root rot, can accelerate or impede succession through creation of openings that offer opportunities to more tolerant climax species (Holah et al. 1993, 1997). Stem decay pathogens also create small openings through tree failures and mortality (Hennon 1995). Late-successional, west-side Douglas-fir forests continually experience small-scale gap disturbances (i.e. - tree failures) that increase downed woody material, increase species diversity, and create complex horizontal and vertical structure.

These types of forest processes, however, conflict with visitor safety in a developed site such as a campground. Therefore, hazard-tree management is an increasingly difficult and complex task within developed sites located in aging forests.

2. Specimen tree pathogens that cause mortality and hazards

Schweinitzii root and butt rot, caused by the fungus *Phaeolus schweinitzii*, has been identified on numerous specimen Douglas-fir throughout Ohanapecosh (personal communication Traci Degerman). This fungus is typically observed impacting larger, older Douglas-fir although it has a wide host range among conifers (Hagle and Filip 2010). Over time the disease causes extensive decay within roots and up the butt of the tree. Decay compromising the strength of the stem and roots, which can result in sudden tree failure, especially with winds at any time of the year or snow and ice loading in the winter. There are no direct treatments available to manage this pathogen, such as a fungicide to eliminate it from the tree, but protection of tree roots and attempting to reduce or eliminate further wounding and soil compaction may prolong tree life.

We also defined the extent of another serious disease of Douglas-fir, laminated root rot (LRR), which is caused by the fungal pathogen *Phellinus sulphurascens* (location data on file with NPS, Figure 1). We say the ‘extent’ of the disease because it spreads from tree root to tree root as it grows, thus forming what are typically referred to as root disease ‘centers’ (Thies and Sturrock 1995). Several Douglas-fir trees are exhibiting crown symptoms of root disease, such as thinning and yellowing (chlorotic) foliage, and Douglas-fir beetles have mass-attacked several Douglas-fir trees in Loop G. Douglas-fir beetles (DFB) can be attracted to mature Douglas-fir that have been windthrown while alive or standing trees stressed by root disease, drought, defoliating insects, flooding, fire or other damages (Furniss and Kegley 2014). It is essential not to let Douglas-fir logs build up in a developed site or you increase the probability that beetles will attack downed logs and emerge to attack standing trees the following year (see management recommendation section below).

Laminated root rot is one of the most hazardous root diseases on developed sites in the Pacific Northwest. Reasons for this include:

1. The fungus extensively decays roots of highly susceptible hosts like Douglas-fir.
2. Not all infected trees exhibit visible signs or symptoms of the disease but yet may already have extensive root and (or) basal decay.
3. Windthrow of infected, green Douglas-fir is frequent. Trees can also come down without warning on calm days.
4. Laminated root rot is a ‘disease of the site’, meaning that stumps and their infected roots act as inoculum sources to potentially infect the roots of surrounding, live trees for as long as 50 years (Hansen 1979, Thies and Sturrock 1995).

From a hazard-tree perspective, we are particularly concerned that Douglas-fir specimen trees likely have both schweinitzii root and butt rot and laminated root rot. We found snapped trees and stumps with both diseases on the hillside between the G and F loops (Figure 1, purple dots).

Management and planning recommendations related to specimen trees

We do not recommend the park attempt to protect or preserve old growth specimen Douglas-fir or true fir species (both susceptible to LRR and schweinitzii) within and around Loops F and G, including the stream area (Figure 1). It is better long-term management to select for and

regenerate other species within these loops (western red cedar, western white pine, western hemlock, hardwood species) (Hadfield et al. 1986). Planning for the long-term management of LRR within a vegetation management plan, by shifting composition to more disease tolerant species, is essential to maintaining a safe site. This disease cannot be safely managed in a recreation site by removing trees only as they display symptoms, die, or fall.

Douglas-fir beetle activity will continue as long as there are mature host trees weakened by root disease and drought. If DFB-infested Douglas-fir are felled and left in place or piled near the campground, DFB adults will emerge from this material the following spring (April-May dependent on air temperature) to possibly attack nearby Douglas-fir and subsequent populations of DFB will be larger. If populations are allowed to expand, even the healthy campground trees may be attacked and killed by DFB. Removing most felled and wind-thrown Douglas-fir from the campground before the campground opens to visitors is crucial to mediating DFB potential.

Management options for *schweinitzii* root and butt rot include regulating stand age (<100-120 years old), avoiding basal stem and root damage, maintaining tree growth and vigor, and favoring less-susceptible species such as western redcedar and various hardwood species (although these can be problematic in campgrounds due to their thin bark being easily and severely wounded).

Thorough evaluations of trees with *schweinitzii* root and butt rot should be completed annually for obvious leans, root wrenching, shade or cracking of the butt, evidence of carpenter ants or wood borers, butt swell, wounds and root decay (Filip et al. 2014). Decay should be estimated by drilling near the base of infected trees for sound rind and roots should be checked for decay. Major lateral roots should be drilled within two feet of the root collar to detect any hidden defects and decay in the roots. If >50% of structural roots are decayed, the tree should be rated as a high failure potential (Filip et al. 2014). The USFS hazard-tree rating system considers trees with *schweinitzii* root and butt decay having <15% of stem diameter with sound rind to be high failure potentials (Filip et al. 2014, p. 17). Decay should also be estimated around the root collar and butt on trees with butt swell, as these trees may have developed the swell over many years of infection.

3. Other (non-specimen) trees throughout campground identified with pathogens that cause root disease and butt rot and can lead to tree mortality and hazard-trees

Four types of root disease and butt rot have been found in Ohanapecosh: laminated root rot, Armillaria root disease, Heterobasidion (formerly annosus) root disease, and schweinitzii root and butt rot. The biology of these diseases makes hazard-tree management extremely challenging. Removal of many existing live trees and conversion to more root disease resistant tree species are necessary in certain sections of the campground. This process would greatly alter both the structure and composition of the forest and thus the site aesthetics.

Laminated root rot was discussed earlier and appears limited to Loops G, F and the stream that runs past these and the D loop (Figure 1). Annual surveys should continue to check for crown symptoms and decay. The best management practice for laminated root rot in campgrounds is to alter species composition away from susceptible species.

Schweinitzii root and butt was also discussed previously in relation to specimen trees. Surveys should continue to drill butts and roots and follow decay progression in trees in which the decay has previously been found.

Heterobasidion root disease (HRD) was found on trees in Loop C (Sites C10, C26, C33), around the amphitheater and sporadically in Loops E and H. The fungus that causes HRD in true fir and hemlock species (*Heterobasidion occidentale*) decays and kills roots leading to reduced vigor, likely attraction of bark beetles, windthrow of trees with either symptomatic and non-symptomatic crowns, or outright tree mortality due entirely to the disease. The fungus can also act as more of a butt decay in some susceptible species. Hazard-tree surveys and drilling methods in Loop C have noted butt decay in hemlock trees (personal communication Traci Degerman).

In the Pacific Northwest, *H. occidentale* primarily infects true firs, hemlocks and spruces. Partial cuttings (e.g. periodic hazard-tree removal over many years) can exacerbate the disease on a site due to the accumulation of infected woody material below-ground. This material is also known as “inoculum”. Heterobasidion root disease is capable of contributing to substantial tree hazards in developed sites.

We identified HRD in stumps and roots of numerous western hemlock trees, and have the impression it occurs at high incidence in other portions of the campground, including the area around the amphitheater. During hazard-tree surveys, butt decay should be estimated by drilling, and the park should be mindful of keeping track and checking roots of recently dead and windthrown trees in the vicinity (regardless of season of windthrow). It is probable that the hemlock decay observed in this loop (personal communication 2017, Traci Degerman) is due to HRD.

Armillaria root disease (ARD) was detected sporadically on true fir trees in Loops A and B (on dead or dying true fir trees around Sites A26, B2 and along the campground loop road next to the Ohanapecosh River). The signs of ARD may be masking Heterobasidion root disease on these trees.

Management and planning recommendations for areas with Heterobasidion and Armillaria root diseases

Heterobasidion root disease and Armillaria root disease are capable of contributing to substantial tree hazards in developed sites. In the USFS hazard-tree rating system, failure potential of trees identified with either HRD or ARD are based on whether infected trees are adjacent to (<50 feet) windthrown trees with root disease (Filip et al. 2014, p. 16). This rating system attempts to incorporate the site history into hazard ratings for these types of root and butt decay.

In areas with HRD and ARD, efforts should be made to minimize tree wounding and soil compaction. Susceptible tree species with butt decay should be removed in areas with known Heterobasidion root disease and more tolerant species should be planted or encouraged if regeneration is already present. In Loop C and around the amphitheater, true firs and hemlocks should be replaced by Douglas-fir, western red cedar, western white pine and hardwood species (Hadfield 1986).

Past hazard-tree surveys have defined unknown butt decay on trees in Loops A, B and C, which we believe is likely Heterobasidion root disease. It is imperative that surveys continue to monitor and measure the amount of butt decay on susceptible tree species in these loops. Decay should be monitored using drilling methods noted above. Roots and butts of recently killed and winter windthrown trees should be checked for decay.

We recommend the park remove dead standing true firs, hemlock or Douglas-fir in this campground based on the prevalence of root disease and butt decay in the area. Roots and butts of dead trees may have extensive decay and tip or break at the base easily.

4. Areas of Ohanapecosh suitable for new campsites (based on potential hazard-trees)

During follow-up communication with the park we learned that an area in Loop G (between sites G8-G11) was under consideration for new campsite development. We believe this could coincide with the tree removal that needs to occur in Loop G due to laminated root rot (see Section 2 of this report). We strongly urge the park to remove all susceptible trees with targets within the extent of the root disease area we defined, both in the current F/G loops and around potential G-loop new campsites. We encourage the use of the data points we collected during our visit and using stump identification during hazard tree removal to further identify trees to remove (see attached “Recognizing Laminated Root Rot...” in Appendix A). Surveyors and sawyers should learn to recognize symptoms and signs of LRR on standing live or dead trees and stumps (Appendix A).

Under the USFS hazard-tree rating system, all symptomatic susceptible tree species within 25 feet of a known tree or stump infected with the laminated root rot pathogen (based on stump staining or tree signs/symptoms) are rated as high failure potentials (Filip et al. 2014, p. 16). Non-symptomatic susceptible tree species within 25 feet of a known infected tree or stump are rated as medium failure potentials (Filip et al. 2014, p. 16). We recommend removing both medium and high failure potential trees using this system based on our GPS points and the stump staining identification technique (Appendix A).

The process for removing trees using the stump identification technique is as follows:

1. Start by removing a tree confirmed to have LRR (or within 25 feet of a stump / downed tree with LRR).
2. Remove all susceptible species within a 25’ radius of stump/tree #1.
3. If stained or decayed stumps determined to be caused by LRR (see attached “Recognizing Laminated Root Rot...”) are encountered while removing trees within a 25’ radius of the original tree, then all susceptible species within a 25’ radius of those fresh stumps should be removed.
4. Repeat this process until no stumps with stain or decay associated with LRR are found.
5. Fallers should mark all LRR stumps by sawing an “X” on the stump surface; this will allow future hazard-tree surveyors to know where root disease was confirmed.

FHP personnel can provide assistance in identifying trees for removal both before and during the removal process. Trees only need to be removed if they have a target. This process requires flexibility in terms of the final number of removed trees reported in the consultation process with other disciplines/management objectives. In other words, more trees may be confirmed with LRR on the stumps as you begin to removing tree and expose stumps. You cannot know exactly how many trees will be removed prior to felling taking place. As mentioned in previous sections of this report, this will change the aesthetics of this area because species conversion is often the safest way to manage for this root disease in developed areas.

There appears to be both *Heterobasidion* root disease and *schweinitzii* root and butt rot around the H and E loops. There appeared to be space around Loop H for additional campsites, but our observations of the area between Sites H12-14 indicate severe, ongoing butt decay of both Douglas-fir and western hemlock. There are many large trees blown over and trees have been

removed in this area with severe decay evident. It is not recommended that this area be considered for additional campsite development unless many susceptible trees are removed in the area.

The inside of Loop E around and between Sites E16-20 have several old tip-ups with decayed roots. It is not recommended that these areas be developed for additional campsites. There is butt rot in the hemlock and Douglas-fir trees between Sites E14 and E17.

With initial baseline hazard-tree surveys that measure the amount of butt decay between sites H7 and H11 it may be possible to add new campsites, however, the slope in this area is fairly steep. Many trees will likely need to be removed if new targets are created. Great care needs to be taken with new construction, as it can disturb and wound already stressed trees and root systems.

5. Sensitive areas with old-growth specimen trees (inside Loop F)

The park expressed particular interest in maintaining tree vigor within the end of Loop F (Sites F3-F15) where some of the largest specimen Douglas-fir occur. We did not detect laminated root rot (LRR) on Douglas-fir inside Loop F, although it occurs not far away at Site 16 on the Loop F road. The infected tree at Site F16 likely represents the leading, visible edge of the LRR center that extends up the hillside towards Loop G.

Currently, the ground area within and around Loop F is highly disturbed with nearly complete loss of the duff (organic) layer, loss of herbaceous and shrub ground layers, and apparently-severe soil compaction (Degerman 2015). Although we did not identify LRR within Loop F, *schweinitzii* root and butt rot is present in many of these older Douglas-firs (Traci Degerman, personal communication).

If maintaining tree vigor and prolonging specimen tree life is the priority inside Loop F we recommend following the protocols devised in Degerman (2015), where critical root radius (CRR) is defined for all trees, in order to protect 100% of the CRR in campsite footprints (> 60% as recommended in Degerman 2015, according to Albers et al. 2003). One of the reasons we recommend protecting more of the CRR, possibly via construction of minimally invasive fencing/borders or by encouraging understory growth, is because tree roots are already compromised by *schweinitzii* root and butt rot in this area. If the majority of the CRR cannot be protected due to campsite(s) being comprised mostly of existing CRRs the area may need to be closed to camping and vehicle slips.

The most effective way to maintain tree vigor within Loop F is to eliminate all camping sites, parking spurs, and foot traffic within that area with specimen trees. A knee-high split rail fence, such as is seen out at the start of Loop A, could serve as a boundary around that entire area to prevent continued entry of foot traffic. In order to allow access, while limiting further physical disturbance, an elevated boardwalk could be constructed. The enclosed loop area could be given a name (e.g. – Old Growth Glade) in order to give it special significance. This would allow visitors to get up close to and enjoy the specimen trees and hopefully gain further understanding of the ecology of old growth via any interpretive signs placed along the elevated boardwalk. If a boardwalk is too expensive to build and maintain, then a well-defined foot path bordered on both sides by split-rail fencing would be the next best thing.

Site preparation and revegetation methods should be carefully considered with existing tree and root health in mind (Degerman 2015). It is unlikely that soil and vegetation restoration will be successful without permanently closing sites. In a revegetation project at a popular alpine camping area in Oregon, Cole and Spildie (2007) found only areas that were closed, scarified, amended, and seeded or transplanted recovered and had developed good plant cover after 10 years. Soil amendments with organic matter and compost did appear to have significant positive effects on soil characteristics and planting seeds and transplants increased plant cover compared to unrestored sites (Cole and Spildie 2007). However, plant cover remained at or below 10% and was significantly lower than adjacent undisturbed forest after 10 years (Cole and Spildie 2007). Their results highlight the lengthy recovery periods required (i.e. decades) and the resource

intensive restoration efforts needed to speed recovery (Cole and Spildie 2007). The Cole and Spildie (2007) document includes a general prescription for campground restoration.

If the priority is maintaining the number of campsites within Loop F, and foot and vehicle traffic continues more or less as at present, then the vigor of Douglas-fir within the loop will likely decrease over time, making them more susceptible to attacks by Douglas-fir beetle or physiological damage during severe drought periods. Other possible recommendations to minimize additional soil compaction might include removing parking slips from inside of Loop F and rerouting parking for these sites to slips near the wetland area (Sites F3, F5 and F6) that may be closed in the future to camping. Tent pads, picnic tables and walkways should be designed outside the specimen tree CRR in an effort to minimize foot traffic over the specimen trees.

6. Educational outreach

We recommend that educational outreach be incorporated into the rejuvenation and restoration process at Ohanapecosh, as well as the overall hazard-tree management program. Among the ways this could be accomplished are:

- Placement of signs or displays, both in the campground and visitor center, explaining and illustrating why large trees, or groups of trees of various sizes, were removed. This would help visitors understand the process of forest succession and the role decay plays as trees age.
 - Note: In this and other outreach efforts, such as ranger presentations, we feel it is important to emphasize that the pathogens present in Ohanapecosh Campground are native to these ecosystems and old-growth forests, they are functioning naturally when they cause tree death or failure, and that there is no ‘treatment’ that will cure what ails them. Also, that while these pathogens are native to the forest, the park cannot simply let them act here as they would in the uninhabited forest, due to the park’s responsibility to protect visitor safety to the best of its ability. Mention could be made that the park has a trained specialist who is continually evaluating tree hazards on developed sites throughout the park.
- Construction of displays in the visitor center that make use of decay conks and the decayed portions of actual trees felled as part of hazard-tree management.
- Develop illustrated, tri-fold pamphlets explaining some of the concepts of old-growth succession and the role decay organisms play in it. These can be distributed to campers and hikers.
- Interpretive signs (larger, waist-high type), such as the one next to the river explaining the history of the landslide, could be used where a detailed explanation with graphics would be best utilized. For example, explaining the life cycle, progression, and impacts of *schweinitzii* root and butt rot, laminated root rot or *Heterobasidion* root disease.
- Other types of signs (smaller, lower to the ground) could be used as reminders to not walk through areas of vegetation in order to protect and maintain a natural ground cover.
- Figures illustrating the acreage of campgrounds versus total forested acreage in the park may help visitors understand that the vast majority of the landscape will remain unchanged in MORA.
- Incorporate the above information into social media outlets such as the park’s Facebook page, web page, Twitter feed, etc.

We would be happy to work with Mount Rainier National Park to develop ideas for educational materials on forest succession and the role of fungus- and disease-caused disturbance, tree vigor and “health”, the impacts of foot traffic on vegetative cover and soils, how wounds can serve as entry points for decay, and hazard tree management as it relates to visitor safety.

Please do not hesitate to contact us if you have any questions.

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Kevin Skerl, Chief of Natural and Cultural Resources

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Figure 1. General location information of observed root disease and butt rot by FHP pathologists in July 2017. A list of diseases observed and their GPS coordinates, tree species susceptible to each disease and best-suited alternate tree species for each disease was sent and is on file with Arnie Peterson and Traci Degerman. The FHP site visit only determined the extent of laminated root rot and several additional locations of unknown mortality and decay, identified as Heterobasidion root disease and Armillaria root disease. Full campground hazard-tree surveys on file with park (Traci Degerman, Hazard Tree Management Coordinator). ARM = Armillaria root disease, Heterobasidion = Heterobasidion root disease, LRR = laminated root rot, SCHW = schweinitzii root and butt rot.

Appendix A. Recognizing laminated root rot in freshly-cut Douglas-fir stumps



Recognizing Laminated Root Rot in Freshly-Cut Douglas-fir Stumps

Laminated root rot, caused by *Phellinus weirii*, is a common root disease of Douglas-fir. Other conifer species, such as grand fir, white fir, Pacific silver fir, larch, and hemlock may also be infected and have similar patterns of stain or decay in affected wood. This guide will help you identify laminated root rot on freshly cut stumps so they can be distinguished in timber sales requiring marking.

It is important to mark infected stumps so that they can be located following site preparation (burning). When the site is replanted, tree species which are not susceptible to laminated root rot can be used around infected (marked) stumps.

In infected trees, stain and decay of laminated root rot usually extend upward from the roots several feet into the main bole. At the stump surface, stain usually will be seen as 1 to 2 inch wide crescent-shaped bands in the inner sapwood-outer heartwood area (Figure 1). Sometimes stain will also be found in the center of the heartwood (Figure 2). It will range in shade from a slightly darker color than the surrounding wood



Figure 1. One to two inch-wide, crescent-shaped bands of stained and/or decayed wood in the inner/outer heartwood.



Figure 2. Stain and decay in the inner heartwood and the sapwood.



Figure 3. Stain appearing as a light shade of discoloration.



Figure 4. Stain appearing as a dark-brown discoloration.



Figure 5. Decayed wood surrounded by stain. Decay is laminated, separating at the annual rings.



Figure 6. Laminated and pitted decayed wood with red-brown fuzzy fungal growth.



Figure 7. This stain and decay is the result of an old wound. It is not laminated root rot. **Do not mark this stump.**



Figure 8. Brown cubical decay, the result of another disease. **Do not mark this stump.**



Figure 9. Example of marking infected stumps: two parallel grooves, 2 inches deep, and 6 inches apart.

(Figure 3), to a dark brown, wet-appearing discoloration (Figure 4). Stumps must be marked soon after tree felling since characteristic stain fades within several days. Stain is the initial stage of wood decay. After several years stained wood will develop into advanced rot. Advanced decay will often be found in the center of stained wood (Figure 5). Advanced decay is characterized by wood separating (delaminating) at the annual growth rings. There are small pits on both sides of the sheets and red-brown fuzzy fungal growth on the surface (Figure 6). In infected older trees, hollows will often form in the butt after years of decay.

The size of laminated root rot disease centers can vary from one tree to hundreds or thousands of trees. Usually if one stained stump is found, stain will be found also in one or more adjacent stumps.

Other stains or decays may be confused with laminated root rot. Old wounds that heal often leave a zone of stain or decay behind the wound face (Figure 7). Other types of root and butt decay may be confused with laminated root rot. A common example is red-brown butt rot of Douglas-fir (Figure 8). This damage is common in mature-over-mature Douglas-fir. Stumps with this dry-crumblly red-brown decay should not be marked. To best meet contract specifications, stumps with laminated root rot stain or decay at the cut surface should be marked with a saw within one hour of felling. Stumps should be marked by making two parallel grooves, 2 inches deep and 6 inches apart (Figure 9).

For further information, contact:
USDA Forest Service, Pacific Northwest Region
Forest Insects and Diseases
P.O. Box 3623, Portland, OR 97208
Phone: (503) 808-2997
<http://www.fs.fed.us/r6/fid/>

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APPENDIX C:

DESIGN GUIDELINES

ILLUSTRATED FIELD REFERENCE

Ohanapecosh Campground, Mount Rainier National Park

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UNIFYING THEMES



These design guidelines are informed by several key unifying design themes that contribute to the Ohanapecosh Campground's sense of place:

- Planning and design for the campground is undertaken holistically, with interdisciplinary consultation.
- A variety of camping experiences are provided for visitors of all abilities, ranging from large and small group sites for gatherings to more secluded, primitive sites.
- The campground is nestled in an old-growth forest and dominated by towering conifers that encourage an understory of fallen logs and a lush undergrowth of shade- and moisture-loving trees, shrubs, ferns, and mosses.
- The site's topography and hydrology shape the location and configuration of campground developments. These natural systems are dynamic and require a proactive and flexible response from managers and planners to relocate facilities, if needed, for safety and resource protection.
- Campsites and parking areas are located on relatively level or gently sloping terrain to minimize ground disturbance. Limiting ground disturbance is critical to protecting archeological resources, vegetation, and hydrological patterns.
- Siting of new campsites and reconfiguration of existing campsites take advantage of previously disturbed areas, wherever possible.
- New campsites and the reconfiguration of existing campsites avoid wetland and drainage areas. Buffers are established between existing campground developments and riparian and wetland areas.
- Maximize opportunities to consolidate parking in order to reduce the impact of parking within the campground.
- Preserve the historic characteristics of Mission 66 master planning in the spatial arrangement of one-way campground loop roads, with a herringbone pattern of individual campsites and parking spurs on each side of the road.
- All buildings, structures, and site features are responsive to the forested character of the landscape and designed to harmonize with the natural setting, consistent with CCC and Mission 66 design principles as applied in the campground.

ENVIRONMENTAL CONTEXT



- The design and construction of new facilities should respond to the climatic and topographical conditions of the site to allow passive climate-control strategies, including shade, ventilation, and insulation.
- Facility design and maintenance will take snow and ice management into account in planning for winter access, visitor safety, and structural integrity.
- The development of new facilities and maintenance of existing facilities will be undertaken in a manner that avoids impacts to state or federally listed threatened or endangered species.



OPPOSITE, TOP: The campground's towering conifers. Source: thecampingview.com.

OPPOSITE, MIDDLE: A typical campsite in the campground. Source: visitrainier.com.

OPPOSITE, BOTTOM: Construction of a comfort station in the campground, 1934. Source: NPS.

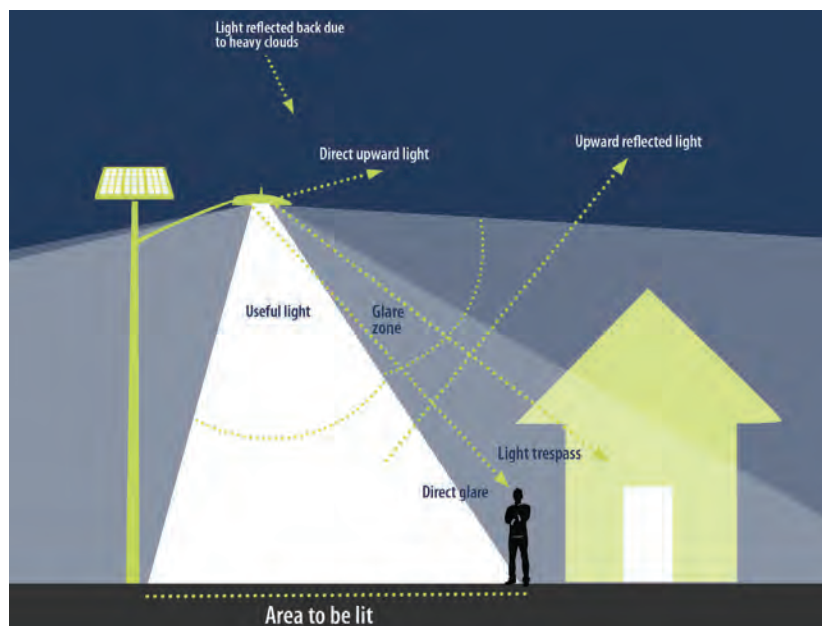
THIS PAGE, TOP LEFT: The campground's forested setting, E loop, 2017. Source: NPS.

THIS PAGE, MIDDLE LEFT: The Mission 66-era Visitor Center, 2009. Source: visitrainier.com.

THIS PAGE, BOTTOM LEFT: One of the campground's CCC-era comfort stations, A loop, 2017. Source: NPS.

THIS PAGE, ABOVE: Ohanapecosh River, looking east (upstream) from the bridge, 2017. Source: NPS.

SOUNDSCAPES, LIGHTSCAPES, + AIR QUALITY



- Take actions to monitor and minimize or prevent unnatural sounds that adversely affect park resources and values, including visitors' enjoyment.
- Minimize noise generated by NPS management activities. Consider noise in the procurement and use of equipment within the campground.
- Collaborate with visitors to find ways to prevent or minimize the intrusion of artificial light into the night scene, including encouraging night-sky friendly flashlights.
- Limit artificial outdoor lighting in the campground to basic safety requirements. Where possible, shield artificial lighting or change lamp types to reduce impacts.
- To avoid unnecessary extra campfire smoke, ensure that only dry, seasoned wood is burned for campfires, and ensure that visitors completely extinguish fires when finished.
- To improve summer air quality, reduce the number of individual campfire pits in the campground over time. Begin by removing fire pits from smaller, more primitive campsites. Plan in the long-term for fewer, more centralized campfire facilities.
- Conduct interpretive outreach to educate visitors about the health impacts associated with campfire smoke and encourage them to limit burn time or eliminate use of campfires altogether.

Protecting the night sky starts with **YOU!**

1 Light only what you need 	2 Use energy efficient bulbs and only as bright as you need 	3 Shield lights and direct them down
4 Only use light when you need it 	5 Choose warm white light bulbs 	6 Join IDA! We need your help to continue the fight against light pollution.

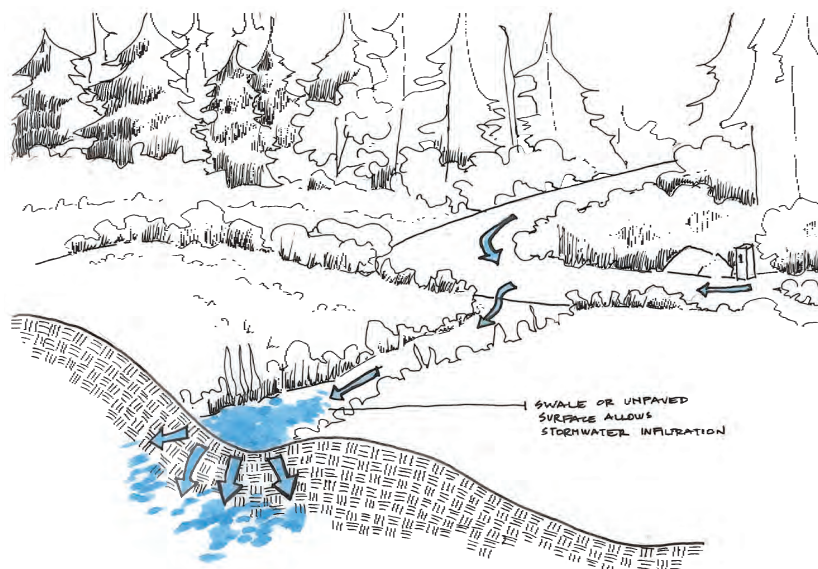


TOP: Diagram illustrating how light pollution occurs. Source: <http://conxcorp.com/understanding-light-pollution/>.

MIDDLE: Best practices for night sky protection. Source: darksky.org.

BOTTOM: To improve air quality, the park should reduce the number of individual fire pits and increase the distance between those that are located especially close together, such as these in C loop, 2017. Source: NPS.

RIVER SYSTEMS + WETLAND AREAS



- Ensure that any new developments consider the potential migration of the Ohanapecosh River and its tributary streams.
- Ensure that all new developments do not adversely affect Wild and Scenic River values for the Ohanapecosh River.
- New development, maintenance, and repairs will not alter the course of natural drainages.
- Avoid alterations to surface water drainage, and if unavoidable, ensure that alterations will not result in erosion.
- New developments or repairs of paved or otherwise impervious surfaces (for example, roads and parking areas) will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- To protect aquatic resources, provide a vegetated buffer that is as wide as practically feasible adjacent to all riparian areas in the campground. Optimal buffer widths depend on stream, soil, and vegetation type and range from 25 to 150 feet. To determine appropriate buffer sizes, campsites should be evaluated on a case-by-case basis with the park's historical landscape architect, plant ecologist, and aquatic resources specialist.

TOP: Optimal riparian conditions upstream of campsite C-27, 2017. Source: NPS.

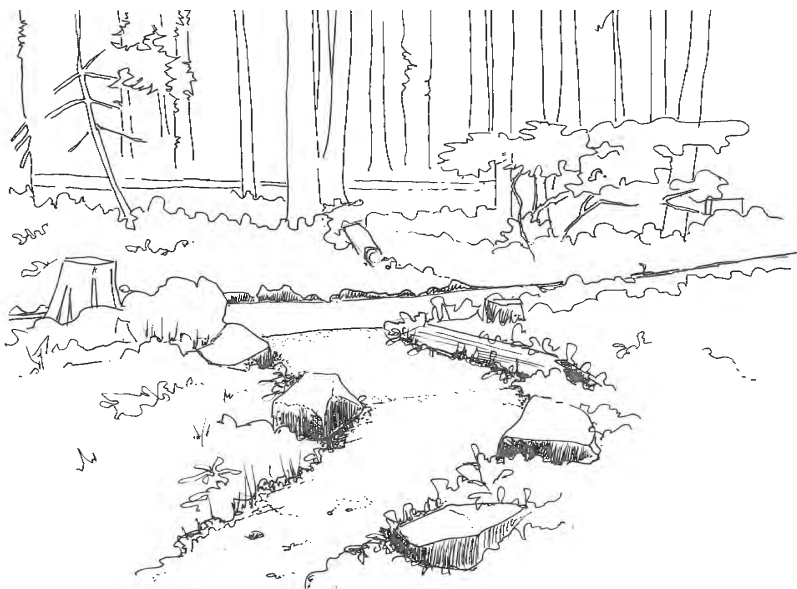
MIDDLE: A vegetated buffer is needed between campsites, roads, and trails and all streams and wetlands. Source: B. Anderson, NPS.

BOTTOM: Runoff from stormwater and snow melt should be directed away from riparian and wetland areas, campsites, and paved areas and directed toward swales or unpaved areas. Source: B. Anderson, NPS.

RIVER SYSTEMS + WETLAND AREAS



- At streamside campsites, where the banks are heavily used, create established access points at key locations to concentrate visitor use. Select areas that are popular for existing features such as boulders or a gravel bank, and look for points that may already have a social trail leading to them. Create barriers at all other locations to encourage vegetation and discourage use. Barriers could consist of fallen logs or woody debris arranged in an overlapping, or “jackstraw,” pattern.
- To protect aquatic resources, the siting of all new development should avoid wetland areas. To determine appropriate wetland buffer sizes, any potential new development and adjacent wetland areas should be evaluated on a case-by-case basis with the park’s historical landscape architect, plant ecologist, and aquatic resources specialist. Development within this sensitive area would be extremely limited and would not occur without interdisciplinary evaluation.
- For existing campsites near wetland areas, provide a vegetated buffer that is as wide as practically feasible. Optimal buffer widths depend on wetland, soil, and vegetation type and range from 25 to 300 feet. To determine appropriate buffer sizes, campsites should be evaluated on a case-by-case basis with the park’s historical landscape architect, plant ecologist, and aquatic resources specialist.

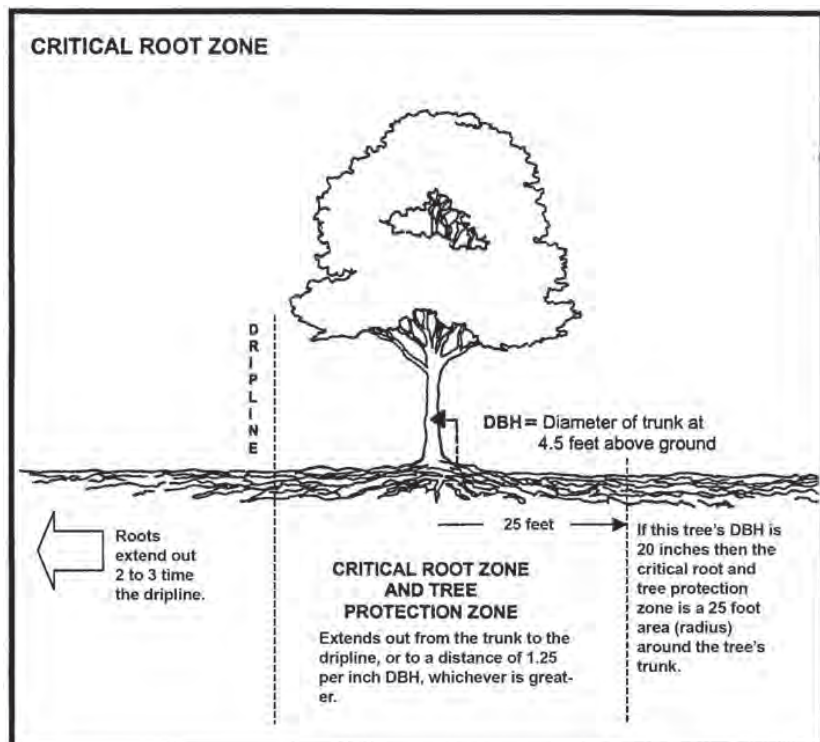


TOP: Large woody debris in a “jackstraw” pattern, used to protect a stream bank and improve habitat. Source: fishbio.com.

MIDDLE: Campsite C-27 adjacent to stream, with significant loss of vegetation. This campsite was closed in 2017, shortly after this photo was taken. Source: NPS.

BOTTOM: Campsite C-27 could be converted into a concentrated stream access point, allowing vegetation restoration elsewhere along the banks. Source: B. Anderson, NPS.

VEGETATION



- Vegetation species within the campground should reflect the species composition of the surrounding forest (see Suggested Species for Revegetation).
- Campground vegetation should include the full forest complement of upper canopy trees, mid-canopy trees, mid-canopy shrubs, understory shrubs, and understory forbs.
- New facilities should be sited to avoid damage to existing healthy vegetation. New construction should be undertaken carefully to avoid disturbing trees and root systems.
- Wherever possible, ensure that at least 60% but optimally 100% of the critical root zone of all trees is protected by encroachment from visitor use. The critical root zone corresponds to the dripline of the tree's canopy and contains the most critical areas of its root system. Avoid locating tents, picnic tables, fire rings, and parking spaces within this area.
- Continue to survey campground for hazard trees and regularly monitor for root and butt rot. For monitoring guidance, refer to "Ohanapecosh Campground Hazard Tree Observations and Vegetation Management Plan Recommendations," "Preliminary Rehabilitation and Revegetation Plan for the Ohanapecosh Campground, Mount Rainier National Park," and the 2010 *Mount Rainier National Park Hazard Tree Management Plan and Environmental Assessment*.
- Before any tree removal occurs, evaluate each tree for potential to be made into a habitat tree or snag feature for wildlife. Not all trees will be suitable for this treatment, therefore consult with the park's plant ecologist and ecologist.

TOP: The campground's forested setting, G loop, 2017. Source: NPS.

MIDDLE: Vegetation conditions in areas of the campground not affected by trampling and compaction, 2017. Source: NPS.

BOTTOM: Critical root zone. Source: Athens/Clark County, Georgia. Unified Government standards for calculating Critical Root Zones.

VEGETATION



SUGGESTED SPECIES FOR REVEGETATION

1. Douglas-fir (*Pseudotsuga menziesii*), upper canopy tree
2. Western hemlock (*Tsuga heterophylla*), upper canopy tree
3. Western red cedar (*Thuja plicata*), upper canopy tree
4. Bigleaf maple (*Acer macrophyllum*), mid-canopy tree
5. Red alder (*Alnus rubra*), mid-canopy tree
6. Vine maple (*Acer circinatum*), mid-canopy shrub
7. Red huckleberry (*Vaccinium parvifolium*), mid-canopy shrub
8. Thimbleberry (*Rubus parviflorus*), mid-canopy shrub
9. Devil's club (*Oplopanax horridus*), mid-canopy shrub
10. Salal (*Gaultheria shallon*), understory shrub
11. Dwarf Oregon grape (*Berberis nervosa*), understory shrub

SOURCES:

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5. Washington Native Plant Society, http://www.wnps.org/plantimages/alnus_rubra.html
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11. Washington Native Plant Society, http://www.wnps.org/plants/mahonia_nervosa.html

VEGETATION



SUGGESTED SPECIES FOR REVEGETATION

12. Bracken fern (*Pteridium aquilinum*), understory forb
13. Sword fern (*Polystichum munitum*), understory forb
14. Blackcap raspberry (*Rubus leucodermis*), understory forb
15. Vanilla leaf (*Achlys triphylla*), understory forb
16. Twinflower (*Linnaea borealis*), understory forb
17. Bunchberry (*Cornus unalaschensis*), understory forb
18. Foamflower (*Tiarella trifoliata*), understory forb
19. Fragrant bedstraw (*Galium triflorum*), understory forb

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ABOVE: *Phaeolus schweinitzii* sporophore emerging from an old-growth Douglas-fir in H loop, 2014. The fungus causes Schweinitzii root and butt rot. Source: T. Degerman, NPS.

OPPOSITE: Instructions for recognizing laminated root rot in recently cut Douglas-fir stumps. Source: Appendix A, "Ohanapecosh Campground Hazard Tree Observations and Vegetation Management Plan Recommendations," U.S. Forest Service, 2017.

- Trees removed for hazard mitigation should be replaced one-for-one. In areas susceptible to pathogens, follow guidance below.
 - In areas where trees are infected with laminated root rot, in particular for loops G and F, plan for the long-term management of the disease by removing all Douglas-fir and shifting composition to more disease-tolerant species. Laminated root rot cannot be safely managed by removing trees only as they display symptoms, die, or fall. For loops F and G and the adjacent stream, do not attempt to protect or preserve old-growth specimen Douglas-fir. Species that are more resistant to laminated root rot include western red cedar, western hemlock, and hardwoods (see Suggested Species for Revegetation). See Recognizing Laminated Root Rot.
 - Schweinitzii root and butt rot should continue to be monitored by internal decay detection methods on large Douglas-fir trees throughout the campground, as trees do not have to be immediately removed if some decay is detected. In areas where Schweinitzii root and butt rot are observed, discourage the regrowth of Douglas-fir and select for and regenerate more disease-resistant species, including western red cedar, western hemlock, and hardwoods.
 - In areas where trees are infected with Heterobasidion root disease (HRD) and Armillaria root disease (ARD), encourage growth of resistant species such as Douglas-fir, western red cedar, and hardwood species. HRD and ARD have been detected in areas in C loop (sites C-10, C-26, C-33) and around the amphitheater.
- Avoid allowing freshly cut or fallen Douglas-fir logs to build up on the ground in a single season, as this increases the chance that Douglas-fir beetles will infest the logs and emerge the next season to attack live Douglas-fir trees. The following guidelines (page 12) describe how to dispose of the fallen wood.



Recognizing Laminated Root Rot in Freshly-Cut Douglas-fir Stumps

Laminated root rot, caused by *Phellinus weirii*, is a common root disease of Douglas-fir. Other conifer species, such as grand fir, white fir, Pacific silver fir, larch, and hemlock may also be infected and have similar patterns of stain or decay in affected wood. This guide will help you identify laminated root rot on freshly cut stumps so they can be distinguished in timber sales requiring marking.

It is important to mark infected stumps so that they can be located following site preparation (burning). When the site is replanted, tree species which are not susceptible to laminated root rot can be used around infected (marked) stumps.

In infected trees, stain and decay of laminated root rot usually extend upward from the roots several feet into the main bole. At the stump surface, stain usually will be seen as 1 to 2 inch wide crescent-shaped bands in the inner sapwood-outer heartwood area (Figure 1). Sometimes stain will also be found in the center of the heartwood (Figure 2). It will range in shade from a slightly darker color than the surrounding wood



Figure 1. One to two inch-wide, crescent-shaped bands of stained and/or decayed wood in the inner outer heartwood.

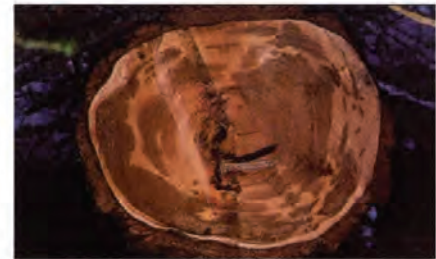


Figure 2. Stain and decay in the inner heartwood and the sapwood.



Figure 3. Stain appearing as a light shade of discoloration.

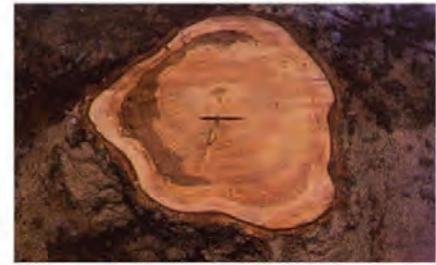


Figure 4. Stain appearing as a dark-brown discoloration.



Figure 5. Decayed wood surrounded by stain. Decay is laminated, separating at the annual rings.



Figure 6. Laminated and pitted decayed wood with red-brown fuzzy fungal growth.



Figure 7. This stain and decay is the result of an old wound. It is not laminated root rot. Do not mark this stump.



Figure 8. Brown cubical decay, the result of another disease. Do not mark this stump.



Figure 9. Example of marking infected stumps: two parallel grooves, 2 inches deep, and 6 inches apart.

(Figure 3), to a dark brown, wet-appearing discoloration (Figure 4). Stumps must be marked soon after tree felling since characteristic stain fades within several days. Stain is the initial stage of wood decay. After several years stained wood will develop into advanced rot. Advanced decay will often be found in the center of stained wood (Figure 5). Advanced decay is characterized by wood separating (delaminating) at the annual growth rings. There are small pits on both sides of the sheets and red-brown fuzzy fungal growth on the surface (Figure 6). In infected older trees, hollows will often form in the butt after years of decay.

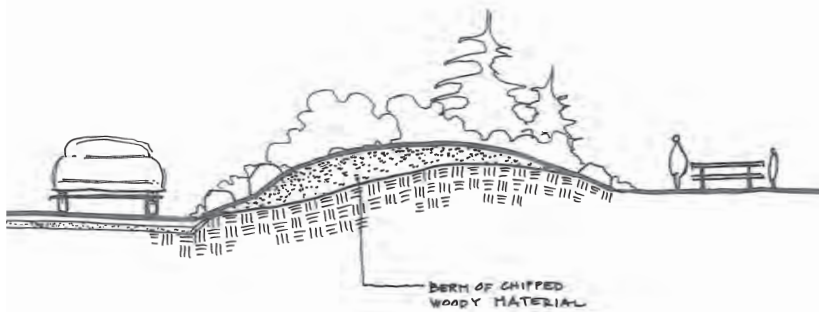
The size of laminated root rot disease centers can vary from one tree to hundreds or thousands of trees. Usually if one stained stump is found, stain will be found also in one or more adjacent stumps.

Other stains or decays may be confused with laminated root rot. Old wounds that heal often leave a zone of stain or decay behind the wound face (Figure 7). Other types of root and butt decay may be confused with laminated root rot. A common example is red-brown butt rot of Douglas-fir (Figure 8). This damage is common in mature-over-mature Douglas-fir. Stumps with this dry-crumbly red-brown decay should not be marked. To best meet contract specifications, stumps with laminated root rot stain or decay at the cut surface should be marked with a saw within one hour of felling. Stumps should be marked by making two parallel grooves, 2 inches deep and 6 inches apart (Figure 9).

For further information, contact:
USDA Forest Service, Pacific Northwest Region
Forest Insects and Diseases
 P.O. Box 3623, Portland, OR 97208
 Phone: (503) 808-2997
<http://www.fs.fed.us/r6/fid/>

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VEGETATION



- Fallen Douglas-fir logs can be used in riparian restoration projects throughout the park.
- If it is impossible to remove fallen Douglas-fir from the campground in a timely fashion, de-bark the logs to reduce the risk of beetle infection.
- Douglas-fir logs can also be burned in piles.
- As a last resort, apply anti-aggregation pheromone packets (called MCH) around logs to prevent beetles from colonizing. This pheromone has been applied at Ohanapecosh in the past but requires funding and pesticide paperwork. For guidance on using MCH, please contact the U.S. Forest Service Wenatchee Service Center for Forest Health Protection.
- Windfall and felled trees that are not Douglas-fir, including western red cedar and western hemlock, could be repurposed for trail and campsite delineation or can be chipped to create berms. Berming can provide delineation and privacy between campsites and trails and will also result in long-term soil improvement. Any chipped woody material that is used should come from within the campground or surrounding forest. Berm or mound construction should be supervised by the park's historical landscape architect, and placement should avoid the root zones of existing trees.

TOP: Chipped woody material can be used to create or augment berms to provide a sense of seclusion for campsites. Source: B. Anderson, NPS.

MIDDLE: Desired conditions along pathways, with thimbleberry plants creating screening, 2017. Source: NPS.

BOTTOM: Desired conditions between campsites, with young western hemlock trees, 2017. Source: NPS.

VEGETATION



- Vegetated buffers and/or woody debris (as appropriate) should be maintained or established between campsites; alongside roads, trails, and paths; and adjacent to riparian and wetland areas. Buffers should be as wide as practically feasible. Ensure that woody debris is disease-free and sourced from within the campground or the surrounding forest.
- Plantings between campsites should provide screening and should include species such as vine maple (*Acer circinatum*) that are relatively tall and possess a dense growth habit.
- Plantings alongside roadways and trails should be restricted to understory shrubs and forbs to maximize visibility and safe circulation.
- Fallen and/or decomposing logs, coarse woody debris, and/or boulders should be used to delineate trails and campsites and protect vegetated buffers. Consider the following factors when delineating trails, campsites, and vegetation:
 - Ensure that logs and woody debris are disease-free; avoid repurposing freshly cut or fallen Douglas-fir logs (see previous guidance).
 - Logs should have a minimum diameter of 2 feet. The decaying organic matter will additionally nourish new plantings and provide a seedbed for future plant regeneration.

TOP: Existing campsite without tree root protection, 2017. Source: NPS.

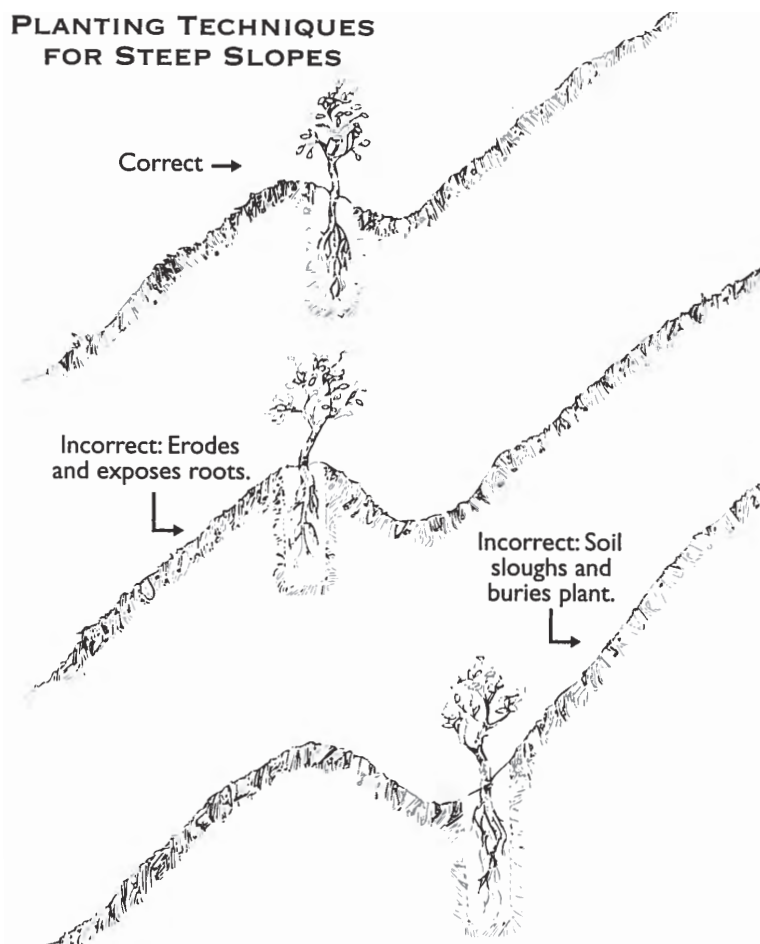
MIDDLE: Campsite with critical root zones protected by boulder and log edging. Source: B. Anderson, NPS.

BOTTOM: An example of desired conditions between campsites or alongside parking spaces, created by delineating vegetated areas (in this case vine maple) with fallen logs; 2017. Source: NPS.

VEGETATION



PLANTING TECHNIQUES FOR STEEP SLOPES



- In areas with tree roots, an unevenly spaced arrangement of boulders is preferable as it allows the roots to move and grow. Boulders are also suitable for areas requiring some slope retention, and they should be carefully arranged to avoid a regular pattern. Ensure that logs and boulders are partially buried for a more natural appearance.
- Soil in areas identified for revegetation should be decompacted, or scarified, to allow for successful seedling establishment. Scarify soil with hand tools to reduce the risk of damage to tree roots. Small picks and spades should be used closer to the tree trunk; Pulaskis are only suitable for areas at the edge of the critical root zone.
- Protection from trampling and soil scarification may be enough to allow the natural regeneration of vegetation in some areas of the campground. In areas where soil has become especially compacted or in areas without sufficient seed rain, replanting is needed to restore understory health. Active replanting should also take place in the most accessible and heavily used areas of the campground.
- Before replanting, incorporate organic matter into soil to improve soil structure, biodiversity, and fertility. Duff and surface debris from the surrounding forest are recommended sources of organic matter.

TOP: Work in the campground, including soil scarification, should be undertaken with hand tools to avoid damaging tree roots. Source: Student Conservation Association, *Lightly on the Land*, 2005.

BOTTOM: Recommended techniques for planting seedlings on slopes. Source: Student Conservation Association, *Lightly on the Land*, 2005.

VEGETATION



- Groundcovers and understory species suitable for erosion control should be established on campground slopes to protect the soil. Depending on exposure and moisture, suitable species could include vine maple, thimbleberry, salal, Oregon grape, and sword fern (see Suggested Species for Revegetation).
- Building foundations should be softened by groupings of native understory and groundcover vegetation similar to that which is found in the surrounding forest.
- Campground vegetation should be monitored annually for exotic plant species, and control measures implemented if any are discovered.

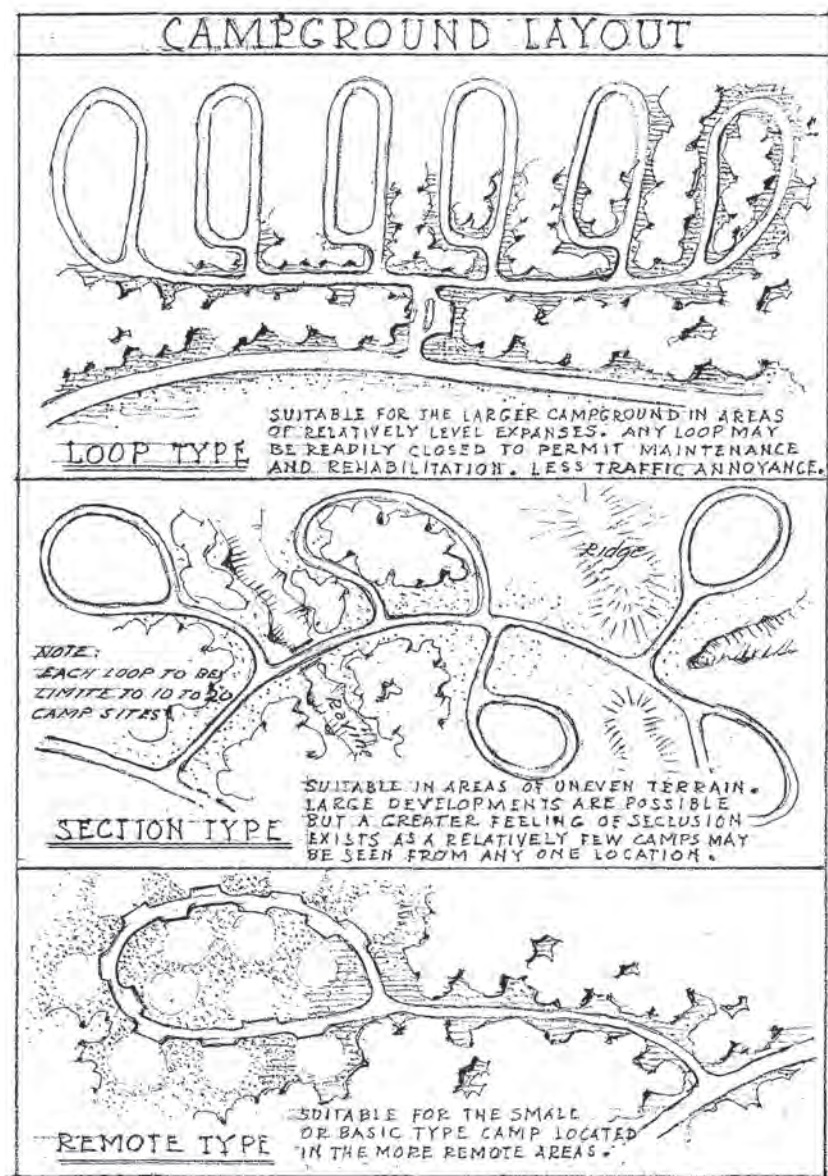


TOP: Desired edge conditions along a slope between a campsite and the road, C loop, 2017. Source: NPS.

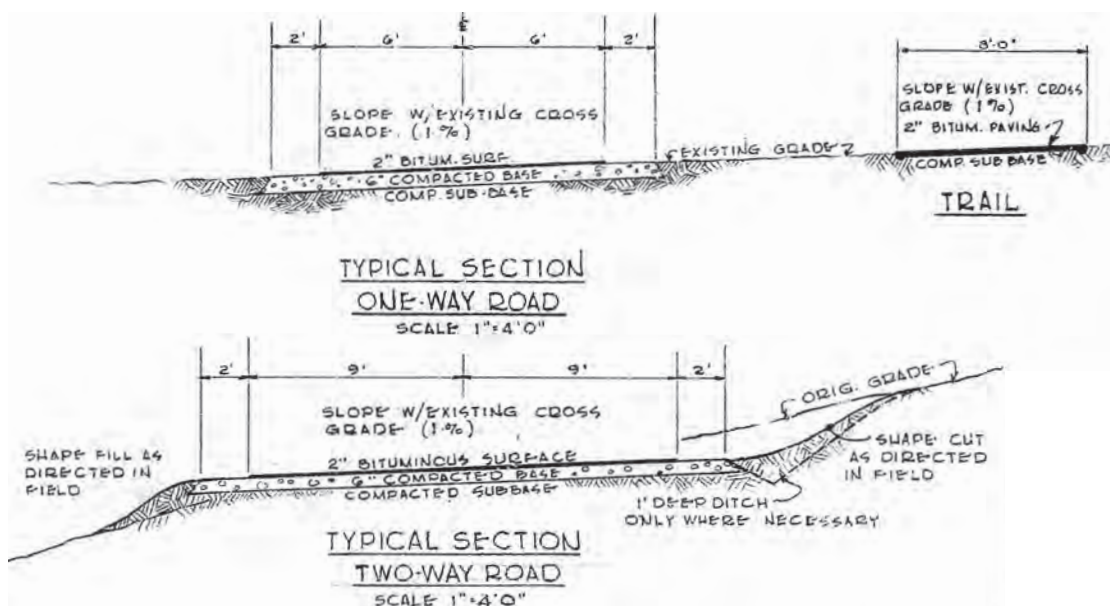
MIDDLE: 1927 photograph showing CCC-era foundation plantings of native sword fern around the Longmire Community Building, Mount Rainier National Park. Source: Tahoma Woods Archives, NPS.

BOTTOM: Example of foundation plantings using native plants, National Park Inn, Longmire, 2003. Source: NPS.

ROADS



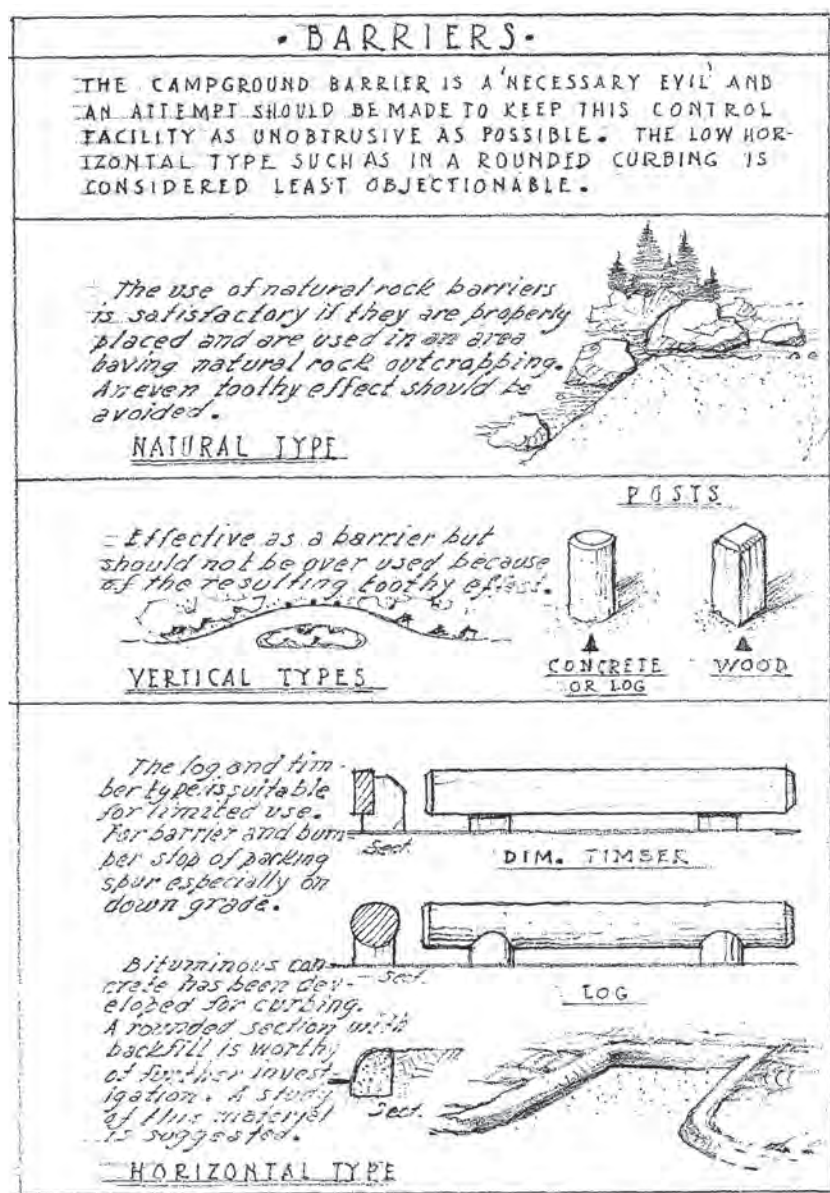
- Retain historic land uses within the campground. These include camping and vehicle and pedestrian circulation.
- Retain the historic characteristics of the campground's CCC and Mission 66 spatial organization, in particular the layout of looped one-way campground roads with angled parking spurs.
- Ensure that the alignment of roads in the campground continues to respond to surrounding topography and natural features. In adjusting or relocating alignments, consider the driver's visual experience when traveling through the campground.
- Retain the visitor center as a key destination that provides a sense of arrival into the Ohanapecosh Developed Area. Retain the historic use of the visitor center for park and campground information and interpretation.
- Retain asphalt paving treatment for campground entrance and loop roads.
- Ensure that paving is installed to meet the existing grade of the surrounding landscape. In areas where the surrounding grade is significantly lower than the paved surface, grade the edge of the adjacent gravel or soil to ensure a smooth transition between the two materials.



OPPOSITE: Road system plan for Mission 66 Ohanapecosh Campground expansion, 1959. Source: NPS.

TOP: Mission 66 campground layout options proposed by the National Park Service Western Regional Office. Source: Campground Study, 1959.

BOTTOM: Details from road system plan, Ohanapecosh Campground. Source: NPS.



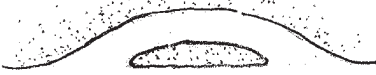
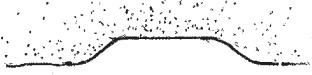
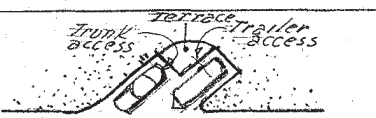
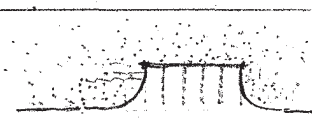
- In areas where informal parking occurs on road shoulders, install log barriers, boulders, and/or sturdy plantings to protect adjacent vegetation and soils.
- Keep impervious paved surfaces to the minimum required for current use and cultural landscape preservation.
- New developments or repairs of paved road surfaces will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- Ensure that any work undertaken with bridges and culverts is approved and supervised by the park's historical landscape architect.
- Where campground roadways provide an accessible route between accessible campsites and comfort stations, ensure a firm and stable surface with a running slope no steeper than 1:20 (5%) and a cross slope no greater than 1:48 (2%).
- Retain historic parking spur arrangement along loop roads. Where new parking areas need to be added, preserve herringbone pattern of angled spurs to the extent possible. Avoid the creation of parallel or pull-over parking spaces.
- Individual campsite parking spurs should be defined and constrained to 12 feet wide for "single-spur" sites and 20 feet wide for accessible sites. "Double-spur" sites occur less frequently in the campground, but where they exist they should measure approximately 24 feet wide and clearly reflect a staggered pattern.



TOP: Mission 66 barrier designs for roads and parking areas, proposed by the National Park Service Western Regional Office. Source: *Campground Study*, 1959.

BOTTOM: Fallen logs can serve as an effective barrier along roads, protecting vegetation. Source: NPS.

PARKING

CAMPSITE PARKING	
 LOOP Suitable for car or car and trailer use. Easy access. Island permits plant screening for privacy.	 PARALLEL For use in basic type camps or where natural features limit depth.
 ARC A variation of parallel, permits easier maintenance by equipment.	 SINGLE SPUR Suitable where trees or rocks restrict space.
 DOUBLE SPUR Suitable for trailer or two family use.	 MULTIPLE For group camp or for the walk in type of camp.
 TRIANGLE Permits parallel or diagonal parking from either direction.	 FAN For trailer use. Car and trailer form a screen for the stabilized soil terrace.

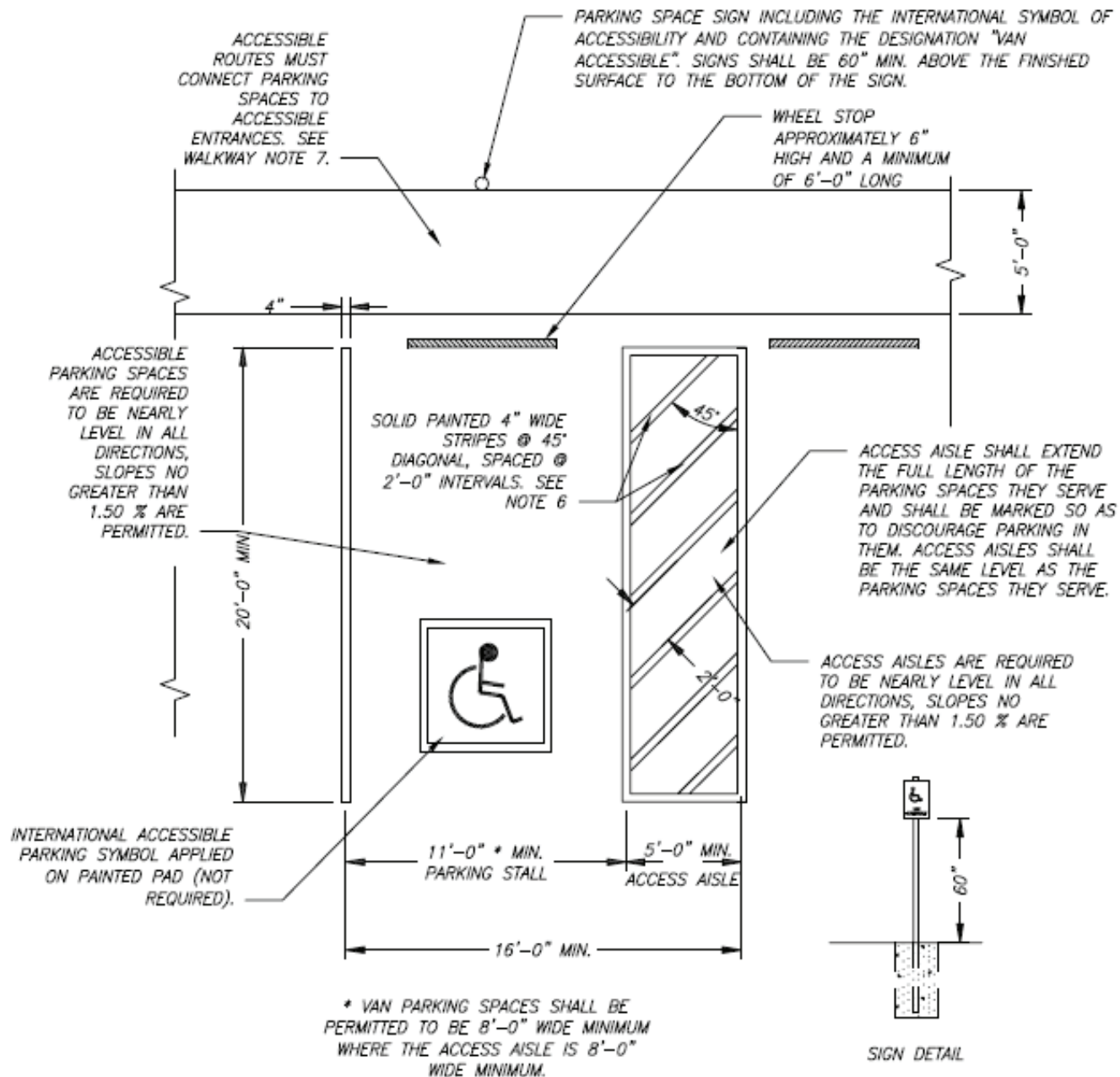
- Campsite parking areas should be signed and should clearly correspond to the appropriate campsite.
- Ensure that each group parking area is a minimum of 25 feet deep to allow 90-degree pull-in parking. For each group parking area, provide one 8-foot-wide accessible van site and 8-foot-wide aisle in addition to the other provided parking spaces. Provide signage and striping to indicate the location of the van accessible site and aisle. See Signage: Campsite Identification section.
- Day-use parking areas should be striped to ensure maximum parking efficiency. For all day-use parking areas, provide at minimum one 8-foot-wide accessible van site with 8-foot aisle.
- Parking spaces should have a firm and stable parking surface. Wherever possible, ensure cross slopes do not exceed 1:48 (2%). Accessible parking areas require a maximum 2% cross slope. Consult the Architectural Barriers Act Accessibility Standards for guidance on other accessibility requirements for parking spaces.
- Parking areas should be edged by large fallen logs or boulders. Existing wooden bollards should be removed and replaced with fallen logs or boulders.
- New developments or repairs of impervious paving surfaces will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.



TOP: Mission 66 parking designs proposed by the National Park Service Western Regional Office. Source: *Campground Study*, 1959.

BOTTOM: Existing parking area delineated by fallen logs, E loop, 2017. Source: NPS.

PARKING



NOTES:

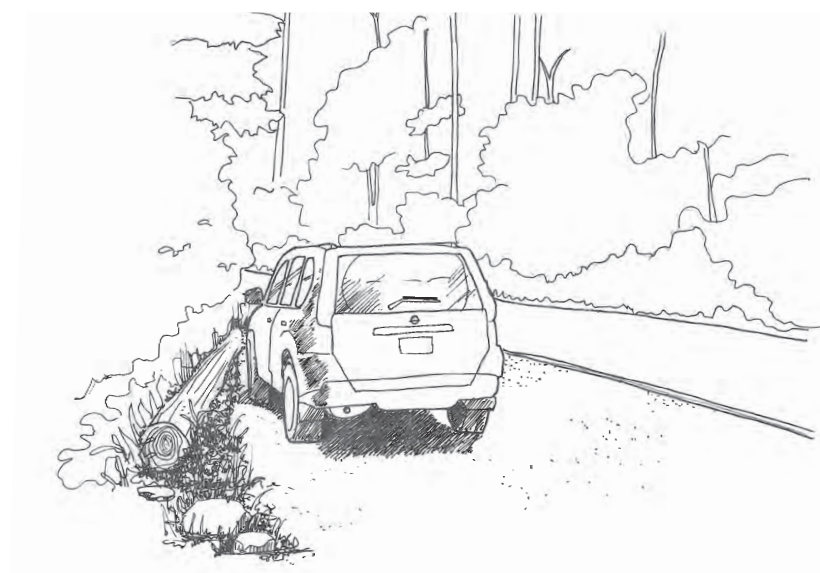
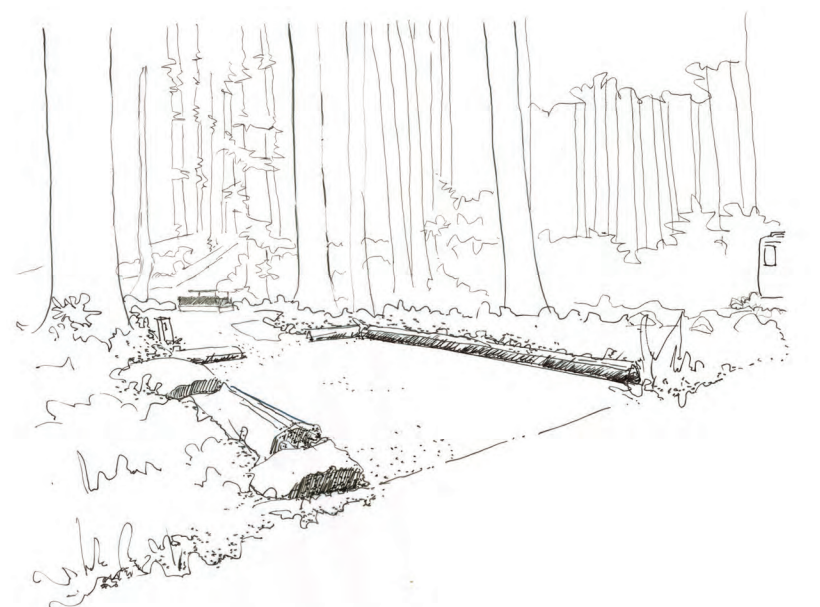
1. THESE FIGURES ARE CONCEPTUAL LAYOUTS
2. FIGURES ARE NOT TO SCALE
3. NOT TO BE USED AS CONSTRUCTION DRAWINGS
4. DESIGNER WILL CONFIRM COMPLIANCE WITH DESIGN CODES, ABAAS, AND ACCESSIBILITY COORDINATOR
5. PARKING AND WALKWAY SURFACE CAN BE CONCRETE OR ASPHALT
6. THE METHOD AND COLOR OF MARKING ARE NOT SPECIFIED BY THESE REQUIREMENTS BUT MAY BE ADDRESSED BY STATE OR LOCAL LAWS OR REGULATIONS. BECAUSE THESE REQUIREMENTS PERMIT THE VAN ACCESS AISLE TO BE AS WIDE AS THE PARKING SPACE, IT IS IMPORTANT THAT THE AISLE BE CLEARLY MARKED.
7. WALKWAY TO HAVE LESS THAN 1.50% CROSS SLOPE AND 4.50% RUNNING SLOPE.

FIGURE G-2: VAN ACCESSIBLE PARKING SPACE

PARKING



- The use of heavy equipment for construction or rehabilitation of parking areas should be limited due to impacts on the critical root zones of campground trees.
- In areas where informal parking occurs on road shoulders, such as in loop A, install log barriers to protect vegetation and soils. Provide signage indicating that shoulder parking is temporary (5- to 10-minute duration).



OPPOSITE: Conceptual layout for a van-accessible parking space. Note that the width of the space can be 8 feet if an 8-foot aisle is provided. Overall width must be 16 feet. Source: Bureau of Reclamation, 2013.

TOP: An ill-defined parking area in loop A, 2017. Source: NPS.

MIDDLE: Recommended delineation for campsite parking using logs and boulders. Source: B. Anderson, NPS.

BOTTOM: Desired conditions along roadsides for informal parking areas, where adjacent vegetation is protected by log barriers or boulder edging, 2017. Source: B. Anderson, NPS.

TRAILS + PATHWAYS



- Pathway width, material, and edging treatment should clearly identify pedestrian-only routes and should help visitors understand the hierarchy of pedestrian circulation in the campground, allowing for easy and logical wayfinding with a minimal number of directional signs.
- Retain the naturalistic characteristics of historic paths within the campground.
- Routes to and from all accessible facilities should be firm and stable. All other paths should be firm and stable wherever feasible.
- Wherever possible, paths should be designed to meet current accessibility standards. Accessibility standards apply to three different types of pathways in the campground: accessible routes, hiking trails, and outdoor recreation access routes (ORARs). Of these, ORARs are the most prevalent. An ORAR is defined as the pedestrian route that connects accessible elements, spaces, and facilities within camping and picnic facilities and at viewing areas and trailheads. Consult the *Architectural Barriers Act Accessibility Standards* for guidance on accessibility requirements, hiking trails, and ORARs.
- Path materials should vary according to the size, location, and purpose of the path. Depending on the path, appropriate surface materials might include asphalt, forest duff, or a pervious surface that can be compacted to meet accessibility standards. Boardwalks may be suitable especially for resource-sensitive areas near wetlands, streambanks, and tree roots.

TOP: Asphalt path leading to amphitheater, 2017.
Source: NPS.

MIDDLE: Newly resurfaced campsite, 2017; forest duff begins to accumulate in the compacted gravel. Source: NPS.

BOTTOM: Boardwalk pathways such as those at the Grove of the Patriarchs (seen here) are a suitable option for areas with sensitive resources (e.g., old-growth trees and wetland/riparian areas). Source: visitrainier.com.

TRAILS + PATHWAYS

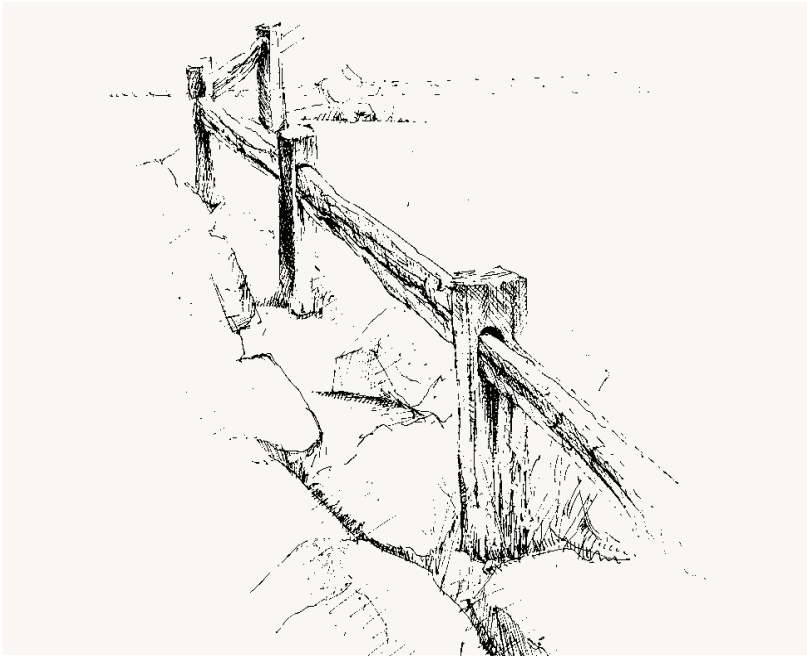


- Wherever feasible, use pervious, compacted granular material for path surfaces, installed on a compacted subgrade to encourage stormwater infiltration. In some areas it may be appropriate to incorporate an integral stabilizer to ensure accessibility. Before initiating a new surfacing project, consider creating a test plot to test color choice and durability.
- Avoid the installation of materials that may pose safety risks in the campground's damp and shady environment. For example, exposed aggregate concrete collects debris and encourages the growth of moss, both of which can be slippery and potentially dangerous.
- New developments or repairs of impervious path surfaces will be designed and constructed to direct stormwater and snowmelt runoff away from campsites, streams, wetlands, and the river and onto unpaved surfaces.
- Alignment of new trails and paths should follow contours, avoid large trees and thickly vegetated areas, and highlight views and other interesting natural features such as large boulders. Consider the purpose of the path when deciding whether to follow direct, existing desire lines or whether to provide a more meandering, relaxed route. The campground should incorporate a mixture of both types of trails.

TOP: Care should be taken to select path and walkway surfaces that are not slippery in the campground's damp climate. The concrete aggregate around the visitor center (seen here) is very slippery. Source: NPS.

MIDDLE: A trail alignment that is responsive to natural features. Source: U.S. Forest Service *Trail Construction and Maintenance Notebook*, 2007.

BOTTOM: An example of a social trail barrier created with fallen branches. Source: blog.twoknobbytires.com.



- Discourage the formation and persistence of social trails by clearly defining existing trails and campsite boundaries. Establish barriers where necessary to prevent the use of unwanted social trails. Barriers can consist of fallen logs, vegetation, or arrangements of boulders. When logs are used, scattering them in an overlapping, or “jackstraw,” arrangement can create an effective and natural-looking impediment.
- Identify locations where trail and path edges need to be defined for resource protection, wayfinding, accessibility, or aesthetic reasons. If edge definition is necessary, select materials that are appropriate to the context. Logs and vegetation are suitable for most situations in the campground and echo the fallen logs that are characteristic of the forest setting. In areas with tree roots, an unevenly spaced arrangement of boulders is preferable as it allows the roots to move and grow. Boulders are also suitable for areas requiring some slope retention, and they should be carefully arranged to avoid a regular pattern. Ensure that logs and boulders are partially buried for a more natural appearance. Wooden split-rail or pierced-post fences may be appropriate in more developed areas or in areas that require a higher barrier for safety reasons. Smaller pathways leading to CCC-era features may be lined with rock.

THIS PAGE, TOP and MIDDLE: Pierced-post or split-rail wooden fencing is an appropriate edging choice if a higher barrier is desired. Sources: NPS.

THIS PAGE, BOTTOM: Stone-lined path leading to bridge between A and C loops, 2017. Note the partially buried stones. Source: NPS.

OPPOSITE, TOP and MIDDLE: Existing stone steps in the Ohanapecosh Campground, loop A. Source (top): C. Moore, NPS; (middle) NPS.

OPPOSITE, BOTTOM LEFT: Example of box steps created from milled lumber, Cataract Falls Trail. Source: eastbaytrails.com.

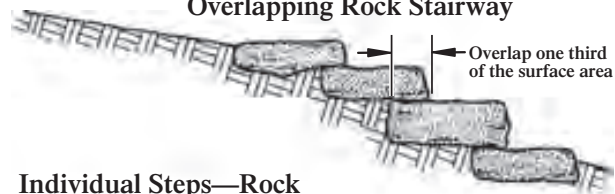
OPPOSITE, BOTTOM RIGHT: Common types of steps for trails. Source: U.S. Forest Service *Trail Construction and Maintenance Notebook*, 2007.

STAIRS + RAILINGS

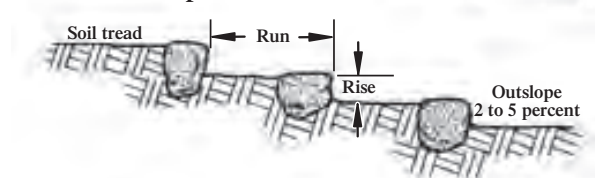


- For safety and erosion control, install steps where pathway grades exceed 20%.
- Consider the location and size of the pathway when choosing staircase materials. Stone steps are most appropriate for heavily used trails and staircases in more developed areas of the campground, for example near comfort stations and other facilities. Timber stairs are useful for more lightly used or remote areas of the campground.
- Stone treads should be set with flattened faces up for safety reasons. Use the largest stones possible to ensure a more rustic appearance and reduce maintenance. The color and form of the stone selected should complement the rock types in the surrounding landscape.
- Timber steps should be created by anchoring logs or sawn timbers across the tread and backfilling with gravel and soil. In more heavily used areas, construct three-sided box steps with timbers anchored with steel rods and backfilled with gravel and soil.
- Ensure a comfortable ratio between step rise and run. Wider treads are in general preferable (at minimum 11" wide), with riser heights between 4" and 7".

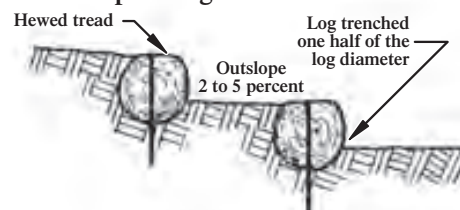
Overlapping Rock Stairway



Individual Steps—Rock



Individual Steps—Logs

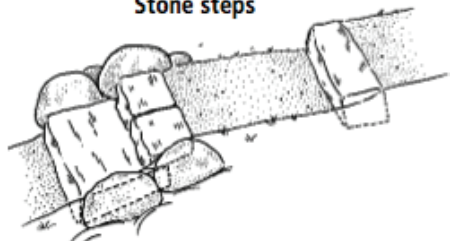


STAIRS + RAILINGS

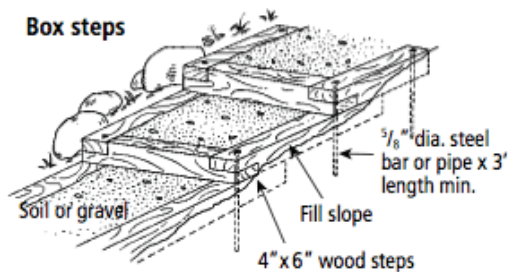


- Ensure slip-resistant surfaces for staircases by scoring or otherwise roughening stone or wood. Maintain naturalistic appearance of step surfaces. Steps should be installed to prevent the accumulation of water on the surface of treads.
- For longer staircases, provide landings at 5-foot intervals.
- Consider installing railings for heavily used staircases longer than three risers. Rail design should carefully take into account the style of the adjacent staircase, the historical character of the park, and code requirements for height and extension. Designs for any new railings should be developed in collaboration with the park's historical landscape architect and historical architect.

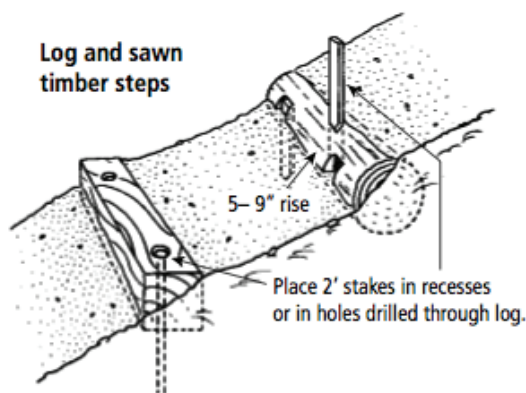
Stone steps



Box steps



Log and sawn timber steps



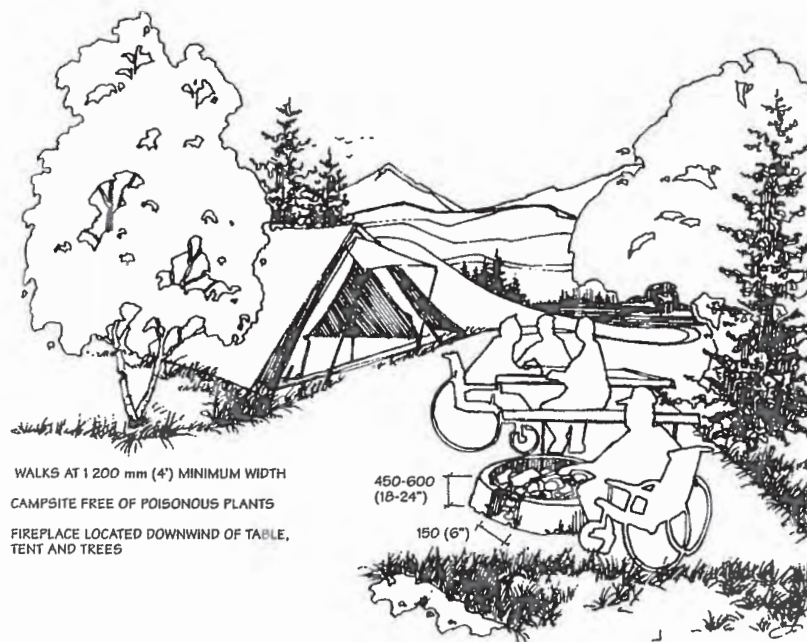
THIS PAGE, TOP: Example of steps built from logs, Skerwink Trail, Newfoundland. Note the scoring on the first tread to improve traction. Source: adventuresinnewfoundland.wordpress.com.

BOTTOM: Techniques for stair construction. Source: Online Woodland Stewardship Resource Area.

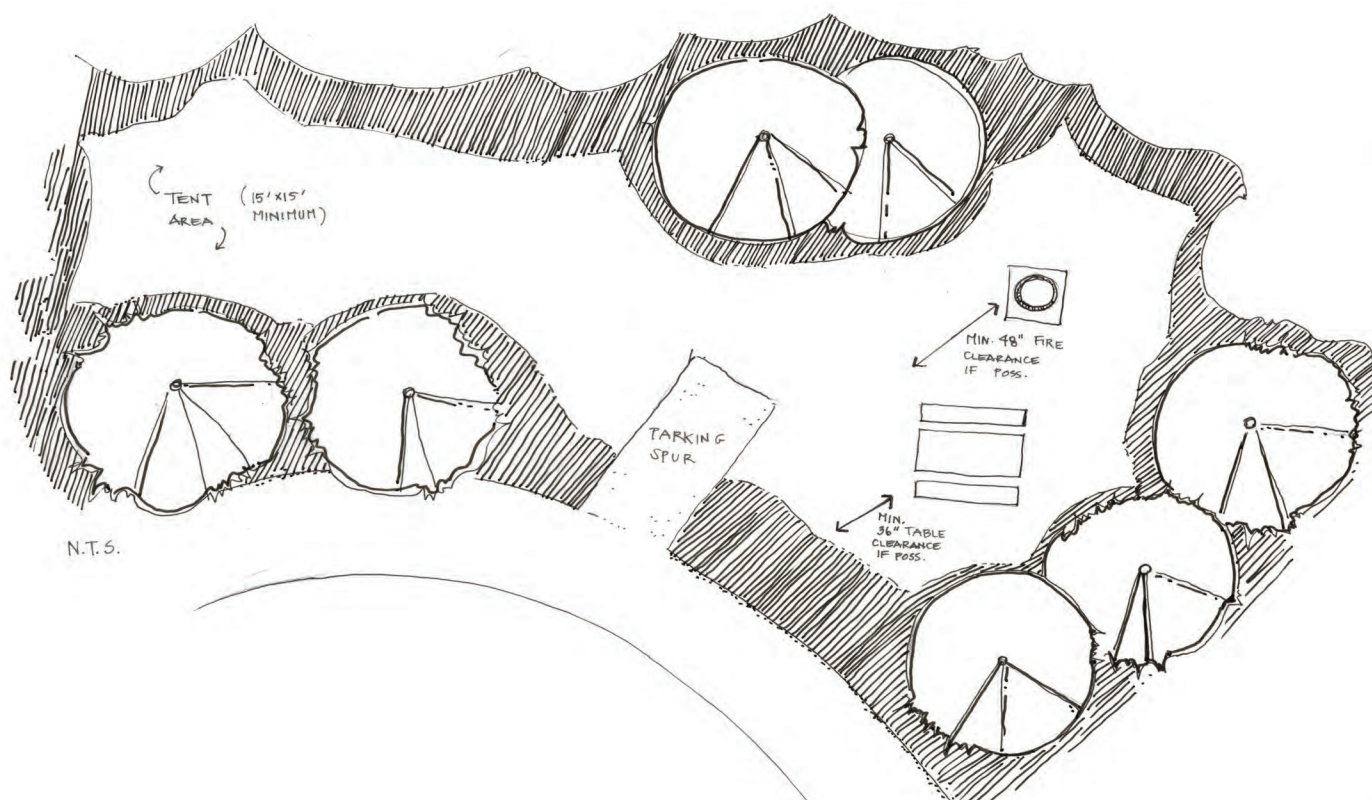
OPPOSITE, TOP: View of a typical accessible campsite. Source: *Time Saver Standards for Landscape Architecture*, 1998.

OPPOSITE, BOTTOM: Conceptual campsite layout, illustrating use areas and protective edging and vegetation around tree roots. Source: B. Anderson, NPS.

CAMPSITES



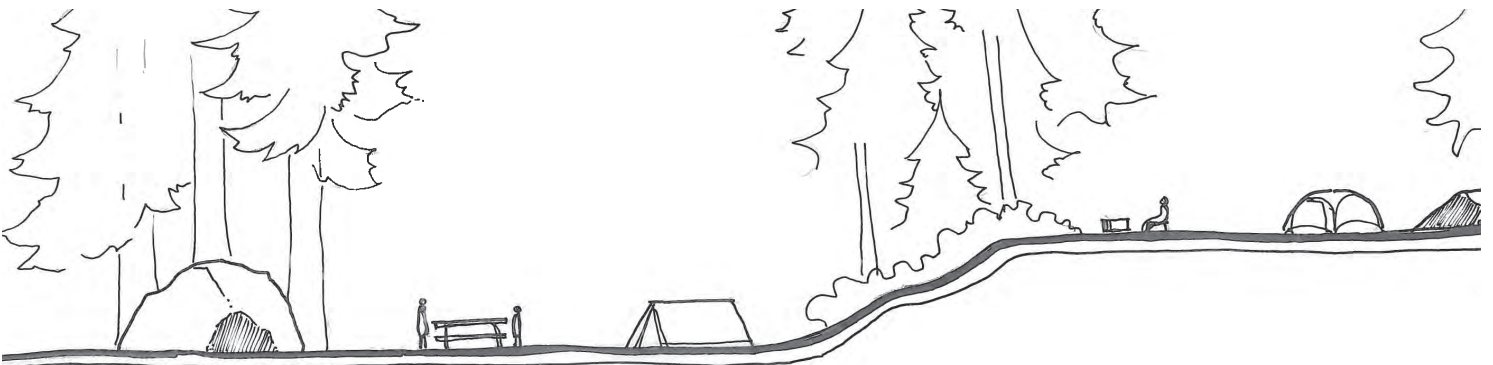
- Clearly identify campsite types for visitors and park managers to ensure that campers select the campsite that best meets their needs. See Signage guidelines.
- Campsite types fall into the following categories: 1) Standard tent or RV (6-person capacity); 2) Small tent (4-person capacity); 3) Walk-in (4- to 6-person capacity); 4) Large group (25-person capacity); 5) Small group (12-person capacity). See General Spatial Guidance for Campsites table for a description of spatial requirements for each site type.
- The park should strive to provide accessible camping options for every campsite type except walk-in sites. Accessible sites require a firm and stable surface, with a slope no greater than 1:48 (2%). For other design requirements for accessible campsites, refer to the *Architectural Barriers Act Accessibility Standards*.
- Campsites should be located in relatively level areas (with less than 10% slope) that will require minimal ground disturbance to create space for campsite amenities such as tents and picnic tables.



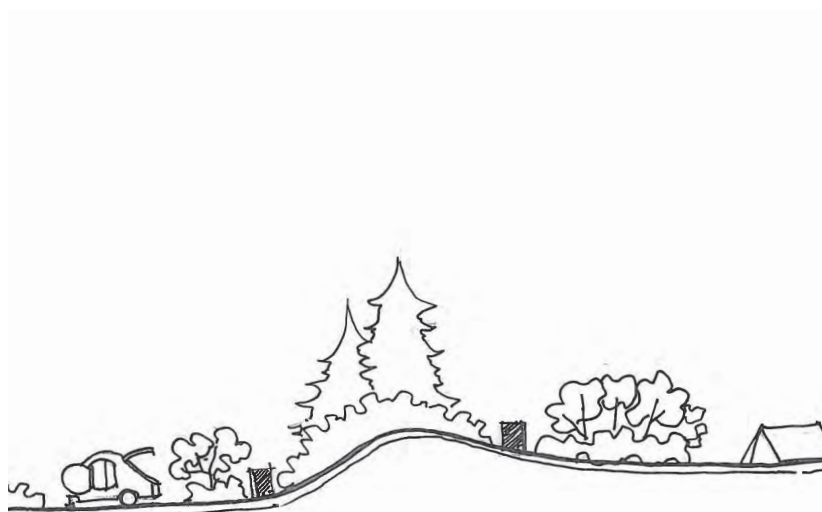
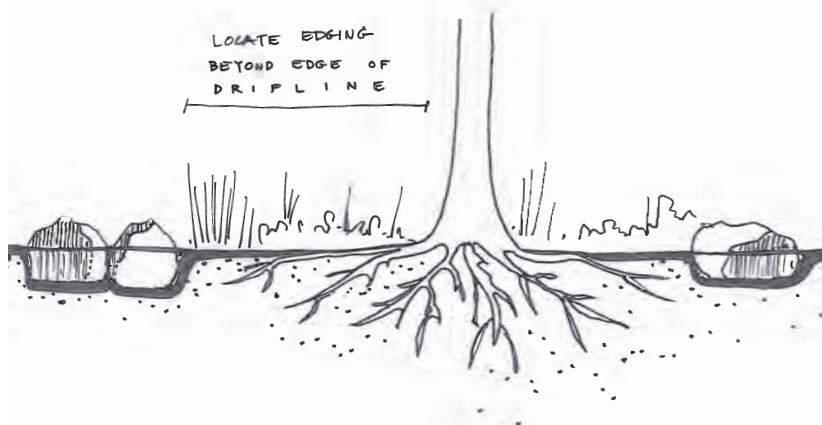
CAMPSITES



- Finished grading of campsites should blend into the surrounding landform to the extent possible and should emulate natural drainage patterns.
- Due to the impacts on the critical root zones of campground trees, the use of heavy equipment for construction or rehabilitation of campsites should only be used when necessary and after all other options have been determined infeasible.
- New campsite and parking areas should be located in previously disturbed areas to the extent possible. New construction should be undertaken carefully to avoid disturbing trees and root systems.
- New campsites and the reconfiguration of existing campsites will avoid wetland and drainage areas and will also take into consideration age, species, and potential hazards of surrounding vegetation.
- The boundaries of individual campsites should be defined by topographical changes and the locations of large trees and boulders, allow sufficient space for vegetative buffers between sites and next to pathways, and accommodate required setbacks from riparian and wetland areas (see Vegetation, River Systems, and Wetland Areas guidelines for more detail).
- Define the edges of individual campsites to help campers find the right site, provide privacy, and reduce uncontrolled expansion of the campsite footprint. Edging can be created by fallen logs or groupings of boulders.



CAMPSITES



- Wherever possible, ensure that at least 60% and optimally 100% of the critical root zone of all trees is protected by encroachment from visitor use. The critical root zone corresponds to the dripline of the tree's canopy and contains the most critical areas of its root system. Delineate a protected area around the tree's root zone and avoid locating picnic tables, fire rings, and parking spaces within this area.
- Use groupings of boulders or fallen logs to delineate protected areas around tree roots and vegetation. An unevenly spaced arrangement of boulders is recommended for areas with tree roots, as boulders allow space for roots to move and grove. Ensure that logs and boulders are partially buried for a more natural appearance; however, dig very carefully around roots to avoid damage. Wooden split-rail fences may be appropriate in areas that have suffered significant resource damage. Walk-in, tent-only campsites should be provided for campers seeking a more secluded, primitive experience. Walk-in sites should take advantage of topography and existing vegetation for maximum screening.
- Locate food storage lockers in areas where they are screened from view by topography and existing vegetation. Purchase lockers in earth tones to make them less conspicuous.

OPPOSITE, TOP: Boulders used to delineate use areas, Cougar Rock Campground, Mount Rainier National Park. Source: T. Degerman, NPS.

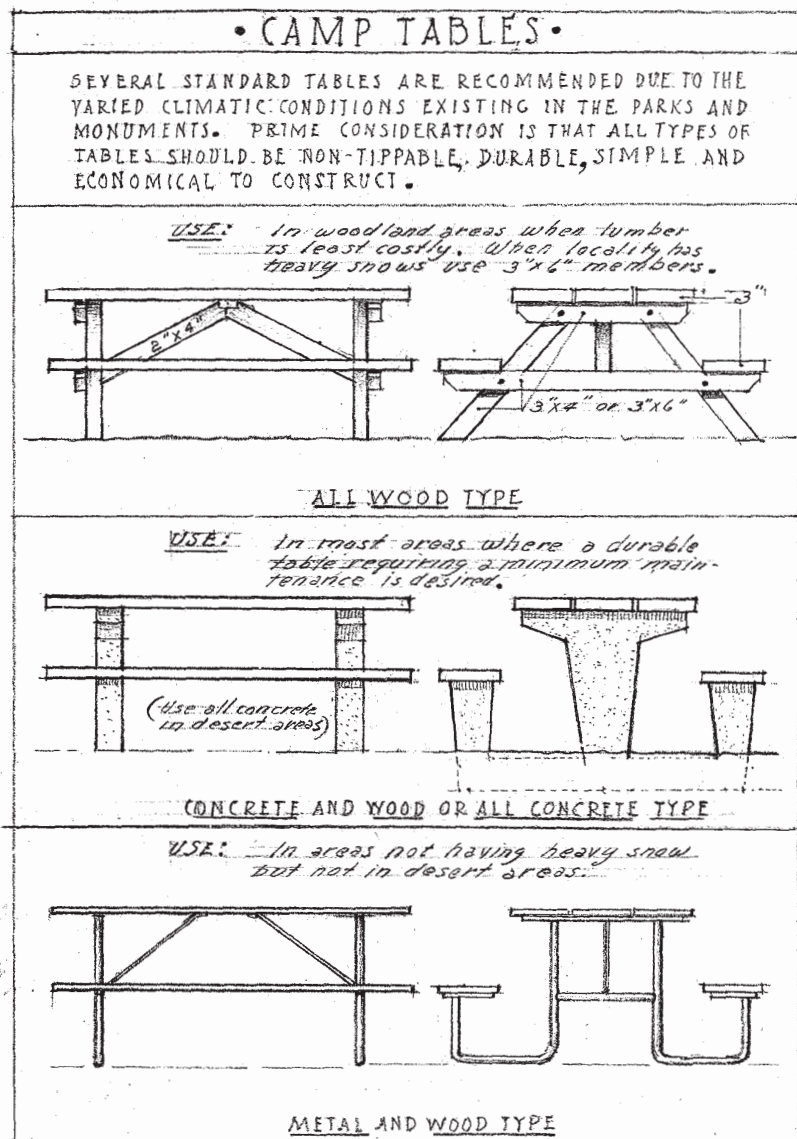
OPPOSITE, MIDDLE: Smaller stones used to protect the critical root zones of trees, Cougar Rock Campground. Source: thecampingview.com.

OPPOSITE, BOTTOM: Campsites should be sited to take advantage of relatively level areas and should respond to natural features such as boulders and existing trees. Source: B. Anderson, NPS.

THIS PAGE, TOP: Boulders and smaller stones are especially suitable for edging in areas with dense tree roots, as they can be more easily installed without disturbance. Source: B. Anderson, NPS.

THIS PAGE, BOTTOM: Food storage lockers should be screened by vegetation or topography wherever possible. Source: B. Anderson, NPS.

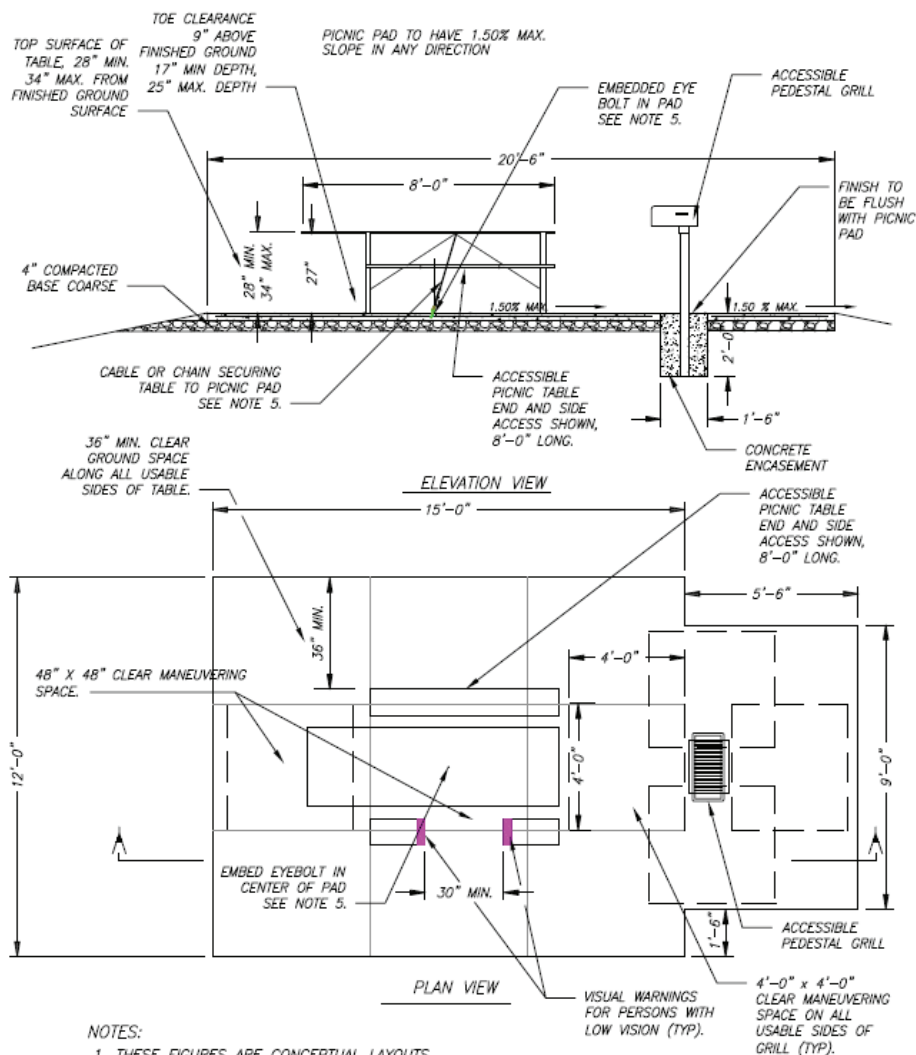
PICNIC TABLES



- Retain Mission 66 picnic tables and replace deteriorating wooden components in kind, as necessary.
- For replacement picnic tables, select from the four styles illustrated below. Avoid the use of synthetic materials in picnic table construction.
- For visual cohesion, locate picnic tables of the same style in the same geographic area.
- Picnic tables at accessible sites and in day-use areas should conform to the requirements in the *Architectural Barriers Act Accessibility Standards*. This includes providing wheelchair seating spaces and ensuring 36–48" of clear ground around each table. Ensure that the ground space has a firm and stable surface, with a maximum cross slope of 2%.
- For all other sites, where feasible provide 36" of clear ground space around each picnic table; ensure ground space has a firm and stable surface.



PICNIC TABLES



NOTES:

1. THESE FIGURES ARE CONCEPTUAL LAYOUTS
2. FIGURES ARE NOT TO SCALE
3. NOT TO BE USED AS CONSTRUCTION DRAWINGS
4. DESIGNER WILL CONFIRM COMPLIANCE WITH DESIGN CODES, ABAAS, AND ACCESSIBILITY COORDINATOR
5. WHEN SECURING TABLE TO PAD SECURE IN A FASHION THAT DOES NOT HINDER THE KNEE SPACE OF THE WHEELCHAIR OCCUPANT.

FIGURE B-12: ACCESSIBLE PICNIC SITE

OPPOSITE, TOP: Mission 66 designs for picnic tables, proposed by the National Park Service Western Regional Office. Source: *Campground Study, 1959*.

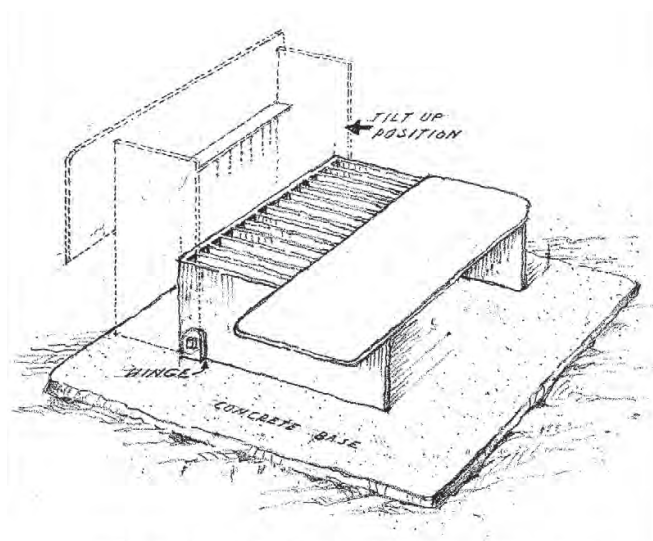
OPPOSITE, BOTTOM: Appropriate picnic table styles for the Ohanapecosh Campground. Source: NPS.

THIS PAGE, TOP: Conceptual picnic site layout illustrating suggested dimensions for accessible picnic tables. Source: Bureau of Reclamation, 2013.

THIS PAGE, BOTTOM: Appropriate picnic table styles for the Ohanapecosh Campground. Source: NPS.



FIRE PITS



- Keep fire rings 10 to 20 feet away from any vegetation and a minimum of 20 feet away from tent areas to minimize the accidental spread of fire. Consider the prevailing wind direction and locate fire rings downwind of tent areas and picnic areas wherever possible.
- Ensure 48" of clear ground space around all usable sides of the fire ring, wherever possible. Consult with the park's historical landscape architect if providing such clearance requires significant ground disturbance or removal of vegetation.
- For accessible sites, conform to guidance in the *Architectural Barriers Act Accessibility Standards*. This includes ensuring that the ground space around the fire ring is firm and stable with a slope that does not exceed 5% (2% max is optimal).
- To improve summer air quality, reduce the number of individual campfire pits in the campground over time. Begin by not including fire pits in the design of smaller, more primitive campsites ("small walk-in" sites: see table 4). In the long term, work with the park's management team to plan for fewer, more centralized campfire facilities.
- To avoid unnecessary extra campfire smoke, ensure that only dry, seasoned wood is burned for campfires, and ensure that visitors completely extinguish fires when finished.
- Conduct interpretive outreach to educate visitors about the health impacts associated with campfire smoke and encourage them to limit burn time or eliminate use of campfires altogether.

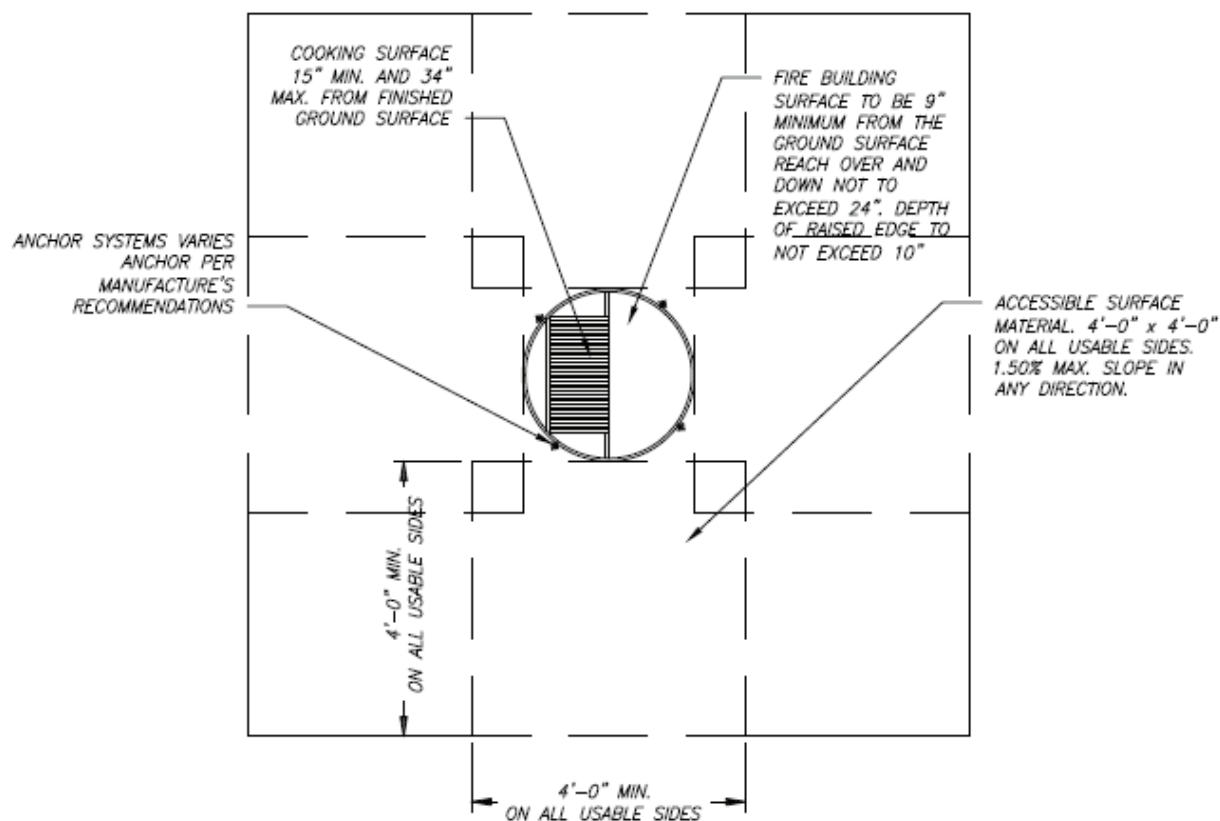
TOP: Round-style fire pit in the campground, 2017.
Source: NPS.

MIDDLE: Rectangular-style fire pit in the campground.
Source: NPS.

BOTTOM: Mission 66 recommendation for fire pit design, proposed by the National Park Service Western Regional Office. Source: *Campground Study*, 1959.

OPPOSITE: Conceptual layout illustrating suggested dimensions for an accessible fire ring. Source: Bureau of Reclamation, 2013.

FIRE PITS



SEE FIGURE B-11a FOR ELEVATION VIEW OF ACCESSIBLE GRILL AND FIRE RING

NOTES:

1. THESE FIGURES ARE CONCEPTUAL LAYOUTS
2. FIGURES ARE NOT TO SCALE
3. NOT TO BE USED AS CONSTRUCTION DRAWINGS
4. DESIGNER WILL CONFIRM COMPLIANCE WITH DESIGN CODES, ABAAS, AND ACCESSIBILITY COORDINATOR

FIGURE B-11b: ACCESSIBLE FIRE RING – PLAN VIEW

GENERAL SPATIAL GUIDANCE FOR CAMPSITES, OHANAPECOSH CAMPGROUND

TYPE	# OF PEOPLE	# OF VEHICLES	PARKING SPACE (IN FEET, PER VEHICLE)	ADDITIONAL REQUIREMENTS
Standard tent or RV	6	1–2	<u>Car</u>—back- in: 20' long x 10' wide; parallel: 24' long by 13' wide <u>RV</u>: 40' long x 10' wide (length of existing RV spaces varies in the campground)	Provide universally accessible site elements wherever possible.
Accessible tent or RV	6	1–2	<u>Car</u>—back- in: 20' long by 16' wide <u>RV</u>: 40' long by 20' wide (length of existing RV spaces varies in the campground). A parking space for a second vehicle (non-RV) can be 16' wide.	Provide clear ground space of 48" fire rings and picnic tables.
Small tent (low-density)	4	1	<u>Car</u>—back- in: 20' long x 10' wide; parallel: 24' long by 13' wide <u>RV</u>: Limit to 15' long by 10' wide	Provide universally accessible site elements wherever possible.
Standard walk-in	6	1	<u>Car</u> —back- in: 20' long x 10' wide; parallel: 24' long by 13' wide	Provide universally accessible site elements wherever possible.
Small walk-in	4	1	<u>Car</u> —back- in: 20' long x 10' wide; parallel: 24' long by 13' wide	No fire pit provided. Provide universally accessible site elements wherever possible.
Group	25	5–6	<u>Car</u>—back in: 20' long x 10' wide; 18' long x 9' wide for multiple spaces Parallel sites are unlikely to occur, but follow guidance above if needed.	Provide universally accessible site elements wherever possible.
Small group	12	2–3	<u>Car</u>—back in: 20' long x 10' wide; 18' long x 9' wide for multiple spaces Parallel sites are unlikely to occur, but follow guidance above if needed.	Provide universally accessible site elements wherever possible.
Accessible group	25	5–6	<u>Car</u>—back- in: 20' long by 16' wide. Other spaces can be 9' wide. Designate and delineate the accessible parking space.	50% but no fewer than 2 of the picnic tables and fire pits should conform to ABA Accessibility Standards.



GENERAL GUIDANCE FOR SIGN DESIGN

- Strive to minimize the number of signs in the campground, while still providing enough information to clearly identify loop names and numbers, vehicle size restrictions for narrow bridges and roads, and parking and day-use areas.
- Retain historic Mission 66 signage in the campground wherever possible.
- Establish a hierarchy of sign types that reinforces the hierarchy of circulation in the campground. Sign character for roadways should be distinguished from signage for pedestrian routes and campsites.
- Develop and keep updated a sign plan for the campground that is part of park-wide sign guidance.

DESIGN GUIDANCE BY SIGN TYPE

1. **Informational signs** should be dark brown-stained wood with white lettering. Use clear cedar whenever possible; the thickness of cedar board will depend on the overall size of the sign (consult with the park's lead sign designer to confirm thickness).

The dark brown stain used on the park's wooden signs is Sherwin Williams SW2014 Beatrix Brown™. The white used for the lettering is currently not specified. Fonts used for wooden signs at Ohanapecosh should match the modified Gothic used for the campground's existing Mission 66-era signage.

TOP: Dark-stained wood informational sign identifying the campground registration station, 2017. Source: NPS.

MIDDLE: Dark-stained wood wayfinding sign, C loop, 2017. Source: NPS.

BOTTOM: Dark-stained wood informational sign for Nature Trail outside visitor center. Source: visitrainier.com.



2. **Wayfinding signs** should be either reflective aluminum or dark brown-stained wood, depending on the location and purpose of the sign. Signs intended to be seen from moving vehicles should be made from aluminum, with a brown vinyl background and reflective white lettering that is clearly visible at night. Signs should be mounted on a cor-ten steel post. Ensure that all aluminum signs have a brown backing to allow them to blend more seamlessly into their natural setting. Sign design for roadways should also conform to the Federal Highway Administration's *Manual on Uniform Traffic Control Devices* and the *NPS UniGuide Standards: Volume 2, Roadway Sign Design Standards* (2005).

Wayfinding signs that are intended to be viewed by pedestrians should be dark brown-stained wood. See guidance above under "Informational signs" for specifications.

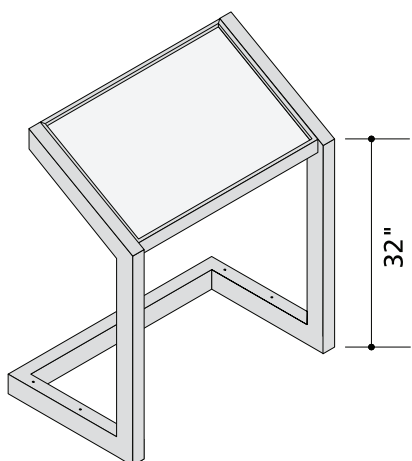
3. **Regulatory signs** should be made from aluminum, with a brown vinyl background and reflective white lettering. Where they relate to vehicle circulation or parking, these signs should also conform to the Federal Highway Administration's *Manual on Uniform Traffic Control Devices* and the *NPS UniGuide Standards: Volume 2, Roadway Sign Design Standards* (2005).

Standard design guidelines for temporary regulatory signs should be developed in consultation with the park's sign shop, maintenance staff, and campground visitor use staff.



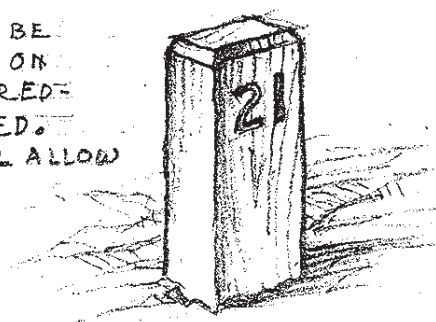
TOP: Aluminum wayfinding sign, 2017. This style of wayfinding sign is suitable for signs intended to be seen from moving vehicles. Source: NPS.

BOTTOM: Interpretive wayside in C loop, 2017. Note that this wayside style does not currently conform to guidelines in the *Visitor Information Sign System*. Source: NPS.



CAMP SITE MARKERS

EACH CAMPSITE SHOULD BE NUMBERED AND INDICATED ON A MARKER. A 3"X6" RED WOOD POST IS SUGGESTED. THE 6" WIDE FACE WILL ALLOW NUMBERS TO 3 DIGITS.



4. **Interpretive waysides.** The design of interpretive waysides will follow the guidelines articulated in the NPS *Visitor Information Sign System* and *Wayside Exhibits* guide. Low-profile, sled-based interpretive waysides are most appropriate for use within the campground. Sled-based signs are relatively portable and can be relocated to new areas to describe dynamic environmental processes impacting the campground.
5. **Campsite identification signs.** Existing signs should be replaced with a style similar to the routed wooden posts or wooden bollards illustrated. Campsite signs could also indicate campsite type by incorporating the suggested campsite identification symbols on the following pages.

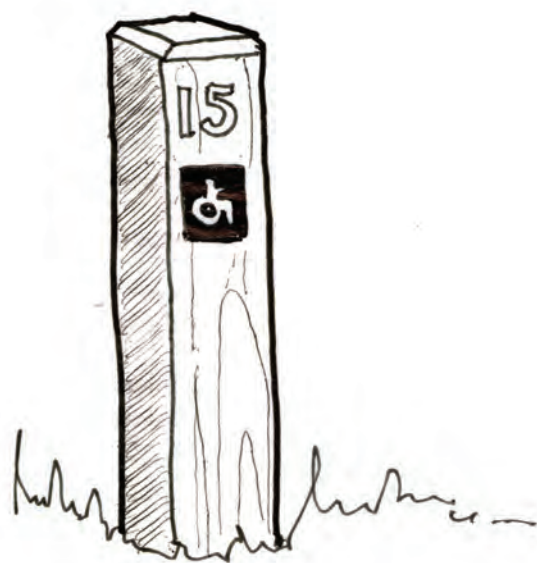
TOP: Design for a sled base interpretive wayside that would be appropriate for the campground. Source: *Visitor Information Sign System*, NPS.

MIDDLE: Existing campsite identification signs with sharp metal corners, 2017. Source: NPS.

BOTTOM: Mission 66 design recommendation for campsite markers. Source: *Campground Study*, 1959.

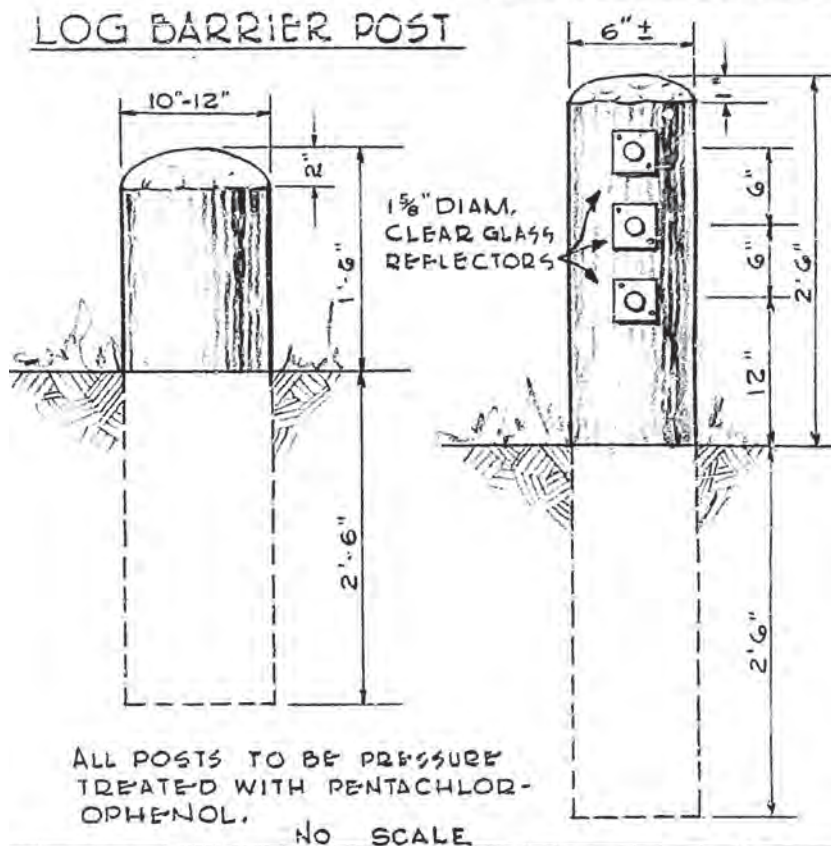
LOG GUIDE PO

LOG BARRIER POST

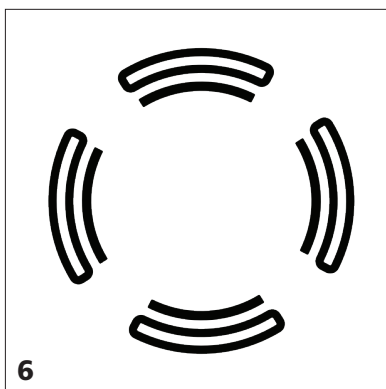
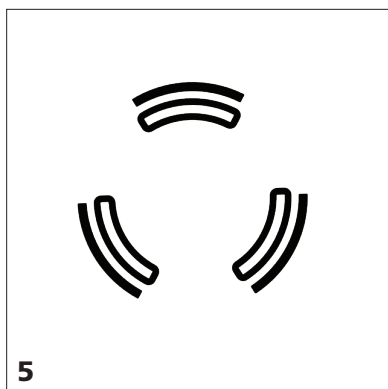
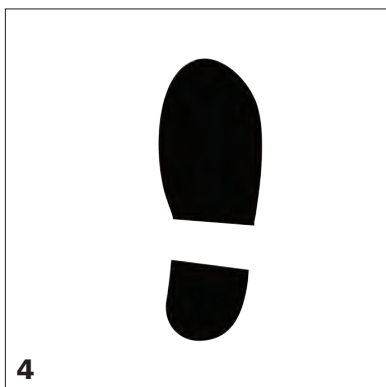
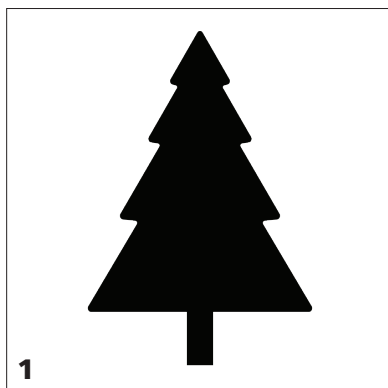


NOTES

1. POSTS ARE 6"X6"
CLEAR CEDAR
(IF AVAIL.)
2. 2 FEET ABOVE
GRADE



SIGNAGE



POSSIBLE SYMBOLS FOR CAMPSITE TYPES

1. Small tent (low-density); 4-person capacity
2. Accessible
3. Standard walk-in; 6-person capacity
4. Small walk-in; 4-person capacity
5. Small group; 12-person capacity
6. Large group; 25-person capacity

SOURCES:

1. Edward Boatman, Noun Project
2. Public domain
3. Novita Dian, Noun Project
4. Novita Dian, Noun Project
5. Tresnatiq, Noun Project
6. Tresnatiq, Noun Project

OPPOSITE, TOP: Example of a post campsite marker appropriate for the campground, with a space to indicate campsite number and type. Source: B. Anderson, NPS.

OPPOSITE, MIDDLE: Design inspiration from Mission 66-era bollards. Source: Western Office of Design and Construction, NPS.

OPPOSITE, BOTTOM: Log/bollard-style sign examples from the NPS Rustic era. Source: Albert H. Good, *Park and Recreation Structures from the 1930s*.