# Chapter 2: Alternatives

# CHAPTER 2: ALTERNATIVES

## INTRODUCTION

In response to deteriorating giant sequoia ecological health and visitor experience, the National Park Service (NPS) has developed a range of action alternatives to restore the Mariposa Grove of Giant Sequoias, consistent with goals outlined for the Mariposa Grove and South Entrance areas in the 1980 Yosemite National Park *General Management Plan*. The primary goals of this project are to restore degraded giant sequoia habitat and natural processes critical to the long-term health of the Grove, and to improve the overall experience for visitors, as described in Chapter 1: Purpose and Need.

The long-term preservation of giant sequoias is dependent on mitigating and minimizing the influences of human activities. In the past 40 years, managers across the Sierra Nevada have sought to remove infrastructure (such as the large restoration project in Giant Forest of Sequoia National Park) and to restore more sustaining fire regimes and hydrologic connectivity within giant sequoia groves. This ecosystem approach is centered on three key management goals (Piirto and Rogers 1999):

- Protect naturally occurring groves from human impacts (e.g., infrastructure, logging) and disturbances outside a natural range of variability (e.g., stand-replacing fire).
- Preserve the groves by promoting natural ecosystem processes and allowing them to prevail.
- Actively restore altered ecosystem functions, particularly fire and hydrology.

The overarching goals of ecological restoration in the Mariposa Grove are to promote giant sequoia germination and establishment and ensure the persistence and longevity of the giant sequoia population. To achieve these goals, a combination of restoration actions would provide the best means of achieving the following ecological restoration objectives:

- Protect, maintain, and enhance environmental conditions and ecosystem function required to sustain the population of giant sequoias
    - Ensure germination and recruitment through frequent surface fires
    - Create and maintain canopy gaps to facilitate giant sequoia germination and recruitment
    - Conduct prescribed burning outside of the Mariposa Grove to reduce the risk of a catastrophic fire originating outside of the Grove
    - Protect individual trees and seedling habitat from structural damage caused by roads, trails, utilities, and visitor trampling
- Protect, maintain, and restore natural hydrologic functions in the Mariposa Grove of Giant Sequoias
    - Remove or modify infrastructure that impacts sheet flow hydrology
    - Where roads and trails remain, remove inside ditches, outslope cutbank areas, and repair, replace, or install culverts to facilitate surface flow
    - Protect and restore wetlands
- Restore areas impacted by the removal, alteration, or relocation of buildings or infrastructure to natural conditions

- Maintain and manage structure and composition of native vegetation within the range of natural variability so that the vegetation functions dynamically over a long-term time frame (50-100 years)
    - Continue prescribed burning and modify as needed to reach target forest conditions
    - Retain large snags for wildlife habitat
    - Continue invasive plant removal in and around the Grove

By removing non-essential buildings and infrastructure; protecting the roots of giant sequoias from impacts of roads, trails, and foot traffic; removing impediments to natural surface and subsurface water flow; and restoring a more natural fire regime (augmented by prescribed fire as necessary), the NPS can effectively preserve, protect, and restore the rare ecosystem of the Mariposa Grove.

This chapter addresses each of the following topics:

- A description of the Choosing by Advantages process through which the alternatives development (pages 2-3 to 2-4)
- A description of each alternative (pages 2-5 to 2-30)
- Alternatives considered but dismissed from further analysis (pages 2-31 to 2-33)
- Mitigation measures (pages 2-33 to 2-38)
- The environmentally preferred alternative (pages 2-38 to 2-40)
- Cost estimates associated with implementing the alternatives (page 2-41)
- A summary comparison of the alternatives (Table 2-2)
- A summary of potential impact and restoration footprint areas (Tables 2-3 and 2-4)

# ALTERNATIVES

Four alternatives are evaluated in this Environmental Impact Statement (EIS): a No Action alternative that represents the continuation of existing conditions and management, and three action alternatives. Ecological restoration activities, certain utility repairs or upgrades, and rehabilitation of historic features at Wawona Point are common to all action alternatives, although there are differences in proposed building and infrastructure removal and relocation among the action alternatives. Initial design concepts for the restoration of the Grove were formulated during three design charettes that were held in January, March, and May of 2012. NPS park and regional staff representing various technical disciplines, as well as the contracted designer and compliance staff, participated in the charettes. Resource issues and concerns were identified based on research and baseline data documenting the existing conditions within the Grove. The park staff, assisted by the designers, identified numerous potential solutions. These concepts were iteratively assessed and improved, resulting in five preliminary alternatives. A choosing by advantages (CBA) workshop and a value analysis held in June 2012 resulted in selection of the alternatives for detailed analysis in this EIS. These sessions were augmented by a separate value analysis for design alternatives to reconfigure the intersection of Wawona Road (State Route 41) and the Mariposa Grove Road that was held in July 2012.

## Choosing By Advantages/Value Analysis Workshops

Three design charettes were conducted in January, March, and May of 2012, and included extensive discussion among the project team, which includes Yosemite National Park staff and management, NPS Pacific West Region staff, and contractors. A wide variety of concepts for restoring the ecology of the Mariposa Grove of Giant Sequoias and improving the visitor experience were considered. A CBA workshop was held in El Portal on June 5-6, 2012. The CBA process is a ranking process that is based on the relative advantages and costs of each alternative in accomplishing servicewide goals and objectives. Through the CBA process, alternatives for the Mariposa Grove restoration effort were evaluated to determine which should be carried through the EIS-level of analysis. The alternatives considered during the CBA process included Alternative A: No Action and five action alternatives that emerged from the design charettes, as follows:

- Alternative B: South Entrance Hub
- Alternative C: Grizzly Giant Hub
- Alternative D: Lower Grove Hub
- Alternative E: South Entrance Hub II (included removal of commercial tram, communications tower, and road within the Grove)
- Alternative F: South Entrance Hub III (included limited commercial tram access)

Each alternative was initially assessed for a paramount advantage when compared to the others in regard to 15 factors. Once the alternative with the paramount advantage had been identified it was given a score of 100, and the others were ranked in descending order relative to that alternative, with higher scores indicating greater advantages. The scores were then normalized by considering the relative importance of each of the 15 factors for this project. Factor 1, Protect and Restore Giant Sequoia Habitat, was allotted the maximum 150 points, and other factors were assigned lesser values, depending on the differences among alternatives and their perceived importance in addressing the purpose of and need for the project.

Following the CBA workshop, NPS recommended refinement of Alternatives B, E, and F, in addition to no-action Alternative A, for analysis in the EIS. During the park's reconsideration phase, these three action alternatives were further developed and refined. However, through public comment received during an open house in June 2012 and through further analysis and discussion, NPS concluded that Alternative E without removal of the commercial tram road too closely resembled Alternative B, and that Alternative C provided different approaches to meeting the purpose and need and thus should be fully assessed in the Draft EIS. Alternative D did not adequately meet the project purpose and need. Alternatives B, C, and F are evaluated in this EIS as Alternatives 2 (South Entrance Hub), 3 (Grizzly Giant Hub), and 4 (South Entrance Hub with Modified Commercial Tram Service), respectively.

**Figure 2-1 – Choosing by Advantages Workshop**

A separate value analysis workshop was held on July 19, 2012, to identify and rank possible designs for an improved Wawona Road/Mariposa Grove Road intersection at South Entrance. The workshop objective was to ensure that a range of proposals was considered, and to ensure that the project satisfied the park's needs with the lowest impact on resources in the context of criteria that relate directly to NPS service-wide goals and objectives.

The highest ranked intersection option was the existing and foreseeable future conditions (which include the planned kiosk expansion), as represented in the No Action alternative. The park would monitor the performance of the proposed improvements. If vehicular back-up at the intersection extends to the kiosks over a sustained period, the park could implement the roundabout option, which was the second highest ranked intersection option. An optimized roundabout is proposed in Alternative 2: South Entrance Hub. This option has several advantages over the current T-intersection design in terms of traffic capacity and safety but is associated with additional costs. A modified T-intersection, incorporated into Alternative 4: South Entrance Hub with Modified Commercial Tram Service, was the lowest scoring and with the lowest benefit-to-cost ratio.

At the conclusion of the CBA, the alternatives were ranked based on overall scores, excluding cost considerations, in descending order as follows: Alternative B (441 points), Alternative E (418 points), Alternative F (331 points), Alternative C (301 points), and Alternative A (88 points). Once costs were considered, Alternative B (Alternative 2, the preferred alternative in this EIS), retained the highest CBA importance score. Based on the processes summarized above, the NPS identified Alternative 2 as the preferred alternative in this Draft EIS.

## Alternative 1: No Action

Under Alternative 1, No Action, the lower Grove area would continue to serve as the primary arrival and departure point and contact area for visitors to Mariposa Grove. Existing buildings and infrastructure at the lower and upper Grove areas, and at South Entrance, would remain. These include the Grove parking lot, the paved commercial tram loop road, tram staging, the concessioner-operated gift shop, Wawona Point overlook features and communications equipment, comfort stations, the Mariposa Grove Museum, and utilities infrastructure (figures 2-2 through 2-4).

Individual giant sequoia trees and Mariposa Grove habitat would continue to be impacted by buildings, roads, utilities, and other infrastructure that are adversely affecting tree roots and regeneration, soils, and hydrologic flow. Paved roads, in-sloped trails, and damaged and insufficient culverts would continue to impede sheet flow and divert water from the Grove, and denuded and compacted soils would continue to limit water infiltration and giant sequoia seedling germination. Plugged culverts would be cleaned as part of routine maintenance; however, additional and/or larger culverts would not be installed. The deteriorating water supply system would continue to leak, and the water storage tank and chlorination unit would remain along the upper Grove loop road (figure 2-1), and continue to require maintenance vehicle access. The gift shop, its diesel-powered generator, and the visitor parking lot would remain in place, and the poorly functioning vault toilets would remain at the entrance to the Grove. Park and concessioner operations and overall management of Mariposa Grove would continue as is, including commercial tram staging and operation in and around sensitive natural resources. Facilities and trails would continue to offer only limited accessibility.

Currently, there is limited parking at South Entrance (25 to 30 spaces) and the Grove (115 spaces, of which 2 are designated for accessible use as shown in figures 2-2 and 2-3). When Grove parking lot capacity is reached and the Mariposa Grove Road closes (most commonly during peak season from Memorial Day to Labor Day), visitors attempting to access the Grove are directed to Wawona by staff at South Entrance, where they can park and take a free shuttle bus to the Grove. The park's shuttle service from Wawona runs approximately every 20 minutes with stops at South Entrance and Mariposa Grove. This process results in backtracking and considerable visitor frustration; some visitors may decide against visiting the Grove given the time and effort required to reach that destination.

Under Alternative 1, potential Grove visitors would continue to be turned back when parking areas are full, and staff would continue to redirect them to Wawona to take the shuttle. At present, Wawona is a staging area for the Grove when the Grove and South Entrance parking areas are full. At Wawona, personal vehicles and commercial buses, park along the road as well as in front of the market to catch shuttles for visitors wanting to go to the Grove. Concessioner staff would continue to provide traffic control at the Mariposa Grove Road gate and the Grove parking lot. The planned widening of Wawona Road and relocation of the South Entrance kiosks farther south (noted as an In-progress Project on figure 2-2), to be completed under a separate project, would alleviate traffic congestion and confusion somewhat. However it is anticipated that Mariposa Grove visitors would largely continue to experience backups at the current Wawona Road/Mariposa Grove Road T-intersection (figure 2-2).

### Accessibility

Under the no-action alternative, visitors with limited mobility can experience the giant sequoias and other remarkable natural and cultural resources in the Mariposa Grove by taking a commercial tram tour, or by following the tram tours in a placarded vehicle. The other universally accessible facilities in the Grove include two parking spaces and eight vault toilets. Within the Grove, the existing bus drop-off area, parking, and trails do not meet current accessibility standards.

## Actions Common to All Action Alternatives

A set of the proposed actions to address the purpose and need for this effort are common to all action alternatives (Alternatives 2, 3, and 4). This section describes these common actions to avoid redundancy in the sections that follow.

**Improve Orientation and Way Finding** – Comments received during public scoping and from park staff indicated that orientation and way-finding signage at the entrance and within the Grove could be improved. All action alternatives would include additional and/or improved signs where needed, to provide clearer orientation, interpretation, and direction to visitors upon arrival at the South Entrance to the park and at Mariposa Grove.

**Rehabilitation of Wawona Point** – All action alternatives call for rehabilitation of historic features at Wawona Point. Wawona Point provides a scenic westerly vista of the western edge of the park and the South Fork Merced River valley, stretching toward the Sierra Nevada foothills and the Central Valley beyond. Historic rehabilitation activities would include repair of rock work, steps, and railings, and removal of asphalt pavement. Ecological restoration activities would include revegetation of denuded areas and areas from which pavement is removed.

**Engineered Hydrology and Road Improvements –** All action alternatives include the repair or replacement of drainage culverts and the grading/outsloping of roads and trails within the Grove to promote unimpeded sheet flow and infiltration of snowmelt and rainwater. The improvements would reduce channelization and erosion, and would correct flow barriers that currently divert water both within the Grove and from the Grove watershed entirely. Routine inspection and maintenance would be required to keep culverts clear of debris and sediment.

**Removal of Gift Shop from Lower Grove Area –** Under all action alternates, the existing concessioner-operated gift shop and the associated diesel-powered generator would be removed from the lower part of the Grove. The gift shop building is not compatible with the historic and natural setting, and the generator is a source of noise and air emissions.

**Repair of Water Supply Pipeline –** All action alternatives would include relocation of the water treatment and storage units in the upper Grove area, and repair or replacement of the associated leaking water distribution piping. The distribution system conveys spring water from Biledo Meadow, located east of Mariposa Grove on U.S. Forest Service land, through the upper Grove area, and to Mariposa Grove and South Entrance facilities. The pipeline is leaking chlorinated water, and may be affecting local hydrology and vegetation.

**Structural and Utility Sustainability Improvements** – All action alternatives would renovate or rehabilitate existing comfort stations, or relocate facilities and functions that do not contribute to the historic significance of the Grove to areas outside of sensitive giant sequoia habitat and wetlands. For

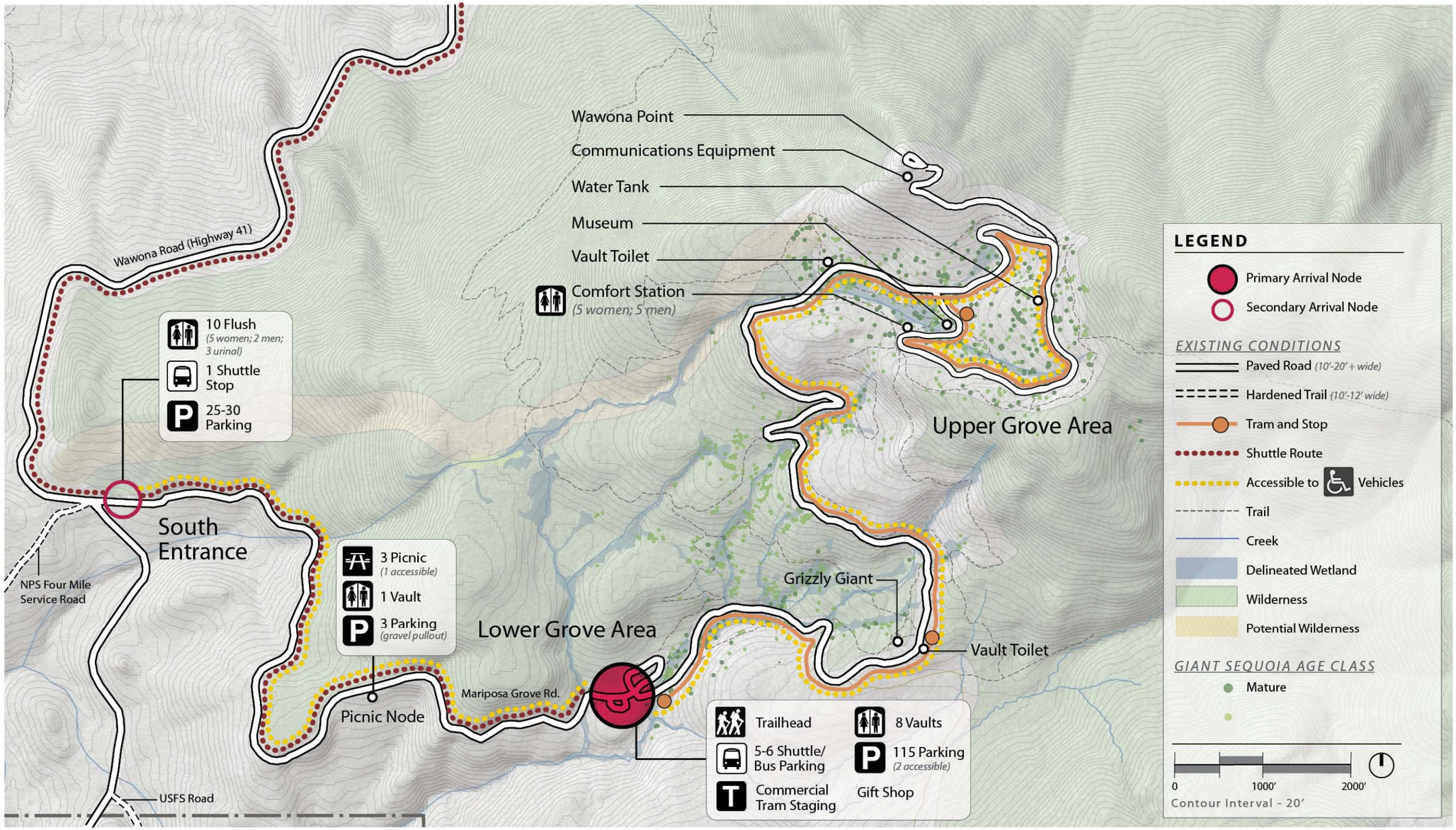



**Figure 2-2 – Alternative 1: No Action**

Source: Mithun 2013

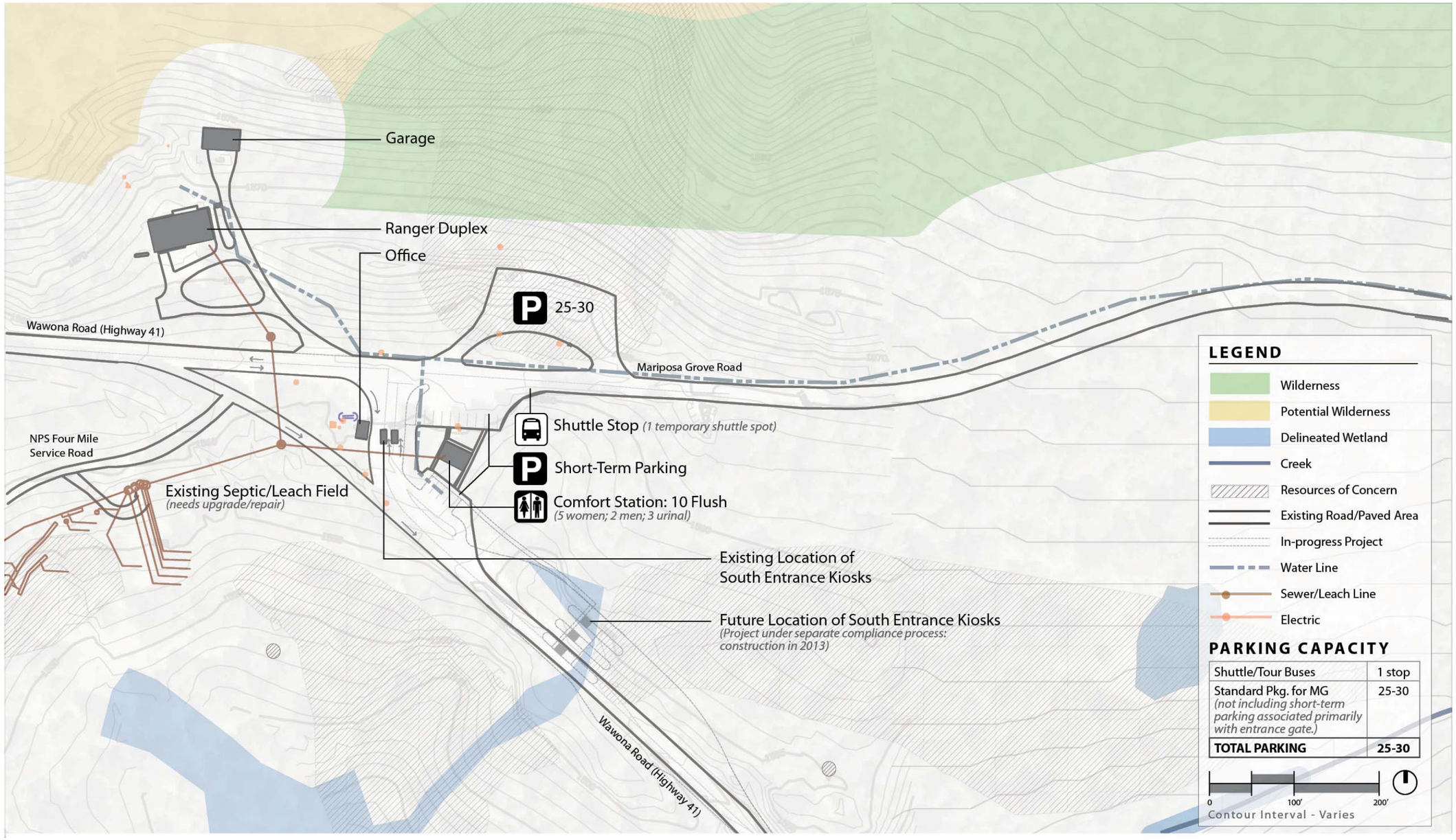



**Figure 2-3 – Alternative 1: No Action – South Entrance Detail**

Source: Mithun 2013

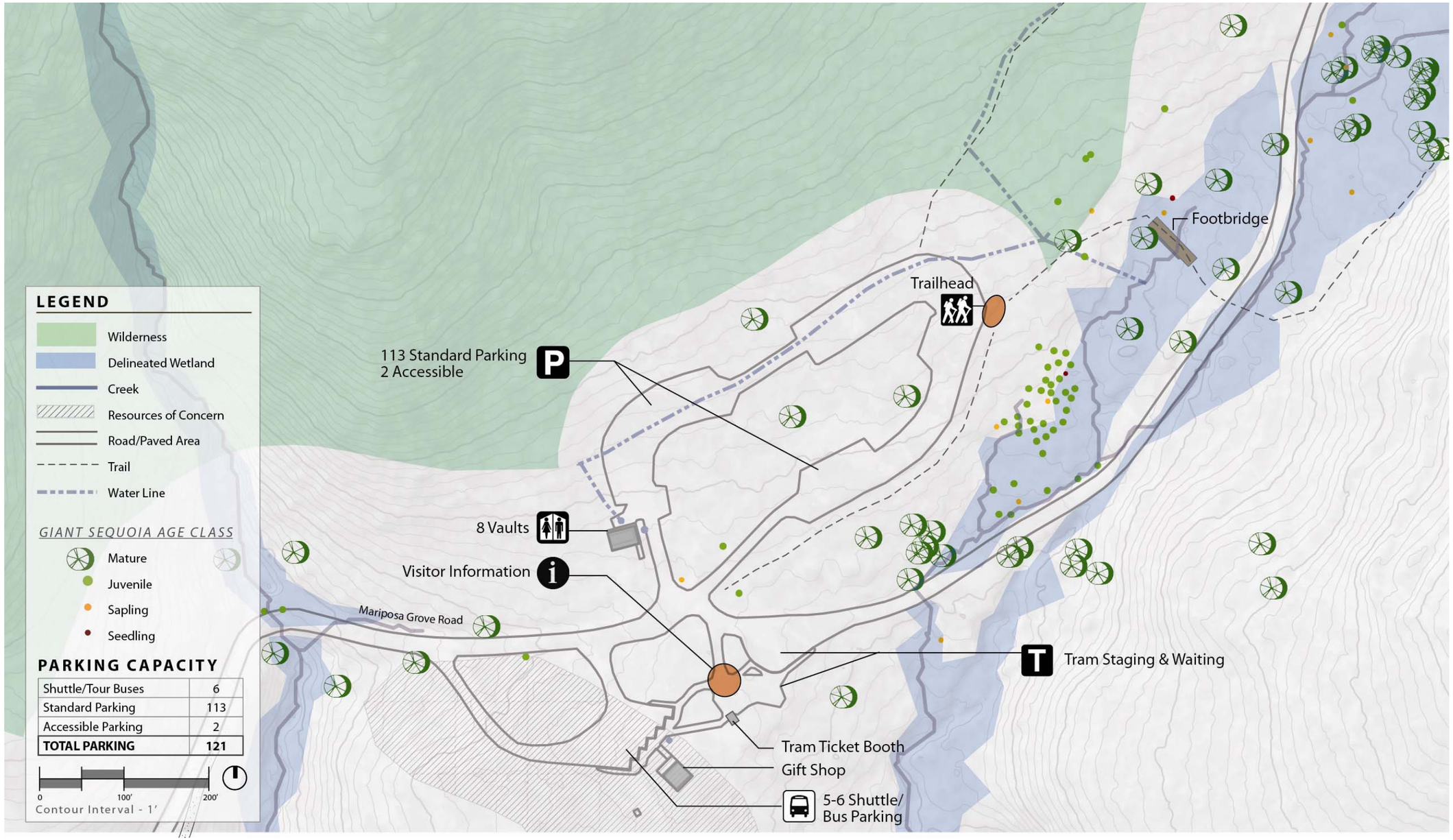



**Figure 2-4 – Alternative 1: No Action – Lower Grove Area Detail**

Source: Mithun 2013

relocated facilities, actions would be undertaken in accordance with the National Park Service *Guiding Principles of Sustainable Design* (1993) and *A Sense of Place – Design Guidelines for Yosemite National Park* (2012). These principles include the orientation of buildings to optimize seasonal solar exposures and to minimize the effects of prevailing winds, design that incorporates the use of natural ventilation, energy-efficient lighting, and the installation of energy- and water-efficient fixtures and utilities.

**Grove Vicinity Fire Management** – All action alternatives would include continued mechanical thinning and prescribed fire. Though fire management activities such as these have been occurring within the Grove since the early 1970s, heavy buildup of surface fuels and dense understories are widespread in forested areas around Mariposa Grove. Planned fire management activities under the current *Fire Management Plan* (National Park Service 2004a) include mechanical thinning of trees smaller than 20 inches in diameter at breast height and prescribed fire in units to the south, east, and west of the Grove. Implementation of planned fire management activities south and west of the Grove to the park's boundary with the Sierra National Forest would help mitigate the risk of a catastrophic crown fire reaching the Grove, as these areas are upwind of the Grove (i.e. the prevailing winds are southwesterly).

**Anthropological Interpretation at Lower Grove Area** – All action alternatives would include interpretation of archeological features in the lower Grove area, as well as interpretation of historic uses and American Indian traditional cultural resources and practices.

**Universal Accessibility** –Each of the action alternatives would extend opportunities for universal access and enjoyment of resources within the Mariposa Grove. The action alternatives would include construction of universally accessible transportation hubs and comfort stations in accordance with applicable policies and guidance. Each would also include a universally accessible trail through the lower portion of the Grove, which would greatly enhance natural quiet and opportunities for solitude and quiet contemplation away from roads. Facilities and trails would be designed to assure that paths of travel, viewpoints, benches and interpretive signage offer all visitors a quality and meaningful experience while in the Grove.

Universally accessible facilities would comply with Architectural Barriers Act Accessibility Standards (ABAAS) and NPS *Director's Order 42: Accessibility for Visitors with Disabilities in National Park Service Programs and Services*. The design of universally accessible trails is guided by the Draft Final Accessibility Guidelines for Outdoor Developed Areas (Architectural and Transportation Barriers Compliance Board 2009: http://www.access-board.gov/outdoor/draft-final.htm).

**Conversion of Southern Portion of the Upper Grove Loop Road to a Pedestrian Trail** – All action alternatives would allow for the conversion of the southern portion of the currently paved historic loop road to a pedestrian trail. This portion of the loop has a remarkable density of giant sequoias and would be an exceptional pedestrian pathway. The segment of the paved road extending to Wawona Point would be converted into a hardened trail that would allow for occasional use by service vehicles, including those needing access to the telecommunications equipment located at Wawona Point.

**Extend Footbridge** – An existing non-contributing pedestrian bridge in the vicinity of the Fallen Monarch would be removed and replaced with an extended footbridge to reduce impacts on stream flow.

**Improvement of Visitor Education** – Interpretive signage in the Grove was updated in 2009. All action alternatives would implement further measures to better educate Mariposa Grove visitors with additional interpretive waysides, orientation, and informational exhibits and a visitor contact station.

**Monitoring** – A monitoring plan would be developed prior to implementation to define the target forest condition and metrics for evaluating the success of restoration efforts.

## ALTERNATIVE 2: SOUTH ENTRANCE HUB (PREFERRED ALTERNATIVE)

Alternative 2, South Entrance Hub, is the park's preferred Alternative. Under this alternative, most public parking, the gift shop, and the concessioner-operated commercial tram staging area and tram operations would be removed from Mariposa Grove to allow for restoration of wetlands, soundscapes, and giant sequoia habitat in Mariposa Gove. Impervious surfaces within the Grove would be minimized, and all areas from which buildings or pavement would be removed and that are not slated for reuse would be ecologically restored to sequoia habitat. Following demolition and removal activities, ecological restoration measures would include soil preparation (e.g., decompaction), surface contouring to match local topography, and planting site-appropriate native vegetation. Visitor parking and information services would be relocated to the park's South Entrance, which would serve as the primary transit hub and contact area for Grove visitors. An overview of the principal components of Alternative 2 is shown in figure 2-5, and details are depicted in figures 2-6 through 2-9.

The South Entrance area would be reconfigured as a hub with the main parking area for Mariposa Grove and a visitor contact area, as shown in figure 2-6. Parking at the South Entrance would be expanded from 25-30 spaces to a total of 269 standard, oversize, accessible, and bus parking spaces. A toe wall may be constructed on the uphill side of the proposed bus parking area (in the current parking area) to allow for re-grading to a suitable cross-slope and to revegetate the cut slope above. A shuttle bus boarding and tour bus transfer area would facilitate visitor use of the park shuttle service to travel to the lower Grove area.

Commercial buses would stop at the South Entrance for visitor orientation, use of facilities (rest rooms), and transfer to shuttles. Buses that are less than 40 feet long may continue on to the lower Grove area. To provide pedestrian access from the South Entrance to the lower Grove area, the segment of the abandoned Washburn road alignment from the South Entrance to the Mariposa Grove Road picnic area would be cleared of vegetation and rehabilitated to a pedestrian trail. Where the Washburn road ends in the vicinity of the existing picnic area, a new trail would be constructed parallel to the Mariposa Grove Road from the picnic area to the lower Grove area (shown on figure 2-5).

The shuttle service to the Grove would continue to operate between the South Entrance and the lower Grove area. A separate, limited schedule shuttle would connect visitors staying at the Wawona Hotel or in nearby accommodations or campgrounds with the South Entrance area where they would be able to catch a shuttle to the Grove. No new shuttles would be required; current shuttle service would be modified. During the shoulder seasons, when the shuttles are no longer running, only placarded vehicles would be provided access to the lower Grove area and Grizzly Giant. Traffic control related to the closure of the Mariposa Grove Road and lower Grove parking lot during periods of heavy visitation during the shoulder/winter season, typically weekends and on holidays, would continue. Road closures because of snow conditions in the winter would continue.

The current tram ticketing and turn-around area in the lower Grove hub would be repurposed to a small transit node to accommodate shuttle bus loading and unloading, and accessible parking for appropriately placarded private vehicles; these facilities would be located within the current development footprint (see figure 2-7). An accessible trail would be developed in the ecologically restored lower Grove area, and would require some vegetation clearing, grading, and surface hardening. Designated accessible parking spaces would be provided at both the lower Grove area and in the vicinity of the Grizzly Giant, but away from the existing giant sequoias. An accessible trail would be constructed connecting the viewing area for the Grizzly Giant with the proposed nearby accessible parking area (figure 2-8). Other trails would provide opportunities to experience the solitude of the giant sequoias in the upper Grove area.

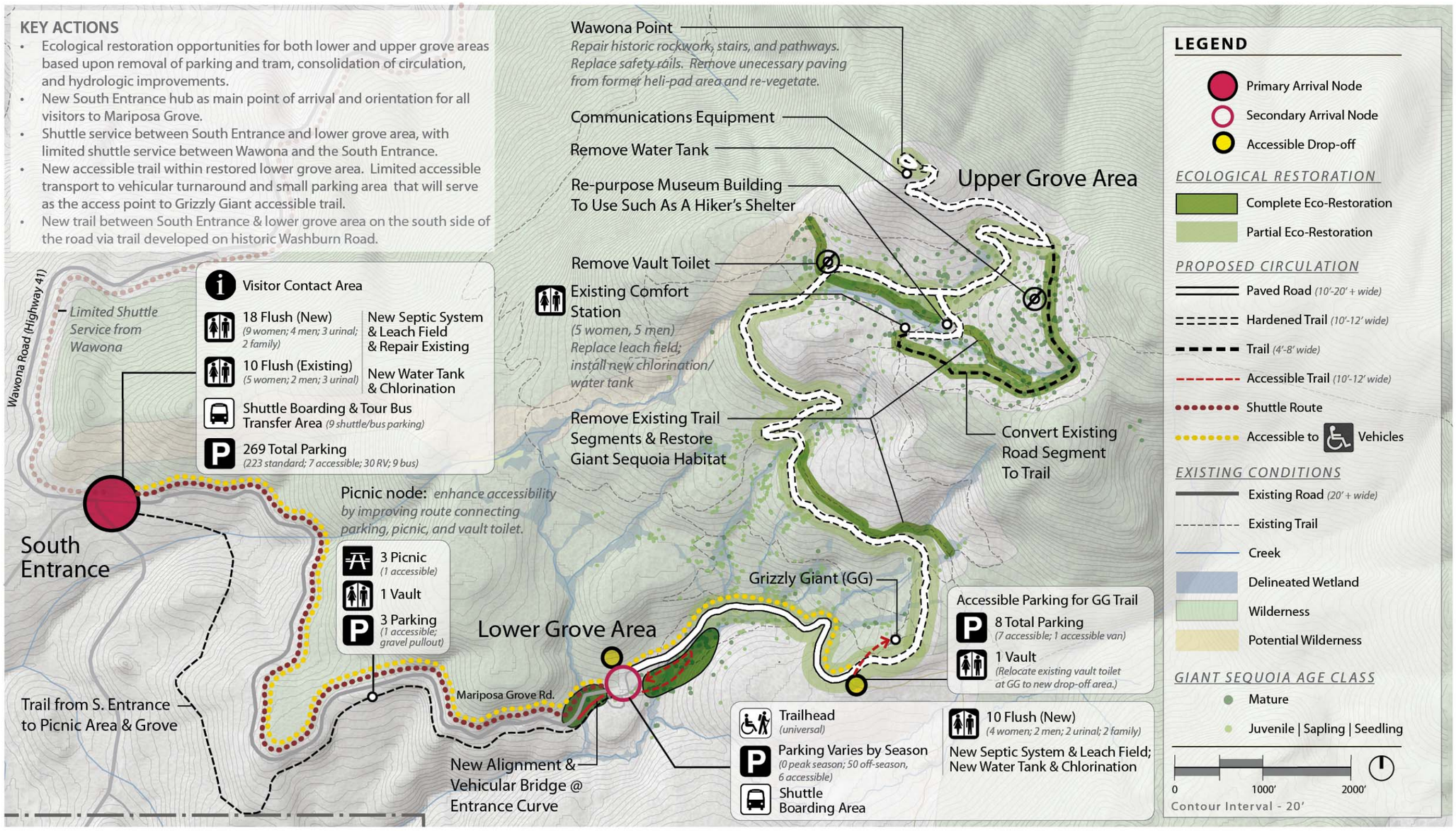



**Figure 2-5 – Alternative 2: South Entrance Hub (Preferred Alternative)**

Source: Mithun 2013

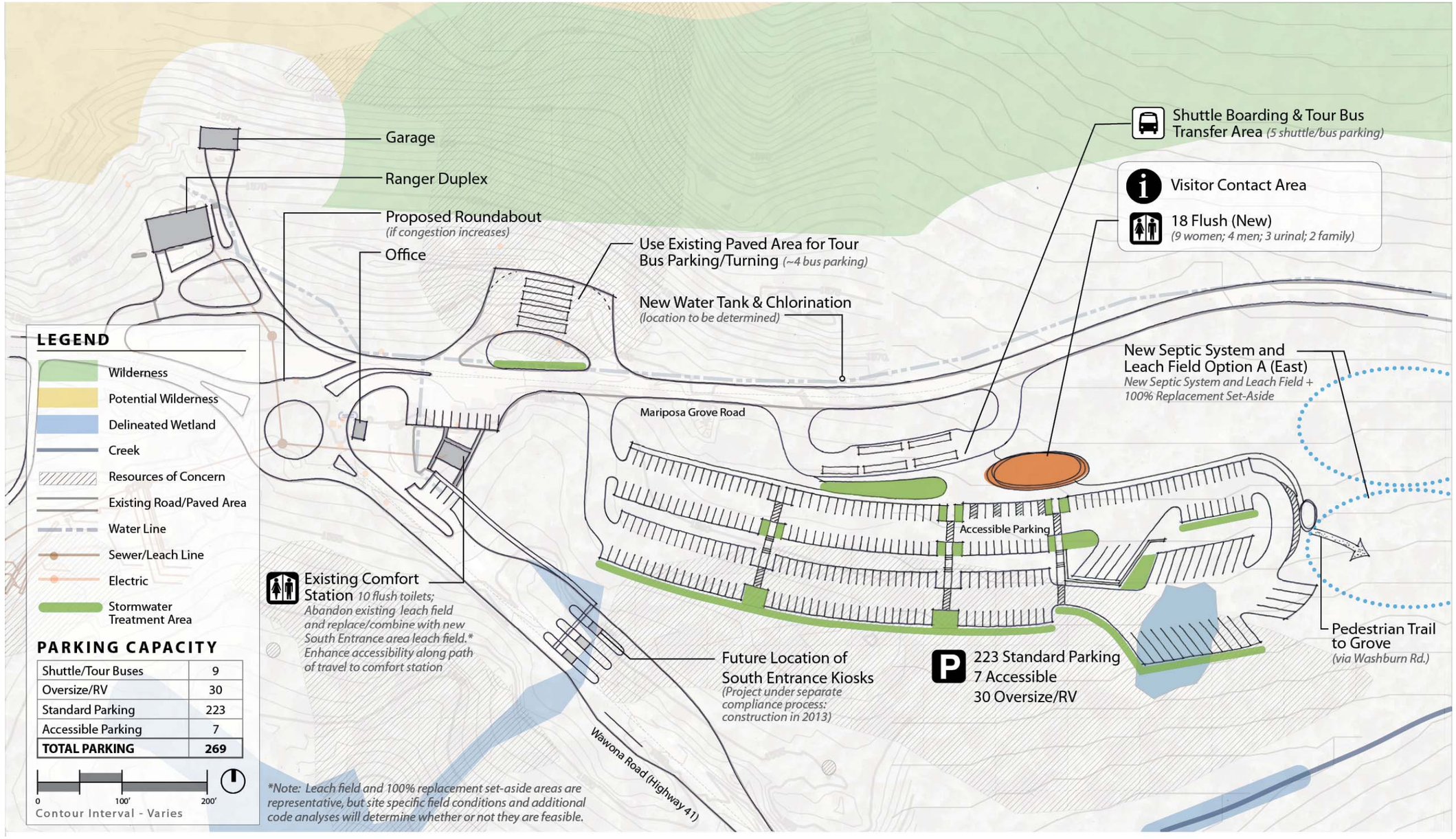



**Figure 2-6 – Alternative 2: South Entrance Hub (Preferred Alternative) – South Entrance Detail**

Source: Mithun 2013

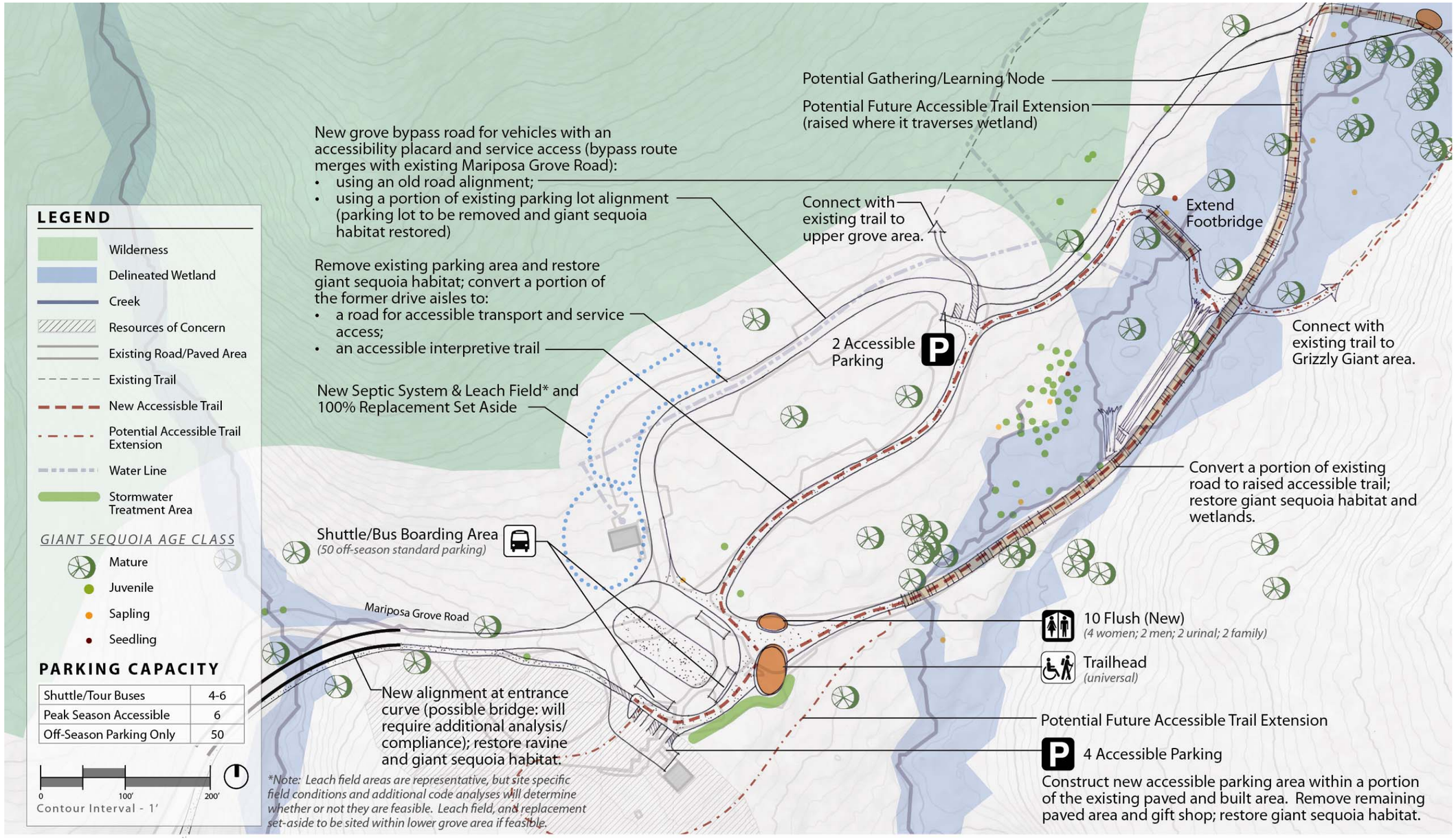



**Figure 2-7 – Alternative 2: South Entrance Hub (Preferred Alternative) – Lower Grove Area Detail**

Source: Mithun 2013

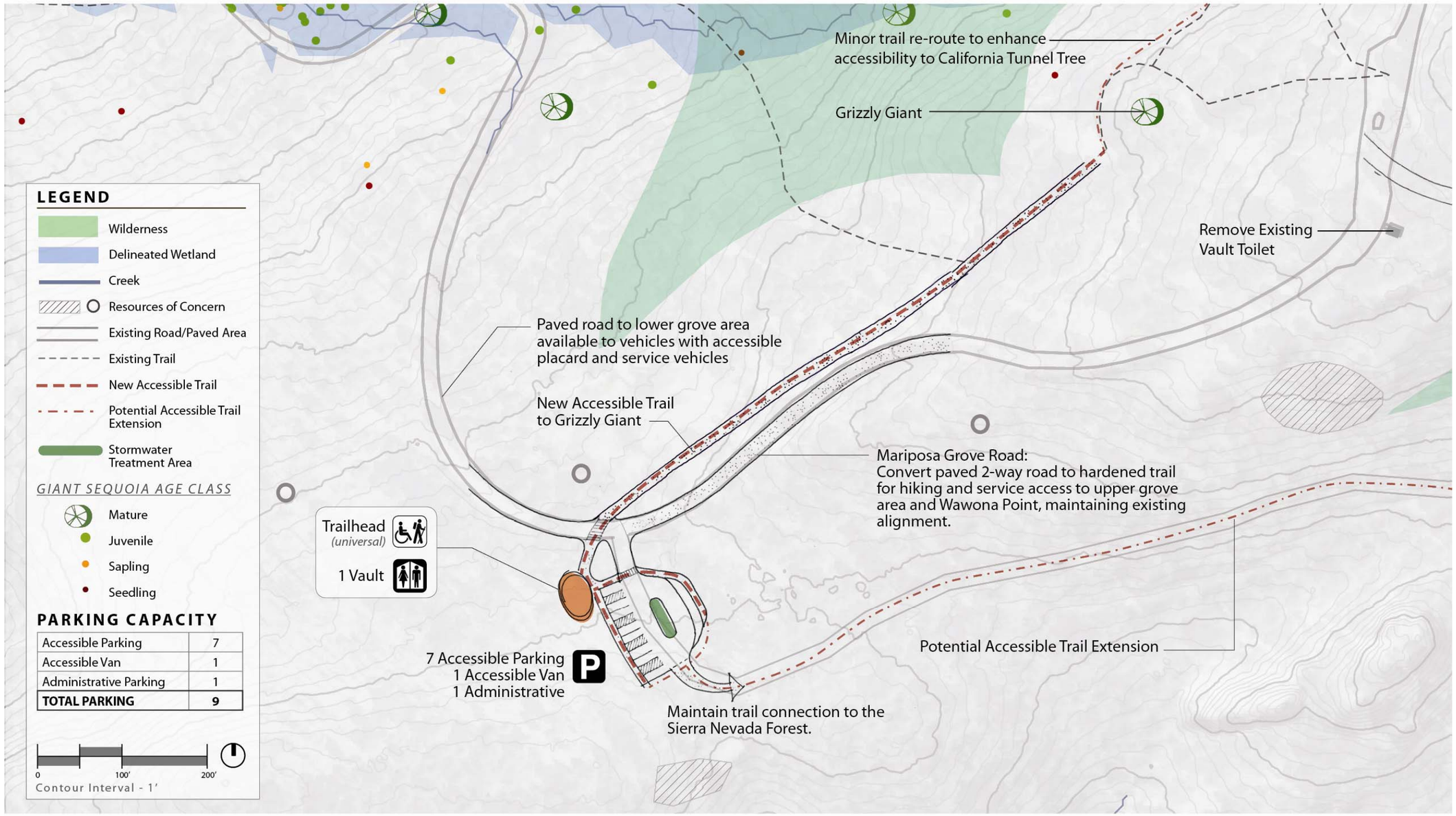
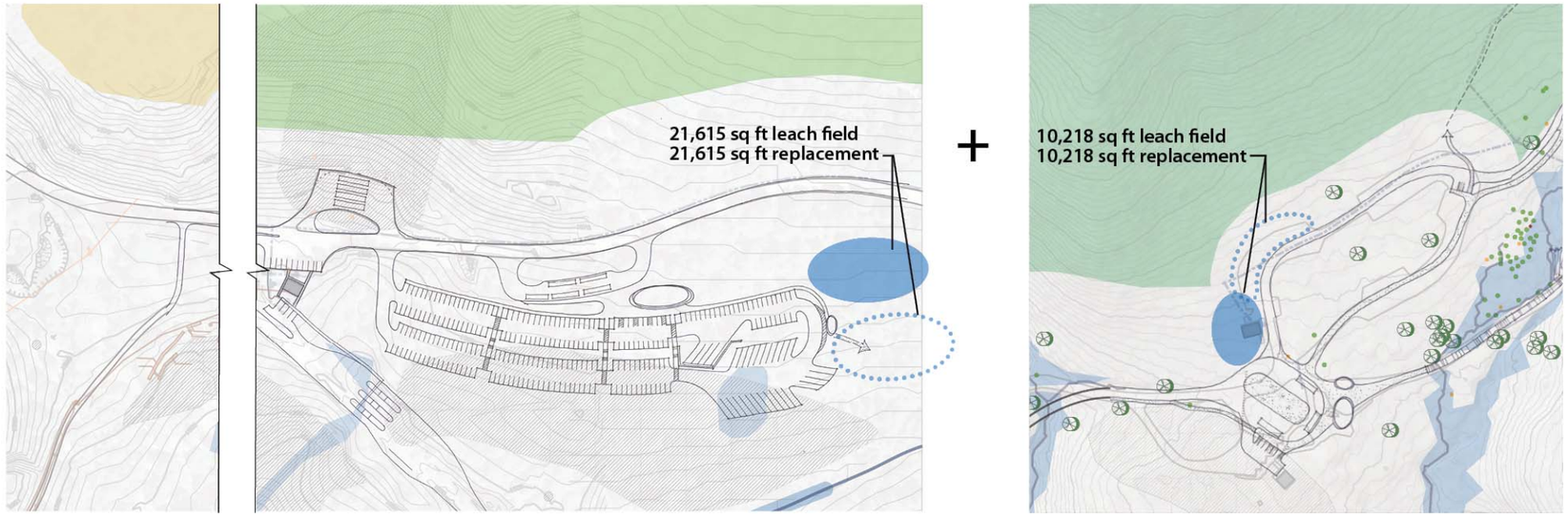


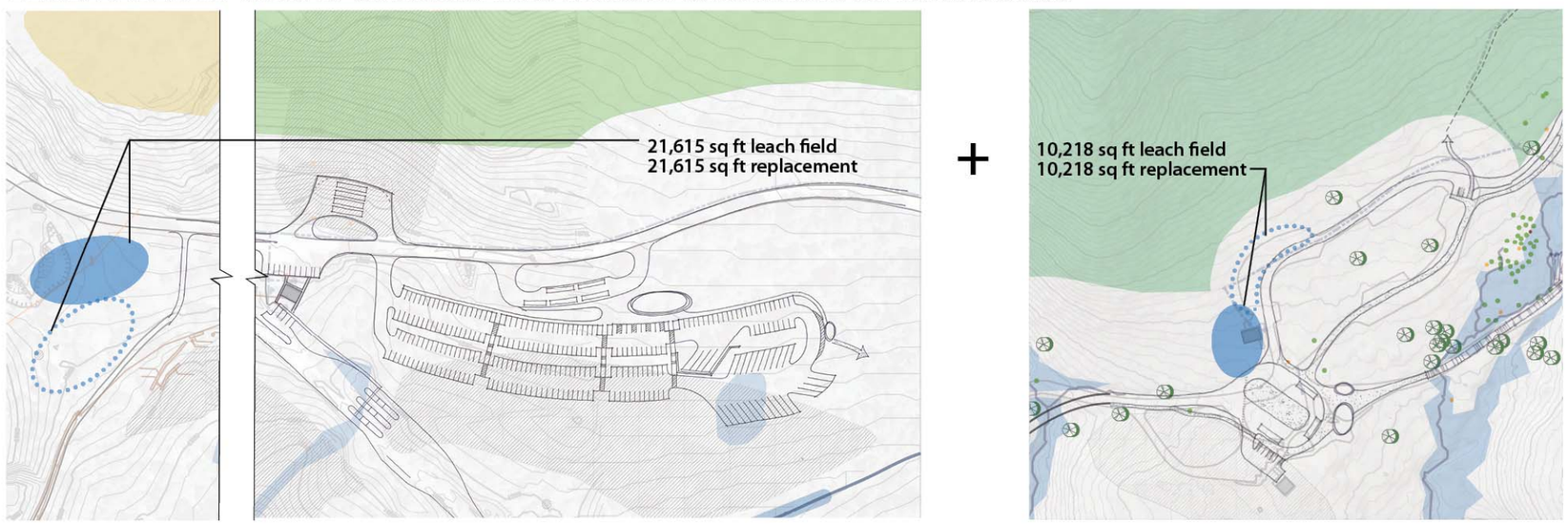

**Figure 2-8 – Alternative 2: South Entrance Hub Grizzly Giant Accessible Parking Area Detail**

Source: Mithun 2013

## LEACH FIELD OPTION A: TWO SEPARATE LEACH FIELDS AT SOUTH ENTRANCE *EAST* AND LOWER GROVE AREA




## LEACH FIELD OPTION B: TWO SEPARATE LEACH FIELDS AT SOUTH ENTRANCE *WEST* AND LOWER GROVE AREA




*Notes:*

- *Each leach field option requires the allocation of a 100% replacement area to be set aside for future use at the time the constructed leach field reaches the end of its life cycle. Replacement areas will not need to be constructed at the same time as the designated leach fields, but must be set aside for future use.*
- *Leach field and 100% replacement set-aside areas are representative, but site specific field conditions and additional code analyses will determine whether or not they are feasible.*

**LEGEND**

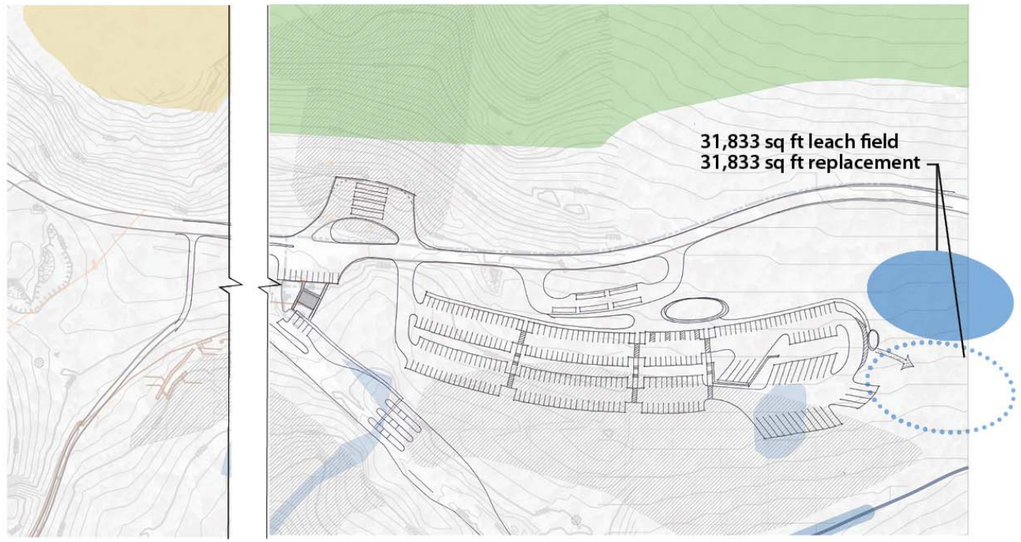
- Wilderness
- Potential Wilderness
- Delineated Wetland
- Creek
- Resources of Concern
- Leach Field
- Replacement Area

Scale Varies

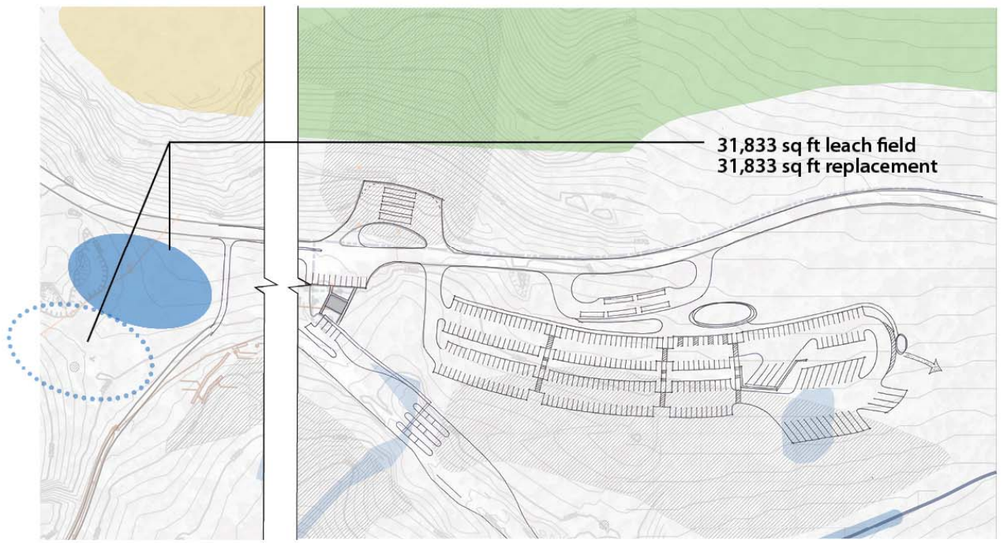
**Figure 2-9 –Alternatives 2/4: South Entrance Hub Options for Leach Field Locations**

Source: Mithun 2013

## LEACH FIELD OPTION C: ONE COMBINED LEACH FIELD AT SOUTH ENTRANCE *EAST (LOWER GROVE AREA WASTEWATER PIPED TO S. ENTRANCE)*




## LEACH FIELD OPTION D: ONE COMBINED LEACH FIELD AT SOUTH ENTRANCE *WEST (LOWER GROVE AREA WASTEWATER PIPED TO S. ENTRANCE)*




*Notes:*

- *Each leach field option requires the allocation of a 100% replacement area to be set aside for future use at the time the constructed leach field reaches the end of its life cycle. Replacement areas will not need to be constructed at the same time as the designated leach fields, but must be set aside for future use.*
- *Leach field and 100% replacement set-aside areas are representative, but site specific field conditions and additional code analyses will determine whether or not they are feasible.*

**LEGEND**

- Wilderness
- Potential Wilderness
- Delineated Wetland
- Creek
- Resources of Concern
- Leach Field
- Replacement Area

Scale Varies

**Figure 2-9 –Alternatives 2/4: South Entrance Hub Options for Leach Field Locations (continued)**

Source: Mithun 2013

The NPS is also exploring options for realigning the entrance to the Grove to enhance restoration efforts and straighten the existing tight curve near the giant sequoias in the vicinity of the Three Sentinels. This work would likely be completed in conjunction with the resurfacing of the Mariposa Grove Road between South Entrance and the Grove which would be completed at a future date. The bridge proposal is included as part of Alternative 2 to assess one of the options for sequoia habitat restoration in future road projects. The potential road realignment is shown on figure 2-7. The crossing over the creek (e.g., box culvert or bridge) would be relocated to improve safety, control erosion of the drainage channel, and avoid giant sequoias. Crossing design and construction would minimize impacts on nearby giant sequoias and wetlands.

Within Mariposa Grove, the paved road between the lower Grove and upper Grove areas currently used by the commercial tram would be narrowed and maintained as a hardened trail for pedestrian use and limited service vehicle access. Access would also be available for vehicles with accessibility placards to travel to accessible parking spaces at the Grizzly Giant trailhead. Service access is needed beyond the Grizzly Giant to maintain communications equipment at Wawona Point, comfort stations, and the upper Grove area leach field. The water supply treatment unit and storage tank currently located along the loop road would be relocated to the lower Grove to eliminate the need for maintenance vehicle access along the southern segment of the loop road, which would be narrowed to between 4 and 8 feet wide and converted into a hiking trail (figure 2-5). The remaining maintenance road to Wawona Point would undergo drainage improvements, including repair or replacement of existing culverts and minor grading to establish out sloping to improve surface sheet flow and reduce channelization and diversion of water outside the Grove watershed. To the maximum extent practicable, historic road prisms and materials would be preserved. The Mariposa Grove Museum building would be repurposed to a use such as hiker's rest shelter, and interpretive functions would be moved to the visitor contact area at the South Entrance hub. No physical modification of the historic building would be undertaken.

New septic systems and leach fields would be installed at both the South Entrance and the lower Grove area to accommodate flush toilets. The final locations of the new leach fields would be determined based on further analysis of resource and topographic constraints. The installation of septic in the lower Grove area would be contingent upon additional soil surveys; an additional option is installation of a sewer line between the Grove and the South Entrance that would be located within the Mariposa Grove road right-of-way. Several options for the leach field locations are shown in figure 2-9. There are four potential leach field options for the Alternative 2. Each leach field option would require the allocation of a 100% replacement area to be set aside for future use at the time the constructed leach field reaches the end of its life cycle. Replacement areas would not need to be constructed at the same time as the designated leach fields, but must be set aside for future use.

- Option A would require a 10,218 square foot leach field in the lower Grove area, in tandem with a second 21,615 square foot leach field on the east side of the proposed South Entrance parking lot. Both leach fields would require a viable replacement area of equal size in close proximity.
- Option B would also require a 10,218 square foot leach field in the lower Grove area, in tandem with a 21,615 square foot leach field on the west side of Wawona Road adjacent to the South Entrance station. Both leach fields would require a viable replacement area of equal size in close proximity.
- Option C would require a 31,833 square foot leach field on the east side of the proposed South Entrance parking lot. The leach field would require a viable replacement area of equal

size in close proximity. This option would require waste to be transported via a new wastewater pipe from the lower Grove area restrooms to the South Entrance leach field.

- Option D would require a 31,833 square foot leach field on the west side of Wawona Road at South Entrance Station. The leach field would require a viable replacement area of equal size in close proximity. This option would also require waste to be transported via a new wastewater pipe from the lower Grove area restrooms to the South Entrance leach field.

At the upper Grove area comfort station, the leach field would be replaced nearby, outside of sequoia habitat, and the chlorination and water tank would be relocated near the comfort station. The water supply pipeline would be repaired or replaced.

Two non-historic trail segments would be removed under Alternative 2: a section just above the Grizzly Giant that parallels the Mariposa Grove Road, and a segment that extends from the southern end of the upper Grove loop road northwestward to a point below and west of Wawona Point. As noted above, a 3,364–foot-long segment of the historic loop road in the upper Grove would be converted to a pedestrian trail 4 to 8 feet wide.

### Wawona Road/Mariposa Grove Road Intersection

Under Alternative 2, the park would reconstruct and possibly realign the intersection of Wawona Road and Mariposa Grove Road (figure 2-6). This would affect up to 700 feet of road beginning on Wawona Road approximately 200 feet south of its intersection with Mariposa Grove Road, and ending approximately 400 feet west on Wawona Road and 200 feet east on Mariposa Grove Road beyond the existing comfort station parking. A roundabout would be explored if the proposed kiosk improvements at the South Entrance (to be implemented in 2013) do not adequately address congestion for visitors coming into the South Entrance from Fish Camp. A proposed roundabout would be optimally located for the site conditions and roadway requirements and would have a 120-foot outside diameter to accommodate the existing type and volume of traffic using the intersection. There would be one lane of traffic in a counter-clockwise direction with an inner concrete paved circle with a mountable curb. The center of the roundabout could be revegetated. Realignment of the intersection is intended to reduce risk of collisions, better accommodate larger vehicles, increase the intersection's vehicle traffic capacity, improve clarity of way finding and travel directions for visitors, reduce traffic congestion at the intersection, and improve working conditions for NPS staff.

### Accessibility

Under Alternative 2, integrated, universally accessible transportation hubs/nodes, parking spaces, comfort stations, interpretive signs and displays, and trails at the South Entrance Station and lower portion of the Grove would allow park visitors with a greater range of physical abilities to experience and enjoy the Mariposa Grove. Visitors with vehicles displaying accessible parking placards could drive through the Grove to the Grizzly Giant. Several pullouts would be installed to allow these visitors to stop and view individual sequoias or groups of sequoias such as the Bachelor and Three Graces. Accessible parking spaces would be available at the lower Grove area and Grizzly Giant for visitors with accessible parking placards, and the existing vault toilet would also be improved at the Grizzly Giant. The shuttle originating at the South Entrance would also be available to visitors with limited mobility.

Accessibility improvements (consistent with ABAAS) would be made to the approach to the existing South Entrance comfort stations, which is a contributing feature to the historic district. Any alterations would be designed to meet the Secretary of the Interior's rehabilitation treatment standard for historic properties. Actions would be reversible, historic materials would be salvaged

and reintegrated, and character-defining stonework would be retained. Thresholds would be affected only to the extent necessary to allow for universal access, and modifications would be implemented per Secretary of the Interior's *Standards for the Treatment of Historic Properties*.

Additional accessible trails are proposed in the lower Grove area that would allow visitors of all abilities the opportunity to enjoy the beauty and tranquility of Yosemite's giant sequoia forest in a less crowded, more peaceful setting than is available under current conditions. Under Alternative 2, an accessible trail would be created in the ecologically restored lower portion of the Grove that would include boardwalks, and benches and viewpoints outside of paths of travel (see figure 2-7). The loop trails would enable all visitors, including those in wheelchairs or with otherwise limited mobility, to move beyond the activity of the parking and shuttle boarding area and into the Grove. Visitors could experience the beauty of the giant sequoias, including the Fallen Monarch, wetlands, streams, and wildlife at their own pace and in a more natural setting. A short interpretive loop at the lower portion of the Grove hub would take visitors along the stream and near cultural resources. Specific accessible trail alignments will be refined based on site conditions and to maximize use of previously disturbed areas.

A similarly accessible, approximately 2,000-foot-long trail would be built along a previously abandoned trail and existing trails to the Grizzly Giant (see figure 2-8). This trail would extend beyond the Grizzly Giant for approximately 400 feet to the California Tunnel Tree, and then beyond for just over 300 feet to an open overlook on a small ridge between two streams. The overlook would offer visitors a glimpse of the landscape context of the Grove; the hillslopes, forest, wetlands and streams that comprise the habitat of the giant sequoias. A trail leading to the adjacent Sierra National Forest is also located at the Grizzly Giant trailhead where the new accessible parking spaces would be located. A potential accessible trail extension could start here, and would wind through forest, past a massive granite outcrop, to a small wetland within the park boundary (see figure 2-8).

## Alternative 3: Grizzly Giant Hub

Alternative 3, Grizzly Giant Hub, would include removal of the Mariposa Grove parking lot, gift shop, and commercial tram staging area and operations to allow for comprehensive restoration of wetlands, soundscapes, and giant sequoia habitat. Under Alternative 3, a new Grove bypass road, including two bridges, would be routed south of the current Grove access road to a new parking lot southwest of the Grizzly Giant, and outside of giant sequoia habitat (figures 2-10 through 2-12). The new parking area at Grizzly Giant would serve as the primary departure point for visitors wishing to enter the Grove and would be open to all private vehicles (including recreational vehicles and trailers) and buses. At the Grizzly Giant Hub, vault toilets would be used due to the infeasibility and high cost of delivering water to, and disposing of wastewater at, this location.

The roadway between the Grizzly Giant and Wawona Point area would be converted to a hardened trail between 10 to 12 feet wide. Service vehicles would still use the hardened trail for access to the telecommunications facilities at Wawona Point and other facilities in the upper Grove area. The existing road from the lower Grove area to the Grizzly Giant area would be converted to a trail that is between 4 and 8 feet wide. The remaining road would undergo drainage improvements, including cleaning of existing culverts and installation of new culverts to improve water infiltration and prevent diversion of water outside the Grove. Vault toilets along the road within the Grove would be removed. Similar to Alternative 2, a 3,364-foot-long segment of the loop road above the Mariposa Grove Museum would be converted into a 4- to 8-foot-wide pedestrian trail.

The current parking lot in the lower Grove area would be removed. Transit service to the Grove from the South Entrance would be discontinued, and the commercial tram would no longer operate. During heavy visitation, electronic signs at the South Entrance would advise visitors when parking at the Grizzly Giant is at capacity. A significantly smaller parking lot providing up to ten ABAAS-compliant accessible parking spaces, trailhead, and loop trail at the lower Grove area, and a new accessible trail at the Grizzly Giant would serve visitors with disabilities. Other visitors could choose to explore the lower Grove area using existing trails near the Grizzly Giant.

Two non-historic trail segments would be removed under Alternative 3: a section just above the Grizzly Giant that parallels the Mariposa Grove Road, and a segment that extends from the southern end of the upper Grove loop road northwestward to a point below and west of Wawona Point. Other trails within the Grove with connections to Wawona and south and east to Sierra National Forest land would remain.

The new bypass road build-out footprint would be 2.20 acres, primarily through non-giant sequoia forest. Approximately 0.33 acre would be in identified giant sequoia forest, and 0.10 acre would be raised crossings over wetlands. Under Alternative 3, the current Wawona Road/Mariposa Grove Road T-intersection would be retained, and would be the same as described for Alternative 1 (No Action).

### Accessibility

Under Alternative 3, ten ABAAS-compliant parking spaces, trailhead, and loop trail would be developed at the lower Grove area. An additional seven accessible parking spaces would be provided at the main hub at Grizzly Giant, as well as a new accessible trail to the Grizzly Giant.

Alternatives 2 and 3 both provide accessible trails from the lower Grove area and Grizzly Giant, but Alternative 3 would not provide for additional potential accessible trail development at these locations. Under Alternative 3, accessible facilities would remain unchanged at the South Entrance and the shuttle that accommodated visitors with limited mobility would no longer operate.

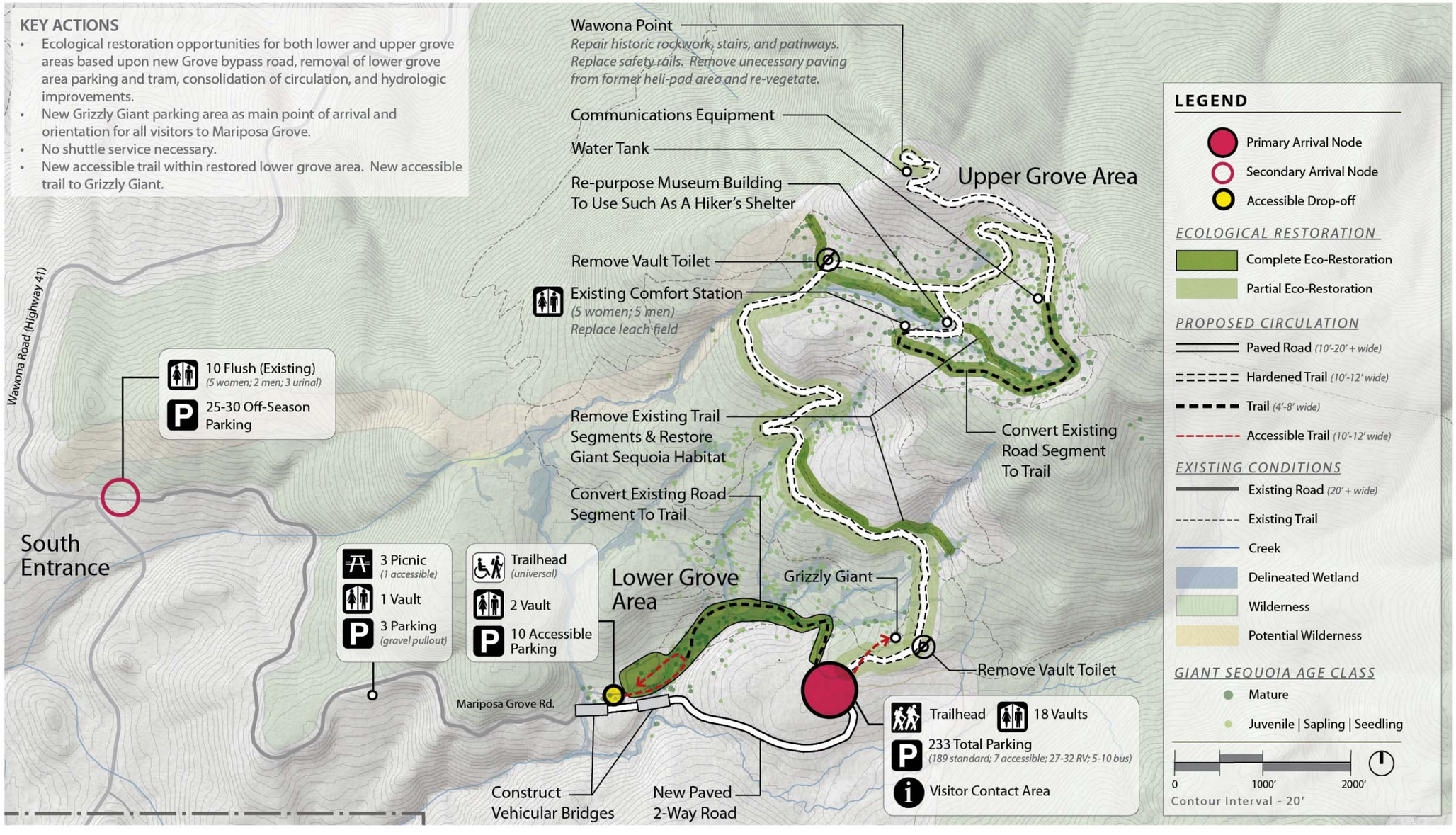



**Figure 2-10 – Alternative 3: Grizzly Giant Hub**

Source: Mithun 2013

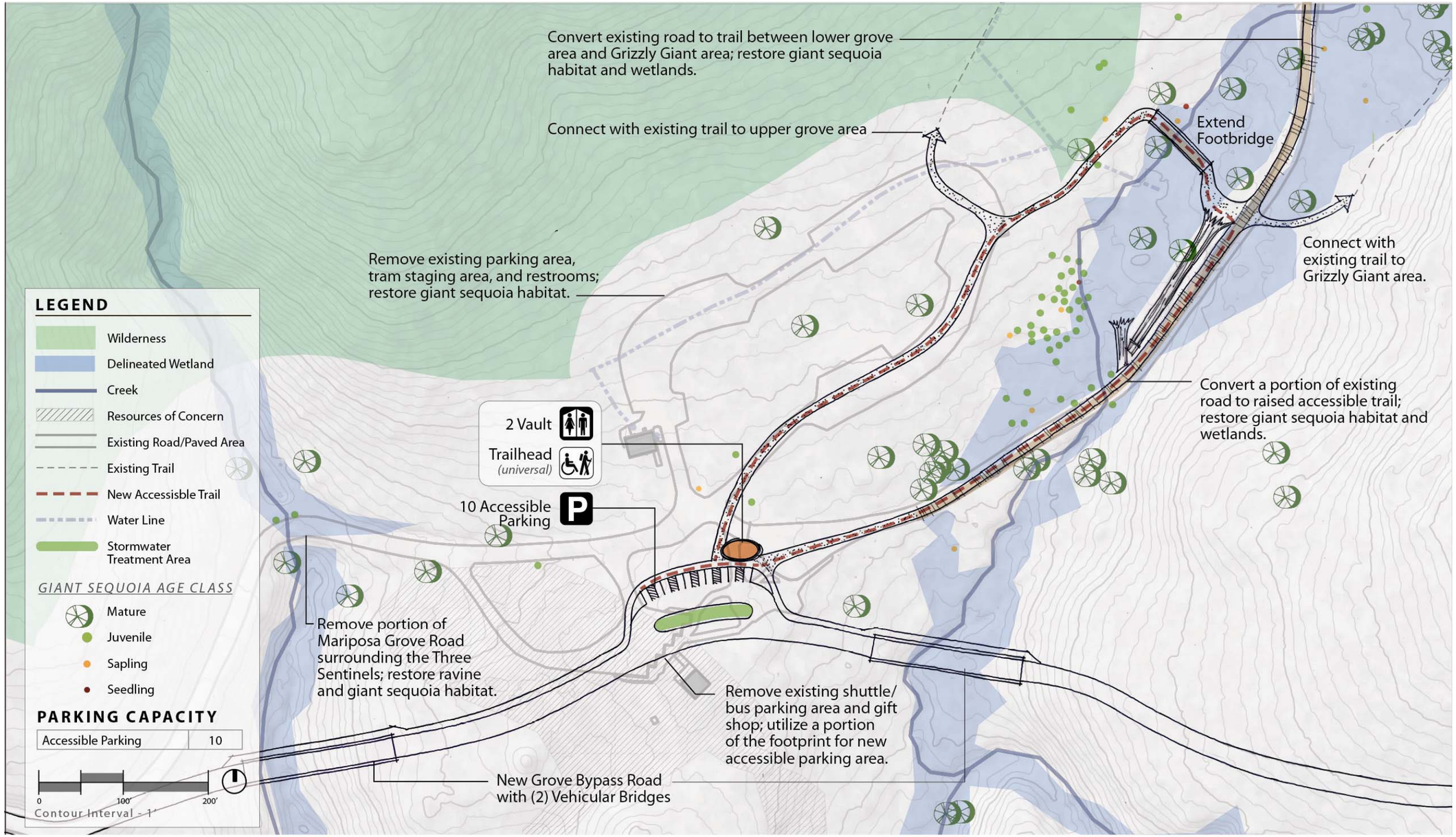



**Figure 2-11 – Alternative 3: Grizzly Giant Hub – Lower Grove Area Detail**

Source: Mithun 2013

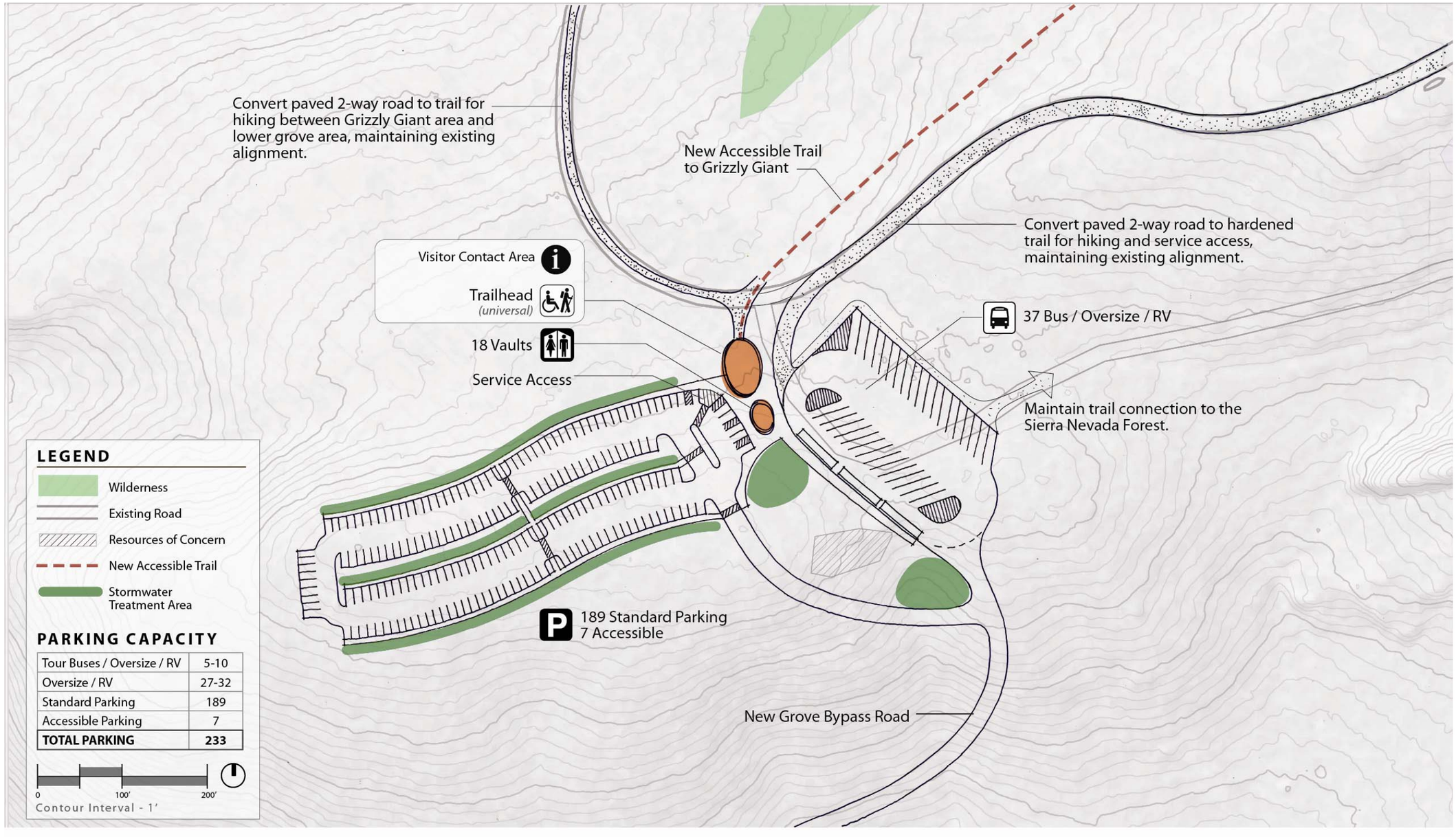



**Figure 2-12 – Alternative 3: Grizzly Giant Hub – Grizzly Giant Area Detail**

Source: Mithun 2013

## ALTERNATIVE 4: SOUTH ENTRANCE HUB WITH MODIFIED COMMERCIAL TRAM SERVICE

Alternative 4, South Entrance Hub with Modified Commercial Tram Service, would remove public parking, the gift shop, and commercial tram staging from Mariposa Grove, and relocate these facilities to the park's South Entrance. Previously developed areas not slated for reuse would undergo ecological restoration of wetlands and giant sequoia habitat, similar to that described for Alternative 2. An overview of the principal components of Alternative 4 is shown in figure 2-13, and details are depicted in figures 2-14 through 2-16.

Under Alternative 4, visitor parking would be relocated to South Entrance east of Wawona Road and south of the Mariposa Grove Road (figures 2-13 and 2-14). The proposed configuration at the South Entrance as the primary arrival node would be very similar to Alternative 2. However, the commercial tram tour would operate from the South Entrance, with stops at the lower and mid Grove areas, and the Mariposa Grove Museum. To obtain a balance between visitor access and opportunities for quiet and solitude in the upper portion of the Grove, the hours of operation for the tram would be reduced.

Shuttle service would also continue to operate as a free service between the South Entrance and the lower area of the Grove. Under Alternative 4, the shuttle and the commercial tram would share the same road from South Entrance to the lower Grove area. In addition, a shuttle with a more limited schedule than existing conditions would connect visitors staying at the Wawona Hotel and campground or nearby private accommodations with the South Entrance. No new shuttles would be required; the current schedule would be modified.

The paved road through Mariposa Grove would undergo drainage improvements, including installation of new culverts to improve sheet flows and reduce channelization and diversion of water out of the Grove watershed. The paved road would be maintained to the historic museum building and restroom in the upper portion of the Grove, and tram service would transport visitors to the upper Grove along this road. Similar to the other action alternatives, a 3,364-foot-long segment of the loop road in the upper Grove area would be converted into a 4- to 8-foot wide trail. The Mariposa Museum would be repurposed to another use such as a hiker's shelter, and interpretive functions would be moved to visitor contact area at the South Entrance hub.

A comfort station with flush toilets would be provided at the South Entrance Hub. A new septic tank and leach field would be installed at the South Entrance to accommodate additional flush toilets (see figure 2-14 and options shown in figure 2-9). The final locations of the new leach fields would be determined based on further analysis of resource and topographic constraints. The options for the leach fields would be the same as described under Alternative 2. The installation of septic in the lower Grove area would be contingent upon additional soil surveys; an additional option is installation of a sewer line between the Grove and the South Entrance that would be located within the Mariposa Grove Road right-of-way.

Path-of-travel accessibility improvements would be made to the historic comfort stations at the South Entrance and in the upper Grove area. Building modifications would be designed to meet the Secretary of the Interior's rehabilitation treatment standard for historic properties. Historic materials, such as any character-defining stonework along the existing paths to the comfort stations, would be incorporated into the upgraded accessible paths-of-travel in a manner consistent with the Secretary of the Interior's Rehabilitation Standard. The upper Grove leach field would be renovated, and the leaking water line would be repaired or replaced.

One non-historic trail segment would be removed under Alternative 4: a section that extends from the southern end of the upper Grove loop road northwestward to a point below and west of Wawona Point. Because of occasional commercial tram use of the Mariposa Grove Road, the non-historic trail segment proposed for removal under Alternative 2 would remain under Alternative 4 to give pedestrians a vehicle-free option above the Grizzly Giant.

### Wawona Road/Mariposa Grove Road Intersection

Under Alternative 4, the park would reconstruct and possibly realign the intersection of Wawona Road and Mariposa Grove Road (figure 2-14). This would include up to 700 feet of road beginning on Wawona Road approximately 200 feet south of the intersection with Mariposa Grove Road, and ending approximately 400 feet west on Wawona Road and 200 feet east on Mariposa Grove Road beyond the existing comfort station parking. Under Alternative 4, the T-intersection would be shifted to the northwest, making the entrance into the park a through movement directly toward Wawona and Yosemite Valley destinations, and allowing a right turn onto the Mariposa Grove Road as the minor intersecting roadway. A protected left turn lane for traffic coming from Yosemite Valley and headed toward Mariposa Grove would be provided. This would widen the existing exit lane to three lanes: one in each direction and a turning lane. Realignment of the intersection is intended to reduce accident risks, better accommodate larger vehicles, increase the intersection's through-traffic capacity, improve clarity of way finding and travel directions for visitors, reduce traffic congestion at the intersection, and improve working conditions for Yosemite National Park staff.

### Accessibility

Under Alternative 4, placarded vehicles would be able to drive beyond the Grizzly Giant into the upper Grove area. Accessible parking spaces would be provided at the upper Grove (4 spaces) as well as Grizzly Giant (4), lower Grove area (6), and South Entrance (7). The tram would also be available for visitors with limited mobility from the South Entrance to the upper Grove, with several stops in between. Visitors would be able to experience the mid-Grove area from an accessible overlook; unlike Alternatives 2 and 3, an accessible trail would not be constructed under Alternative 4. The shuttle originating at the South Entrance would also be available to visitors with limited mobility to take to the lower Grove.

Accessibility improvements would be made at the South Entrance, lower Grove area, and upper Grove. An accessible trail would be constructed in the ecologically restored lower Grove area, and an accessible overlook would be provided at the Grizzly Giant.

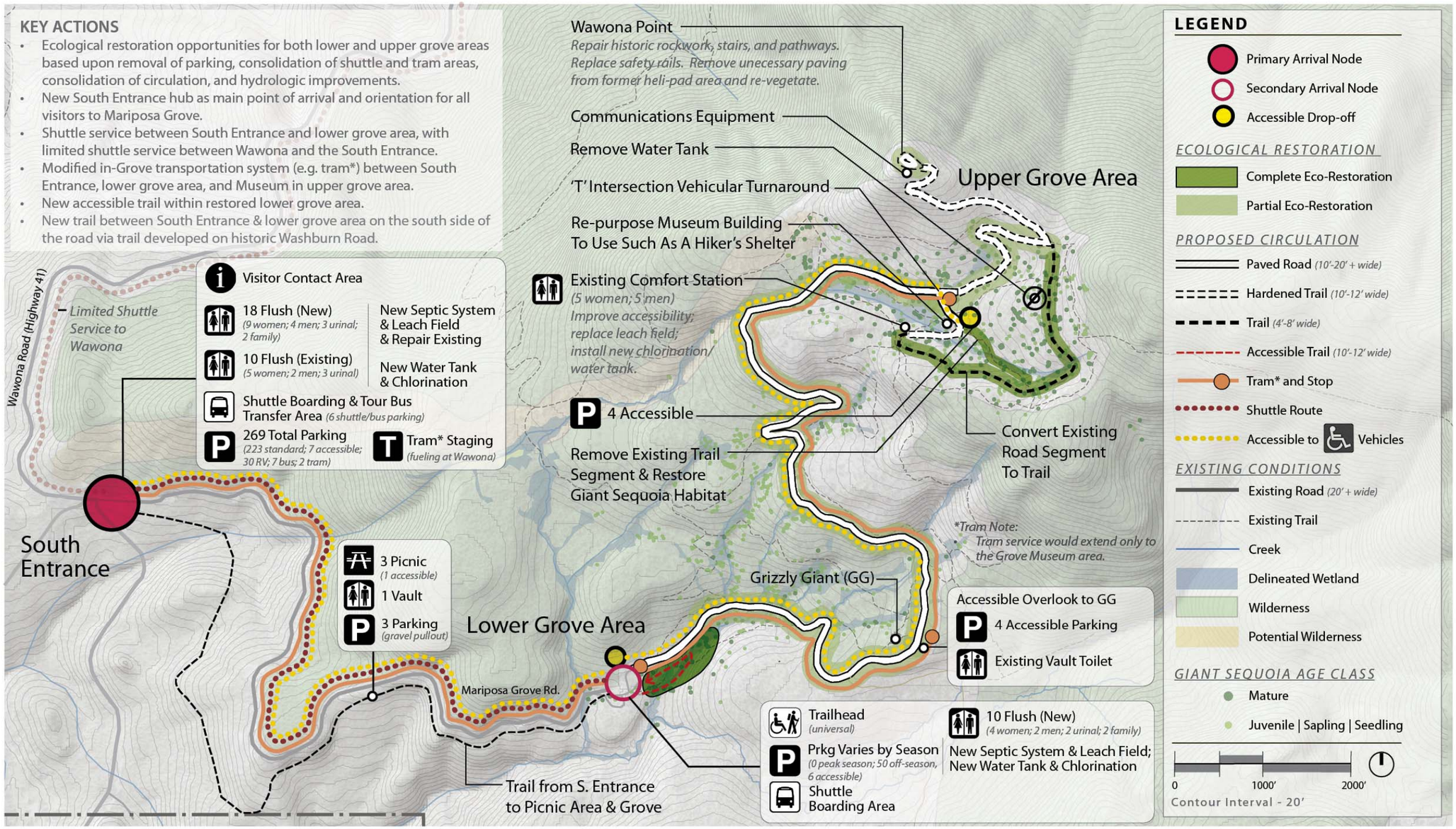



**Figure 2-13 – Alternative 4: South Entrance Hub with Commercial Tram Service**

Source: Mithun 2013

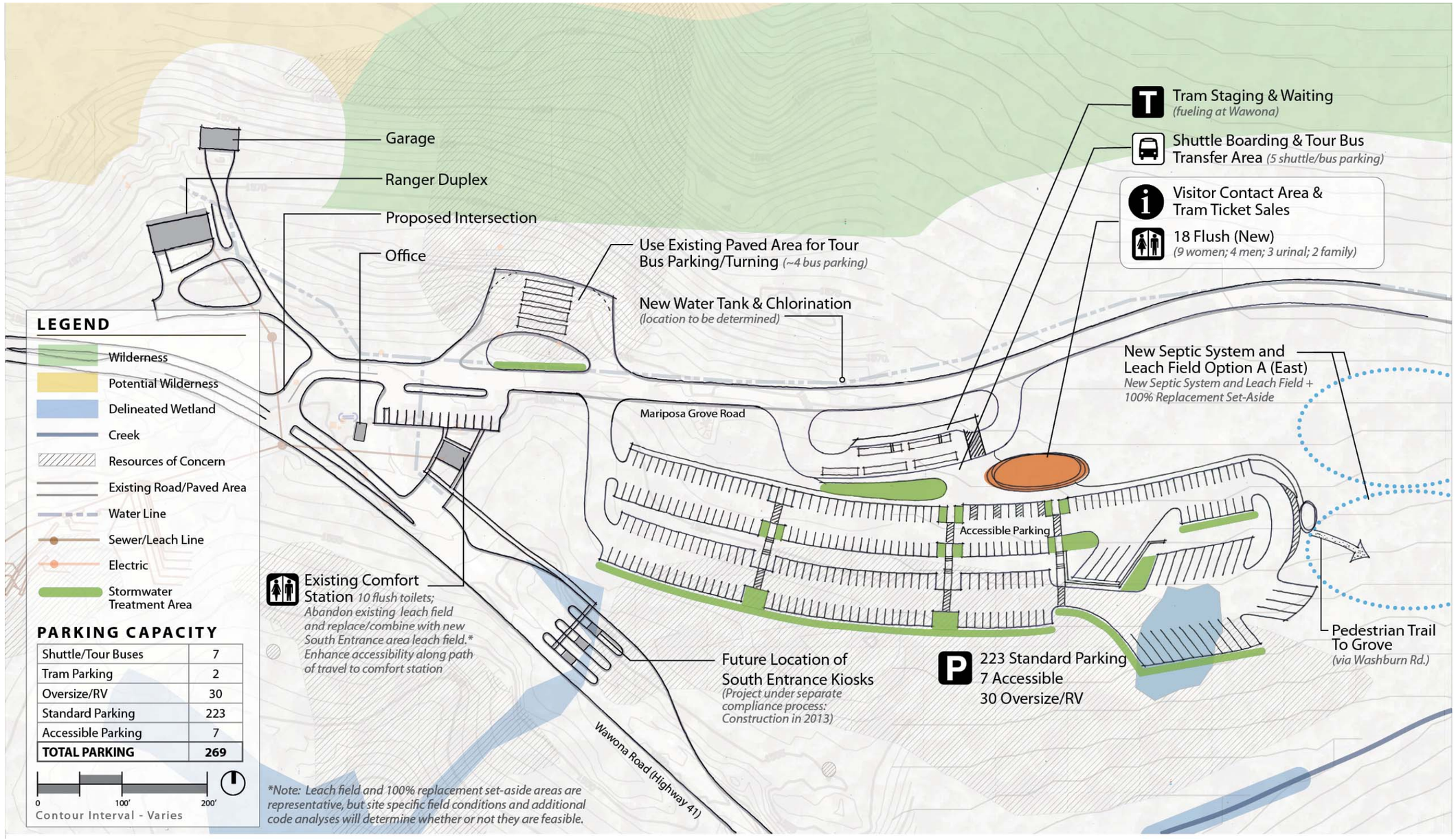



**Figure 2-14 – Alternative 4: South Entrance Hub with Commercial Tram Service – South Entrance Detail**

Source: Mithun 2013

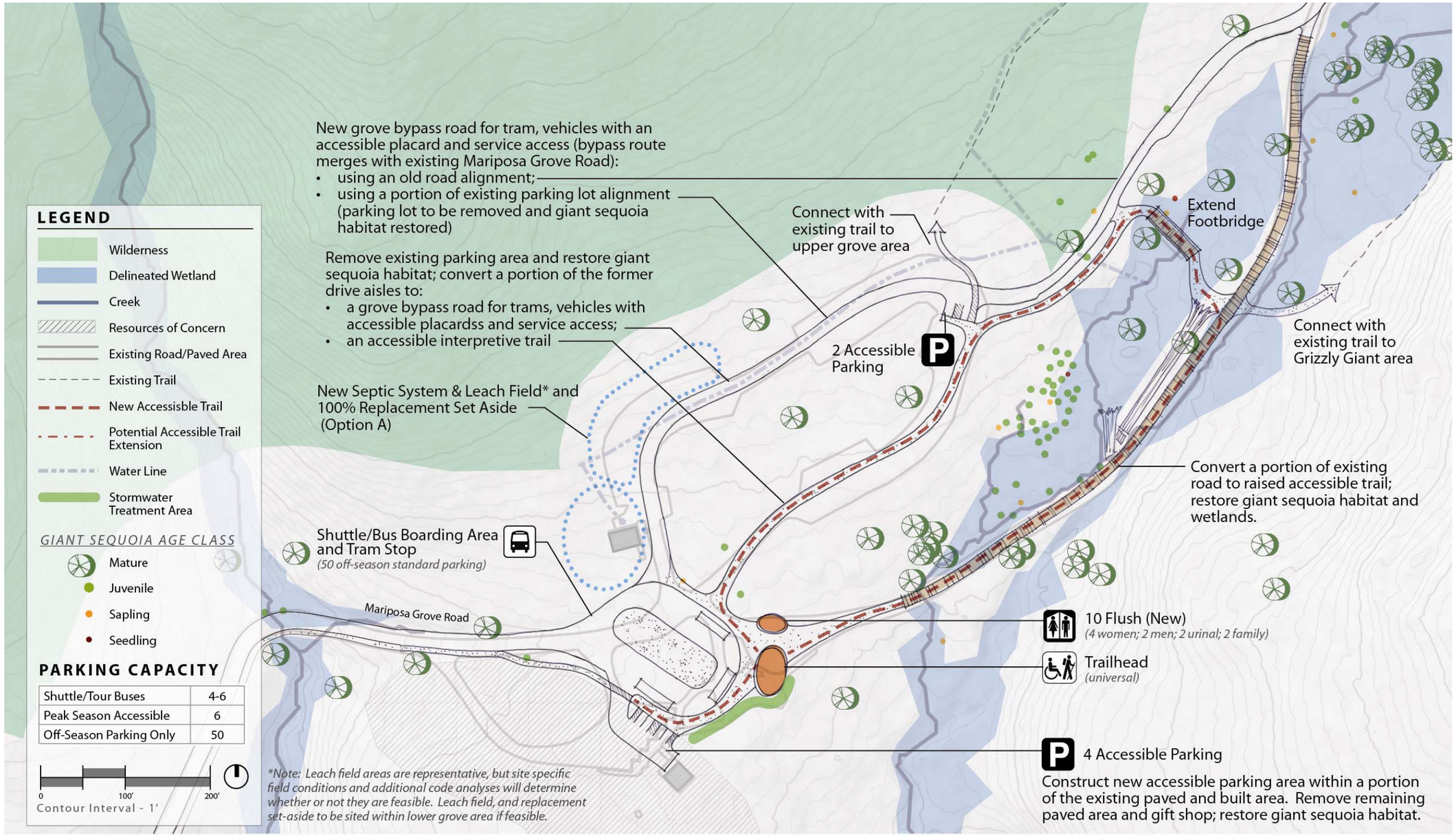



**Figure 2-15 – Alternative 4: South Entrance Hub with Commercial Tram Service – Lower Grove Area Detail**

Source: Mithun 2013

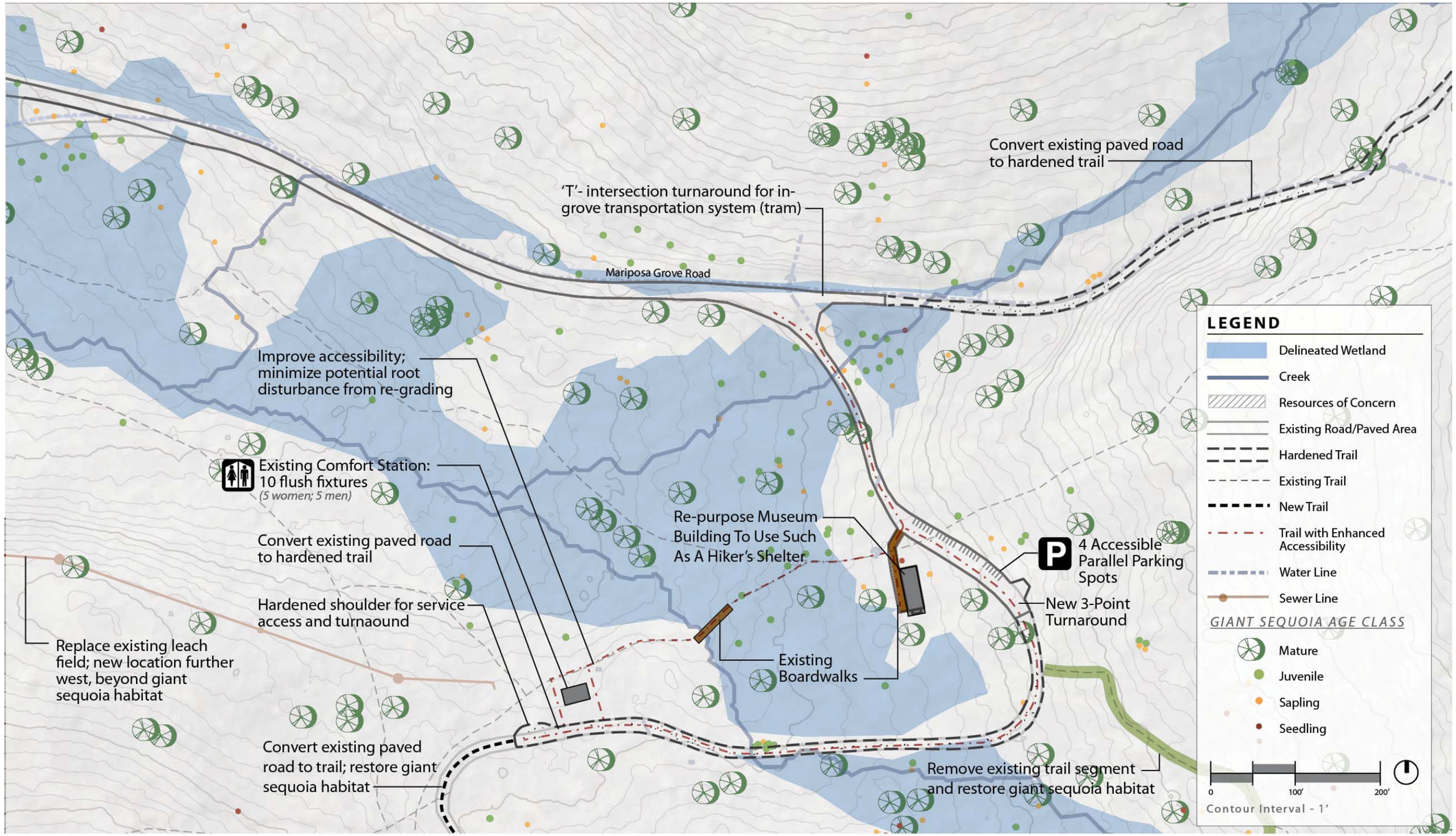



**Figure 2-16 – Alternative 4: South Entrance Hub with Commercial Tram Operation – Upper Grove Area Detail**

Source: Mithun 2013

## ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

Under the National Environmental Policy Act (NEPA), an alternative may be eliminated from detailed study for the following reasons (Title 40 Code of Federal Regulations [CFR] Part 1504.14 (a)):

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

The following alternatives and options were considered during the preliminary design phase of the Mariposa Grove of Giant Sequoias restoration project; because they met one or more of the above criteria, they were eliminated from detailed analysis in this EIS.

### Lower Grove Area Hub

This alternative was developed to explore low-cost changes that might make a significant difference in resolving the major issues at the Mariposa Grove. In this alternative, the commercial tram would be removed, the Mariposa Grove parking lot would have a smaller footprint, and modest giant sequoia habitat restoration could be achieved in the lower Grove area that would improve existing conditions. An accessible trail could be constructed, and restroom accessibility at the lower Grove area could be greatly improved. This conceptual alternative had an accessible viewpoint overlooking the Grizzly Giant, but no accessible trails. The primary arrival point and contact area for visitors would have remained in the lower Grove area, and access and parking would remain fragmented at the Grove, South Entrance, and Wawona. The alternative, though offering some restoration opportunities, did not adequately address the purpose and need components of addressing the sustained overflow parking problems at South Entrance and the subsequent adverse impact on visitor access times and visitor experience. In addition, lower Grove area buildings and infrastructure that are currently adversely impacting giant sequoias as well as other sensitive resources such as wetlands would have remained under this alternative. Therefore, because this alternative did not adequately meet the project purpose and need, it was dismissed from further analysis.

### South Entrance Hub, Complete Commercial Tram Road Removal, Relocate Wawona Point Communications Equipment

An alternative was devised that would offer extensive giant sequoia habitat restoration by completely removing and restoring the existing commercial tram/service road from the lower Grove area to Wawona Point, including the upper Grove area loop road. Other aspects of this alternative were essentially the same as the Alternative 2, South Entrance Hub. To eliminate the service road, the NPS would have had to relocate the recently installed communications tower at Wawona Point. The location of the Wawona Point communications tower is a critical component of the park-wide communications network. The tower requires periodic maintenance (e.g., refueling) throughout the year, and therefore must be accessible via a roadway that must be accessible to service vehicles.

The park reviewed possible sites for tower relocation, but the only suitable alternate location lies within designated wilderness, and relocation costs would be prohibitive, possibly exceeding several

million dollars. The project team also considered alternate power supply for the Wawona Point equipment, but determined that new power transmission lines would cross designated wilderness, solar panels would be unreliable in the winter due to snow cover, and delivery of propane via other transportation modes (e.g., helicopter) during winter months would require extensive site preparation and would be expensive and unreliable during inclement weather. Because the communications tower and the current fueling system could not reasonably be relocated or replaced, the "full" restoration benefits envisioned in this alternative could not be realized, and the alternative ended up being nearly identical to Alternative 2: South Entrance Hub. Therefore, this alternative was dismissed from further analysis. Under the retained action alternatives, the road to Wawona Point would continue to be hardened for occasional vehicular use until such time that the telecommunications tower becomes obsolete due to technological advances, after which more permeable trail surfaces may be explored.

### Studhorse Parking

NPS considered adding supplemental parking at the Studhorse parking area located on Wawona Road between Wawona and the South Entrance, to support visitation at the Mariposa Grove. However, the area's proximity to designated wilderness and topographic constraints made a new large parking lot infeasible in the area. In addition, the South Entrance area, being in closer proximity to the Grove, provides more logical centralized placement for Grove visitor parking. Therefore, this area was dismissed as a possible parking component of the alternatives, and was not evaluated further.

### Sierra National Forest Parking Siting

NPS considered collaborating with the U.S. Department of Agriculture, Forest Service to create a collection/parking hub and visitor contact area for Mariposa Grove in the Goat Meadow snow play area on Sierra National Forest land, or using Sierra National Forest land for road access. Extensive issues with road widening and fee collection were identified. Complications of planning and managing an out-of-park site with multiple jurisdictions, and a desire to have visitor facilities for the Mariposa Grove closer to the Grove and within the boundaries of the park, led to the dismissal of this option.

### New Parking at South Entrance West of Wawona Road

The option of developing new parking on the west side of Wawona Road, near the Wawona Road/Mariposa Grove Road intersection, was considered. Initial analysis indicated this would likely be problematic in terms of topography, visitor orientation, traffic flow, and pedestrian safety. The main concerns were the safety of entrances and exits on the Wawona Road curve, and the complication of pedestrians crossing the highway safely. A possible vehicle or pedestrian underpass beneath Wawona Road was considered to mitigate some of the safety concerns, but the cost associated with a grade separation at this location, coupled with the difficulty in maintaining efficient operations at the South Entrance due to parking congestion, led to dismissal of this alternative. Operational concerns were also a concern, as the park service ranger shooting range would be close to the proposed visitor parking. Parking on the east side of the road is more intuitive for people going eastward from South Entrance to Mariposa Grove and allows for a simpler transition for people entering the park from the south. This option also would displace the existing septic system and leach field at South Entrance. The possibility of routing wastewater from South Entrance to the Wawona treatment plant via a new sewer line that would be constructed along Wawona Road also was considered. However, the 7-mile-long sewer line was determined to be cost-prohibitive, at an estimated cost of $12 million to $14 million, and this option was dismissed.

### Oakhurst or Fish Camp Parking and Visitor Contact

Developing a visitor contact area (similar to that in Mariposa) and possible parking outside park boundaries in Fish Camp or Oakhurst was considered. Complexities with land and building ownership outside the park and a desire to have visitor facilities for the Mariposa Grove closer to the Grove and within the boundaries of the park led to the dismissal of this option.

# MITIGATION MEASURES

NPS places a strong emphasis on avoidance, minimization, and mitigation of adverse impacts under NEPA, and adverse effects under NHPA. To help ensure that project activities protect natural, cultural, and social resources and the quality of the visitor experience, mitigation measures have been developed. Standard mitigation measures that would occur prior to, during, and after construction of specific management and project actions are presented in Appendix A, Standard Mitigation Measures. Additional mitigation measures may be identified through consultation with the California SHPO under 36 CFR Part 800 and implemented through a project-specific Memorandum of Agreement.

Additional project-specific mitigation measures and management practices were developed to ensure protection of resources in the Mariposa Grove of Giant Sequoias during project implementation and are listed below. Many of these measures and practices are based on the successful giant sequoia ecological restoration project in Giant Forest, Sequoia National Park (USDI 1995). Additional mitigation measures are identified as part of the draft Statement of Findings for Protection of Wetlands; these measures are described in Appendix D.

## GENERAL PRACTICES

- All equipment used in the Grove should have a low compaction factor and may include excavator, dozer, backhoe, loader, skid steer, and/or dump truck.
- Ensure that construction or restoration actions do not impact the surrounding area, specifically giant sequoia, wetland, or riparian ecosystems or any primary ecological processes, by limiting size and development of staging and construction areas, and confining them to developed or disturbed areas to the extent practicable.
- Minimize any impacts on giant sequoias including damage to boles, roots, root zone, and seedling habitat.
- Minimize impacts on hydrology and water quality, and control erosion potential.
- Minimize impacts on wetlands and processes (i.e. hydrology) that sustain them.
- Minimize impacts on wildlife by monitoring and scheduling (i.e. modifying time of day, season, etc.) construction and maintenance activities to avoid sensitive life stages and activities, including but not limited to breeding, nesting, fledging, denning, and whelping seasons for special status wildlife species.
- Ensure that any soil or amendment imported from outside the Grove for use in the Grove is checked for pathogens (e.g., root rot) to limit the spread of tree diseases
- Ensure that all equipment and materials are weed seed free.
- Protect rare or sensitive plant and animal species from direct and indirect impact.

- Protect restoration areas from further impacts with fencing or appropriate deterrents.
- Establish vegetation monitoring plots (both qualitative and quantitative) and photo-document project implementation and results.
- Ensure consistency with the Secretary of Interior's *Standards for the Treatment of Historic Properties* on actions affecting historic properties. The park would seek to first avoid, then minimize and lastly mitigate any actions adversely affecting historic properties.

## WILDLIFE

Based on all available anecdotal and scientific evidence, 78 amphibian, reptile, mammal, and bird species occur in the Mariposa Grove and South Entrance project area. Of these 78 species, 13 are special status species, including 7 bird species (northern goshawk, golden eagle, peregrine falcon, bald eagle, great gray owl, California spotted owl, and olive-sided flycatcher) and 6 mammal species (pallid bat, spotted bat, western red bat, western mastiff bat, Sierra Nevada mountain beaver, and Pacific fisher).

Snags are an essential habitat element for the majority of special status species documented using the Mariposa Grove. Removal of snags may indirectly result in decreased rates of reproduction and increased rates of mortality for fisher (USDA Forest Service 2001), and spotted owls use cavities in snags for nesting and raising young. The following management recommendations protect key habitat features for fisher, bats, and owls

- Minimize hazard tree removal and protect and restore vegetation and wildlife habitat
  - Retain and recruit large-diameter snags (Freel 1991; Buskirk and Powell 1994) and large-diameter (greater than 24-inch-diameter at breast height) live conifer and oak trees with decadence such as broken tops or cavities (Freel 1991).
  - Retain and recruit large woody debris, including large-diameter (at least 15-inch diameter at breast height by 15-foot length) downed logs (Freel 1991, Buskirk and Powell 1994) and complex structure near the ground (e.g., downed logs, large downed branches, root masses, live branches) (Buskirk and Powell 1994).
- If hazard tree removal cannot be avoided
  - Remove snags only under consultation with the park biologist and park forester.
  - Prior to removal, a wildlife biologist will examine any trees and snags for nesting, denning, or roosting wildlife.
- Avoid disturbing basal hollows (created by repeated fires), deep bark furrows, and cavities and crevices of tree crowns important for bats and other wildlife (Pierson et al. 2006).
- FISHER: Park biologists will continue to work closely with fisher researchers working in and around Yosemite National Park to establish whether fisher are actively foraging or denning near the project area. Mitigation for the Pacific fisher would include adding wildlife culverts/underpasses or inserting culvert structures at riparian crossings near South Entrance and Mariposa Grove, and along Wawona and Mariposa Grove roads as any construction work is being done. The park would continue monitoring active fishers in the park and vicinity of the Grove to better inform project work and operations and provide a buffer to prevent disturbance around any active dens. Fuels reduction activities would occur outside of maternal season. Large-diameter woody debris, mature black oaks and cedars with cavities for denning, and foraging habitat would be retained as is possible. Canopy cover, especially

in riparian zones, would be retained as is feasible. The park would provide a mosaic of age class and structure through restoration, but would maintain connectivity of quality habitat and riparian habitat that promotes survival and dispersal of individuals. Additional protection measures would be identified as deemed necessary to avoid disturbance during construction or restoration-related activities.

- OWLS: Conduct surveys in the spring (beginning March 15) to determine if spotted owls are nesting or foraging in the vicinity of the construction/restoration area. If owls are present, the park construction project manager should work with park biologists to determine appropriate measures to avoid disturbance, such as no construction activities between 30 minutes before dusk and 30 minutes after dawn, and an approximate 1,250-foot buffer of no disturbance (light or noise) around nest trees from March 15 through August 31.
- BATS: If a project targets any trees for removal during the winter, a biologist should survey for roosting bats the preceding fall (September and October). If the biologist suspects hibernation in a tree, do not remove that tree until mid-April to mid-May. If a project targets any trees for removal during the summer, a biologist should survey for roosting bats within one week prior to removal to determine if a bat maternal colony occurs in the tree.
- WILDLIFE USE: In construction zones, conduct owl and bird surveys and bat acoustic surveys and install carnivore cameras as needed to inform proper mitigation actions that would reduce impacts on wildlife.

## Soil Conditions

Where soils are heavily compacted and are covered with asphalt, soil conditions may be such that reestablishment of vegetation is unlikely without further treatment. Demetry (1997) found that soil impacts most frequently observed in Giant Forest were soil compaction, loss of organic matter, topsoil erosion, and loss or alteration of natural soil structure. Soil compaction was greatest under pavement (Demetry 1997).

Soil conditions in restoration areas of the Mariposa Grove will be tested for compaction, texture, and chemical properties such as organic matter content and nitrogen, and amendments or treatment will be applied accordingly. Listed below is a range of soil treatments available to improve the potential for plant establishment, particularly giant sequoias.

- Measure depth of compaction with a penetrometer and decompact to that depth (typically 6 to 10 inches) (Demetry 1997).
- Decompact soils by hand or with heavy equipment (dozer or skid steer with rippers) under moderately moist conditions (may require 1 week of irrigation if work is completed in late summer or fall).
- Avoid large roots during decompaction; a rototiller or hand decompaction may be more appropriate in these areas.
- Add locally gathered duff to provide seeds and organic matter.
- If available, add local native soil and topsoil.
- If determined that soil conditions are not conducive to plant reestablishment, amendments such as peat moss, kelp, or other natural fertilizers may be used.

- To provide nutrients to the soil, open cones on adult giant sequoias, and prepare a seedbed, woody debris may be scattered over the area and burned. If woody debris is not available for burning, fuel may be burned at a single location and the ashes mixed into the topsoil of the restoration area

## Surface Topography

Depending on the degree of alteration in landform, a variety of recontouring and topography restoration actions may be implemented and are listed below:

- Regrade with existing soil: Where extensive recontouring to natural topography is required (e.g., road cuts), attempt to accomplish this through re-balancing cut and fill.
- Fill: Where additional material is needed, soils of the same type from the Mariposa Grove area is preferable, but soil may need to be imported from South Entrance or other nearby locations.
- Topsoil retention: Wherever removal or compaction of topsoil will occur, salvage and stockpile the top 12 inches of soil, and replace it on the surface. To preserve microbial communities and limit erosion and the establishment of weeds, mulch all soil piles or cover with erosion blankets.
- Leave final grades uneven to provide microhabitat for seed germination and establishment.

## Site Preparation

After decompacting soils, particularly on sloped areas, erosion potential can be high. Following is a list of available erosion-control measures.

- Duff: Spread locally gathered litter and woody debris over disturbed areas for erosion control and to provide a source of seeds and organic matter.
- Rice straw: If insufficient quantities of duff are available, use rice straw mulch (which is relatively inert and not a source of non-native seeds).
- Erosion-control blankets and/or wattles: Use coconut fiber or rice straw erosion-control blankets and/or wattles only on steep slopes (3:1 or greater) and in unprotected drainages.
- Stones, boulders, limbs, and logs: In conjunction with any other erosion control methods, place these materials (gathered from adjacent areas) on the surface to provide microclimate for plants and to slow water flow.

## Revegetation

There is a range of actions available to revegetate an area with native plants, and a combination of actions will provide the most successful restoration. For any revegetation activities within Mariposa Grove, only locally gathered plant material will be used to retain genetic integrity.

- Natural regeneration: Rely on natural regeneration from adjacent seed sources and duff.
- Seed collection, seed increase, and direct seeding: Plant the area with local native seed. It may not be practical to collect enough seed for direct seeding of the acreage involved. Increasing seed can provide necessary quantities. This process requires 3 years.

- Seed or cutting collection and nursery propagation: Gather local native seeds and cuttings and plant in a nursery setting to provide established plants for planting in restoration areas. Place plants in a manner that mimics natural distribution – not landscaping. This requires 1 to 3 years.
- Plant salvage and transplanting: In cases where plants may be damaged or destroyed when infrastructure is removed, repaired or relocated, salvage plants and replant them when the area is recontoured to more natural conditions, or in an adjacent restoration site. Store salvaged plants on site, and protect with shade cloth and irrigate as necessary.
- Giant sequoias: Nearly all restoration sites lie within the seed-rain area of adult giant sequoias, so the need for propagating giant sequoias in a nursery setting and planting these trees is not likely to be necessary for germination and recruitment. Rather, prepare sites to facilitate germination, including burning woody debris to provide nutrients and a heat source to open cones on the trees. If seed dispersal does not occur (e.g., adequate heat is not created), hand spread locally collected giant sequoia seeds.

## Canopy Gaps

Canopy gaps are integral to successful giant sequoia recruitment. The Giant Forest Restoration Project focused on creating and maintaining gaps as part of the restoration program because according to assessments of existing recruitment and gaps, neither was adequate. However, based on NPS assessment of the giant sequoia population in the Mariposa Grove, many canopy gaps exist in the Grove, and recruitment is relatively high when compared to other giant sequoia groves (Kuhn 2011). Based on this assessment, the park will continue to rely on fire to create and maintain these canopy gaps in Mariposa Grove, and to capitalize on the gaps created by removing existing infrastructure (e.g., parking areas) as areas for giant sequoia recruitment.

## Hydrology and Water Quality

An erosion control plan would be prepared specifying measures to prevent erosion/ sedimentation problems during project construction. The plan would include a map of the project site delineating where erosion control measures will be applied. The following minimum criteria, adapted from the *Guidelines for Protection of Water Quality During Construction and Operation of Small Hydro Projects* (CVRWQCB 1983), would be met:

- Where working areas are adjacent to or encroach on live streams, barriers shall be constructed that are adequate to prevent the discharge of turbid water in excess of specified limits.
- Material from construction work shall not be deposited where it could be eroded and carried to the stream by surface runoff or high stream flows.
- All disturbed soil and fill slopes shall be stabilized in an appropriate manner.
- Surface drainage facilities shall be designed to transport runoff in a non-erosive manner.
- Wastewater contaminated with by-products from construction activities shall be contained in a holding or settling tank to prevent contaminated material from entering watercourses or wetlands.

- Waters shall be free of changes in turbidity that cause a nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits, as described in *The Water Quality Control Plan for the Central Valley Regional Water Quality Control Board* (CVRWQCB 1998). In determining compliance with the limits below, appropriate averaging periods may be applied, provided that beneficial uses will be fully protected:
    - Where natural turbidity is between 0 and 5 nephelometric turbidity units (NTUs), increases shall not exceed 1 NTU.
    - Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20% of the natural turbidity.
    - Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
    - Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10%.
- Implement stormwater management measures to reduce nonpoint-source pollution discharge. This could include measures such as oil/sediment containment or street sweeping.
- Remove hazardous waste materials generated during implementation of the project from the project site immediately.
- Dispose of volatile wastes and oils in approved containers for removal from the project site to avoid contamination of soils, drainages, and watercourses. Keep absorbent pads, booms, and other materials onsite during projects that use heavy equipment to contain oil, hydraulic fluid, solvents, and hazardous materials spills.
- Final design and installation of site drainage improvements will be closely coordinated with the park's Resources Management and Science Division.
- Salvage hydric soils and use them as fill in wetland excavations to the maximum extent possible. Minimize use of fill materials with high permeability in wetland areas to prevent development of unnatural groundwater conduits.
- Incorporate trench plugs into new and abandoned utility corridors through wetland areas where required to prevent formation or continuation of groundwater conduits.

Alternative-specific mitigation measures would include limiting hours of commercial tram operation under Alternative 4: South Entrance Hub with Modified Commercial Tram Service, to reduce noise impacts on wildlife; under Alternative 3: Grizzly Giant Hub closing the road to the Grizzly Giant transit hub from dusk until dawn; and regulating speeds on the Mariposa Grove Road under all alternatives to reduce the potential for wildlife/vehicle collisions.

# ENVIRONMENTALLY PREFERRED ALTERNATIVE

In accordance with NPS *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* and Council on Environmental Quality requirements, NPS is required to identify the "environmentally preferred alternative" in all environmental documents, including EISs. The environmentally preferred alternative is determined by applying the criteria listed in NEPA Sec. 101(b). The Council on Environmental Quality (46 *Federal Register* 18026-18038) states that the "environmentally preferable alternative is the alternative that would promote the national environmental policy as expressed in NEPA's Section 101." Generally, the environmentally preferable alternative is the alternative that causes the least damage to the biological and physical

environment and that best protects, preserves, and enhances historic, cultural, and natural resources (46 Federal Register 18026 – 46 Federal Register 18038). Per Section 101 of NEPA, it is the responsibility of the federal government to:

(1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

All of the action alternatives meet goal 1 to varying degrees by reducing development footprints within the Mariposa Grove, restoring hydrologic and ecological systems to more natural (i.e. predevelopment) conditions, and protecting, stabilizing, and/or rehabilitating cultural resources at South Entrance, the Grove, and Wawona Point. Analysis of environmental consequences associated with each alternative indicates that Alternative 2 best meets goal 1 relative to Alternatives 1, 3, and 4 because it would result in a net reduction of developed areas across the project area and would minimize new development within the Grove; implement substantial restoration of wetlands and giant sequoia ecology; best curtail vehicle traffic on the Mariposa Grove Road and within the Grove (thereby better protecting Pacific fisher from road fatalities); and restore soundscapes throughout the Grove by eliminating most private vehicle Grove parking and discontinuing operation of the fee-for-service commercial tram. All of these actions would address visitor and operational services that are adversely affecting giant sequoia (e.g., impeded hydrology, soil compaction in root zones, bark removal and bole damage from visitor and tram impacts), and provide the best opportunity for sustaining the Mariposa Grove for the enjoyment of future generations.

(2) Assure for all visitors safe, healthful, productive, and aesthetically and culturally pleasing surroundings.

All of the action alternatives would meet goal 2. Alternative 2 best fulfills goal 2 for several of the reasons stated above, in conjunction with affording the best balance of more efficient visitor transport via shuttle to and from the Grove; relocation of traffic- and parking-related impacts outside of the Grove to South Entrance; universal access to a quality giant sequoia Grove experience in the lower portion of the Grove while preserving a less developed, more natural visitor experience in the upper portion of the Grove through elimination of the commercial tram operations and reducing the footprint of trails and roadways; and assuring a safe, productive, and aesthetically and culturally pleasing environment for visitors to the Mariposa Grove of Giant Sequoias.

(3) Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.

Consistent with goal 3, and as described under goals 1 and 2, Alternative 2 attains the widest range of beneficial uses of the environment while minimizing further degradation of the sensitive giant sequoia environment, and managing risks to visitor health and safety concerns by eliminating vehicle/pedestrian conflicts within the Grove. All of the action alternatives would improve sanitary facilities, and reduce current safety hazards associated with Grove traffic management, shuttle stops, and parking. Alternative 2 would also improve visitor safety by eliminating the commercial tram service and redesigning parking areas and shuttle stops, thereby reducing vehicle/pedestrian conflicts currently associated with shared use of the in-Grove parking lot and roadway.

(4) Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice.

Consistent with goal 4, Alternative 2 best restores and preserves the giant sequoias of the Mariposa Grove, which are an important natural aspect of our national heritage and representative of the country's environmental movement and the NPS mission. All of the action alternatives would preserve historic and traditional cultural aspects of the Grove and Wawona Point to similar degrees; Alternative 3 would have the least effect on the historic context at South Entrance, but would sustain the most extensive disturbances on archeological resources and alter historic circulation patterns within the Grove by constructing a new road outside of the Grove to a new visitor parking and information hub near Grizzly Giant.

(5) Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.

Alternative 2 reduces in-Grove infrastructure and consolidates it outside of the Grove. Alternative 2 best conserves energy by significantly restricting private vehicle access to the Grove and eliminating diesel-powered generator use and commercial tram operations within the Grove. All action alternatives improve accessibility to the giant sequoia Grove for visitors with limited mobility, which contributes to the wide sharing of life's amenities. Alternative 2 offers the best opportunity for expanding the range of visitor experiences by expanding accessible trail opportunities in diverse areas with increased solitude in the lower Grove area and at Grizzly Giant.

(6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Consistent with goal 6, all of the action alternatives would implement sustainable technologies designed to minimize impacts on natural resources, in accordance with *Guiding Principles of Sustainable Design* (NPS 1993). Sustainable principles and technologies would include recycling of demolition debris to the extent practicable, using recycled materials in construction, repair or replacement of inefficient systems, improved operational practices, and installation of energy- and water-efficient features and utilities. Alternative 2 represents the most efficient management of depletable fossil fuels both by eliminating in-Grove tram operations, diesel-powered generators, and most private vehicle access during peak visitor season, and by concentrating visitor and employee parking near a park entrance and implementing efficient shuttle service using buses that operate on alternative fuels.

In summary, Alternative 2 (the preferred alternative) on balance best achieves these national environmental policy goals, and therefore is identified as the environmentally preferable alternative.

# COST ESTIMATE

The estimated approximate costs of "hard construction" for each alternative, as understood at the 50-percent schematic design development phase, were assembled using empirical market data and input from vendors and industry professionals. The estimating process attempted to anticipate design and scope in advance of the development of engineering, architectural detailing, inventory of existing conditions, and topographical surveys. The estimate employed unit assembly costs extrapolated, in part, from modeling data from similar completed projects. The unique nature and remote location of the Mariposa Grove of Giant Sequoias, however, presented a challenge for identifying comparable project data. Table 2-1 presents the preliminary cost estimates for construction costs, transit operations, and transit vehicle replacement. With regard to the accuracy of the estimated costs, Alternative 3 has the most uncertainty since additional geotechnical investigation would be needed to determine the costs of construction for a new segment of road within the Grove. Unlike the action alternatives, the No Action Alternative has no net construction costs, but does have ongoing maintenance and operational costs.

**Table 2-1 – Preliminary Cost Estimates**

| Action | Alternative 1: No Action | Alternative 2: South Entrance Hub | Alternative 3: Grizzly Giant Hub | Alternative 4: South Entrance Hub with Commercial Tram Operation |
|---|---|---|---|---|
| Facilities at South Entrance | $ 0 | $9,986,000 | $ 0 | $9,986,000 |
| Facilities in Lower Grove Area | $ 0 | $1,317,000 | $433,000 | $1,578,000 |
| Facilities at Grizzly Giant | $ 0 | $214,000 | $3,819,000 | $54,000 |
| Facilities in Upper Grove Area | $ 0 | $547,000 | $476,000 | $498,000 |
| Roads, Trails, and Restoration | $ 0 | $8,647,000 | $18,070,000 | $9,339,000 |
| **Construction Costs** | **Existing conditions** | **$20,711,000** | **$22,798,000** | **$21,455,000** |
| | | | | |
| 50-Year Project Life Cycle Costs for Transit Operations | $13,300,000 | $15,900,000 | $ 0 | $14,300,000 |
| Vehicle Replacement Costs | $3,400,000 | $3,600,000 | $ 0 | $3,400,000 |
| Deferred Maintenance Costs | $7,600,000 | $ 0 | $ 0 | $ 0 |

Notes:
1) Construction of an optional bridge in the lower Grove area under Alternative 2 would require additional cost/design analysis and compliance. A preliminary estimate for construction of the bridge is $4M.
2) If soil conditions in the lower Grove area are such that a septic system is not feasible, a sewer line would need to be installed within the road prism and would add an additional $2M to the cost for Alternatives 2 and 4. Alternative 3 relies on use of vault toilets at the Grizzly Giant.
3) 50-year project life cycle costs assume a 2.2% discount rate (which refers to the interest rate used in discounted cash flow analysis to determine the present value of future cash flows).
4) Commercial tram operations are not included in the life cycle and replacement costs since they are incurred by a private entity.
5) No transit would operate under Alternative 3.

Table 2-2 presents a summary comparison of alternatives, and Table 2-3 summarizes build-out and ecological restoration acreages by alternative. The characteristics of the leach field options are described separately, in Table 2-4.

## Table 2-2 – Summary Comparison of Alternatives

| Proposed Project Action/Component | Alternative 1: No-Action | Alternative 2: South Entrance Hub (Preferred Alternative) | Alternative 3: Grizzly Giant Hub | Alternative 4: South Entrance Hub with Modified Commercial Tram Service |
|---|---|---|---|---|
| **Ecological Restoration** | | | | |
| Wetland restoration at lower Grove area with boardwalk | No | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| Remove 115-car parking lot and other infrastructure in lower Grove area | No | Yes, but 6 accessible peak season and 50 seasonal spaces in new design | Yes, but 10 accessible spaces in new design | Yes, but 6 accessible peak season and 50 seasonal spaces in new design |
| Remove upper Grove area loop road/convert to trail | No | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| Install/repair/replace culverts to improve hydrology | No | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| Prescribed fire and thinning within and surrounding the Grove | Yes | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| Soil decompaction | No | Yes | Yes | Yes, more limited than Alternative 2 |
| Natural soundscapes improved/restored | No | Yes | Yes | Yes, more limited than Alternative 2 |
| Additional fencing for root protection | No | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| **Visitor Use and Access** | | | | |
| Improved visitor orientation and wayfinding | No | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| Improved ecological and cultural interpretation | No | Common to all action alternatives | Common to all action alternatives | Common to all action alternatives |
| Primary visitor contact | At lower Grove staging area | At South Entrance Hub | At Grizzly Giant Hub | At South Entrance Hub |
| Visitor amenities | Gift Shop (snacks) at lower Grove area, Museum (interpretation, books) in upper Grove area | New/relocated visitor information and services at South Entrance Hub | New /relocated visitor information and services at Grizzly Giant Hub | New /relocated visitor information and services at South Entrance Hub |
| Mariposa Grove Museum interpretive components | Contains interpretative exhibits | Interpretive information relocated to South Entrance Hub. Repurpose museum to ensure protection of historic resource. | Interpretive information relocated to South Grizzly Giant Hub. Repurpose museum to ensure protection of historic resource. | Interpretive information relocated to South Entrance Hub. Repurpose museum to ensure protection of historic resource. |
| Wawona Point overlook | Access for utility functions only. | Common to all action alternatives: Repair historic walls and overlook. | Common to all action alternatives: Repair historic walls and overlook. | Common to all action alternatives: Repair historic walls and overlook. |
| Visitor winter access to Grove (all-season visitor enjoyment ) | Road closed, not plowed. Can ski/snowshoe from South Entrance, limited parking (25 spaces) at South Entrance, visitors park along roadside. | Could ski/snowshoe, hike from South Entrance if road/gate closed, ample parking at South Entrance | Could ski/snowshoe, hike from Grizzly Giant trailhead if road open (parking at Grizzly Giant lot). If road closed, still have limited parking at South Entrance (25 spaces). | Could ski/snowshoe, hike from South Entrance if road/gate closed, ample parking at South Entrance lot |
| Accessible trail | No<br>Paths of travel in lower Grove area not up to accessibility standards. | Lower Grove area, Grizzly Giant with potential accessible trail expansions in those areas | Lower Grove area, Grizzly Giant | Lower Grove area, Grizzly Giant overlook |
| Trail from South Entrance to the Grove | None | Utilize abandoned Washburn Road as trail to picnic area and continue into lower Grove area. | None | Utilize abandoned Washburn Road as trail to picnic area and continue into lower Grove area. |
| Accessible road access(for private vehicles with placards) | Access to lower Grove area, Grizzly Giant, and upper Groverarea loop road. | Access to lower Grove area and Grizzly Giant. | Access to lower Grove area and Grizzly Giant. | Access to lower Grove area, Grizzly Giant, and a portion of the upper Grove area. |
| Accessible parking spaces | 2 at lower Grove area | 7 at South Entrance; 6 at lower Grove area ; 1 accessible pullout at picnic area; 8 at Grizzly Giant | 7 at Grizzly Giant; 10 at lower Grove area | 7 at South Entrance; 6 at lower Grove area ; 4 at Grizzly Giant; 4 at upper Grove |
| Accessibility of visitor amenities | Accessible vault toilet at picnic area along Mariposa Grove Road (outside Grove) .Accessible vault toilet in lower Grove area. | Accessible comfort stations at South Entrance, and lower Grove. Accessible vault toilets at Grizzly Giant and picnic area. | Accessible vault toilets at picnic area, lower Grove, and Grizzly Giant. | Accessible comfort stations at South Entrance, and lower Grove. Accessible vault toilets at Grizzly Giant and picnic area. |
| **Transportation** | | | | |
| Commercial tram staging area and operations (approximate) (Tram is accessible.) | Yes, through upper Grove loop road, staging at lower Grove area | No service | No service | Yes, to museum, staging at South Entrance |
| Shuttle access to lower Grove area (Shuttle is accessible.) | Yes, peak season (Memorial Day-Labor Day) | Yes, expanded to include shoulder seasons (May through November as weather permits) | N/A | Yes, during peak season |
| Shuttle schedule (approximate) | May – October, South Entrance and Wawona to lower Grove area | March – October, South Entrance to lower Grove area; occasional service between South Entrance and Wawona | No service | March – October, South Entrance to lower Grove area; occasional service between South Entrance and Wawona |
| Standard vehicle parking spaces | 25-30 at South Entrance, 115 seasonal at lower Grove area. Over 100 spaces at Wawona are used for overflow parking. | 223 at South Entrance, 50 seasonal at lower Grove area | 25-30 seasonal at South Entrance, 189 at Grizzly Giant | 223 at South Entrance, 50 seasonal at lower Grove area |
| Large vehicle parking spaces | <5 | 30 RV, 9 bus at South Entrance | 27-32 RV, 5-10 bus at Grizzly Giant | 30 RV, 7 bus, 2 commercial tram at South Entrance |

| Proposed Project Action/Component | Alternative 1: No-Action | Alternative 2: South Entrance Hub (Preferred Alternative) | Alternative 3: Grizzly Giant Hub | Alternative 4: South Entrance Hub with Modified Commercial Tram Service |
|---|---|---|---|---|
| Tour bus access | Buses less than 40 feet long can park and drop passengers in lower Grove area. Buses greater than 40 feet park at Wawona and transfer passengers to park shuttles. | Buses greater than 40 feet long would stop at South Entrance for transfer to shuttle. Buses less than 40 feet long would drop off passengers in lower Grove area and park at South Entrance. | All buses would drive to Grizzly Giant Hub. | Buses greater than 40 feet long would stop at South Entrance for transfer to shuttle. Buses less than 40 feet long would drop off passengers in lower Grove area and park at South Entrance. |
| Parking monitoring | Requires staffing during peak season | Yes, year-round remote/intelligent signage system | Yes, year-round remote/intelligent signage system | Yes, year-round remote/intelligent signage system |
| **Infrastructure Improvements** | | | | |
| Road surface within the Grove | Paved to Wawona Point | Paved to Grizzly Giant, then hardened trail (10-12' wide) to Wawona Point | Paved to Grizzly Giant, then hardened trail (10-12' wide) to Wawona Point | Paved to museum, then hardened trail (10-12' wide) to Wawona Point |
| Water pipe repair or replacement | No | Yes | Yes | Yes |
| Water tank and chlorination unit | Present location along upper Grove loop road | Relocate near museum | Relocate near museum | Relocate near museum |
| Comfort stations (Flush [F], Vault [V] fixtures) | 10F at South Entrance, 1V at picnic area, 8V at lower Grove area, 1V at Grizzly Giant, 1V and 10F at upper Grove area | 28F at South Entrance, 1V at picnic area, 10F at lower Grove area, 1V at Grizzly Giant (shuttle drop off), 10F at upper Grove | 10F at South Entrance, 1V at picnic area, 2V at lower Grove area, 18V at Grizzly Giant, 10F at upper Grove | 28F at South Entrance, 1V at picnic area, 10F at lower Grove, 1V at Grizzly Giant (shuttle drop off), 10F and 2V at upper Grove area |
| **Infrastructure Relocation/Realignment** | | | | |
| Parking hub | Lower Grove area | South Entrance | Grizzly Giant | South Entrance |
| New roads | None | Lower Grove bypass road (0.10 mile) | New road from Three Sentinels to Grizzly Giant (0.76 mile) | Lower Grove bypass road (0.10 mile) |
| New bridges | None | Optional bridge at Three Sentinels pending further study. | Two in lower Grove area | None |
| Septic tank/leach field Installation and/or improvement | No | New system at South Entrance and lower Grove areas, replace system in upper Grove area | Replace system, in upper Grove area | New system at South Entrance and lower Grove areas, replace system in upper Grove area |
| Mariposa Grove Shuttle Drop Off areas | Wawona, South Entrance, and lower Grove area | South Entrance and lower Grove area | None | South Entrance and lower Grove area |
| Bus parking pads (for heavy vehicle parking loads) | No | Yes, South Entrance and lower Grove area | Yes, Grizzly Giant | Yes, South Entrance, and lower Grove area |
| South Entrance intersection | Existing T | Roundabout if T-intersection exceeds capacity | Existing T | Modified T |
| **Sustainability** | | | | |
| Infrastructure consolidation | No | Yes | Yes | Yes, more limited than Alternatives 2 and 3 |
| Improved traffic flow and orientation | No | Yes | Yes | Yes |
| Improvements to energy- and water-efficient design | No | Yes | Yes, more than Alternative 2 | Yes, more limited than Alternatives 2 and 3 |

## Table 2-3 – Summary of Potential Impacts and Restoration Footprint Areas

| Surfaces / Ground Disturbance | Alternative 1: No Action | Alternative 2: South Entrance Hub | Alternative 3: Grizzly Giant Hub | Alternative 4: South Entrance Hub with Modified Commercial Tram Service |
|---|---|---|---|---|
| **Existing Conditions** | | | | |
| Existing impervious (asphalt)surface in lower Grove area | 2.9 acres | N/A | N/A | N/A |
| Existing impervious (asphalt) surface at South Entrance parking lot | 0.31 acre | N/A | N/A | N/A |
| Existing impervious(asphalt) surface at Wawona Point | Yes, at overlook | N/A | N/A | N/A |
| Existing road through the Grove | 8.4 acres | N/A | N/A | N/A |
| Existing trails within the Grove | 3.5 acres minimum (based on estimated widths) | N/A | N/A | N/A |
| **Ecological Restoration** | | | | |
| Net change in development, excluding areas needed for new leach fields | N/A | 0.05 acre *reduction* of developed area project-wide (comprised of 3.93 acre net reduction of developed area within the Grove, plus 3.88 acre new development at the South Entrance) | 0.5 acre *addition* of developed area project-wide (comprised of 5.75 acre net reduction of developed area within the Grove, plus 6.25 acre new development at the Grizzly Giant arrival area and the new Grove bypass road) | 2.13 acre *addition* of developed area project-wide (comprised of 1.79 acre net reduction of developed area within the Grove, plus 3.88 acre new development at the South Entrance) |
| Restoration of giant sequoia habitat through reduction of impervious surfaces in lower Grove | N/A | 1.39 acres restoration of giant sequoia habitat (1.5 acre of new build out, all except 0.32 acre atop previous impervious footprint.) Removal of 1.39 acres of the existing development footprint within the lower Grove area would comprise a 48% reduction of impervious surfaces. | 2.38 acres restoration of giant sequoia habitat (0.52 acre of new build out, all atop previous impervious footprint.) Removal of 2.38 acres of the existing development footprint within the lower Grove would comprise an 82% reduction of impervious surfaces. | 1.55 acres available for restoration of giant sequoia habitat (1.35 acres of new buildout, all except 0.17 acre atop previous impervious footprint.) Removal of 1.55 acres of the existing development footprint within the lower Grove area would comprise a 53% reduction. |
| Net restorable area due to trail removal | N/A | 0.43 acre | 0.58 acre | 0.02 acre |
| Restoration of giant sequoia habitat resulting from narrowing of Mariposa Grove Road or conversion of road segments to trails | N/A | Removal of 2.11 acres of the existing paved road throughout the Grove comprises a 25% reduction of road. | Removal of 2.79 acres of the existing paved road throughout the Grove comprises a 33% reduction of road. | Removal of 0.23 acres of the existing paved road throughout the Grove comprises a 3% reduction of road. |
| Restoration of hydrologic connectivity to areas where natural flow is disrupted | N/A | Restore two areas where water is currently diverted from its natural course within the Grove (areas are 21.1 acres and 27.5 acres). Restore flow in one area where water is being diverted from the Grove altogether (88.5 acres). | Same as Alternative 2 | Same as Alternative 2 |
| Giant sequoia habitat restoration area within the Grove | N/A | 3.93 acres removal of built footprint within Grove (27% reduction) | 5.75 acres removal of built footprint in the Grove (39% reduction) | 1.79 acres removal of built footprint in the Grove (12% reduction) |
| Restore of natural hydrologic process by repairing leaking water pipe in upper Grove area | N/A | Restore natural hydrologic condition within the western end of the upper Grove Palustrine Emergent wetland by analyzing 4000 lineal feet of water pipe that is understood to be leaking and contributing chlorinated water to the wetland. | Same as Alternative 2 | Same as Alternative 2 |
| Wetland restoration | N/A | 1.0 acre total of wetland restoration due to ecological restoration activities in the lower Grove area and removal of trails and road narrowing in the upper Grove area. | Same as Alternative 2 | 0.77 acre total of wetland restoration due primarily to ecological restoration activities in the lower Grove area. |
| **Construction Footprint** | | | | |
| Trail from South Entrance to picnic area using existing Washburn Road to picnic area and construction of a new trail extending from picnic area to lower Grove | N/A | 0.66 acre (includes 0.42 acre along old road alignment through non-giant sequoia forest; 0.21 acre new trail through non-giant sequoia forest; and 0.03 acre new trail through giant sequoia forest) | N/A | Same as Alternative 2 |
| Area required for South Entrance construction | N/A | 4.2 to 5.3 acres +/- of non-giant sequoia forest | N/A | Same as Alternative 2 |
| South Entrance build out (i.e. net footprint after construction) | N/A | 3.88 acres of non-giant sequoia forest (3.13 acres of impervious surfaces) | N/A | Same as Alternative 2 |
| Clearing area required for Grizzly Giant Hub construction | N/A | N/A | 5.61 acres +/- of non-giant sequoia forest/shrubland | N/A |

| Surfaces / Ground Disturbance | Alternative 1: No Action | Alternative 2: South Entrance Hub | Alternative 3: Grizzly Giant Hub | Alternative 4: South Entrance Hub with Modified Commercial Tram Service |
|---|---|---|---|---|
| Grizzly Giant area build out (net footprint after construction) | N/A | N/A | 3.13 acres of non-giant sequoia forest (includes 2.92 acres impervious surfaces) | N/A |
| New bypass road build out footprint under Alternative 3 | N/A | N/A | 2.20 acres, primarily through non-giant sequoia forest, but with 0.33 acre through giant sequoia forest and 0.10 acre of raised crossings over wetlands. | N/A |
| **Prime Habitat Considerations** | | | | |
| Disturbance to prime denning pacific fisher habitat | 0 acres | 0 acres | 3.11 acres disturbed by new road | 0 acres |
| Traffic impacts through fisher habitat | Current activity in habitat areas | Decreases overall traffic | Increases overall traffic | Decreases overall traffic |
| **Potential Impacts to Trees** | | | | |
| Giant Sequoia Seedlings/Saplings potentially removed or transplanted (0-15" DBH) [1] | N/A | 30 (+5 at least seedlings) | 0 | 30 (+5 at least seedlings) |
| Juvenile Giant Sequoia Trees potentially removed(15-30" DBH) [1] | N/A | 5 | 0 | 5 |
| Giant Sequoia Trees Potentially Removed (30"or greater DBH) [1] | N/A | 0 | 0 | 0 |
| Non-Giant Sequoia Trees potentially removed (area in acres) | N/A | 4.2 – 5.3 acres | 6.9 acres (Includes bypass road and new parking lot at Grizzly Giant.) | 4.2 – 5.3 acres |
| Non-Giant Sequoia Trees potentially removed (Total comprised of cedar, pine, fir, and oak [2] | N/A | 424 trees; includes leach field option A (West) | 591 trees (comprised of the sizes and species noted below) | 424 trees; includes leach field option A (West) |
| Non-Giant Sequoia Trees potentially removed (0-15" DBH) | N/A | 36 trees | 189 trees (160 estimated in Grizzly Giant west parking lot and bypass road, 29 measured in Grizzly Giant east parking lot and lower Grove accessible drop off) | 36 trees |
| Non-Giant Sequoia Trees potentially removed (15-30" DBH) | N/A | 271 trees | 291 trees (242 estimated in Grizzly Giant west parking lot and bypass road, 49 measured in Grizzly Giant east parking lot and lower Grove accessible drop off) | 271 trees |
| Non-Giant Sequoia Trees potentially removed (30+" DBH) | N/A | 117 trees | 111 trees (100 estimated in Grizzly Giant west parking lot and bypass road, 11 measured in Grizzly Giant east parking lot and lower Grove accessible drop off) | 117 trees |
| Non-Giant Sequoia Trees potentially removed (Cedar) | N/A | 153 | 59 | 153 |
| Non-Giant Sequoia Trees potentially removed (Pine) | N/A | 117 | 135 | 117 |
| Non-Giant Sequoia Trees potentially removed (Fir) | N/A | 153 | 394 | 153 |
| Non-Giant Sequoia Trees potentially removed (Oak) | N/A | 1 | 3 | 1 |
| Non-Giant Sequoia Tree habitat potentially impacted by construction of new trail from South Entrance to the lower Grove area using Washburn Road alignment | N/A | 0.67 acres (includes 0.42 acres along old road alignment through non-giant sequoia forest; 0.21 acres new trail through non-giant sequoia forest; 0.03 acres new trail through giant sequoia forest) | N/A | Same as Alternative B |

[1] Giant sequoia tree impacts would be due to the proposed re-route of Mariposa Grove Road through the lower Grove area under Alternatives 2 and 4. The potential tree impacts are based on a visual assessment of the general location of the re-route, but specific locations have not been surveyed yet. During the design of the re-route, impacts on giant sequoia trees would be avoided as much as possible.

[2] Tree Impact Measurement Constraints: (1) Trees below 10" dbh were not surveyed at South Entrance. (2) Tree density and composition was estimated for the Grizzly Giant bypass road (Alt 3) based on average composition in non-giant sequoia surveyed areas. (3) Tree density and composition was estimated for west Grizzly Giant parking area (Alt 3) based on average composition in surveyed east Grizzly Giant parking area.

## Table 2-4 – Summary of Leach Field Options

| | **Option A** | **Option B** | **Option C** | **Option D** |
|---|---|---|---|---|
| Leach field impact (acres) including 100% replacement area set-aside | 1.46 acres (0.73 acre each) | 1.46 acres (0.73 acre each) | 1.46 acres (0.73 acre each) | 1.46 acres (0.73 acre each) |
| Total number of trees impacted | 82 | 96 | 72 | 81 |
| Tree species: Cedar | 19 | 25 | 27 | 26 |
| Tree species: Pine | 17 | 22 | 20 | 24 |
| Tree species: Fir | 39 | 48 | 18 | 31 |
| Tree species: Oak | 7 | 1 | 7 | 0 |
| Tree size: 0-15" DBH | 19 | 19 | 0 | 0 |
| Tree size: 15-30" DBH | 49 | 48 | 54 | 49 |
| Tree size: 30"+_DBH | 14 | 29 | 18 | 32 |