Sequoia and Kings Canyon National Parks

U.S. Department of the Interior
National Park Service

ENVIRONMENTAL ASSESSMENT FOR THE RESTORATION OF CAHOON MEADOW SEQUOIA NATIONAL PARK

Tulare County, California
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PROJECT LOCATION

The National Park Service (NPS) is evaluating a range of ecological restoration options to address a large erosion gully in Cahoon Meadow, located within the John Krebs Wilderness of Sequoia and Kings Canyon National Parks (SEKI or parks). Note that there are two Cahoon meadows within the parks. The Cahoon Meadow referred to in this proposal is located 2.8 miles west of Hockett Meadow in the southwestern portion of Sequoia National Park (Figure 1 and Figure 2). Cahoon Meadow, a 25.1 acre fen and wet meadow wetland complex, is the second largest wetland in the East Fork drainage of the Kaweah River. The site ranges from 7,260 to 7,430 feet in elevation, which is on the low end of the elevation range of wet meadows in Sequoia and Kings Canyon National Parks.

BACKGROUND


Photo 1. Gully in Cahoon Meadow circa 1973

Cahoon Meadow is in a parcel of land that was acquired by the NPS in 1980; previously it was under private ownership and used as summer cattle pasture. The earliest records indicate that in 1918, 250 head of cattle were permitted to graze in Cahoon Meadow and by 1935 the permitted number of cattle was 70. This level of grazing seems to have been maintained until the NPS purchased the property in 1980, when grazing was discontinued in Cahoon Meadow.

Cahoon Meadow has existed as a wetland complex for approximately 3,000 years, as indicated by accumulated layers of sediment and peat that only form in stable, saturated conditions (Wood 1975, Davis et al. 1985, Davis and Moratto 1988, Koehler and Anderson 1994). There have undoubtedly been natural fluctuations in conditions over the past 3,000 years, including small changes in drainage patterns and deposition of sediments. However, based on soil conditions, no natural climatic or biogeomorphic phenomena, have caused a major gullying or wetland draining event; such events would have interrupted the naturally layered meadow sediments and prevented further accumulation of saturated, peat-forming, soils. Gully formation and consequent draining of wetlands has occurred only in recent history (100-150 years ago) (Wolf et al. 2015).

Figure 1. General location of Cahoon Meadow in Sequoia National Park

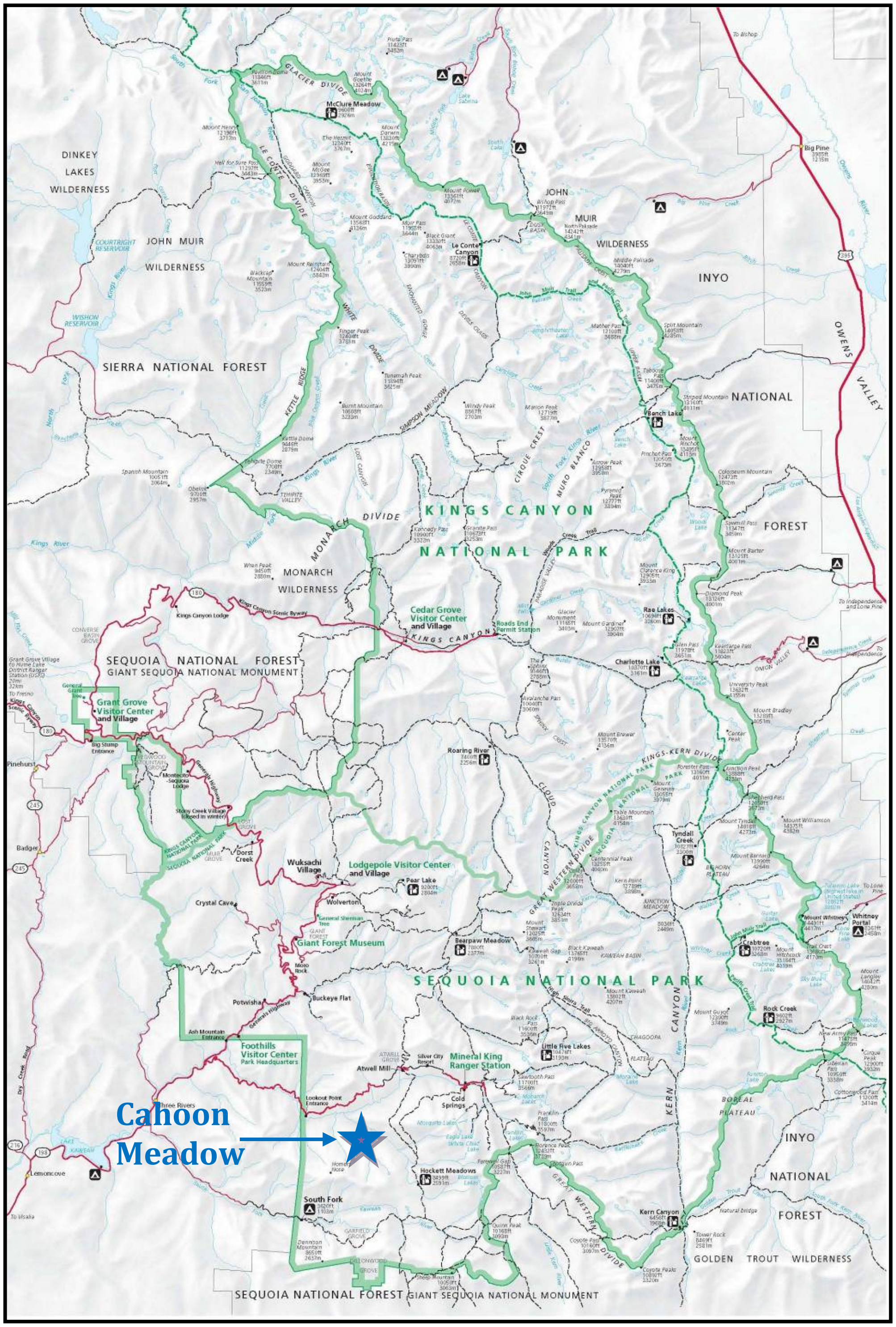
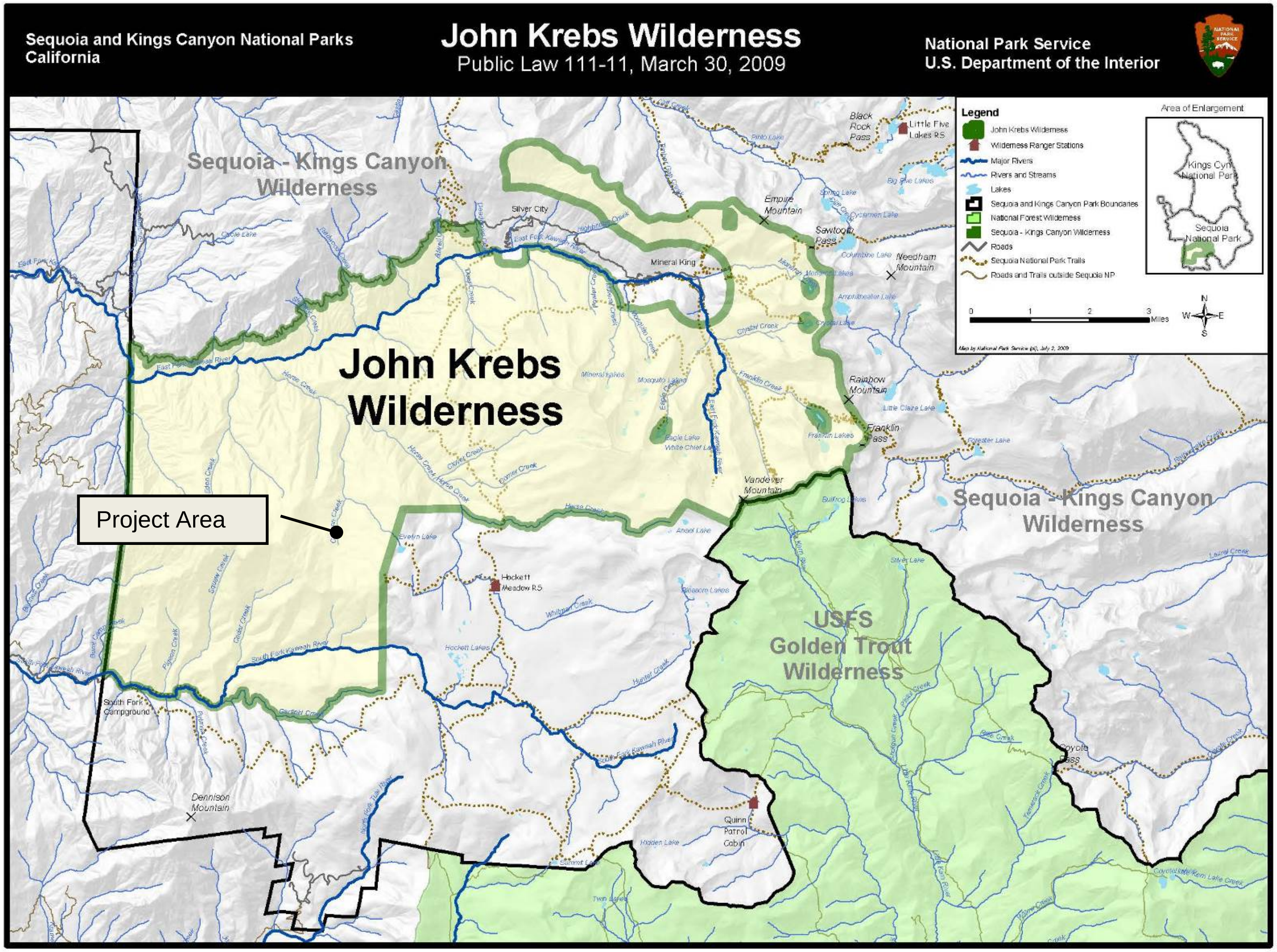


Figure 2. Project Area within John Krebs Wilderness



The erosion problem at Cahoon Meadow was first documented in 1970, ten years before the land was acquired by the NPS (photo 1). The main purpose of the work in 1970 was to locate the private property boundary, and to establish photo points to document the erosion gully. The photographs and notes describe significant trampling from cattle, erosion of the meadow surface, and recent major bank collapse into the "8-12 foot deep gully"; "gully width averages 41 feet" (Briggs 1971). Ten years later, in 1980, when the NPS purchased the land, the erosion gully at Cahoon Meadow was recommended for restoration. An unattributed report from approximately 1983, titled "Cahoon Meadow Project Proposal," described the gully in Cahoon as having a maximum width of 65 feet and depth of 15 feet. The report outlines a plan of action for gully restoration using a series of hand-built check dams and other methods pioneered by the SEKI Soil and Moisture Conservation Crew (SMCC).

The 1983 report notes that annual maintenance of the dams would be required, but makes no estimate of the expected sediment accumulation rate (and thus the length of maintenance period required to completely fill the gully), nor is there any comparison of the size or steepness of the Cahoon gully to previous efforts in other meadows that employed hand-built check dams. While restoration work in Cahoon Meadow was not accomplished at that time, in other restoration efforts in the parks, the SMCC, in their annual summaries and trip reports, indicate that such check dams needed to be repaired or rebuilt numerous times over the 30-year tenure of the SMCC operations.

As part of an effort to understand the origins, impacts, and restoration potential of erosion gullies in wetlands across the Sierra Nevada, in 2011 the Sierra Nevada Conservancy provided funding to SEKI to investigate Cahoon Meadow. The project objectives included collecting topographic information to create a base map, assessing the success of past meadow restoration efforts by the SEKI SMCC, developing a range of feasible restoration goals and alternatives for Cahoon Meadow, and creating a conceptual plan and alternatives that could be used to develop an environmental compliance document.

In June of 2014, an interdisciplinary team including wetlands scientists from Colorado State University and biologists from SEKI visited Cahoon Meadow to collect data on the meadow topography, soil, hydrology, and vegetation (Figure 3). The team measured the dimensions and volume of the erosion gully and identified three separate, nearly vertical headcuts, each 7-8 feet high, at the head of the gully. These headcuts were observed to be actively eroding further into the intact wet meadow immediately upstream. Using this information, and building from the results of past and ongoing restoration efforts within and outside of the parks, several alternatives were developed to address the erosion gully, threats to intact wetlands, and draining of former wetlands in Cahoon Meadow. The alternatives provided options that ranged from no action, to methods to halt further erosion of the wetlands area, to methods to fully restore the hydrological and ecological processes in the gullied portion of Cahoon Meadow. The alternatives were also analyzed to determine the ecological and financial costs and benefits. The final alternatives for consideration are provided in detail in Chapter 2 of this environmental assessment (EA).

This EA has been prepared by the NPS in accordance with the National Environmental Policy Act (NEPA, 1969, as amended), Department of the Interior (DOI) regulations, NPS guidance, and in accordance with the California Environmental Quality Act (CEQA).

PROJECT PURPOSE AND NEED

The purpose of this project is to protect the remaining intact wetlands and restore wetland ecosystem function to Cahoon Meadow in such a manner that minimizes impacts to park resources, while ensuring a sustainable and feasible solution.

Intact wetlands are important because they provide water storage and flood attenuation by reducing peak flows, stream velocity, and erosion. Wetlands function to filter and store water, and help control downstream sediment loads and sedimentation of adjoining waters. Wetlands maintain flows in down-gradient streams longer into the dry season, thereby sustaining downstream aquatic habitat (Figure 4). The following are project objectives that were considered important in the development of the proposed action and alternatives.

Objective 1: Comply with NPS legal mandates and policies.

The NPS Organic Act (16 U.S.C. 1) mandate is to conserve the scenery and the natural and historic objects and the wild life therein…in such a manner…as will leave them unimpaired for the enjoyment of future generations.

The Wilderness Act (16 U.S.C. 1131-11136) mandates the management of wilderness to preserve the wilderness character of the area. Except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

Executive Order 11990, Protection of Wetlands (42 Fed. Reg. 26961), directs the NPS and other federal agencies to protect and manage wetlands as follows:

> Section 1. (a) Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

This regulation is translated into agency policy in Director's Order #77-1: Wetland Protection. Section 2.7 of DO 77-1 states "Where natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human activities, the NPS will, to the extent appropriate and practicable, restore them to pre-disturbance conditions."

NPS *Management Policies 2006* provides the following direction:

- Restore natural landscapes when manipulation is necessary to mitigate for excessive disturbance caused by past human effects (4.4.2.4). For natural resources management in wilderness, the principle of nondegradation will be applied; each wilderness area's condition will be measured and assessed against its own unimpaired standard. Management intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries (6.3.7).
- If a wet meadow or fen system condition is degraded, management is instructed to reestablish natural functions and process unless otherwise directed by Congress, specifically including lands overgrazed by domestic animals (4.1.5).
- Prevent the destruction, loss, or degradation of wetlands, preserve and enhance the natural and beneficial values of wetlands, and avoid direct and indirect support of new construction in wetlands unless there are no practicable alternatives and the proposed actions minimize harm to wetlands (4.6.5).
- Strive to achieve a longer-term goal of net gain of wetlands across the national park system through restoration of previously degraded or destroyed wetlands (4.6.5).

The 2007 Sequoia and Kings Canyon National Parks General Management Plan states that:

> Wetlands that have been damaged or degraded by previous uses will be considered for restoration. . . original functions and values of each wetland will be restored to the greatest extent practicable.

The 1999 Sequoia and Kings Canyon National Parks Resource Management Plan prioritizes Cahoon meadow as one of two that is in most need of restoration.

The NPS Director's Memo "Applying National Park Service Management Policies in the Context of Climate Change" (2012) reinforces that restoring ecological integrity is an important strategy to adapt to climate change: "restoring naturally functioning ecosystems. . .and continuing other actions that build and support system resilience – remain as viable management strategies that are also consistent with our need to adapt to climate change."

Objective 2: Protect the character of Sequoia and Kings Canyon National Parks' wilderness.

- The natural quality of wilderness character has been compromised by past cattle grazing activities, and exacerbated by gully formation and continued erosion in Cahoon Meadow.
- Actions that are undertaken as part of this project must be the minimum required for the administration of the area as wilderness.
- The project must be conducted in a way that minimizes the impacts on wilderness character.

Objective 3: Prevent the loss of ecosystem functions in the currently intact meadow above the headcuts.

- If no action is taken, the gully will continue to migrate upstream in large runoff events, eroding and draining the remaining portions of the intact wetland.

Objective 4: Restore wetland ecosystem functions to the 5.4 acres of dewatered wetland and gully below the headcuts.

- The gully conveys water more quickly than the intact meadow, which may increase peak flood flows downstream.
- The actively eroding gully sends sediments downstream, potentially impacting water quality.
- In the dewatered wetland adjacent to the erosion gully, wetland plants have died and have been replaced with a sparse cover of dry-site plant species.
- Mineral and organic soils are eroding from the dried-out meadow, resulting in substantial carbon loss from the meadow and decomposition of organic matter that releases carbon dioxide to the atmosphere.

Objective 5: Protect the plant biodiversity provided by the intact fen and wet meadow complex within and downstream of Cahoon Meadow.

- Cahoon Meadow has a long history as a saturated, peat-accumulating fen/wet meadow complex. Only two meadows in the East Fork contain more peat-accumulating wetland area. If no action is taken, Cahoon Meadow will continue to lose fen habitat, which is rare in the Sierra Nevada.
- It is important to preserve wetland habitats because they contain a diverse suite of highly productive wetland plants.
- Cahoon Meadow is one of ten locations where the insectivorous plant the sundew (*Drosera rotundifolia*) is known to exist in SEKI. It only grows in intact fens.

- Cahoon Meadow is the headwaters wetland of the Cahoon Grove of giant sequoia trees; the water storage and slow release provided by the wetland could supply late-season water to the grove.

Objective 6: Protect the wildlife biodiversity provided by fens and wet meadows in the Cahoon Meadow area.

- Both fens and wet meadows are important breeding grounds for invertebrates, which are key elements in many food chains. Many insects breed in wet meadows and then disperse into adjacent forests and woodlands as the season progresses. Meadow invertebrates also serve as pollinators for montane plants.
- Wetlands provide important habitat for frogs, toads, shrews, and other species that frequent aquatic communities and stream channels.
- A number of bird species, such as the Wilson’s warbler, use meadows for foraging, nesting, or both. Wetlands are also important to mammals. Black bear use meadows as a substantial forage source early in the season. Mule deer take advantage of the cover provided by montane meadow vegetation by hiding their fawns in dense vegetation.

Figure 3. Existing conditions at Cahoon Meadow. Direction of water flow is from south to north.

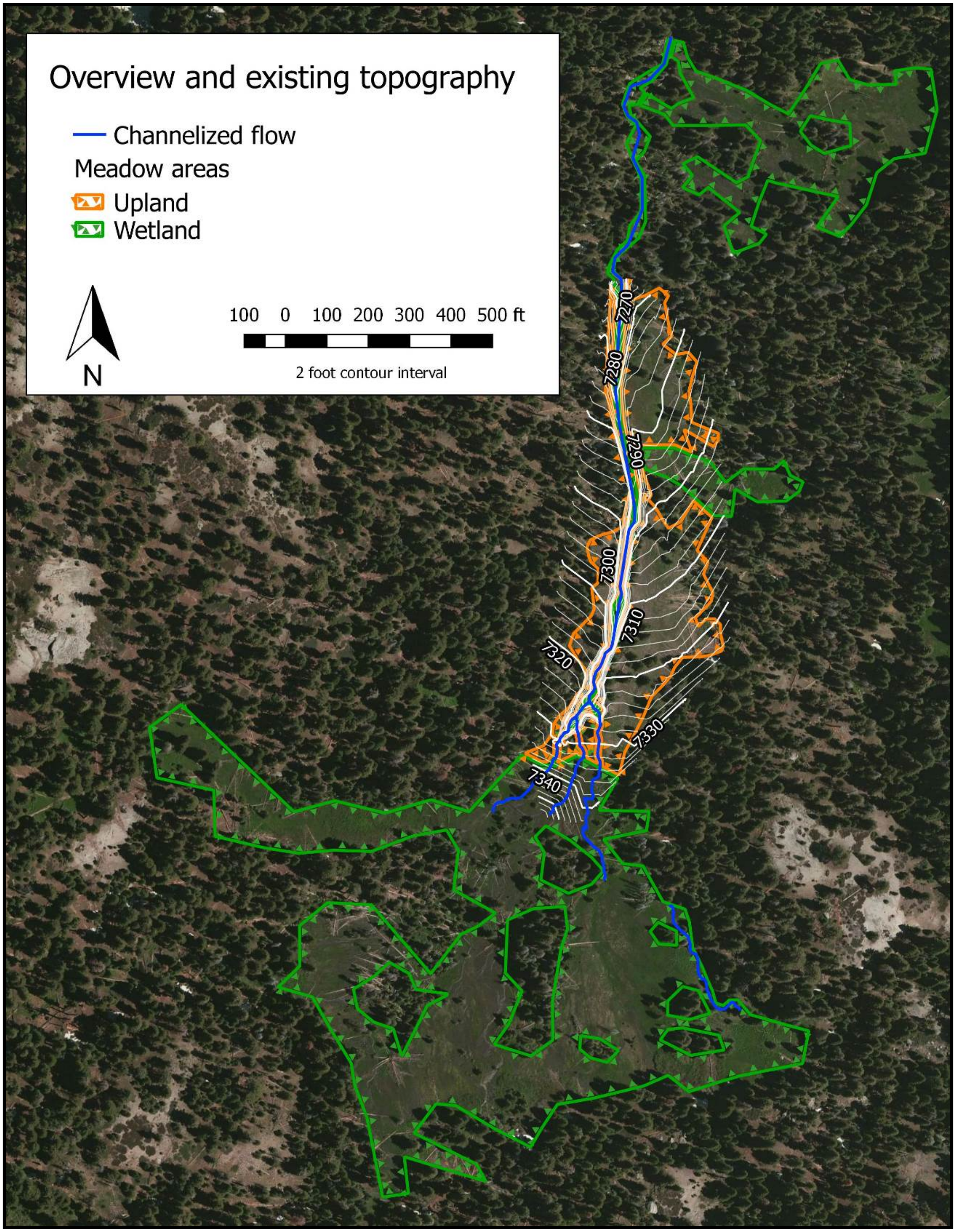
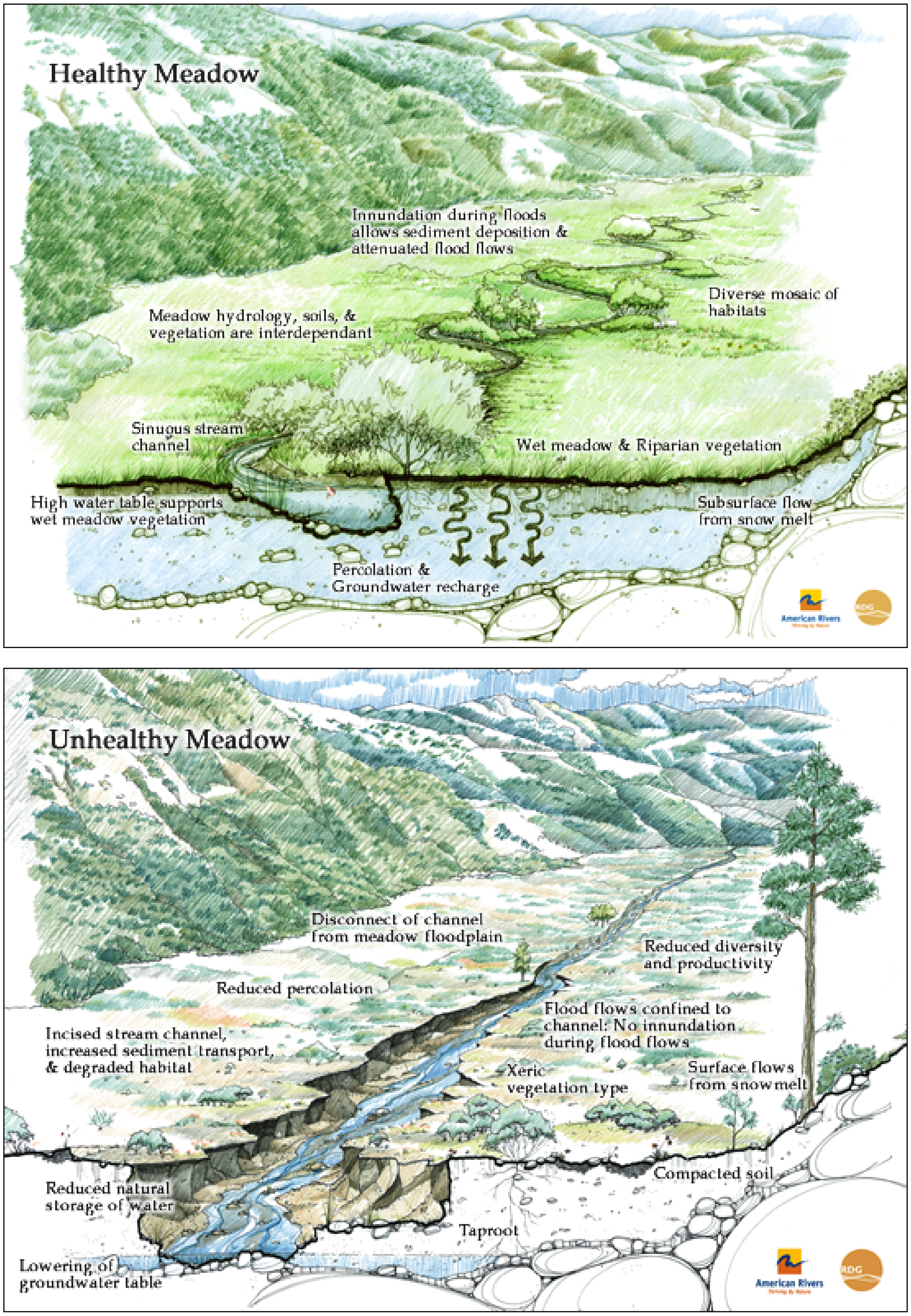


Figure 4 Condition of a healthy, intact wetland (upper) compared to a gullied, degraded wetland (lower). *Illustration by Restoration Design Group for American Rivers.*



ISSUES AND IMPACT TOPICS

SCOPING

Between December 10, 2014 and January 23, 2015, SEKI sought public input on the proposed action and alternatives to restore ecosystem function to Cahoon Meadow. A news release with project information was distributed to local and regional media outlets. A scoping letter was mailed to approximately 380 individuals, agencies, businesses, and interest groups, and 590 individuals on the parks' mailing list. A letter/email was sent to 54 tribal leaders, and 60 tribal representatives or individuals affiliated with area tribes. Notices were published in several newspapers and internet sites such as the Kaweah Commonwealth, Imperial Valley News, Valley Voice, and WN.com (World News).

The parks received comments from 13 different sources during the 45-day public scoping period. Nine correspondences were from unaffiliated individuals (one stated they do not have any comments at this time); one correspondence was from a tribe stating the project is outside their area of interest; one correspondence was from an official representative from a business called SCC Sequoia; and, two correspondences were from recreational groups- Kaweah Fly Fishers and Backcountry Horsemen of California- High Sierra Unit. In general, of the eleven substantive comments, most were in support of restoring the meadow and some shared past similar experiences and suggestions. Some of the supporting commenters included recommendations, such as using heavy earthmoving equipment and rock and earth for the dams; reintroducing beavers to accomplish the restoration work; and, to fill in the large gully with fill materials to avoid using check dams. Some of these supporters also questioned whether it's best to accept the change in Cahoon Meadow and take no action. The Backcountry Horsemen of California expressed support for using non-mechanized methods to restore and protect the wetland, and were not in favor of using mechanized equipment in wilderness. Many of the recommendations have been incorporated into the EA. Some options that were brought up during scoping were considered but dismissed (see "Alternatives Considered but Dismissed").

ISSUES TO BE FURTHER DISCUSSED

Based on internal and external scoping, the potential for significant adverse or beneficial impacts on these resources, and because the impacts associated with the issue are central to the proposal, the following issues / topics will be further evaluated in this document: wilderness character, including untrammeled, undeveloped, natural, and opportunities for solitude or primitive and unconfined recreation; wetlands, including vegetation, plants of conservation concern, soils, and hydrology; and, water quality and water quantity.

ISSUES CONSIDERED BUT DISMISSED

The following issues were initially considered because they are either in or near the project area, or could be potentially affected by project implementation. However, after additional analysis and consideration of mitigation measures, these issues were dismissed from detailed analysis.

Wild and Scenic Rivers

Cahoon Meadow is within the East Fork Kaweah River drainage; the East Fork Kaweah River is eligible for designation as a Wild and Scenic River (WSR) under the Wild and Scenic Rivers Act (WSRA). Section 7(a) of the WSRA provides each river designated into the National Wild and Scenic River System with permanent protection from federally licensed or assisted dams, diversions, channelization or other water resources projects that would have a direct and adverse effect on its free-flowing condition, water quality, or "outstandingly remarkable values"; or, for projects upstream, downstream, or on a tributary to the designated segments, that would invade or unreasonably diminish the segment's fish, wildlife, scenic, or recreational resources. NPS *Management Policies 2006* states that for eligible rivers, no management actions will be taken that could adversely affect the values that qualify a river for inclusion (4.3.4).

The alternatives evaluated in this EA would not adversely affect the values that qualify the East Fork Kaweah River as eligible for designation as a WSR, nor would they diminish the qualifying segments' outstandingly remarkable values which are: scenery, recreation, and geology. The Cahoon Meadow restoration project could potentially enhance the qualifying segments resources by reducing the gullying, erosion and sedimentation, improving the overall water quality of the river, and protecting and enhancing the recreation and scenic values of the East Fork Kaweah River. However, this benefit would likely be slight and not measureable due to the vast quantities of erosion and sedimentation occurring naturally in this drainage. Therefore this topic will not be further evaluated and a Section 7(a) determination is not needed.

Special Status Species and Species of Management Concern
On November 6, 2015, the NPS accessed the U.S Fish and Wildlife Service (USFWS) website to obtain an official species list for endangered and threatened species that may be in the project area and could be affected by project activities (USFWS 2015). NPS biologists reviewed the USFWS list and lists of state-listed species and species of concern to determine which species could potentially be affected by implementation of the proposed project. The NPS determined that there would be no effect on threatened or endangered wildlife species from implementation of an action alternative. Thus special status wildlife species will not be further evaluated in this EA. Special status vegetation is being evaluated under "Wetlands."

Wildlife and Wildlife Habitat
Riparian, wetlands, and meadow habitat are important to numerous wildlife species. These types of habitats are valuable due to the availability of water in a region with six-eight months of drought, lower summer temperatures, shade, higher productivity of riparian plants for food, hiding cover, increased availability of insect prey, and special plant structures (e.g., willow thickets) (Graber 1996). While meadows are important to wildlife, there is no evidence to suggest that Cahoon Meadow specifically is of critical value to any species. Additionally, the spatial scale of the project (e.g., 5 acres) is relatively small when compared to the spatial scale of available wildlife habitat across the park, and in the Sierra Nevada. Collectively, this means that the beneficial impacts on wildlife population parameters (e.g., abundance, density, population growth rates, etc.) would not differ in any meaningful way between the alternatives.

While there could be temporary displacement of wildlife during implementation of any of the action alternatives, the impacts would be localized and temporary. Population numbers and structure would remain stable and viable. Occasional responses to disturbance by some individuals are expected, but without measurable interference with survival, reproduction, or other factors affecting population levels. Sufficient habitat remains to maintain viability of all species. For these reasons, this topic has been dismissed from further evaluation.

Air Quality and Greenhouse Gas Emissions
During construction activities, fugitive dust would be emitted into the air by activities that disturb the soil, such as earthmoving and vehicular/equipment traffic. There would be slight impacts from increased emissions from the use of construction equipment and helicopters. The dust and emissions would be slight, localized, and temporary with no long-term effects. Overall, there would be a slight, localized, and temporary degradation of local air quality due to dust generated from earthmoving activities and emissions from motorized equipment. Impacts on air quality and greenhouse gas emissions would last only as long as construction activities occurred, and would not exceed standards, therefore this topic will not be further evaluated.

During the June 2014 field visit, Wolf and Cooper (2015) collected preliminary carbon flux data from the intact and degraded zones of Cahoon Meadow. Carbon flux provides an estimate of carbon inputs to the soil, through photosynthesis, vs. carbon outputs from the soil, through respiration by soil microbes. The intact wetland above the erosion gully (where no wetland indicators are missing) was photosynthesizing at about the same rate as it was respiring, resulting in a near-zero net CO_2 flux. Upland meadow zones missing wetland hydrology, or missing both hydrology and vegetation, experienced a net loss of about 4 g of CO_2-carbon per square meter per day. Upland zones that had no wetland indicators (missing wetland hydrology, vegetation, and soils) had no photosynthesis (no plants) and only a small amount of respiration, resulting in a small net loss of CO_2. This data, supported by the hydrologic, vegetation, and soils data showing decomposition of the peat body in the upland zones, suggests that the former fen in the dewatered portion of Cahoon Meadow has been a source of carbon (greenhouse gas) to the atmosphere, whereas the intact meadow is maintaining, and may possibly accumulate, sequestered carbon. In the long term, preservation or restoration of saturated soil conditions could prevent soil organic carbon stocks from being released to the atmosphere as greenhouse gasses, resulting in slight long term beneficial effects. Because the impacts would be slight, this topic is not further evaluated.

Cultural Resources (Historic structures, archeological resources, cultural landscapes, ethnographic resources)
In 2014, the Cahoon Meadow and surrounding area were surveyed for the presence of archeological resources and historic structures. One historic structure and one historic site were found. Though the identified sites are well away from the project site, the proposed temporary camp area is nearby. Based on the recommendations of the parks' archeologist, as long as materials for the project work are not obtained from the site, and the proposed crew camp area is situated south of the historic structure, cultural resources would not be negatively affected by the project. To ensure this, work limits would be established and enforced, include temporarily flagging the perimeter of the cabin site and avoiding work in this area. No cultural landscapes and no known ethnographic resources would be affected by implementation of either action alternative. Because recommendations by the parks' archeologist would be integrated into the action alternatives, there is no potential for effects on cultural resources; therefore this topic is dismissed from further evaluation.

Other Issues Considered
There would be no effect from the project on Indian Trust Resources or Prime and Unique Farmland because there are none of these resources in the project area. There would be no change in visitation, no growth inducing impacts since the project is in wilderness, and no change to the overall area economy. The activities proposed in this environmental document would not involve modifications to the "built environment" thus Section 504 of the *Rehabilitation Act of 1973* (23 USC 794 PL 93-112) and the *Architectural Barriers Act of 1968* (42 USC 4151) does not apply. There would be no effect on health or environmental effects on minorities or low-income populations or communities as defined in the EPA's *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA 1998). No areas within the project site are designated as critical habitat or ecologically critical areas. The alternatives being considered in this document would not affect the parks' status as an international biosphere reserve. For these reasons, these topics are dismissed from further analysis.

ALTERNATIVES

INTRODUCTION

This chapter describes the no action alternative, and two action alternatives that consider the stabilization and/or full restoration of Cahoon Meadow. The alternatives were based primarily on the report titled "Existing condition assessment and preliminary stabilization/restoration alternatives for Cahoon Meadow, Sequoia and Kings Canyon National Parks" (Wolf et. al, 2015). In June 2015, an interdisciplinary team participated in a workshop to evaluate the alternatives from the report, identify which were feasible, and determine which alternative would be recommended as the management preferred alternative. The following section includes descriptions of the alternatives that were selected for detailed analysis followed by those alternatives considered but dismissed from further evaluation.

While the NPS has identified a proposed action in this EA, the no action alternative remains a viable alternative for this project. The EA affords the opportunity for the public to provide input on whether it is more important to preserve the untrammeled and undeveloped qualities of wilderness character, or to restore and protect the natural quality of wilderness character. As no funding is yet available for implementation, if an action alternative is approved, funds specifically targeted for wetland restoration and/or disturbed lands restoration would be sought from sources inside and outside the NPS.

ALTERNATIVE A - NO ACTION

Under the no action alternative, no stabilization or restoration of the gully would occur. NPS biologists and/or cooperators would monitor the site periodically to document headward erosion, bank collapse, expansion of the dewatered area, and any other signs of rapid changes to the meadow.

Contingent on the availability of funding, monitoring could also include relocating the 2014 survey monuments, documenting the topography of the gully margins (especially at headcuts), and measuring the depth to water table and vegetation composition at the meadow plots. In addition, the photopoints established in 1970 could be located and photographed, and, if warranted, new photopoints established to document the changing condition of the site.

ELEMENTS COMMON TO ACTION ALTERNATIVES

The common elements of both action alternatives, alternatives B and C, include:

<u>Reconstruct Trail from Cahoon Rock to Cahoon Meadow</u>
There is currently a route from Cahoon Rock to Cahoon Meadow (Figure 5). This route was likely used as part of the cattle operations in the area and is in poor condition. Per the 2015 WSP there are no long-term plans to reestablish and formalize additional trails in this area. However, trail access to the project site is critical; therefore, the route would be converted to a trail for the duration of the project work.

In year one, a NPS trail crew (up to 15 people) would reconstruct the trail to stock standards. This would take approximately 6 weeks. The trail would be approximately 2 miles long and 2 feet wide to allow for stock crews to access the project site. Due to public safety concerns and to protect equipment at the project site, the trail would be designated for administrative use only when project work is underway. Under both action alternatives, once the project work at Cahoon Meadow is completed, the trail would no longer be maintained and would be restored to natural conditions.

Establish Temporary Crew Camps
A temporary crew camp would be established in the vicinity of the Evelyn Lake or Cahoon Rock trail to support trail construction. Upon completion of the trail work, all items at the crew camp would be removed and the area restored.

A temporary crew camp would be established either in the dewatered portion of Cahoon Meadow or at a nearby upland area during project work at the meadow site. Upon completion of the stabilization and/or restoration work, all items at the crew camp would be removed and the area restored, as needed.

Supply Crews by Pack Stock
Pack stock staged out of the Atwell Mill administrative corral and Hockett Meadow would resupply project crews on an as needed basis.

ALTERNATIVE B: STABILIZE HEADCUTS WITH MACHINE-BUILT ROCK CHUTE

The goal of alternative B is to stabilize the gully erosion to protect the remaining 14.9 acres of intact wetland upstream of the gully. In addition to the project components described under "Elements Common to Action Alternatives," the following project components would be implemented under alternative B.

Overview and Design of Alternative B

A "rock chute" would be constructed along the headcut area to prevent further erosion of the intact meadow upstream. A standard engineering design for sloped transitions of water flow would be used (Figure 6). A backhoe or excavator would be used to contour the headcuts to a 3:1 slope. The slope would be lined with geotextile and armored with rock sufficiently large enough to resist erosion from high flow events.

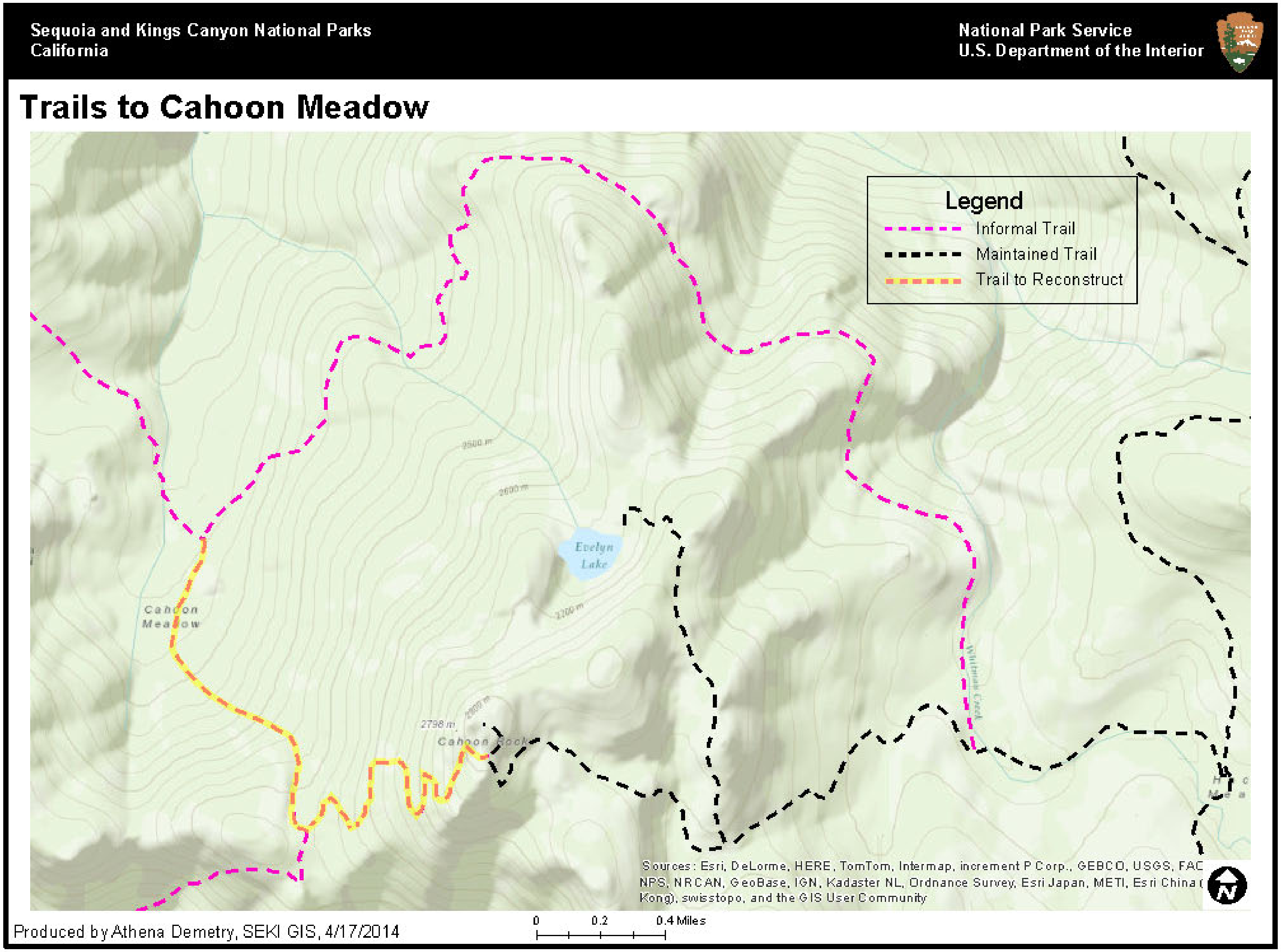
Regrading the headcut area to create a 3:1 slope (33%) would require excavating and placing approximately 1,060 cubic yards of existing soil using a small excavator. After lining the slope with geotextile fabric, the excavator would then place a 16-inch thick layer of imported 8-inch diameter rock (about 520 cubic yards). The final rock surface would be at grade with an inlet apron receiving water at the intact wetland surface, and an outlet apron collecting and discharging water into the bottom of the gully (Figure 7). One or two low (one foot tall) check dams constructed of logs would be installed in the stream channel below the rock chute.

The rock chute would be approximately 160 feet wide, and designed to convey the 25-year recurrence interval flood, calculated to be 87 cubic feet per second (cfs). The design would use rock large enough to allow 87 cfs to flow down one-third of the 160-foot wide chute (a 53-foot effective flow width) without moving the rock.

Description of Project Implementation

Alternative B would be implemented over three years not including long-term potential repairs and maintenance actions (Table 1). Year one includes the trail-construction elements described under "Elements Common to All Action Alternatives." In year two, the rock chute and check dam(s) would be constructed. The contractor would stage in the dewatered portion of Cahoon Meadow. A helicopter would be staged either out of the "Wolverton Helispot," located at 5,200 feet elevation off the Mineral King Road, or from a staging area located outside the park off the South Fork Road. Crews would be resupplied by stock on an as needed basis. The total duration of project work in year two would be about 3-5 weeks. Erosion repairs, if necessary, and trail restoration would occur in year 3.

Figure 5. Trails to Cahoon Meadow



Construct Rock Chute

Importing heavy machinery, rock, and geotextile fabric would require helicopter support. Large helicopters are capable of carrying 10 tons (20,000 lbs) during optimal conditions; though 7.5 tons (15,000 lbs.) is more realistic for the conditions (elevation, air temperature) of this project. A large helicopter (such as a Chinook) would be used for about 6 days (approximately 25 flight hours and 105 round trips) in July or August, within a window of 6 to 21 days.

The helicopter would transport a small excavator weighing approximately 15,000 pounds. The excavator would be used to clear trees, downed logs, and other debris from the headcut area and grade to a 3:1 slope. Prior to construction of the rock chute, water would be impounded above the project and a pipe installed to divert water around the project work area.

The helicopter would then be used to transport materials to construct the rock chute. Rock weighs approximately 1.4 tons per cubic yard. Approximately 520 cubic yards of rock material weighing about 730 tons is needed for this project. The standard way of hauling rock by helicopter is with a 5.5 cubic yard bin. Rock would be transported 5.5 cubic yards at a time over about three days, requiring an estimated 100 round trips. Once delivered, rock would be placed by the excavator. Additional items transported by helicopter (about 5 round trips) would include supplies for the contractor's camp, diesel fuel for the excavator, supplies for water diversion, and a shipping container to protect the equipment and supplies.

Construct In-Channel Check Dams

Year two would include the construction of one or two check dams within an 80-foot long reach at the shallowest sloped (1.3%) portion of the gully, located about 600 feet downstream of the headcut. Over a one-week period, check dams would be constructed by hand-crews using chainsaws and hand tools. Two trees per dam would be cut and used for construction. Logs would be installed perpendicular to the water flow and keyed into both the banks and the channel bed to create a backwater to retain sediment.

Project Follow-Up and Long-term Maintenance Requirements

Follow-up repair may be needed in year three (one year after construction), after the rock structure has sustained a season of flooding and spring runoff. Minor maintenance of the structure is estimated to be needed about every 25 years. The 25-year maintenance would likely require about 2-4 weeks of crew time and helicopter support. The total life of the structure is expected be about 100 years.

After any rock chute repairs in year three, the trail from Cahoon Rock to Cahoon Meadow would be restored to natural conditions. A temporary crew camp would be established and crews would be resupplied by stock on an as needed basis.

Additional in-channel check dams may be necessary in the future if needed to capture eroded material. Check dams would be monitored every 2-3 years or following large run-off events, and repaired as necessary. Site-specific analysis and environmental compliance would occur, and required water quality permits would be obtained, prior to installation of additional check dams.

Monitoring

After construction, park staff or cooperators would track the function and integrity of the rock structure so that repairs could be made promptly. A solar-powered remote camera would be installed to photograph site conditions on a daily basis in the winter, when access would be challenging. This information would be uploaded remotely and sent to the park via satellite.

Figure 6. Alternative B – Rock chute design plan

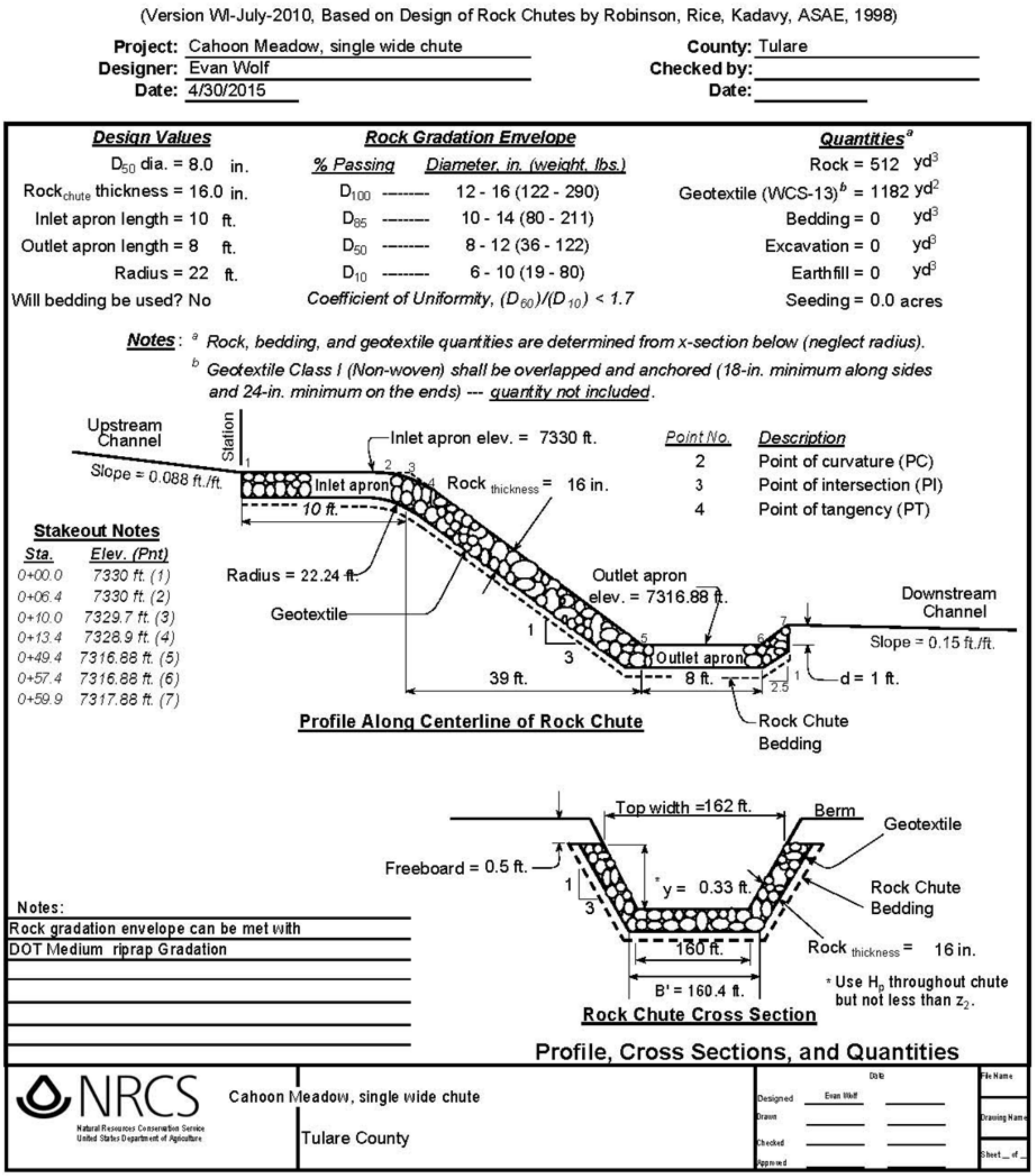


Figure 7. Alternative B – Stabilize meadow with machine-built rock structure

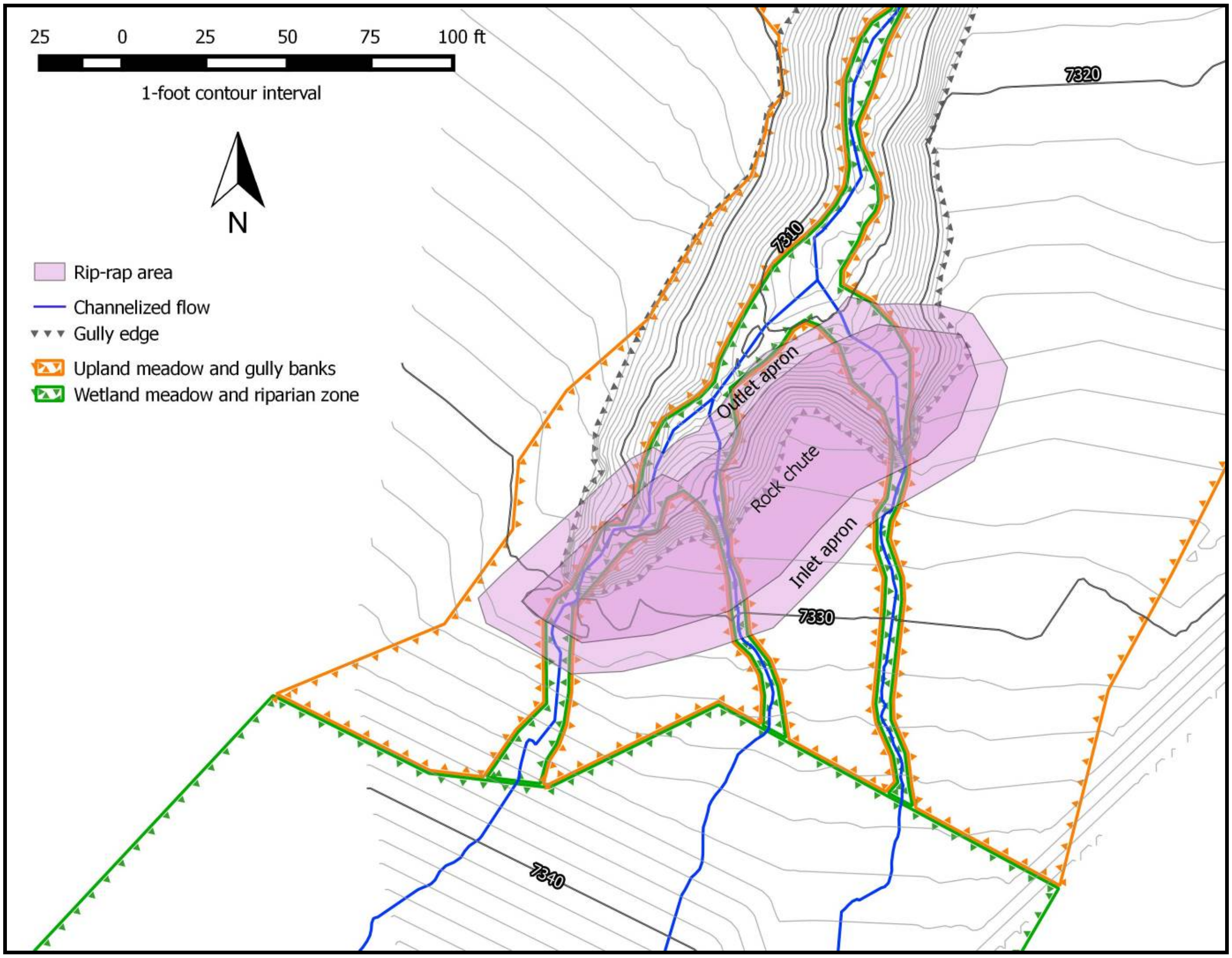


Table 1. Alternative B – Summary of Project Implementation Schedule and Work Items

Year 1	Reconstruct hiking trail from Cahoon Rock to Cahoon Meadow. Crew staged out of Evelyn Lake or nearby camp, supplied by stock throughout duration of project. Estimated 6 weeks of crew work, up to 15-person crew.
Year 2	Contractor builds rock chute during a 3 to 5 week period, supported by helicopter. Chinook used for about 6 days (25 flight hrs., 105 round trips) within a window of 6 to 21 days. • About 100 helicopter round trips to transport 520 cubic yards of rock. • About 5 helicopter round trips to transport equipment and supplies, including: Contractor's camp, food, diesel fuel, diversion pipe, shipping container for equipment. Contractor diverts water in a pipe around project area until rock chute is completed. Small excavator airlifted in; used to clear headcut area and grade to 3:1 slope. Construct one or two check dams in shallowest 80-foot stretch of gully. Camp/stage in dewatered portion of the meadow or upland area. Crews would be resupplied by stock on an as needed basis.
Year 3	Follow-up repair after first spring flood flows. Restore trail from Cahoon Rock to Cahoon Meadow to natural conditions.
Follow-up and Maintenance and Monitoring	Minor maintenance repairs every 25 years (2 – 4 weeks of crew time with helicopter support). Check dams would be monitored every 2-3 years or following large run-off events, and repaired as necessary. A solar-powered camera would be installed to monitor site conditions. Construct additional in-channel check dams in the future, as needed.
Estimated Life of Structure	Total life of structure 100 or more years.

ALTERNATIVE C: FULL RESTORATION; REGRADE WITH MACHINERY TO RESTORE WETLAND TOPOGRAPHY, HYDROLOGY, AND VEGETATION (NPS-PREFERRED ALTERNATIVE AND PROPOSED ACTION)

The goal of alternative C is to protect 14.9 acres of wetland upstream of the gully from further loss and restore sustainable wetland function to 5.4 acres of dewatered meadow and gully bottom by reestablishing wetland topography, hydrologic regime, and vegetation similar to the pre-erosion meadow. This alternative includes filling the gully to recreate a sheetflow system, and planting native wetland vegetation. In addition to the project components described under "Elements Common to Action Alternatives," the following project components would be implemented under alternative C.

Overview and Design of Alternative C

The gully would be filled using existing soils from the adjacent dewatered meadow (Figure 8). The meadow would be graded to be flat in cross-section and eliminate all preferential flow paths, which would restore a sheetflow hydrologic regime and saturated soil conditions (Figure 9). Regrading the gully portion of Cahoon Meadow to fill the gully and create level topography would require excavating, moving, and placing 12,500 cubic yards of sediment obtained from the top 0.5 to 5.5 feet of the dewatered meadow soils. Much of this fill could be pushed 100 feet or less from the dewatered meadow terraces, across the meadow, and into the gully. However, a greater proportion of fill is needed at the southern end of the gully (at the headcuts), while a greater proportion of cut material would be generated at the northern end. Therefore, substantial upslope transport of the fill material would be required. It is estimated that 4,700 cubic yards of fill (out of a total 12,500 cubic yards) would need to be moved 1,000 feet up valley.

The final meadow surface would be graded level in cross-section, with salvaged topsoil placed on top of the finished surface. Trees and other woody plants (e.g. willows) that are currently growing on the dewatered meadow surface or in the gully would be cut and buried in the gully as fill or left on the surface after restoration. There would be about 100 small to medium lodgepole pines and 50 to 100 shrubs that would be cut and removed under this alternative. Log segments without branches could be buried sub-grade as long as they would not leave voids or interfere with compaction of the lower lifts.

Wetland plants, propagated in a nursery from seed collected at Cahoon Meadow, would be planted in the regraded and formerly dewatered areas. The plants would take several years to grow to sufficient density to prevent sediment erosion. Erosion blanket and coconut (coir) "mattress" fiber or wattles, would be placed on the bare soil surface, and wetland plants embedded through the blanket.

Description of Project Implementation

Alternative C would be implemented as a four-year project (Table 2). Year one activities are described under "Elements Common to all Action Alternatives" and would also include cutting trees within the grading limits, using chainsaws and handsaws. In year two, all earthwork would be completed. The earthwork could be accomplished by one scraper/grader, a loader, a small bulldozer. About half of the native plants would be planted in year two, and the remaining would be planted in year three. Erosion repairs, if necessary, and trail restoration would occur in year 4.

<u>Grade Dewatered Meadow and Fill Gully</u>

Grading would be completed by a contractor in year two of the project (Table 2). Topsoil and intact wetland vegetation would be salvaged prior to grading and placed on top of the finished surface. Water would be temporarily diverted 1,200 feet around the grading limits in plastic pipe. A large helicopter (such as a Chinook) would be used for 1 day (approximately 3 to 4 flight hours, or 15 to 20 round trips) in July to mobilize 3 to 4 pieces of earthmoving equipment, diesel fuel, and supplies; and for 1 day in August (approximately 3 flight hours, or 8 to 10 round trips) to demobilize earthmoving equipment and all supplies. An additional 10 to 20 round trips by a light helicopter (e.g, AStar) may be needed as a construction contingency, for example to bring in unanticipated supplies.

Earthmoving equipment would likely consist of one tracked bulldozer (approximately 16,000 lbs), one 11-cubic yard wheel tractor-scraper or two 6-cubic yard wheel tractor-scrapers to excavate and transport soil, and one small skid-steer loader, such as a Bobcat. Additional items transported by helicopter would include food and supplies for the contractor's camp, diesel fuel, supplies for water diversion, erosion control blanket, live plants, and a shipping container for contractor equipment (such as pumps, compressors, generators, power tools, wattles, erosion blanket, equipment repair items, food, drinking water). The helicopter would be staged either out of the Wolverton Helispot, located at 5,200 feet elevation off the Mineral King Road, or from a staging area outside the park off the South Fork Road. The total duration of construction in year two is estimated at 10 to 12 weeks (approximately 28-35 days of heavy equipment use).

To protect soils after the area has been graded, approximately six acres of two-layered erosion control blankets, consisting of aspen and coir fibers – one lighter fibrous blanket to provide a finer scale of blanket-soil contact, and one heavy woven blanket to provide longevity and added surface roughness – would be placed over all disturbed soils. Approximately 1,000 coconut (coir) wattles would also be installed to provide surface roughness and minimize erosion. All fibers in the blankets and wattles would be natural (no plastic) and biodegradable. After approximately 5 years, the wattles and erosion fabric would break down and the plants would be established, barring any large flood events.

Approximately 90,000 container plants grown in commercial nurseries would be planted on site. The risk of importing nonnative plants with nursery materials would be minimized by using container plants rather than nursery-grown wetland sod. Half of the container plants would be installed in the fall of year two, immediately after construction; the remainder would be installed in early summer of year three. In year three, the plants would be transported by a small helicopter, requiring an estimated five round trips. A crew of 5-8 people would require an estimated two to three weeks to install the remaining plants. Crews would camp in an upland area and be resupplied by stock on an as needed basis.

Project Follow-Up and Maintenance

Maintenance to repair localized erosion gullies that may form prior to establishment of protective vegetation would be needed for one to three years until the plants grow to full density. No further long-term maintenance to the graded area is anticipated. In year four, the trail from Cahoon Rock to Cahoon Meadow would be restored to natural conditions. A temporary crew camp would be established and crews would be resupplied by stock on an as needed basis.

Monitoring

The resulting hydrology, vegetation, and wetland function would be monitored in order to assess success. The site would be monitored annually for 2-3 years, then less than annually up to 10 years to assess long-term success. Hydrology would be monitored in approximately 10 groundwater wells (2-inch slotted polyvinyl chloride/PVC pipe rising approximately 12 inches above-ground) and one stream-level logger (4-inch long x 0.5-inch diameter data loggers secured to a tee-post in the stream channel). The stream-level logger would be associated with a rectangular-notched plywood weir in the creek so that cross-sectional geometry, and therefore water volume, could be measured. The PVC wells, tee-post, and plywood weir would be removed 10 years after project completion. Vegetation would be monitored non-destructively in unmarked plots associated with the groundwater wells.

Figure 8. Alternative C – Restore the meadow by regrading.

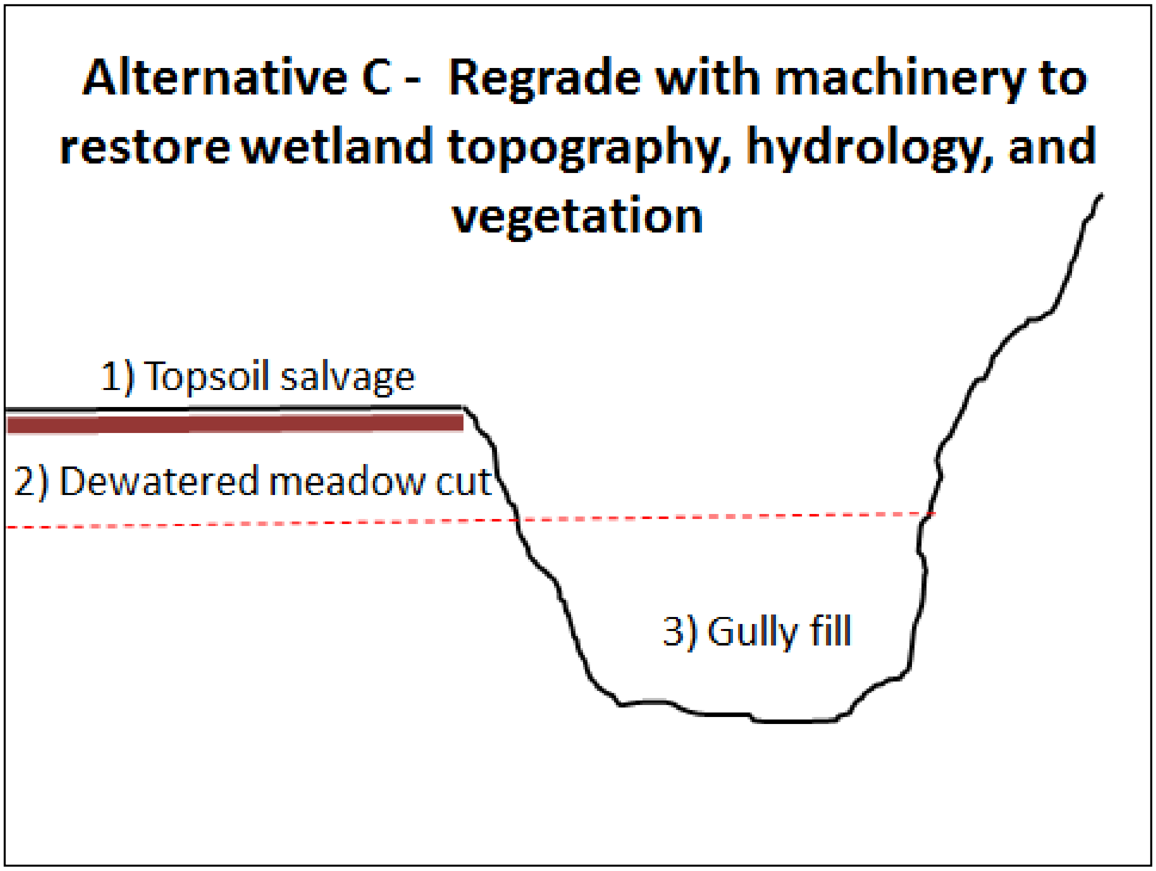


Figure 9. Alternative C – Grading plan using in-place meadow sediment.

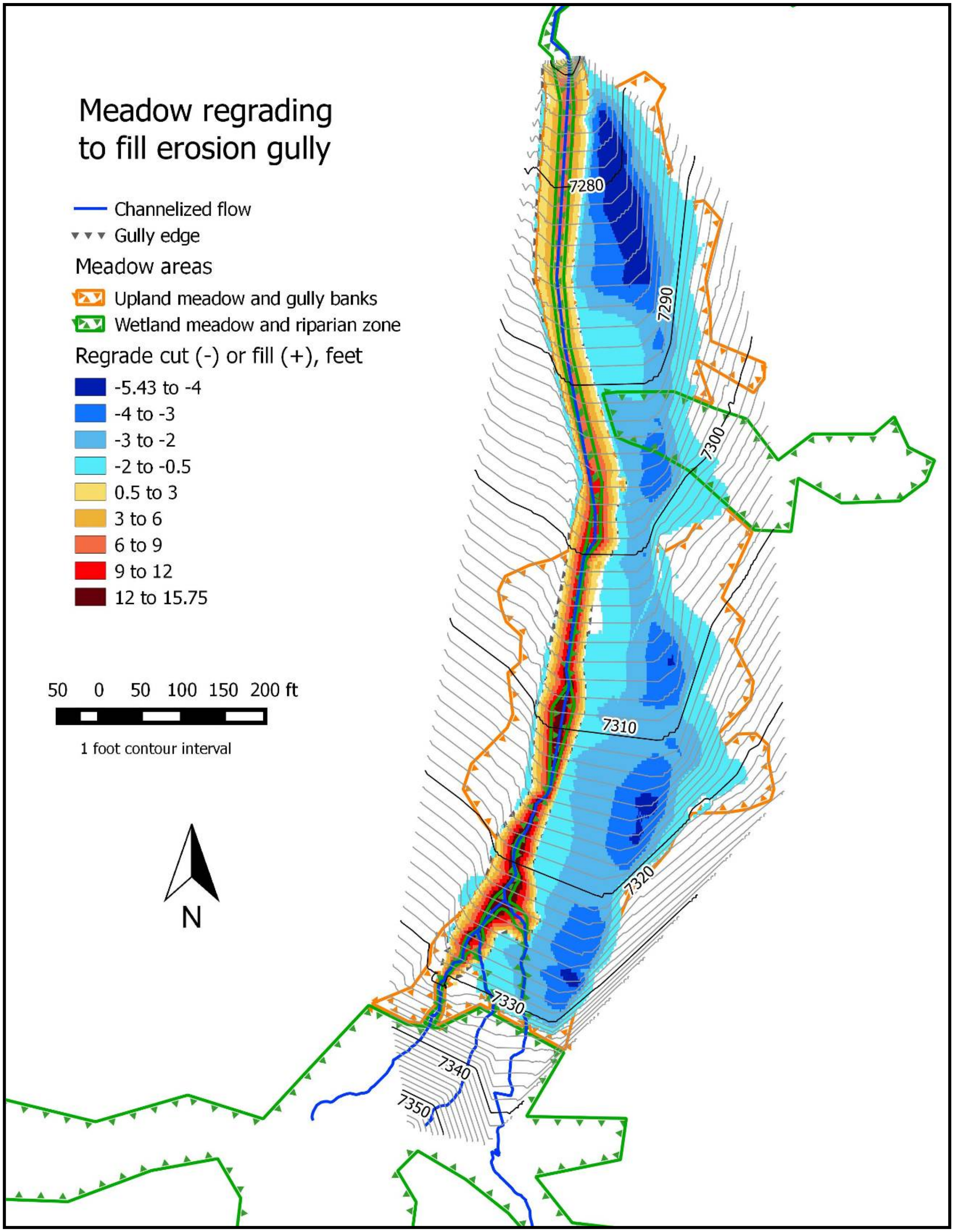


Table 2. Alternative C – Summary of Project Implementation Schedule and Work Items

Year 1	Reconstruct hiking trail from Cahoon Rock to Cahoon Meadow. Crew staged out of Evelyn Lake or nearby camp, supplied by stock throughout duration of project. Cut, limb, buck trees within grading limits. Estimated 10 weeks (construct trail and cut trees) with a 15-person crew.
Year 2	Contractor diverts water in a pipe around project area and conducts grading, soil protection, and partial revegetation during a 10 to 12 week period. Chinook used for approximately 2 days; 3-4 hours (15-20 trips) in July to mobilize equipment and supplies - 3 hours (8 to 10 round trips) in August to demobilize equipment and supplies. Light helicopter used for approximately 10-20 round trips as a construction contingency. Equipment used on-site for approximate 4 weeks would include: • One tracked bulldozer (16,000 lbs). • One 11-cubic yard wheel tractor-scraper OR two 6-cubic yard tractor-scrapers. • One small skid-steer loader (Bobcat). • Contractor's camp, food, supplies, diesel fuel, diversion pipe (1200 ft), erosion control blanket, live plants, shipping container of equipment. Camp/stage in dewatered portion of meadow or upland area. Crews would be resupplied by stock on an as needed basis. Up to 6 acres of erosion control blanket would be placed. Approximately 45,000 of 90,000 container plants would be planted. Approximately 1,000 coir wattles would be placed on site to control erosion.
Year 3	Repair erosion, if necessary, after spring flood flows (2-4 weeks large crew time and minor small helicopter support). Plant remaining 45,000 of 90,000 container plants (additional 5 flights by small helicopter).
Year 4	Repair erosion, if necessary, and restore trail from Cahoon Rock to Cahoon Meadow to natural conditions.
Follow-up and Maintenance and Monitoring	No further maintenance or repairs after year five. The site would be monitored using approximately 10 groundwater wells and on stream-level logger, which would be removed 10 years after project completion.
Estimated Life of Structure	N/A (no structure).

MITIGATION MEASURES

Mitigation measures are designed to prevent or minimize adverse impacts or to contain impacts within acceptable limits during and after project implementation. Mitigation measures and guidance have been included in each project alternative. The following are additional guidance and mitigation measures that would be incorporated into project implementation.

Protect Wilderness Character
• Plan helicopter loads and flights carefully to maximize loads and minimize flights. • Materials that are small and light would be transported by pack stock. No motorized equipment would be used in camps.
Protect Visitor Experience
• Wilderness visitor would be informed of upcoming and ongoing construction activities and potential area closures. This would occur through the permit issuance process, wilderness rangers on the trail, and other educational contacts. • Visitors would be told of alternate locations and times to avoid helicopter routes.
Protect Water Resources and Wetland Values
• Silt fencing would be installed in and around construction areas to prevent excessive sediment flow into wetlands or waterways. Water flows would be diverted around the project site to provide a dry work environment and prevent sediment entry to water body below project. • Operations would be halted when weather conditions could cause excessive erosion or sediment to enter any naturally-occurring water body. • All equipment that would be used on the project, prior to entering the parks and transporting to the project site, would be thoroughly cleaned of soil/mud and all organic matter by power washing the equipment and inspected prior to entering the parks. • Fuel and other hazardous materials would be accessed, applied, and stored within a containment barrier placed at least 100 feet from any waterbody. • Every day, prior to commencement of work, all machinery would be inspected for leaks, and leaked material removed from the environment and placed in containment drums. If a leak is found, the machinery would not be used until repaired, and would be parked at least 100 feet from any waterbody and placed within appropriate containment. • Machinery maintenance involving potential contaminants would occur in a designated appropriate area with appropriate containment (e.g. on a mat, surrounded by berms). All routine equipment maintenance will be completed in the frontcountry, prior to mobilization to the project site, with only critical maintenance and repair occurring in wilderness. • A hazardous spill plan would be in place, stating what actions would be taken in the case of a spill; notification measures; and, preventive measures to be implemented such as the placement of refueling facilities, storage, and handling of hazardous materials, etc. Hazardous spill clean-up materials will be on site at all times and spilled hazardous materials would be cleaned up immediately and would not be allowed to seep into the soil or reach open water sources. • Per the *NPS Procedural Manual #77-1: Wetland Protection*, application of Best Management Practices and conditions must be adhered to for excepted actions (see supporting documentation in PEPC at http://parkplanning.nps.gov/cahoon).

• An Erosion and Sediment Control Plan would be written and appropriate water quality permits (Clean Water Act section 404 and section 401) would be acquired prior to the commencement of work. Additional mitigation measures or monitoring associated with those plans and permits would be implemented.
Protect Cultural Resources
• Work limits would be established and enforced. The cabin site would be flagged around the perimeter and workers would be instructed to avoid this area. • Should previously unknown historic or prehistoric resources be unearthed during project implementation, work would be halted in the discovery area, the site secured, and the parks' Cultural Resources Program Manager notified. A qualified cultural resource management specialist would examine the area as soon as possible and will follow the procedures of 36 CFR Part 800.13[c]. • In the event that human remains, funerary objects, sacred objects, or objects of cultural patrimony are discovered during project activities, the regulations implementing the *Native American Graves Protection and Repatriation Act* (43 CFR Part 10) shall be followed.
Protect Air Quality
• Motorized equipment would not be allowed to idle for more than 5 minutes. • All haul trucks carrying construction materials or debris to and from the frontcountry helicopter staging areas would be covered.
Protect Native Wildlife
• SEKI food-storage and garbage disposal requirements would be adhered to. The proper treatment of human waste would be required. A litter control program would be implemented. • Nesting bird surveys would be conducted prior to the project work. If nesting birds are found, individual trees with nests would not be cut, and areas with bird nesting would be flagged and no tree cutting would occur in those areas until after nesting season, in consultation with the parks' wildlife biologist.
Protect Native Vegetation and Soils
• All equipment would be pressure washed to remove all dirt and plant parts before entering the park, paying special attention to undercarriages and grills/radiators. Project manager would inspect equipment for compliance prior to entry into the park and reject equipment that is not adequately clean. • Helispots would be surveyed for non-native plants; non-native plants would be treated/ removed prior to project work. Construction materials would be staged and sling-loaded from asphalt, rather than on vegetated edges of helispots, whenever possible. • Clothing, boots, tools, helicopter skids, cargo nets, and equipment would be inspected for plant seeds and plant parts; plant seeds and plant parts would be removed, and properly disposed of prior to staff and equipment entering the wilderness. Disposal consists of removing the seed and plant parts from clothing and equipment at a spot near the infestation area, or bagging the seeds and plant parts and disposing in dumpsters or garbage cans. • Imported rock would be obtained from approved sources only. • The project and staging areas would be surveyed for non-native vegetation one to three years after project activities are completed. Follow-up treatments would occur as necessary. • Plant propagation contracts would require sterile media and nursery practices that do not allow plants to acquire organisms other than the target plant. Plants will be inspected by a government representative prior to transport and treatments required if non-target organisms are found. • Straw products (e.g., "certified weed-free straw" and other straw products) are not authorized on

project work sites. Excelsior (aspen fiber) or coir (coconut fiber) products would be used for erosion control, sediment filtration, or other needs. • Only approved travel routes and designated staging areas would be used. Workers would be instructed to stay within construction limits. • Crews would practice “Leave No Trace” methods. • Crew camps would use scrim or other protective coverings to protect vegetation in temporary crew camps. • All temporary access trails would be restored to natural conditions by obliterating the trail tread and covering soils with forest litter and duff. Existing rock walls that occur along the informal route would be left undisturbed to protect cultural resources. • The top 6 to 8 inches of soil (topsoil) in the construction area would be removed, stockpiled, and replaced on the surface after grading to preserve the topsoil seed bank. • California or Nevada certified weed-free forage (baled or loose hay, hay cubes, or straw bedding) would be required when hay products are used as supplemental forage or bedding in the frontcountry. • Stock would be purged on pellets, rolled grain, fermented hay, or certified weed-free forage for 3 days prior to entering the wilderness. Stock would be inspected and cleaned by handlers prior to entering the wilderness to remove any plant parts, seeds, or soil that may have adhered to animals, packs, or equipment. • Any feed carried into wilderness would be commercially processed pellets, rolled grains, or fermented hay. Baled or loose hay and compressed hay cubes, which have little to no processing, would not be allowed in the wilderness.
General Considerations
• All tools, equipment, barricades, signs, surplus materials and rubbish would be removed from the project work limits upon project completion. When possible, debris would be disposed of at a materials recycling facility.

ALTERNATIVES CONSIDERED BUT DISMISSED FROM DETAILED ANALYSIS

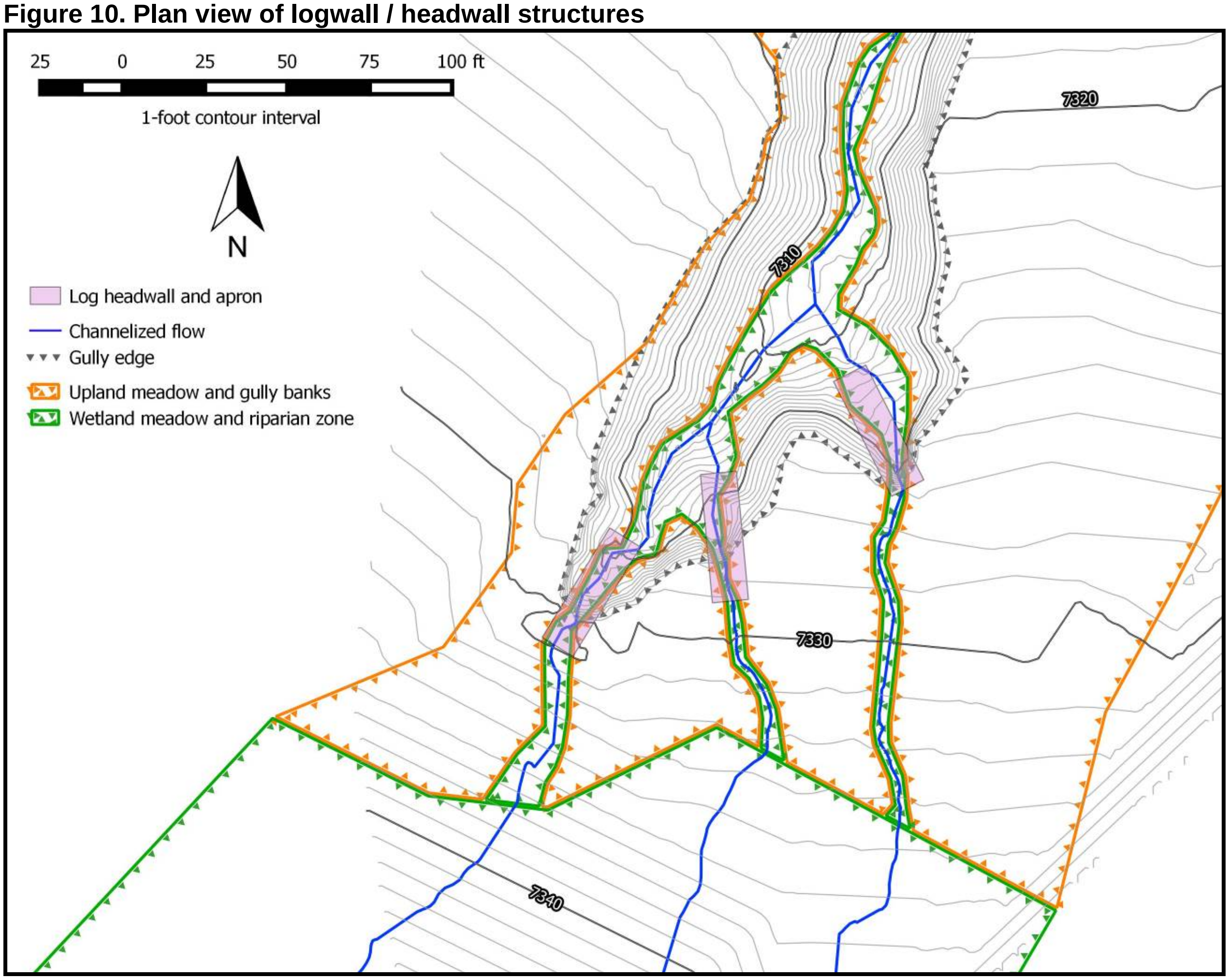
STABILIZE INTACT WETLAND WITH HAND-BUILT LOG STRUCTURES

An alternative to stabilize the gully headcut using hand-built log structures was considered during project planning and was presented during public scoping. This option considered hand-building a set of three headwall/stepdown structures, one for each headcut location, constructed of logs obtained on-site, and stepped down on the downstream face to disperse cascading-water energy (Figure 10). The structures would be 7-8 feet tall to accommodate the vertical drops from the meadow surface, and keyed into the existing meadow headcut with both at-grade inlet and outlet aprons to discourage water from flowing around or under the logs. One possible design (Figure 11) for the log headwall and step-down apron was based on work by William Zeedyk treating erosion gullies and headcuts, which include design elements such as wire and geotextile (Zeedyk & Jansens 2006). The proposed design would likely be the largest hand-built log headwall/step-down structures implemented in an attempt to stabilize an erosion gully. This design (Zeedyk) is typically applied to erosion gullies 3-4 feet deep and 10-12 feet wide and is used in the semi-arid southwestern United States.

The advantage of log structures is that the bulk of the structure would be built from on-site, native materials, with some imported anchoring materials such as steel posts and wire. Approximately 3,960 linear feet of logs would be needed; assuming each tree could produce 30 feet of usable logs over 12 inches in diameter; approximately 130-150 trees would need to be cut. Though very difficult, it may be possible to construct log structures using hand crews, possibly with stock assistance. The disadvantages are that the logs would decompose over time. In large floods, logs may become dislodged and can float away. The three log structures would also be more susceptible to erosion at their lateral edges, as compared to the single large rock chute. Annual monitoring would be needed to check the log structures for damage, and repairs would likely be needed every 3 to 5 years. The estimated life of the structure is 20-30 years.

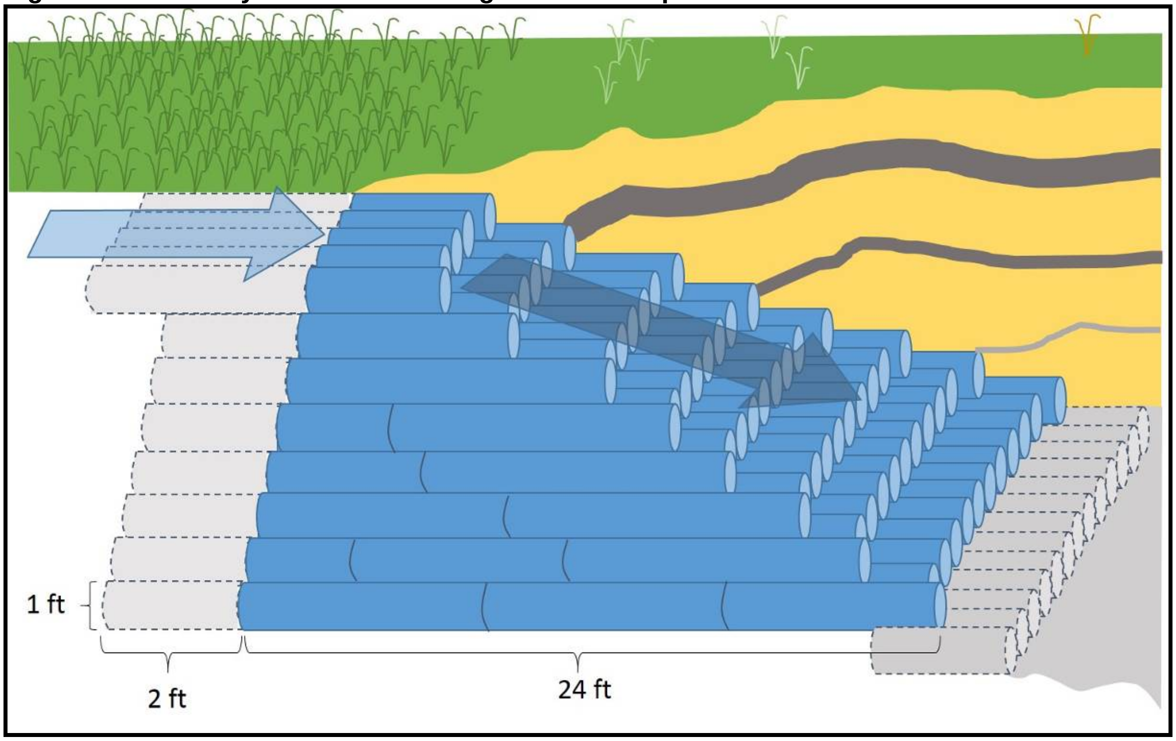
This alternative was eliminated from further consideration due to the safety concerns of using hand crews to construct these structures. The risk exposure to crews digging 8 foot-deep trenches in wet and unstable soil conditions was considered too severe to make this a feasible and safe alternative. In addition, the application of this type of design to the gully widths and depths of Cahoon Meadow are well outside the bounds of successful application in other locations, and the structure is likely to fail in flood events, requiring frequent maintenance, repair, and complete rebuilding with long-term safety risks to crews. For these reasons, the option to stabilize the gully with hand-built log structures was dismissed from further evaluation.

Figure 10. Plan view of logwall / headwall structures



This plan view map shows the locations and areal extents of the three log headwall/ stepdown structures with associated inlet and outlet aprons. Each structure is located where channelized flow enters the gully and has created vertical headcuts. The contour interval is 1 foot.

Figure 11. Cut-away schematic of a log headwall/stepdown structure



This figure shows the cut-away schematic of a log headwall / stepdown structure dropping 8 ft over a 24 foot long distance (3:1 slope) and expanding from 5 feet wide at the top tier of logs to 12 feet wide at the bottom. The meadow surface is shown as green, and meadow sediments exposed by the gully are yellow with dark bands. These dimensions are required to treat each of the 3 headcuts. Grey logs are embedded into the headcut wall, or buried at-grade in the inlet and outlet aprons. NOTE: figure is not drawn to scale.

CONSTRUCT CHECK DAMS ALONG THE LENGTH OF THE CHANNEL

One common technique used to treat gully erosion has been the construction of check dams along the length of the channel. The check dams provide three functions: they slow the flow and disperse energy by creating pools of water, they encourage the deposition of sediment that slowly fills the gully, and they can raise the water table in the adjacent meadow. The SMCC installed and maintained hundreds of check dams in the backcountry of SEKI. In low gradient meadows with small dimension channels, these structures may be effective. Another setting where small check dams have been effective is in narrow, approximately 5-feet deep gullies in peat. Near Manchester, UK, restoration teams have successfully deployed sheet metal dams in narrow peat gullies, raising the water table high enough to have ecological importance to the plants on the peat surface.

The steep gradient and deep, wide gully in Cahoon Meadow make large check dam structures highly likely to fail. The dimensions of check dams that would be needed to span the width and height of the gully in Cahoon Meadow are outside the range of the check dams installed by the SMCC or in other Sierra Nevada locations; the largest known check dam hand-built by the SMCC was about 8 feet tall and 20 feet wide, at Sugarloaf Meadow. Placing flow obstructions in such a steep, confined channel is likely to force flow around the obstruction, causing channel widening by collapsing the banks and eroding more of the meadow. Stable check dams cannot be built by hand more than 3 or 4 feet high, and, in Cahoon Meadow, this would still leave the water table 10 or more feet below the meadow surface in most places. This would have little ecological benefit for the dewatered wetland. The amount of time required to accumulate sediment behind these dams is difficult to estimate because each site's watershed sediment yield is different. The meadow sediments themselves suggest that several thousand years is required to accumulate approximately 20 feet of sediment in a sheetflow environment. At most, this is a rate of 1 foot per 100 years, which is far too slow to be considered as a management alternative.

Application of prescribed fire to the surrounding watershed in order to increase sediment yield and subsequent accumulation behind check dams was also considered. However, it would be difficult to direct the sediment deposition where it is desired, and sediments could be deposited on the surface of the intact meadow rather than in the gully, to the detriment of those wetlands. Finally, nearly annual repair would be needed to maintain check dams so that they result in improvement rather than worsening of gully conditions, requiring a multi-century commitment. For these reasons, the option to construct check dams along the length of the channel was dismissed from further consideration.

CONSTRUCT IN-STREAM STRUCTURES TO TREAT GULLY EROSION

Techniques such as cross-vanes and other hardened in-stream structures designed to keep flow in a central channel, reduce channel migration and bank erosion, and provide grade control were considered, but dismissed because they do not address the primary problem of the headcut instability. In addition, the gully already contains a vegetated inset floodplain within the larger confined, eroded gully. This vegetation is providing more stabilization, sediment trapping, and flow dispersal than small hardened cross-vanes would. In fact, cross-vanes are specifically designed to pass sediment in a stabilized high-velocity central channel, which would be counter to the goal of accumulating sediment through time to slowly fill in the gully. For these reasons, these techniques were dismissed.

REINTRODUCE BEAVERS

There is considerable interest across North America in using beaver reintroduction to maintain instream dams. This recommendation was also brought forward through the public comment process. Although there are significant stands of willow in the upper portion of Cahoon Meadow, beaver conduct 90% of their foraging within 100 feet of their dams (Hall 1960), and there are very few willows, and no aspen or cottonwood, within 100 feet of the gully in Cahoon Meadow. In addition, beavers tend to require connected habitat up and/or downstream for dispersal. Cahoon Meadow is near the top of the watershed and the channel below the meadow is steep and confined with little or no willow for miles. Finally, beaver colonies form and disappear annually across a broad landscape, meaning that even if a colony could be established at this particular site, it would be unlikely to be continuously occupied. In order to ensure a sustainable beaver meta-population over the long-term, restoration efforts would have to occur over a broad spatial scale with hundreds of animals. Such a project is outside the scope of this EA, as it would have substantial impacts that extend far beyond Cahoon Meadow. For these reasons, the option to reintroduce beavers was dismissed.

AFFECTED ENVIRONMENT

This section provides a summary of the resources associated with the alternatives and the environmental consequences of the alternatives. It is organized by impact and resource topics that were derived from internal park and external public scoping, and is limited to those topics where there is the potential for significant adverse or beneficial impacts on the resources, or because the impacts associated with the issue are central to the proposal. More detailed information on resources in SEKI can be found in the GMP (NPS 2007); and, more detailed site-specific information on the resources at Cahoon Meadow can be found in the *Wetland delineation for Cahoon Meadow, Sequoia National Park* (Wolf and Cooper 2015).

LOCATION

Cahoon Meadow is a 25.1 acre fen and wet meadow wetland complex with patches of dry meadow and upland. The site ranges from 7,260 to 7,430 feet in elevation and is located 2.8 miles west of Hockett Meadow in the southwestern portion of Sequoia National Park (Figure 12), within the John Krebs Wilderness Area.

WILDERNESS CHARACTER

The Wilderness Act mandates the preservation of wilderness character. This document uses the interagency wilderness character framework (Landres et al. 2008) to assess the impacts of this project on wilderness character. This framework describes wilderness character as "the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. These ideals combine to form a complex and subtle set of relationships among the land, its management, its users, and the meanings people associate with wilderness." In total, these relationships and meanings are described as "wilderness character."

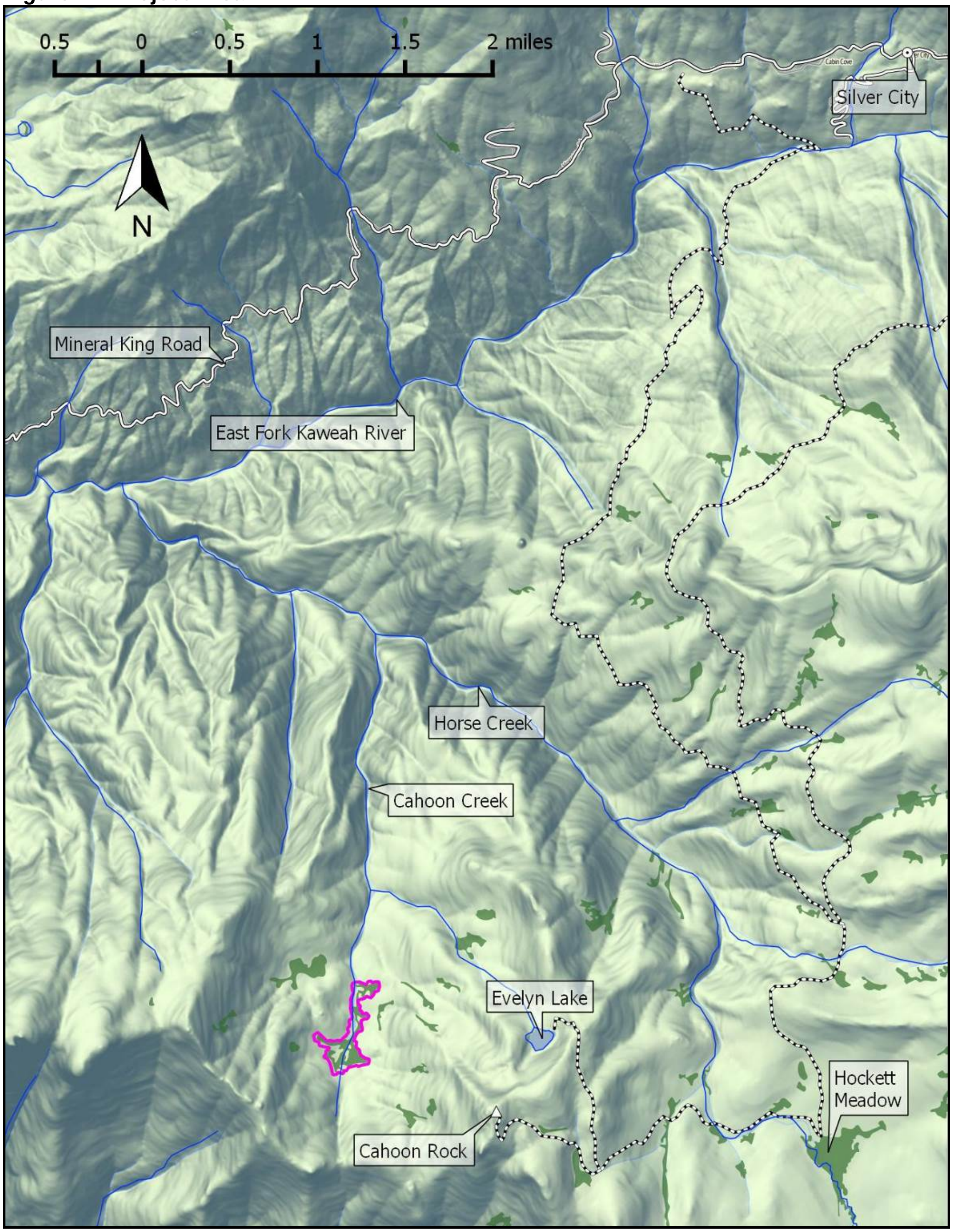
The four primary qualities that contribute to wilderness character are:

Untrammeled — The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man" that "generally appears to have been affected primarily by the forces of nature." Therefore, wilderness is essentially unhindered and free from the actions of modern human control or manipulation. This quality is influenced by any activity or action that is intended to control or manipulate the components or processes of ecological systems. Actions that are taken to preserve or restore the natural quality often degrade the untrammeled quality, even though these actions are taken to protect resources. Examples of such actions include removing invasive plants, or reducing unnatural fuel loads by cutting fuels or performing prescribed fires.

Natural — The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." Ecological systems within wilderness are to be substantially unaffected by modern civilization. This quality aims to preserve native species, patterns, and ecological and evolutionary processes, and to understand and learn from natural systems. This quality is degraded by such things as the loss of native species, the alteration of ecological processes such as fire regimes, and the effects of climate change.

Undeveloped — The Wilderness Act defines wilderness as "an area of primeval character and influence, without permanent improvements or human habitation…where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." Wilderness is to retain its

Figure 12. Project Area



Shaded relief topographic map showing the project area at Cahoon Meadow (pink border), other wet meadows in the region (dark green), maintained hiking trails used to access the Cahoon area (black-white dashed lines), and labelled built and natural features. See figure 3 for informal trails in the project area.

primeval character and influence. This quality is affected by what are commonly called *Section 4(c) prohibited uses* — the presence of structures, aircraft landings, and the use of motor vehicles, motorized equipment, or mechanical transport. Removal of structures and avoiding these prohibited uses preserves or improves this quality.

Solitude or a primitive and unconfined type of recreation — The Wilderness Act states that wilderness offers "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is primarily about the opportunity for people to experience wilderness, and is influenced by factors that affect these opportunities. It provides for primitive recreation; the use of traditional skills; personal challenge, risk, and self-discovery; and freedom from constraints of modern life. This quality is preserved or improved by management actions that reduce visitor encounters, signs of modern civilization inside wilderness, facilities, and management restrictions on visitor behavior.

In addition to these four qualities, there are other values identified in the enabling legislation of the parks or wilderness that may contribute in a positive way to the overall concept of wilderness character. The Wilderness Act Section 2(c)(4) states that a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." These may include paleontological features, cultural resources, or even mining structures that are of wilderness-enhancing historical value. Wilderness areas in these parks contain valuable historic, cultural, and scientific features.

The untrammeled, undeveloped, and solitude or a primitive and unconfined type of recreation qualities of wilderness character at Cahoon Meadow are currently in good condition and do not require action to preserve. The natural quality, however, has been degraded. "Natural" in this circumstance, relates to ecological integrity - the ability of Cahoon Meadow to sustain wetland conditions in the face of changing environmental conditions.

Currently, 14.9 acres of existing, high quality fen/wet meadow complex are threatened with loss, and wetland function has been completely lost on 5 acres of former wetland, due to the alteration of landforms, hydrology, and vegetation that support sustainable wetland function. These properties no longer function to sustain wetlands in Cahoon Meadow as a direct result of the historic human action of livestock grazing. The erosion gully is unstable and dynamic, with recent slumping and calving observed at the gully edges in 2014. Without intervention, headcuts will continue to migrate upstream, draining intact wetland and degrading downstream aquatic habitats. Without intervention, the intact wetland above the gully may completely convert to upland and nearly 15 acres of wetland would be lost as a natural feature.

Analysis of sediments indicates that Cahoon Meadow has remained a functional wetland during the changing environmental conditions of the past several thousand years, and that it only changed to a new state with the advent of livestock grazing in the last 150 years. While it is not the management goal to restore Cahoon Meadow to a specific pre-European condition, the landforms, hydrology, and vegetation characteristic of Cahoon Meadow prior to the advent of livestock grazing provides the best target for sustainable wetland conditions in the future. Restoring ecological integrity will also increase ecosystem resilience to future climate-induced changes.

NATURAL RESOURCES

Wetlands (Vegetation, Soils, and Hydrology)

Sierra Nevada meadows are defined by the presence of persistent shallow groundwater, fine-textured surficial soils, and predominantly herbaceous vegetation (Weixelman et al. 2011). The herbaceous species are generally perennial grasses, sedges, rushes, bulrushes, and broadleaved herbs. Trees and shrubs inhabit some meadow systems but are not dominant. Meadows in the parks range from upland meadows, where groundwater may be near the surface in spring but is generally deeper than one meter during the summer; to wet meadows, with surface water or near-surface groundwater for most of the growing season; to fens, which have persistent surface water or near-surface groundwater throughout the growing season that promotes peat accumulation. Wet meadows and fens are generally classified as wetlands (Cowardin et al. 1979); upland meadows lack wetland hydrology, hydric soils, or hydrophytic (wetland) vegetation. Defined broadly, there are more than 5,300 meadows that occupy approximately 23,800 acres within the parks, slightly less than 3% of the parks' area (NPS 2015).

The ecological significance of meadows within the parks is disproportionate to this limited extent. These systems support much of the Sierra Nevada flora and fauna at both local and regional scales. Plant communities are highly diverse within individual meadows and clusters of meadow systems, and include over 30 taxa of meadow-endemic vascular plants and bryophytes (Weixelman et al. 2011). Meadows provide essential habitat for a wide diversity of fauna, including invertebrates, amphibians, birds, and mammals for at least a portion of their life cycles.

Wet meadows and fens are a subset of the meadow habitats in the parks and occur on the wettest end of the range of hydrology for these systems. They comprise about 45% of the meadow habitat in the parks (NPS 2015; Table 3) and include over 2,300 wetlands within SEKI. Distribution of plant communities in Sierra Nevada wet meadows and fens are influenced by soil drainage and water table depth more than any other environmental factors (Heady and Zinke 1978, Allen-Diaz 1991). Species composition in these systems is determined by the timing and duration of near-surface groundwater (Allen-Diaz 1991, Ratliff 1985). Wet meadows are characterized by high water tables that remain near the surface for much of the growing season. Fens are maintained by a perennially high water table that restricts decomposition of organic matter, thus leading to the formation of peat soils. Peat is often patchy within a single meadow, so meadow-fen complexes are common in the Sierra Nevada (Cooper and Wolf 2006a). Wet meadows and fens often support similar vegetation, but fens are usually characterized by a higher proportion of bryophytes (e.g., Sphagnum spp.) and obligate wetland species than wet meadows.

Peat-accumulating areas are extremely rare within the parks' meadows. Fens contribute 15 acres and fen/wet meadow types contribute 338 acres of peat-accumulating area in SEKI (NPS 2015; Table 3).

Table 3. Distribution of Meadow Types in Sequoia and Kings Canyon National Parks (NPS 2015)

Meadow Types	Acres	% of Total	Total Peat-accumulating Area (Acres)	Peat-accumulating Area (% of Total)
Fen	24	0.1%	15	4%
Fen/wet meadow	2,575	10.8%	338	91%
Wet meadow	7,859	33.0%	19	5%
Moist meadow	9,181	38.6%	0	0%
Dry meadow	4,161	17.5%	0	0%
Grand Total	**23,800**	**100%**	**371**	**100%**

Wet meadows and fens provide a critical interface for nutrient transfer between aquatic and terrestrial ecosystems. Other ecosystem services provided by wet meadows and fens include sediment storage, nutrient cycling, and slow release of seasonal runoff. These ecosystem services have implications for water quality, quantity, and flood prevention for down-stream users and park visitors. The hydrology supporting these systems varies by site, with water sources including precipitation, runoff from snowmelt, flooding from adjacent lakes and streams, or groundwater inflows from seeps and springs. Often the hydrology of a single system is influenced by several of these sources (Weixelman et al. 2011).

Cahoon Meadow is a 25.1 acre fen/wet meadow complex with patches of dry meadow and upland. It is one of the largest montane meadows between 5,000 and 8,000 feet elevation in SEKI, and one of only nine montane meadows larger than 15 acres; the total area of these nine meadows is 167 acres. The acreage of the delineated wetland and upland areas of Cahoon Meadow are described in Table 4 and shown in Figure 13 and Figure 14.

Data indicate that prior to disturbance by livestock grazing (that may have begun as early as the 1800s), Cahoon Meadow was a perennially saturated wet meadow-fen complex supported by a sheet-flow hydrologic regime, with a water table near the soil surface and shallow water flowing downgradient across the entire site in early to mid-summer. There were no deeply incised channels. Any channels would likely have been shallow and braided, shifting course over time as sediments were deposited. Highly productive, sod-forming obligate wetland species such as panicled bulrush (*Scirpus microcarpus*) and mountain sedge (*Carex scopulorum*), would have dominated the vegetation layer, along with a carpet of mosses, and kept the meadow surface from eroding.

Table 4. Summary of delineated wetland and upland areas of Cahoon Meadow (Wolf and Cooper 2015)

Zone	Acreage
Wetland above erosion gully headcut (0.089 acres are defined as Waters of the United States (WoUS))	14.921 acres
Lower east-side wetland	3.572 acres
Middle east-side wetland arm	0.771 acre
Riparian channel wetland (Waters of the United States)	0.836
Wetland Meadow Subtotal	**20.100**
ACOE WoUS	0.925
ACOE wetlands (WoUS excluded)	19.175
Upland, drained meadow, with wetland soils and vegetation (orange zone)	0.400
Upland, drained meadow, with wetland soils (brown zone)	0.572
Upland, drained meadow (tan zone)	3.104
Upland, erosion gully banks	0.942
Upland Meadow Subtotal	**5.018**
Total Meadow Area	**25.118 acres**

Note: Zone colors refer to figure 14.

Current Conditions of Cahoon Meadow

The gully at Cahoon Meadow, at its deepest point, is incised 17 feet below the adjacent, and approximately the original, meadow surface (photo 2). Gully width varies considerably, but averages about 60 feet, with a maximum width of 90 feet. The total surveyed gully is 1,150 feet long and 1.35 acres in extent. The gully tapers at least 150 feet of unsurveyed length downstream. The most deeply and widely eroded portion of the gully is the upstream and southernmost approximate 570 feet of gully, terminating on its upstream end in three separate and nearly vertical headcuts, each 7 to 8 feet high (Wolf and Cooper 2015).

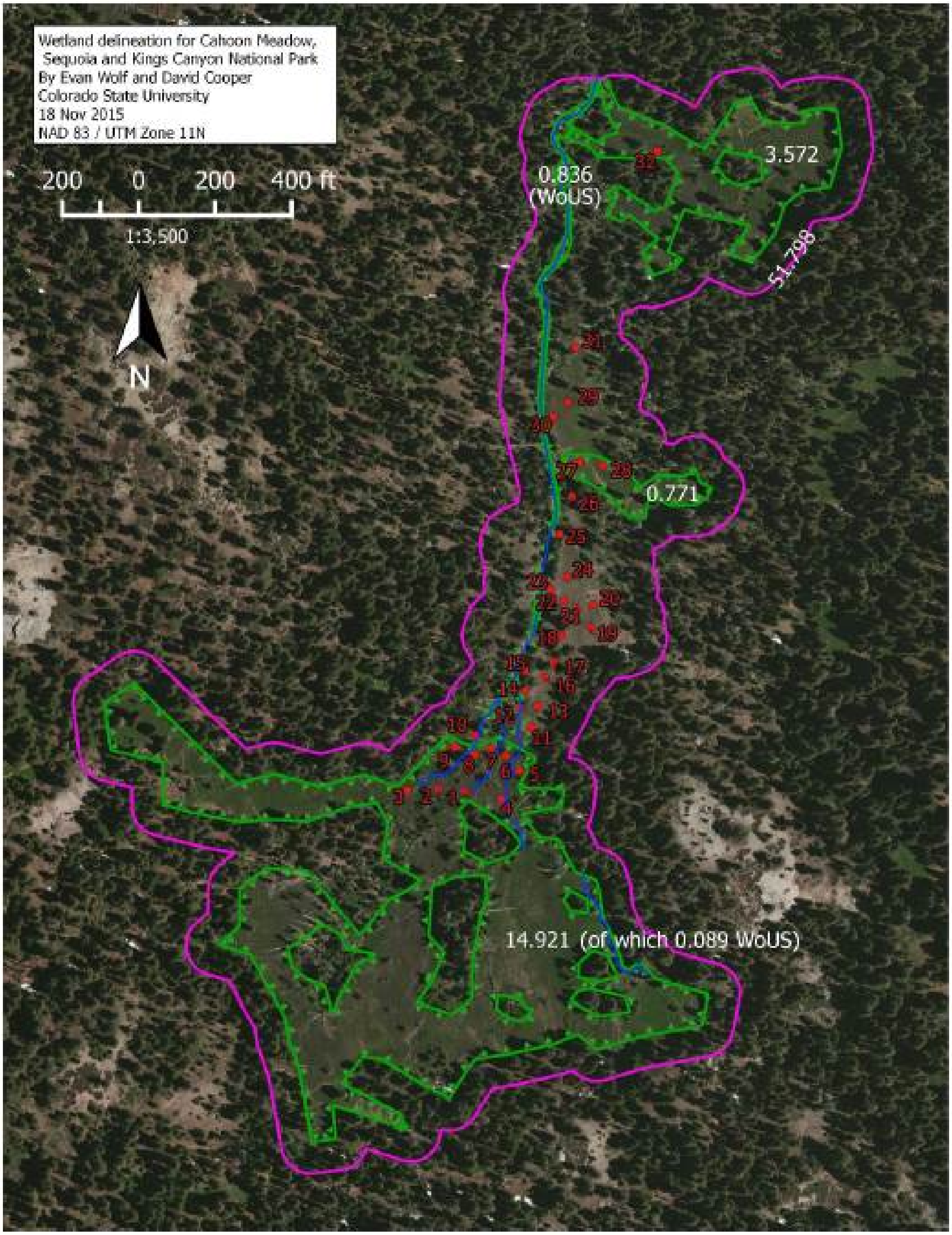
Photo 2. Gully in Cahoon Meadow circa 2014

A fen and wet meadow wetland complex extends for about 820 feet upstream from the gully headcut. The contributing watershed area above the headcut is approximately 520 acres with the intact wetland covering 14.9 acres. Downstream of the headcut the meadow drains into the gully and the water table is deeper than a meter during the growing season. The total area of dewatered meadow that no longer functions as a wetland is approximately 5.0 acres, of which 0.9 acre is occupied by the erosion gully banks. An additional 0.836 acre of riparian channel wetland occupies the gully bottom, including about 0.4 acres within the potential project area.

The fen portions of Cahoon Meadow contribute substantial peat-accumulating area. Approximately 6.2 acres contain more than 1.3 feet of peat within the top 2.6 feet of soil, qualifying them as organic soils. Of the 6.2 acres, 4.9 acres of intact fen are above the gully head-cut and remain perennially saturated, peat-accumulating soils, while 1.3 acres is degraded fen, with a gently sloping dry peat surface that has been completely drained of water by the gully and no longer accumulates peat. In addition, approximately 1.3 acres, much of which was probably fen judging by the exposed peat at cut banks, was eroded as the gully formed and widened (Wolf et. al 2015).

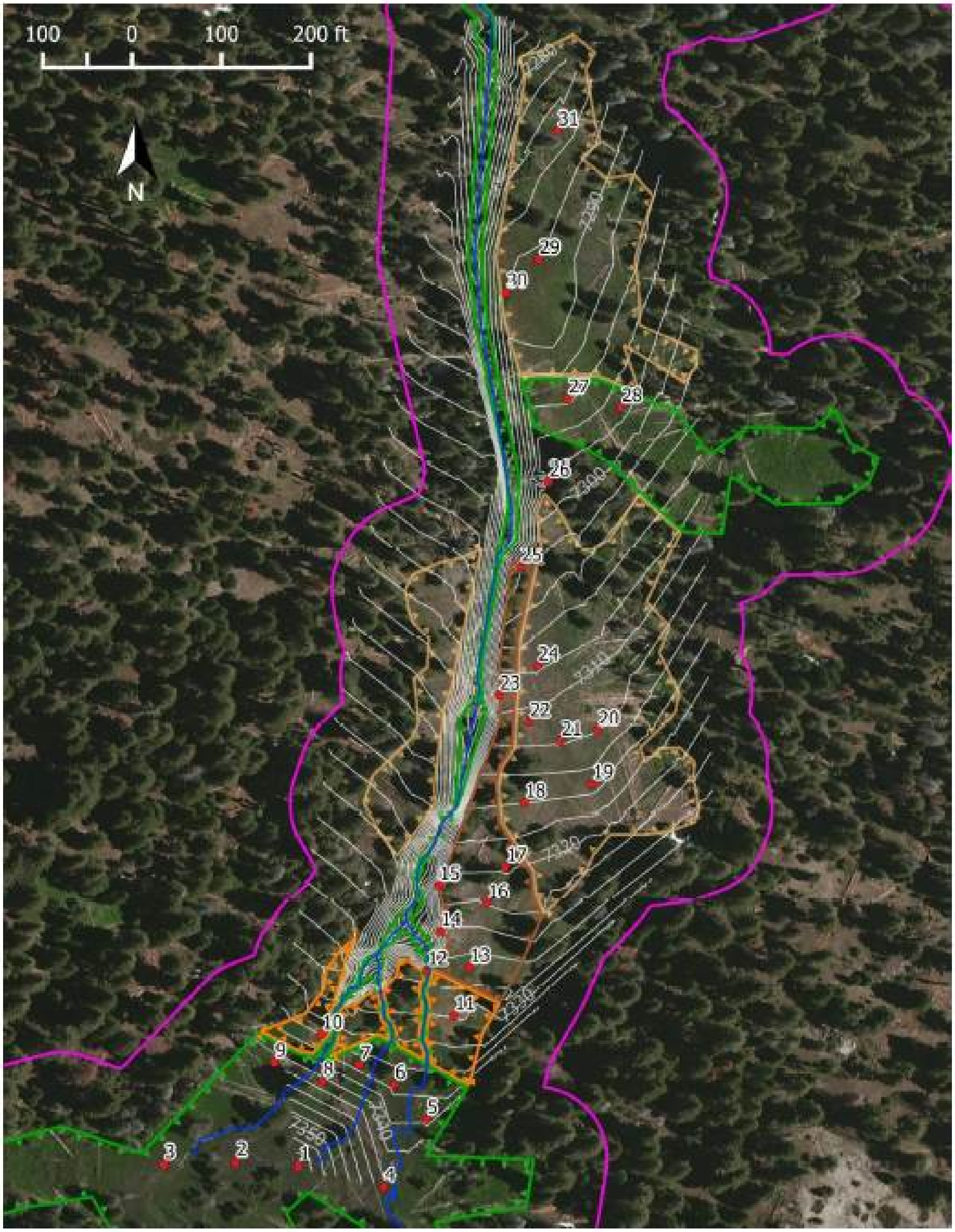
A small intact wetland 0.771 acre in size abuts the eastern edge of the dewatered wetland 650 feet downstream of the gully headcut; and, a larger 3.572 acre wetland meets Cahoon at the very bottom of the surveyed reach where the erosion gully transitions to a natural, forested stream channel. An additional 160 acres (0.250 square miles) of contributing watershed drains into the downstream end of the gully below the headcut, for a total watershed area of 680 acres (1.065 square miles) (Wolf and Cooper 2015).

Figure 13. Aerial image showing the delineated wetlands



Delineated wetlands are the green toothed outlines, labeled with area in acres within the investigated area (purple outline) at Cahoon Meadow. U.S. Army Corps of Engineers Waters of the US (WoUS) are identified as blue lines. Meadow slope and water flow is generally from south to north. (Wolf et. al 2015)

Figure 14. Close-up aerial map of upland zones within the meadow



The unforested or patchy small trees on flat ground show where wetland vegetation and soils exist without wetland hydrology (orange polygons), where only wetland soils are present (dark brown polygon), and where flat meadow shows no wetland indicators (light tan). Note the narrow wetland zone (green) delineated along the main channel and tributaries. The steep erosion gully edges are also classified as upland, and are interpreted as former meadow.

The average 15-feet high cut banks created by the gully display the meadow stratigraphy down to bedrock in several locations. The presence of peat layers as observed in the cut banks and in the 25 augured soil samples in the meadow, indicate that Cahoon Meadow was formed over thousands of years in relatively stable, saturated wetland conditions (peat layers accumulate very slowly, but decompose more rapidly when drained). Periodic large sedimentation events, as evidenced by the coarse sand layers, occasionally buried the meadow, but the wetland plants and hydrology reformed peat layers on top of these disturbance deposits. Several sand layers contained pieces of charcoal, suggesting that some sedimentation events may have followed forest fires (Wolf and Cooper 2015).

Vegetation

The 14.9 acres of intact wetland above the gully headcut is composed of dense, hydrophilic vegetation with average 110% aerial vegetative (vascular plants and bryophytes) cover and 0% bare ground, measured in 9 plots. Typical vascular plant species in this intact wetland are beaked sedge *(Carex utriculata)*, American bistort *(Bistorta bistortoides)*, tall mannagrass *(Glyceria elata)*, western cowbane (*Oxypolis occidentalis*), short-beaked sedge (*Carex simulata*), and Sierra shootingstar (*Dodecatheon jeffreyii*). The water table in late June, 2014, averaged 11 inches below the meadow surface in these areas (Wolf and Cooper 2015).

Photo 3. Dewatered Portion of Wetland

Below the intact wetland, immediately above the headcut, is a 0.4 acre zone where wetland hydrology is no longer present due to the lowering of the water table near the headcut, but where wetland plants and soils still persist. The vegetation averages 68% aerial cover and 0% bare ground, measured in 4 plots. Typical vascular plant species in this degrading wetland are tall mannagrass, common yarrow (*Achillea millefolium*), manyrib sedge (*Carex multicostata*), and panicled bulrush. The water table in late June 2014, averaged 45 inches below the meadow surface in these areas (Wolf and Cooper 2015).

Photo 4. Intact Wetland Area

Below the headcut, a 0.57 acre zone exhibits the next stage of wetland degradation, where wetland hydrology and wetland plants are no longer present, but wetland soils persist. A further 3.1 acre zone no longer exhibits wetland characteristics (hydrology, plants or soils). The vegetation averages 29% aerial cover and 68% bare ground, measured in 15 plots. Typical vascular plant species in this dewatered wetland are spreading groundsmoke (*Gayophytum diffusum*), common yarrow, and manyrib sedge. The water table in late June 2014, averaged at least 39 inches below the meadow surface in these areas (Wolf and Cooper 2015).

In summary, significant areas of dewatered, upland meadow have wetland vegetation and/or soil, indicating that they have been wetlands in the past. The different zones of upland and the degree to which they lack wetland indicators may reflect the history of dewatering of the site. The upland meadow areas furthest downstream retain no wetland indicators, the next zone contains only wetland soil, while the area just between the headcut and upstream wetland still has both wetland soil and vegetation, but lacks wetland hydrology. This spatial pattern may reflect the advance of the headcut upstream through time, with the furthest downstream sections having been dewatered first and therefore showing the greatest degradation (Wolf and Cooper 2015).

Conifers, primarily lodgepole pine (*Pinus contorta* ssp. *Murrayana)*, are present in Cahoon Meadow. Lodgepole pine is found both in wetlands and uplands throughout the montane and subalpine zones of the Sierra Nevada. It colonizes meadows during periods of drier climate or after disturbance. Patches of willow (*Salix* spp.) are also present at meadow edges.

The steep, forested slopes in the watershed surrounding Cahoon Meadow consist of red fir (*Abies magnifica* var. *shastensis*)-lodgepole pine, red fir-white fir (*Abies concolor*), red fir-western white pine (*Pinus monticola*), and Jeffrey pine (*Pinus jeffreyi*) forest types. Understory shrub species include greenleaf manzanita (*Arctostaphylos patula*), pinemat manzanita (*Arctostaphylos nevadensis*), and bush chinquapin (*Chrysolepis sempervirens*). Other than the Hockett fire in 1988 (73 acres), there are no recorded fire events over 0.25 acres in the watershed above Cahoon Meadow.

Cahoon Meadow is the headwaters wetland of the Cahoon Grove of giant sequoia (*Sequoiadendron giganteam*), and the water storage and slow release provided by the wetland may supply late-season water to the grove.

<u>Plants of Conservation Concern</u>

Two plant species of conservation concern may be affected by the proposed alternatives. Neither is listed under the California or United States Endangered Species acts. Both species occur in the intact fen portion of Cahoon Meadow, upstream of the headcut.

Photo 5. Round leaf sundew in Cahoon Meadow

Round leaf sundew (*Drosera rotundifolia*) is an uncommon carnivorous perennial herb that occurs in swamps, wet meadows, and peatlands. It was considered for rare plant ranking by the California Native Plant Society (CNPS), but rejected as being too common. The species' southernmost distribution in the Sierra Nevada occurs in a few locations south of the parks on the Sequoia National Forest; the Cahoon Meadow population is one of only ten known occurrences in the parks.

Marsh claytonia (*Claytonia palustris*) is a rare perennial herb that occurs in marshy meadows, springs, and on stream banks. CNPS ranks it as 4.3

(watch list, uncommon in CA, not very endangered). The species southernmost distribution in the Sierra occurs south of the parks on the Sequoia National Forest. There are eight known occurrences in the parks, but it is likely more widespread but overlooked due to its small size (Wolf and Cooper 2015).

Soils

The soil at Cahoon Meadow is composed of two distinct layers that are interbedded, generally in 1-2 foot intervals. Across much of the meadow, including most of the saturated upstream wetland above the erosion gully, the surface layer of soil is peat. Underlying the approximately 1-foot thick peat layer is a 1-2 foot thick sandy gravel layer. The alternation of peat and sand/gravel layers continues 8-10 feet down, as far as the strata are exposed on the sides of the erosion gully. The sand/gravel layers are generally poorly sorted homogenous units that are interpreted as rapidly laid-down storm or snow melt high-flow deposits. The peat layers clearly reflect long periods of perennial groundwater saturation and accumulation of wetland plant organic matter (Wolf and Cooper 2015).

WATER QUALITY AND WATER QUANTITY

The East Fork Kaweah drainage area is approximately 20,412 ha (50,418 acres); the mapped stream length is 128 km (79.4 miles); and, the estimated discharge 300-11,600 l/sec. (10.59- 409.48 CFS) (NPS 1989).

Cahoon Meadow is the headwater of Cahoon Creek which flows into Horse Creek, a tributary of the East Fork of the Kaweah River. The East Fork joins the Kaweah River in the town of Three Rivers, California. Three small tributary channels form the upper wetland and they converge in an area near the primary headcut responsible for gully advance (Figure 10, page 28). Two additional channels are found farther downstream in the lower-east and middle-east wetlands adjacent to the gully (Figure 13, page 37). All of these channels are contiguous with and functionally linked to vegetated wetlands (Wolf and Cooper 2015).

The northern-most margin of Cahoon Meadow is the outlet of an approximately 700 acre, north-facing catchment. This outlet is at approximately 7,170 feet elevation. The highest point in the catchment lies approximately 6,170 feet southeast at Cahoon Rock, near 9,300 feet in elevation. The catchment is remote, undeveloped, and likely rarely visited by humans. Anthropogenic contaminants in the watershed are introduced almost exclusively from atmospheric deposition. Regionally and globally sourced atmospheric contamination has been well studied and continuously monitored in SEKI for many years (Christie, 2008).

The steep gradients in the uplands surrounding Cahoon Meadow are covered by a thin mantle of soil over granitic bedrock with high erosive potential. While the dense hillslope vegetation holds the soil in place and provides good erosion protection, large disturbances to the vegetation, such as wildfire, are possible and could lead to high levels of sediment delivered to the meadow. Prior to gully development, most upland sediments delivered to the meadow were captured by the low slopes and dense vegetation found in the meadow itself. This is evident in the sediment profile of Cahoon Meadow. It is likely that grazing, and specifically a livestock trail up the long axis of the meadow, allowed for the initiation of gully erosion and caused a disruption in the sediment deposition regime.

The primary impact to water quality downstream of Cahoon Meadow is high sediment loads and turbidity due to erosion. Sediment is generated as the gully enlarges and surface sediments can be easily transported overland to the gully across the unvegetated portion of the meadow.

There are numerous mechanisms for erosion at the gully itself, and much sediment is derived from the gully banks and delivered directly into Cahoon Creek. Surface water cascading over the top bank of the gully contributes to bank failure at the top edge of the bank and again at the bottom of the bank as free-falling water impacts the streambed. The water impacting at the streambed also tends to undercut the bank leading to localized mass wasting as cantilevered blocks of soil collapse into the streambed. As groundwater migrates toward the gully, soil-pore water pressure at the bank margin is unopposed by the free-air surface and spalling of the soil frequently occurs. A similar mechanism of failure occurs when wet soil freezes, expands, and breaks cohesive bonds within the soil. As this soil thaws, it spalls into the streambed where it is subject to downstream transport.

Almost 15,000 cubic yards of soil has been lost directly from the gully itself. Soil loss occurs both incrementally, as ground water induces spalling, and catastrophically during large storm events. One account of a large storm in Hockett Meadow, less than 3 miles from Cahoon Meadow, is related in Austin (2012):

> *The heaviest 24-hour rainfall ever recorded in the Central Valley, 17.0 inches, occurred on December 6, 1966 at Hockett Meadow. This record would last for 20 years. It would eventually be exceeded by the 17.6 inches recorded at Four Trees in the Feather River Basin on February 17, 1986.*

Storms of these magnitudes can erode and transport large amounts of soil, but the absence of relict gully scars in the meadow suggests that prior to grazing Cahoon Meadow was stable and continued to act as a depositional area for upland sediments. Once a preferential flow path and denuded area were established along the livestock trail, the meadow became susceptible to erosion and the single storm event of 1966 may be responsible for much of the gully we see today.

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter analyzes both beneficial and adverse impacts that would result from implementing the alternatives considered in this EA. This chapter also includes methods used to analyze direct, indirect, and cumulative impacts. The resource topics presented in this chapter and the organization of the topics correspond to the resource discussions contained in "Chapter 3: Affected Environment."

This EA assesses whether significant impacts would occur from implementing any of the alternatives, resulting in the need to prepare an environmental impact statement (EIS); or, whether a finding of no significant impact (FONSI) is the appropriate decision document.

GENERAL METHODOLOGY

This section describes the environmental impacts, including direct and indirect effects, and their significance for each alternative. The analysis is based on the assumption that the mitigation measures identified in the alternatives and in the "Mitigation Measures" section of this EA would be implemented for the action alternatives. Mitigation measures would be implemented to achieve the reduction or avoidance of acceptable and foreseeable impacts. Overall, the NPS based the impact analyses and conclusions on the review of existing literature and park studies, information provided by experts within the park and other NPS personnel, other agencies, professional judgment and park staff insights, and public input.

In accordance with the CEQ regulations, direct, indirect, and cumulative impacts are described (40 CFR 1502.16) and the impacts are assessed in terms of context and intensity (40 CFR 1508.27). Where appropriate, mitigating measures of adverse impacts are also described and incorporated into the evaluation of impacts. The specific methods used to assess impacts for each resource may vary; therefore, these methodologies are described under each impact topic.

The geographic study area is generally defined as Sequoia and Kings Canyon National Parks, and more specifically, the wilderness areas of SEKI, and the East Fork Kaweah watershed. The specific area of analysis for each impact topic is defined at the beginning of each impact topic discussion.

The following terms are used in the discussion of environmental consequences to assess the nature of impacts associated with each alternative (the terms "impact" and "effect" are used interchangeably throughout this document).

Type: Impacts can be beneficial or adverse. A beneficial impact is an impact that would result in a positive change in the condition or appearance of the resource. An adverse impact is an impact that causes an unfavorable result to the resource when compared with the existing conditions.

Duration: Impact duration is described as short term or long term for each resource. Duration of impact is defined and analyzed independently for each resource because impact duration is dependent on the resource being analyzed. Depending on the resource, impacts may last for the implementation period, a single year or growing season, or longer.

Direct and Indirect Impacts: Effects can be direct, indirect, or cumulative. Direct effects are caused by an action and occur at the same time and place as the action. Indirect effects are caused by the action and occur later or farther away, but are still reasonably foreseeable. Direct and indirect impacts are considered in this analysis. Cumulative effects are discussed in the next section.

Context: This means the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Context includes both overall context (based on the purpose and significance of SEKI) and resource-specific context. Resource-specific context is presented in the "Methodologies" section under each resource topic, as applicable, and applies across all alternatives.

Intensity: This refers to the severity of impact. The following should be considered in evaluating intensity:

(1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect would be beneficial.
(2) The degree to which the proposed action affects public health or safety.
(3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, parklands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.
(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
(8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.
(10) Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

For each impact topic analyzed, an assessment of the potential significance of the impacts according to context and intensity is provided in the "Conclusion" section that follows the discussion of the impacts.

CUMULATIVE EFFECTS ANALYSIS METHODOLOGY

A cumulative effect is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). As stated in the CEQ handbook entitled *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ handbook 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on impacts that are truly meaningful. The California Environmental Quality Act (CEQA) also requires an assessment of cumulative impacts that could be associated with the proposed project when the project's incremental effect is "cumulatively considerable." "Cumulatively considerable" means that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects (as defined by Section 15130).

Cumulative effects are considered for all alternatives. Cumulative effects were determined for each affected resource by combining the impacts of the alternative being analyzed and other past, present, and reasonably foreseeable actions that would also result in beneficial or adverse impacts to that resource. Because some of these actions are in the early planning stages, the evaluation of the cumulative effect is based on a general description of projects. These actions were identified through the internal and external scoping processes. The geographic scale of the analysis varies by impact topic. The temporal scope includes actions that have occurred in the past that are still affecting resources, actions that are ongoing, or those expected to begin in the next 10 years based on current funding cycles.

Table 5. Projects or Actions making up the Cumulative Effects Scenario

Action or Project	**Temporal and Spatial Scale**	**Brief Description**	**Affected Resources**
Meadow Restoration Efforts Related to Past Grazing by Cattle and Sheep	Past and future SEKI wilderness-wide	Prior to designation, livestock grazing by sheep and cattle occurred in several areas of the parks. Most of the cattle grazing leases in Kings Canyon National Park were surrendered or expired in the 1950s. In 1948, NPS crews began actively restoring the most damaged meadows, focusing on sites in the Evolution Creek, Roaring River, Crabtree Creek, and Rock Creek watersheds. Efforts also targeted impacts from recreation trails. Restoration efforts by the NPS ended in the 1970s and included actions in about 50 meadows. Many of these projects were successful in restoring the wetland function of the treated area. In treated sites where gully erosion has stabilized but wetland function has not been fully restored, additional, small-scale (hand-crew focused) restoration efforts may occur in the future to improve wetland function and increase resiliency to climate change. Meadow restoration efforts are included because the potential adverse and beneficial cumulative effects on wilderness character wilderness-wide, and potential beneficial effects on natural resources.	Wilderness Character Natural Resources (wetlands, water quality/ quantity)
Recreational and Administrative Pack Stock Grazing	Past, ongoing, and future	Recreational and administrative pack stock grazing has occurred and continues to occur in the parks. The 2015 Wilderness Stewardship Plan / Final Environmental Impact Statement (WSP/FEIS) identifies those areas where grazing will be allowed. Grazing will continue to be managed and	Wilderness Character Natural Resources (wetlands)

Action or Project	Temporal and Spatial Scale	Brief Description	Affected Resources
	SEKI wilderness-wide	informed by results of the Stock Use and Meadow Monitoring and Management Strategy. Estimated grazing capacities for wilderness meadows will continue to be used to inform grazing management, and will be refined as additional information is acquired. There is no evidence that Cahoon Meadow experiences recreational or administrative grazing, though it is in an area open to off trail use and grazing is allowed. Recreational and administrative grazing is included due to potential cumulative adverse and beneficial effects on wilderness character and meadow / wetlands resources wilderness wide.	
Halstead Meadow Restoration	Past, ongoing, and future SEKI wilderness-wide and parkswide	Halstead Meadow, a portion of which is in wilderness, was the most severely damaged meadow in Sequoia National Park. Two phases of restoration were completed in 2007 and 2012. Project goals include restoring the meadow landforms, hydrologic processes, wetlands vegetation, and functions. To date, approximately 15 acres have been restored and an additional 6 acres would be evaluated for potential restoration in the final phase. Planning for the final phase of meadow restoration will occur in 2016-2017 with anticipated implementation in 2020 or later. The restoration of Halstead Meadow is included due to the potential cumulative adverse and beneficial effects on wilderness character wilderness wide, and the beneficial cumulative effects of meadow restoration parkswide.	Wilderness Character Natural Resources (wetlands, water quality/ quantity)
Ecological Restoration Program at SEKI	Past and ongoing	This program restores landscapes disturbed by human impacts or development to more natural conditions. Abandoned or illegal human development may be removed (asphalt, marijuana grow-site materials, etc.); altered landforms recontoured to	Wilderness Character Natural Resources (wetlands, water

Action or Project	Temporal and Spatial Scale	Brief Description	Affected Resources
	SEKI wilderness-wide	predisturbed conditions to restore natural drainage patterns; and, erosion-control measures installed. Projects that may occur in wilderness include restoration of illegal marijuana cultivation sites, restoration of abandoned wilderness trails, and campsite restoration. The ecological restoration program is included due to potential cumulative adverse and beneficial effects on natural resources and wilderness character from restoring areas wilderness wide.	quality/ quantity)
High Elevation Aquatic Ecosystem Restoration Program	Past, ongoing, and future SEKI wilderness-wide	SEKI has an ongoing habitat restoration program that includes eradication of nonnative fish in wilderness. Thus far, SEKI has restored or is in the process of restoring, 26 lakes by eradicating nonnative trout. A draft Environmental Impact Statement to expand the program was released for public review and comment; and the NPS is currently preparing the final plan. If the program is approved for expansion, nonnative trout eradication activities would continue to occur for the next 25-30 years within the parks' wilderness. This program is included due to potential cumulative adverse and beneficial effects on wilderness character and natural resources from restoring areas wilderness wide.	Wilderness Character Natural Resources (water quality/ quantity)
Administrative Mechanical Transport and Motorized Equipment Use	Past, ongoing, and future	The parks, in administering wilderness, will on occasion use mechanical transport and motorized equipment, land aircraft (helicopters), and erect installations. Administrative activities, such as wilderness trail and facility operations (e.g. transporting supplies and equipment, use of rock drills or chainsaws, etc.) and ranger activities (e.g.,	Wilderness Character

Action or Project	Temporal and Spatial Scale	Brief Description	Affected Resources
	SEKI wilderness-wide	providing emergency services, fire management, search and rescue, etc.), may require one of the above listed activities. All actions that require mechanical transport, motorized equipment, landing of aircraft, or installations, with the exception of emergencies, are analyzed to determine if they are the minimum required for the administration of the area as wilderness. Ongoing administrative actions are included due to the potential adverse and beneficial cumulative effects on wilderness character wilderness wide.	
Existing Dams, Related Infrastructure, and SEKI Administrative Structures	Past and ongoing SEKI wilderness-wide (wilderness character); East Fork Kaweah Watershed (water quality and quantity)	In the East Fork Kaweah watershed, there are four storage dams in 112 acres of designated potential wilderness additions. Their purpose is to hold and regulate water flow for downstream hydroelectric generation. The dams receive periodic maintenance. Existing dams and related infrastructure is included in the cumulative effects analysis due to the long-term adverse effects on wilderness character wilderness wide, and potential effects on water quality and quantity in the East Fork Kaweah watershed. SEKI has structures in wilderness that have been determined by the WSP to be necessary for the administration of these areas as wilderness, including ranger stations, trails / trail bridges, fences and gates, and food storage boxes.	Wilderness Character Natural Resources (water quality/ quantity)

WILDERNESS CHARACTER

METHODOLOGY FOR ANALYZING IMPACTS

A minimum requirement analysis was conducted to evaluate alternatives and determine the potential effects on wilderness character (Appendix A). Park staff reviewed the Wilderness Character Assessment (NPS 2014) to determine the baseline of overall wilderness conditions; site visits and available data provided information to determine site specific conditions within the project area. Each alternative was analyzed based on the four qualities of wilderness character, as there were no features identified in the project area related to the fifth quality (other features of value) that had the potential for significant effects.

IMPACTS OF ALTERNATIVE A: NO ACTION

Untrammeled – The no action alternative has no effect on the untrammeled quality of wilderness character in the project area, since managers would refrain from taking actions that manipulate, control, or intervene with the ecological system.

Undeveloped – The no action alternative maintains the undeveloped quality of wilderness character at Cahoon Meadow, since no structures would be installed, no trails would be built, and no motorized equipment or helicopter transport would be used.

Natural – The 14.9 acres of intact fen and wet meadow above the three vertical headcuts would be threatened by further headward erosion of the gully. High discharge events will be concentrated into the unprotected gully, causing further headward erosion of the headcut, undercutting and collapse of steep gully banks, and disturbance and possible erosion of the vegetated areas within the gully. The existing dewatered meadow adjacent to the gully would continue to degrade as peat soils decompose and erode. This alternative would almost certainly lead to degradation or complete loss of wetland function in Cahoon Meadow in the long term. In addition, there are potential riparian impacts as fine-grained meadow sediment is washed downstream.

Solitude or a primitive and unconfined type of recreation – Few staff and infrequent visits would be required for monitoring the conditions at Cahoon Meadow, so effects on this quality would be slight to none.

Cumulative Effects of Alternative A

Since this project would result in no effects on untrammeled, undeveloped, or solitude or a primitive and unconfined type of recreation, there would be no cumulative effects on these qualities of wilderness character. Not restoring the natural processes of Cahoon Meadow, when considered with other impacts occurring in the past, present, and future, could create long-term cumulative adverse effects on the natural quality of wilderness character in the SEKI wilderness. While the natural quality of wilderness character when considering the overall wilderness in the parks is considered good (NPS 2014), the natural quality has been adversely affected in specific locations by past livestock grazing activities, the planting of non-native fish in hundreds of high elevation lakes, the accidental introduction of non-native plants, and past current recreational and administrative development and use. There have also been beneficial cumulative effects on the natural quality due to past, ongoing, and planned future restoration actions, including the restoration of high elevation native ecosystems, the removal of non-native vegetation, and the restoration of several meadow areas. Overall, these effects have resulted in both adverse and beneficial cumulative effects on the natural quality of specific areas in the park wilderness and the overall cumulative effects would be slight and insignificant.

IMPACTS OF ALTERNATIVE B

Untrammeled – This alternative would result in short-term trammeling over a three year period. The first and third year effects on trammeling relate to the trail construction and subsequent restoration of the trail, both of which would occur for up to 6 weeks. Year two of the project would result in intense manipulation of the wilderness because about 0.5 - 1 acres would be manipulated for a period of 3-5 weeks over one season. The headcut area would be reshaped and manipulated to harden the change in grade from the top of the headcut to the bottom of the gully, in order to prevent further headward erosion of the vertical face of the headcut. The meadow in this area would be manipulated into a novel condition uncharacteristic of natural meadows (it has a quality of being engineered).

Because the rock structure is expected to be durable and require long-term maintenance on about a 25-year cycle, repeated manipulation would be minimized (compared, for example, to a log structure requiring more frequent maintenance).

Undeveloped – Reconstructing the access trail into the project site is considered a development, though the adverse effect on this quality would be short term as the trail would be rehabilitated and the area restored to natural conditions. There would be short-term adverse effects on the undeveloped quality from the use of motorized equipment, motor vehicles, landing of aircraft, and long term impacts on the undeveloped quality from the construction of a rock chute using 520 cubic yards of imported rock.

Landing of aircraft, which includes delivery of loads via long line, is estimated at 105 round trips by a Chinook helicopter. One excavator would be used in a localized area (approximately 0.5 – 1 acre) for 6 to 21 days. Water pumps, compressors, generators, and power tools would be needed for a construction period of 3 to 5 weeks. In addition, there would be short-term construction installations (water diversion pipes) and long-term scientific installations (mounted camera). Long-term, the rock chute and 1 to 2 check dams would remain evident as a human construction, though the impact would be reduced slightly in the long-term as vegetation grows back into the area allowing the structures to blend with the natural environment.

Natural –A 0.5-1 acre area would be disturbed in the vicinity of the headcut. An excavator would clear trees and downed logs from the headcut area, grade to a 3:1 slope, and place the rock. The tree removal would not adversely affect wildlife or ecosystem function. There would likely be increased downstream turbidity for the 3-5 week duration of construction, but construction-related sedimentation would be mitigated and monitored. All these actions have an adverse effect on the natural quality of wilderness character.

There would be long-term beneficial impacts on the natural quality of wilderness character at Cahoon Meadow compared to no action. Preventing further headward erosion of the vertical faces of the headcuts would protect the 14.9 acres of intact wetland from additional to complete loss, including 4.9 acres of rare fen habitat, one of ten known locations of round leaf sundew in SEKI, and the suite of ecosystem services provided by functioning wetlands.

Solitude or a primitive and unconfined type of recreation – There would be short-term increases in administrative crews in the project area for three years resulting in adverse impacts on solitude. This is a seldom-visited area of the park, and work would occur in a limited timeframe, therefore the impacts are expected to be slight. Crews would return for monitoring work and periodic maintenance (expected every 25 years) but crew sizes would be within the limits of standard wilderness group sizes, and therefore would not be noticeable. The short-term re-establishment of the trail could provide benefits to hikers wishing to visit Cahoon Meadow, but this benefit is short-term as the trail would be restored to natural conditions after project work is completed.

Visitors to the Hockett Meadow area, Evelyn Lake, or the Mineral King Road would be adversely affected by distant visual and noise effects of the helicopter. Use of the South Fork Road for staging the helicopter would reduce these effects in the wilderness area east of the Mineral King Road.

Cumulative Effects of Alternative B

Untrammeled – The parks' wilderness is considered highly untrammeled. There are periodic projects and research efforts that result in the manipulation of the wilderness, including removing non-native plants and fish in specific areas of the wilderness. These projects are expected to continue to occur in the future; the removal of non-native fish may be expanded if ongoing planning efforts are approved. Alternative B would contribute slightly to these adverse effects during the three years of project implementation, but on a very small spatial and temporal scale due to the limited size and timeframe of the project area. Thus the cumulative effects on the untrammeled quality of wilderness are short-term and adverse, but would not result in long-term adverse cumulative effects on the untrammeled quality of wilderness.

Undeveloped – While the SEKI wilderness is primarily undeveloped, there are existing structures in wilderness, and past, present, and future potential actions that affect or have affected the undeveloped quality of wilderness character. Alternative B would contribute to ongoing administrative mechanical transport, motorized equipment use, resulting in short term adverse cumulative effects on the undeveloped quality, and would add two installations to the parks' wilderness, resulting in a long-term cumulative adverse effect. The rock chute and check dams proposed in alternative B would add 2-3 additional developed structures (about 0.2 acre in size) to the wilderness. When considering the low level of development in the parks wilderness, adding three rock structures would not result in a significant cumulative effect.

Alternative B would add 105 helicopter flights and use of an excavator and power tools for up to 5 weeks to the cumulative impact scenario. Considering that the average number of non-emergency flights per year is about 175-250 (NPS 2012), this could represent a 40%-60% increase in helicopter flights for a year. The noise, visual disturbance, and outwash from a Chinook-type helicopter used for this project would also be much larger than the disturbance produced by the parks' contracted AStar helicopter. However, this use would be localized and short term, and would not result in a permanent change on the undeveloped quality of wilderness, and no long term cumulative effects.

Natural – Several past, present and reasonably foreseeable future restoration projects have been designed to improve the natural quality of wilderness character. Several meadows have been restored in the parks, including Halstead Meadow and wilderness meadows previously damaged by historic livestock grazing. SEKI also has an ongoing high elevation aquatic ecosystem restoration program that is currently restoring 26 lakes by eradicating nonnative trout. These restoration efforts could be increased in the future if proposed projects are approved, resulting in long-term improvements on the natural quality of wilderness. When considered with the long-term beneficial effects of alternative B, the overall cumulative effects on the natural quality of wilderness would be long term and beneficial.

Solitude or a primitive and unconfined type of recreation – There are ample opportunities for solitude or a primitive and unconfined type of recreation. These opportunities would continue to be available throughout the wilderness even if this alternative is implemented. This project would result in a slight and short term adverse effect on this quality of wilderness character on one area of the park over a short period of time, and would have no cumulative effects on this quality wilderness wide.

IMPACTS OF ALTERNATIVE C (PROPOSED ACTION AND NPS PREFERRED)

Untrammeled – This alternative would result in short-term trammeling on approximately 5-6 acres - soils would be manipulated and vegetation would be planted in order to restore the meadow to its pre-grazed condition. The dewatered portion of the meadow, about 5 acres, would be graded down in elevation and the resultant material used to fill the 0.4 acre gully, creating a level cross-section and sheet-flow hydrologic regime. Plants propagated in a nursery (grown from seed collected at Cahoon Meadow) would be installed. The trammel occurs to a larger spatial area than alternative B, and over a longer period of time for on-site project work (12 weeks in year 2, 2-3 weeks in year 3 for planting activities).

Two to three years of crew work to repair erosion that would likely occur after large storm events, prior to full establishment of vegetation, would cause some additional trammel. Over the long-term, the restoration is designed to restore natural processes (sheet flow hydrology) so the site is sustainable as a wetland system and does not require further maintenance (or trammeling) past five years.

Undeveloped – Reconstructing the access trail into the project site is considered a development, though the adverse effect on this quality would be short term as the trail would be rehabilitated and the area restored to natural conditions. There is short-term development because of the use of motorized equipment, motor vehicles, and landing of aircraft. Landing of aircraft, which includes delivery of loads via long line, is estimated at up to 30 round trips by a Chinook helicopter. Motor vehicles would include up to four pieces of earthmoving equipment in a large area (approximately 6 acres) for about 28-35 days. Motorized equipment would include use of chainsaws, water pumps, compressors, generators, and power tools for the construction period of 10 to 12 weeks. In addition, there would be short-term construction installations (water diversion pipes) and short-term scientific installations (2" PVC water monitoring wells, T-post staff gauges, stream-level loggers). Long-term, the meadow would appear natural with no permanent development or human improvement.

Natural – There would be short-term, adverse impacts on the natural quality of wilderness during the 12-week earthmoving phase of this alternative. Prior to regrading, trees, woody vegetation, and downed logs would be cleared from the 5.4-acre area to be regraded, and wetland vegetation from the gully bottom and topsoil throughout the project would be salvaged, stored, and replaced on the regraded surface at the end of the project. Because the tree removal is limited in scale, and there is high quality wildlife habitat proximate to the project site, it would not adversely affect wildlife or ecosystem function. Soil would be disturbed for regrading over a 5.4-acre area (5 acres dewatered meadow and 0.4 acres gully bottom); soils would be exposed for about 6 to 8 weeks before being protected by erosion control blanket, so there is some risk of soil loss and increased downstream turbidity during summer rain events. There would likely be increased downstream turbidity for up to 12 weeks of site work, but earthmoving-related sedimentation would be mitigated and monitored to assure the adverse effects are minimized.

There would be long-term, beneficial impacts on the natural quality of wilderness character at Cahoon Meadow due to the restoration of the meadow and protection from further degradation. Regrading the dewatered portion of the meadow would eliminate the headcut, providing the most sustainable, reliable, stable protection for the 14.9 acres of intact wetland. In addition, 5.4 acres of dewatered wetland and gully would be restored to a vegetated sheetflow wetland ecosystem.

Solitude or a primitive and unconfined type of recreation – There would be short-term increases in administrative crew presence in the project area with slight adverse impacts to solitude because this is a seldom-visited area of the park. The short-term re-establishment of the trail could provide benefits to hikers wishing to visit Cahoon Meadow, but this benefit would be short term only during the project activities, then the trail would be restored to natural conditions.

Visitors to the Hockett Meadow area, Evelyn Lake, or the Mineral King Road would be adversely affected by distant visual and noise effects of the helicopter. Use of the South Fork Road for staging the helicopter would reduce these effects on the Mineral King Road.

Cumulative Effects of Alternative C

Untrammeled – Similarly to alternative B, this project would result in a short term adverse effect on the untrammeled quality of wilderness character. When considered with other projects ongoing and planned in the parks' wilderness, this project would contribute to the short term adverse effects on the untrammeled quality of wilderness during project implementation. There would be no long term cumulative effects.

Undeveloped – Alternative C would contribute to ongoing administrative mechanical transport and motorized equipment use in the wilderness by adding 30 Chinook helicopter flights, 10-20 light helicopter flights, use of four pieces of motorized earthmoving equipment, and use of power tools for up to 12 weeks. Considering that the average number of non-emergency flights per year is about 175-250 (NPS 2012), this could represent a 20%-30% increase in helicopter flights for a year. The noise, visual disturbance, and outwash from a Chinook-type helicopter used for 30 of these flights would be much larger than the disturbance produced by the parks' contracted AStar helicopter. However, this use would be localized and short term, and would not result in a permanent change on the undeveloped quality of wilderness, and no long term cumulative effects. Alternative C would not add any developed structures to the wilderness, thus there would be no change in the development in wilderness in the long term, and no cumulative effects.

Natural – As stated in alternative B, the natural quality of wilderness character has improved in recent years, and will likely improve in the future if restoration projects continue. When considered with the long-term beneficial effects of alternative C, the overall cumulative effects on the natural quality of wilderness would be long term and beneficial.

Solitude or a primitive and unconfined type of recreation– As stated under alternative B, the restoration project at Cahoon Meadow would result in a slight and short term effect on this quality of wilderness character on one area of the park over a short period of time, and would have no cumulative effects on this quality wilderness wide.

Conclusion

Alternative A (no action) best preserves the untrammeled and undeveloped qualities of wilderness character, but at the expense of the natural quality. Alternative B preserves the existing natural quality of wilderness character over the long term at the expense of limited short-term and long-term trammeling, substantial short-term development, and limited long-term development. Alternative C preserves and improves the long-term natural quality of wilderness character at the expense of more intensive, widespread, short-term trammeling, and more substantial short-term development. However, there is no long-term trammeling or long-term development under alternative C. None of the alternatives would result in significant adverse or beneficial cumulative effects.

WETLANDS (VEGETATION, SOILS, AND HYDROLOGY)

Methodology For Analyzing Impacts

Executive Order 11990 (Protection of Wetlands) requires an examination of impacts to wetlands, and NPS *Management Policies 2006* and Director's Order 77-1 provide guidelines for evaluating proposed actions within wetlands. For the purposes of this analysis, and in accordance with the 1987 *ACOE Wetlands Delineation Manual*, a three parameter method was used and includes consideration of effects on vegetation, soils, and hydrology in the overall wetland analysis. Impacts on wetlands were assessed by reviewing existing literature and characterizing the effects based on the types of impacts that could occur, and analyzing factors that could contribute to impacts under each alternative. Site visits and surveys were conducted to help inform alternatives, identify potential impacts, and develop mitigation measures to reduce the level of impact.

Impacts to wetlands were evaluated based on (1) the acres of currently-intact wetland likely to retain long-term (decades to centuries) ecological integrity (wetland function as measured by wetland vegetation, soils, and hydrology), (2) the acres of currently-dewatered wetland likely to regain ecological integrity (wetland vegetation, soils, and hydrology) through restoration, (3) potential additional loss of soil from Cahoon Meadow to downstream riparian areas, (4) short-term disturbances to natural resources as a result of implementing the action alternatives, and (5) probability of success, i.e. that the action alternatives, once implemented, will produce the anticipated results.

The impacts on soils and vegetation due to the access trail reconstruction were evaluated but are not fully analyzed. The trail would be minimally constructed as a Class 1 trail to support stock access for the project over 1-3 years. Much of the work involves moving downed vegetation that have covered an existing route or informal trail and moving rocks from the route. Stock use would serve to pack the trail, but the area would be rehabilitated and restored to natural conditions after project work is completed. Because the impacts would be localize and temporary, and there is no potential for significant impacts, these topics were not further evaluated.

Internal scoping – including discussions with university wetland scientists, NPS regional water resource professionals, SEKI natural resource management staff, engineers, and others – contributed to the analysis. Information yielded from the June 2014 site visit and survey, along with the subsequent report *Wetland delineation for Cahoon Meadow* (Wolf and Cooper 2015), provided the NPS with a better understanding of the meadow's characteristics and potential effects associated with each alternative. Public scoping, and preliminary discussions with the ACOE and the Central Valley RWQCB, also informed the assessment of effects.

Predictions about short- and long-term impacts were based on professional judgment and experience gained from previous projects. Short-term impacts on wetlands were considered to be those impacts that would last only during project implementation activities, while long-term impacts would be those that extend beyond project implementation. The geographic scope considers impacts proximal to Cahoon Meadow and within the East Fork Kaweah River watershed.

Note that the impacts to wetlands and amount of acres potentially affected are based on current conditions and are subject to change due to weather events that may occur between the time of initial analysis and project implementation, should an action alternative be selected. Acreages provided here are to assist in the analysis and help the reader understand the current situation and projected outcome from the treatments or from taking no action. Prior to permitting with the ACOE and RWQCB, the project area would be reassessed and acreages updated, as necessary.

IMPACTS OF ALTERNATIVE A: NO ACTION

Under the no action alternative, the existing 5 acres of dewatered wetland adjacent to the gully would continue to degrade as peat soils decompose and erode. In addition, the 14.9 acres of intact fen and wet meadow above the headcut would be threatened by further headward erosion of the gully.

This alternative would require little to no direct expenditure by the NPS, however, it would almost certainly lead to natural resource degradation and eventual conversion from wet meadow into a gullied forest as well as potential riparian impacts as meadow sediment is washed downstream. High discharge events would be concentrated into the unprotected gully causing headward erosion of the headcuts, undercutting and collapse of steep gully banks, and disturbance and possible erosion of the vegetated area (0.836 acre) within the gully. Additionally, the collapse of the gully side walls, downcutting of the gully bottom, and formation of additional headcuts could threaten the intact lower east-side wetland (3.572 acres) and the middle east-side wetland arm (0.771 acre).

Within the 14.9 acres of intact wetland, approximately 4.9 acres of fen could be lost, either directly, through soil erosion, or through a lowering of the water table, conversion to upland vegetation, and decomposition of organic soils. This loss could lead to a conversion of the entire wetland site to an upland forest. Within the 5 acres of dewatered wetland, 1.3 acres of former fen could be lost under the no action alternative. It is estimated that 1.3 acres of fen soils have already been lost to the gully. The potential further loss of 4.9 acres of peat accumulating wetland from continued degradation of Cahoon Meadow represents approximately 1.7% of the total estimated area of peat accumulating wetlands in the parks and 25% of the total estimated area of peat accumulating wetlands in the East Fork Kaweah watershed.

Almost 15,000 cubic yards of soil has been lost directly from the gully itself, and given the size of the uneroded portion of Cahoon Meadow, there is potential that the total volume of soils lost may increase from current levels by a factor of ten, a potential further loss of about 150,000 cubic yards. Erosion of the gully and associated soil loss would occur incrementally during normal precipitation years, with larger amounts of soil loss during heavy storm events. The wetland hydrology would continue to be compromised as the gully expands and the water table drops, thereby expanding the dewatered acreage of the meadow and accelerating the decomposition of organic soils.

The rate at which the headcuts may advance and the intact wetland degrades cannot be estimated with current data. Visible, recent bank failure at the top edges of the gully and active spalling of soil on gully faces suggest that erosion is ongoing, and there is no indication that the gully would self-stabilize before reaching the upstream margins of the meadow. In this case, the entire wet meadow would be converted to a dry, gully-incised landscape, likely over the course of a few hundred years.

Plant Species of Conservation Concern

Under the no action alternative, the gully would continue to expand and the 5 acre area of dewatered wetland would increase. The 14.9 acres of intact wetland that provides habitat for marsh claytonia and round leaf sundew would likely degrade or be lost at some point in the future, and the populations of these species likely lost from Cahoon Meadow. Round leaf sundew is one of only ten populations within the parks and marsh claytonia is one of only nine known populations in the park. While these populations are regionally important, and their loss from Cahoon Meadow would be adverse and long-term, the effects to the persistence of the species would be inconsequential.

Cumulative Effects of Alternative A

There are a number of past, ongoing, and reasonably foreseeable projects occurring within the parks that have an adverse or beneficial effect on wetlands. Past, ongoing, and potential future meadow restoration efforts improve conditions in wetlands by stabilizing intact areas and/or improving wetland function by restoring degraded areas. For example, the first two phases of the Halstead Meadow restoration project restored 15 acres by filling deeply-eroded gullies, and 6 additional acres may be restored in the future. Smaller efforts to stabilize meadows damaged by historic livestock were conducted by SMCC hand crews in 1948-1970s, and similar small-scale efforts may be resumed at a future date to improve wetland integrity. Restoration activities, such as realigning trails outside of wetlands and filling/revegetating deeply incised trail treads, is ongoing and improves wetland function in areas throughout the parks. Activities associated with these restoration activities (such as using heavy equipment to move soils, revegetating disturbed areas, restoring natural drainage patterns) typically result in short term adverse effects on wetlands in localized areas during project implementation, and long-term beneficial effects from restoring or stabilizing wetlands and improving the overall wetland function within the parks.

Recreational and administrative stock use would continue to impact wetlands in approximately 5,800 acres of wilderness meadows. Stock grazing would continue to be monitored and managed to limit impacts to primary productivity, plant species composition, vegetative cover, bare ground, erosion, and streambank stability. These limits would prevent stock use from precipitating the kind of gullying found at Cahoon Meadow, and would prevent the loss of wetland function and structure (soils, vegetation, and hydrology) due to grazing.

No wetland stabilization or restoration would occur under the no action alternative and Cahoon Meadow would continue to degrade. The five acres of existing dewatered meadow would remain, and the potential for additional acreage to degrade and wetland function to diminish would continue. When considering the effects of the no action alternative with past, present, and future projects as a whole, the no action alternative would present an incremental adverse effect to the overall beneficial long-term effects associated with stabilizing and restoring wetlands within SEKI. While the no action alternative would present an adverse effect to the overall beneficial long term cumulative effects of meadow restoration within SEKI, the potential for an additional 14.9 (or 20.1 including the wetland arms and riparian channel wetland) –acre loss of fen/wet meadow, when considered with the overall 10,458 acres of fen/wet meadow types that occupy SEKI, would be locally substantial, but would not constitute a significant cumulative effect to wetlands.

IMPACTS OF ALTERNATIVE B

Under alternative B, 14.9 acres of existing intact wetland would be stabilized and zero acres would be restored. The 14.9 acres of existing wetland would be stabilized by constructing a rock chute that would inhibit progress of the headcut further upstream. This would allow the intact meadow to retain its wetland hydrology, soils, and vegetation, and halt the loss of organic soils through decomposition. Since flow would still be concentrated into the gully downstream of the rock chute, the small (0.836 acre) amount of wetland that has formed at the bottom of the gully would remain vulnerable to disturbance and further erosion.

Alternative B would produce no improvements in the dewatered meadow adjacent to the gully, which is prone to continued degradation. In addition, the side banks are likely to collapse and may develop additional headcuts, causing further loss of sediment. The collapse of the side walls, downcutting of the gully bottom, and formation of additional headcuts could threaten the intact lower east-side wetland (3.572 acres) and the middle east-side wetland arm (0.771 acre). The 1-2 low check dams installed in the flattest area of the gully could accumulate up to 40 cubic yards of sediment, a small fraction of what could potentially be eroded from the dewatered wetland and gully below the rock chute.

Of the 6.2 acres of fen at Cahoon Meadow, this alternative would protect 4.9 acres of fen within the 14.9 acres of intact wetland above the gully headcut area. A 1.3 acre area of former fen within the dewatered portion of the meadow may be lost to further decomposition of organic soils or direct erosion of soils downstream. The protection of 4.9 acres of peat accumulating area within the intact wetland represents approximately 1.3% of the total estimated area of peat accumulating wetlands in the parks and 25% in the East Fork Kaweah, an incremental long-term parkwide benefit, but a long-term local and substantial benefit to the East Fork Kaweah watershed.

Preparation of the site for construction of the rock chute would require the removal of up to 20 mature trees (lodgepole pine and white fir) currently growing on the gully banks. This grading would cover about 0.045 acres of riparian wetland in the gully bottom; the total area of the rock chute is designed at 0.216 acres. Approximately 1,060 cubic yards of on-site sediment would be excavated and reshaped within the gully and dewatered portion near the headcuts to provide the necessary slope. The rock chute would consist of 520 cubic yards of 8-inch diameter rock that would be imported to the site. To reduce the risk of introducing non-native plants from imported rock and earthmoving equipment, mitigation measures would include pressure washing equipment to remove dirt and plant parts before entering the park, ensuring imported rock material is from a pre-approved source, and surveying and controlling invasive non-native vegetation for one to three years after project activities are completed.

Approximately ½-1 acre of dewatered meadow would be temporarily disturbed from staging and crew camp operations. Construction equipment and materials would be longlined at a designated helispot outside of the intact meadow.

Alternative B has a moderate chance of succeeding in stabilizing the headcuts and protecting the ecological integrity of the intact wetland above the gully. The rock chute could wash out in large floods, and would be particularly vulnerable at its edges. A long-term institutional commitment would be required to monitor the condition of the structure and provide repairs (including potentially importing additional rock) to maintain the rock chute's function of hardening the headcut area against further headward erosion. Because rock is durable (as compared to a log structure, for example), the rock chute is expected to have a lifespan of about a century, requiring repairs every 25 years. Finally, there is a substantial risk that unanticipated events could interfere with project implementation due to the technical difficulties of transporting and repairing earthmoving equipment in a remote wilderness site and planning contingencies.

<u>Plant Species of Conservation Concern</u>
Under alternative B, stabilization of the 14.9 acres of intact wetland would have beneficial and long term effects by maintaining habitat for marsh claytonia and round leaf sundew; the populations would likely remain extant. The round leaf sundew and marsh claytonia populations are uncommon and regionally important due to their disjunct nature and potential for reproductive isolation, therefore maintaining the existing habitat is beneficial; however, any effects to the overall persistence of the species would be inconsequential.

Cumulative Effects of Alternative B

The projects and actions described under the cumulative effects section in alternative A are the same for alternative B; however, the contribution of alternative B to the overall cumulative effects on wetlands differs. Under alternative B, 14.9 acres of intact wetland would be stabilized; no meadow restoration would occur. The five acres of existing dewatered meadow would remain, and the potential for additional acreage to degrade and wetland function to diminish would continue below the rock chute. Temporary, localized, short term adverse effects would occur from the staging of equipment and crews within the dewatered meadow portion; no long term adverse effects are anticipated. A permanent, adverse impact to a small portion of intact riparian wetland that has formed in the gully bottom would occur from grading and installing the outlet apron at the headcut.

When considering the effects of alternative B with past, ongoing, and future projects as a whole, this alternative would protect 14.9 acres of intact wetland and would provide an additive long term beneficial effect toward stabilizing existing meadows and wetlands in SEKI. There would be an incremental loss of wetland function due to the potential loss of an additional 4.3 acres of intact wetland if further downstream degradation occurs. While alternative B would present both a beneficial effect by stabilizing

14.9 acres of intact wetland and an adverse effect by not restoring 5 acres of dewatered meadow and the potential loss of an additional 4.3 acres of intact wetland, this acreage, when considered with the overall 10,458 acres of fen/wet meadow types that occupy SEKI, would be locally beneficial, but would not constitute a significant cumulative effect to wetlands.

IMPACTS OF ALTERNATIVE C (PROPOSED ACTION AND NPS PREFERRED)

Under alternative C, 14.9 acres of existing intact wetland would be stabilized and 5 acres of wetlands would be restored by filling in the gully with soil cut from the dewatered meadow. In addition, this alternative would protect 3.572 acres of the intact lower east-site wetland and 0.771 acre of the middle east-side wetland arm. A small amount of wetland that has formed at the bottom of the gully would be disturbed (0.4 acre of the 0.836 acre gully bottom) and reestablished on top of the gully fill, at a higher elevation. Wetland function would be returned to 5.4 acres of dewatered wetland and gully bottom, and the loss of organic soils through decomposition would halt.

Of the 6.2 acres of fen at Cahoon Meadow, this alternative would protect 4.9 acres of fen within the 14.9 acres of intact wetland above the gully headcut area. Grading would occur within the 5 acres of dewatered meadow and fen areas. These organic soils would be protected from further decomposition by the saturated conditions produced by restoration of sheet-flow hydrology. The protection of 4.9 acres of peat accumulating area within the intact wetland represents approximately 1.3% of the total estimated area of peat accumulating wetlands in the parks and 25% in the East Fork Kaweah, an incremental long-term parkwide benefit, and a long-term and substantial benefit to the East Fork Kaweah watershed. The restoration of saturated conditions and wetland plant species in the 5.4 acres of former gully and dewatered wetland provides the long-term potential to regain peat-accumulating soils in any portion of this area. Six to eight inches of topsoil would be salvaged, the organic soils would be redistributed throughout the finalized surface, and the saturated conditions would protect the organics from further decomposition.

Grading would occur within the 5.4 acre gully and dewatered portion of the meadow to create a flat cross-section and eliminate all preferential flow paths, which would restore a sheetflow hydrologic regime and saturated soil conditions. The gully would be filled using the top 0.5 to 5.5 feet of soil from the adjacent dewatered meadow. Regrading the gully portion of Cahoon Meadow, using existing dewatered soils to fill the gully and create level topography, would require excavating, moving, and reconfiguring 12,500 cubic yards of soil. Because much of the gully fill is needed at the southern end of the project, at the headcut, but much of the cut material would be generated at the northern end, substantial upslope transport of the fill material would be required. Equipment transporting materials would be confined to the gully and dewatered portions of the meadow and would not impact intact wetland or vegetation except as shown on the grading plan. Temporary impacts to the intact lower east-side wetland and the middle east-side wetland arm may occur from grading and sloping the intact wetlands to the newly restored area.

Approximately 90,000 container plants would be installed at about 18-inch spacing, half in early September, following construction, and half the following spring in year three. Container plants pose lower risk of introducing non-native organisms than pre-vegetated wetland sod mats, which were also considered but rejected based on high risk of introducing non-native organisms. Container plants would be grown in a commercial nursery selected, in part, by the strength of its measures to ensure growing methods do not introduce non-native organisms to the project site.

Trees and other woody plants (e.g. willows) that are currently growing on the dewatered meadow surface or in the gully would be cut and placed into the gully. Log segments without branches could be buried sub-grade so long as they do not leave voids or interfere with compaction of the fill. There may be as many as 100 small to medium lodgepole pines and 50-100 shrubs that would need to be cleared.

Lodgepole pines and shrub species in the area are plentiful, and this would have a minimal impact to the upland vegetation at the site.

Approximately ½-1 acre of dewatered meadow would be temporarily disturbed from staging and crew camp operations during project implementation. When heavy equipment work is nearing completion, an upland site would be designated for staging prior to demobilization. Construction equipment and materials would be longlined at a designated helispot outside of the intact meadow.

Implementation of this alternative would have short-term (one season), direct, adverse, impacts to the 5.4 acres of dewatered wetland and gully bottom from excavating, moving sediment, and grading activities; and would result in long-term, beneficial effects by restoring wetland function to 5.4 acres.

Alternative C has a moderate to high chance of long-term success. Its largest advantage is that it solves the underlying problem caused by the rapid change in elevation between the wetland surface and the gully bottom by filling the gully and recreating the level landform, sheet-flow hydrology, and wetland vegetation that existed prior to livestock grazing. Thus, the action restores wetland integrity and is a fully sustainable solution, requiring no commitment to long-term maintenance after 5 years. However, the project would be vulnerable to damage by a severe storm event in the first three years after construction, prior to dense vegetation establishment. This vulnerability is minimized by using several layers of erosion control blanket, using coir wattles, and taking measures to maximize the rate of vegetation growth (loosening compact soils, producing high-quality plants in larger containers), all measures that have shown to be effective in rapid vegetation establishment at the Halstead Meadow restoration site. Finally, there is a substantial risk that unanticipated events could interfere with project implementation due to the technical difficulties of transporting and repairing earthmoving equipment in a remote wilderness site and planning contingencies.

<u>Plant Species of Conservation Concern</u>
Under alternative C, the effects on marsh claytonia and round leaf sundew from stabilizing 14.9 acres of intact wetland would be beneficial and long term as described under alternative B. While it is uncertain whether restoring the 5 acres of dewatered meadow would expand habitat due to the specialized requirements of these species, the opportunity to do so would be realized under this alternative and the area could be monitored for potential establishment.

Cumulative Effects of Alternative C

The projects and actions described under the cumulative effects section in alternative A are the same for alternative C; however, the contribution of alternative C to the overall cumulative effects on wetlands differs. Under alternative C, 14.9 acres of intact wetland would be stabilized, an additional 4.3 acres of intact wetland would be protected, and 5.0 acres of dewatered wetland would be restored. While adverse localized short term effects on the 5 acres of dewatered meadow would occur during grading and project implementation activities, the overall net result would be 5 acres of restored wetland.

When considering the effects of alternative C with past, ongoing, and future projects as a whole, this alternative would stabilize 14.9 acres of intact wetland, protect 4.3 acres of intact wetland adjacent to the gully, and restore 5 acres of degraded wetland, resulting in additive long term beneficial cumulative effects associated with restoring wetlands within SEKI. This alternative would ultimately protect 19.6 acres (including the wetland arms and 0.486 acre of the riparian channel wetland) of fen/wet meadow, and restore 5.4 acres, resulting in protection of the 25.1 acres of Cahoon Meadow. This acreage, when considered with the overall 10,458 acres of fen/wet meadow types that occupy SEKI, would be locally beneficial, but would not constitute a significant cumulative effect to wetlands.

CONCLUSION

Under alternative A, the 5 acres of existing dewatered wetland would continue to degrade and the 14.9 acres of intact wetland above the headcut would be threatened by further headward erosion of the gully. It is anticipated that the entire wet meadow would be converted to a dry, gully-incised landscape over time. Habitat for the plant species of conservation concern would degrade or be lost over time.

Both alternatives B and C include actions that would stabilize the 14.9 acres of intact wetland above the gully headcut. Alternative C would also restore 5 acres of existing dewatered meadow. About 4.3 acres of intact wetland below the gully would be protected under alternative C, whereas this acreage would be susceptible to degradation under alternative B. Both action alternatives would have temporary, localized, adverse effects during grading and site preparation although alternative C would result in a larger area of disturbance. Mitigation measures would be implemented to stabilize soils and minimize soil erosion in each alternative. Alternative B presents a moderate risk of importing nonnative organisms due to rock/gravel import and earthmoving equipment; whereas alternative C presents a moderate to high risk due to nursery plant production and earthmoving equipment. Both action alternatives would result in temporary, localized, adverse effects from the staging of equipment and crews although this would be within the dewatered meadow portion and no long-term adverse effects are anticipated.

Alternatives B and C would have beneficial and long term effects by maintaining habitat for marsh claytonia and round leaf sundew; restoring the 5 acres of dewatered meadow under alternative C may expand habitat for these species. Alternative C would ultimately protect the 25.1 acres of Cahoon Meadow. While the alternatives being considered would have substantial localized short term adverse and long term beneficial effects, none of the alternatives would result in significant adverse effects. While alternative A would result in long term adverse effects on the wetland at Cahoon Meadow, and both alternative B and C would result in locally beneficial effects, there would not be significant cumulative effects on wetlands from any of the alternatives.

Table 6. Summary of Impacts on Wetlands

Factor Considered	Alternative A No Action	Alternative B Stabilize Gully Headcut with Rock Chute	Alternative C Full Restoration
Stabilization of existing 14.9 acres of wetland.	No. Further degradation/ loss of wetland expected from headcutting.	Yes. 14.9 acres stabilized.	Yes. 14.9 acres stabilized.
Restore additional wetland function.	No	No	Yes. 5 acres of wetland function restored.
Short-term risk of soil erosion from disturbed soils.	N/A	Small disturbed area.	Large disturbed area (5-6 acres).
Risk of importing nonnative organisms.	No risk	Moderate risk due to rock/gravel import and earthmoving equipment. Implement mitigations to minimize risk.	Moderate/high risk due to nursery plant production and earthmoving equipment. Implement mitigations to minimize risk.
Impacts to upland vegetation.	None	Cut about 20 trees at rock chute site and to construct check dams.	Cut 100 trees and 50-100 shrubs within the grading limits.

WATER QUALITY AND WATER QUANTITY

METHODOLOGY FOR ANALYZING IMPACTS

In NPS *Management Policies 2006* (section 4.6.3), it states that the NPS will work with appropriate governmental bodies to obtain the highest possible standards available under the Clean Water Act for the protection of park waters; take all necessary actions to maintain or restore the quality of surface waters and groundwater within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations; and, enter into agreements with other agencies and governing bodies, as appropriate, to secure their cooperation in maintaining or restoring the quality of park water resources.

The proposed project would occur within the Upper Kaweah River watershed, specifically the East Fork Kaweah drainage. As indicated in the California Regional Water Quality Control Board- Central Valley Region's *Water Quality Control Plan for the Tulare Lake Basin, Second Edition* (SWRCB 2004), the state considers the surface water quality of the Kaweah River, above Lake Kaweah, to be beneficial for wildlife; cold and warm freshwater habitat; freshwater replenishment; habitat for rare, threatened and endangered species; habitat for spawning, reproduction, and/or early development; water contact recreation and non-contact water recreation; hydropower generation; and, municipal and domestic water supply.

Impacts to water quality and water quantity were assessed by reviewing existing literature and characterizing the effects based on the types of impacts that could occur, and analyzing factors that could contribute to impacts under each alternative. Site visits and surveys were conducted to help inform alternatives, identify potential impacts, and develop mitigation measures to reduce the level of impact.

Internal scoping – including discussions with university wetland scientists, NPS regional water resource professionals, SEKI natural resource management staff, engineers, and others – contributed to the water quality and water quantity impact analysis. Information contained in the June 2014 site visit and survey report, the *Wetland delineation for Cahoon Meadow* (Wolf and Cooper 2015), and information derived from the June 2015 interdisciplinary CBA workshop informed the environmental impacts analysis. Public scoping, preliminary discussions with the ACOE and the Central Valley RWQCB, also informed the assessment of effects. Potential mitigation measures and monitoring associated with Clean Water Act permitting, including section 404 and section 401 for implementation of an action alternative, were also considered in the analysis.

Predictions about short- and long-term impacts were based on professional judgment and experience gained from previous projects. Short-term impacts on water quality and water quantity were considered to be those impacts that would last only during project implementation activities, while long-term impacts would be those that extend beyond project implementation. The geographic scope considers impacts within the East Fork River watershed.

IMPACTS OF ALTERNATIVE A: NO ACTION

Under the no action alternative, the gully would remain untreated. High discharge events would continue to be concentrated into the unprotected gully causing headward erosion, undercutting and collapse of the steep gully banks. High sediment loads and turbidity due to erosion would impact water quality downstream. Under current conditions, vegetation is largely absent from the dry portion of the meadow.

Upland sediments transported to this portion of the meadow are more likely to reach Cahoon Creek and be transported downstream.

Under alternative A, water has shorter residence time in the meadow and during storm events, streamflow downstream of the meadow would have higher flow stages for a shorter duration. There is a potential for increased erosion downstream of the meadow under more energetic flow regime. The reduction of ground water in the wet meadow results in a corresponding reduction in base flow which could result in Cahoon Creek going dry during the summer months.

Under current conditions, impacts to hydrology extend up-gradient from the margins of the gully as the lowering of the local water table is evidenced by desiccated soils and changes in vegetation. Impacts extend downstream as far as Lake Kaweah in the form of increased sediment and faster response time to precipitation events. Proportionally, downstream impacts decline exponentially as you move away from the gully. That is to say, sediment eroded from the gully makes up a large percentage of the total sediment load in Cahoon Creek just downstream of Cahoon Meadow, but quickly becomes a negligible percentage of the total load as it moves downstream into the East Fork of the Kaweah. The presence or absence of the gully is essentially undetectable at Lake Kaweah. However, all sediment that reaches Lake Kaweah reduces the reservoir capacity and reduces its effectiveness for flood control.

Impacts would persist as the gully continues to migrate upstream into Cahoon Meadow until equilibrium is reached sometime in the distant future. The gully in Cahoon Meadow would continue to migrate upstream over the course of a few hundred years in a continuous, incremental fashion, punctuated by rapid growth during the largest runoff events. Given the size of the uneroded portion of Cahoon Meadow, there is a potential that the total volume of soil lost may increase from current levels by a factor of ten.

There is no indication that the gully would self-stabilize before reaching the upstream margins of the meadow. In this case, the entire wet meadow would be converted to a dry, gully incised landscape. It remains uncertain if conditions would allow stabilization and re-deposition of soils over the course of a few millennia.

Cumulative Effects of Alternative A

There are a number of past, present, and reasonably foreseeable projects occurring within the parks that have an adverse or beneficial effect on water quality and water quantity. Past, current, and potential future meadow restoration efforts improve water quality and quantity conditions by stabilizing soils in intact areas and/or improving or restoring groundwater storage in degraded areas. Restoration activities, such as realigning trails outside of wetlands and filling/revegetating deeply-incised trail treads, is ongoing and improves water quality in park areas. Activities associated with these restoration activities (such as using heavy equipment to move soils, revegetating disturbed areas, restoring natural drainage patterns) typically result in short-term adverse effects on water quality in localized areas during project implementation, and long-term beneficial effects from restoring or stabilizing wetlands and improving the overall hydrologic function within the parks.

Recreational and administrative stock use would continue to impact water quality in approximately 5,800 acres of wilderness meadows. Stock grazing would continue to be monitored and managed to limit impacts to primary productivity, plant species composition, vegetative cover, bare ground, erosion, and streambank stability. These limits would prevent stock use from precipitating the kind of gullying found at Cahoon Meadow, and serve to maintain water quality and quantity by preventing the loss of wetland function and structure (soils, vegetation, and hydrology) due to grazing.

No wetland stabilization or restoration would occur under the no action alternative and Cahoon Meadow would continue to degrade. The five acres of existing dewatered meadow would remain, and the potential for additional acreage to degrade and wetland function to diminish and the associated impacts to water quality and quantity would continue. When considering the effects of the no action alternative with past, present, and future projects as a whole, the no action alternative would detract from parkwide efforts to protect and preserve water quality and quantity. However, if an additional 150,000 cubic yards of sediment were to be introduced into the South Fork of the Kaweah River over a number of years, it would represent a small fraction of the total sediment naturally transported by the river during the same period of time. Therefore, the overall cumulative effects from the no action alternative would be adverse, locally important, but insignificant on a watershed scale.

IMPACTS OF ALTERNATIVE B

Under this alternative, the gully would not be eliminated and unstable banks below the rock structure could continue to erode. One to two in-channel log check dams would be constructed within the shallowest and flattest reach of the gully to trap and retain sediment; additional dams may be added in the future if necessary. A single dam would create a backwater about 77-feet long and help retain eroded material, thereby reducing downstream sedimentation and turbidity.

During project implementation, there would be temporary, adverse impacts on water quality from an increase in sedimentation and turbidity from construction activities. With 0.5 to 1 acre of bare soil exposed for 3 to 5 weeks in the summer, there is a short-term risk that heavy summer rain event could erode some portion of this disturbed soil. The operation of one piece of earthmoving equipment for 6 to 21 days and use of power tools presents a short-term risk that fuel and hydraulic fluids could leak into the water. To ensure water quality standards are not exceeded, mitigation and monitoring measures, including those stipulated in water quality permits acquired through the ACOE and RWQCB to be obtained prior to project implementation, would be adhered to. A site-specific erosion and sediment control plan and a hazardous materials spill plan would be prepared prior to work. This document would outline best management practices to ensure that sedimentation of waterways and turbidity in streams does not exceed water quality standards.

Long-term beneficial effects on water quality and quantity associated with this alternative include stabilization of up to 150,000 cubic yards of sediment that would otherwise be susceptible to gully erosion. Retaining vegetation above the rock chute would also capture sediment eroded from the uplands surrounding the meadow resulting in a further reduction of sediment delivered to Cahoon Creek. The unvegetated portion of the meadow near the gully would remain susceptible to erosion, especially in the form of bank collapse during heavy rains or wet-dry cycling. There is a chance that continued erosion below the rock chute could migrate around the stabilized headcut resulting in a reestablishment of headward erosion. Periodic maintenance and inspection would reduce this potential.

A stabilized headcut would maintain the groundwater storage potential in the wet meadow upstream. Under current conditions, it appears that groundwater stored in the wet meadow is sufficient to provide year-round baseflow to Cahoon Creek. This is noteworthy given the exceptional drought conditions present at the time of the field investigations.

Cumulative Effects of Alternative B

The projects and actions described under the cumulative effects section in alternative A are the same for alternative B; however, the contribution of alternative B to the overall cumulative effects on water quality and quantity differ. Under alternative B, 14.9 acres of intact wetland would be stabilized by constructing a rock chute and installing check dams to impede sediment transport; no meadow restoration would occur.

The five acres of existing dewatered meadow would remain, and the potential for additional acreage to degrade and wetland function to diminish would continue below the rock chute. Temporary, localized, adverse effects would occur from the staging of equipment and crews. A permanent, adverse impact to a small portion of intact riparian wetland that has formed in the gully bottom would occur from grading and installing the outlet apron at the headcut.

The five acres of existing dewatered meadow would remain, and the potential for an additional 4.3 acres to degrade and wetland function to diminish and the associated impacts to water quality and quantity would continue. When considering the effects of the no action alternative with past, present, and future projects as a whole, the alternative B would detract slightly from parkwide efforts to protect and preserve water quality and quantity. However, even if additional sediment is introduced into the South Fork of the Kaweah River, it represents a small fraction of the total sediment naturally transported by the river each year. Therefore, the overall cumulative effects from alternative B would be adverse, slight, but insignificant on a watershed scale.

IMPACTS OF ALTERNATIVE C (PROPOSED ACTION AND NPS PREFERRED)

Under alternative C, the gully that has formed at Cahoon Meadow would be filled in with on-site vegetation materials and approximately 12,500 cubic yards of sediment. If successful, approximately 150,000 cubic yards of sediment upstream of the current headcut would be protected from gully development and erosion. Additionally, dried meadow soils below the current headcut would be protected and rewetted. It is anticipated that groundwater levels surrounding the remediated gulley would quickly return to pre-disturbance levels and promote the reestablishment of wetland vegetation. As vegetation reestablishes, upland sediments transported by overland flow would be retained within the meadow.

Storm discharges would be attenuated when compared to current levels. Peak flows would be reduced and storm-related discharges would be prolonged as water is retained in the meadow and released slowly. Baseflow would be more persistent as stored groundwater would be slowly released during dry summer months.

Mitigation measures, monitoring, and best management practices, as described in alternative B would be implemented to minimize impacts to water quality from activities associated with this alternative.

During project implementation, up to 6 acres of bare soils would be exposed for up to 12 weeks with a risk of erosion during large summer rain events. Four pieces of earthmoving equipment and power tools would be onsite for 28-35 days. There is a short-term risk that fuels and hydraulic fluids would leak on site. To ensure water quality standards are not exceeded, mitigation and monitoring measures, including those stipulated in water quality permits acquired through the ACOE and RWQCB to be obtained prior to project implementation, would be adhered to. A site-specific erosion and sediment control plan and a hazardous materials spill plan would be prepared prior to work. This document would outline best management practices to ensure that sedimentation of waterways and turbidity in streams does not exceed water quality standards.

With the stabilization of the 14.9 acres of wetlands and restoration of 5 acres of wetlands, long-term beneficial effects on water quality and water quantity would result from providing water storage and flood attenuation by reducing peak flows, stream velocity, and erosion. Long-term beneficial effects on water quality would also result from the wetlands ability to filter and store water, and help control downstream sediment loads and sedimentation of adjoining waters.

Cumulative Effects of Alternative C

The projects and actions described under the cumulative effects section in alternative A are the same for alternative C; however, the contribution of alternative C to the overall cumulative effects on water quality and quantity differ. Alternative C would result in the most wetland acreage being stabilized, and the most restored and protected, when compared with alternatives A and B. This would result in long-term improvements to water quality and quantity. Temporary, localized, adverse effects would occur from the staging of equipment and crews although this would be within the dewatered meadow portion and in upland areas as needed; no long-term adverse effects are anticipated.

When considering the effects of alternative C with past, present, and future projects as a whole, this alternative would result in additive long-term beneficial effects associated with water quality and quantity within SEKI. This alternative would ultimately protect 20.1 acres of fen/wet meadow, and restore 5.0 acres, resulting in protection of the 25.1 acres of Cahoon Meadow. This would constitute a measureable improvement to local water quality and quantity, but proportionally would not constitute a significant cumulative effect on a watershed scale.

CONCLUSION

Alternative A would result in further degradation of water quality and quantity as no action would be taken to stabilize the gully. Stable groundwater levels and saturated soils are required for the formation and maintenance of wet meadows and fens. Gully formation has allowed groundwater levels to fall, resulting in the desiccation of soils and degradation of Cahoon Meadow. Under alternative A, with no intervention, headward erosion of the gully and the corresponding degradation of meadow condition would continue until the entire meadow is impacted. Functioning meadows improve water quality and store groundwater for later release during dry periods. Impacts on water quality and quantity would continue to be observed locally, and adverse impacts would increase as the gully enlarges; however impacts would be below the level of detection at the watershed scale.

Both alternatives B and C include actions that would stabilized the 14.9 acres of intact wetlands above the gully headcut. Alternative C would protect an additional 4.3 acres of intact wetland below the gully. Both alternatives would result in long term beneficial effects on the water quality and quantity in the area and watershed from providing water storage and flood attenuation by reducing peak flows, stream velocity, and erosion. Long-term beneficial effects on water quality in the watershed would also result from the wetlands ability to filter and store water, and help control downstream sediment loads and sedimentation of adjoining waters. The overall cumulative effects, either adverse or beneficial, from the alternatives, would be insignificant on a watershed or parkswide scale.

Table 7. Summary of Impacts on Water Quality and Quantity

Factor Considered	Alternative A- No Action	Alternative B- Stabilize Gully Headcut with Rock Chute	Alternative C- Full Restoration (Proposed Action and NPS Preferred Alternative)
Potential for downstream benefits of increased late season water flow (including to sequoia grove) and flood attenuation.	Potential for reduced downstream late season water flow and flood attenuation.	No change.	Increased downstream late season water flow and flood attenuation; potential benefits to downstream sequoia grove.
Potential benefits for downstream water quality/ long-term risk of soil erosion from dried meadow sediments.	Potential for reduced downstream water quality with continued/ increased erosion.	Small/ medium benefit to downstream water quality.	Large benefit to downstream water quality.
Exposure to equipment failure and leaks. Potential for persistent pollution on-site.	None	1 excavator, 105 helicopter round trips. Moderate fuel and hydraulics. Potential for persistent pollution is low-moderate. Implement mitigations to minimize risk.	3-4 pieces earthmoving equipment, 30 helicopter round trips. High fuel and hydraulics. Chainsaw use. Potential for persistent pollution on-site is moderate. Implement mitigations to minimize risk.

CONSULTATION AND COORDINATION

SCOPING

Public Scoping

On December 10, 2014, SEKI released a news release and letter to initiate a 45-day public scoping period on the proposed restoration of ecosystem function in Cahoon Meadow proposal. The news release was distributed to local and regional media outlets. A notification letter was mailed to approximately 380 individuals, agencies, businesses, and interest groups, and 590 private individuals on the parks' mailing list. A letter was sent to 54 tribal leaders, and emailed to 60 tribal representatives or individuals affiliated with area tribes. Public scoping notices were published in several newspapers and internet sites, including the Kaweah Commonwealth, Imperial Valley News, Valley Voice, and WN.com (World News).

The parks received comments from 13 different sources during public scoping which ended on January 23, 2015. Nine correspondences were from unaffiliated individuals (one stated they do not have any comments at this time); one correspondence was from a tribe stating the project is outside their area of interest; one correspondence was from an official representative from a business called SCC Sequoia; and, two correspondences were from recreational groups- Kaweah Fly Fishers and Backcountry Horsemen of California- High Sierra Unit.

CONSULTATION AND PERMITTING REQUIREMENTS

On November 6, 2015, the NPS accessed the USFWS website to obtain an official species list for endangered and threatened species that may be in the project area and could be affected by project activities (USFWS 2015). NPS biologists reviewed the FWS list and lists of state-listed species and species of concern, to determine which species could potentially be affected by implementation of the proposed project. The NPS has determined that there would be *no effect* on threatened or endangered species from implementation of the preferred alternative. The NPS will send the EA and a letter of *no effect* to the USFWS for their review and concurrence.

An archeological survey was completed for the project area and no cultural resources were found. The NPS will send the EA and a letter to the California State Historic Preservation Office for their notification and review.

Permitting and Policy Requirements

Implementation of an action alternative would require a Clean Water Act section 404 permit issued through the ACOE, and a Clean Water Act section 401 certification/ notification issued through the RWQCB. These would be obtained prior to the commencement of work.

The preferred alternative (C) involves activities that would have some adverse impacts on wetlands during the construction process. Activities with the potential to have direct or indirect adverse impacts on wetlands must comply with NPS Director's Order #77-1: Wetland Protection and its accompanying Procedural Manual #77-1: Wetland Protection. If after avoiding and minimizing adverse impacts to the extent practicable there would still be adverse impacts on wetlands, a Wetland Statement of Findings must be prepared and attached to NEPA documents for public review (unless the activity qualifies as an Excepted Action). The NPS has determined that the preferred alternative qualifies as an Excepted Action under Section 4.2.h of Procedural Manual #77-1 (Actions designed to restore degraded wetland, stream, riparian or other aquatic habitats or ecological processes), so a Statement of Findings is not required for the preferred alternative. As required for Excepted Actions, the NPS will adhere to the Best Management Practices and Conditions described in Appendix 2 of Procedural Manual #77-1 (see supporting documentation in PEPC at http://parkplanning.nps.gov/cahoon).

AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

The following agencies and organizations received a printed copy, CD, email, or written notification of the EA:

COOPERATING AGENCIES

The following agency was a cooperator in the preparation and review of the EA:

U.S. Army Corps of Engineers, Sacramento District Office

The following agencies and organizations received a printed copy, CD, or email or written notification of the environmental assessment:

CONGRESSIONAL REPRESENTATIVES

Senator Barbara Boxer, California
Office of Senator Boxer, Fresno – District Director Ameen Khan

Senator Dianne Feinstein, California
Office of Senator Feinstein – Field Representative Sarah Moffat

Representative Kevin McCarthy, 23rd District, California
Office of Representative McCarthy – Field Representative Keenan Hochschild

Representative Tom McClintock, 4th District, California
Office of Congressman McClintock, California – District Director Rocky Deal

FEDERAL AGENCIES

U.S. Bureau of Management, Field Manager- Bakersfield
U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento Fish & Wildlife Office
U.S. Geological Survey, Biological Resources Division, Western Ecological Research Center
U.S. Forest Service: Sequoia and Sierra National Forests
Federal Highway Administration

CALIFORNIA STATE GOVERNMENT REPRESENTATIVES

Governor Jerry Brown, State of California
State Senator Jean Fuller, California
State Assemblyman Jim Patterson, California
Office of State Assemblyman Patterson – Alicia Wolfe, Field Representative
State Assemblywoman Connie Conway, California
Office of State Assemblywoman Conway – Stuart Anderson, Field Representative
State Senator Tom Berryhill, California

STATE, COUNTY, AND LOCAL AGENCIES

County Government Representatives

Fresno County Board of Supervisors
Fresno County Office of Tourism
Fresno County Sheriff's Office
Tulare County Board of Supervisors
Tulare County Civic Center
Tulare County Conservation District
Tulare County Environmental Health
Tulare County Sheriff's Office
Tulare County Resource Conservation District
City Government Representatives
City of Clovis, Business Manager
City of Dinuba, Deputy City Clerk
City of Fowler, City Clerk
City of Fresno, Communications Office
City of Hanford, City Manager
City of Kingsburg, City Clerk
City of Orange Cove, Mayor
City of Parlier, City Manager
City of Reedley, City Council
City of Reedley, Mayor
City of Sanger, Mayor
City of Selma, Executive Director
City of Tulare, City Manager
City of Visalia, Convention and Visitor Bureau
City of Visalia, Mayor
City of Visalia, Community Relations Manager
City of Visalia, Transit Analyst
City of Woodlake, City Council

State Agencies

California Travel and Tourism Commission
California Department of Pesticide Regulation
California Department of Toxic Substances Control
California Environmental Protection Agency
California Department of Forestry and Fire
California Air Resources Board
California Conservation Corps
California Department of Conservation
California Department of Transportation
California Department of Fish and Wildlife
California Farm Bureau Federation
California Geological Survey
California Highway Patrol
California Resources Agency
California State Board of Education
California State Clearinghouse

California State Office of Historic Preservation
California State University: Bakersfield, Fresno
Fresno Yosemite International Airport
Kern Valley Resource Conservation District
University of California, Merced

AMERICAN INDIAN TRIBES, ORGANIZATIONS, AND INDIVIDUALS

American Indian Council of Mariposa County
Benton Paiute Reservation
Big Pine Paiute Tribe of Owens Valley
Big Sandy Rancheria of Mono Indians
Bishop Indian Tribal Council
Bishop Paiute Tribe
Bridgeport Paiute Indian Colony
California Basket Weavers Association
California Native American Heritage Commission
Chemehuevi Reservation
Chumash Native Nation
Cold Springs Rancheria of Mono Indians
Dumna Wo-Wah Tribal Government
Dunlap Band of Mono Indians
Eshom Valley Band / Wuksache Indian Tribe
Fort Independence Paiute Indians
Fort Mojave Indian Tribe
Haslett Basin Traditional Committee
Kawaiisu Tribe
Kern River Paiute Council
Kern Valley Indian Community Tribal Council
Kings River Choinumni Farm Tribe
Kitanemuk & Yowlumne Tejon Indians
Kutzadika Indian Community Cultural Preserve
Lone Pine Paiute-Shoshone Reservation
Mono Lake Indian Community
Native American Heritage Commission
North Fork Mono Tribe
North Fork Rancheria of Mono Indians
Northern Band of Mono Yokuts
Ramona Band of Cahuilla Mission Indians
San Manuel Band of Mission Indians
Santa Rosa Rancheria
Serrano Nation of Mission Indians
Sierra Nevada Native American Coalition
Squaw Valley Tribe
Table Mountain Rancheria
Tejon Indian Tribe
The Choinumni Tribe of Yokuts
The Mono Nation
Traditional Choinumni Tribe
Tubatulabals of Kern Valley
Tule River Indian Tribe

Tule River Tribal Elders Committee
Wukchumni Tribal Council

NPS CONCESSIONERS

Delaware North Companies Parks and Resorts

LOCAL ORGANIZATIONS

Central California Hispanic Chamber of Commerce
Central Sierra Chamber of Commerce
College of the Sequoias
Dinuba Chamber of Commerce
Exeter Chamber of Commerce
Fresno Chamber of Commerce
Fresno Economic Development Corporation
Fresno Parks & Recreation
Greater Fresno Area Chamber of Commerce
Greater Reedley Chamber of Commerce
Kern Valley Resource Conservation District
Kingsburg Chamber of Commerce
Lindsay Chamber of Commerce
Lone Pine Chamber of Commerce
Porterville Chamber of Commerce
Sequoia Foothills Chamber of Commerce
Sequoia Natural History Association
Sequoia Parks Foundation
Sequoia Riverlands Trust
Sierra Business Council
Sierra Nevada Conservation
Tulare Kings Hispanic Chamber of Commerce
Visalia Chamber of Commerce

OTHER SPECIAL INTEREST, BUSINESSES, AND PRIVATE ORGANIZATIONS

Backcountry Horsemen of California
Californians for Western Wilderness
California Preservation Foundation
California Travel and Tourism Commission
Center for Biological Diversity, California and Pacific Office
Fresno Audubon Society
Friends of the Earth
High Sierra Hiker’s Association
Mineral King District Association
Mineral King Preservation Society
National Audubon Society; Tulare Audubon Society
National Parks and Conservation Association
The Nature Conservancy, California Field Office
Pacific Crest Trail Association
Public Employees for Environmental Responsibility
Sierra Club – National Headquarters; Tehipite Chapter; Kern-Kaweah Chapter; Sacramento Field Office

Student Conservation Association Northwest Office
The Wilderness Society
Wilderness Land Trust
Wilderness Watch
The Wildlife Society, San Joaquin Valley Chapter
Wilsonia Historic District Trust

AREA LIBRARIES AND UNIVERSITIES

California State University: Bakersfield, Fresno
Clovis Regional Library
Fresno County Libraries:
- Central
- Fowler
- Kingsburg
- Orange Cove
- Parlier
- Reedley
- Sanger
- Selma
- Sunnyside

Kern County Library, Bakersfield
Porterville Public Library
Tulare County Libraries:
- Lindsay
- Dinuba
- Three Rivers
- Visalia

University of California: Merced

UNAFFILIATED INDIVIDUALS AND BUSINESSES

List is available upon request.

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

NPS SEKI (March 2016)