



ALPINE MEADOWS

CONSERVATION
Designed by | Gretchen Hinz

TUOLUMNE MEADOW

CONSERVATION OF YOSEMITE'S MEADOWS THROUGH RECREATIONAL & EDUCATIONAL PLANNING

A Design Thesis Submitted to the
Department of Architecture and Landscape Architecture
of North Dakota State University

By
Gretchen Hinz

In Partial Fulfillment of the Requirements for
the Degree of Bachelor of Landscape Architecture



Primary Thesis Advisor



Secondary Thesis Advisor



TABLE OF CONTENTS

INTRODUCTION

Pg. 5

Abstract

Inspiration

Statement of Intent

LITERATURE REVIEW

Pg. 6-8

Typology

Critical Evaluation

Questions

Hypothesis

CASE STUDIES

Pg. 9-12

Case Studies 1-4

RESEARCH

Pg. 13 - 24

Research

SITE

Pg. 25 - 41

Site Location

Existing Conditions

ANALYSIS

Pg. 42 - 48

Analysis

Process Sketches

DESIGN

Pg. 49 - 58

Master Plan

Details



INTRODUCTION



THESIS

Alpine meadows are delicate ecosystems that are being damaged and declining. In Yosemite only 3% of the park is considered meadow habitat. Through this thesis I am exploring the question; how can we conserve these alpine meadows? To discover this I will research and collect data to understand these underlying questions. What is the major cause of alpine meadow decline? What are the aspects of a healthy alpine meadow? Can there be human interaction with alpine meadows without further destruction, and if so how? These questions cumulatively help show what is needed to restore an alpine meadow, and what is the best way to go about conserving. Then once a meadow is restored it will show how human interaction can be promoted without damage to the alpine environment. This thesis will help to allow for a more efficient educational and recreational conservation design of these alpine meadow natural landscapes, and a future amplification of conservation.

INSPIRATION

Every year my family goes on a two week road trip visiting different National Parks across the US hiking, climbing, mountain biking, and camping. This has cultivated a passion for these preserved areas and a longing to keep them for future generations to enjoy them. Alpine meadows are major sustainer of these incredible places. So combining my love for these National Parks and my knowledge in Landscape Architecture I intend to try and figure out a way that we can conserve the natural alpine meadows that are in decline and find a way to allow for improved human interaction with these delicate ecosystems.



STATEMENT OF INTENT

Alpine meadow ecology is one of the most complex sciences. According to the National Park Service In Yosemite National Park meadows only make up 3% of the National Parks area yet support most of the areas species. Meadows are sponges, absorbing water as snow pack on a mountain melts and holding it. This allows for the water to be filtered by the meadows. This filtered water run-off provides clean water for wildlife, healthy habitat for aquatic animals and most of San Francisco's water is filtered by Yosemite's meadows. These delicate ecosystems are very sensitive to changes including human-caused changes or disruptions such as walking over the land causing compaction. This thesis will look at how Landscape Architecture as a design tool can conserve these natural meadows in decline, allowing for better preservation of this ecosystem while still providing educational and recreational human activities.

PROJECT TYPOLOGY

ALPINE ECOLOGY ALPINE MANAGEMENT SUB-ALPINE RECREATION



1 NON-NATIVE PLANTS AND TRAILS

Authors Liz Ballenger (biologist), Katherine Wilkin (biological science technician), Lisa Acree (botany program manager), Joy Baccei (interdisciplinary resource specialist), Terressa Whittaker (natural resource analyst), and Erin Babich (biological science technician) in their resource management and science journal **“2010 Assessment of Meadows in Merced River Corridor, Yosemite National Parks”** (April 2011, revised 2012) explain with their research that meadows with trails are more vulnerable due to people wandering off the path causing compression. They surveyed nearly all meadows in the corridor, tailoring individual protocols to three groups: Yosemite Valley meadows (4,000 feet elevation), sub-alpine meadows (7,000 to 9,600 feet elevation), and alpine meadows (above 9,600 feet). In Yosemite Valley meadows, we sampled 5x5m plots on a grid across each meadow and collected additional information on two issues of concern, non-native plants and informal trails. In sub-alpine meadows, they used the same plot sampling method and collected additional information on pack stock impacts, a specific concern for these meadows. They also employed a peer-reviewed inter-agency stream monitoring protocol to assess perennial stream conditions in sub-alpine meadows. For alpine meadows, they used a rapid assessment protocol to gather coarse quantitative data on meadow and stream characteristics. In alpine meadows, and also adapted a rating system from neighboring wilderness areas (USDA 2003) to quantify indicators of meadow health such as ground cover and water shed completeness, recreation impacts, and vulnerability to impact. These authors intend for an audience who has an interest in ecology using terminology that goes with the field. The did this research for those looking to help the welfare of meadows within Yosemite Park and develops a researcher common ground with the reader. These authors are able to come up with what puts a meadow at risk, and the health of the meadows within the Merced River Corridor. But they do not explain how to reverse these effects, or what kind of design would help to prevent further damage to the meadows health.



2

HYDROLOGY RESTORATION

Similarly author Courtney Moore in her article **“Modeling Alpine Meadow Restoration Techniques and their Effects on Stream Stage Regimes”** looks at problems for meadow health arguing that groundwater dependent ecosystems, such as meadows, are especially vulnerable to channel degradation because alteration of stream stage propagates through the groundwater system to affect riparian vegetation. Moore uses HEC-RAS modeling to provide critical stream stage boundary conditions for groundwater modeling. Scenarios are chosen that are most effective at increasing stream stage and therefore water table levels. The effectiveness is quantified by modeling how each scenario changes the rating curve for a particular channel. Additionally, surface stage modeling allows decision makers to see under what flow conditions and what time period of the hydro-graph is affected by restoration. Moore desires to use this quantification of stream stage alterations as a key for understanding restoration impacts during the short growing season in alpine meadows. Her results for the HEC-RAS modeling at Tuolumne Meadows are presented to highlight the ways in which this work can be used as a vital tool in management decisions regarding meadow restoration. Moore intends to write to individuals with knowledge in hydraulics looking at restoration of meadows, specifically the Tuolumne Meadows in the Sierra Nevada of California. Moore establishes an educated relationship with the audience. Moores' research allows for informed decisions based on sound science to help achieve restoration goals in the future based on hydrology, but these results fail to take to account any other factors that may be causing a decline in the alpine meadows such as human elements, invasive plant life, or large wildlife migration and grazing.

3

HUMAN ACTIVITY

While authors Beatrice Wilard Ph.D. and Jon Marr Ph.D. in their journal **“Effects of human activities on alpine tundra ecosystems in Rocky Mountain National Park, Colorado”** (Biological Conservation, Volume 2, Issue 4,) focus more on human impact suggesting that the activities of summer visitors to the tundra of Trail Ridge in Rocky Mountain National Park results in the rapid destruction of vegetation in the areas seen by most visitors at close range—especially near parking areas. To support this they conducted studies throughout the tundra region of Trail Ridge, but intensive research was centered around the four major parking areas above tree-limit, where about 95 per cent of the visitors congregated. This study was seeking information on the effects which visitors have in the course of doing whatever they normally do while in the tundra region. Consequently, our data consist of observations made without the knowledge of the visitors, and in the absence of any attempt to conduct experiments. These authors intend for an audience who is looking to have low impact on National parks, specifically the Rocky Mountain's Alpine ecosystems. This research shows the effects of human activities on alpine tundra and what the negative effects are caused by, but is silent on how to reverse those effects that may have already taken place.

4

TUOLUMNE MEADOWS

Contacting Yosemite National Park I was able to get in touch with **Garrett Dickman Yosemite National Parks ecologist**. He was able to give me some insiders perspective on what is happening to Tuolumne Meadows and what factors are causing effects withing the meadows. One of the longest detriments to the meadows was sheep hearding in Tuolumne meadows before it was protected. There are still impacts today from over grazing with bare soil areas. Now deer and burrowing rodents bare the largest effects on the meadows. Overpopulation of deer because of human presence contribute to overgrazing of the meadow and burrowing rodents create bare areas with digging and creating holes may disturb the hydrology. Humans cause degradation to the meadow themselves creating social trails, and going off road. This is most prevelent along the road around the meadows and at trailheads. These social trails and erosion compact the ground stopping vegetation growth and changing hydrology flow.

TITLE: YANWEIZHOU PARK

Location: Jinhua city

Project Typology: ecology, preservation, urban

Date Designed: 2013

Construction Completed: May 2014

Size: 90-hector

Firm: Turenscape Landscape Architecture

Client: The city of Jinhua

Context: The park is a wetland on the end of a small peninsula that is surrounded by the Wuyi River on two sides and juts up to the city of Jinhua. It is a small ecological area surrounded by urbanism.

Site Analysis: A rainbow bridge that flies above the wetland park acts as an access into the designed wetland. Spindly orange walkways are raised above the waters and meadows of this wetland park on concrete stilts plugged into the riverbed silt, while grasses and flowers line the river and an observation tower made from metal framework perches on a waterside platform.

Genesis of Project: The regeneration project was commissioned by the local government as part of a campaign of environmental improvement for the city.

Project Background and History: The industrial city – once dominated by coal, steel and cement factories and the pollution from their industrial chimneys – sits in a valley surrounded by limestone hills with the river running through its center.

Design Intent: Water resilient terrain and plantings are designed to adapt to the monsoon floods; A resilient bridge and paths system are designed to adapt to the dynamic water currents and people flows. The bridge and paths connect the city with nature and connect the past to the future; Resilient spaces are created to fulfill the need for temporary, intensive use by the audience from the opera house, yet are adaptable for daily use by people seeking intimate and shaded spaces.

Decision Making Process: Initially the city of Jinhua decided to make giant walls separating the city from Yanweizhou park, in order to keep the flooding from monsoon season from damaging the city. However, The regeneration project was commissioned by the local government as part of a campaign of environmental improvement for the city. This design for the park would not only effectively resist and manage flood water, but would allow the community to stay connected with the river, wetland, and vegetation, unlike the wall that was initially planned.

Design Process and Development: This project used a “cut and fill,” strategy to help accommodate for the flood waters. There were multiple aspects to this project. River Embankments were filled with plants and vegetation that are naturally adapted for flood water and help to absorb the water. Secondly, this project allowed for pedestrian paths that were made specifically to be flooded during monsoon season so water could be stored there. These paths were closed off temporarily during flood season. The manner in which these two aspects manage flooding allow for fertile silt to be placed on the wetlands. This results in no fertilization or irrigation to be necessary for the whole year. They also use of gravel around pedestrian areas and permeable concrete roads for vehicles which allow for the absorption of flood water. Bio Swales were also used when placing trees so that water can be channeled. All of these aspects were designed so that the water absorbed



and filtered by the wetland vegetation would drain to the ponds in the middle of the wetland. In addition to all of this, a bridge was made across the rivers and wetlands, connecting the city to the wetlands, and across the river.

Project Success : The project is a proven a partial conservation success. After the park opened in May 2014, an average of 40,000 visitors used the park and the bridge each day. The local media exclaimed: "the whole city is crazy about one single bridge!" And now, the Yanweizhou Park has created a new identity for the city of Jinhua. The park may be popular but the success measured in conservation of the wetland ecology is lacking its natural environment designed extremely man-made containing mass plantings in linear patterns instead of organic plantings simulating a natural wetland.



THIS DESIGN SEPARATES OUT TYPES OF PLANTS AND PLANT COMMUNITIES. THIS ALLOWS FOR VISITOR OBSERVATION OF ALL ASPECTS OF THE VEGETATION AND ECOLOGY IN SEPARATION. THIS WOULD BE A GREAT WAY TO BRING OUTDOOR EDUCATIONAL DISPLAYS TO THE VISITORS CENTER FOR TUOLUMNE MEADOWS.



THE LOUD COLORS AND FOCUS ON BUILT STRUCTURE WITHIN THIS DESIGN WOULD DISTRACT TO MUCH FROM THE NATURAL ENVIRONMENT THAT VISITORS GO TO THE NATIONAL PARKS TO SEE. THE DESIGN NEEDS TO BE RUSTIC AND MINIMAL AS TO BLEND IN WITH THE ENVIRONMENT, NOT COMPETE WITH IT.

TITLE: THE BIG CYPRESS BEND BOARDWALK

Location: Big Cypress Swamp, Naples Florida

Project Typology: ecological, conservation, recreational

Date Designed:

Construction Completed:

Size: 2,300 foot wooden boardwalk

Client: Friends of Fakahatchee

Context: On the north side of Route 41 east of SR-29

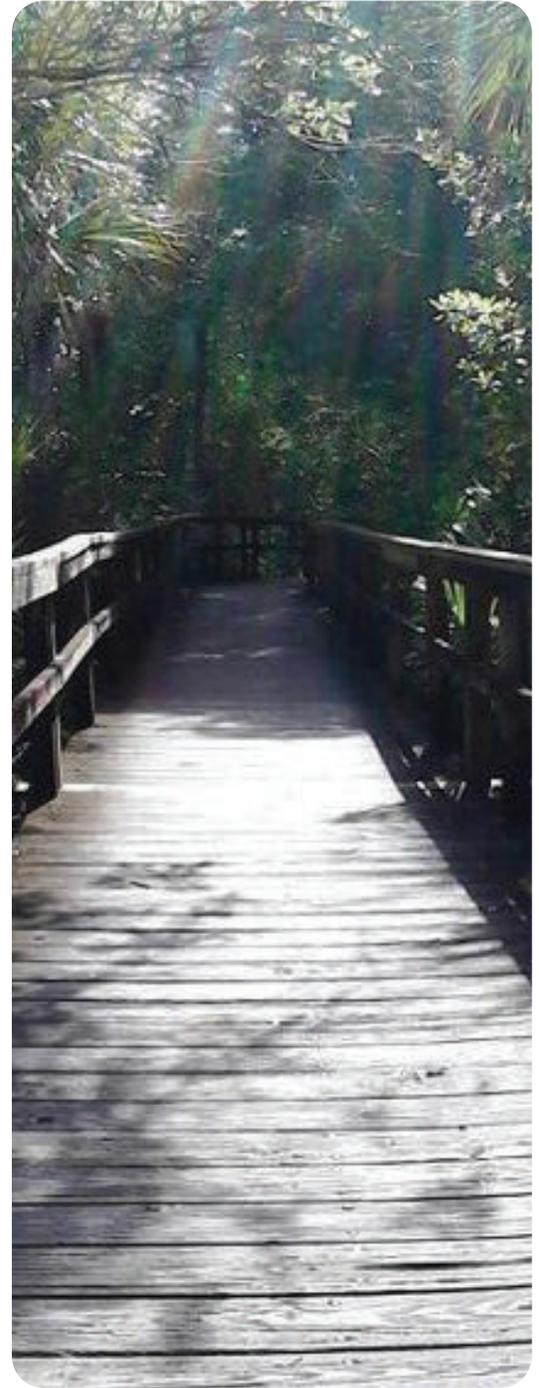
Site Analysis: As you walk along the boardwalk, you are entering the central slough, the deepest part of the Fakahatchee Strand. The bald cypress trees surrounding the boardwalk are hundreds of years old. The smaller pop ash and pond apple trees host epiphytic orchids, ferns and bromeliads in their multiple trunks. Pickerel weed and alligator flag plants thrive in the slowly moving water below the boardwalk. Forty interpretive signs provide information along the way.

Genesis of Project:

Project Background and History: The Big Cypress Bend Boardwalk area on the north side of Route 41 east of SR-29 still looks much as it did some 60 years ago when Lee-Tidewater Cypress Company was still logging the rest of the Fakahatchee.

Design Intent: The swamp and everglades are extremely dangerous to walk through when you can, but are mostly unstable vegetation and water. So the board walks were designed to allow people to have a safe easy walking path through the swamp in order to see its natural beauty while having a minimum footprint left by elevating the paths off of the ground.

Upkeep: The current boardwalk is maintained entirely through volunteer labor. Their work to keep up with the of weather and wear in the planks and pilings often goes unnoticed, but is critical to exposing visitors to the Fakahatchee Strand.



TITLE: THE BOARDWALKS OF YELLOWSTONE NATIONAL PARK

Location: Yellowstone National Park

Project Typology: ecological, conservation, recreational

Date Designed:

Construction Completed:

Size: 14 miles sq.

Client: Yellowstone National Park

Context: Yellowstone National Parks have boardwalks meandering throughout the park. The paths circle around the pools. With such a flat landscape and lack of vegetation able to grow around the pools the boardwalks become a feature of the site, helping to create the character of the park. The geology of Yellowstone is constantly changing requiring the boardwalks to move change or disappear with time.

Genesis of Project: The National Park isn't just out to protect the thermal features. They were trying to protect the fluctuating geology of the site allowing for the pools and features to move as they naturally would. The lack of permanence helps to keep this alive.

Project Background and History: "The National Park Service doesn't just protect the thermal features. If that were the case we'd be out there with epoxy and cement making sure Old Faithful wasn't going anywhere," Henry Heasler "We're here to protect Yellowstone's wonderfully



APPROACH TO RESEARCH

“ MY APPROACH TO THIS SITE WILL TAKE A MULTI MEDIA APPROACH, OBSERVING QUALITATIVE AND QUANTITATIVE DATA AND DISPLAYING IT THROUGH GALLERY AND GRAPHIC PORTRAYALS. RESEARCH WILL FOCUS ON THE ENVIRONMENT AND HOW THE ECOLOGICAL CYCLE OF AN ALPINE MEADOW PROGRESSES AND WHAT NATURAL AND ARTIFICIAL DISRUPTIONS CAN CHANGE IT. LOOKING AT THE DEMOGRAPHIC AND AMOUNT OF INDIVIDUALS WHO USE THE MEADOWS, AND WHAT RECREATIONAL ACTIVITIES WOULD BE MOST ENJOYED BY THE USER WHILE CAUSING THE LEAST AMOUNT OF IMPACT ON THE MEADOWS. COLLECTION OF THE DATA MAY BE FOUND THROUGH SCIENTIFIC ARTICLES, GIS, SURVEYS AND SPEAKING WITH PROFESSIONALS. THE RESEARCH APPROACH TO MY SITE WILL BE ANSWERING THESE IMPORTANT RESEARCH QUESTIONS. ”

INTRODUCTION TO RESEARCH

Ecology

1. What is the ecological cycle of an alpine meadow?
2. How are pines encroaching onto meadows?
3. What other systems do alpine meadows support?

Users

4. How many people are drawn to this area per day?
5. Where are users from?
6. What is the average age of a user?

Activities

7. What are the degree of effects from recreational activities?
 - Hiking
 - Fishing
 - Mountain Biking
 - Snowmobiling
 - Cross country skiing

Design

8. Do people prefer a small welcome center or larger learning center?
9. Do people prefer modern or rustic trail experiences?
10. What type of trail will keep people on the path?
11. What type of rest area is preferred. What distance of viewing area is desired from the road?
13. How wide should the trail be?

The data measures that will be used to answer each of these questions will be answered in the data measure section.

RESEARCH QUESTIONS |

- What is the major cause of alpine meadow decline due to humans?
- What is the ecology of a healthy meadow?
- How do you allow for safe human interaction with the meadows?
- What is the carrying capacity for a boardwalk?

RESEARCH HYPOTHESIS |

I expect that for an alpine meadow, the most efficient way to allow for human interaction while conserving the ecology of the area will be to design path systems that work with the psychology of an individual to create simulated boundaries and borders to keep individuals on the designated pathways and reducing impromptu paths.





KEYSTONE ECOLOGY

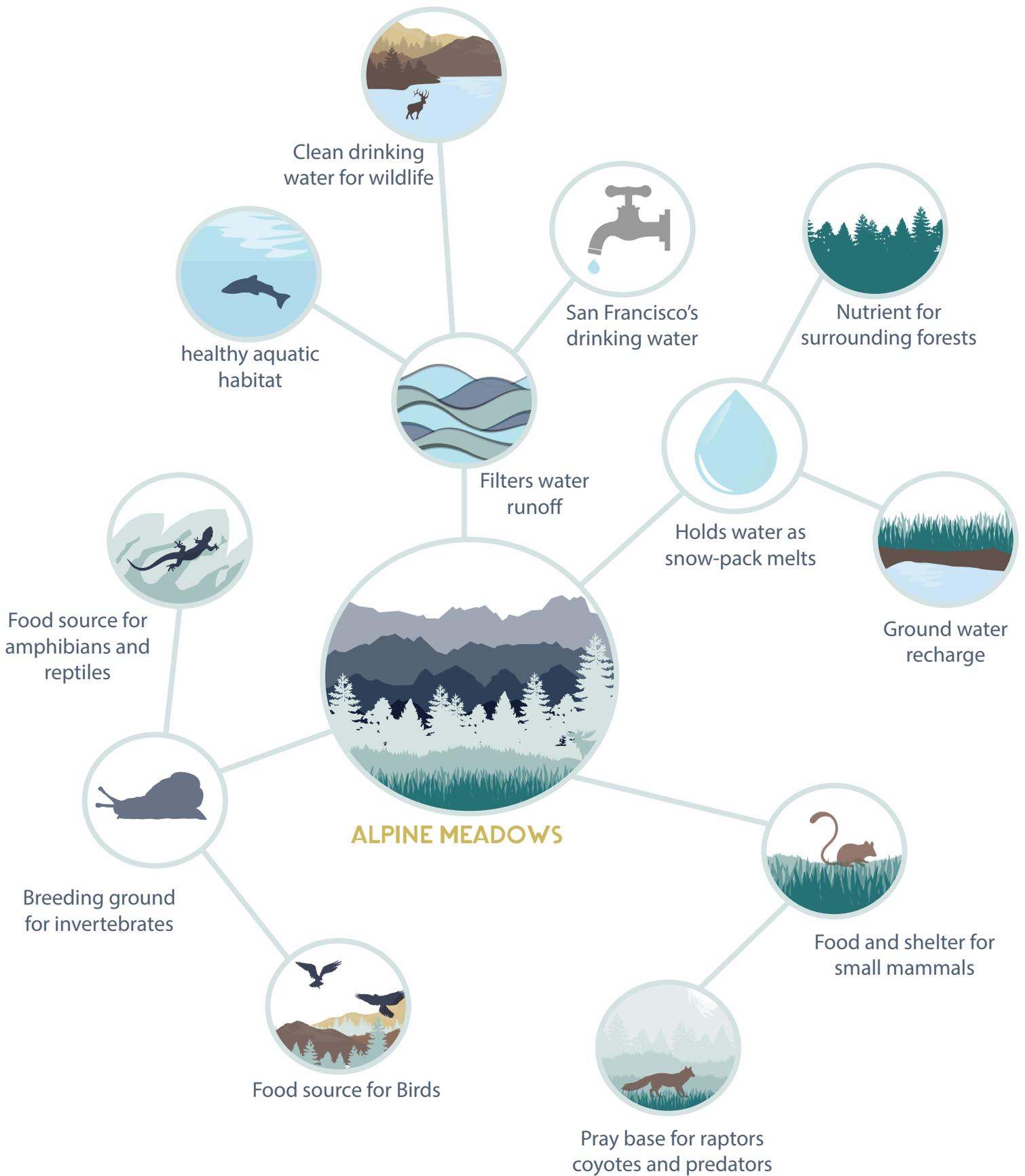


Alpine meadows are a keystone ecosystem for Yosemite National Park. Only three percent of the park is made up of meadows, but they support the health of the rest of the park. The meadows are sponges that hold water recharging ground water and supplying nutrient to the surrounding forests. Filtering the water runoff creating healthy aquatic habitat, cleaning drinking water for wildlife, and San Francisco with a majority of their drinking water. The water is so clean, that it is one of the few urban reservoirs in the United States to require only minimal water treatment. The meadows support many species that live exclusively there. Along with small mammals which create the prey base for larger predators and is a breeding ground for invertebrates which are a food source for birds, amphibians, and reptiles.



APPLICATION for the information within Tuolumne Meadows Project could be the education on how important these meadow ecosystems are. Education visitors on how much they effect the surroundings and how easily visitors can cause distress and damage to them may help keep users on paths and hold and appreciation for them that is not only based upon beauty.

Support web of alpine meadows





VEGETATION & NON-NATIVES



Sedge communities of *Carex senta* (rough sedge) and *Carex lanuginosa* (woolly sedge) were the most common plant communities across Yosemite Valley Meadows with the exception of El Capitan, Stoneman and Sentinel. Communities of the non-native grass *Poa pratensis* ssp. *pratensis* (Kentucky bluegrass) dominated El Capitan and Stoneman vegetation. Non-native species were common across all Yosemite Valley meadows.



Stoneman and El Capitan had the lowest percentage of wetland area, suggesting a connection between the amount of nonnative species currently within Yosemite Valley meadows and the extent of wetland in Yosemite Valley.



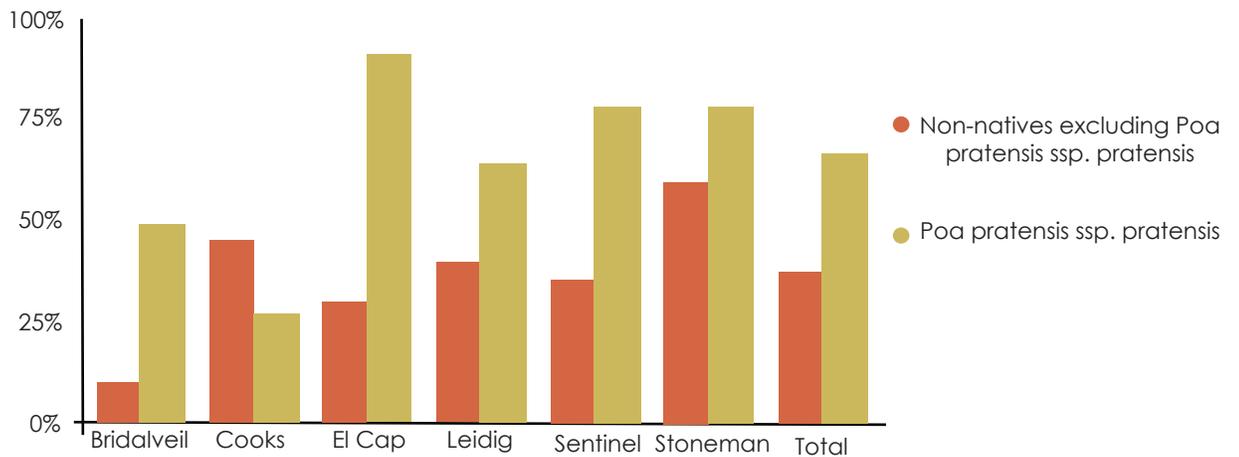
APPLICATION for the information within Tuolumne Meadows Project would be to conserve wetland areas by keeping recreation from happening that compresses and compacts the landscape also creating erosion This can cause the hydrology to change drying up the meadows. Reducing these effect will keep the wetlands saturated allowing native plants to have the edge over non-native species trying to invade the meadow.

**"2010 Assessment of Meadows in Merced River Corridor,
Yosemite National Parks"**

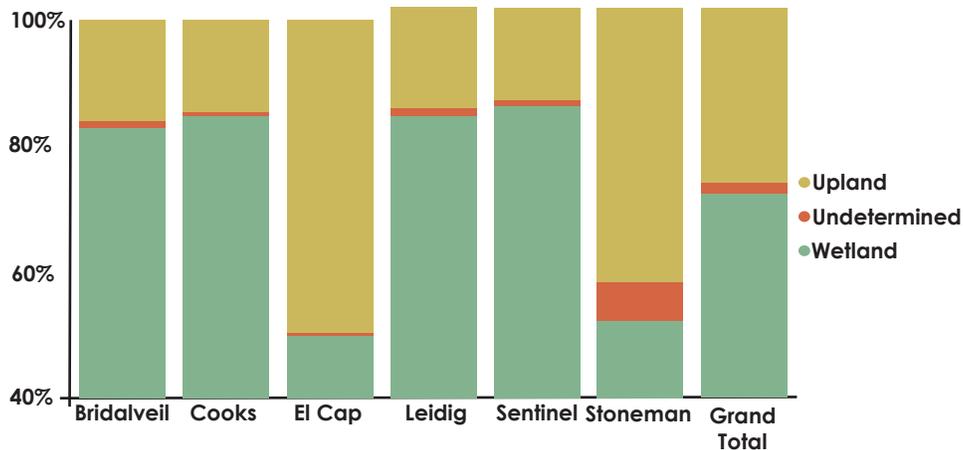
Percent of Plots with non-native plants present



Percent of Plots with non native species other than Poa Pratensis ssp. pratensis



Percent of Plots classified as Wetland or Upland





BARE GROUND & TRAILS



Not surprisingly, bare ground from informal trails was highest in El Capitan, Sentinel and Bridalveil that had 15-19% of plots with informal trails. Stoneman and Cook's had the lowest extent of informal trails, likely due to the presence of elevated boardwalks that concentrate visitor foot traffic, discouraging visitors from venturing cross country through the meadows and mitigating trampling effects.

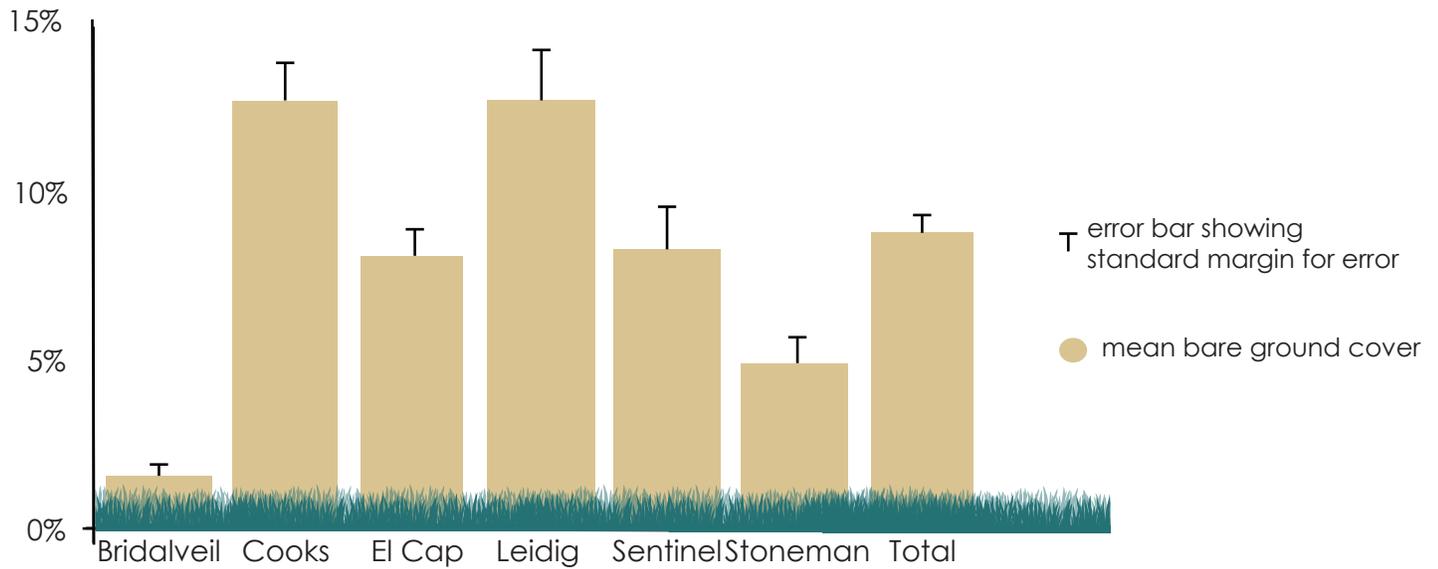


The valley streams are in overall good health, but there are some recreational impacts of potential concern. Such as bank alteration and heavily eroded stream crossings were severe in localized areas where humans created social trails.



APPLICATION for the information within Tuolumne Meadows Conservation Project would be to reduce the amount of bare ground due to humans within Tuolumne meadow. This would be trying to reduce the informal trails, footprints, and erosion. The meadows in the valley that incorporated boardwalks within the area reduced all three of these. So designing boardwalks within areas that are prone to of trail habits such as trail heads, paths through Tuolumne meadow, and spots along Tioga road with heavy stopping to get out and sight see.

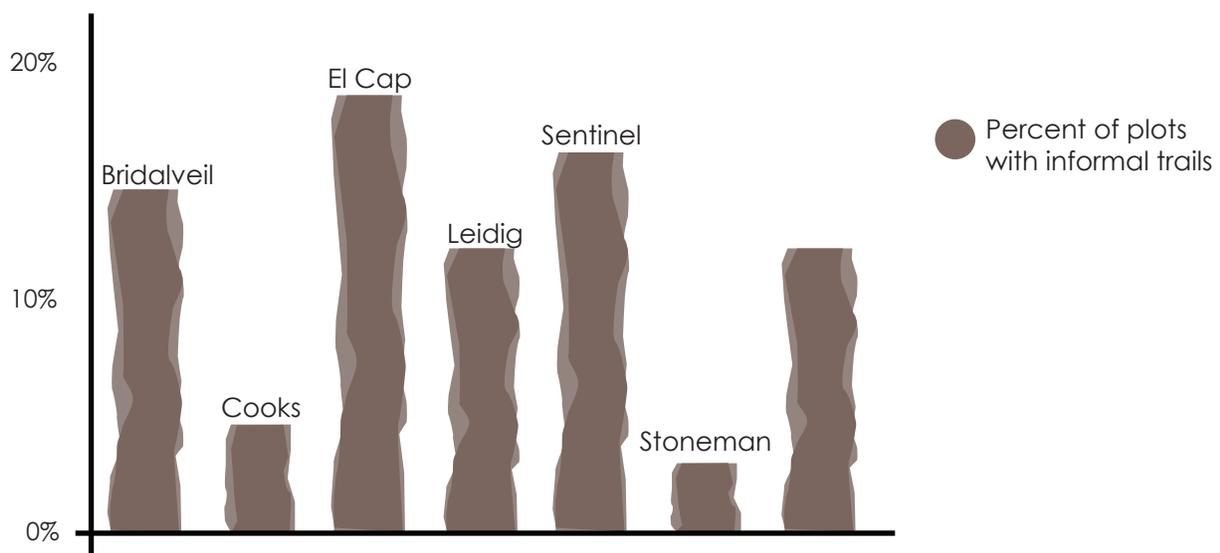
Mean percent of bare ground in Yosemite Merced River Corridor meadows



Bare ground types in Yosemite valley

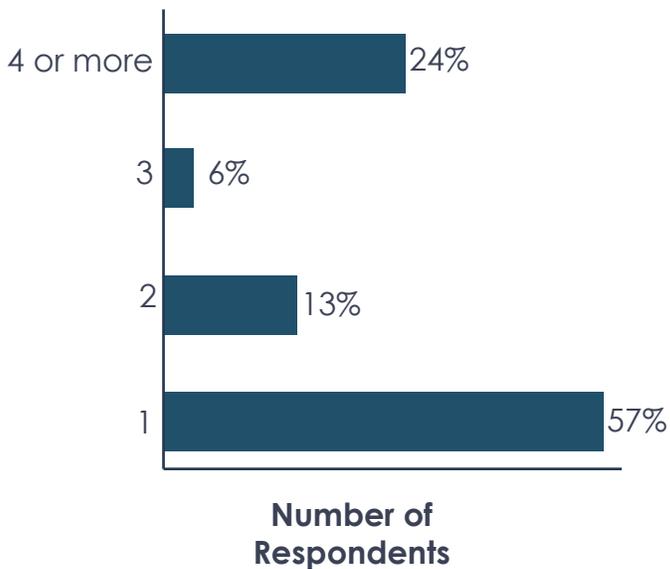
	Bridalveil	Cooks	El Captain	Leidig	Sentinel	Stoneman	Total
Undisturbed	56%	69%	77%	65%	78%	80%	72%
compacted soil		1%	1%	3%	1%		1%
deer prints			1%	2%		2%	1%
erosion			1%	3%	10%		2%
footprints		1%	2%	1%			1%
other		2%	2%	1%	1%	1%	1%
sediment deposition			2%	2%	4%		2%
small mammals	4%	6%	66%	26%	14%	37%	29%
informal trails	7%	1%	14%	6%	8%	1%	7%

Proportion of plots with informal trails within Yosemite meadows



USERS

Number of visits in Lifetime



The average person using the park is there for the first time and may need to know basic information and warnings. This may be the only time they visit. So giving them as much of a full experience as possible within a small area such as the visitor center would enrich their experience.



The next percent of people visiting are from the area and repeat visitors. So creating areas and education that are still exciting and desired to be experienced more than once.

Age

<15 YEARS

19% of visitors

41-60 YEARS

37% of visitors

>66 YEARS

7% of visitors

From where

United States

75%

California

62%

International

25%

Amount of Visitors



Park visitors:	4,029,416 (2014)	3,829,361 (2013)	3,996,017 (2012)
Overnight Hikers:	56,308 (2014)	50,274 (2013)	53,679 (2012).
Overnight stays:	175,095 (2014)	156,347 (2013)	152,505 (2012)

Frequency of visits



20% of respondents had visited Yosemite National Park at least twice in the past 12 months.



26% of respondents were visiting Yosemite National Park for the first time.

The size of group



35% of visitors were in groups of 2.



31% of visitors were in groups of 3-4.



69% of visitors came in groups with children.

Group Expenditure



The median group expenditure in the park and the surrounding 50-mile area was **\$490**.

Types of Activities



41%

Viewing
Scenery



27%

Day Hike



11%

Scenic Drive



5%

Camping



3%

Overnight
Hike



1%

Stay in
Lodge

Visitor Center



only 45% of
visitors said
indoor exhibits
were
important.



62% of visitors
said **outdoor**
exhibits were
the most
important.

RECREATION



SITE VALUES:

Natural meadow
River running through
Populated area

PLAN FOR PROCEEDING:

To proceed with this project I will be using case studies, research information, and looking at what the users desire, along with listening to input from Yosemite Park.

DESIGN GOALS :

CREATE PSYCHOLOGICAL EDGES TO TRAILS TO ELIMINATE SOCIAL PATHS
REDUCE EROSION ALONG SIDE OF ROAD AND RIVER
EDUCATE VISITORS ON THE IMPORTANCE OF ALPINE MEADOWS AND ALL OF THEIR USES
REDUCE HYDROLOGY IMPACT

PROGRAM ELEMENTS

- Outdoor educational exhibits (ecology)
(hydrology)
- interpretive signs
- trail head boarders
- vista pull over and look outs
- reestablished vegetation in eroded areas

CLIENT : Yosemite National Park will be the main client for the Tuolumne Meadows project. That means that this would be a government run operation. Yosemite Park would be the ones using the conservation of the meadows for research and would allow the park to thrive while still allowing for visitors to enjoy and learn.

USERS : The design for Tuolumne meadows will have to take into consideration two clients.

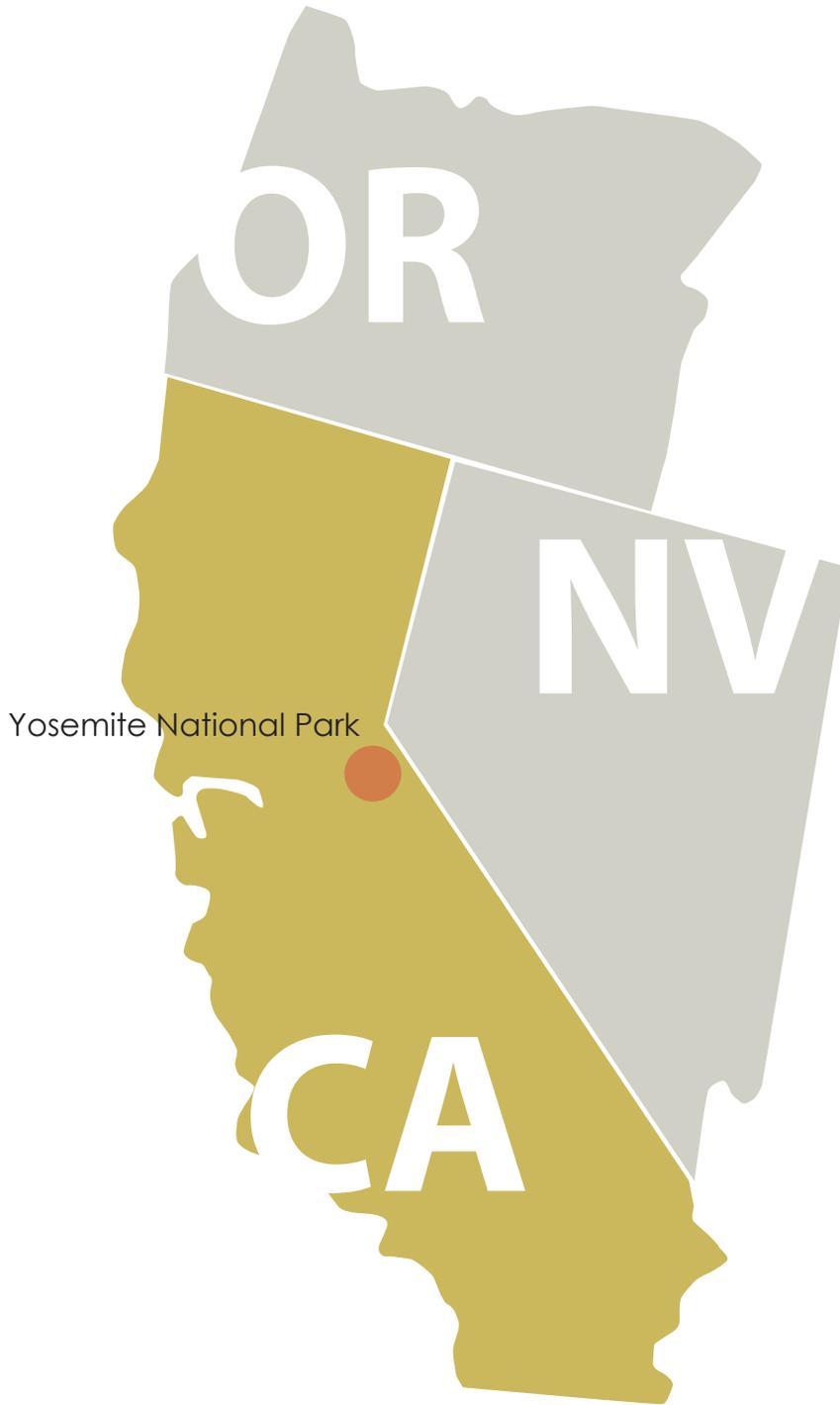
(1) THE VISITORS TO THE PARK (2) THE MEADOW ITSELF

The Visitors of the park would be the people who benefit most from the project. It will allow them to come and visit, interact and learn from the meadows while still keeping the meadow healthy as time goes by so that they can come and visit the meadow again and have it just as beautiful and lush as it was before without the erosion and compaction of over use.

The meadow would benefit from the design protecting and conserving it from compaction, and social trails. This project will take off at-least one pressure on the meadows lowering the disturbance of humans on the landscape.



Visitors Center in Tuolumne Meadows
photo from Yosemite National Park



YOSEMITE NATIONAL PARK



TUOLUMNE MEADOW



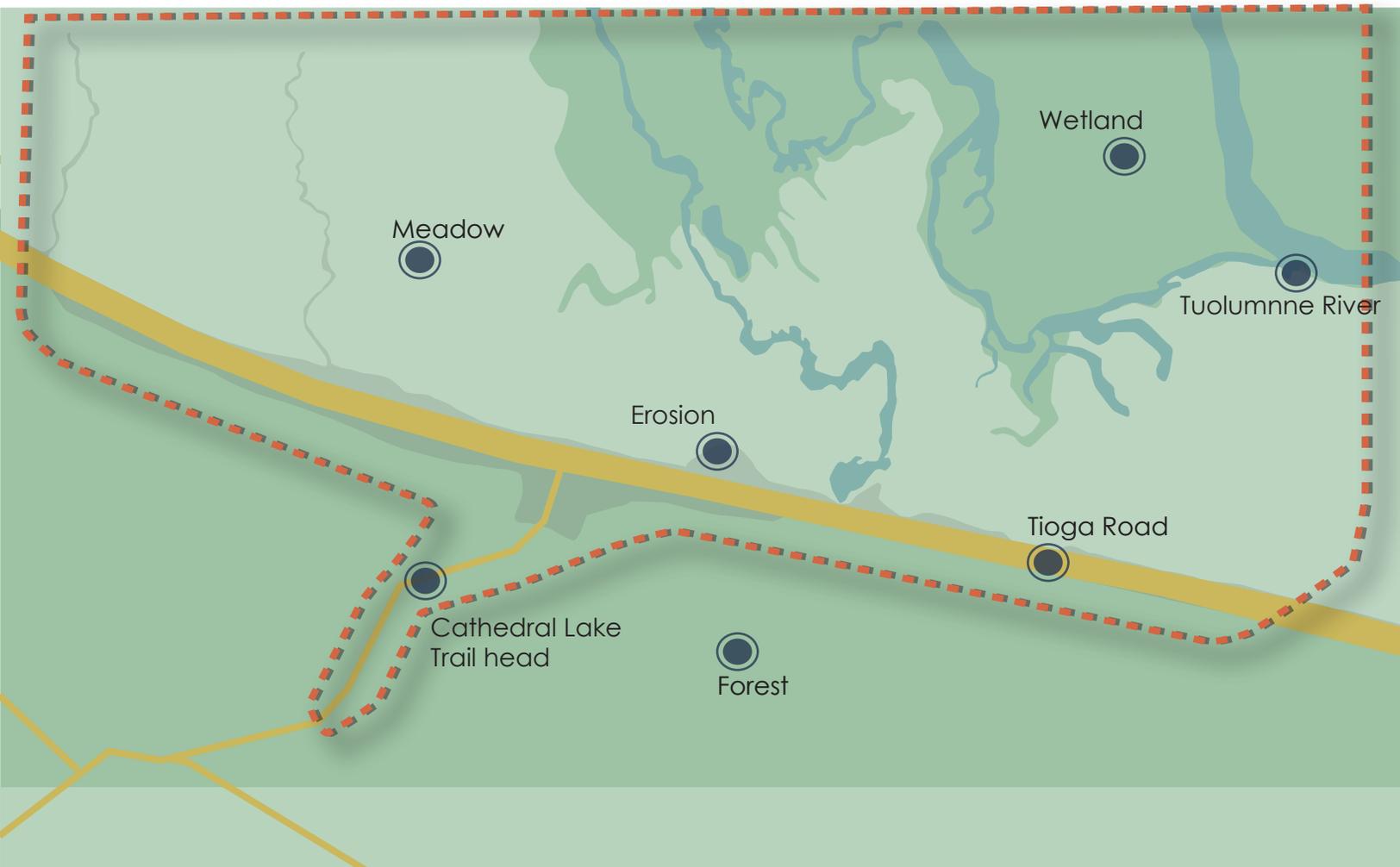
TUOLUMNE MEADOW SITE

Strengths

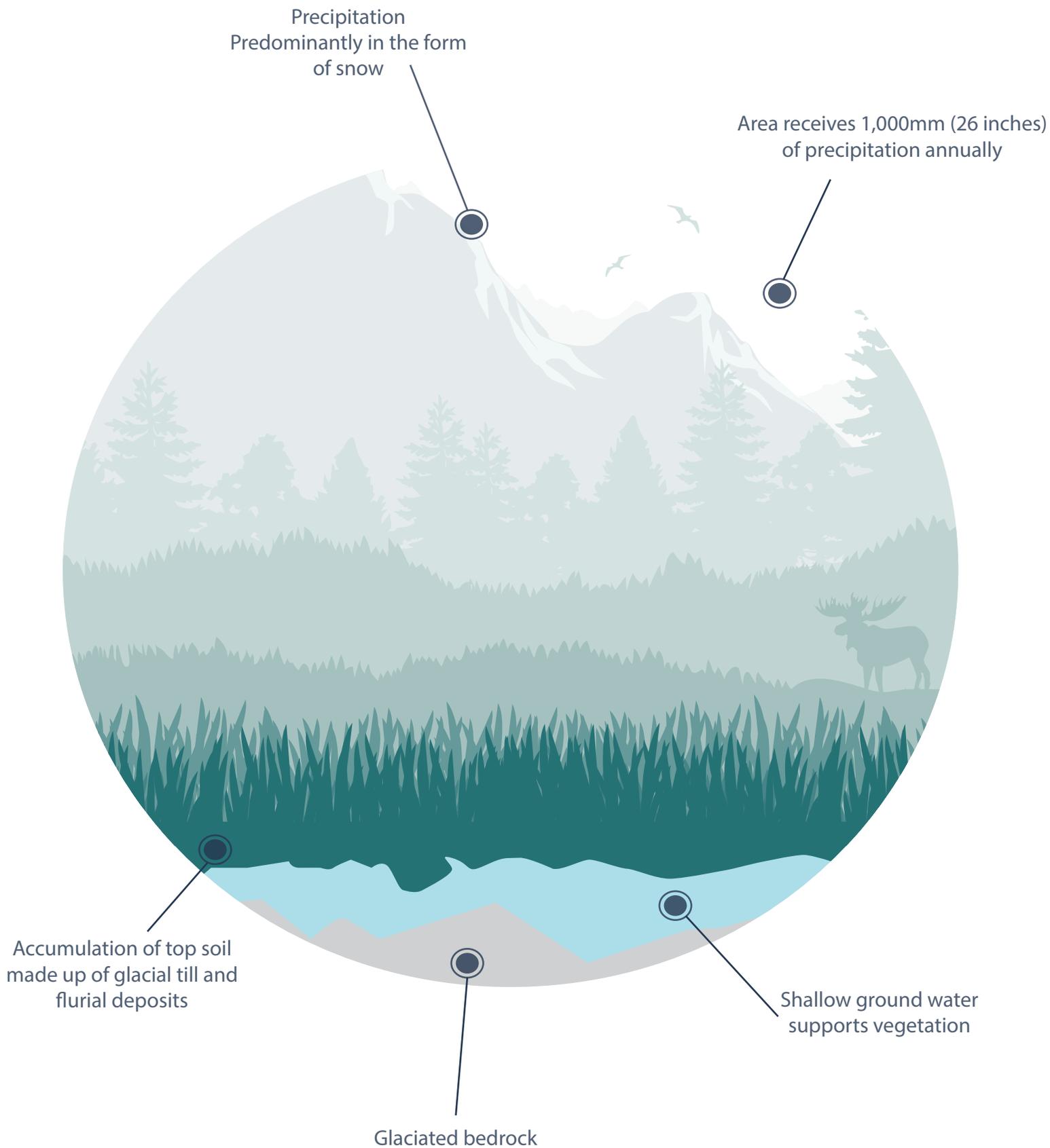
- This site has an existing beautiful view
- The road allows for easy access
- Tuolumne River runs right through the site up to the road
- Tioga road is narrow allowing plenty of vehicles while still keeping speeds low
- The other side of the meadows is a trail head

Weaknesses

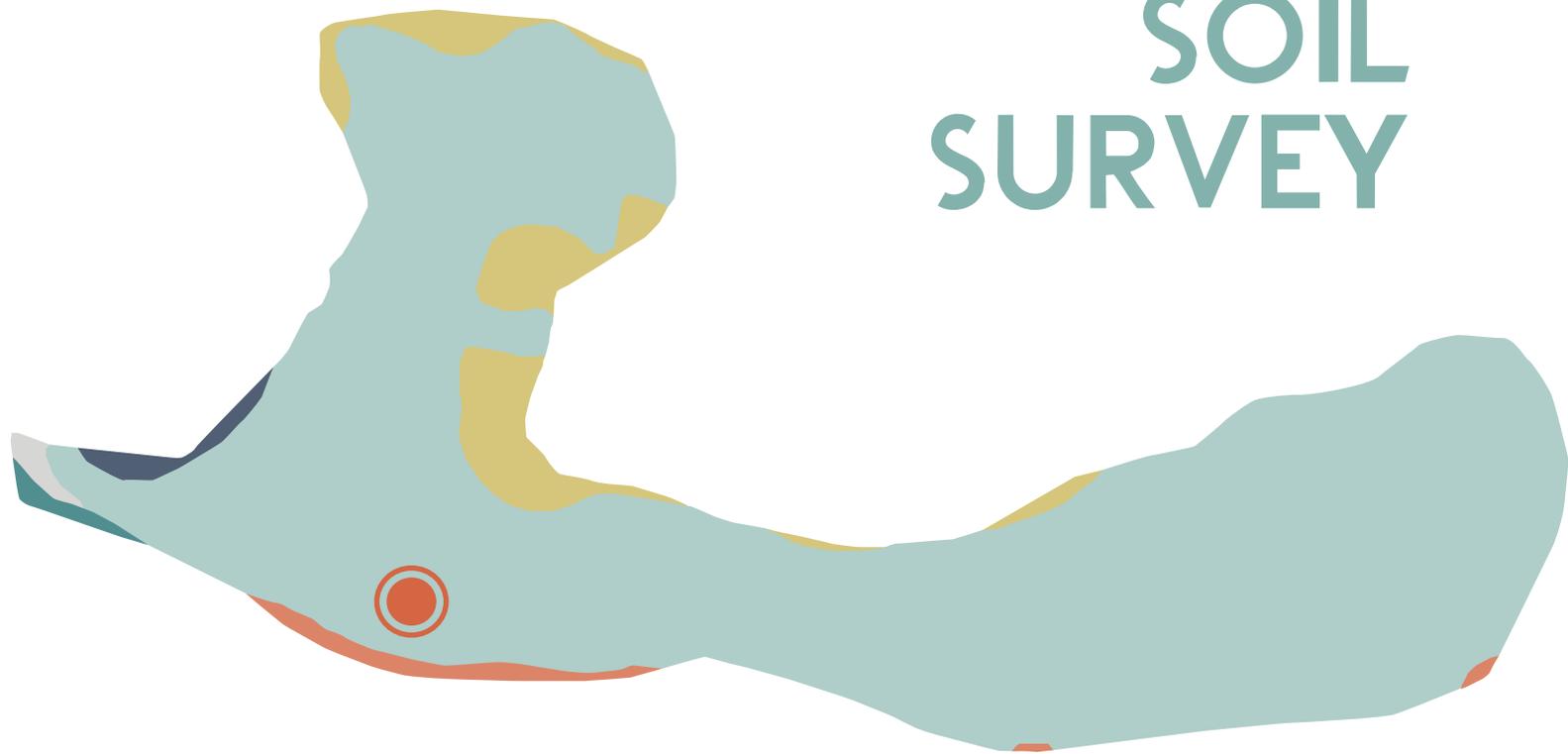
- There is already a built visitors center half mile away.
- The meadow has quite a bit of development
- National Parks tend to have natural simplistic elements creating difficulty for creative design
- Tioga Road is not open all year round due to weather



NATURAL EXISTING



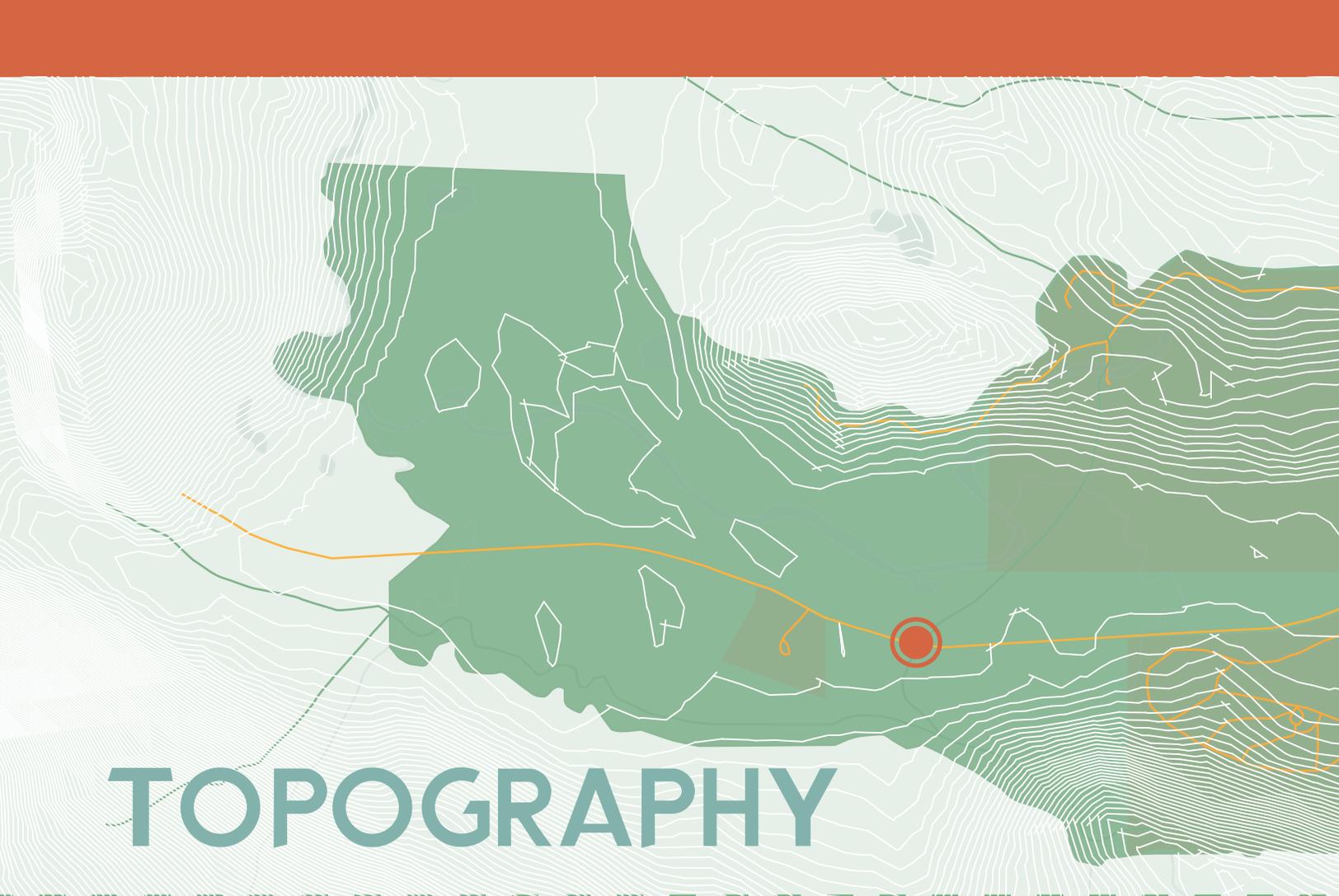
SOIL SURVEY



 Site

Map Unit Name **Acres** **Percent**

	Marmotland-Oxyaquic Dystrocryepts-Xeric Dystrocryepts complex, 0 to 15 percent slopes, mountain valley floors, cryic	526.9	90.3%
	Rock outcrops-Crasymule Vitrandic Cryorthents association 0 to 45 percent slopes, joints, fractures, scoured, cryic	40.6	7.0%
	Canisrocks - Glacierpoint complex, 0 to 25 percent slopes, lateral moraines, cryic	6.2	1.1%
	Rock outcrop, domes, cryic	4.6	0.8%
	Canisricjs-xeruc Dystrocryepts association, 5 to 30 percent slopes, mountain valleys, moraines, cryic	2.4	0.4%
	Canisrocks-Glacierpoint-Humic Dystrocryepts complex, 15 to 55 percent slopes, lateral moraines, cryic	2.7	0.5%

A topographic map of Tuolumne Meadows in Yosemite National Park. The map features white contour lines on a light green background, with a darker green area representing the meadow. A red circle highlights a specific location on the map. The word "TOPOGRAPHY" is written in large, bold, teal letters at the bottom of the map area.

TOPOGRAPHY

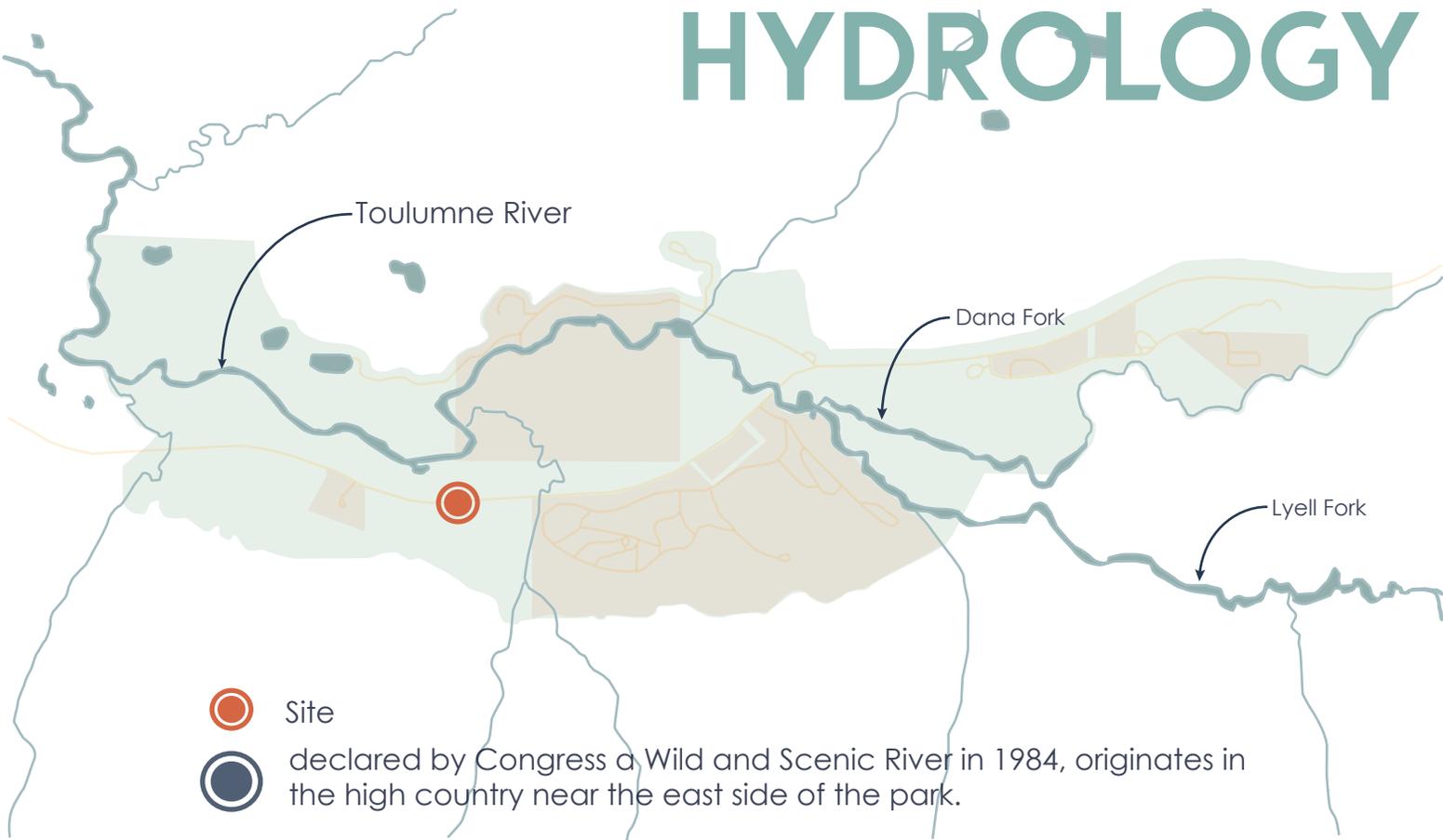


Tuolumne meadows 8,575 feet

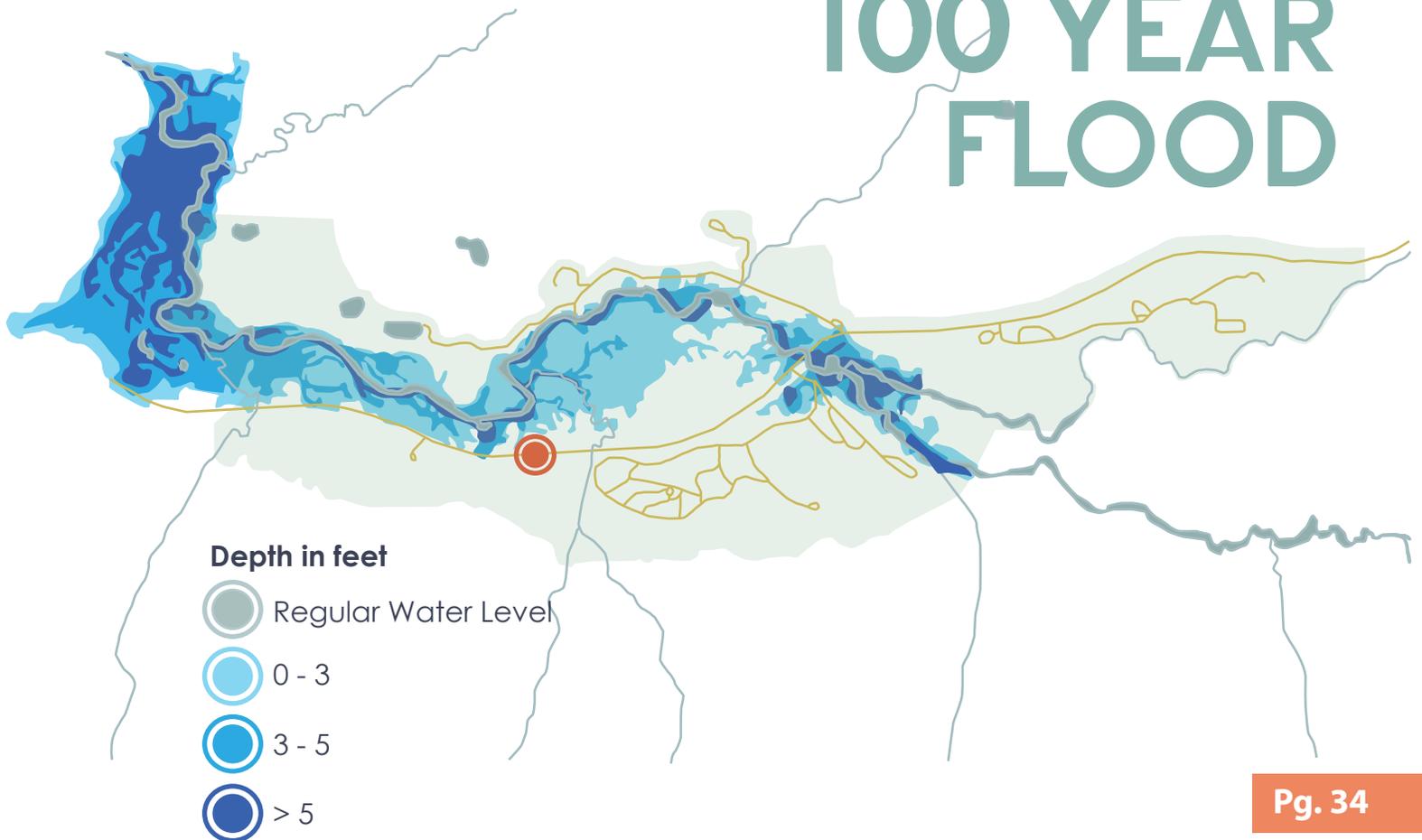


The overall landforms of the meadow is composed of a long and narrow U-Shaped valley which runs in an east-west direction. It is approximately a half-mile wide and two miles long. The smooth valley is bounded on the north and south sides by the undulating slopes of surrounding mountain peaks while the east and west sides are delineated by weathered granite domes. This dramatic landform provides the setting for a series of impressive views, highlighted by the long, grassy valley floor and the surrounding mountain peaks. (Scenic Analysis of Tuolumne Meadows Yosemite National Park, Steven Torgerson)

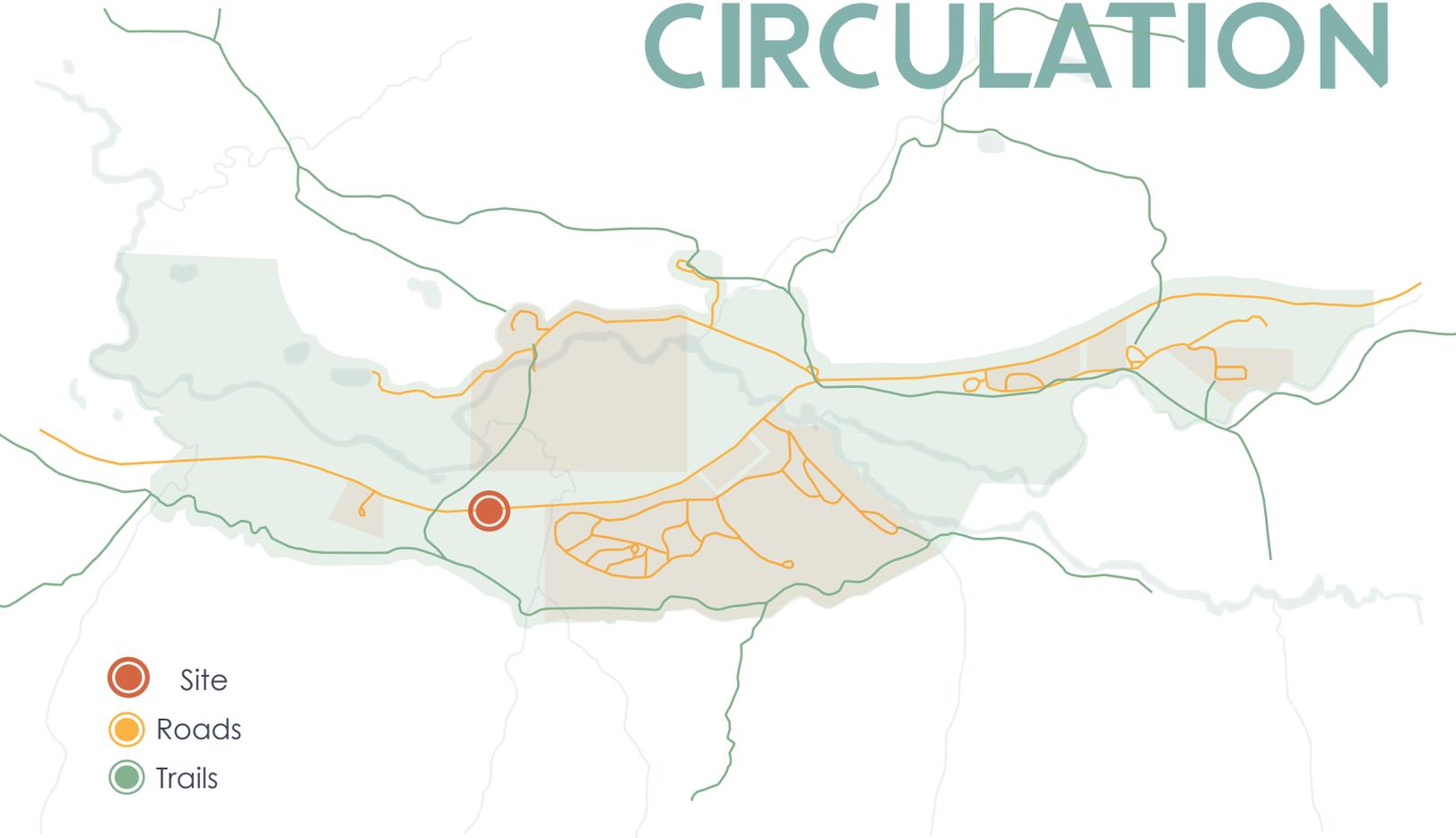
HYDROLOGY



100 YEAR FLOOD



CIRCULATION



- Site
- Roads
- Trails

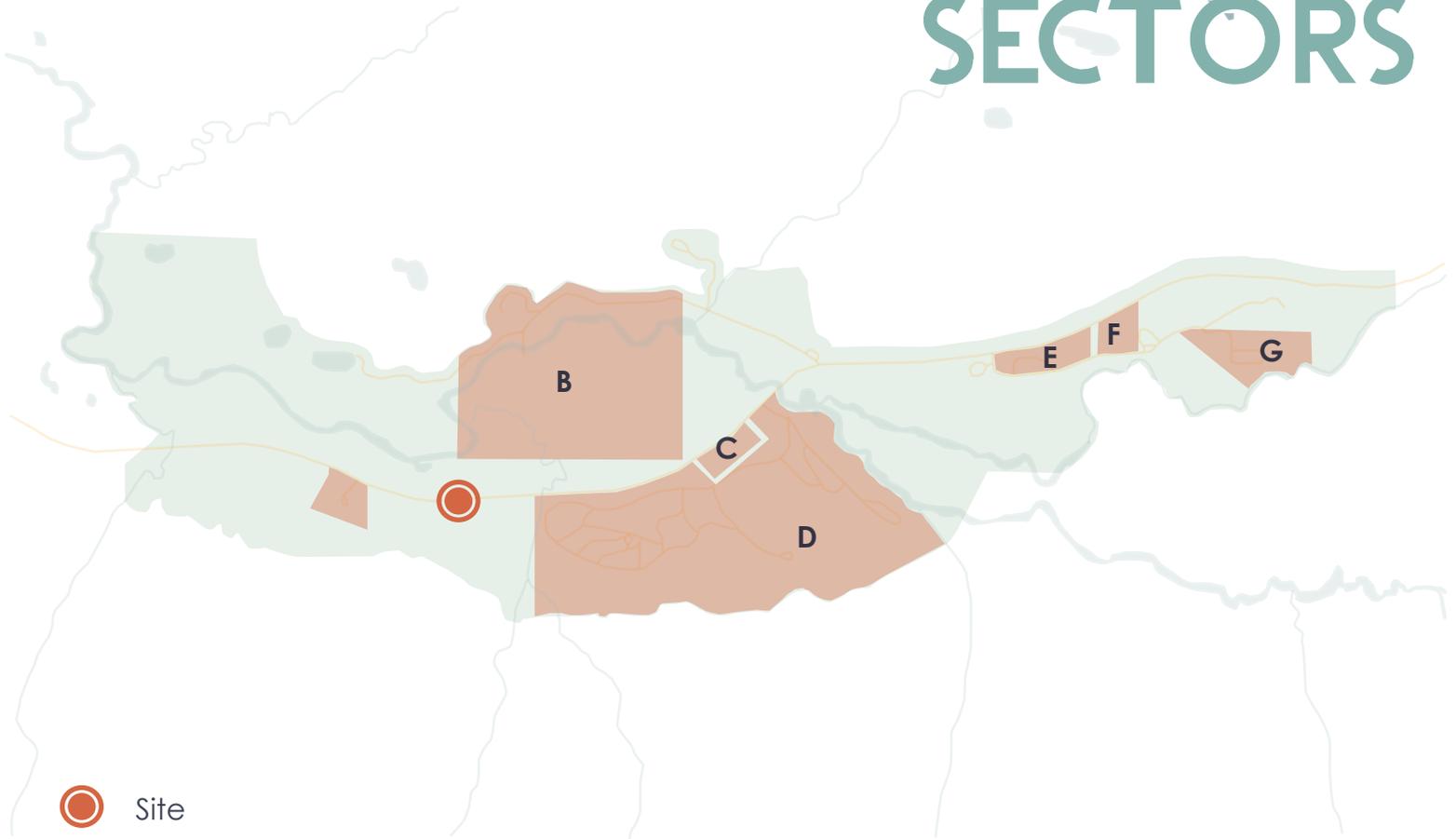


Tioga Road, a 39-mile (62 km) drive from Crane Flat to Tioga Pass. **Tioga Road is closed December through May.**



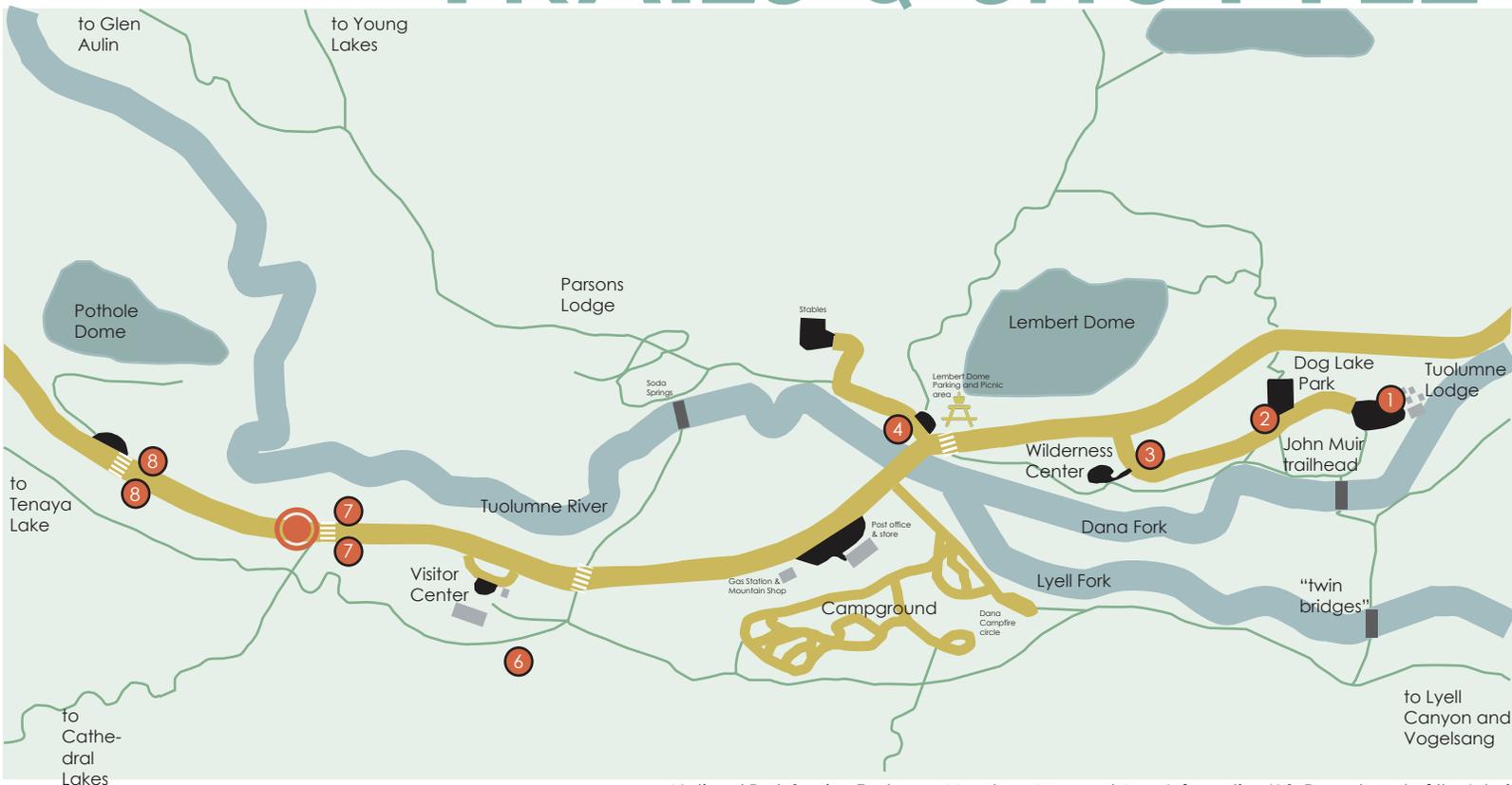
Tioga Road and the old Great Sierra Wagon Road are the most dominant cultural features in the Tuolumne landscape. These circulation features can be seen within the foreground, middleground and background of views and they create artificial edges that may detract from the natural view-shed. Their color and texture is different from the surrounding landscape and their existence may alter the meadow's natural vegetation patterns.

SECTORS



- A** Road Crew Camp
- B** Soda Springs Historic District
- C** Tuolumne Meadows Store and Gas Station
- D** Tuolumne Meadows Campground
- E** Administrative area (Rangers Quaters)
- F** Insect Research Station
- G** Tuolumne Meadows High Sierra Camp

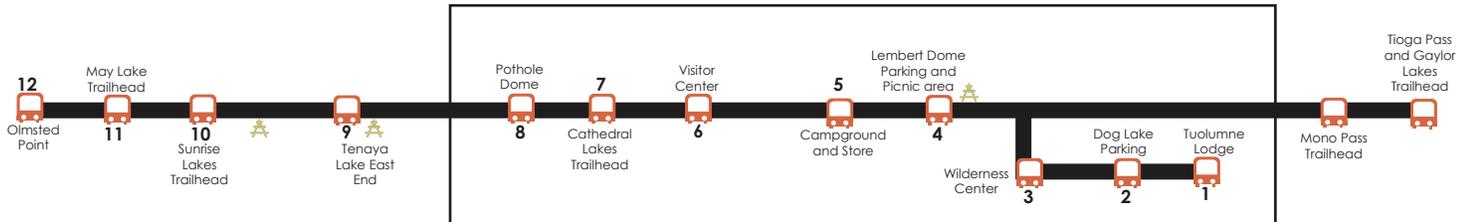
TRAILS & SHUTTLE



National Park Service Tuolumne Meadows Map and Area Information U.S. Department of the Interior



Tuolumne Meadows shuttle bus along Tioga Road



Tuolumne Meadows Lodge: 69 units



Soda Springs/Parsons Memorial Lodge
1.5 miles (2.4 km) RT*
1 hour



Lyell Canyon via the John Muir Trail
8 miles (12.8 km)
200-ft. elevation gain



Dog Lake or Lembert Dome
2.8 miles (4.5 km) RT*
3 hours, 600-ft. elevation gain to Dog Lake or 850-ft. to Lembert Dome



Elizabeth Lake
4.8 miles (7.7 km) RT*
4 - 5 hours 1,000-ft. elevation gain



Cathedral Lakes
7 miles (11.3 km) RT*
4 - 6 hours 1,000-ft. elevation gain



Glen Aulin
11 miles (17.7 km) RT*
6 - 8 hours, 800-ft. elevation gain on return



Mono Pass
8 miles (12.9 km) RT*
4 - 6 hours 1,000-ft. elevation gain



Gaylor Lakes
2 miles (3.2 km) RT*
2 hours 500-ft. elevation gain



Vogelsang Area
13.8 miles (22.2 km) RT*
6 - 8 hours 1,360-ft. elevation gain

ACTIVITIES



- Site
- Scenic Tioga Road for Auto Tours

- Hiking difficulty varies from easy to strenuous
- Fishing Tuolumne River is open Last Saturday in April through November
- Birdwatching
- Biking on paved trails
- Backpacking trailheads
- Auto tour on Tioga road
- Art and photography classes (\$10 per student/day) are offered spring through fall
- horseback riding - except
Gaylor Lakes Basin above Lower Gaylor Lake
The Muir Gorge Trail segment from Return Creek to Pate Valley in the Grand Canyon of the Tuolumne

WILDLIFE IN THE MEADOWS



Steller's Jay



Mountain lion



Black bear



Coyote



Elk



Mule deer



Pocket Gopher



Black Bears



Mule Deer - also one of the easiest mammals to find



Coyotes



Bobcats



California Ground Squirrel - most prolific squirrel



Western Grey Squirrel



Mountain Lions - rarely seen by humans, but they help control the deer and raccoon populations



Marmots



Pocket Gopher



Elk



The most regularly seen resident birds include Steller's jay, American robin, acorn woodpecker, common raven, and mountain chickadee. In spring, you can see red-winged blackbird (most often seen in wet meadows) or the tropical looking western tanager foraging in the conifers. American dipper can be found near streams.



Some of the more sought-after birds to see in Yosemite include the great gray owl, spotted owl, peregrine falcon, pileated woodpecker, and northern goshawk.

VEGETATION



 Lodgepole pines

 Sub alpine meadow

 Mule deer

 The vegetation pattern in the area is a sub alpine meadow with upland lodgepole pines

 Three mammals appear to be the principal herbivores of meadow vegetation in recent decades, pocket gophers (*Thomomys cf. monticola*), voles (*Microtus montanus*) and mule deer (*Odocoileus hemionus*).

In a recent vegetation analysis, six plant communities were identified in the Tuolumne Meadows



Areas with seasonal flooding and deep-standing water support the **inflated sedge-Sierra willow** (*Carex vesicaria*-*Salix eastwoodiae*) community.

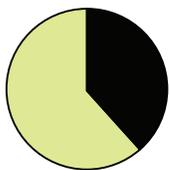
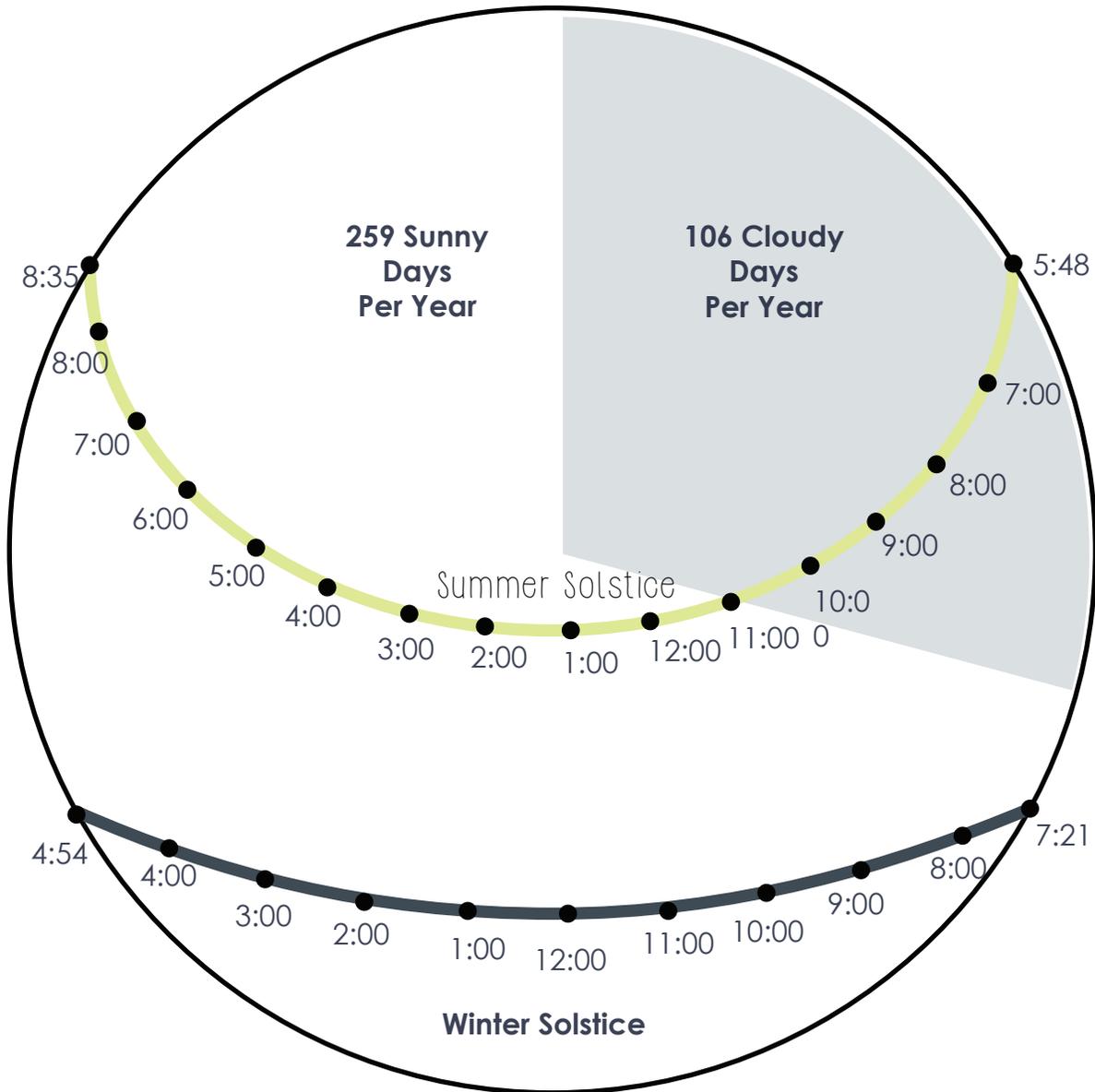


The main herbaceous wet-meadow communities are **alpine aster-nearly-black sedge** (*Aster alpigenus*-*Carex subnigricans*), **King's ricegrass-western bistort** (*Ptilagrostis kingii*-*Polygonum bistortoides*), and **Brewer's reed grass-dwarf bilberry** (*Calamagrostis breweri*-*Vaccinium caespitosum*) communities.

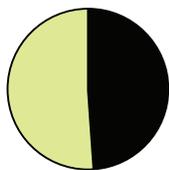


Finally, found in drier uplands within or on the edge of the meadow are the **thread-leaved sedge-meadow pussy-toes** (*Carex filifolia*-*Antennaria corymbosa*) and **Sierra lodgepole pine-Ross sedge** (*Pinus contorta*-*Carex rossii*) communities.

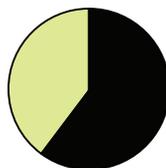
SOLSTICE



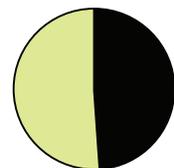
Summer Solstice



Fall Equinox



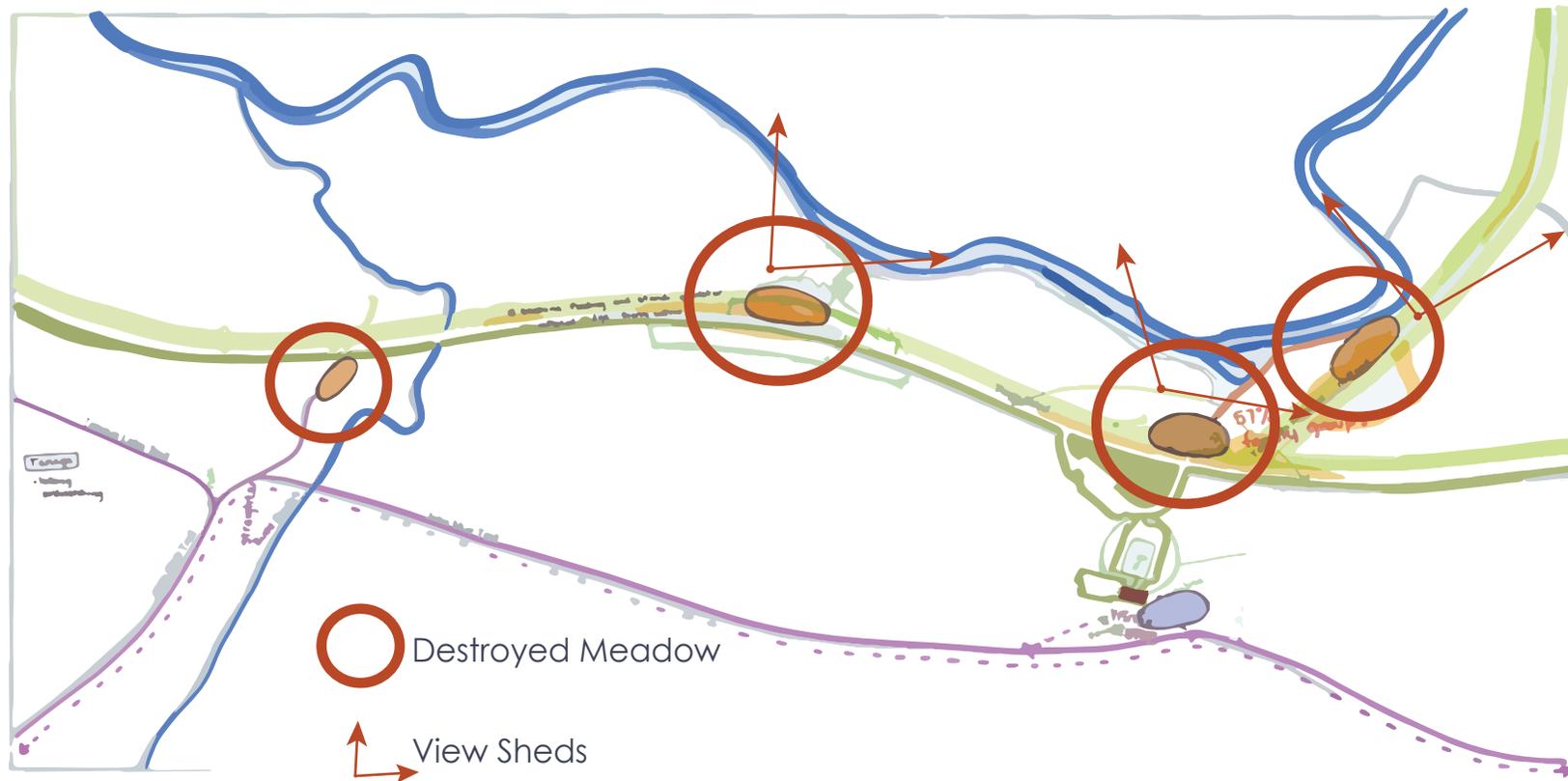
Winter Solstice



Spring Equinox

ANALYSIS



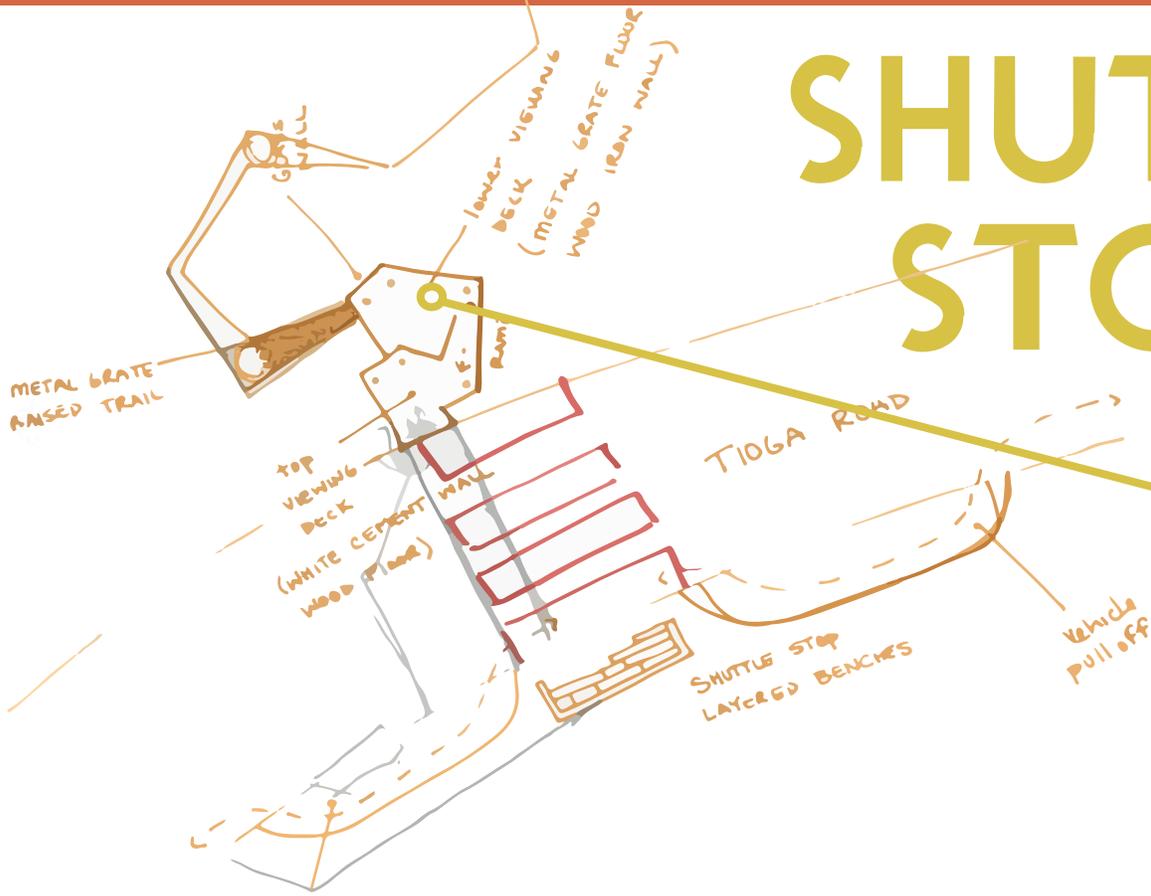


Areas where the meadow has been the most destroyed also correlate with areas containing the best view sheds.

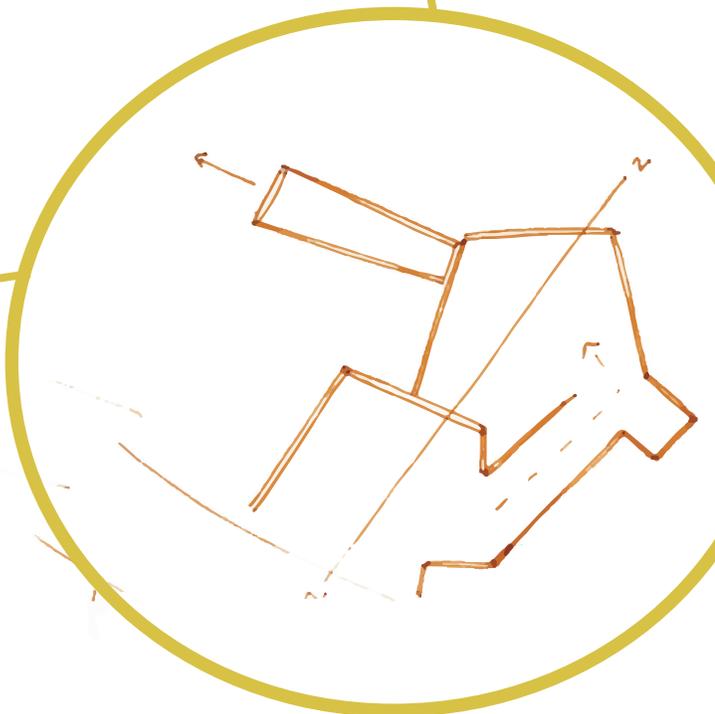
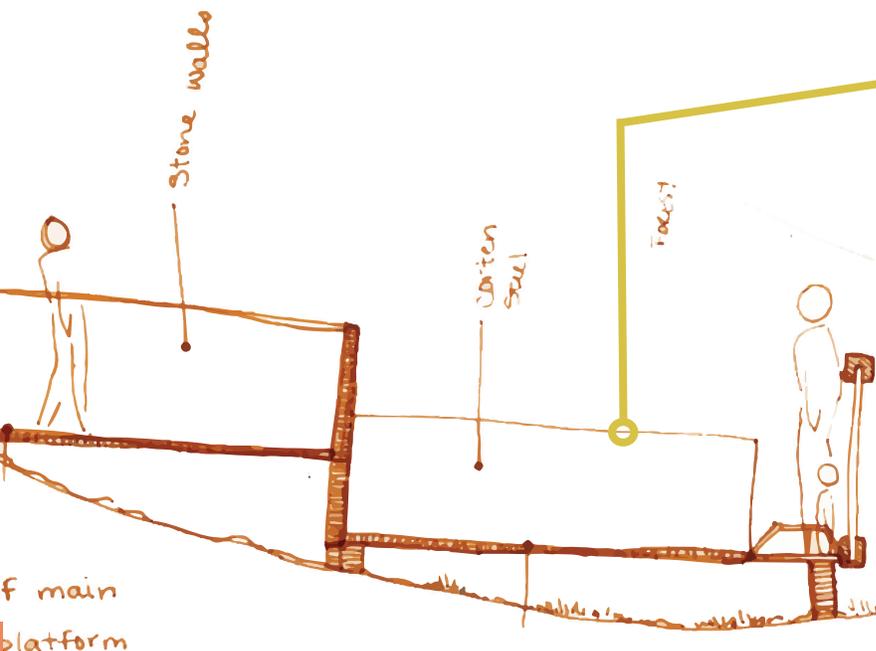


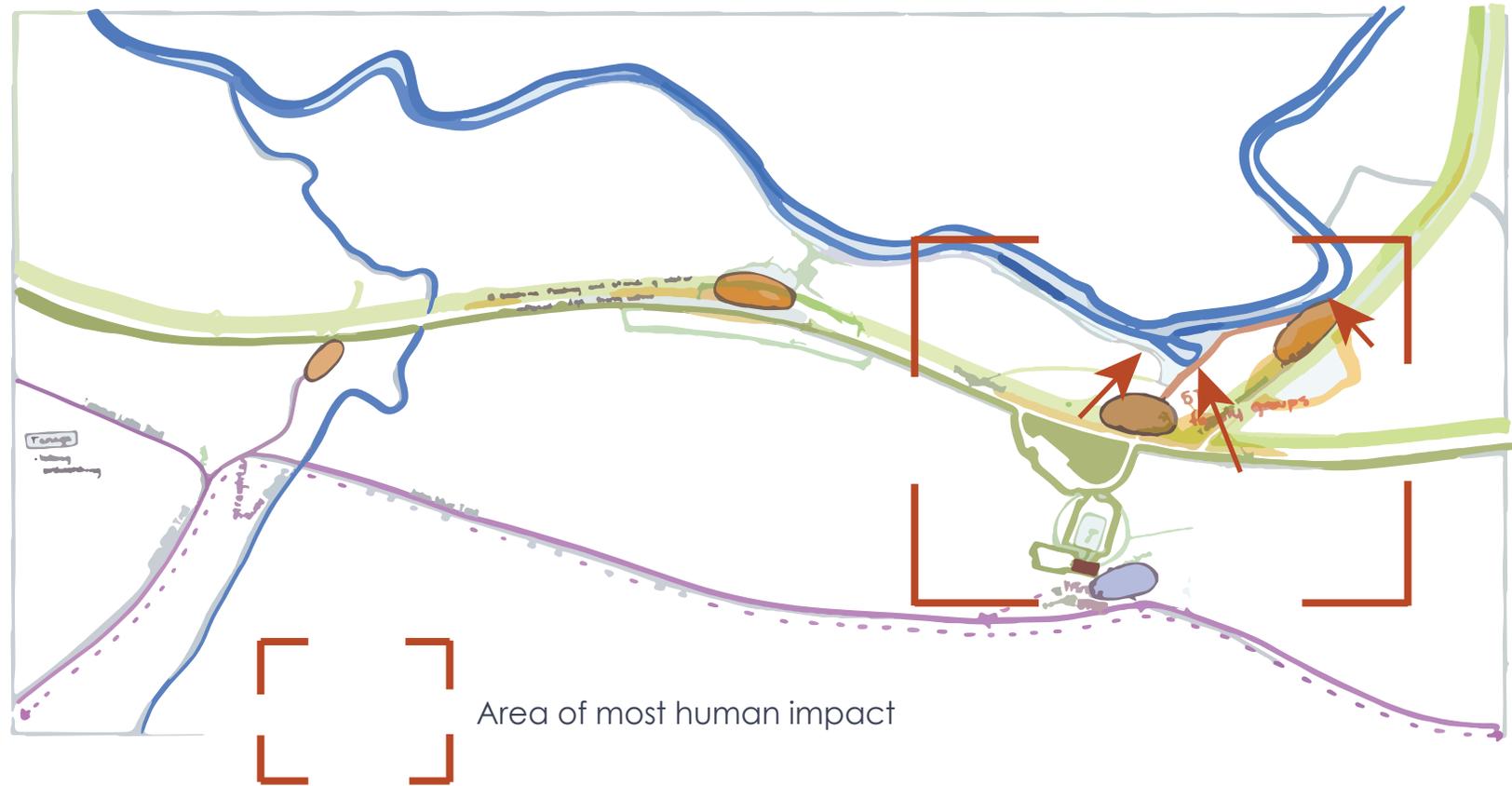
VIEW SHEDS AND DESTROYED MEADOW

SHUTTLE STOPS



Creating specific areas to stop and park at with places to view will help minimize visitors walking onto the meadow.

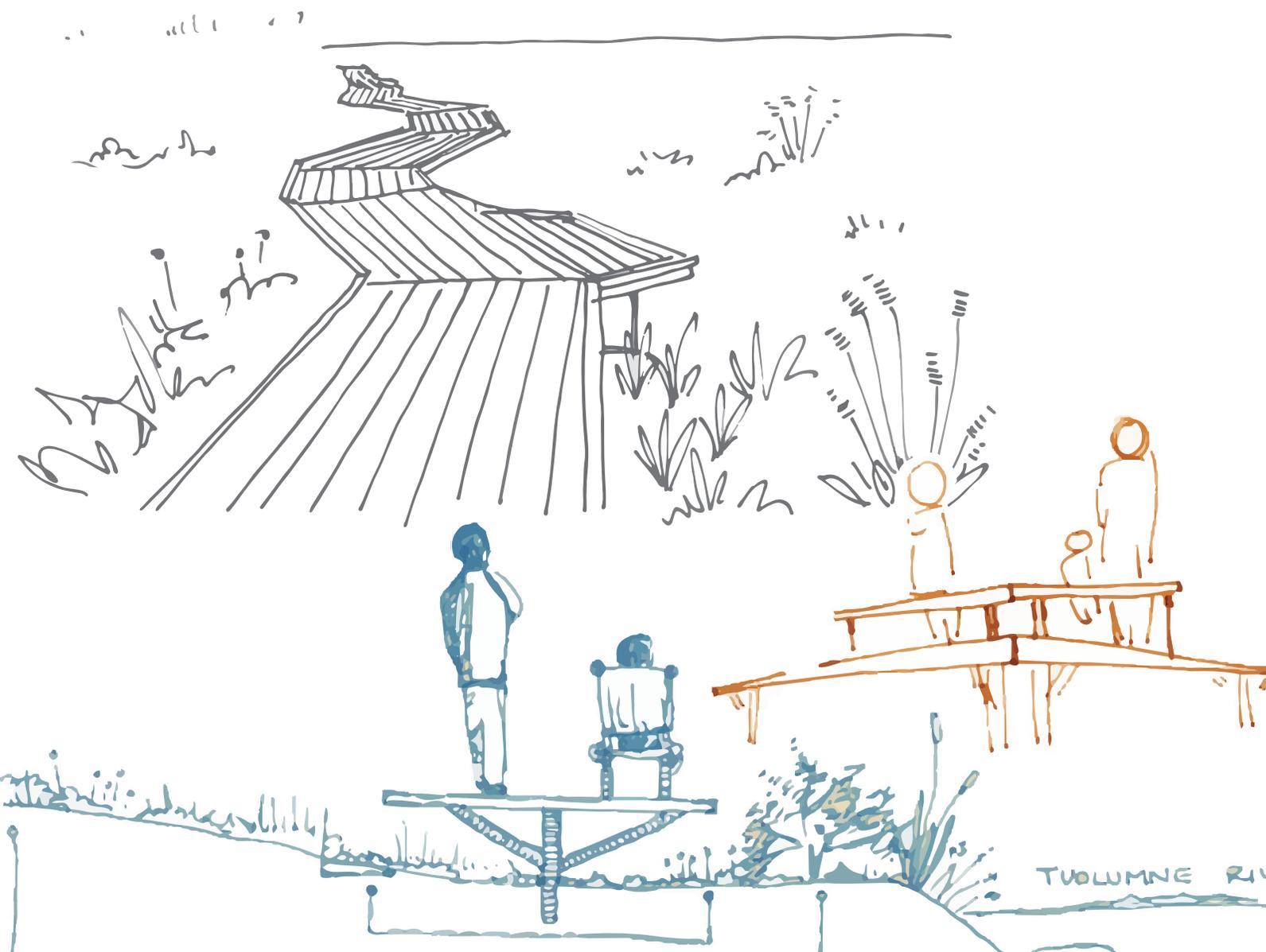




People are wanting to interact with the environment getting closer to it. Areas where the most destruction happened are places the river comes closest to the paths.



INTERACTION PROBLEMS

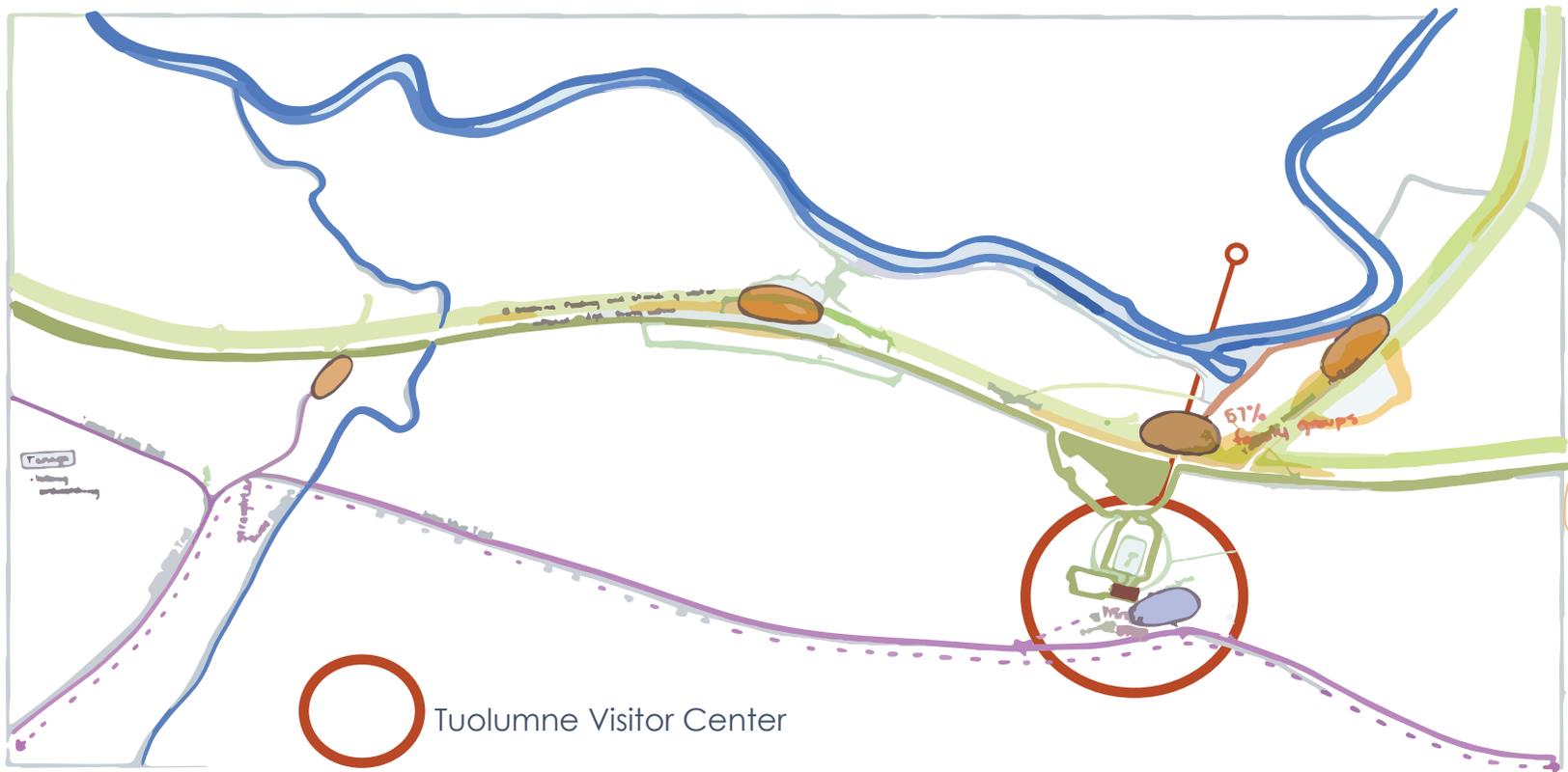


- WET MEADOW
- BLACK SEDGE
 - ASTER
 - WESTERN BISTORT
 - DWARF BILBERRY

- DEEP STANDING WATER
- SKY PIVOT
 - ROUND-EDGE SEDGE
 - SIERRA WINDW SEDGE
 - SITKA SEDGE

Raised pathways will allow people to go into the meadow getting a closer look while not damaging the ecology.

RAISED PATHWAYS



 Tuolumne Visitor Center

Using outdoor exhibits at the visitor center can help educate visitors about the meadow while giving children a place to explore the meadow without harming it

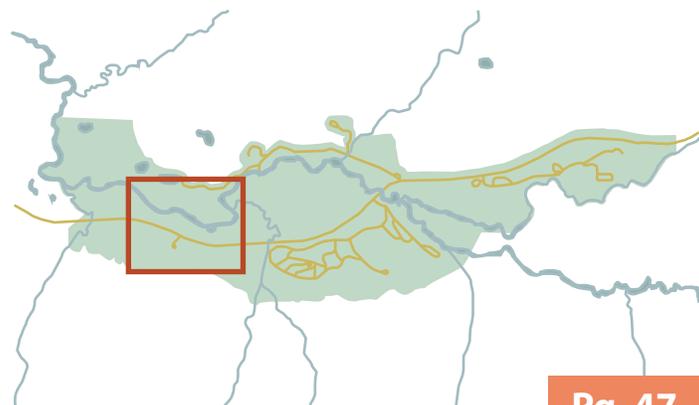


69% of visitors came in groups with **children**



62% of visitors said **outdoor** exhibits were the most important.

VISITOR CENTER





Learning through play and experience, the playground taking elements and characteristics from the meadows.



NATURAL PLAYGROUND

MASTER PLAN KEY

 HANDICAP ACCESSIBLE

 PARKING

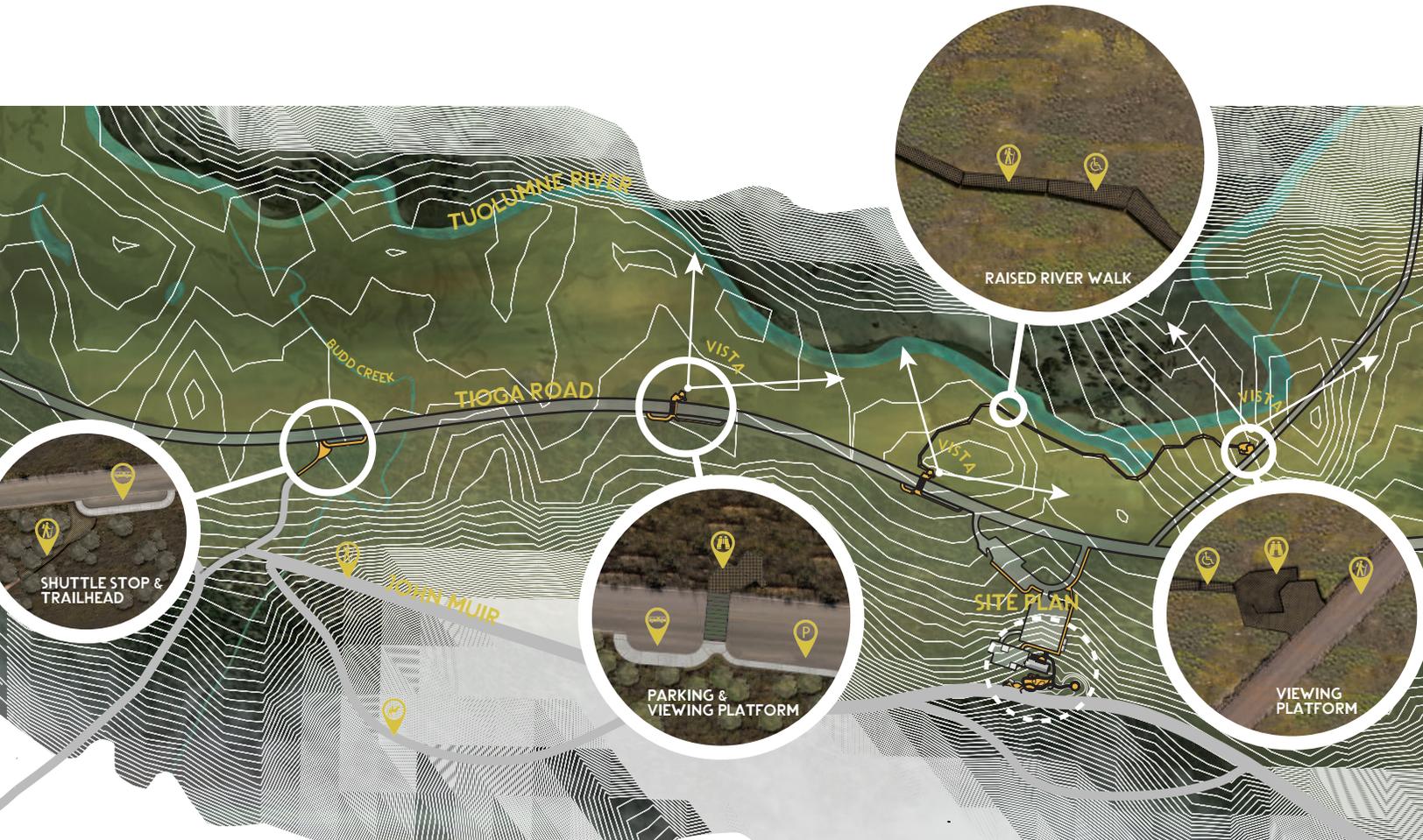
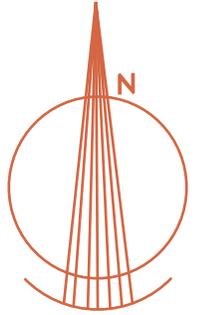
 SHUTTLE STOP

 HIKING

 SCENIC VIEWING

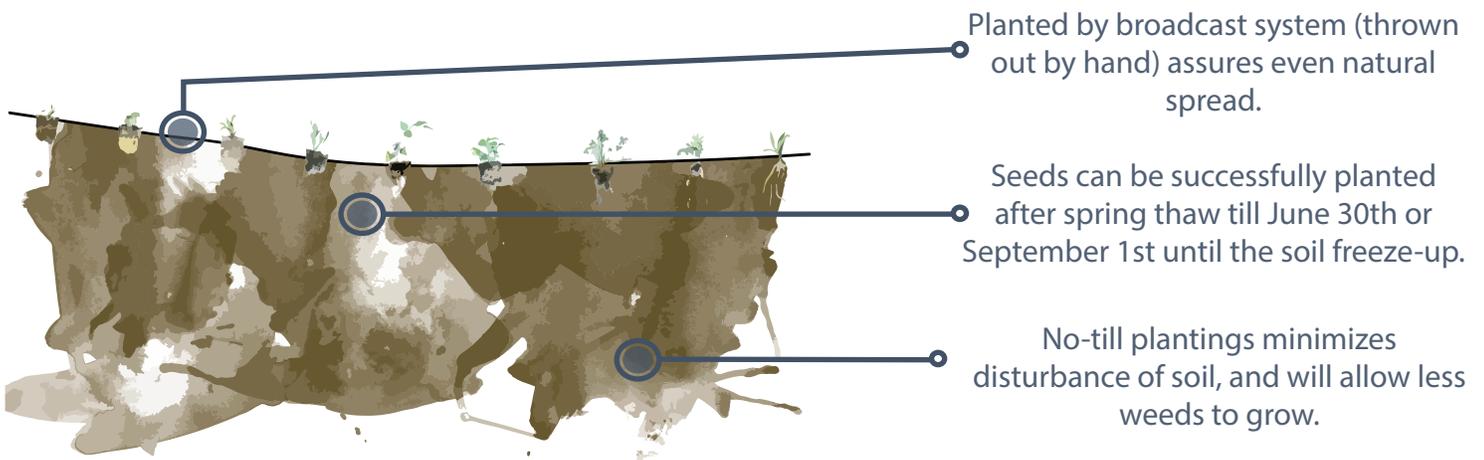
 HORSEBACK PERMITTED

MASTER PLAN



BEFORE CONSERVATION CAN TAKE PLACE, RE-ESTABLISHMENT OF DESTROYED AREAS MUST HAPPEN



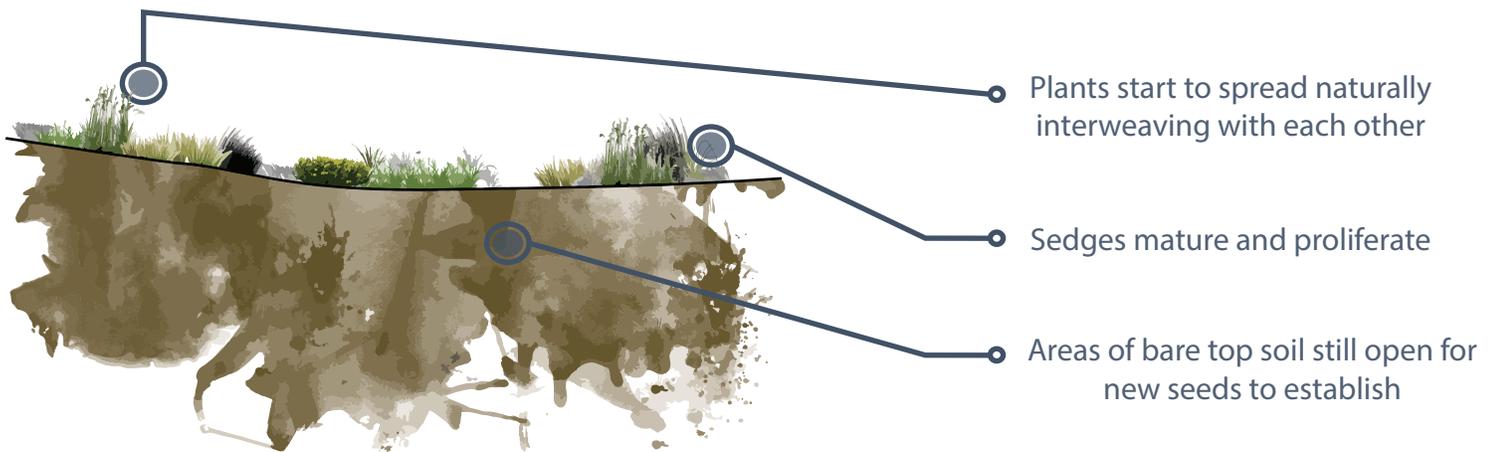


Planted by broadcast system (thrown out by hand) assures even natural spread.

Seeds can be successfully planted after spring thaw till June 30th or September 1st until the soil freeze-up.

No-till plantings minimizes disturbance of soil, and will allow less weeds to grow.

RE-ESTABLISHMENT

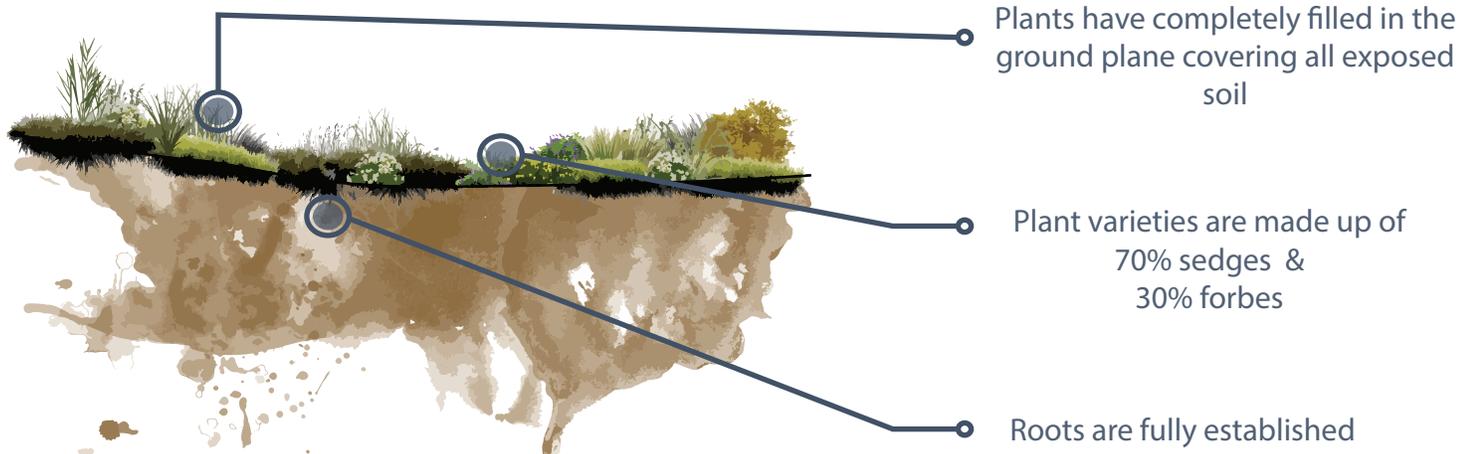


Plants start to spread naturally interweaving with each other

Sedges mature and proliferate

Areas of bare top soil still open for new seeds to establish

AFTER ONE YEAR



Plants have completely filled in the ground plane covering all exposed soil

Plant varieties are made up of 70% sedges & 30% forbes

Roots are fully established

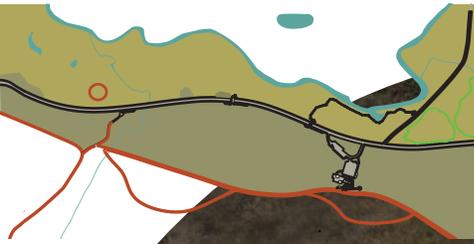
FULLY RE-ESTABLISHED

TRAIL & SIGNAGE

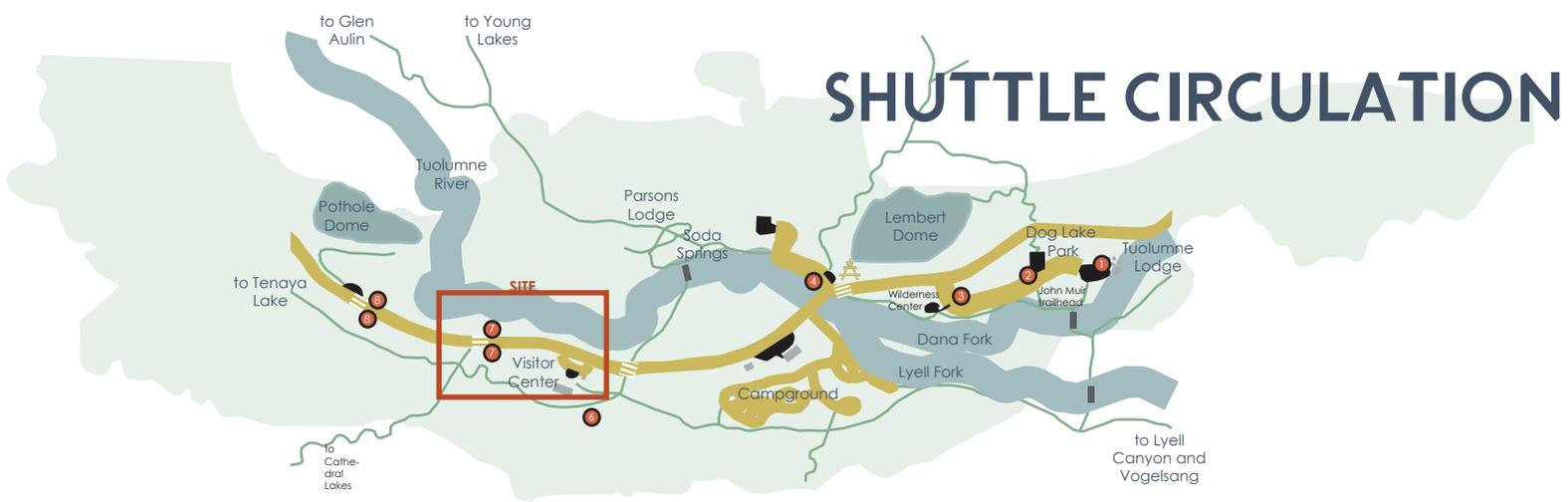
TRAILS ACCOMMODATING MORE DESTRUCTIVE RECREATION SUCH AS BIKING, CROSS COUNTRY SKIING, AND HORSE BACK RIDING TAKE THE STRESS OFF THE MEADOW WHILE STILL ALLOWING VISITORS TO TAKE PART IN THESE ACTIVITIES.

THE WAYFINDING DRAWS FROM THE MINIMALISTIC DESIGN & RUSTIC MATERIALS UTILIZED THROUGHOUT THE SITE.

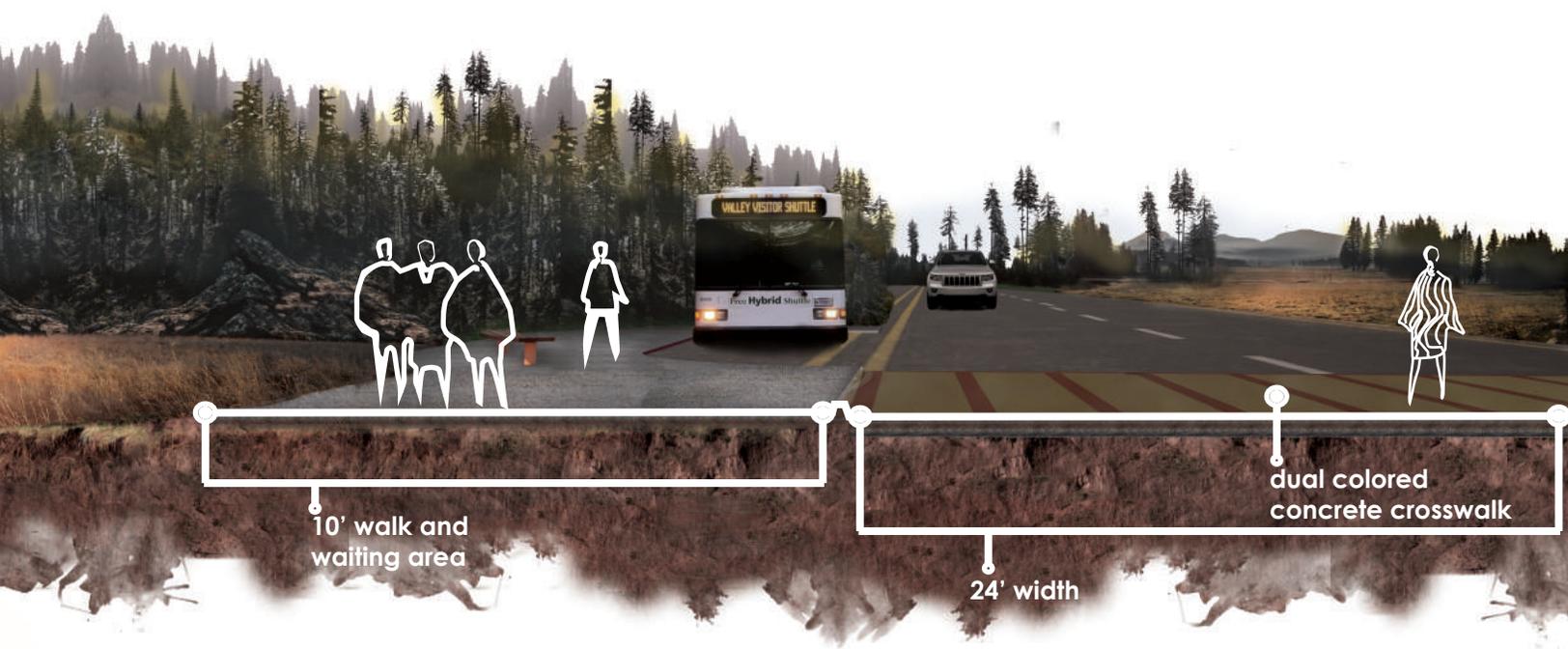
WAYFINDING SYSTEM



SHUTTLE CIRCULATION



TUOLUMNE MEADOWS SHUTTLE BUS ALONG TIOGA ROAD

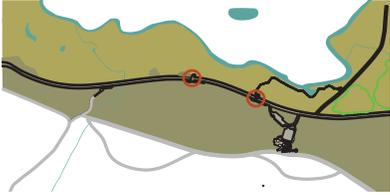


10' walk and waiting area

24' width

dual colored concrete crosswalk

SHUTTLE STOP



PARKING & SHUTTLE STOPS ON THE LESS DELICATE FORESTED SIDE OF THE ROAD FUNNEL PEOPLE ACROSS THE STREET TO VIEWING PLATFORMS KEEPING THEM OFF THE MEADOW ECOLOGY.

10 FOOT WALKWAY ACCOMMODATES FOR LARGE GROUPS OF SHUTTLE BUS TOURS.

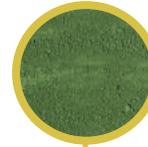
Native
"Lodgepole
Pine" Timber



Brushed
Concrete

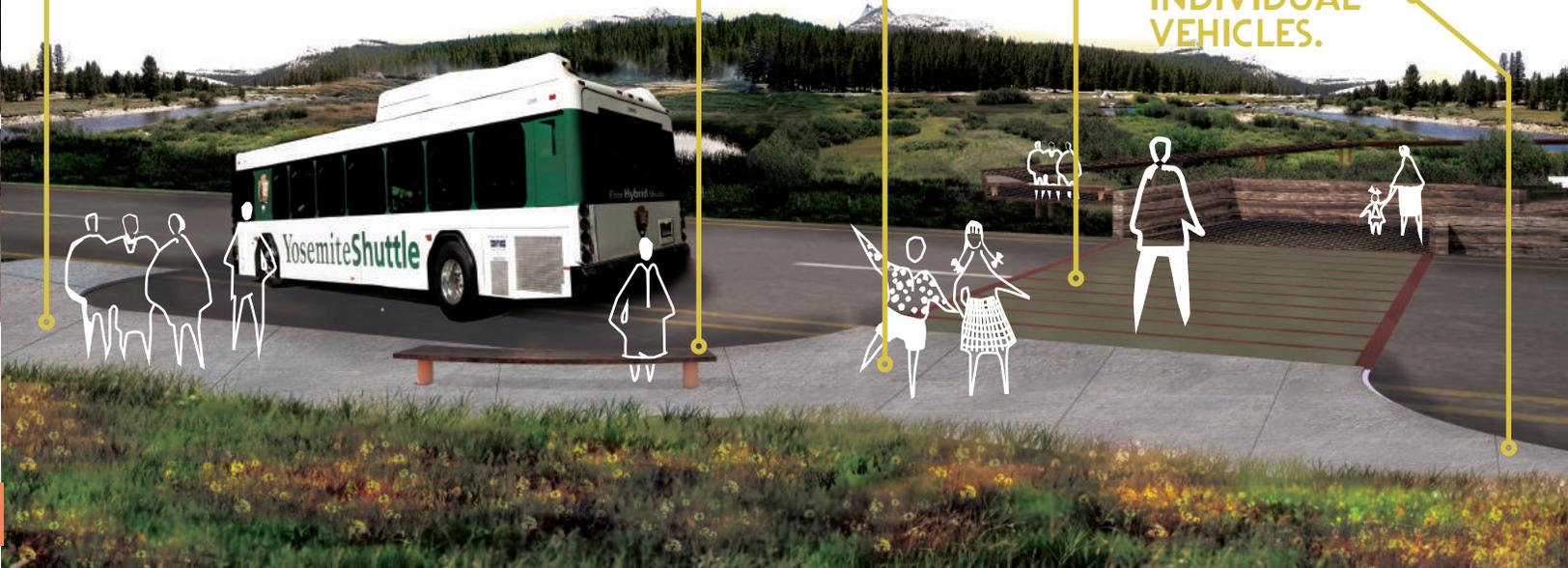


Colored
Concrete



DIRECTS PEOPLE ACROSS STREET TO VIEWING PLATFORMS.

5 FOOT WALKWAY TO ACCOMMODATE INDIVIDUAL VEHICLES.



VIEWING PLATFORM

THE RIVER WALKS MINIMALISTIC DESIGN ALLOWS IT TO BLEND IN WITH THE SURROUNDING VEGETATION KEEPING THE STRUCTURE FROM BECOMING A VISUAL DISTRACTION.

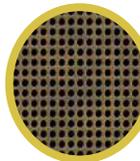
Glass Wall



Native "Lodgepole Pine" Timber

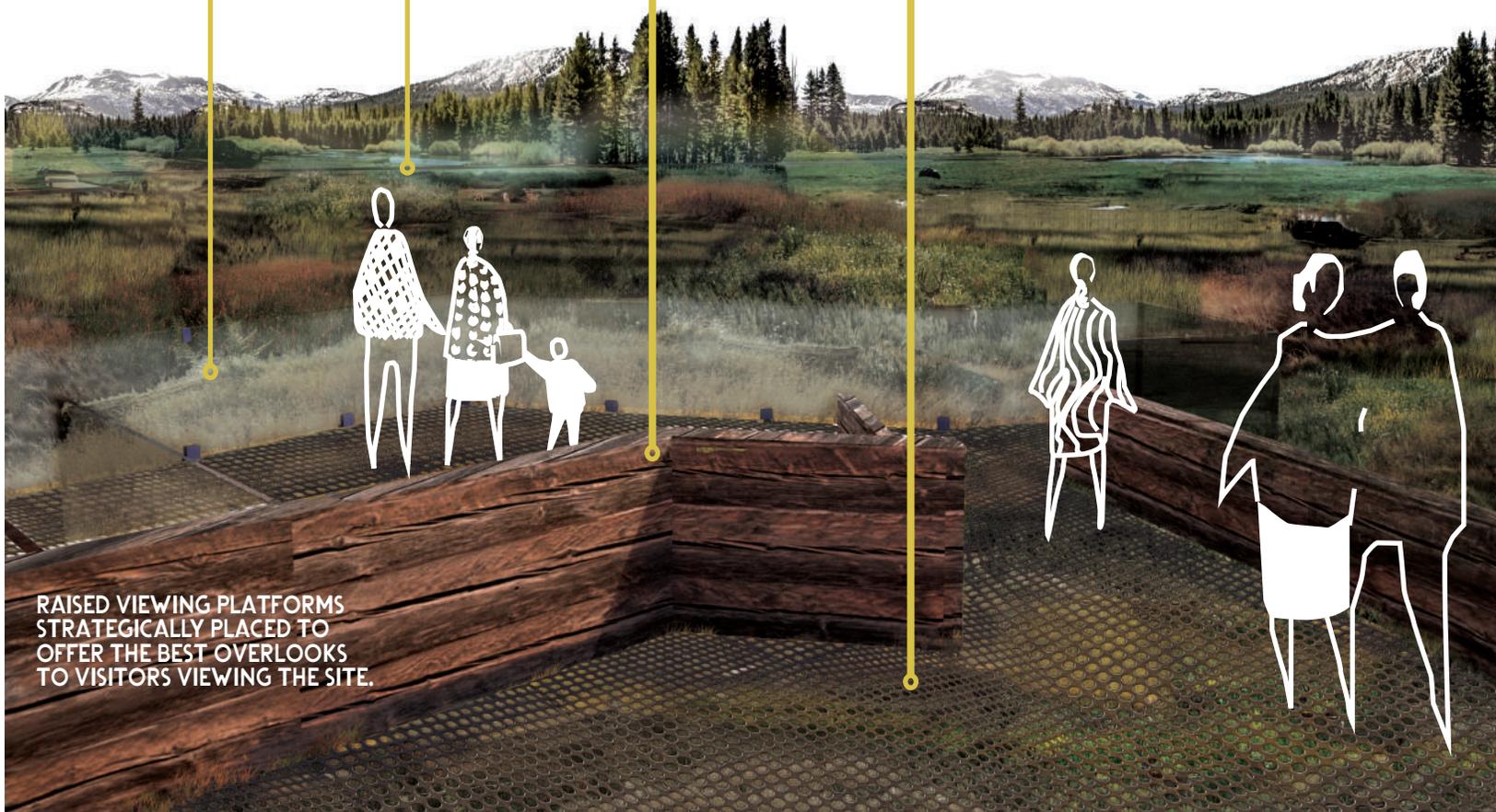


Metal Grate

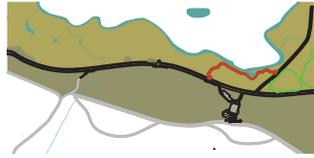


METAL GRATE FLOORING ON VIEWING PLATFORMS AND RIVER WALK ALLOWS FOR SUN AND RAIN TO REACH THE MEADOW BELOW

RAISED VIEWING PLATFORMS STRATEGICALLY PLACED TO OFFER THE BEST OVERLOOKS TO VISITORS VIEWING THE SITE.



THE RIVER WALK PLACEMENT KEEPS THE PATHWAY ABOVE WATER ALL THROUGH THE YEAR, EVEN DURING SPRING FLOODING. THIS ALLOWS VISITORS A UNIQUE EXPERIENCE ALL YEAR LONG.



RIVERWALK SECTION



4" steel lip welded

1- 3' rise

WITH PLANT RE-ESTABLISHMENT VARIETIES OF PLANTS SHOULD AMOUNT TO 70% SEDGES & 30% FORBS IN ORDER TO BLEND INTO THE NATURAL PRAIRIE.

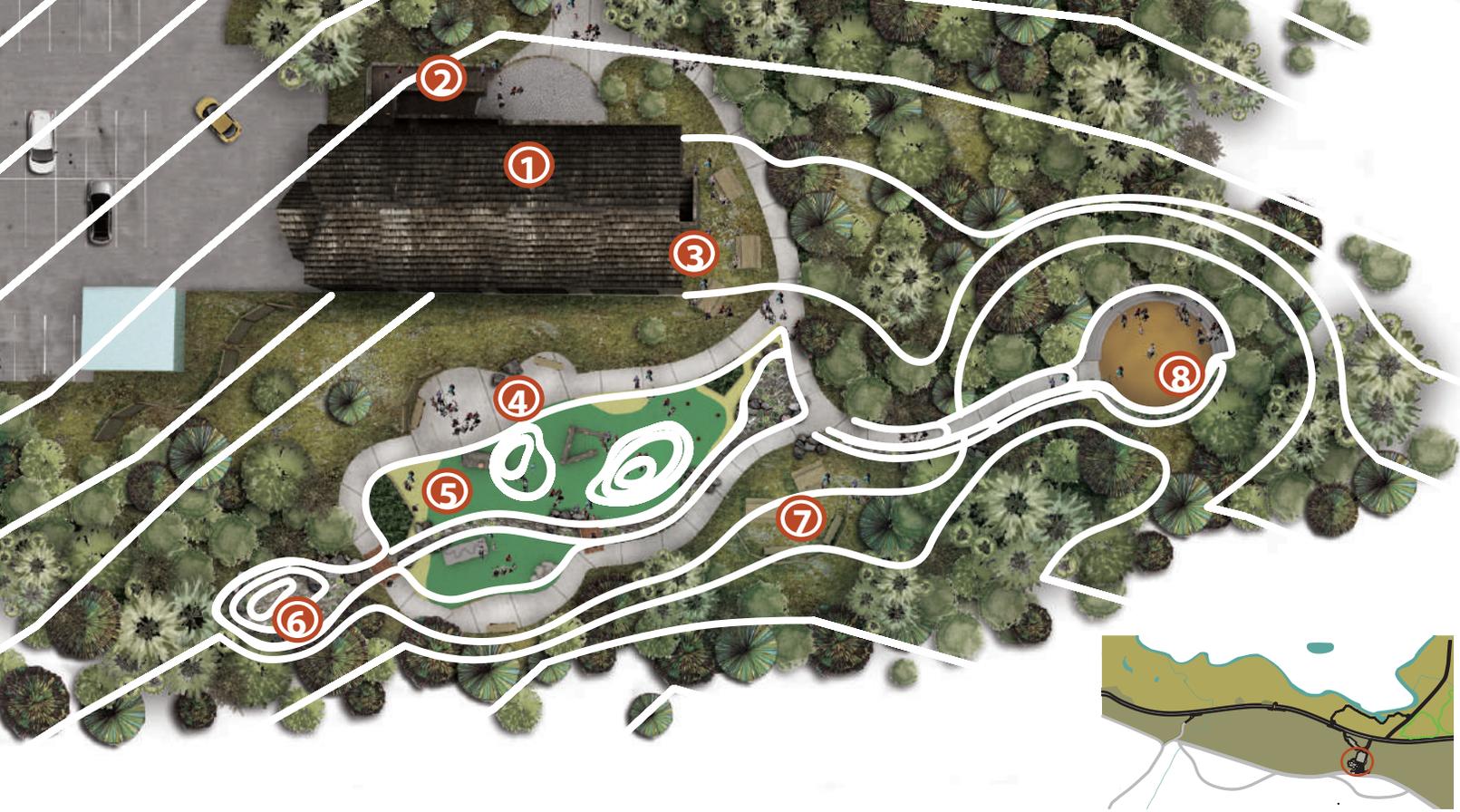
plant Re-establishment

5-10' wide walkway

transparent metal grate

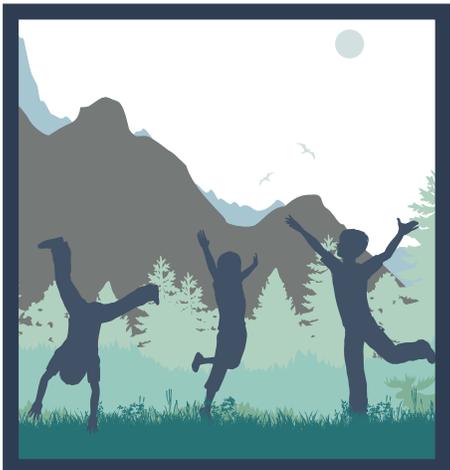
steel supports every 10'



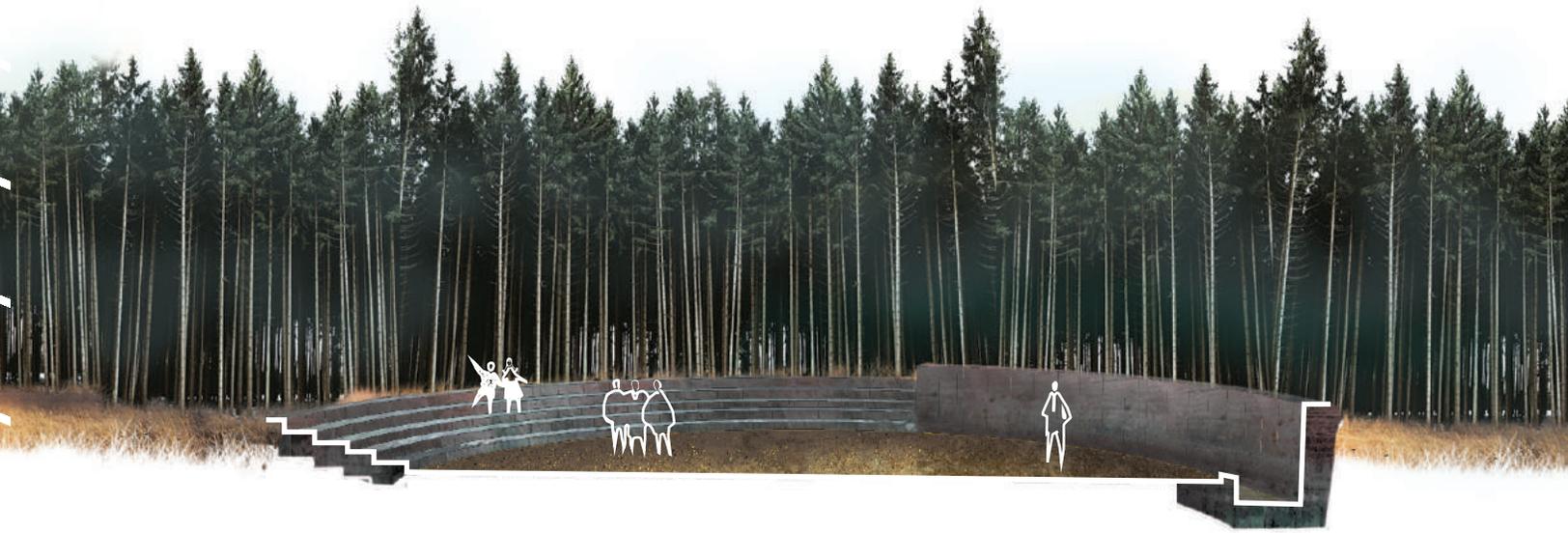


VISITOR CENTER

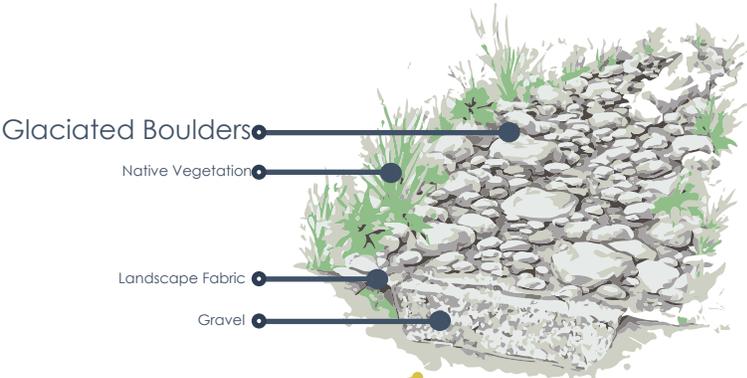
- ① TUOLUMNE VISITOR CENTER
- ② ADA COMPLIANT RAMP
- ③ PICNIC AREA
- ④ PARENT SEATING
- ⑤ MEADOW INSPIRED NATURAL PLAYGROUND
- ⑥ DRY CREEK BED
- ⑦ PLAYGROUND PICNIC AREA
- ⑧ ALPINE AMPHITHEATER



AMPHITHEATER



DRY CREEK BED



NATURAL PLAYGROUND



THE Poured RUBBER MIMICS THE SPONGY FEEL OF THE MEADOW.

69% OF GROUPS VISITING THE MEADOW COME IN A GROUP WITH CHILDREN. THE PLAYGROUND GIVES THEM AN AREA TO BLOW OF STEAM WHILE HAVING MEADOW INSPIRED EDUCATIONAL EXPERIENCE

THE DRY CREEK BED BRINGS THE FLOW, FORMS, & VEGETATION OF THE ALPINE MEADOW INTO THE NATURAL PLAYGROUND.