Annual Report

User Capacity Management Monitoring Program

Yosemite National Park
National Park Service
United States Department of the Interior

2008

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EXECUTIVE SUMMARY

2008 represented the fifth year of data collection for the long-term monitoring of indicator variables related to visitor use and its impact throughout the park. This year, indicators and standards were improved upon and field monitoring and data collection built upon operational efficiencies. Individual indicators were refined and standards were improved upon based on the last several years of data. Indicators and standards are currently being developed for inclusion in the Tuolumne river plan. The information collected in this report will be used by park managers, planners and the public alike to ensure that the quality of park resources and visitor experiences in Yosemite National Park are maintained.

- **Water Quality:** Monitoring efforts continued to build a rich dataset from which to establish baseline water quality conditions. Results from 2008 suggest a continuation of a high degree of water quality throughout the Merced corridor.
- **Riverbank Condition:** This year culminated in a full implementation of this indicator for 2008, with extensive sampling planned for 2009 as well. Field work was completed on sixteen 200 meter sites in Yosemite Valley.
- **Wildlife Exposure to Human Food:** Monitoring procedures worked well and efficiently in 2008. Results from the field season suggest that food storage compliance rates at most major locations approached or exceeded the proposed standard.
- **Extent and Condition of Informal Trails:** In order to streamline data collection efforts and improve operational efficiencies, a rotational sampling plan was initiated this year. A subset of meadows was monitored this year with rotations to occur on a bi-annual basis, with an additional sample of meadows in the Tuolumne River Corridor added during this field season.
- **Wilderness Encounters:** Monitoring efforts for wilderness encounters were improved with more attention given to following established protocols. However, concerns over sample size remain. Results for three trail segments suggest periodic, but frequent encounters with more than one group per hour.
- **Visitor Use/People at One Time (PAOT) At Attraction Sites**: This indicator was previously titled People-At-One-Time. However, the data collected this year expanded the scope of the indicator to encompass a wider variety of metrics, including: crowding, congestion, and encounter type variables. These data were collected through numerous studies that monitored visitor use conditions throughout the park.
- **Parking Availability:** This indicator is being reconstructed to be more inclusive of the cumulative transportation experience in the park.
- **Archaeological Integrity:** Archeological sites, recognized as part of the Cultural Outstandingly Remarkable Values (ORV) for the Merced and Tuolumne Wild and Scenic Rivers were monitored during 2008. This marks the first year of the application of a refined experimental design for this indicator.

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1.0 INTRODUCTION AND BACKGROUND

The Organic Act established the National Park Service to, "conserve the scenery and the natural and historic objects and the wild life therein" while at the same time providing for "the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (NPS Organic Act 1916 - 16 USC 1). Thus, park planners and managers are charged to protect resources while providing for their enjoyment. How do we strike this balance?

The User Capacity Management Monitoring Program (UCMMP) has been developed to serve as a report for the park on how we are managing the natural, cultural and social resources (visitor experience). The indicators that have been developed for this program have been identified as impacted by visitor use, measurable, non-destructive to collect, and sensitive to change (Hof et al. 1994, NPS 1995, NPS 1997). The monitoring program and process is dynamic and constantly being updated with the advent of technological advances, changes in visitor behavior and the successes that management action yields. Figure 1.0.1 displays the process that a multitude of protected areas, including Yosemite National Park, go thru to manage and provide meaningful data from their long-term visitor use management programs.

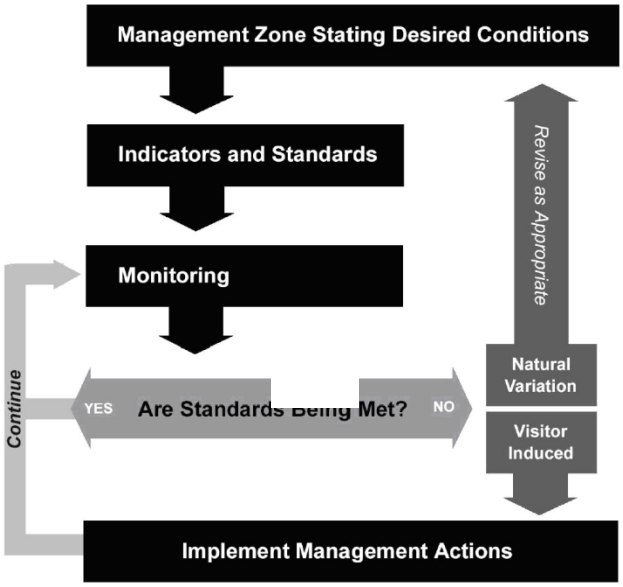


Figure 1.0.1 demonstrates the User Capacity Management monitoring framework.

Indicators are measurable, manageable variables that reflect the condition of park resources and visitor experiences, while standards represent the desired condition of indicator variables (Manning 1999, Manning 2007). Monitoring indicator variables provides important information to park planners and managers on the condition of park resources and human experiences (Hof and Lime 1997). Collectively, defining indicator variables, setting standards, and monitoring serve as an early warning system informing park managers of potentially unacceptable changes in resource and social conditions. This program utilizes the National Park Service's Visitor Experience Resource Protection (VERP) framework and the United States Forest Service's Limits of Acceptable Change (LAC) protocol as a model for the continued implementation of a long-term monitoring program to understand user capacity.

1.1 PROGRAM DEVELOPMENT IN 2008

2008 marked the fifth year that we have been developing the indicators and standards as part of the User Capacity Monitoring Program. Table 1.1.1 below presents the list of indicators and standards for this year.

Table 1.1.1. Indicators and Standards in 2008.

Indicators	Standards
Water Quality	Anti-degradation for each segment, for *E. coli,* nutrients (total dissolved nitrogen, nitrate and nitrite, total dissolved phosphorous, and total phosphorus), and total petroleum hydrocarbons. Absolute minimum for all segments: State *E. coli* standard for recreational contact. Yosemite-specific standards, which will be much more protective than available state and federal standards, will be established once sufficient data has been obtained through this sampling protocol.
Riverbank Condition	Standards: 1. Channel Morphology: No greater than 10 percent increase in cross-sectional area due to bank scour in 80 percent of sites. 2. Vegetation Condition (Trend): No greater than 10 percent cover of bare ground in 80 percent of sites. This trend will be determined using the 2008 data to reflect current condition as compared to future assessments. This will help determine our desired condition and to detect change. 3. Vegetation Condition (Status): No greater than 20 percent of (strata-based) sites will have less than C percent green understory cover.
Wildlife exposure to human food	95% or greater compliance with food storage regulations in selected campgrounds and parking areas.
Extent and Condition of Informal Trails	Standard development is currently underway for this indicator. Standards will be based on five years of informal trail data, further informed by site specific research linking patch size to degree of ecological impact to species diversity.
Wilderness Encounters	Untrailed: No more than 1 encounter with another party per hour, 80% of the time. Trailed: No more than 1 encounter with another party per 4 hour period, 80% of the time.
Visitor Use Monitoring	Findings from 2007 use studies indicate predictable crowding/congestion conditions at key attraction sites to that of vehicle arrivals at entrance stations earlier in the day. As a result of this, the visitor use monitoring indicator is exploring a way to be collected in tandem with a developing transportation indicator.
Archaeological Condition and Stability	No deterioration in site stability or condition related to visitor threats or disturbances. No new visitor related (including park management actions related to visitor use) threats or disturbances to archeological sites that have the potential to degrade stability or condition. No change in condition from baseline to current as a result of visitor use.
Parking Availability	A standard has yet to be determined. Additional transportation-related work will yield valuable understanding in addition to the current parking availability indicator thru the 2008 and 2009 data collection seasons.

The indicators presented above were monitored at a variety of locations representing a broad spectrum of management zones. Figure 1.1.1-1.1.7 show all monitoring locations throughout the park, excluding the archeological sites protected from disclosure. Sampling locations were chosen to be representative of the various management zones and coincide with areas of resource or experiential concern.

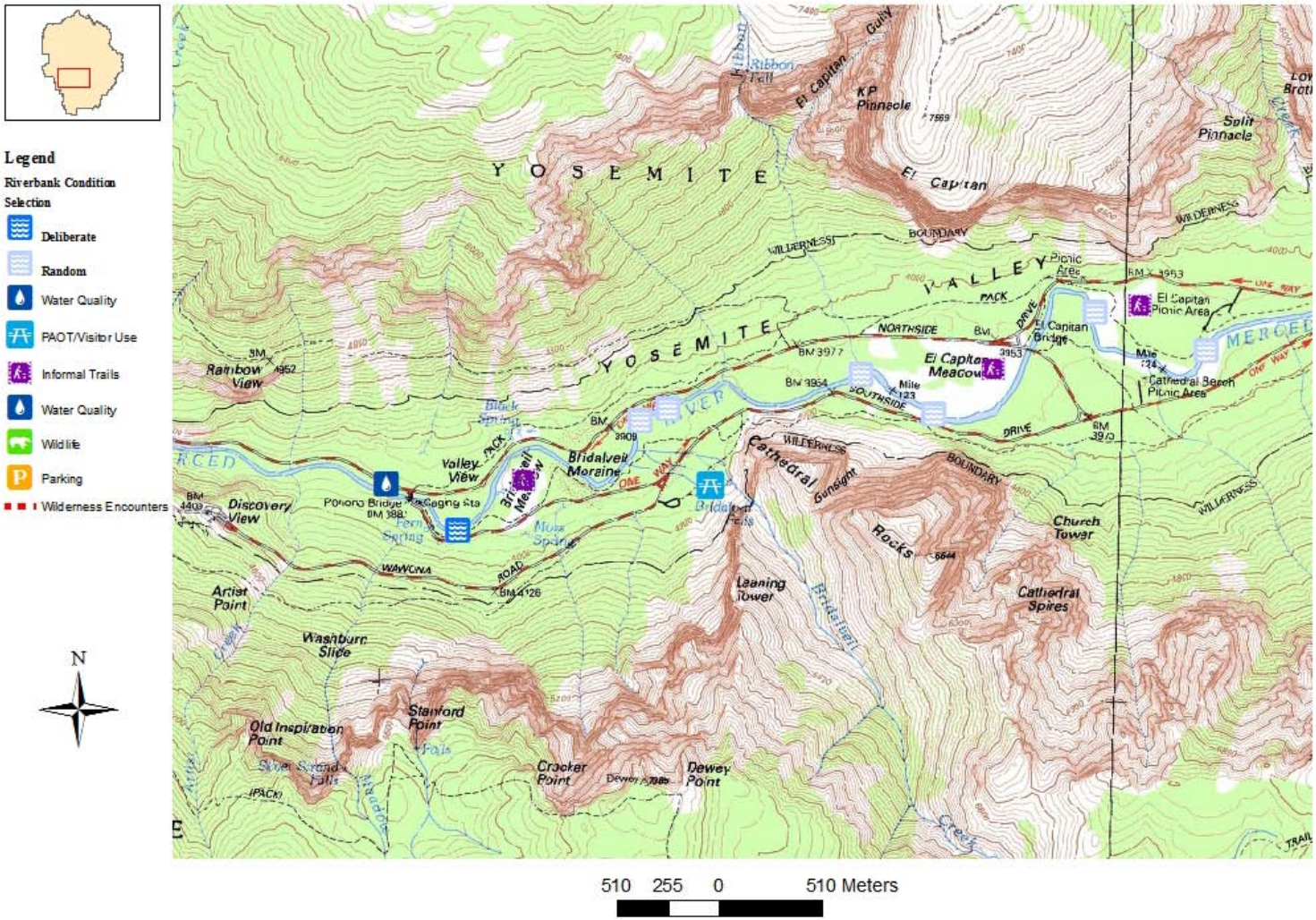


Figure 1.1.1 shows monitoring locations in 2008 in West Yosemite Valley.

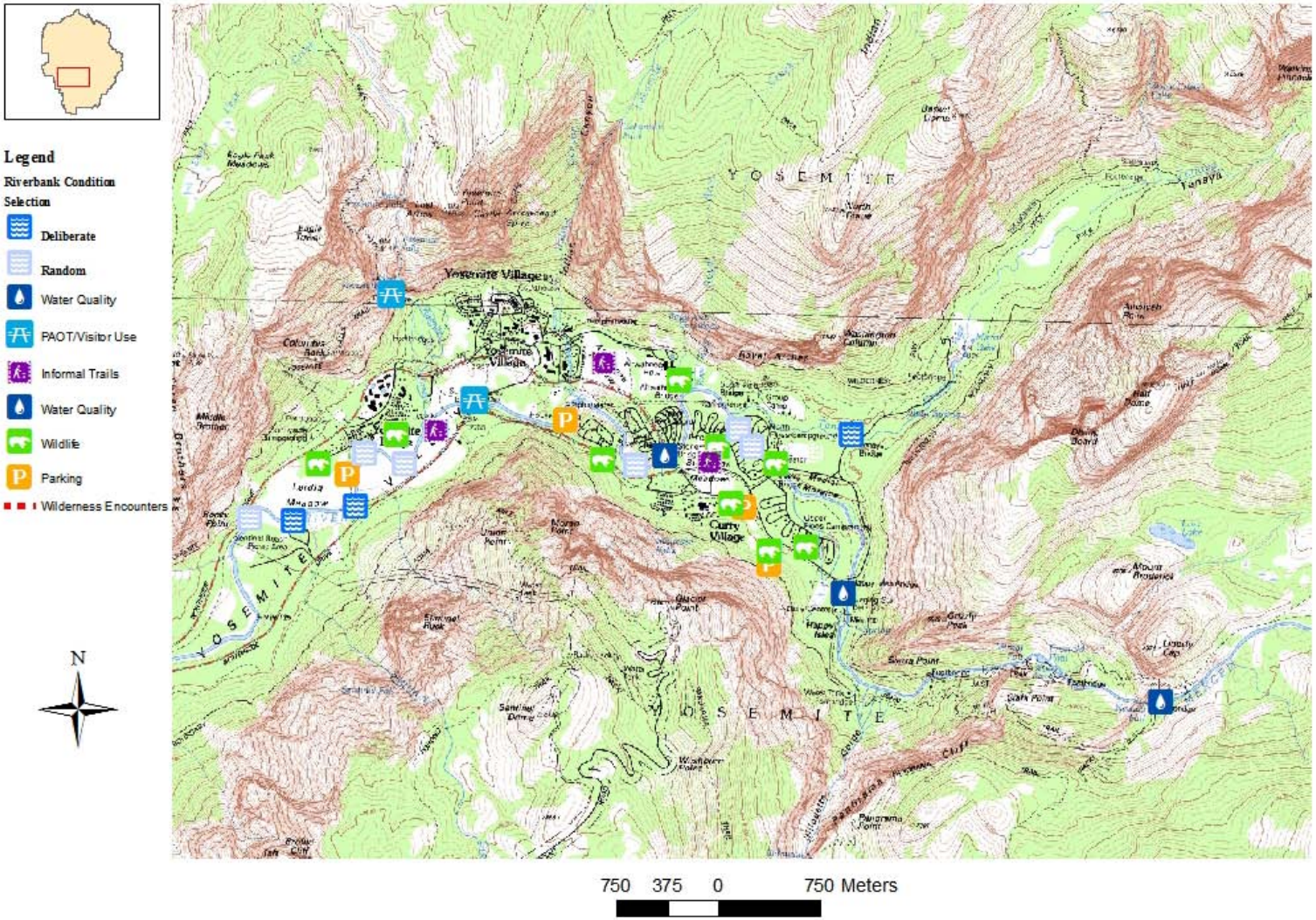


Figure 1.1.2 shows monitoring locations in 2008 in East Yosemite Valley.

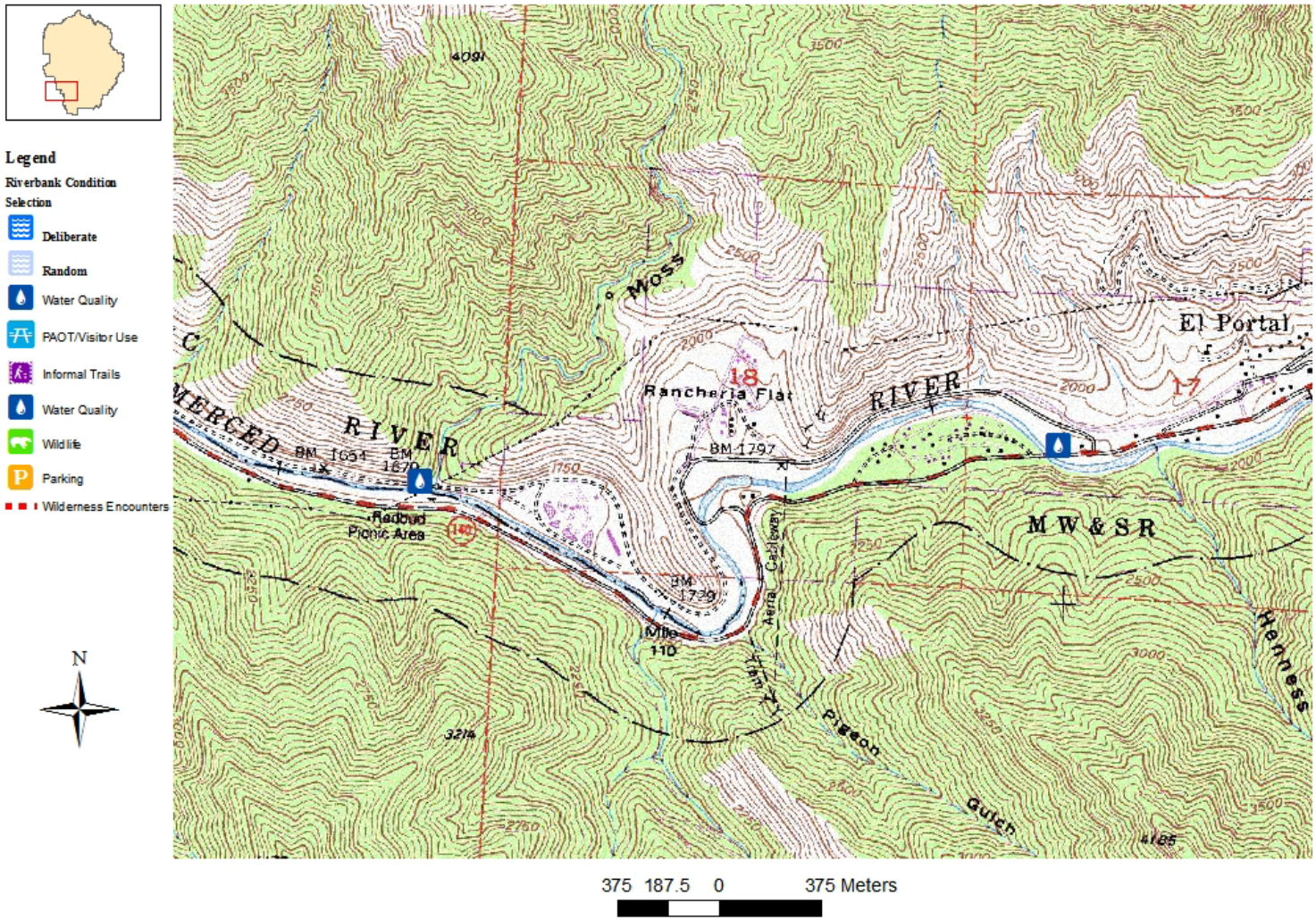


Figure 1.1.3 shows monitoring locations in 2008 in El Portal.

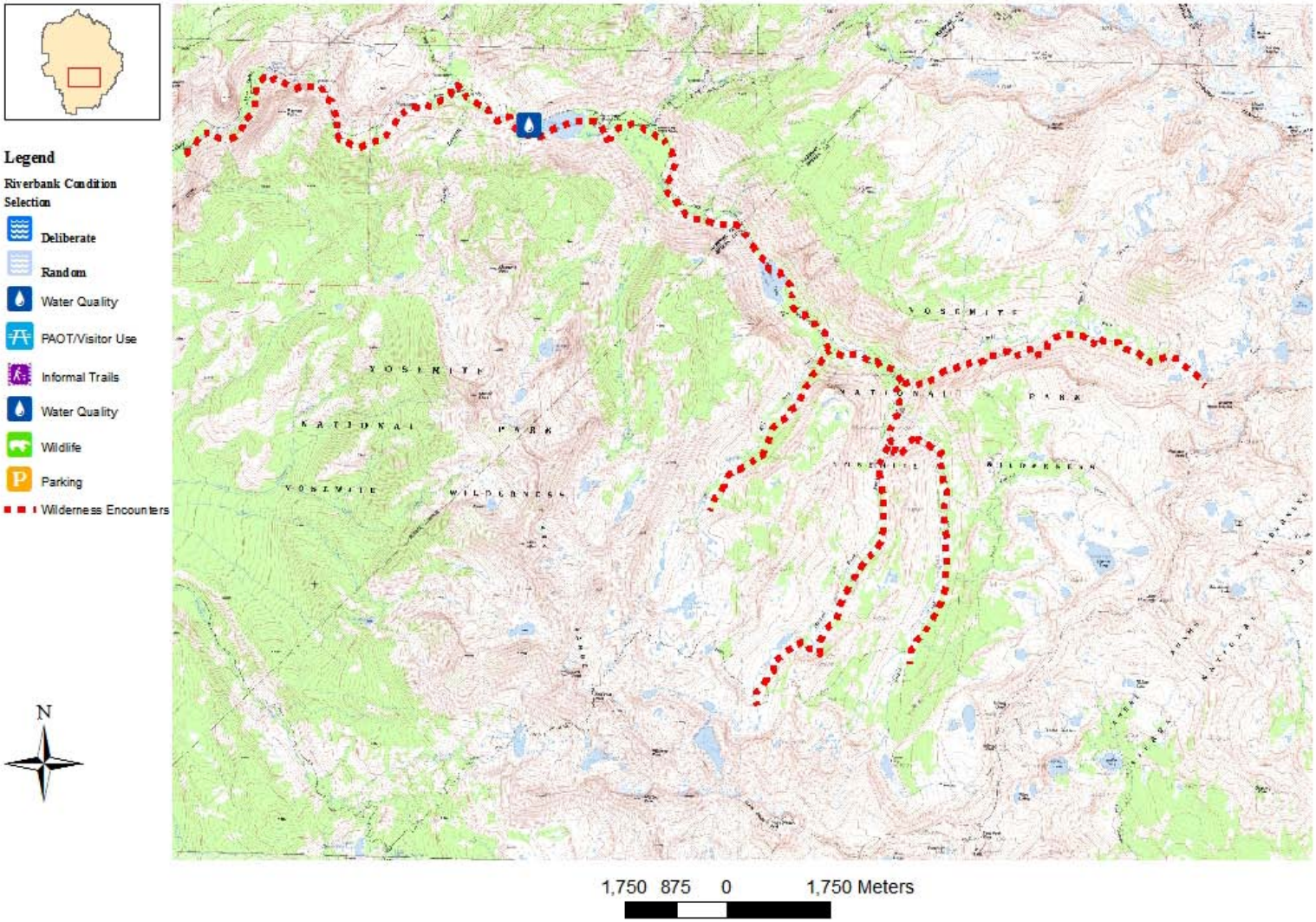


Figure 1.1.4 shows monitoring locations in 2008 in Merced Lake area.

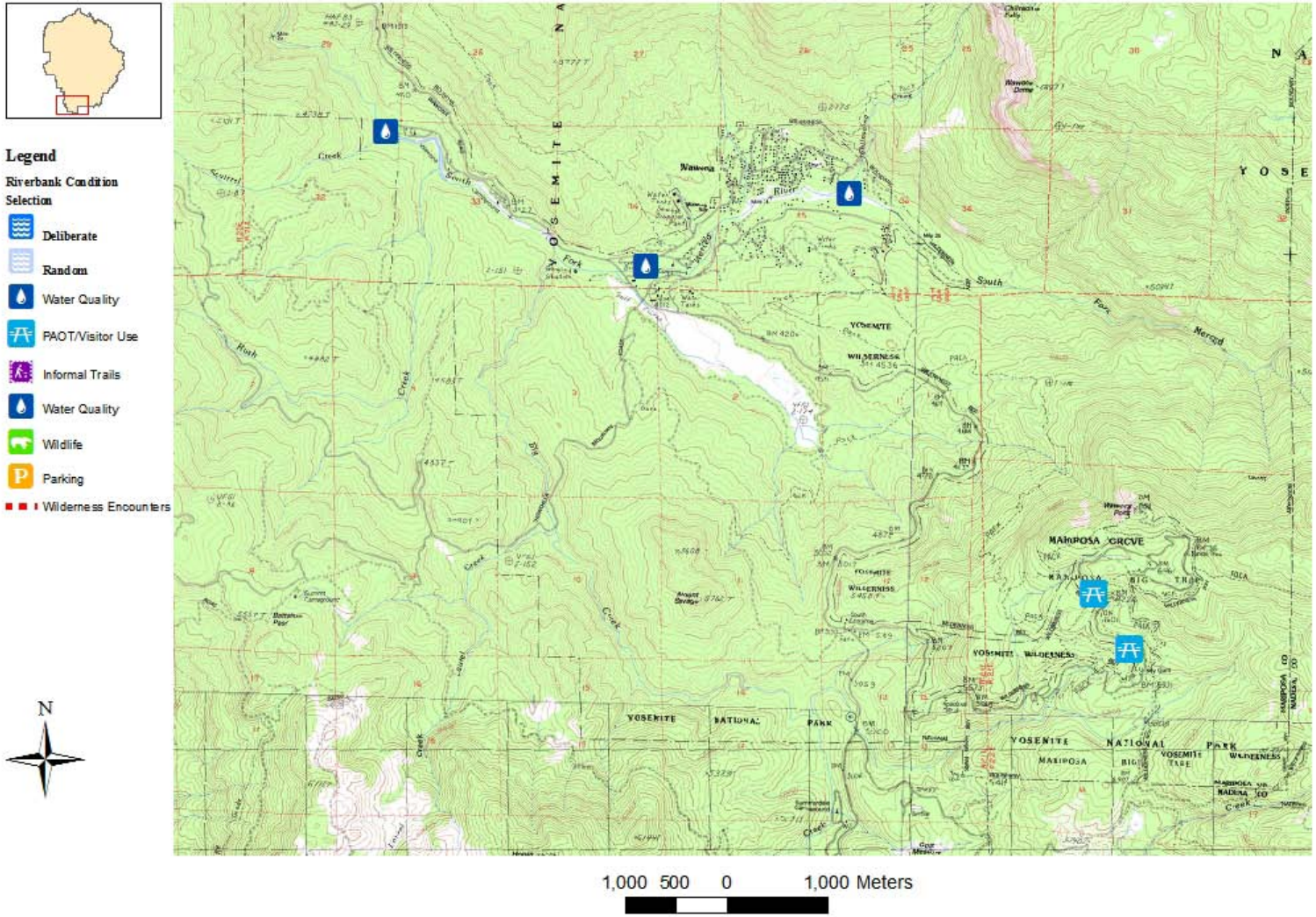


Figure 1.1.5 shows monitoring locations in 2008 in Wawona.

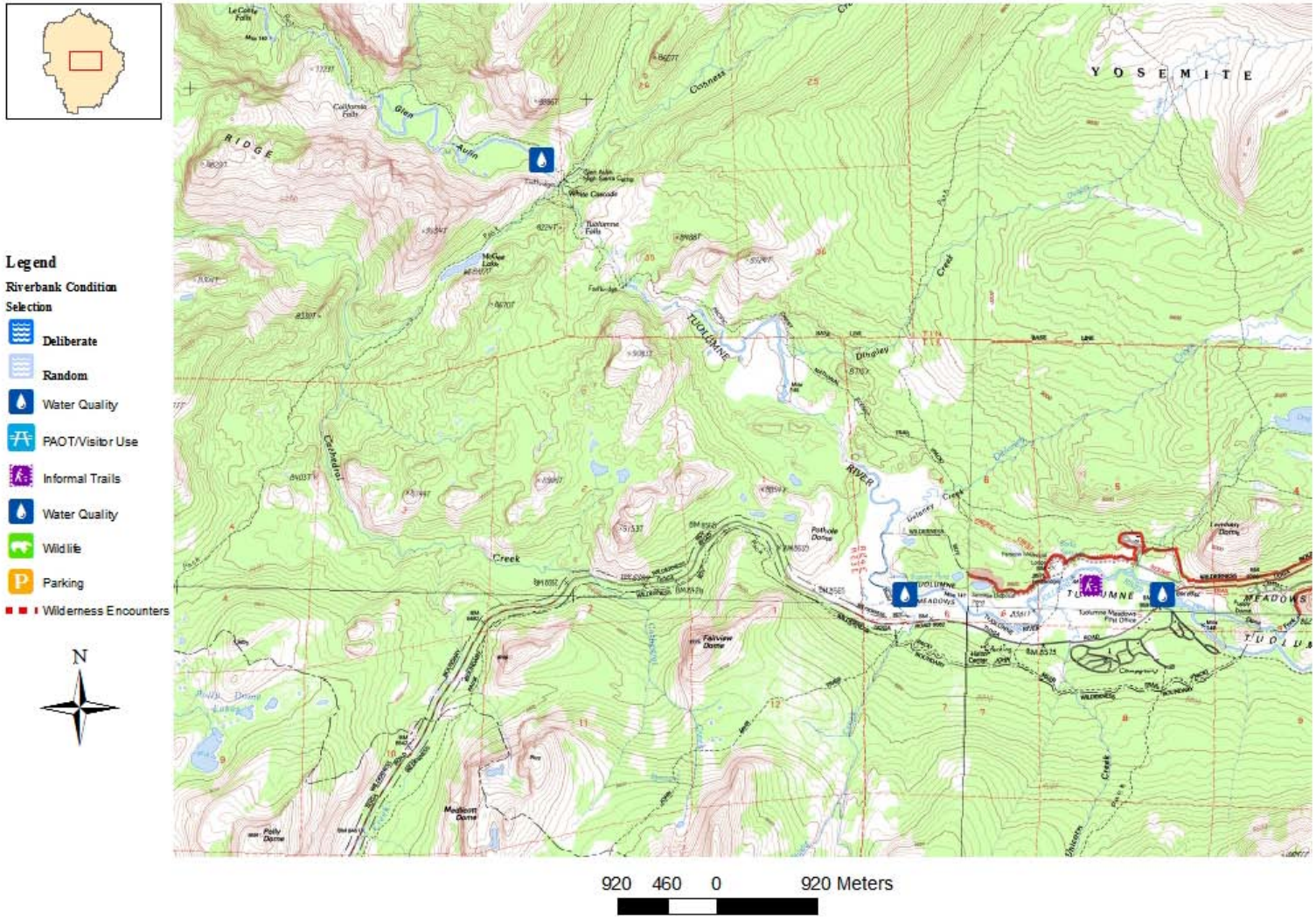


Figure 1.1.6 shows monitoring locations in 2008 in west Tuolumne Meadows.

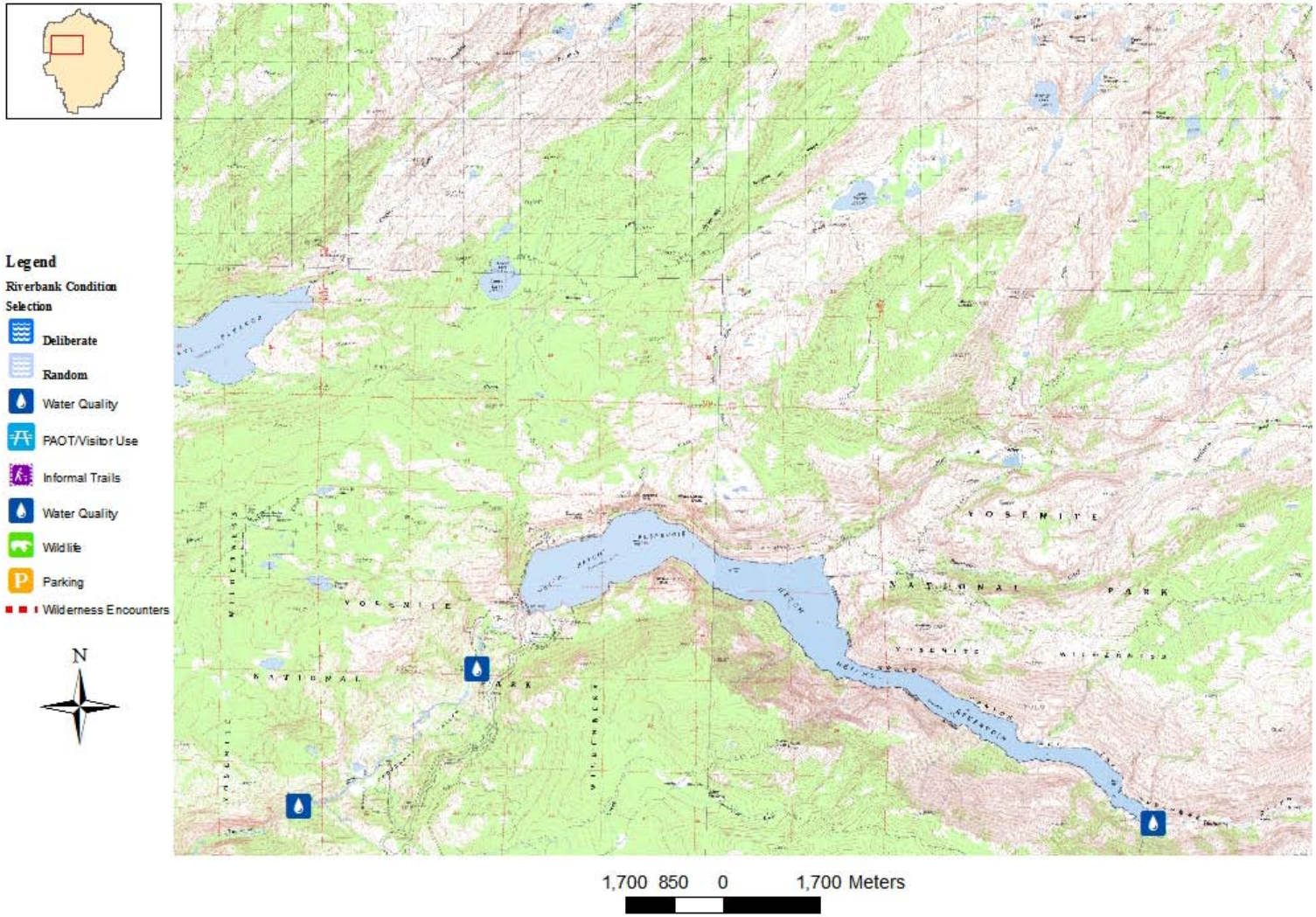


Figure 1.1.7 shows monitoring locations in 2008 in west Hetch Hetchy.

Figure 1.1.8 shows monitoring locations in 2008 in east Tuolumne Meadows.

Please See Figure 2.6.1 for Tioga Trailhead Sampling Locations.

Similar to previous years, the User Capacity Management Monitoring Program followed a timeline as represented in Figure 1.1.8 below. Generally, the late winter and early spring months were spent refining and improving monitoring protocols. In the spring preparations were made for data collection including hiring field staff, recruiting and organizing volunteers, preparing data sheets and finalizing protocols, checking and obtaining equipment, etc. The majority of data collection efforts took place during the summer and early fall. In the fall data were coded, analyzed and incorporated into a draft report. The annual report was finalized during the winter months concluding the program year.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Complete Annual Report from previous year											
		Refine monitoring protocols, prepare for new field season									
				Finalize Field Monitoring Guide, conduct field monitoring and collect data							
								Compile and analyze data, report writing, Fall workshop			
Progress report			Progress report			Progress report			Progress report		
Implement management actions throughout as stipulated in action plan											

Figure 1.1.9. shows the user capacity monitoring program timeline.

1.2 2008 Visitor Use Summary

Understanding that user capacity refers to the types and levels/amounts of visitor use that may appropriately be accommodated in a particular park unit, it is important to include in the beginning of this report a characterization of visitor use for 2007 as this may assist in understanding the results.

In 2008, Yosemite National Park received 3,431,514 recreation visits. Compared to 2007, recreation visits fell by 71,914 visits. Table 1.2.1 presents visitor use statistics by month throughout 2008. It is important to note that Tioga Road opened on May 21st and closed on December 6th. Glacier Point Road opened on May 6th and closed December 12th. The peak visitation season (Memorial Day to Labor Day weekends) is best described as dry with occasional peak temperatures over 100 degrees Fahrenheit at 4,000 feet.

Table 1.2.1 shows the number of recreation vsits to Yosemite National Park in 2008.

Month	Recreation Visits
January	95,124
February	107,729
March	153,735
April	199,592
May	361,193
June	473,186
July	539,874
August	543,799
September	416,918
October	295,547
November	146.838
December	97,979
Total	**3,503,428**

For more information on Yosemite NP's visitor use statistics please visit http://www.nature.nps.gov/stats/.

1.3 Collaboration and Consultation

The UCMMP relies on the efforts of a diversity of park staff, park partners, cooperating institutions, interns, volunteers and other members of the public.

The National Park Service collaborated with Colorado State University, North Carolina State University and Virginia Polytechnic Institute and State University under cooperative agreements for technical expertise and academic support on monitoring protocol development, data collection and analysis, and reporting. Applying monitoring methods that have undergone academic rigor, the UCMMP was able to make substantial progress in its iterative capacity.

The monitoring program also benefited in 2008 from the efforts of several Student Conservation Corps (SCA) volunteers. Each year, SCA volunteers provide a vital component to the field team of the monitoring program. The SCAs provided crucial field and technical support for data collection and monitoring. Additionally, the program relies heavily on intern and volunteer support to provide data collections and input while providing a key educational component on the parks visitor use management issues.

1.4 Report Overview

This Annual Report presents UCMMP activities and data collection results for the 2008 calendar year. It is organized into the following sections: 1) Introduction, 2) Monitoring Results, 3) Program Evaluation, 4) Summary, and 5) Appendices. The reader will note that a section outlining the various methods used to collect and analyze data is absent from this report. This information is compiled in the 2008 UCMMP Field Monitoring Guide. This guide and other documents pertaining to the UCMMP may be found on the park's website at: **www.nps.gov/yose/planning**. Data collected from the 2008 field season is available on request from the UCMMP Coordinator, Todd Newburger at (209)379-3285 or todd_newburger@nps.gov. In the coming years, data will be posted on the park website with brief descriptions on how to interpret the indicator datasets. Additional analysis from research institutions and other interested organizations of the UCMMP datasets is encouraged.

2.0 MONITORING RESULTS

This section presents the findings from indicator monitoring in 2008. Results are organized by indicator variable including the following information: indicator and standard description; indicator performance summary; monitoring activities; results; discussion; and management implications.

2.1 WATER QUALITY

Excellent water quality was identified by the Merced River Plan as part of the hydrologic processes Outstandingly Remarkable Value in three segments of the river corridor: in the wilderness reaches of the main stem and South Fork, as well as in the impoundment segment of the South Fork (above Wawona). Water quality will also be a significant indicator along the Tuolumne Wild and Scenic River.

This report summarizes data collected during Water Year 2008 (October 1st, 2007 to September 30th, 2008) and compares these results to draft water quality standards developed from 2004-2007 data (Peavler et al, in prep.).

Table 2.1.1 shows water quality constituents sampled in 2008.

Constituent	Analytical Method	Analytical Reporting Limit	California Standard	Source Document
Total Dissolved Nitrogen (TDN)	USGS/NWQL[1] 2754	0.03 mg/l	None	
Nitrate + Nitrite (NO3+NO2)	USGS/NWQL[1] 1979	0.016 mg/l	10 mg/l (Drinking water)	State of California Regulations, Title 22 – Drinking water standards, Maximum Contaminant Levels - Inorganic Chemicals
Total Phosphorous (TP)	USGS/NWQL[1] 2333	0.004 mg/l	None	
Total Dissolved Phosphorous (TDP)	USGS/NWQL[1] 2331	0.004 mg/l	None	
E. coli	SM 9221F[2]	2 MPN/100ml (MPN = Mean Probable Number of bacterial colonies)	Geometric Mean of 5 samples taken over a 30-day period shall not exceed 126 MPN/100 ml. No single sample shall exceed 235 MPN/100 ml.	Proposed standard currently under review by the California Regional Water Quality Control Board.
Total Petroleum Hydrocarbons (TPH)	EPA 306M[3]	13-17 µg/l	Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.	State of California, 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth Edition—1998. California Regional Water Quality Control Board.

[1] U.S. Geological Survey National Water Quality Laboratory
[2] Standard Methods for the Examination of Water and Wastewater
[3] Environmental Protection Agency Standard Method

Measurement

The following water quality parameters were measured: Nutrients (total dissolved nitrogen, nitrate + nitrite, total phosphorous and total dissolved phosphorous), *E. coli*, and total petroleum hydrocarbons. Associated field data collected with each water quality sample included water temperature, specific conductivity, dissolved oxygen, and pH.

Standards

The standards developed from 2004-2007 baseline data are intended to be anti-degradation for each segment for *E. coli*, nutrients (total dissolved nitrogen, nitrate + nitrite, total dissolved phosphorous, and total phosphorus), and total petroleum hydrocarbons per sampling period. Additionally, the park must comply with the proposed state standard for *E. coli* for recreational contact at all times. Standards are worded as follows:

Nutrients: The 75th percentile concentration of constituent X over one water year shall not exceed the standard for a site (at the 95th confidence interval) more than 1 in 5 years.

E. coli: The 50th percentile concentration of E. coli colonies over one water year shall not exceed the standard for a site (at the 95th confidence interval) more than 1 in 5 years.

Total Petroleum Hydrocarbons: The concentration at a site over one water year shall not exceed 14 µg/l 80% of the time in more than 1 in 5 years.

Table 2.1.2 shows draft Yosemite water quality standards.

Site	NO3+NO2 (mg/l)	TDN (mg/l)	TDP (mg/l)	TP (mg/l)	*E. coli* (MPN/100ml)
Merced River (main stem)					
Below Merced Lake	0.044	0.109	0.0032	0.004	n/a
Above Nevada Falls	0.034	0.088	<0.003	<0.004	n/a
Above Happy Isles Bridge	0.032	0.128	0.0032	0.0074	6.0
Above Sentinel Bridge	0.033	0.114	0.0031	0.0068	7.5
Above Pohono Bridge	0.020	0.130	0.0061	0.0114	7.0
Above Hwy 140 Bridge	0.019	0.132	0.0057	0.0078	*
Below Foresta Bridge	0.043	0.238	0.0049	0.0123	5.0
South Fork Merced River					
Above Swinging Bridge	0.037	0.172	<0.003	0.0047	2.0
Above Hwy 41 Bridge	0.042	0.166	0.0032	0.0042	8.0
Below Wawona Campground	0.017	0.143	0.0064	0.0089	4.1
Tuolumne River					
Dana Fork Below Gaylor Creek	0.013	0.079	<0.003	<0.004	4.1
Lyell Fork Above Twin Bridges	0.048	0.097	<0.003	0.0052	5.0
Tuolumne River Above Tioga Road Bridge	0.064	0.096	<0.003	0.0042	5.2
Tuolumne River Above Budd Creek	0.049	0.131	0.0031	0.0181	4.1
Tuolumne River Below Conness Creek	0.019	0.074	<0.003	<0.004	*

* Insufficient data for standard determination as of October 2008.

Sampling

Field staff sampled at eight locations quarterly on the Merced River and South Fork Merced (Figure 2.1.1) and monthly at 5 locations on the Tuolumne River (Figure 2.1.2). In addition, several storm events were sampled as well as additional summer samples in August and September on the Merced, and bimonthly winter samples in Tuolumne Meadows (2 sites). Nutrients (total dissolved nitrogen, nitrate, total phosphorous and total dissolved phosphorous) were sampled at all sites. *E. coli* was sampled only at front-country sites due to the maximum six-hour hold time for these samples. Total petroleum hydrocarbons were sampled at three locations downstream of developed areas. In addition to collecting samples, field staff measured water temperature, specific conductivity, pH, and dissolved oxygen as well as river stage where possible.

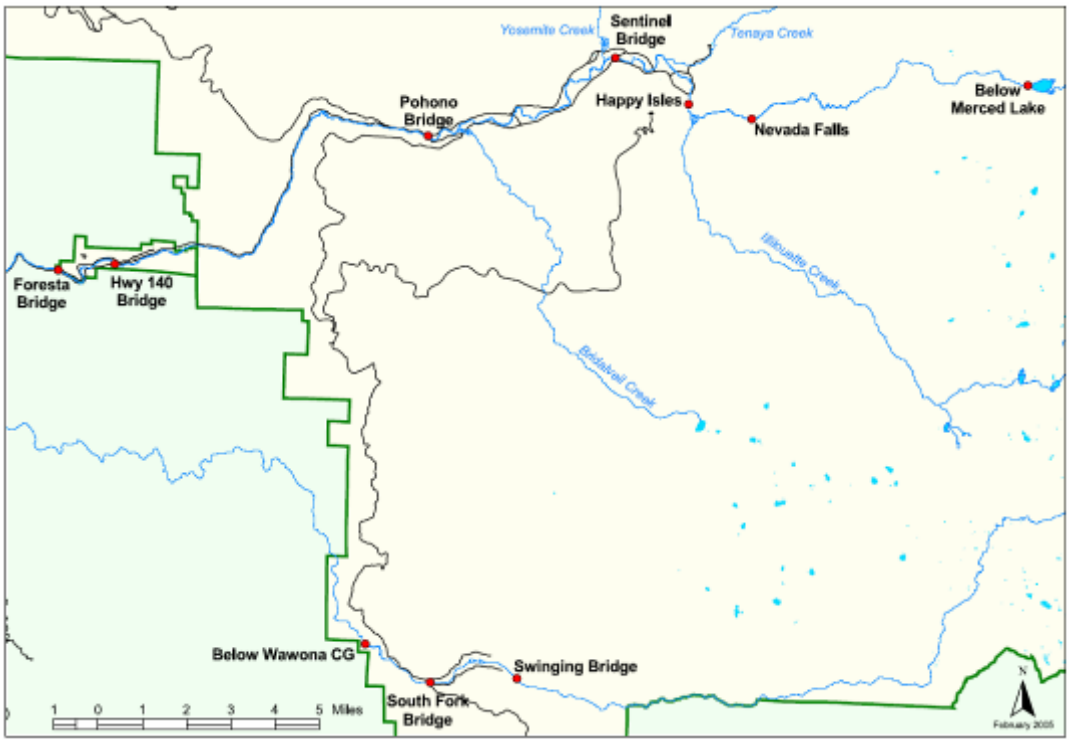


Figure 2.1.1 shows the water quality sampling locations on the Merced River.

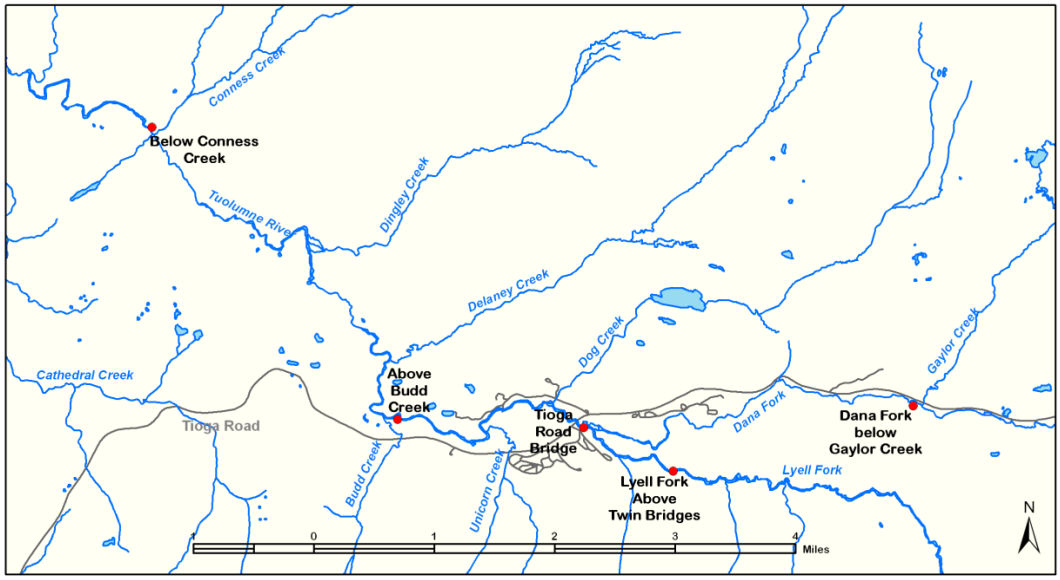


Figure 2.1.2 shows water quality sampling locations on the Tuolumne River.

Results

Table 2.1.3 summarizes 2008 data indices by site. Nutrient values represent the 75th percentile of data, E.coli values represent the 50th percentile, and TPH values are number of exceedences of the detection limit. Results for the Merced River include quarterly and storm samples only, excluding the additional summer samples mentioned in the Sampling section. The reason for this exclusion is that results should represent year-round conditions at a site in order to compare the draft standards. Adding the additional summer samples to the analysis biases the result and makes comparison to the standard meaningless.

Table 2.1.3 shows 2008 Water Quality Indices by Site. The top number is the value of the index and the bottom number (in italics) is the number of samples. No indices exceeded the draft standard at the 95% confidence level in WY2008.

Site	NO3+NO2 (mg/l)	TDN (mg/l)	TDP (mg/l)	TP (mg/l)	*E. coli* (MPN/100 ml)	TPH (exceedences)
Merced River (main stem)						
Below Merced Lake	* *1*	* *1*	* *1*	* *1*	–	–
Above Nevada Falls	0.026 *3*	0.125 *3*	0.001 *3*	0.004 *3*	–	–
Above Happy Isles Bridge	0.050 *6*	0.084 *6*	0.003 *6*	0.004 *6*	1.0 *6*	–
Above Sentinel Bridge	0.069 *4*	0.107 *4*	0.002 *4*	0.004 *4*	3.6 *4*	–
Above Pohono Bridge	0.057 *6*	0.077 *6*	0.004 *6*	0.009 *6*	6.3 *6*	0 *6*
Below Foresta Bridge	0.205 *6*	0.242 *6*	0.005 *6*	0.009 *6*	17.4 *6*	0 *6*
South Fork Merced River						
Above Swinging Bridge	0.040 *6*	0.084 *6*	0.003 *6*	0.003 *6*	2.1 *6*	–
Below Wawona Campground	0.025 *6*	0.124 *6*	0.007 *6*	0.009 *6*	3.1 *6*	0 *6*
Tuolumne River						
Dana Fork Below Gaylor Creek	0.015 *5*	0.054 *5*	0.002 *5*	0.002 *5*	2.0 *5*	–
Lyell Fork Above Twin Bridges	0.045 *7*	0.089 *7*	0.002 *7*	0.002 *7*	1.0 *5*	–
Tuolumne River Above Tioga Road Bridge	0.024 *5*	0.068 *5*	0.002 *5*	0.002 *5*	3.6 *5*	–
Tuolumne River Above Budd Creek	0.052 *7*	0.078 *7*	0.002 *7*	0.003 *7*	2.0 *5*	0 *5*
Tuolumne River Below Conness Creek	0.021 *5*	0.054 *5*	0.001 *5*	0.002 *5*	1.0 *5*	–

* Insufficient data for index determination
– Indicates data not collected for a particular site

Discussion

Water year 2008 marks the first year that results are compared to standards. No single index of water quality exceeded the draft standards at the 95% confidence level. One should note that the value for E. coli at Foresta is 17.4 MPN/100 ml apparently exceeds the standard of 5.0 MPN/100 ml. However, given the limited number of samples the lower confidence limit (95%) is less than the standard Peavler et al. (in prep.) will recommend a higher sampling frequency to decrease the range of upper and lower confidence intervals and give the manager greater confidence of the actual condition of the river.

Excepting the limited number of samples, water quality remains excellent. That is, nutrient and E. coli concentrations are not significantly (at the 95% confidence level) different from conditions in 2004-2007 when the baseline data were collected. Sampling for petroleum hydrocarbons revealed no reportable amounts in all sampling for the reporting period.

2.2 RIVERBANK CONDITION

Riverbank condition has been selected as an indicator because the soils and vegetation that stabilize them are essential to the integrity of riparian ecosystems. Although soil erosion occurs along the river as a result of natural river processes, such erosion can be accelerated and exacerbated by human activities (Kondolf et al 1996). Increasing visitor use on susceptible substrates often results in increased soil erosion. Therefore, this indicator is valuable for assessing a site's ability to sustain varying types and levels of visitor use.

Riverside soils and vegetation affect water quality by regulating the entry of groundwater, surface runoff, nutrients, sediments and other particulates, and fine and coarse organic matter to rivers and streams. Accelerated erosion associated with trampling and visitor access can alter these processes, leading to changes in hydrology and water quality.

In addition to indicating loss of soil, erosion may affect cultural Outstandingly Remarkable Values. The amount of riverbank erosion associated with visitor use will be used as an indicator of changes that may be occurring to any cultural resources—namely to archeological sites—that may exist along the river corridor. Riverbank soil erosion that occurs at archeological sites would suggest a potential loss of site stability and loss of intact archeological artifacts and features, critical components of archeological site integrity. Once artifacts and features are displaced from their original context or lost, the information inherent to those deposits is also lost.

Measurement

At each 200 meter long sample reach, we measure channel dimensions, bank vegetation cover, substrate size, and the amount of large wood in the channel. We also collect photographic qualitative data.

Channel cross-sectional transects are measured between permanent markers on opposite sides of the river at three locations: 1) the downstream end of the reach, 2) the center of the reach, and 3) the upstream end of the reach. We also obtain high-resolution topographic scans of the entire reach using a tripod-mountain LiDAR (Light Detection and Ranging) scanner. Two 100-meter vegetation plots are located within the reach, one on either side of the bank.

Vegetation cover, substrate size and the amount of large wood in the channel are measured using point-intercept methodology within a 100-meter vegetation plot and along transect lines. The vegetation plot consists of one baseline and several transect lines, resulting in approximately 200 points per plot. The baseline is located 4 meters beyond the top of the river terrace with the midpoint perpendicular to the reach mid-point. The transects are located from the baseline to the water's edge at 10-meter increments with point data being collected at 1, 2, or 4-meter increments along the transects.

Within the vegetation plots, percent cover of bank stabilizing functional groups (bare ground, canopy cover, herbaceous cover, shrub cover, trees, and large wood) is determined using presence or absence. Substrate is classified by size. (For more detailed information on the vegetation plots see the Riverbank Condition section of the 2008 User Capacity Monitoring Field Guide).

Continuous bank photography is collected using a high resolution digital camera and taking photos approximately every 50 meters along each bank or at such spacing as to allow stitching photos together without edge distortion. Permanent monuments are installed for exact relocation and replica.

Indicator Language and Standards

The indicator language is defined as:
Degree of riverbank erosion along the Merced River. This will be assessed through a combination of vegetative cover condition and substrate erosion condition characteristics.

Standards

Standards for this indicator take in both the aspect of vegetation monitoring and river morphology. After a complete set of sites has been monitored at the end of the 2009 season, morphological and vegetation status standards will be assessed. Vegetation trend will be assessed on sites will begin after sites are repeatedly measured on a 3-5 year rotation.

> **Channel Morphology:** X percent increase in cross-sectional area due to bank scour will lead to management action.
>
> **Vegetation Condition (Trend):** No greater than 10 (or 20) percent decrease in green understory cover (per site or overall?) as compared to a 2008 baseline per stratum.
>
> **Vegetation Condition (Status):** No greater than 20 percent of sites will have less than C percent green understory cover per stratum.

Sampling

In order to be able to characterize conditions along the Merced in Yosemite Valley, we randomly selected sites using the Generalized Random Tessellation Stratified (GRTS) model (Stevens and Olsen 1994) in two river strata. Sites were grouped by those in stretches of river with slopes greater than (Strata 1) or less than 0.005(Strata 0). In addition, we deliberately selected two reaches in high use areas and two reaches in low use areas. Figure 2.2.1 shows all sites sampled in 2008. Additional sites will be added in 2009. More detail is available in the 2008 Field Monitoring Guide.

Sites are visited in order and discarded if not appropriate. Due to the limited field sampling season, we will collect our first set of data over the course of two seasons 2008 and 2009. During the field season

In addition to the randomly selected sites, deliberately chosen sites were selected at four locations in Yosemite Valley. This aspect of the sampling program is vital to ensuring that we are able to examine the types of visitor-related impacts that exist in comparison with the randomly selected sites. Four sites were chosen with consideration given to site access, proximity to destination sites or infrastructure, evidence of erosion, and vegetation quality. Two sites were chosen with these parameters to represent areas of seemingly high use. Two low-use sites were additionally chosen to represent less impacted conditions, stable banks, and healthy vegetation communities. In 2009, a visitor use study will be initiated to link actual visitation numbers of the deliberately chosen sites with the findings of our vegetation and cross-section monitoring.

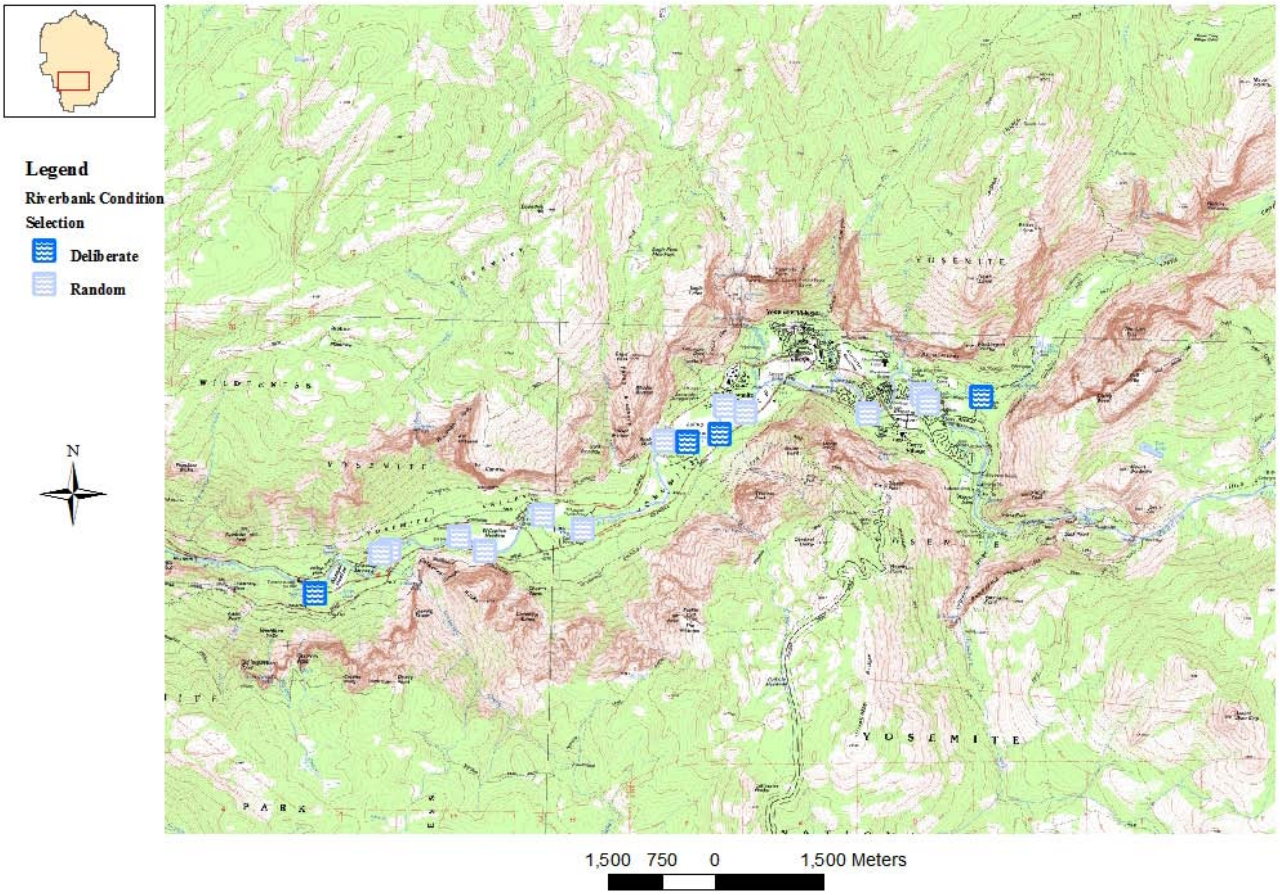


Figure 2.2.1 shows the riverbank condition 2008 sample locations are represented.

Results

Channel Morphology

Given that this was the first season of data collection under this protocol, there is nothing with which to compare cross-section and scanned topographic data. We can, however, demonstrate how this analysis will take place. Figure 2.2.2 is cross-section data from the three cross-sections at Site 003.

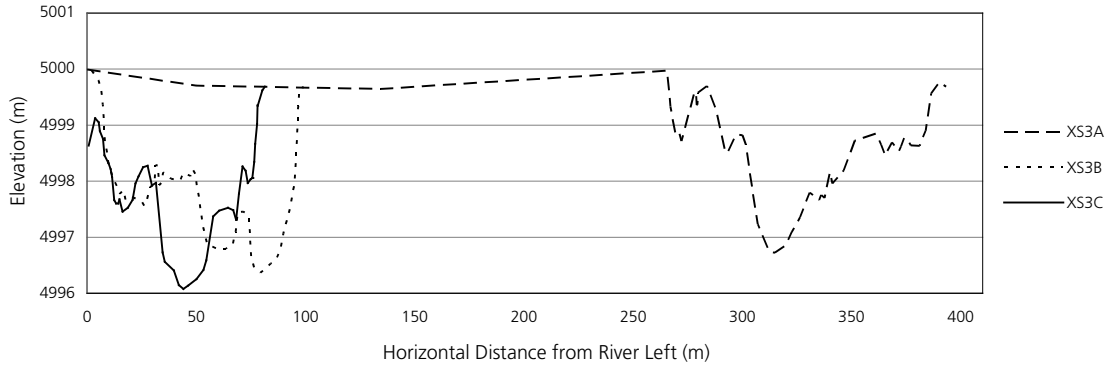


Figure 2.2.2. Cross-sections at Site 003. The view is looking downstream with cross-section 3A furthest upstream to 3C at the downstream end of the reach.

Each cross-section would be compared to the previously surveyed cross-section at that location via the permanent benchmarks at the endpoints and a rate of bank retreat would be calculated. Figure 2.2.3 shows a schematic illustration showing how this would be done. Bank retreat rate for each cross-section would be summed and averaged for each reach.

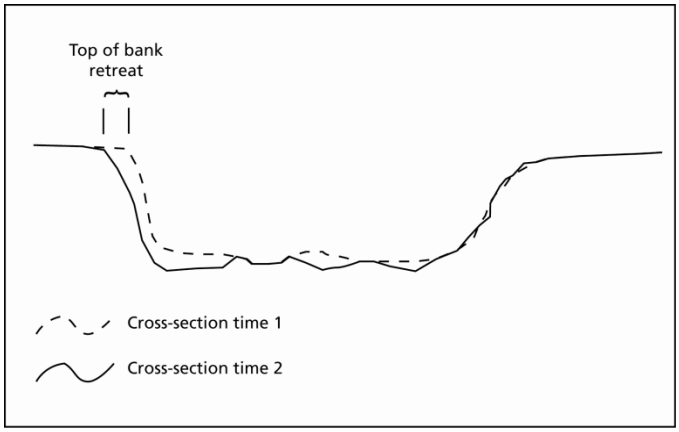


Figure 2.2.3. Schematic Cross-section comparison and calculation of bank retreat.

LiDAR Scans

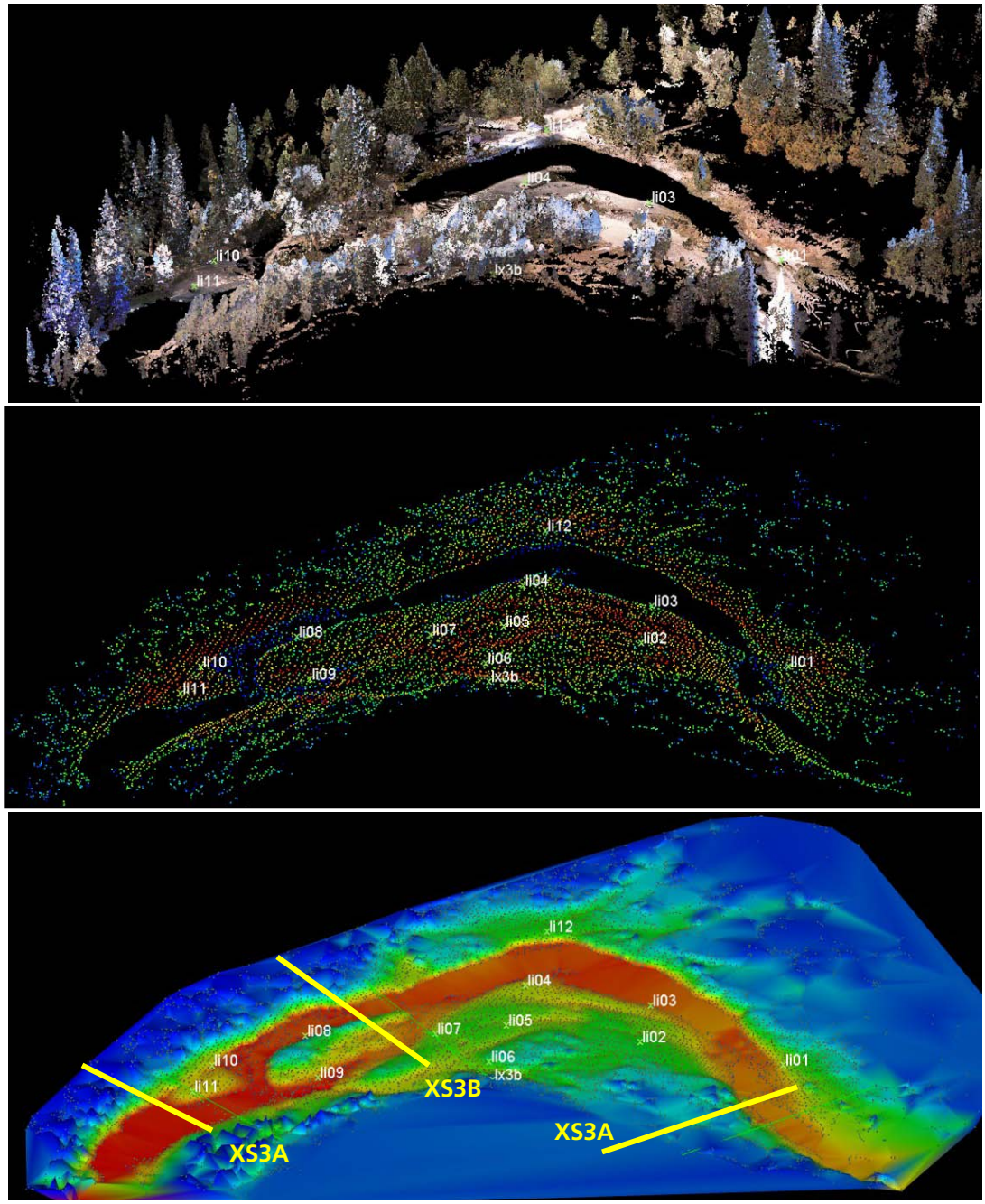


Figure 2.2.4 depicts LiDAR data from Site 003 first as unfiltered point data, then point data with most vegetation filtered out, and finally a surface generated from the ground points. The latter is the most useful for this indicator as we will be able to compare future scans of the same reach and detect changes in riverbank morphology and determine the net amount of change to bank volume, loss or gain.

Vegetation Status

For 2008 data, summary statistics are provided to give a course overview of our preliminary findings. A full statistical analysis will be performed when the complete sample has been collected at the end of the 2009 field season. Tables 2.2.1 through 2.2.5 depict the status of the riverbank condition as presented in the average mean percent cover of functional groups for strata 0-1 and the deliberately chosen sites.

Table 2.2.1 shows average mean percent cover of functional groups for strata 0.

Percent Cover of Functional Groups: Strata 0												
Plot	**Bare Ground or Litter**	**LWD**	**Exposed Roots**	**Non-Vascular**	**Ann / Bien**	**Fibrous Rooted Perennial**	**Tap-Rooted Perennial**	**Shrub**	**Woody Seedling**	**Evergreen Tree**	**Deciduous Tree**	**Snag**
1 VL	0.973	0.024	0.000	0.000	0.141	0.279	0.192	0.131	0.003	0.323	0.168	0.007
1 VR	0.775	0.000	0.017	0.000	0.162	0.156	0.069	0.006	0.006	0.462	0.173	0.017
2 VL	0.740	0.004	0.007	0.004	0.014	0.227	0.000	0.007	0.004	0.282	0.336	0.011
2 VR	0.792	0.017	0.033	0.108	0.000	0.133	0.092	0.017	0.000	0.033	0.517	0.000
3 VL	0.667	0.011	0.004	0.000	0.103	0.131	0.146	0.051	0.000	0.013	0.099	0.105
3 VR	0.852	0.016	0.016	0.000	0.082	0.287	0.189	0.029	0.000	0.127	0.275	0.000
4 VL	0.986	0.014	0.007	0.000	0.027	0.514	0.182	0.007	0.000	0.764	0.115	0.068
4 VR	0.924	0.010	0.000	0.000	0.018	0.472	0.133	0.068	0.000	0.119	0.039	0.000
5 VL	0.984	0.000	0.008	0.000	0.008	0.378	0.024	0.094	0.008	0.425	0.606	0.000
5 VR	0.989	0.005	0.005	0.000	0.005	0.434	0.037	0.011	0.005	0.360	0.148	0.000
6 VL	0.946	0.003	0.000	0.000	0.061	0.240	0.000	0.003	0.000	0.218	0.147	0.022
6 VR	0.878	0.063	0.016	0.000	0.074	0.397	0.000	0.053	0.005	0.069	0.090	0.021
7 VR	0.521	0.013	0.003	0.000	0.000	0.148	0.003	0.088	0.000	0.039	0.181	0.000
7 VL	0.868	0.000	0.041	0.008	0.000	0.385	0.000	0.066	0.000	0.000	0.785	0.000
8 VR	0.913	0.020	0.020	0.000	0.000	0.067	0.000	0.000	0.007	0.513	0.213	0.013
8 VL	0.398	0.019	0.025	0.016	0.003	0.085	0.000	0.016	0.013	0.091	0.232	0.000

Table 2.2.2 shows average mean percent cover of functional groups for strata 1.

Percent Cover of Functional Groups: Strata 1												
Plot	**Bare Ground or Litter**	**LWD**	**Exposed Roots**	**Non-Vascular**	**Ann / Bien**	**Fibrous Rooted Perennial**	**Tap-Rooted Perennial**	**Shrub**	**Woody Seedling**	**Evergreen Tree**	**Deciduous Tree**	**Snag**
201 VL	0.426	0.044	0.007	0.000	0.000	0.060	0.007	0.077	0.007	0.154	0.258	0.000
201 VR	0.601	0.000	0.065	0.007	0.007	0.105	0.020	0.007	0.007	0.373	0.412	0.000
202 VL	0.817	0.024	0.041	0.018	0.006	0.148	0.012	0.041	0.006	0.308	0.213	0.000
202 VR	0.853	0.011	0.038	0.016	0.000	0.136	0.000	0.043	0.000	0.446	0.299	0.016
203 VL	0.800	0.000	0.007	0.047	0.000	0.080	0.000	0.060	0.007	0.460	0.447	0.047
203 VR	0.789	0.000	0.041	0.035	0.000	0.257	0.006	0.023	0.000	0.725	0.392	0.006
207 VL	0.634	0.021	0.014	0.097	0.000	0.076	0.000	0.007	0.007	0.276	0.228	0.048
207 VR	0.687	0.015	0.060	0.022	0.007	0.067	0.000	0.015	0.030	0.828	0.157	0.000

Table 2.2.3 shows average mean percent cover of functional groups for deliberately chosen sites.

Percent Cover of Functional Groups: Deliberately Chosen Sites												
Plot	**Bare Ground or Litter**	**LWD**	**Exposed Roots**	**Non-Vascular**	**Ann / Bien**	**Fibrous Rooted Perennial**	**Tap-Rooted Perennial**	**Shrub**	**Woody Seedling**	**Evergreen Tree**	**Deciduous Tree**	**Snag**
DL1VL	0.931	0.055	0.003	0.031	0.038	0.391	0.000	0.010	0.021	0.322	0.370	0.010
DL1VR	0.925	0.025	0.025	0.000	0.006	0.419	0.000	0.063	0.031	0.656	0.294	0.019
DL2VL	0.805	0.030	0.006	0.213	0.000	0.201	0.000	0.006	0.000	0.396	0.732	0.000
DL2VR	0.508	0.008	0.008	0.000	0.012	0.104	0.004	0.236	0.012	0.180	0.200	0.004
DH1VL	0.873	0.000	0.057	0.000	0.000	0.228	0.000	0.032	0.000	0.335	0.639	0.000
DH1VR	0.497	0.000	0.000	0.000	0.003	0.042	0.000	0.127	0.000	0.071	0.088	0.000
DH2VL	0.804	0.003	0.000	0.000	0.007	0.213	0.000	0.010	0.000	0.189	0.143	0.000
DH2VR	1.000	0.000	0.008	0.000	0.008	0.636	0.000	0.017	0.008	0.000	0.240	0.000

List of Abbreviations
Ann / Bien = Annual/Biennial Plant
DL = Deliberately Chosen Low
DH = Deliberately Chosen High
VL = Vegetation Plot Left Bank
VR = Vegetation Plot Right Bank

Figure 2.2.5 shows the list of abbreviations used in Tables 2.2.1 through 2.2.3.

Brief Definition of Terms
Litter = less than 25 centimeters in diameter
Large Woody Debris = less than 25 centimeters in diameter
Shrub = woody, multi-branched at base, life form and adult stage typically a shrub
Woody Seedling = tree or shrub less than 0.5 meters tall and less than 0.5 meters wide
Snag = Dead standing tree

Figure 2.2.6.shows a brief definition of terms used in Tables 2.2.1 through 2.2.3.

Functional Groups:

The following graphs (Figures 2.2.6 through 2.2.17.) show the means for each functional group measured throughout sites. The sites are grouped into deliberately chosen high and low sites and by strata in the random sample. When a complete sample of random sites is completed at the end of the 2009 field season, further analysis will be used to determine significance of individual functional groups. At this point we will better understand the relationships between the presence or absence of these groups to the overall bank stability and channel morphology. The improved visitor use monitoring will further our understanding of the relationship between vegetation status and degree of impact.

Figures 2.2.6.-2.2.17 represent box and whisker plot of the one-way analysis of large woody debris. The x axis represents the average percent cover for all of strata 0, strata 1, deliberately chosen high, and deliberately chosen low sites as observed in 2008. The width of the boxes shown corresponds to the overall number of points sampled in that group. Strata 0 had the most sites sampled, while the deliberate sites only had two sample sites for each designation.

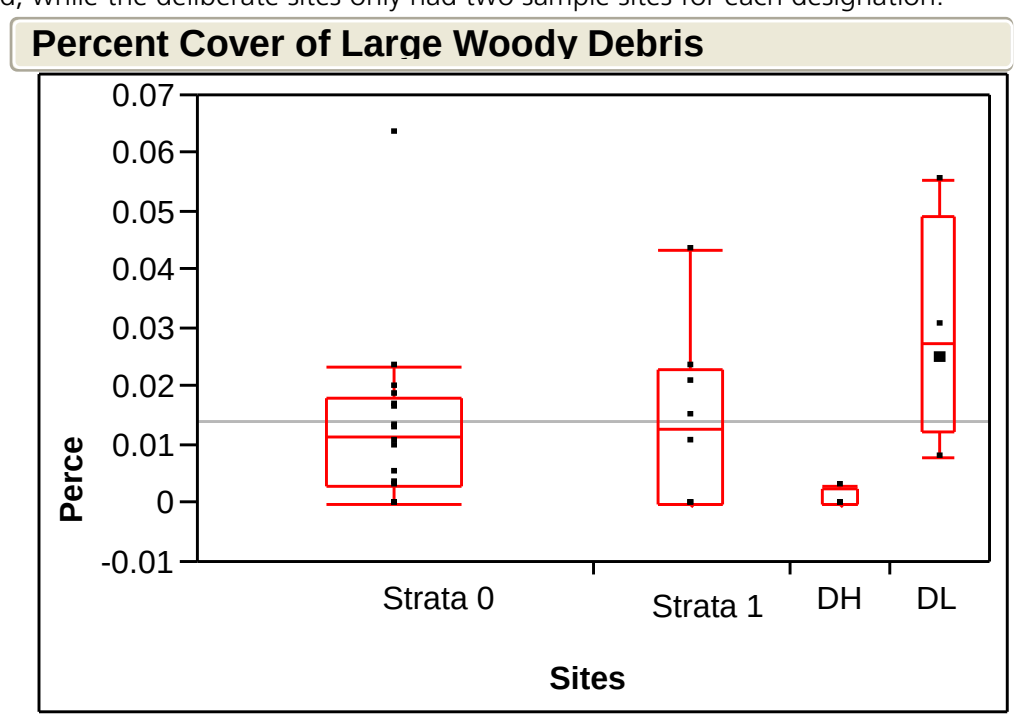


Figure 2.2.7 shows a one-way analysis of percent cover for large woody debris.

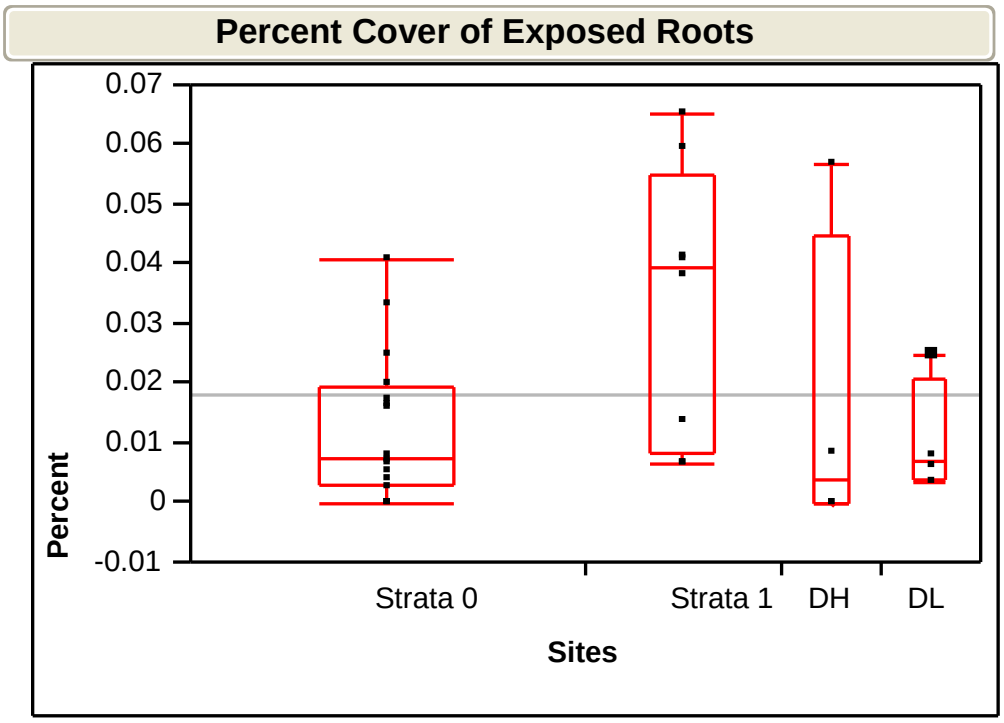


Figure 2.2.8. shows a one-way analysis of percent cover for exposed roots.

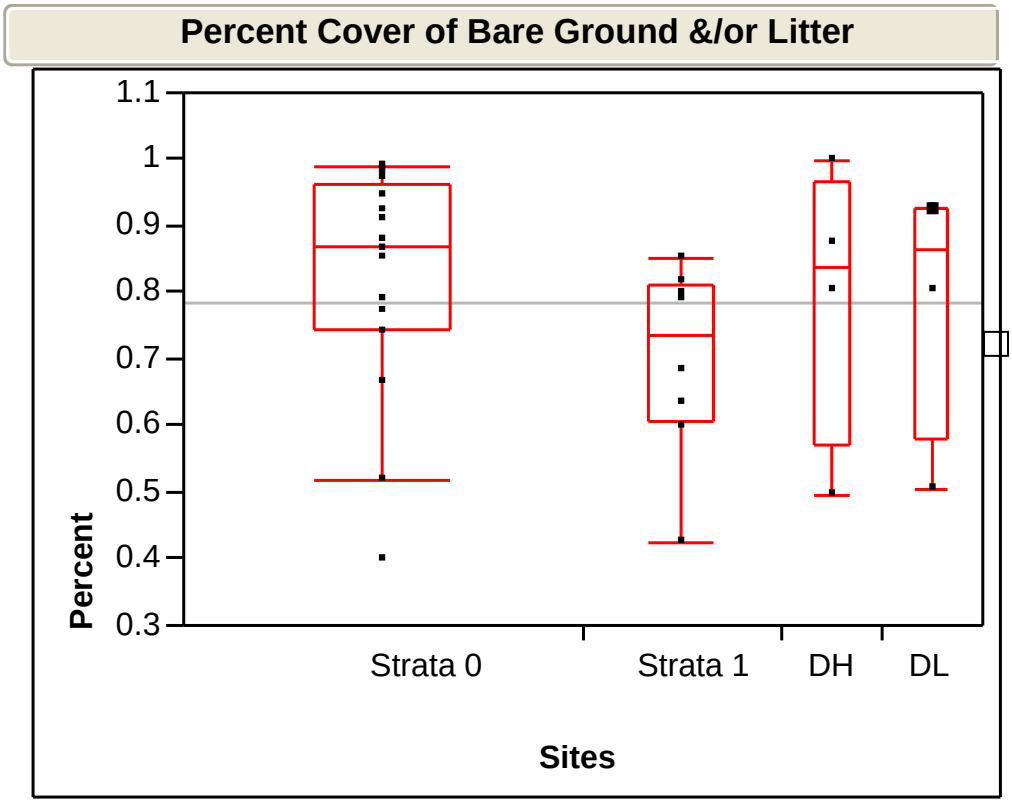


Figure 2.2.9 shows a one-way analysis of percent cover for bare ground &/or litter.

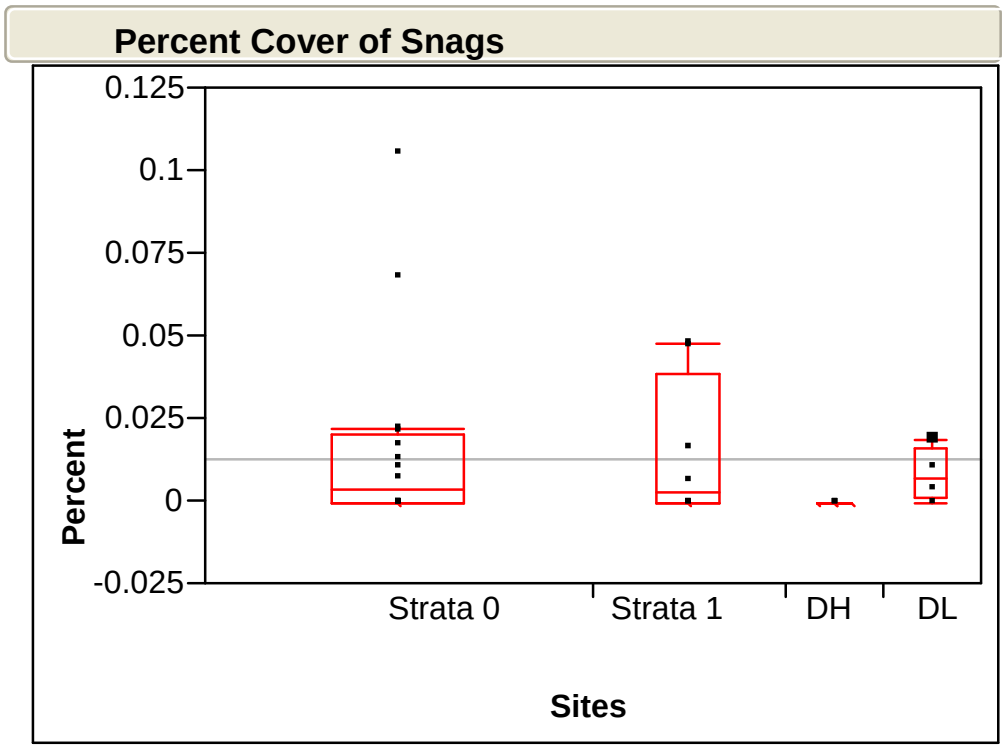


Figure 2.2.10 shows a one-way analysis of percent cover for snags.

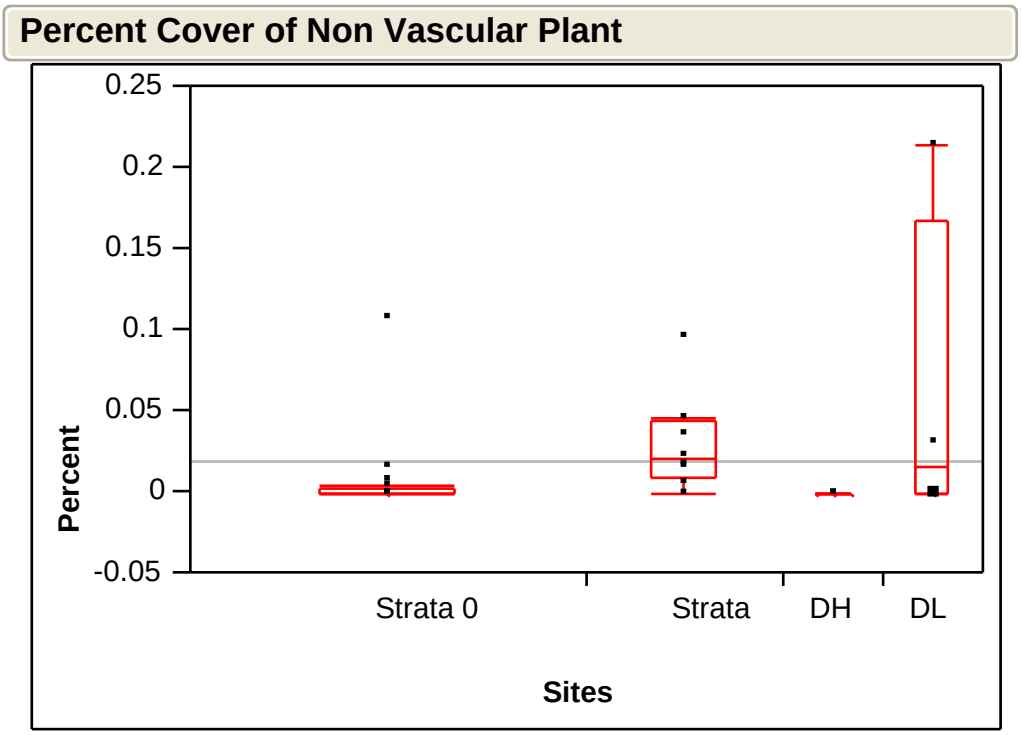


Figure 2.2.11 shows a one-way analysis of percent cover non-vascular plants.

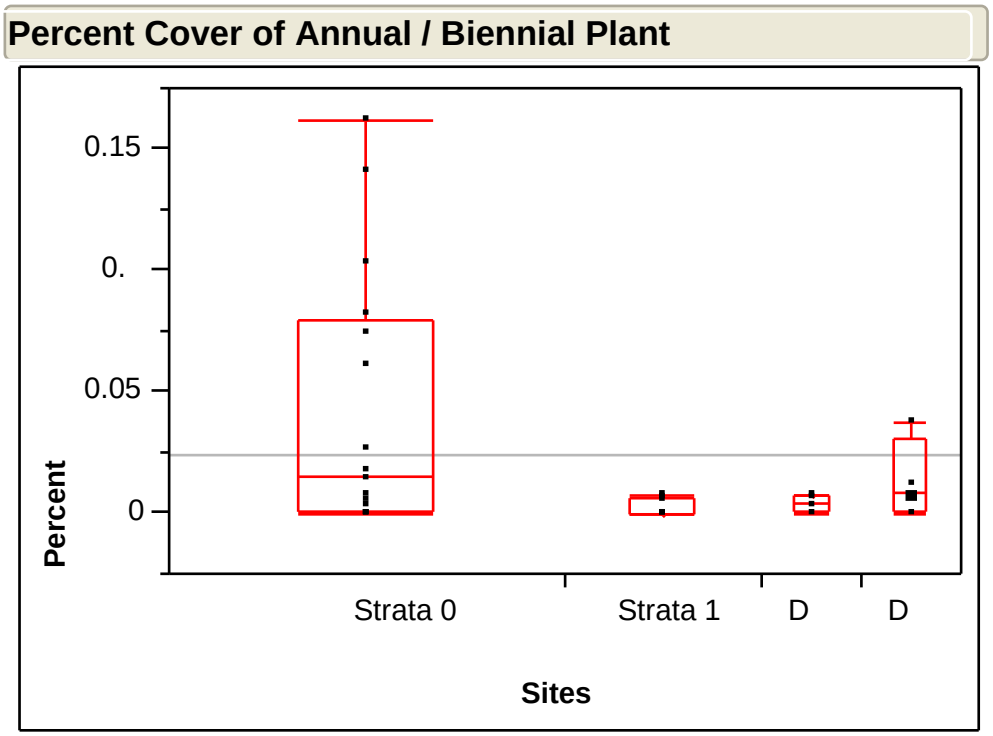


Figure 2.2.12 shows a one-way analysis of percent cover for annual/biennials.

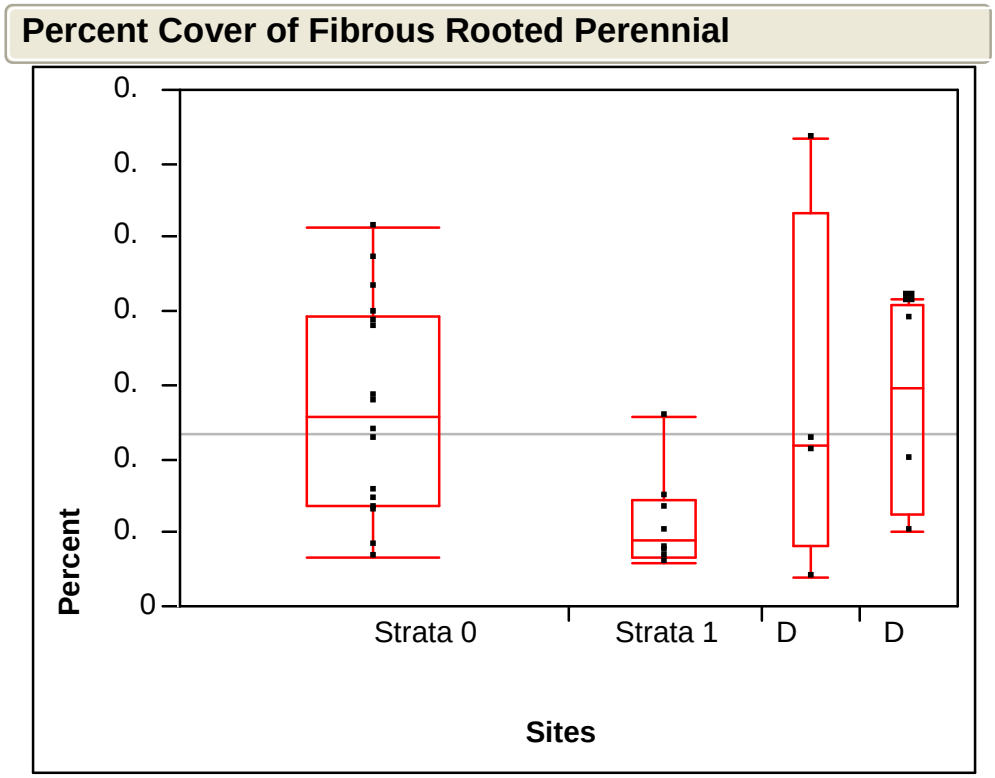


Figure 2.2.13 shows a one-way analysis of percent cover for fibrous-rooted perennials.

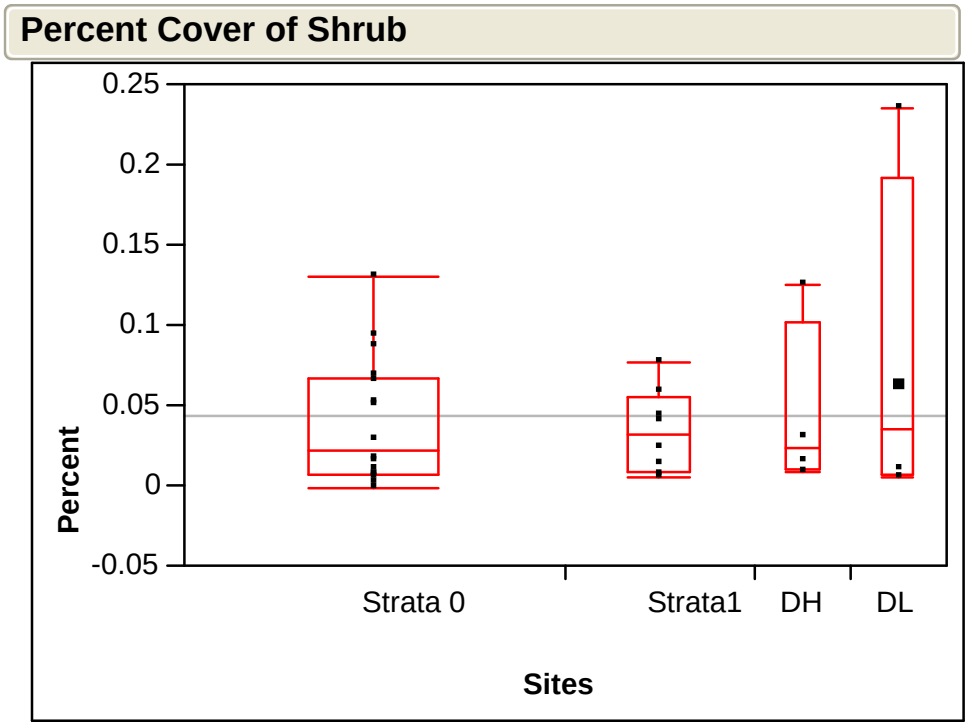


Figure 2.2.14 shows a one-way analysis of percent cover for shrubs.

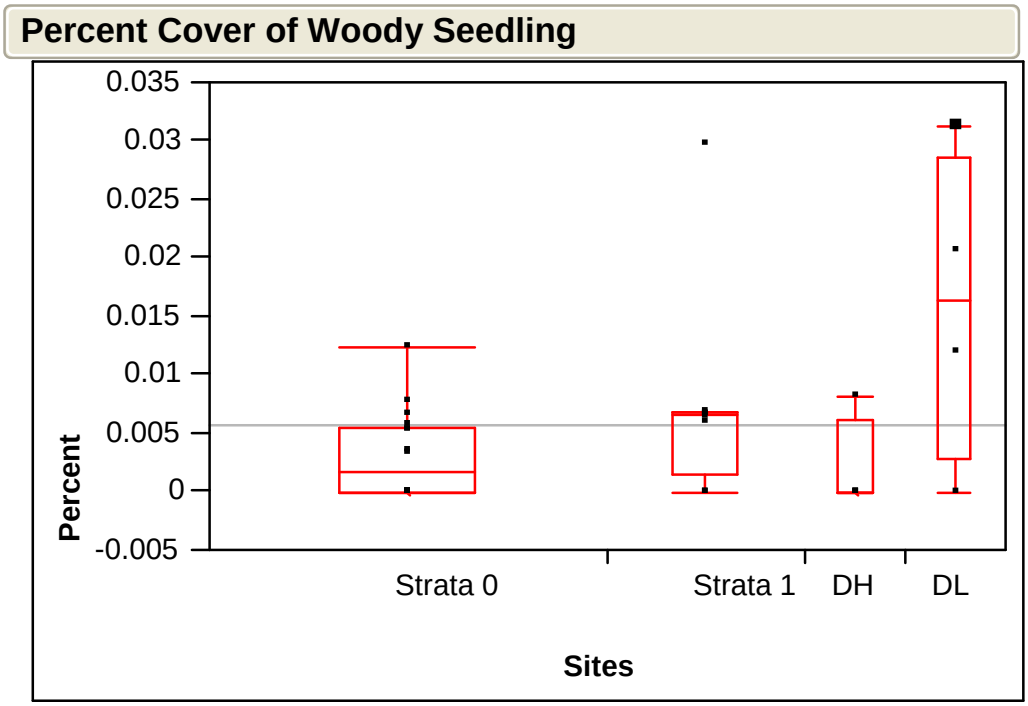


Figure 2.2.15 shows a one-way analysis of percent cover for woody seedlings.

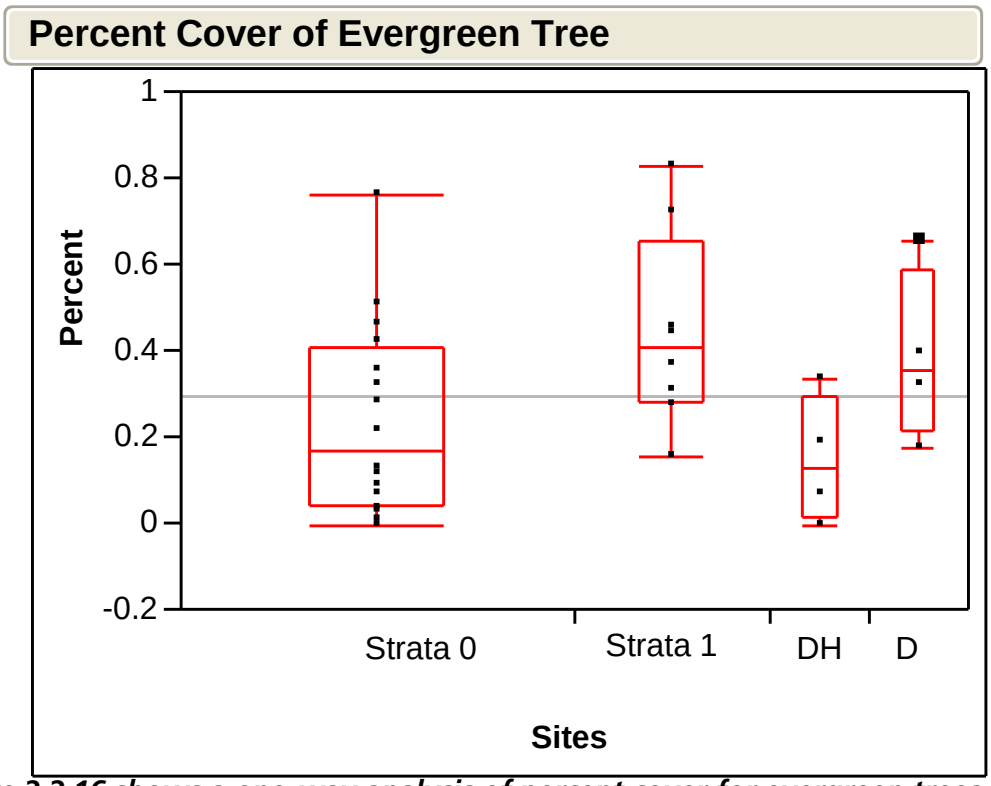


Figure 2.2.16 shows a one-way analysis of percent cover for evergreen trees.

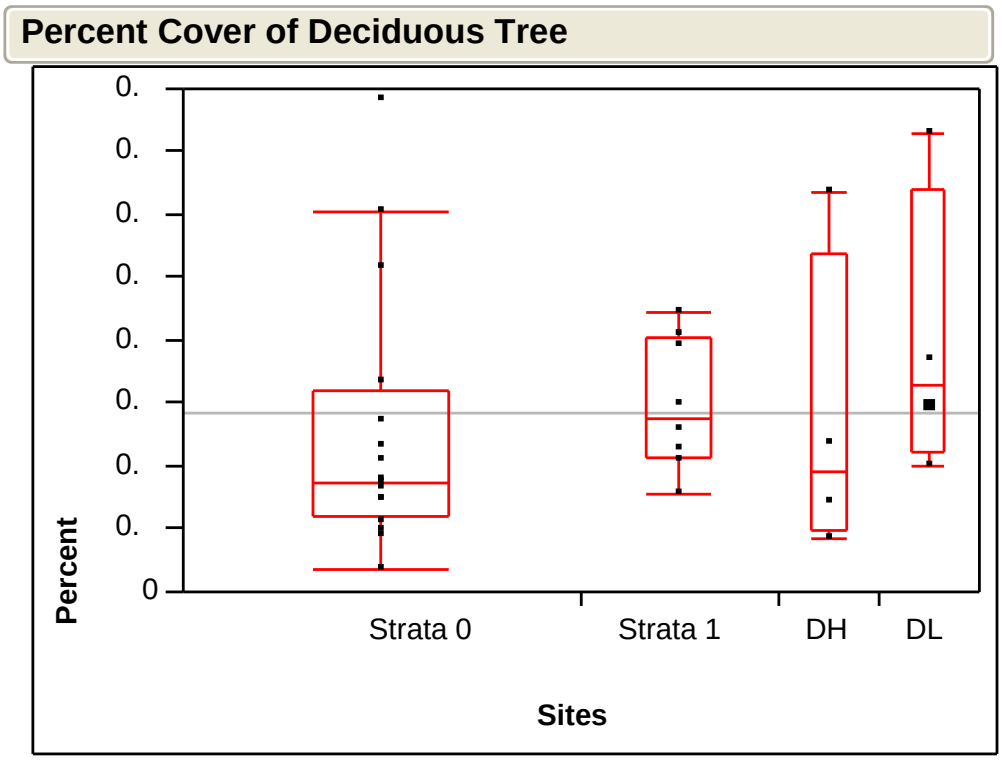


Figure 2.2.17 shows a one-way analysis of percent cover for deciduous trees.

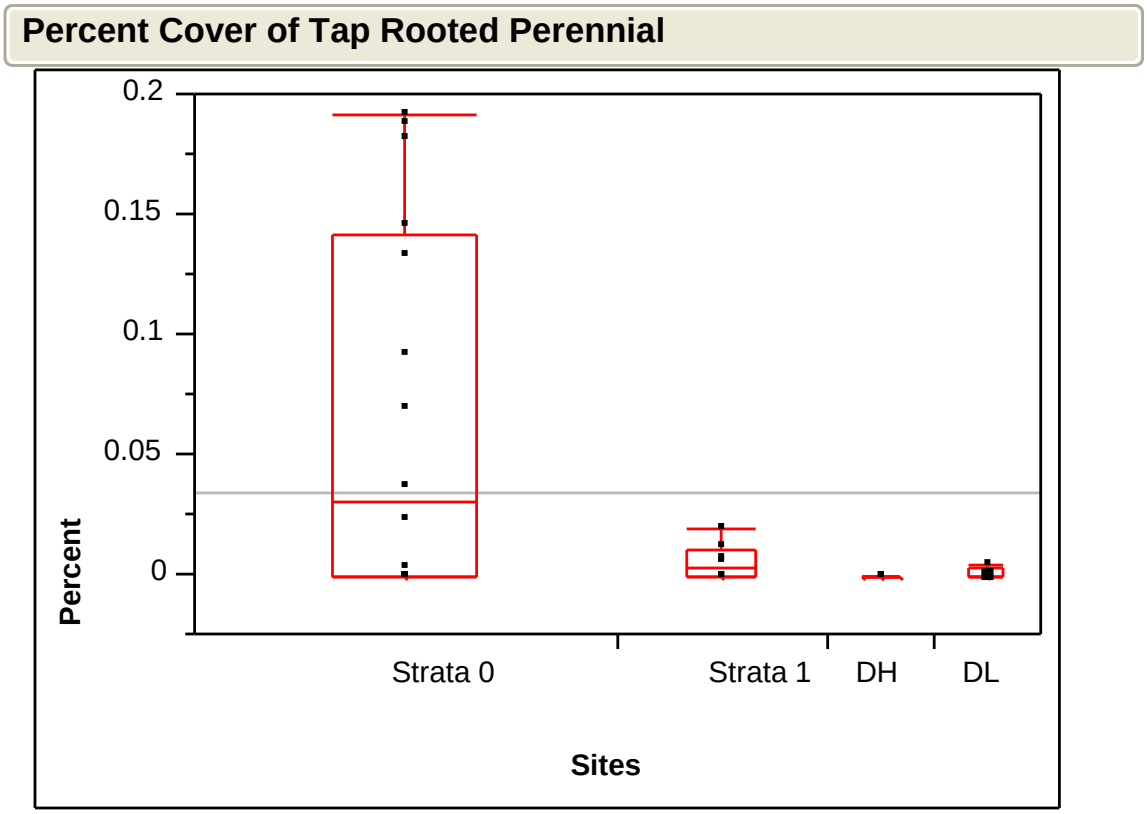


Figure 2.2.18 shows a one-way analysis of percent cover for tap-rooted perennials.

Discussion

The focus of this year's efforts has been on developing stronger protocols and experimental design. We have refined sampling techniques, training for employees, and strategy for data collection. At the end of the 2007 field season various adjustments were made to the sampling protocol and overall experimental design. The most drastic change was the application of the GRTS model for sampling random locations from two slope-determined strata along the river. Additionally we sampled from two deliberately chosen low use sites, and two deliberately chosen high use sites. Due to constraints in staffing and sampling timing, we have broken up the sampling schedule into two cycles. Currently we have only completed the first half of the selected sample. When the second stage of sampling has ended, all data will be analyzed for relationships between vegetation status, channel morphology, and visitor use levels. In 2009, we will complete the sampling of the GRTS generated sample. Park managers are currently working with statisticians from Oregon State University to develop a statistical package that will attempt to test relationships between the vegetation status and the current condition. In addition, visitor use data will be collected at the deliberately chosen sites. This data will be used to better understand the relationships between use levels and behaviors and resulting vegetation condition.

Vegetation Status

Figures 2.2.6 through 2.2.17 demonstrate the average percent cover of each functional group measured, grouped by the two randomly selected strata and the high and low use deliberate sites. In examining the graphs, a few patterns emerge that might reflect indications that will be reflected when the data set is complete. Using the deliberately chosen sites as indicators of more intense impacts, Figure 2.2.7 represents how there is a lower percent cover of exposed roots in the low use sites. A strong presence of this functional group is a clear indicator of soil loss and bank erosion. Another important functional group that indicates potential to stabilize banks and prevent erosion is the large woody debris functional group. Figure 2.2.6 shows how the deliberately chosen low sites demonstrate higher percent cover of large woody debris than that found in the high use sites.

Similarly, Figure 2.2.14 portrays that the deliberately chosen low use sites demonstrate a higher percent cover for woody seedlings than their high use counterparts. These summary statistics help us understand some of the connections that we might be able to identify once our data set for one full set of sites is completed.

Future Directions

This indicator has gone through several variations before reaching its current methods and approach. Although this indicator proves to be fairly labor intensive and complicated, we are optimistic about potential behind the data for demonstrating the current condition of the Merced River banks and channel. After another season of data collection, effort will be focused on analysis and reporting of results. The survey will then be repeated using all existing permanent sites starting in three to five years. With repeat data, we will be able to assess vegetation trends as well as vegetation status. Continuous monitoring is planned in order to monitor changes to bank condition and to evaluate whether standards are being met. We will continue to improve this indicator as other research and methods are developed. With the improvement of visitor use data collection in Yosemite, we will develop ways to correlate visitation numbers with the status of riverbank condition.

2.3 WILDLIFE EXPOSURE TO HUMAN FOOD

The Merced River corridor provides habitat for a variety of animal species. Myriad insects, birds, amphibians and mammals depend on the river and its surroundings for survival. This wildlife is part of the Merced River's Biological Outstandingly Remarkable Values. However, studies have shown that human use may have an adverse impact on wildlife (Decker et al. 1992, Manfredo et al. 1995). Impacts include loss of habitat and food, predation, habituation, and others.

Black Bear (*Ursus americanus*) is quite common in the park and human interaction with them is frequent. These interactions, however, have not always been positive. Often visitors will make their food available to bears by leaving it un-attended at their campsite or in their car. There are documented instances of bears breaking into visitors' vehicles or rummaging through their camp to obtain this food. Bears can become conditioned to human food and are intelligent enough to pursue this food source to the detriment of both the animal and the visitor. A bear's ability to successfully survive in the wild is diminished when it becomes conditioned to human food. And bear "break-ins" to visitors' vehicles and campsites can cause significant impacts to personal property and the quality of a visitors' experience.

An indicator was developed in 2004 to measure visitor compliance with food storage regulations. Compliance rates provide meaningful information as to the extent to which human food may be available to bears. This indicator is thought to be the best proxy to understand the extent to which human use in the Merced River corridor is causing negative impacts to bear populations.

Measurement

Percent compliance with food storage regulations at selected sights.

Standards

95% or greater compliance with food storage regulations in selected campgrounds and parking areas.

Sampling

The monitoring data for this indicator was collected and incorporated into the Bear Patrol Log Database (BPLD). The BPLD was developed for the Human-Bear Management Program (HBMP) in 2005 to ensure accountability with HBMP-funded employees and to collect data on bear monitoring and management activities in the field. In Yosemite Valley, there are an average of 15 HBMP-funded employees that spend at least 80% of their time on bear related issues between the months of May and September. These employees include Visitor Protection, Campground and Interpretation Rangers, and Wildlife Technicians. While the primary duties differ among work units, all employees share the common goal of mitigating human-bear conflicts and protecting wildlife from exposure to human food. This is accomplished through proactive patrols between the hours of 5 p.m. and 4 a.m. when bear activity is the greatest. During patrols, visitors are educated about proper food storage through one-on-one interpretive contacts, campsites and vehicles are checked for food storage compliance, and food storage regulations are enforced through verbal or written warnings and citations. Non-compliance includes the following violations:

1. Feeding human food to wildlife – Knowingly offering human food or baiting wildlife.
2. Improper food storage – Human food stored in locations that are considered inappropriate, such as inside vehicles after dark or in containers that are not approved by the park as wildlife resistant;
3. Improper use of food locker – Food is put in food locker but the locker is wide open, unlocked, or not latched in a way consistent with the instructions provided and the visitors are either away from their site or asleep.
4. Leaving food unattended – Food left in open locker, out in campsite, or other location where the food is out of arms reach, is not actively being prepared or eaten, and/or the food is not visible to any of the camp occupants.

Campground inspections to determine compliance rates were generally conducted after 10 p.m. when most visitors were finished eating dinner and food was put away. Inspections conducted earlier than 10 p.m. often resulted in a very low compliance rate because most people preparing dinner had their food lockers open and food items out of arms reach. These incidents were documented in the BPLD as educational contacts rather than violation or inspection records.

Parking lot inspections were conducted throughout the night, but because food stored inside vehicles during daylight hours is legal, compliance checks on vehicles could only be performed after dark.

Figure 2.3.1 shows a row of bear control food storage lockers.

Results

1. General Compliance

The primary measure for this indicator is *compliance rate*, or the extent to which visitors comply with Yosemite's food storage regulations. Table 2.3.1 presents results of compliance analysis based on the wildlife patrol log database. Data represents inspections and violations that occurred between May 15, 2008 and November 10, 2008. Inspections included only those with over 50% of the average units inspected. Campsite inspections were also only included if they occurred after 10 pm May through August and after 8 pm September through November. Among these eleven locations a total of 604 inspections were conducted in 2008. During these inspections 35,947 vehicles and 26,938 campsites were inspected. Results show that Upper Pines Campground and the Curry Orchard Parking Lot had the highest overall compliance rates of 97.7% and 94.9%, respectively, for campsite and vehicle inspections, whereas Housekeeping Camp campsites had the lowest overall compliance rate of 91.8%.

Table 2.3.1 shows the results of general compliance analysis.

Location	Inspection Type	# Inspected	Overall Compliance Rate (Red indicates location met 95% standard)
Ahwahnee Parking Lot	Vehicle	4441	94.7%
Camp 4 Parking Lot	Vehicle	7704	93.4%
Curry Orchard Lot	Vehicle	3711	94.9%
Curry Village – DNC	Vehicle	5725	94.4%
Wilderness Lot	Vehicle	4172	92.9%
Yosemite Lodge Parking Lot	Vehicle	10194	94.2%
Camp 4 Campground	Campsite	3220	92.0%
Housekeeping Camp	Campsite	10497	91.8%
Lower Pines Campground	Campsite	2534	95.5%
North Pines Campground	Campsite	3176	96.0%
Upper Pines Campground	Campsite	7511	97.7%

2. Monthly Compliance:

Detailed results of monthly compliance are provided in Table 2.3.2. None of the eleven locations exceeded the 95% standard during all five months.

Table 2.3.2 shows the monthly compliance rates by location.

May			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	244	98.4%
Camp 4 Parking Lot	Vehicle	428	97.2%
Curry Orchard Lot	Vehicle	0	NA
Curry Village – DNC	Vehicle	599	97.2%
Wilderness Lot	Vehicle	336	94.3%
Yosemite Lodge Parking Lot	Vehicle	321	96.9%
Camp 4 Campground	Campsite	175	93.7%
Housekeeping Camp	Campsite	200	93.5%
Lower Pines Campground	Campsite	605	97.5%
North Pines Campground	Campsite	682	96.8%
Upper Pines Campground	Campsite	1972	99.1%
June			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	476	96.6%
Camp 4 Parking Lot	Vehicle	1223	95.5%
Curry Orchard Lot	Vehicle	45	93.0%
Curry Village – DNC	Vehicle	705	94.3%
Wilderness Lot	Vehicle	525	95.4%
Yosemite Lodge Parking Lot	Vehicle	1026	93.5%
Camp 4 Campground	Campsite	385	90.6%
Housekeeping Camp	Campsite	2860	92.3%
Lower Pines Campground	Campsite	468	97.2%
North Pines Campground	Campsite	688	96.4%
Upper Pines Campground	Campsite	1961	98.4%
July			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	925	93.9%
Camp 4 Parking Lot	Vehicle	1816	92.6%
Curry Orchard Lot	Vehicle	826	97.5%
Curry Village – DNC	Vehicle	1016	95.3%
Wilderness Lot	Vehicle	1124	91.8%
Yosemite Lodge Parking Lot	Vehicle	3234	93.3%
Camp 4 Campground	Campsite	770	94.3%
Housekeeping Camp	Campsite	3892	91.2%
Lower Pines Campground	Campsite	310	92.9%
North Pines Campground	Campsite	344	94.5%
Upper Pines Campground	Campsite	1069	97.7%

Table 2.3.2 shows the monthly compliance rates by location (continued).

August			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	1265	92.9%
Camp 4 Parking Lot	Vehicle	1983	92.0%
Curry Orchard Lot	Vehicle	1330	94.6%
Curry Village – DNC	Vehicle	1116	92.3%
Wilderness Lot	Vehicle	1228	91.6%
Yosemite Lodge Parking Lot	Vehicle	2704	94.7%
Camp 4 Campground	Campsite	945	93.5%
Housekeeping Camp	Campsite	2617	93.0%
Lower Pines Campground	Campsite	636	95.9%
North Pines Campground	Campsite	774	96.9%
Upper Pines Campground	Campsite	1313	95.8%
September			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	1072	95.1%
Camp 4 Parking Lot	Vehicle	1451	92.3%
Curry Orchard Lot	Vehicle	521	96.0%
Curry Village – DNC	Vehicle	1747	95.2%
Wilderness Lot	Vehicle	865	94.6%
Yosemite Lodge Parking Lot	Vehicle	2294	93.2%
Camp 4 Campground	Campsite	385	93.5%
Housekeeping Camp	Campsite	928	89.2%
Lower Pines Campground	Campsite	437	94.1%
North Pines Campground	Campsite	602	94.7%
Upper Pines Campground	Campsite	693	97.8%
October			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	345	95.9%
Camp 4 Parking Lot	Vehicle	803	95.5%
Curry Orchard Lot	Vehicle	398	92.0%
Curry Village – DNC	Vehicle	542	91.7%
Wilderness Lot	Vehicle	94	89.4%
Yosemite Lodge Parking Lot	Vehicle	615	100%
Camp 4 Campground	Campsite	525	85.1%
Housekeeping Camp	Campsite	0	NA
Lower Pines Campground	Campsite	78	85.0%
North Pines Campground	Campsite	86	95.4%
Upper Pines Campground	Campsite	503	94.6%

Table 2.3.2 shows the monthly compliance rates by location (continued).

November			
Location	**Inspection Type**	**# Inspected**	**Compliance Rate**
Ahwahnee Parking Lot	Vehicle	114	96.5%
Camp 4 Parking Lot	Vehicle	0	NA
Curry Orchard Lot	Vehicle	0	NA
Curry Village – DNC	Vehicle	0	NA
Wilderness Lot	Vehicle	0	NA
Yosemite Lodge Parking Lot	Vehicle	164	100%
Camp 4 Campground	Campsite	0	NA
Housekeeping Camp	Campsite	0	NA
Lower Pines Campground	Campsite	0	NA
North Pines Campground	Campsite	0	NA
Upper Pines Campground	Campsite	0	NA

Figure 2.3.2 portrays the overall compliance rates of vehicle inspection locations from May through October. Data was incomplete for some locations in November, therefore that month was eliminated from the graph. The parking lots exhibited less stability compared to campground compliance rates. North Pines Campground (campsite inspection) exhibited high levels of stability over the use season, while the compliance at the other five locations was less stable. For example, the Yosemite Lodge Parking Lot ranged from 93% to 100% throughout the season.

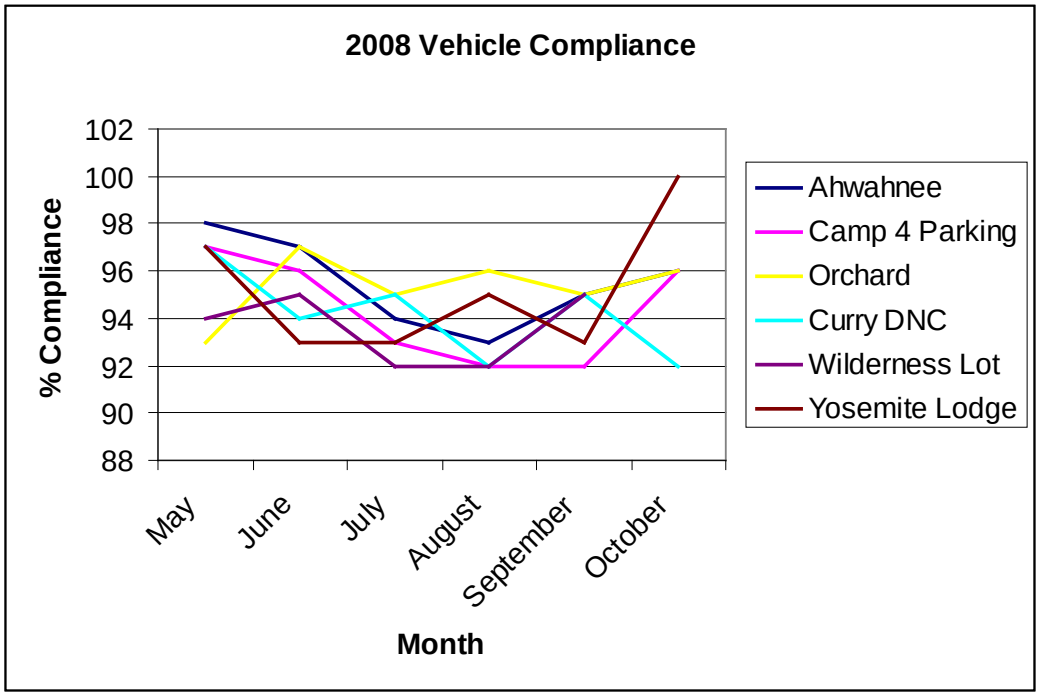


Figure 2.3.2 shows the overall vehicle compliance rates by month and location.

Figure 2.3.3 portrays the overall compliance rates of campsite inspection locations from May through October. Data were incomplete for some locations in November due to campground closures; therefore that month was eliminated from the graph. The campsites exhibited higher levels of stability compared to vehicle compliance rates. Camp 4 Campground and Housekeeping Camp never reached a compliance rate greater than 95%.

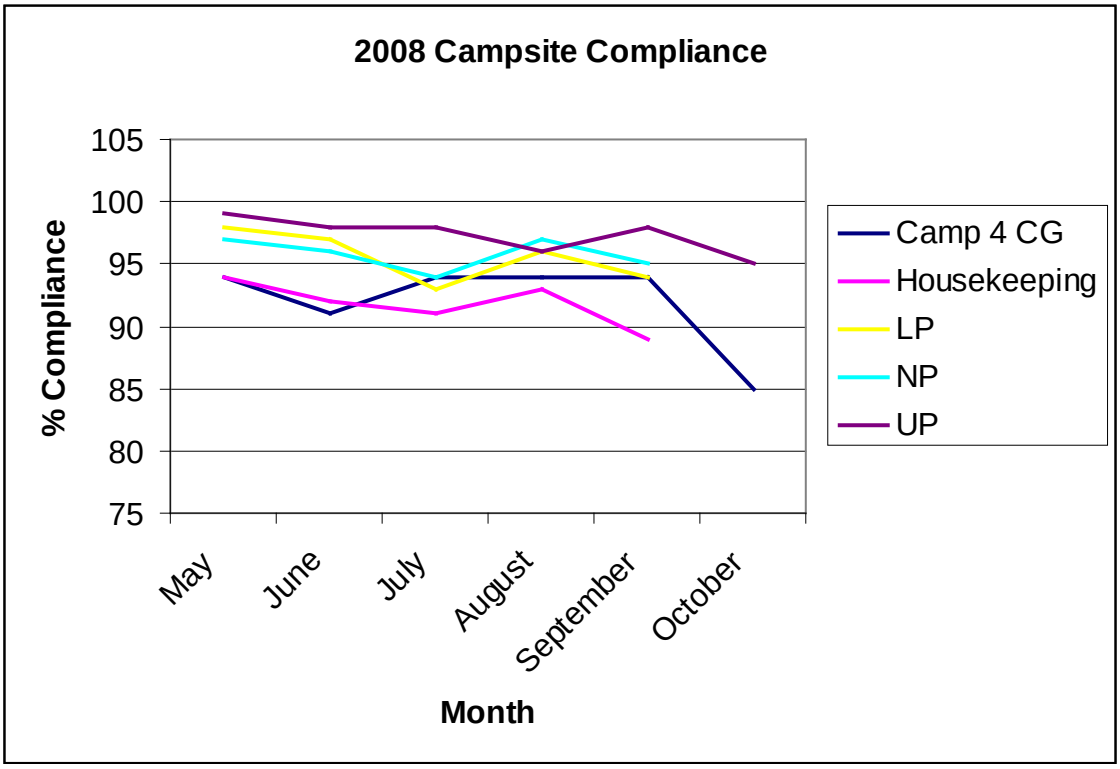


Figure 2.3. shows the overall campsite compliance rates by month and location.

3. Types of Violations:

The BPLD documented the type of violation for each non-compliance record. An understanding of the distribution of violation types in different locations can help customize management and public communication strategies at specific facilities and use areas. Table 2.3.3 displays the distribution of violation types across six vehicle inspection locations and across the seven different violations that are tracked during inspections.

Table 2.3.3 shows frequencies of violations by type and location for vehicle inspections.

Violation Type	Ahwahnee	Camp 4 Parking	Orchard Parking	Curry Village	Wilderness Lot	Yosemite Lodge	Total (Type)
Unattended food or attractant in vehicles	230	498	177	319	292	568	2084
Unattended food or attractant	0	0	0	0	1	0	1
Food Locker/left open	0	0	0	0	1	0	1
OB camper w/ food in vehicle	0	0	0	0	0	0	0
Visitors too far from food	0	0	0	0	0	0	0
Food Locker/Improperly locked	0	0	0	0	0	0	0
Baiting	0	0	0	0	0	0	0
Total *(Location)*	**230**	**498**	**177**	**319**	**294**	**568**	**2086**

The results indicate that unattended food or attractant in vehicles was the most common type with 2084 counts of violation. Camp 4 and Yosemite Lodge Parking Lots appear to have a significant problem with visitors leaving their food or attractant unattended in vehicles.

Table 2.3.4 shows frequencies of violations by type and location for campsite inspections.

Violation Type	Camp 4 CG	Housekeeping Camp	Lower Pines	North Pines	Upper Pines	Total (Type)
Unattended food or attractant in vehicles	0	7	31	26	37	101
Unattended food or attractant	77	266	14	20	34	411
Food Locker/left open	8	53	6	6	7	80
OB camper w/ food in vehicle	0	0	0	0	0	0
Visitors too far from food	20	86	19	30	41	196
Food Locker/Improperly locked	150	472	44	44	33	743
Baiting	0	0	0	0	0	0
Total *(Location)*	**255**	**884**	**114**	**126**	**152**	**1531**

Campgrounds had a wider range of violations, especially those related to food locker use and unattended food. Food lockers improperly locked, visitors leaving food unattended, and visitors too far from their food were the most common violations. Housekeeping Camp appears to have the most significant problem with visitors not storing food properly.

Year to year comparison:
In 2008, compliance rates dropped compared with 2007 compliance rates. Camp 4 Campground was the only location to show an increase in compliance rate (by 3%) while the Wilderness Lot and Housekeeping Camp had the largest decrease in overall compliance rate at 3.4%. Factors that could have influenced the increase at Camp 4 Campground include the presence of two campground hosts dedicated to educating campers and mitigating human-bear conflicts.

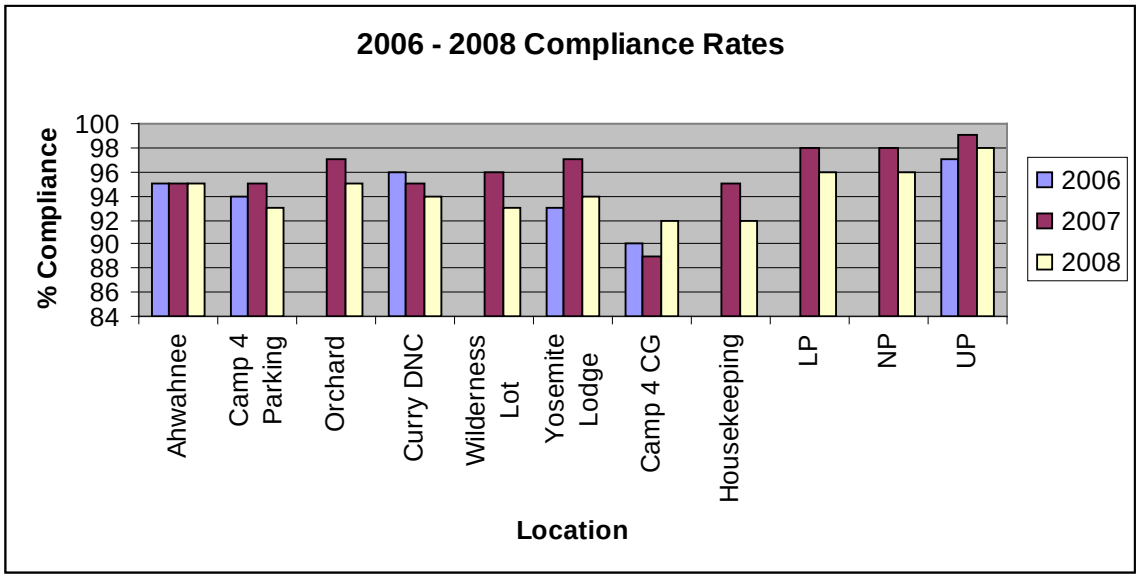


Figure 2.3.4 shows the overall 2008 compliance rates compared with 2006 compliance rates.

Discussion

Results from the 2008 field season suggest that food storage compliance rates at three out of the eleven inspection locations exceeded the proposed standard of 95%. The three locations exceeding the standard are campgrounds located in close proximity to one another and are heavily patrolled by the Interdivisional Bear Team. Management attention is needed for certain locations, such as Camp 4 Campground, Housekeeping Camp, and the Wilderness Lot, especially towards the end of the summer months. An increase in public contacts by Interpretation staff during early evening hours could help increase compliance at Camp 4 and Housekeeping Camp. In addition, a campground host in Housekeeping Camp could also be beneficial in increasing food storage compliance. A greater emphasis should be placed on the importance of a properly latched food locker in campgrounds, either through public contacts or improved signage. The compliance rate in the Wilderness Lot could be increase by improved messaging through the Wilderness Office when visitors obtain their backcountry permits.

In 2007 and 2008, five additional locations in Yosemite Valley were inspected as part of the User Capacity Monitoring protocol for this indicator. The Interdivisional Bear Team was patrolling these locations on a regular basis as a normal part of their routine so it made sense to add these locations to the locations inspected for User Capacity Monitoring. In the protocol, inspections were to be completed once a week per location, May 15th through November 10th. However, due to several factors including staffing levels, campground closing dates, high bear activity during the day, and bear activity in other areas of the park, inspections were not always completed once a week for every location. Table 2.3.5 portrays the number of inspections completed throughout the season for each location and the percentage of weeks that were inspected. Many times, locations were inspected more than once a week, but due to bear activity in other areas, the same location would not be inspected at all the following week. Depending on bear activity in 2009, a better effort should once again be made to ensure all locations are inspected each week. A weekly check list of inspection locations might help to ensure inspections are completed.

Table 2.3.5 shows the total inspections completed by site.

Location	Total Inspections Completed (May 15 – Nov 10)	Percentage of Weeks Inspected
Ahwahnee Parking Lot	48	91%
Camp 4 Parking Lot	109	96%
Curry Orchard Lot	18	53%
Curry Village – DNC	39	77%
Wilderness Lot	81	81%
Yosemite Lodge Parking Lot	70	86%
Camp 4 Campground	92	96%
Housekeeping Camp	41	62%
Lower Pines Campground	34	58%
North Pines Campground	37	77%
Upper Pines Campground	35	72%

In 2009, accomplishing the following objectives may improve food storage compliance rates:

- Campground hosts for Housekeeping Camp to patrol the area during the early evening hours to give educational bear and food storage messages and to perform a later patrol to ensure food lockers have been latched properly and all food has been stored.
- Improved messaging through the Wilderness Office by educating visitors picking up backcountry permits about removing all food from vehicles while parked in the Wilderness Lot overnight. Better signage in the parking lot may also help increase compliance.
- Recognizing the importance of good training; DNC front desk staff will again be trained to give effective wildlife messages to visitors checking into lodging.
- Increased messaging through Interpretation and Campground staff on the importance of ensuring food lockers are latched properly.

2.4 EXTENT AND CONDITION OF INFORMAL TRAILS

Informal trails (or visitor-created "social" trails) may be defined as discernible and continuous trail segments that were created by visitors and which do not follow a park's formal trail system (Leung et al. 2002). Since informal trails are not planned or constructed they are usually poorly located with respect to terrain. These trails also receive very little or no maintenance. These factors substantially increase their potential for degradation in comparison to formal trails. The proliferation of informal trails may increase habitat fragmentation and can directly threaten sensitive habitats when crossed or accessed by unplanned trails (Tyler and Johnson 2004). From a social perspective, a web of informal trails creates a visually scarred landscape and may lead to safety and liability concerns

Monitoring can provide timely information on the extent, distribution and condition of informal trail segments. The findings from data collection combined with established minimum acceptable conditions can serve as warning signs of resource degradation and habitat intrusion. In turn, such information can trigger management action.

This report presents the findings from the data collected through surveying the extent and condition of informal trails in selected sites in Yosemite Valley and Tuolumne Meadows. In 2008, baseline data was further expanded with monitoring conducted in the meadows of Lyell Canyon and Dana Meadows.

The data collection methods from 2007 were repeated. However, there were slight changes made to the trail-condition classification. Particular attention was placed on collecting more detailed information of all features. Braided and rutted became features with attributes, instead of attributes of a feature. Disturbed areas were assigned condition class ratings. Also, the data dictionary was streamlined, making it more efficient and user friendly. The same methodology was applied to Yosemite Valley and Tuolumne Meadows. Otherwise, our collection methods remained consistent with the 2007 protocols.

Description of indicator and standard

Indicator: The proliferation and condition of informal trails in meadows and the resulting fragmentation of meadow habitat.
Standard: Numerical standards are currently in development for this indicator. Separate standards will reflect both fragmentation and extent of informal trailing.
Rationale for indicator: Monitoring the extent and condition of informal trails in meadows contributes to the protection and enhancement of many of the Outstandingly Remarkable Values (ORV) of the Merced and Tuolumne river corridors. The biological ORV is represented through the following rationale: the extent and condition of informal trails is indicative of the contiguity and ecological health of meadows and wetland areas, and impacts to wildlife habitat, including special-status species. The cultural ORV is represented through the fact that archaeological sites and traditional gathering areas used by American Indian groups exist in some meadows, and could be affected by the proliferation and length of informal trails in meadows. The recreation ORV is represented through the understanding that informal trails in meadows may affect visitor experience, as meadows are enjoyable areas in which to engage in a variety of recreational opportunities—including nature study, photography, etc. And lastly, but not finally, the scenic ORV is represented by the extent to which informal trails may impact the scenic interface of river, rock, meadow, and forest.

Objectives

To document the extent and condition of informal trails in meadows of Yosemite Valley and Tuolumne Meadows; to further establish baseline data on these impacts; and to compare results (where applicable) to data collected in 2004 through 2008. Results will be used to inform management decisions regarding protection of meadow health. Documentation of informal trailing impacts is currently confined to meadows to most efficiently monitor visitor impacts to important ecological components.

Sampling Design

For the past five years, eight meadows in Yosemite Valley have been monitored to inventory and assess the presence and condition of informal trails therein. These eight meadows were selected because they lie within the Merced River corridor. All meadows have been measured since the 2007 refinement of data collection methods and the overall scope of the indicator. Several meadows in the Tuolumne River Corridor have been monitored since this refinement as well. In 2009 meadows in Yosemite Valley will be repeat measured. During that time additional meadows will be selected to round out our understanding of meadow impacts.

Site selection

In 2008, five Yosemite Valley meadows were monitored: Ahwahnee, Cooks, El Capitan, Stoneman and Slaughterhouse (previously and erroneously referred to as Woskey Pond). Meadow selection each field season adheres to a three to five year monitoring rotation. Additionally meadows with management concerns are more frequently monitored.

In Tuolumne Meadows, three areas were monitored: Tuolumne Meadows, the meadows of Lyell Canyon, and Dana Meadows. This marks a significant development in the monitoring program, in that it provides a much more comprehensive view of the meadows within the Tuolumne River corridor and will greatly increase the knowledge needed to develop the protocol and standards.

Sampling schedule

In Yosemite Valley, monitoring was conducted over a four-week period, between mid-June and mid-July. In Tuolumne Meadows, monitoring was conducted in July.

Data Analysis Procedures
(For detailed data analysis procedures see the Informal Trails section of the 2008 UCMMP Field Guide.)

Fragmentation Analyses:

Due to the large amount of attributes that may influence the integrity, functioning and quality of landscape, ecosystem or park environment, indices are commonly used to integrate various attributes for data reporting and communication in such fields as ecology, landscape ecology, conservation studies and environmental sciences. There is a large body of literature on landscape indices (Chust et al. 2004; Forman 1995; McGarigal & Mark, 1995) as well as indices developed for characterizing visitor impacts (Leung & Marion, 1998). One of the most comprehensive references

on this topic was published by McGarigal and Marks (1995) in which more than 50 landscape indices were identified and described.

An initial review of landscape indices suggested that *three* indices were closely related to the key issues and concerns about informal trails. The indices were chosen due to their reflection of *proliferation* and *fragmentation* in a landscape (meadow), and for their relative ease to derive from GIS/GPS data using common GIS software such as ESRI ArcGIS. These three indices, Mean Patch Size, Core Area Index and Largest Patch Size (McGarigal and Marks, 1995), were tested in ArcGIS with El Capitan Meadow's 2006 data and results reported to the Park staff in October 2007.

Based on the discussion with park staff and particularly the GIS specialist, two of the three indices, Mean Patch Size and Largest Patch Size, were modified to better reflect the nature of informal trail impacts. The modified indices are named *(1) Weighted Mean Patch Index (or WMPI) and (2) Largest Patches Index (or LPI-5)*. The Core Area Index was eliminated from consideration because of the difficulties of its interpretation. Efforts will continue to be made to identify other appropriate metrics so that the most informed choice of informal trail indices can be made at the end of the pilot monitoring program (2009). The following is a description of each selected index:

A. Weighted Mean Patch Index (WMPI)
Definition: This index was built on the Mean Patch Size (MPS) metric described in McGarigal and Marks (1995). Despite its intuitiveness, this index proved to be less effective in capturing the effect of informal trails and disturbed areas on patch size.. To address this limitation, a weighting factor was added to adjust for the spatial extent of informal trail network. It is defined as the average area (in square meters) of all patches without informal trails in a landscape, weighted by the extent of disturbed areas associated with informal trail impacts. In other words, this index is indicative of the average size of patches without informal trials with consideration of the dominance of informal trail features in a landscape.

Metric: $WMPI = wf * (\sum aij / n) * (1/10000)$

where $wf = (\sum aij / A)$

Notations: aij = area (m2) of patch ij, n = total # of patches without informal trails, wf = weight factor, A = landscape/meadow area
Unit: square meters
Range: 0 to infinity
Interpretation: Decreasing values indicate increasing degrees of fragmentation. Increasing spatial extent of informal trails would result in reduced index values even if the average patch size does not change.

B. Largest Patches Index – Five (LPI-5)
Definition: Adapted from the concept of Largest Patch Index (McGarigal and Marks 1995), this index is derived from the sum of areas of the five largest patches without informal trails, divided by total landscape (meadow) area. The main purpose of including the largest patches as a group, rather than merely the largest patch, is to reduce the index's over-sensitivity to changes in one single patch. Three and ten largest patches (LPI-3, LPI-10) were also considered, and five was chosen by the research team and park staff to achieve a balance between simplicity and representativeness. This index could be easily adapted if a different number of patches was desired in a later date.

Metric: LPI-5 = ∑ max5 (aij) / A * 100%

Notations: maxi = the largest i patches; aij = area (m2) of patch ij, A = area (m2) of the landscape (meadow)
Unit: Percent
Range: 0-100
Interpretation: Decreasing values would suggest increasing degrees of fragmentation

Extent and Proliferation Analyses:
Additional indices are used to determine the change in trail density and proliferation when compared with previous data. The following are descriptions of the additional indices:

C. Median Patch Size The average median patch size. Decreasing value suggests increasing fragmentation.
D. Total Extent of Impact The length and density of informal trails. Increasing value suggests increasing trailing.
E. Total Percent of Impact The extent of impact divided by the total meadow area. Increasing value suggests increasing trailing.

Meadow Boundary

In 2005, the meadow boundary of each of the eight Yosemite Valley meadows was mapped using a GPS mapping device. The boundary locations were determined through vegetation classification, the location of roads, and historic meadow boundaries.

Additionally, beginning in 2007, infrastructure such as formal trails, boardwalks, and roads will be used to determine meadow boundaries, and in some cases will result in meadows being separated into sub-meadows for purpose of analysis. Also for analysis purposes, infrastructure will not be included as part of the meadow, because infrastructure does not fit the definition of meadow nor are they informal trails or disturbed areas. The following steps summarize these procedures and can be viewed in more detail in the Informal Trails section of the 2007 UCMMP Field Guide.

First, if the meadow contains infrastructure, the infrastructure is erased from the meadow area and meadow segments are created. The area of the resulting segments are then calculated and compared to the area of the original meadow. If the segment area is greater than five percent of the original meadow area, then a sub-meadow is created. If the segment area is less than or equal to five percent of the original meadow area, then the segment remains part of the original meadow and a sub-meadow is not created. In both cases, infrastructure is not included as data to be analyzed.

Influence Zone

Lastly, based on work by Jeff Holmquist (Holmquist and Schmidt-Geggenbach 2008), a five meter buffer was added to the informal trails and disturbed areas to illustrate these findings. This influence zone allows us to take into account areas beyond the measureable impacts that could reflect disturbance to vegetation and animal communities.

Results

Fragmentation Analysis

The graphs on the following page demonstrate the varying results of all Yosemite Valley meadows analyzed using two selected metrics. The lower bars on the graph demonstrate the greatest concern. When monitoring meadows we consider each metric separately to have a broader understanding of the effect on informal trail impacts on current conditions. The meadows consistently showing least concern are meadows that have been restored in recent years. Figure 2.4.1 demonstrates all Yosemite Valley meadows as analyzed using the weighted mean patch index, while Figure 2.4.2. examines the same meadows as analyzed through the 5 largest patches index. Restoration or infrastructure in meadows can sometimes effect how the results appear. For example, Cooks meadow is broken up into three sections due to boardwalks in the meadows. The smallest segment, Cooks A, shows the highest concern due to the proliferation of impacts in the decreased size of that particular segment.

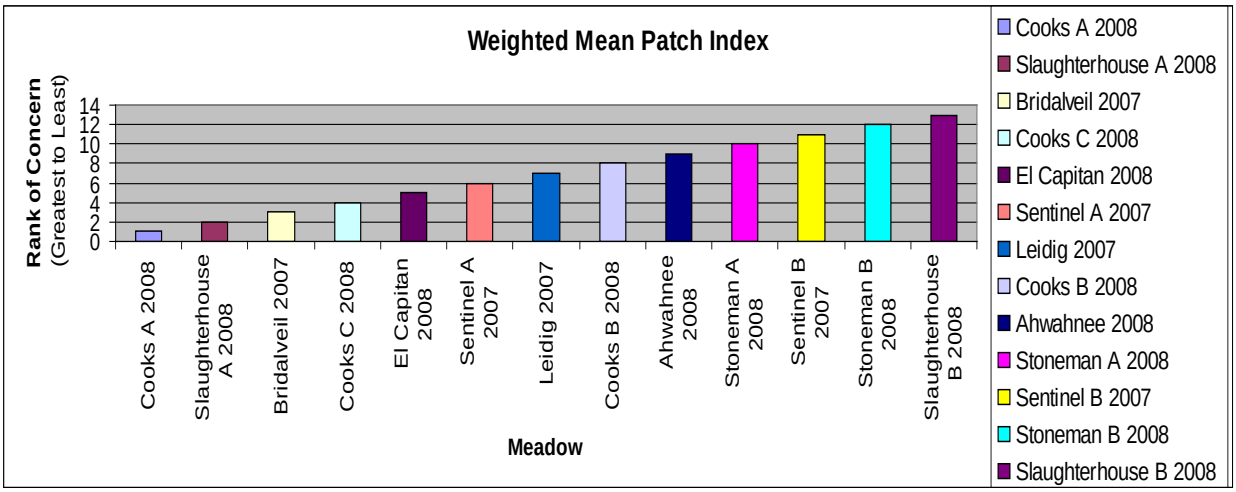


Figure 2.4.1 shows an analysis of Yosemite Valley meadows using the weighted mean patch index.

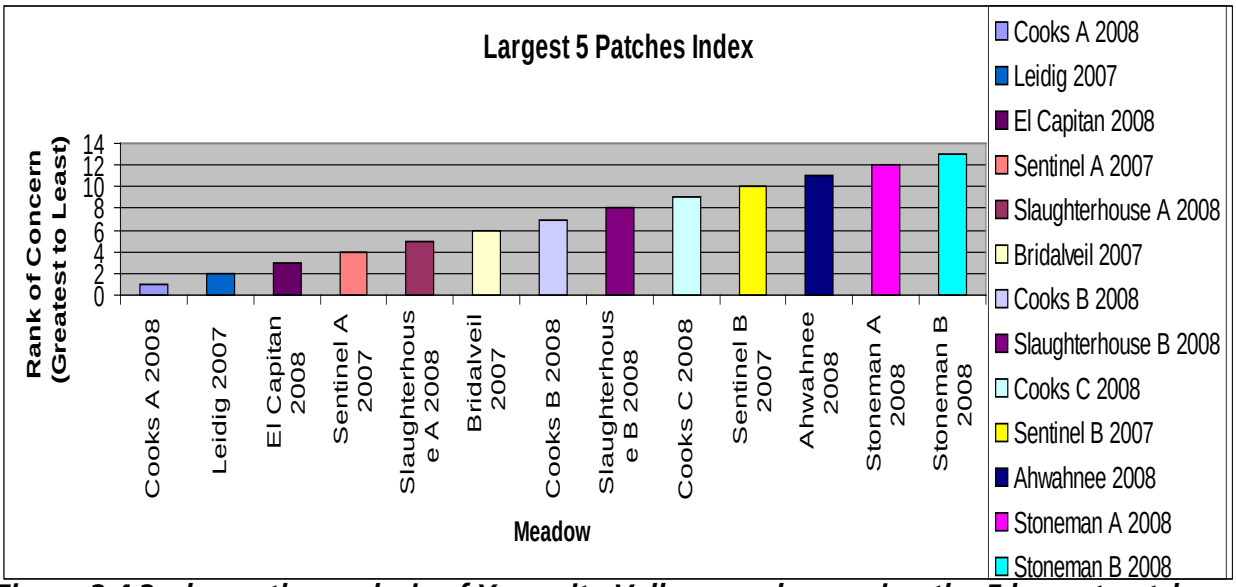


Figure 2.4.2. shows the analysis of Yosemite Valley meadows using the 5 largest patches index.

Meadow Maps:
For each meadow monitored, trails are mapped and analyzed for extent, condition and fragmentation. All maps are shown here in the results section. Each meadow is shown with the extent and condition of informal trails, the patch analysis of resulting fragmentation, and the addition of the five-meter influence zone.

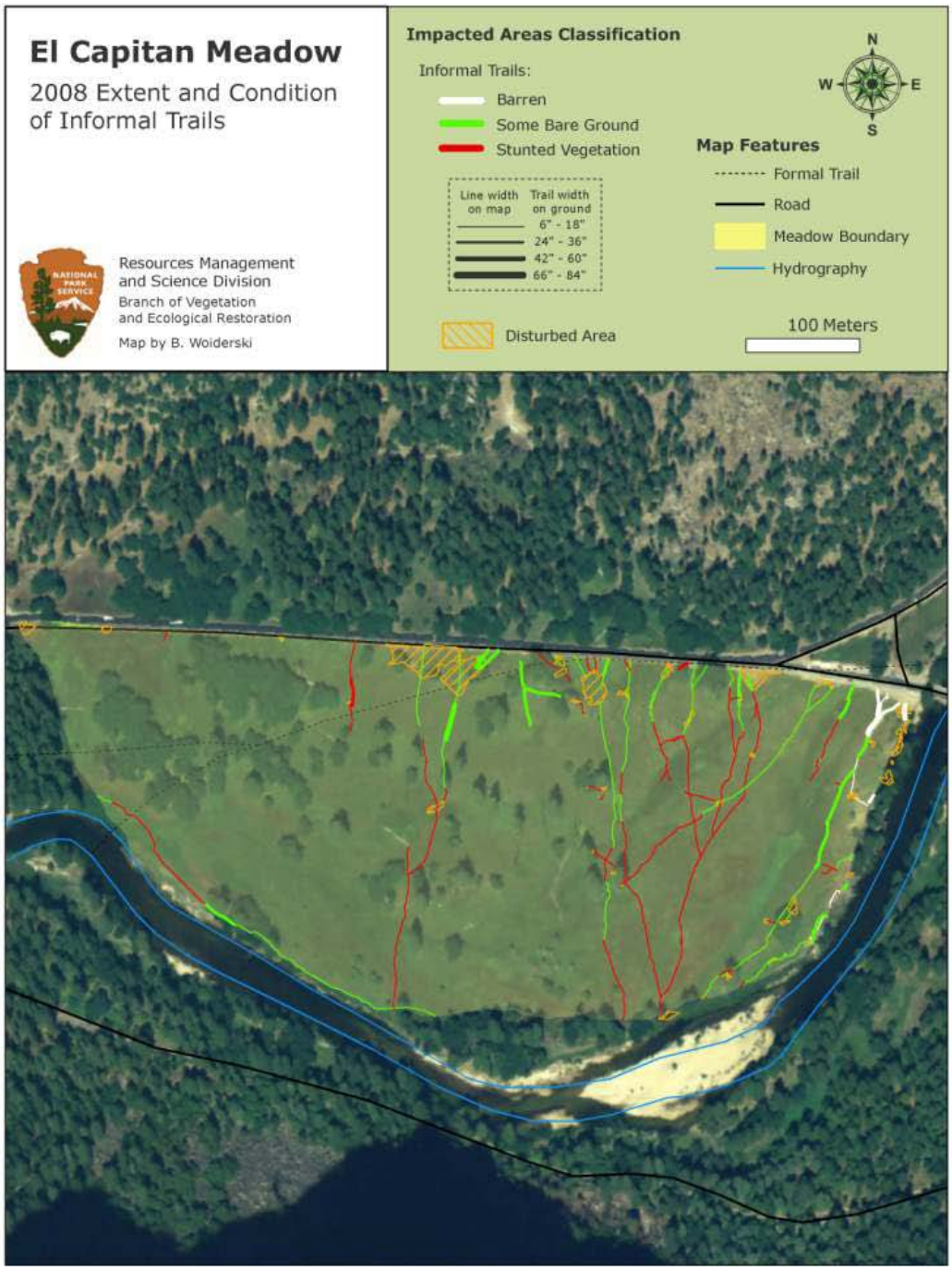


Figure 2.4.3 shows the. extent and condition of informal trailing in El Capitan Meadow.

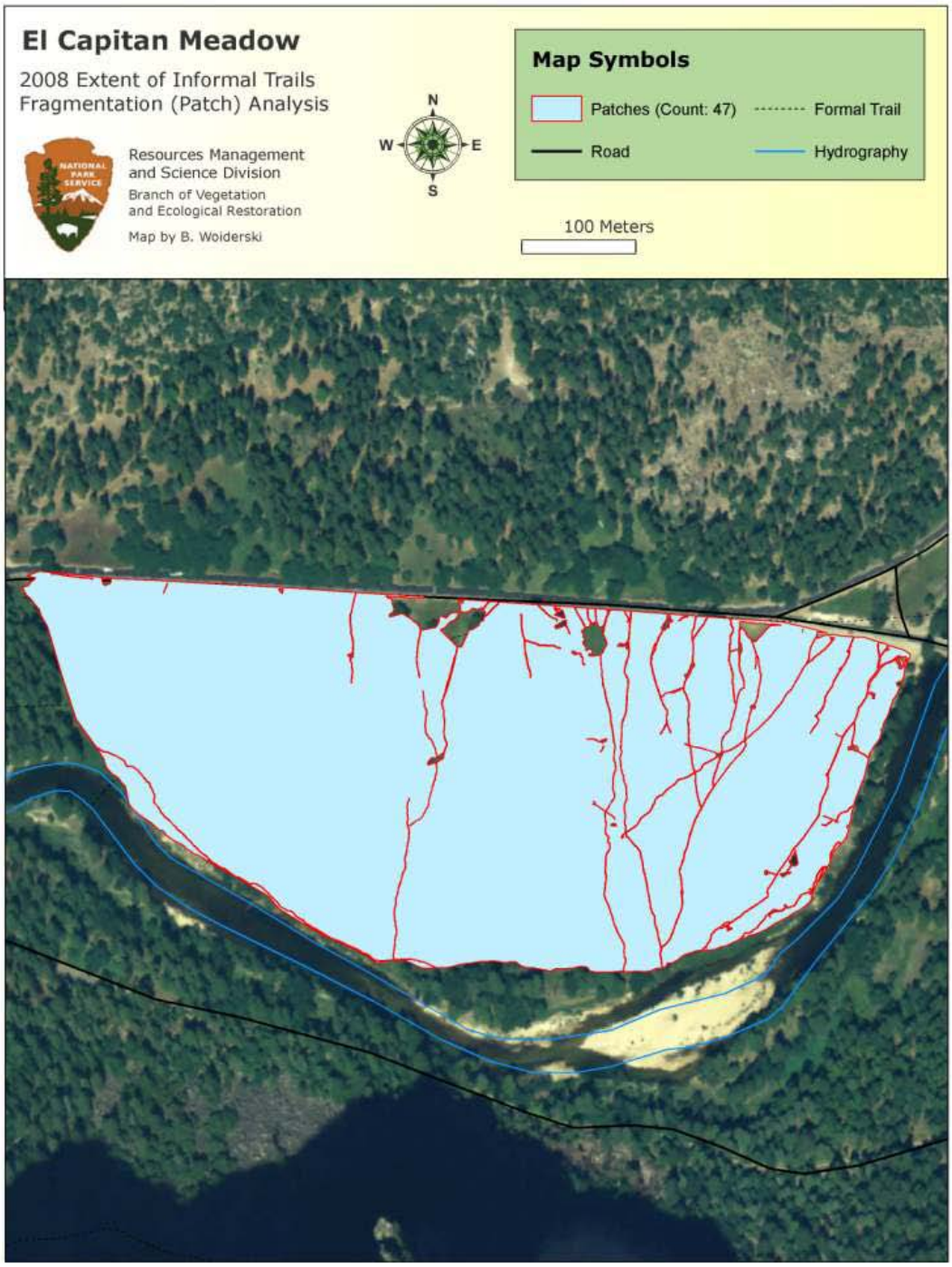


Figure 2.4.4. shows meadow fragmentation in El Capitan Meadow.

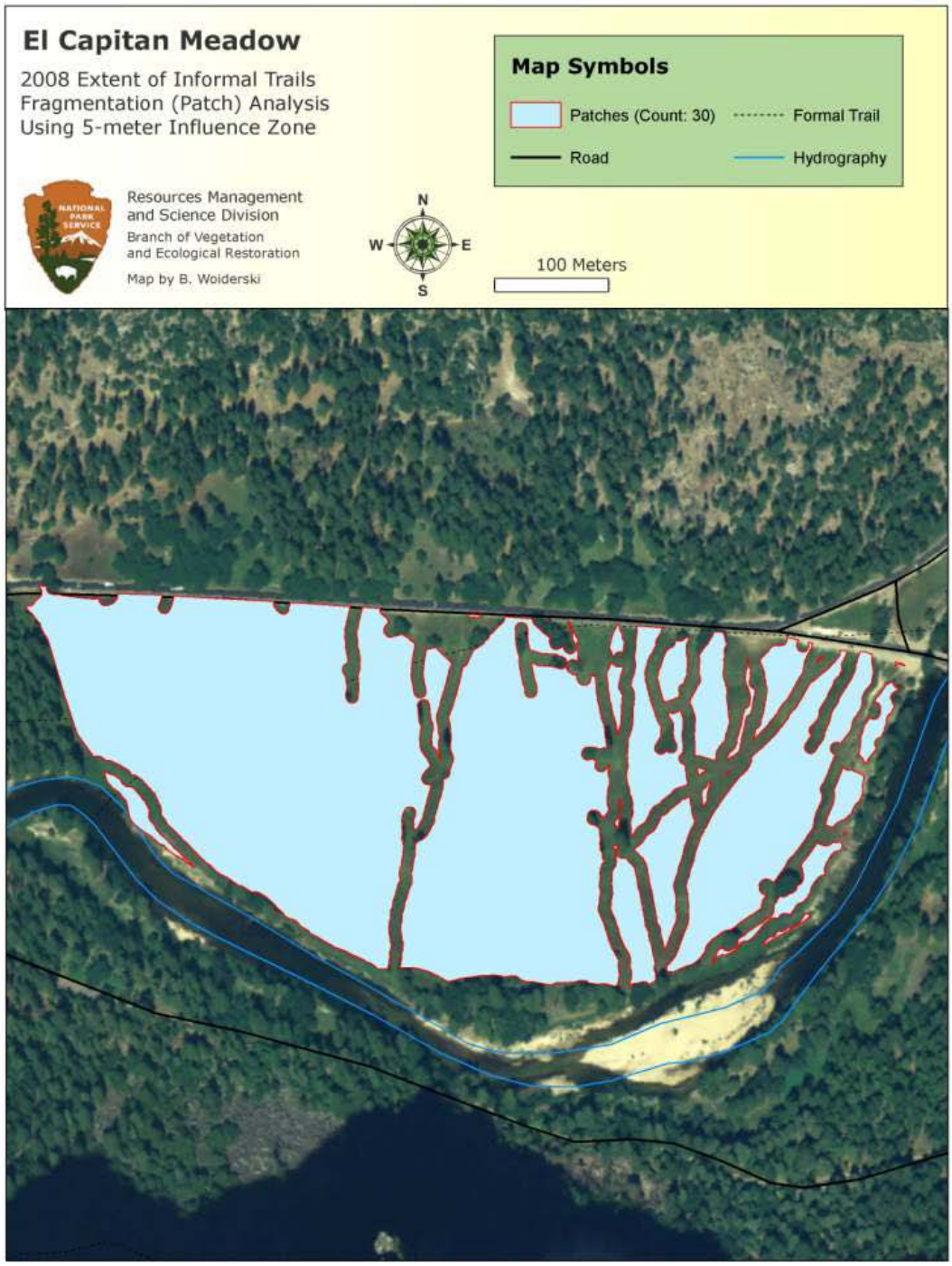


Figure 2.4.5 shows meadow fragmentation with five-meter influence zone in El Capitan Meadow.

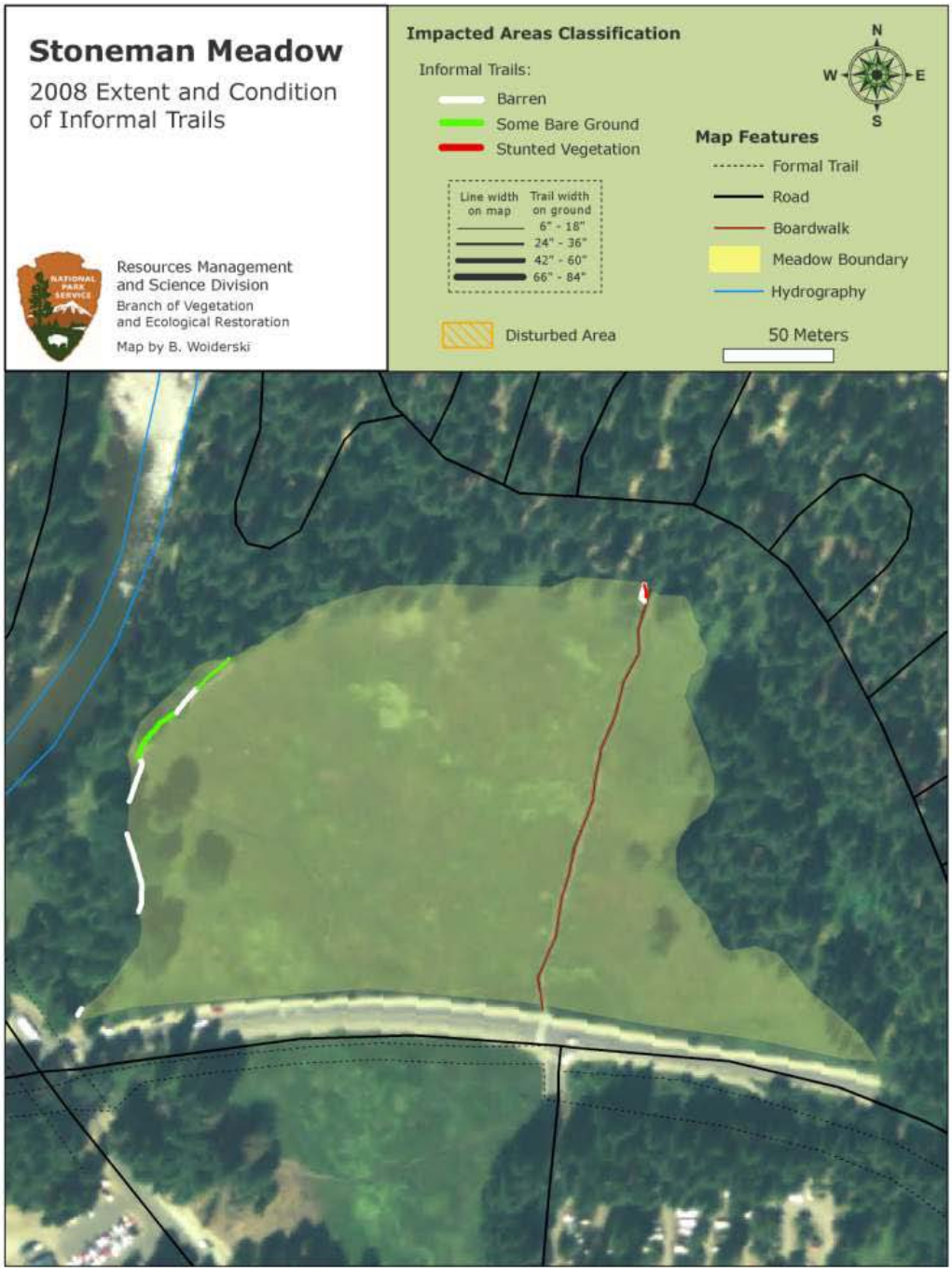


Figure 2.4.6 shows the extent and condition of informal trails in Stoneman Meadow.

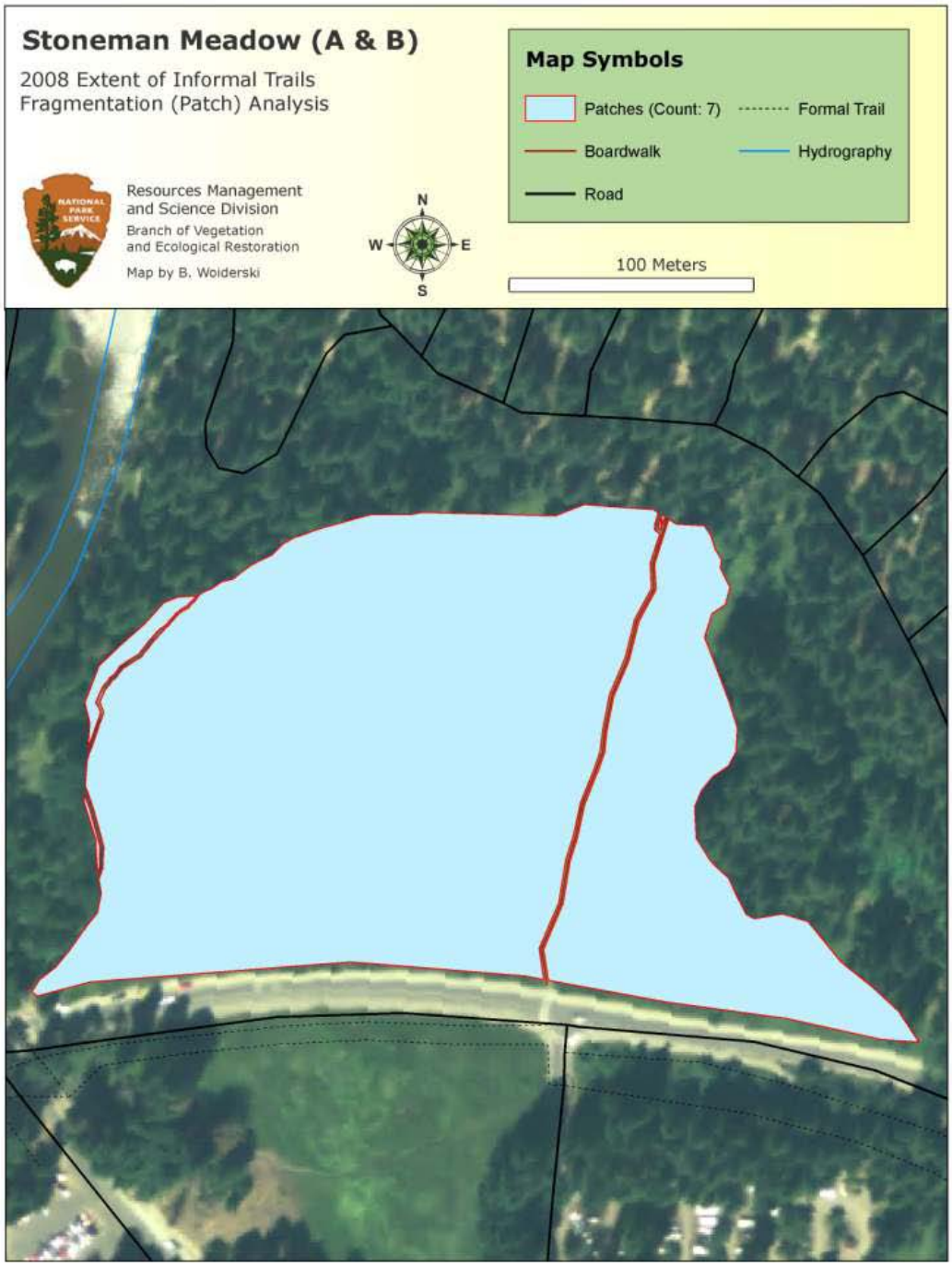


Figure 2.4.7 shows meadow fragmentation without five-meter influence zone in Stoneman Meadow.

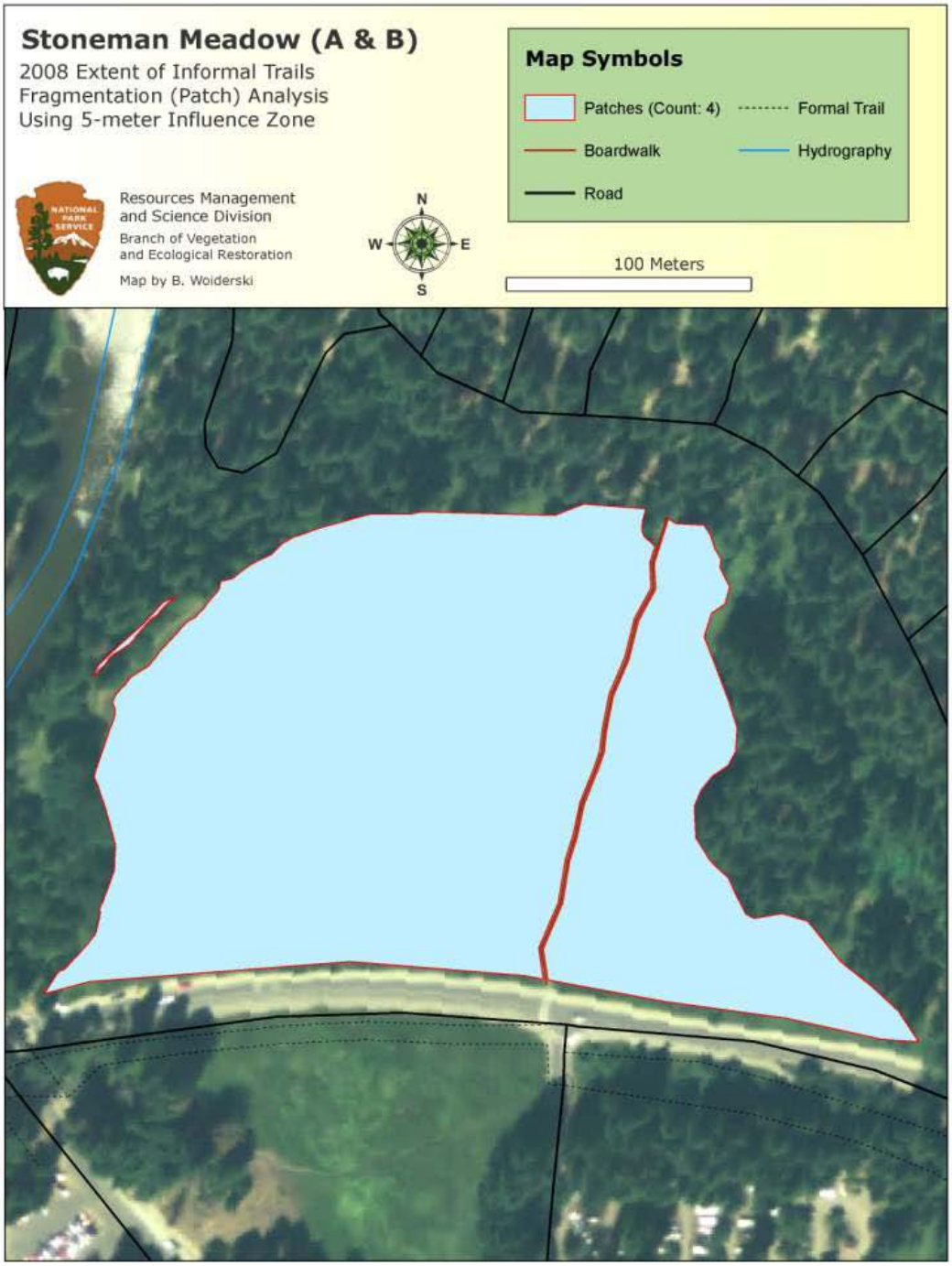


Figure 2.4.8 shows the meadow fragmentation with five-meter influence zone in Stoneman Meadow.

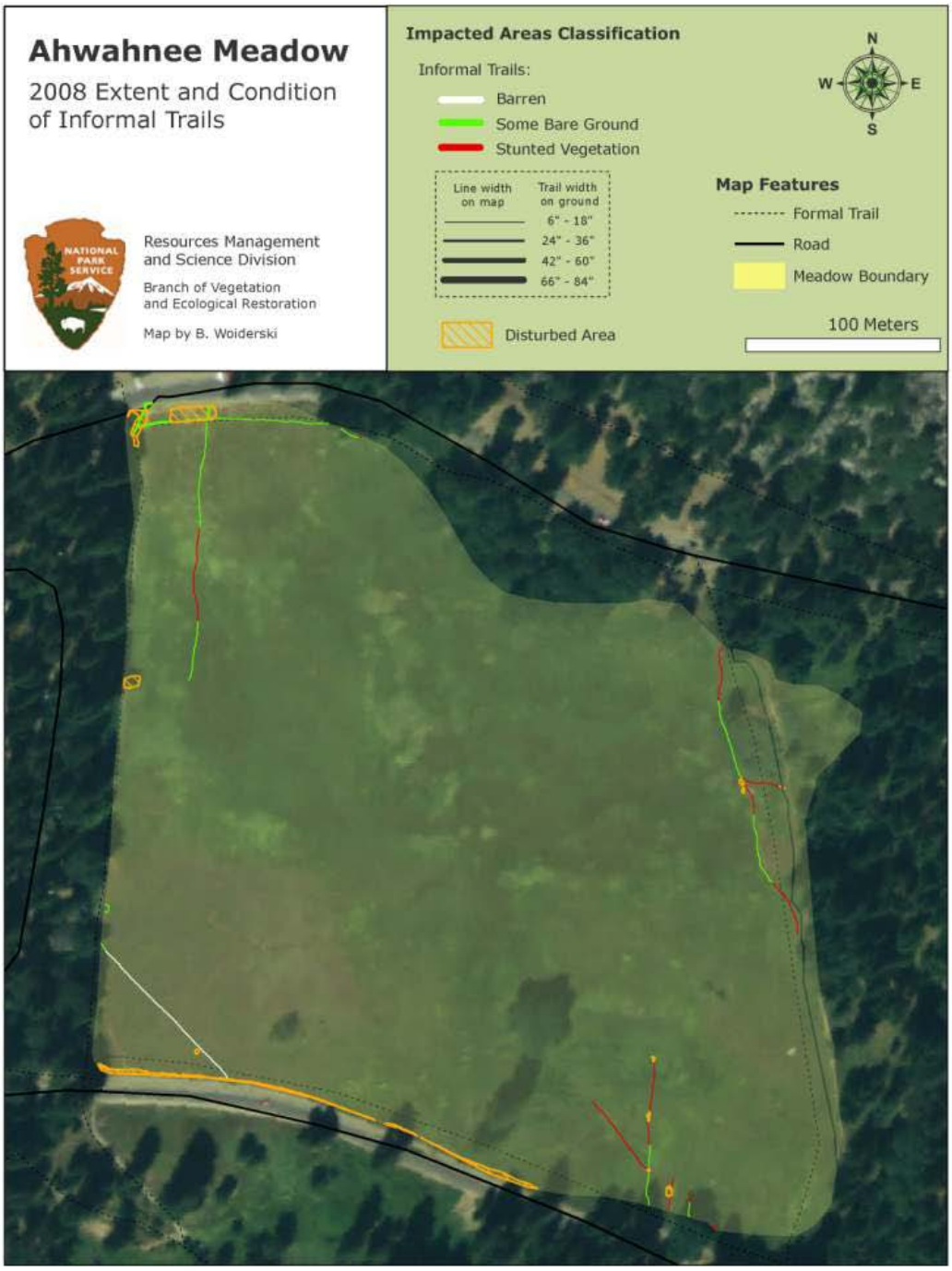


Figure 2.4.9 show the extent and condition of informal trails in Ahwahnee Meadow.

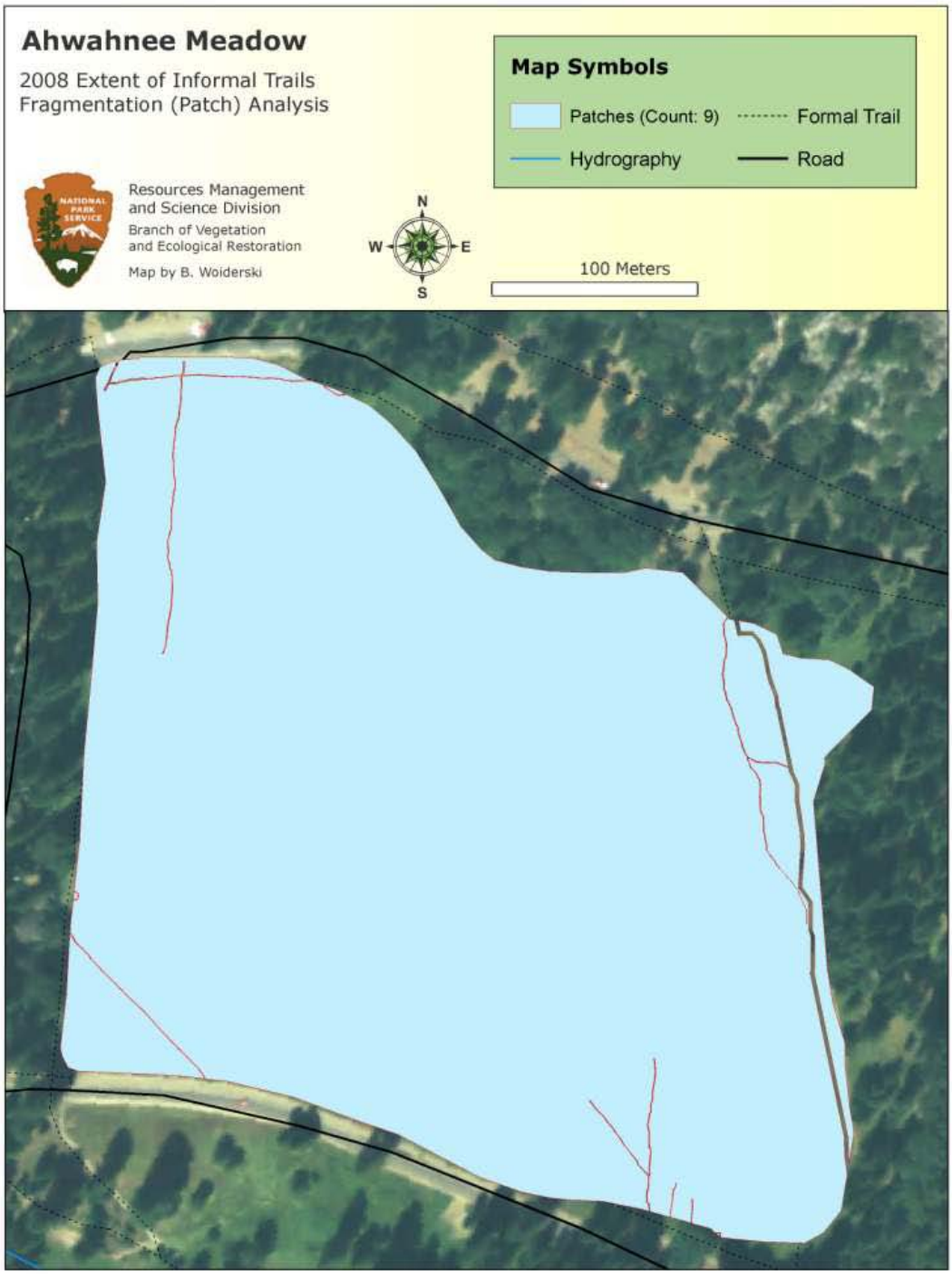


Figure 2.4.10 shows fragmentation without five-meter influence zone in Ahwahnee Meadow.

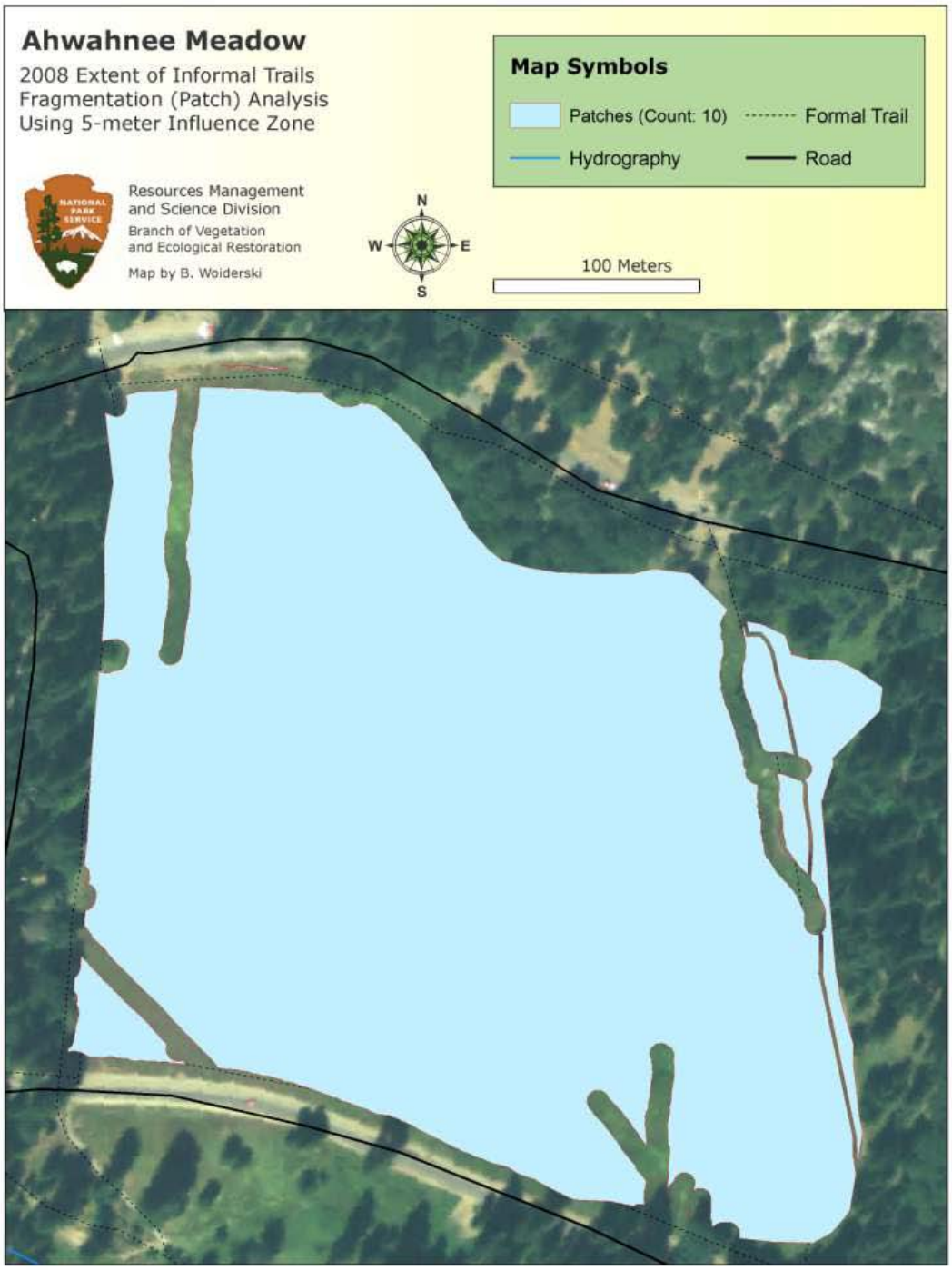


Figure 2.4.11 shows the fragmentation analysis with the five-meter influence zone in Ahwahnee Meadow.

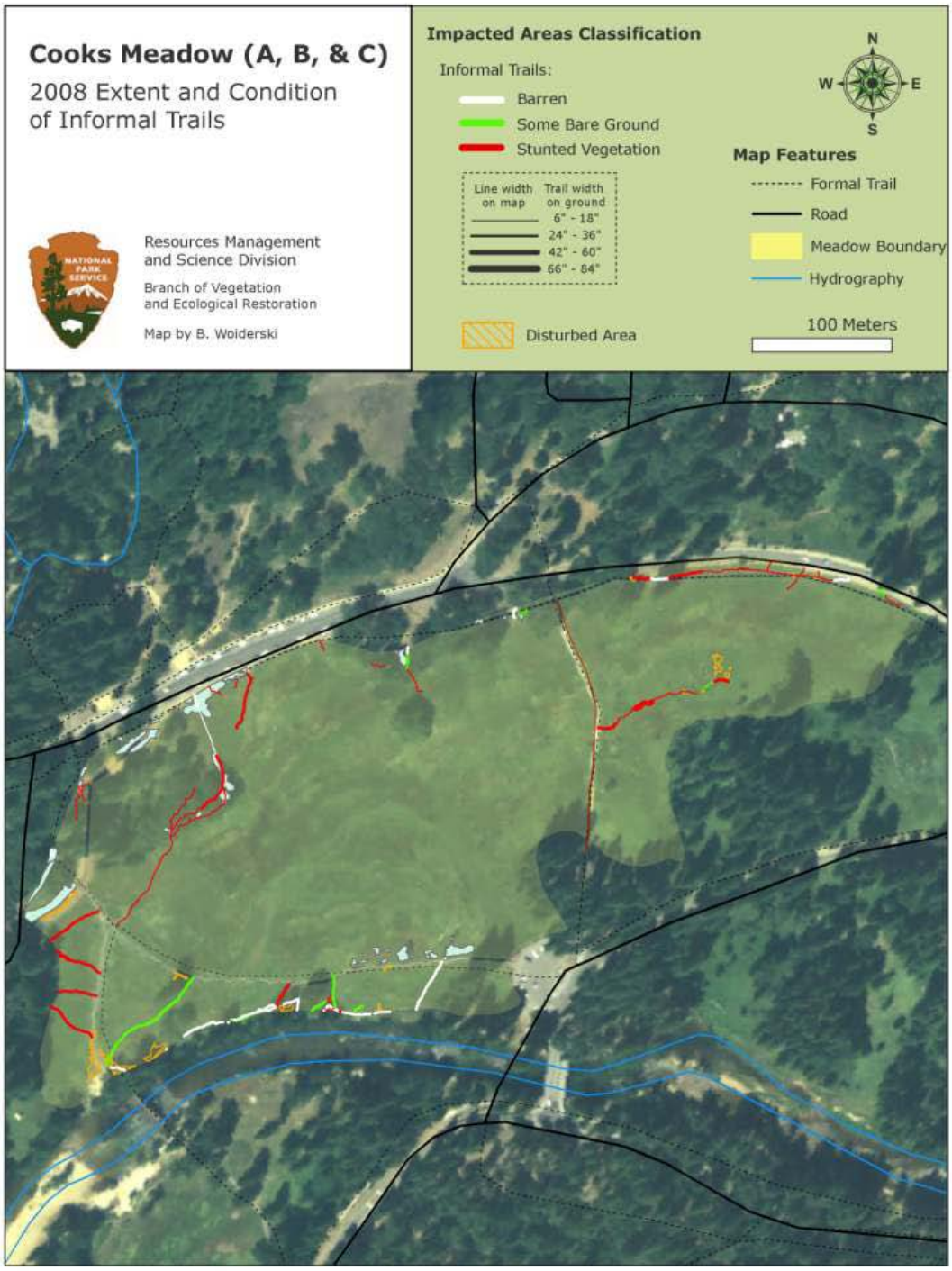


Figure 2.4.12 shows extent and condition of informal trails in Cooks Meadow.

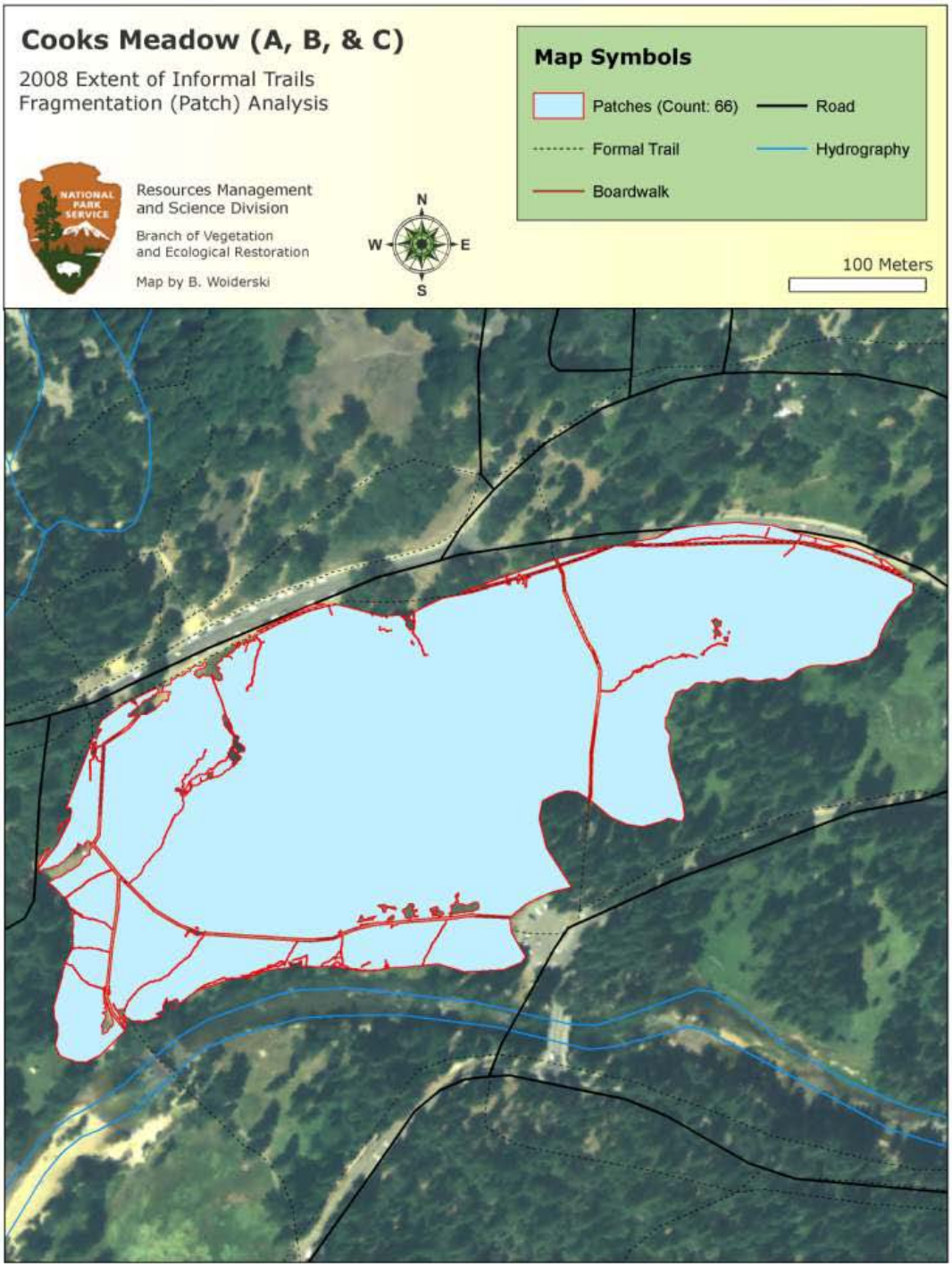


Figure 2.4.13 shows fragmentation without five-meter influence zone in Cooks Meadow.

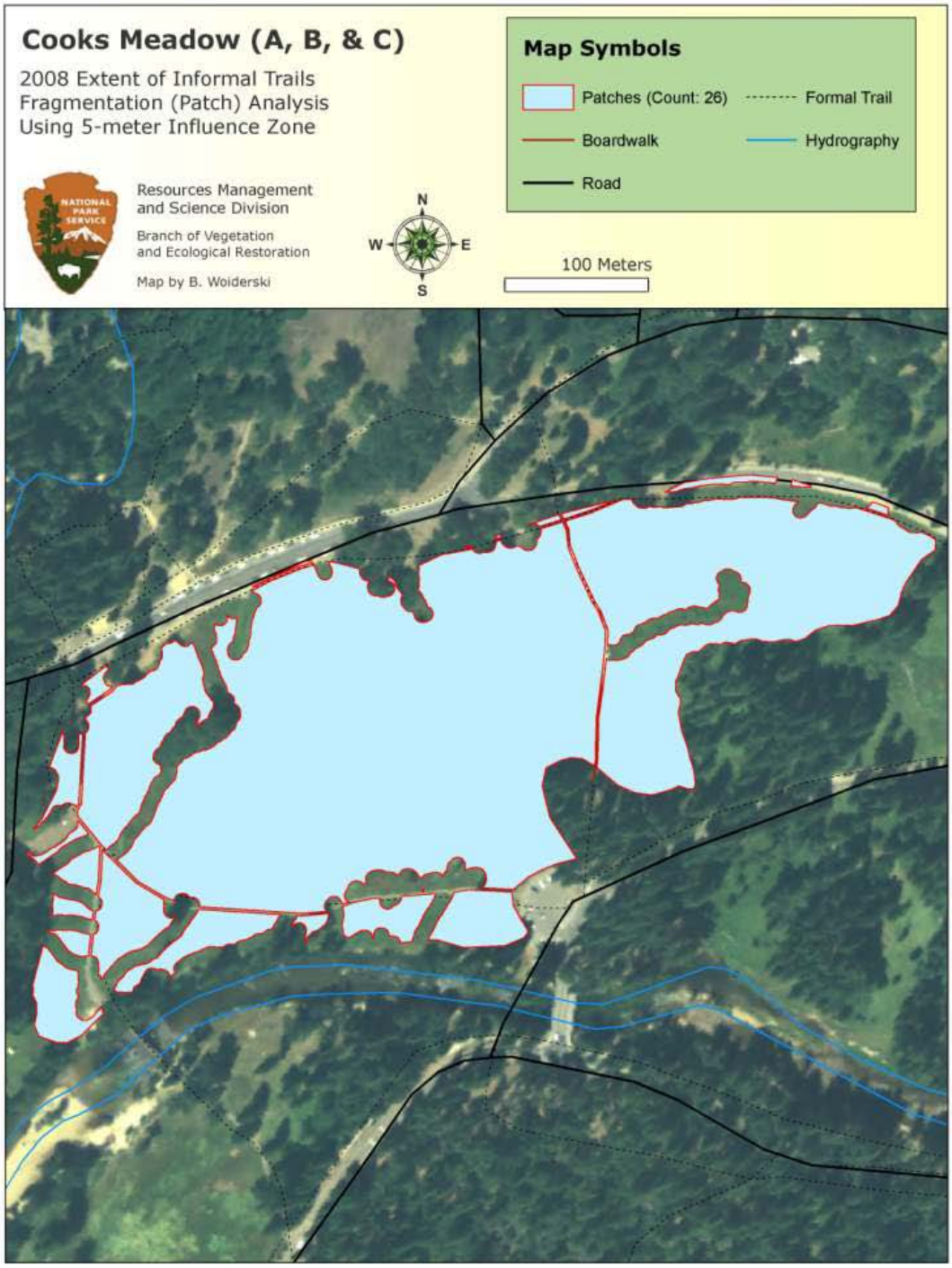


Figure 2.4.14 shows fragmentation with five-meter influence zone in Cooks Meadow.

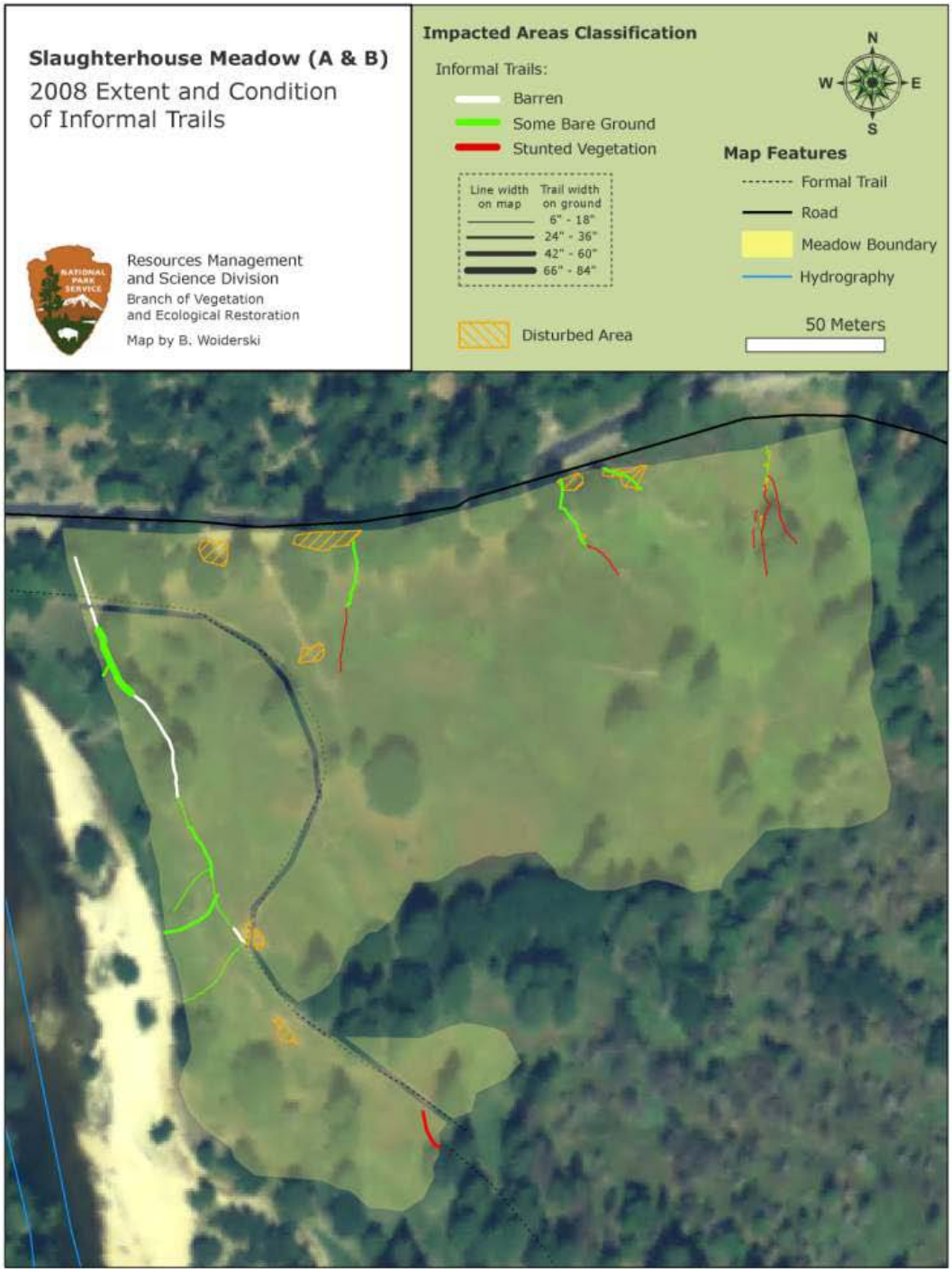


Figure 2.4.15 shows the extent and condition of informal trails in Slaughterhouse Meadow.

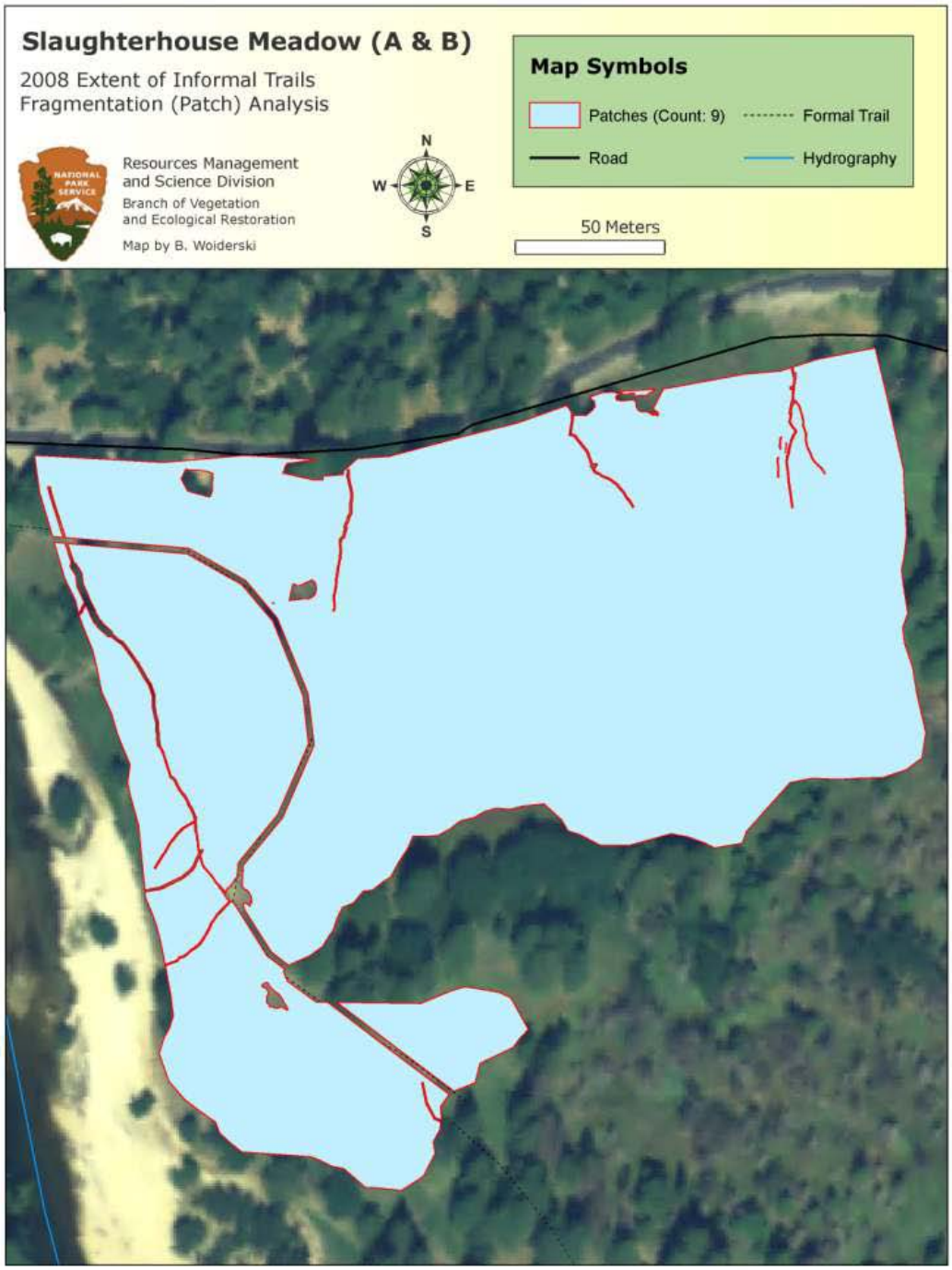


Figure 2.4.16 shows fragmentation without five-meter influence zone in Slaughterhouse Meadow.

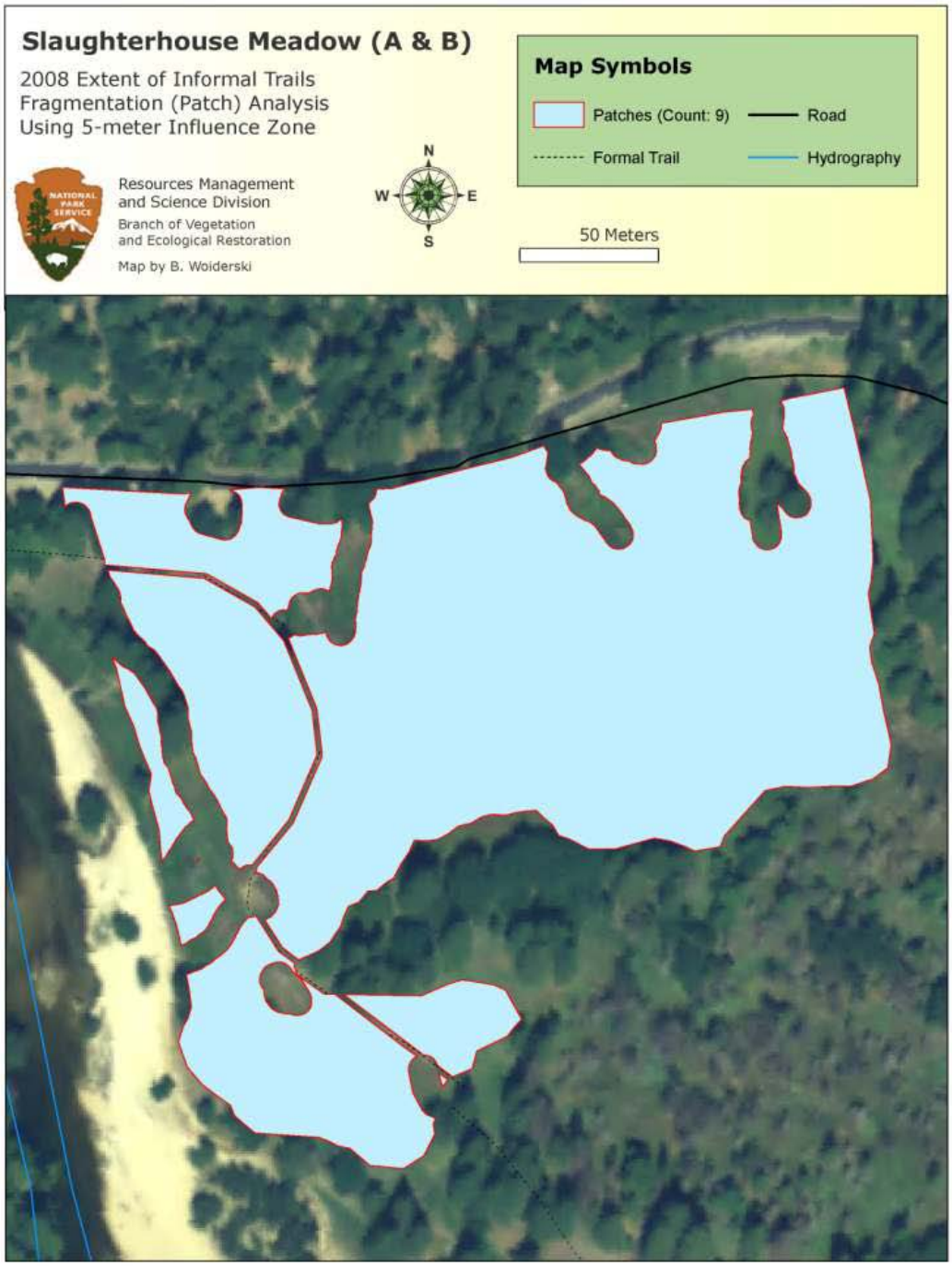


Figure 2.4.17 shows fragmentation without five-meter influence zone in Slaughterhouse Meadow.

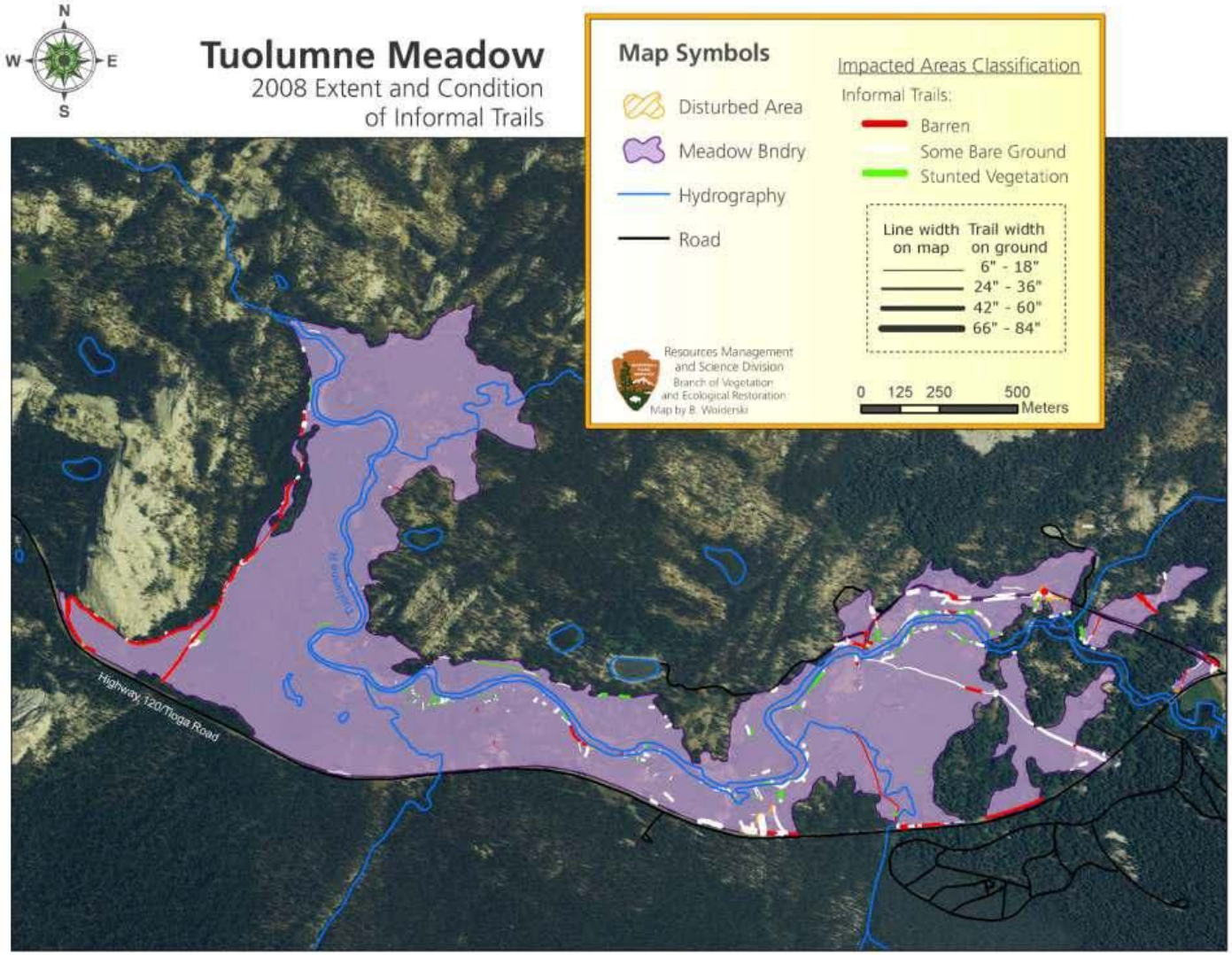


Figure 2.4.18 shows extent and condition of informal trails in Tuolumne Meadow.

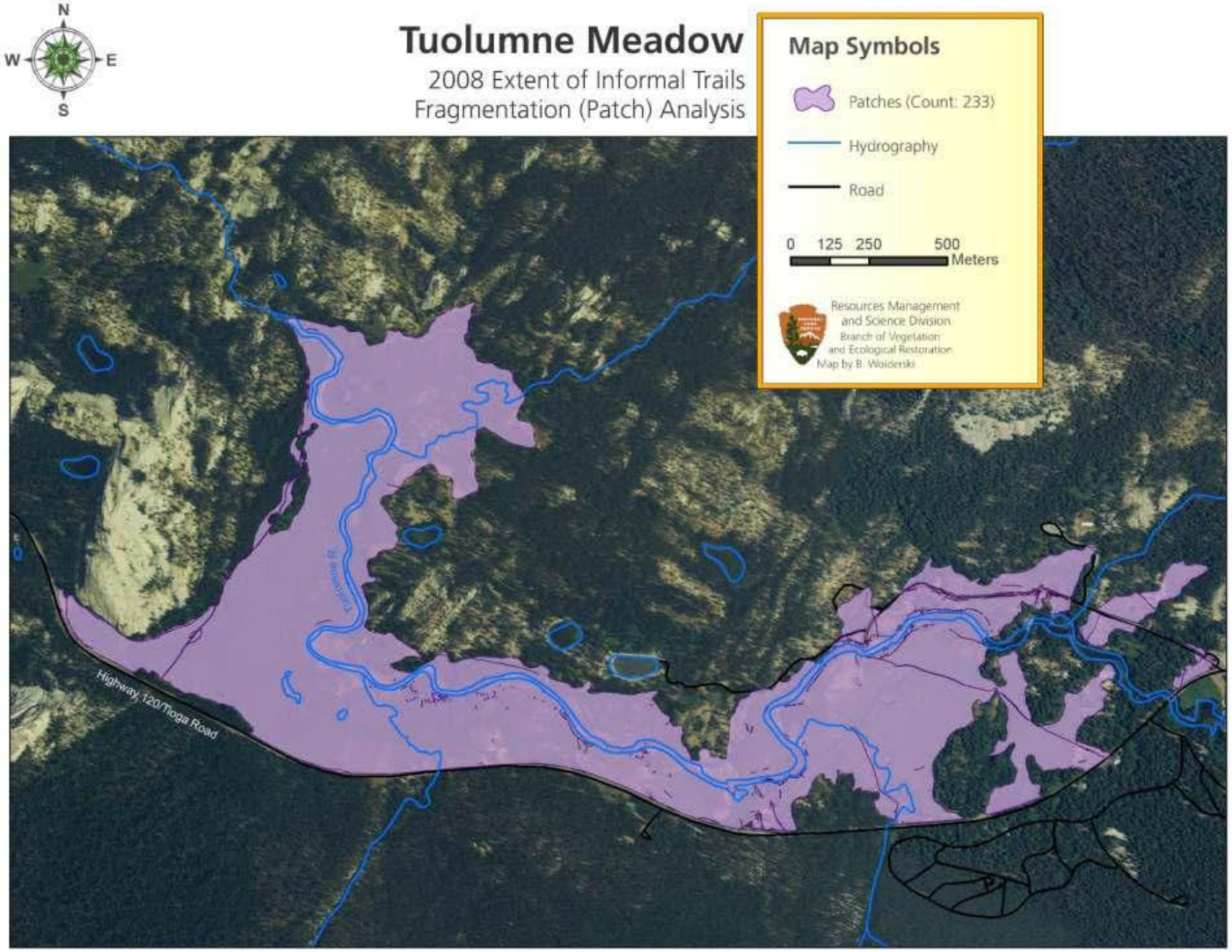


Figure 2.4.19 shows fragmentation without five-meter influence zone in Tuolumne Meadow.

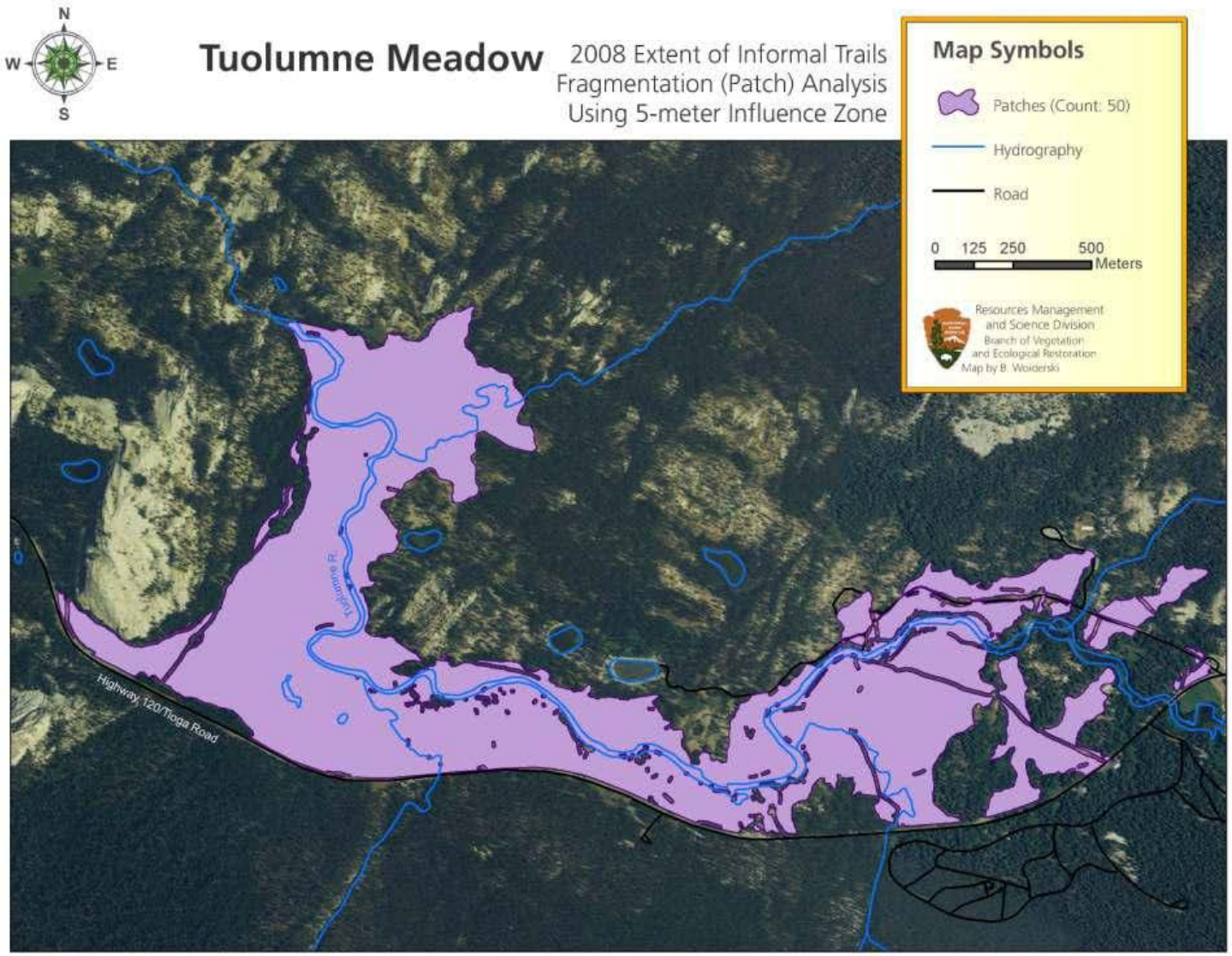


Figure 2.4.20 shows fragmentation with five-meter influence zone inTuolumne Meadow.

Extent of Trails:

The following tables (2.4.1-2.4.12) demonstrate the findings of all meadows fully analyzed during the field season of 2008. All meadows listed were fully mapped, including all informal trails and boundary. These tables examine the difference observed with the application of the five meter influence zone.

Table 2.4.1. shows total metrics for Tuolumne Meadow.

Tuolumne Meadow		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	0.613 ha (wf = 0.995)	1.968 ha (wf = 0.9080)
Largest Patches Indices (LPI-5)	99.41%	90.84%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 50 1.49 m² 67.87 m/ha 1635 m² (0.53% of meadow area)	 13 0.65 m² Same as left 28380 m² (9.16% of meadow area)

Table 2.4.2 shows total metrics for Ahwahnee Meadow.

Ahwahnee Meadow				
Index	**Value (No influence zone)**		**Value (5-m influence zone)**	
Year	**2007**	**2008**	**2007**	**2008**
Weighted Mean Patch Index (WMPI)	0.802 ha (wf = 0.978)	1.299 ha (wf = 0.998)	1.121 ha (wf = 0.873)	0.992 ha (wf = 0.919)
Largest Patches Indices (LPI-5)	97.47%	99.74%	87.34%	91.88%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 14 73.76 m² 102.80 m/ha 2617 m² (2.23% of meadow area)	 9 762.08 m² 61.05 m/ha 285 m² (0.24% of meadow area)	 8 421.84 m² 102.80 m/ha 4864 m² (12.65% of meadow area)	 10 245.44 m² 61.05 m/ha 9523 m² (8.11% of meadow area)

Table 2.4.3 shows total metrics for Cooks Meadow A.

Cooks Meadow A		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	0.061 ha (wf = 0.963)	0.074 ha (wf = 0.656)
Largest Patches Indices (LPI-5)	79.12%	56.04%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 26 8.66 m² 318.49 m/ha 633 m² (3.68% of meadow area)	 10 972.29 m² Same as left 5911 m² (34.42% of meadow area)

Table 2.4.4 shows total metrics for Cooks Meadow B.

Cooks Meadow B		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	0.262 ha (wf = 0.977)	0.596 ha (wf = 0.880)
Largest Patches Indices (LPI-5)	97.49%	87.88%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 28 1.66 m² 65.41 m/ha 1804 m² (2.34% of meadow area)	 10 55.28 m² Same as left 9278 m² (12.04% of meadow area)

Table 2.4.5 shows total metrics for Cooks Meadow C.

Cooks Meadow C		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	0.237 ha (wf = 0.993)	0.378 ha (wf = 0.887)
Largest Patches Indices (LPI-5)	98.74%	88.75%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 12 55.05 m² 103.30 m/ha 209 m² (0.73% of meadow area)	 6 83.89 m² Same as left 3243 m² (11.25% of meadow area)

Table 2.4.6 shows total metrics for El Capitan Meadow.

El Capitan Meadow		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	0.397 ha (wf = 0.975)	0.399 ha (wf = 0.781)
Largest Patches Indices (LPI-5)	84.30%	71.07%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 47 79.49 m² 202.57 m/ha 4916 m² (2.5% of meadow area)	 30 277.83 m² Same as left 43083 m² (21.94% of meadow area)

Table 2.4.7 shows total metrics for Slaughterhouse Meadow A.

Slaughterhouse Meadow A		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	0.207 ha (wf = 0.982)	0.119 ha (wf = 0.803)
Largest Patches Indices (LPI-5)	97.60%	80.20%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 6 1224.67 m² 182.54 m/ha 237 m² (1.84% of meadow area)	 7 589.69 m² Same as left 2543 m² (19.74% of meadow area)

Table 2.4.8 shows total metrics for Slaughterhouse Meadow B.

Slaughterhouse Meadow B		
Index	**Value (No influence zone)**	**Value (5-m influence zone)**
Year	**2008**	**2008**
Weighted Mean Patch Index (WMPI)	1.063 ha (wf = 0.986)	1.324 ha (wf = 0.899)
Largest Patches Indices (LPI-5)	98.62%	89.87%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 3 14.18 m² 65.25 m/ha 453 m² (1.38% of meadow area)	 2 14733.19 m² Same as left 3322 m² (10.13% of meadow area)

Tables 2.4.9 through 2.4.12 observes changes occurring after three years of data collection in Stoneman meadow. Figures 2.4.6. and 2.4.7. represent the patch analysis for Stoneman meadow. These are included to demonstrate changes that have occurred in Stoneman meadow since 2006. Currently, Stoneman meadow is the only meadow for which we have three years of repeat data.

Table 2.4.9. total metrics for Stoneman Meadow A (without influence zone).

Stoneman Meadow A			
Index	**Value (No influence zone)**		
Year	**2006**	**2007**	**2008**
Weighted Mean Patch Index (WMPI)	1.207 ha (wf = 0.996)	0.902 ha (wf = 0.995)	0.602 ha (wf = 0.995)
Largest Patches Indices (LPI-5)	99.64%	99.47%	99.49%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 3 332.83 m² 30.83 m/ha 131 m² (0.36% of meadow area)	 4 235.12 m² 35.80 m/ha 194 m² (0.53% of meadow area)	 6 18.64 m² 37.82 m/ha 185 m² (0.51% of meadow area)

Table 2.4.10 shows total Metrics for Stoneman Meadow A (with five-meter influence zone).

Stoneman Meadow A			
Index	**Value (5-m influence zone)**		
Year	**2006**	**2007**	**2008**
Weighted Mean Patch Index (WMPI)	1.670 ha (wf = 0.957)	1.637 ha (wf = 0.948)	1.115 ha (wf = 0.958)
Largest Patches Indices (LPI-5)	95.71%	94.75%	95.76%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	 2 17452.18 m² 30.83 m/ha 1563 m² (4.29% of meadow area)	 2 172.26 m² 35.80 m/ha 1913 m² (5.25% of meadow area)	 3 66.74 m² 37.82 m/ha 1546 m² (4.24% of meadow area)

Table 2.4.11 shows total metrics for Stoneman Meadow B (without influence zone).

Stoneman Meadow B			
Index	**Value (No influence zone)**		
Year	**2006**	**2007**	**2008**
Weighted Mean Patch Index (WMPI)	0.586 ha (wf = 0.996)	0.589 ha (wf = 0.999)	1.181 ha (wf = 1.000)
Largest Patches Indices (LPI-5)	99.60%	99.90%	100.00%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	2 5880.82 m² 36.68 m/ha 48 m² (0.40% of meadow area)	2 5898.66 m² 28.27 m/ha 12 m² (0.10% of meadow area)	1 11809.20 m² 0.00 m/ha 0 m² (0.00% of meadow area)

Table 2.4.12. shows total metrics for Stoneman Meadow B (with five-meter influence zone).

Stoneman Meadow B			
Index	**Value (5-m influence zone)**		
Year	**2006**	**2007**	**2008**
Weighted Mean Patch Index (WMPI)	1.059 ha (wf = 0.947)	0.550 ha (wf = 0.965)	1.181 ha (wf = 1.000)
Largest Patches Indices (LPI-5)	94.71%	96.48%	100.00%
Other relevant metrics: - Number of patches - Median patch size - Density of informal trails - Total impact extent (informal trails + disturbed areas)	1 11184.80 m² 36.68 m/ha 624 m² (5.29% of meadow area)	2 5696.84 m² 28.27 m/ha 416 m² (3.52% of meadow area)	1 11809.20 m² 0.00 m/ha 0 m² (0.00% of meadow area)

Discussion

As we continue to monitor already established sites and additional meadows using current methodology, we will acquire trend data which will allow a better understanding of the changes occurring in meadows in relation to informal trailing. Currently, park managers and subject matter experts are refining the standard for this indicator. The standard is based on several years of data collection as well as a review of the literature on informal trails. Emphasis will be placed on the evaluation of multiple standards in order to address concerns at varying levels. In addition to acquiring trend data, our findings allow us to understand which meadows to focus on in subsequent monitoring efforts. The graphs in Figures 2.4.1 and 2.4.2 show the increasing levels of concern for Yosemite Valley meadows as determined by two separate geospatial metrics. Those meadows that consistently show high levels of fragmentation and higher level of concern will be selected for more frequent monitoring. For example, Cooks meadow A will be monitored again in 2009 because of its subsequent rating.

The classification of trails through the use of condition classes since 2007 is a vital piece in understanding the types and severity of trail impacts present. This will prove to be even more evident when we can compare meadows with previous data in upcoming field seasons. Figure 2.4.3 shows how in El Capitan meadow, there is more severity of impact found closer to the access points and road, and specifically highlighted in the most concentrated area of use, towards the upper northeast corner of the meadow. When we are able to examine such a data set temporarily we will be able to investigate if trails are showing signs of further degradation in addition to the evidence of more trails. A separate standard for condition classes is being developed.

An important aspect of this discussion presented herein is the importance of monitoring the total metrics of each meadow in order to inform decision making on visitor use in meadows. For example Figure 2.4.6 demonstrates how in El Capitan Meadow the utilization of the five-meter influence zone decreases the number of patches from 47 to 30. The percent area of impact however changes from 2.5% to 21.94% with the addition of the influence zone.

The information presented in this document consistently points to the importance of repeat monitoring and data collection in 2009. With another year of data, we will be able to understand the trends that are appearing in the data. Table 2.4.11 portrays how increased patches have occurred in Stoneman meadow from 2006 to 2008. Despite this meadow having been restored and a boardwalk installed, we are seeing evidence of small informal trails occurring in the meadow. Figure 2.4.6 represents how these trails are occurring at the perimeter of the meadow, showing that for the most part the boardwalk is effective. However, Figure 2.4.7 shows that with the five-meter buffer included isolated islands of habitat occur, showing the severity of fragmentation.

Future Direction

In the upcoming year as we continue work on this indicator, we will refine methods to increase efficiency and consistency (both on extent and condition measures). We will continue to annually collect field data as more data are needed to detect trends and provide full evaluation of different indices. We will continue to broaden our application of WMPI and LPI-5 in more sites, like Tuolumne Meadows and beyond Yosemite to examine the utility and sensitivity of these metrics. We will continue to build a research foundation to support implementation of the fragmentation indices and establish their validity. For example, it would help the determination of influence zone. It would also help showing the relationship (correlation or causal) of informal trail extent and

ecological consequences (vegetation, soil hydrology, soil flora and fauna). Once we have more data for individual meadows that is repeatable after 3-5 years then we will be able to determine the true extent of trail proliferation and degradation.

2.5 WILDERNESS ENCOUNTERS

One of the components of the recreational Outstanding Remarkable Value for the Merced River Plan is the opportunity for solitude. Solitude has been an enduring characteristic of a Wilderness experience (Lucas 1964). The Wilderness Act of 1964 stipulates that areas designated as such provide outstanding opportunities for the enjoyment of solitude. The trailed (1B) Wilderness zones of the Merced River should provide a high opportunity for solitude.

Expectations for solitude and actual numbers and types of groups encountered have been shown to have a significant effect on the quality of visitor experiences (Patterson and Hammitt 1990, Vaske et al. 1986, West 1982, Newman 2002). Encounters are also an excellent way to assess use levels and density, which can affect other Outstandingly Remarkable Values such as the biological, cultural, and scientific values set for the river corridor. For example, higher levels of use may result in compromised water quality.

Measurement

The number of encounters with parties on and off trails in designated Wilderness.

Standards

For trailed zones no more than one encounter with another party per hour 80% of the time.

Sampling

Encounters were recorded by a National Park Service Ranger hiking or on horseback along trails. Monitoring was conducted as part of the Ranger's routine patrol of the backcountry along the Merced River corridor. Encounters were recorded onto index cards and entered into a database. Additional data was collected by students from the Yosemite Institute. Over the last two field seasons, efforts have been made to improve participation in data collection by partnering with local non-profit organizations and volunteer groups. This particular indicator has proven to be an excellent opportunity for such partnerships to develop and flourish.

Sampling was conducted along trails in the upper Merced River corridor (Table 2.5.1). It is important to note that in 2008 as in 2007 only trailed zones were monitored. The previous years of data collection for off-trail encounters in off trail zones suggested that encounters were very infrequent in these areas. Also, considering the nature of hiking across country does not lend itself to encountering other hikers, and that it is time-consuming and in-efficient to gather data in remote areas of this kind, these areas were omitted from data collection this year. The three segments included in the analysis and presentation of results below include 1) Moraine Dome to Echo Valley, Echo Valley to Merced Lake Ranger Station, and 3) Merced Lake Ranger Station to Washburn Lake. These trail segments only were included in this analysis as they had a sufficient sample size from which to draw reliable conclusions. The data from the section to Washburn Lake

to Junction is sparse and included here in comparison with the other sites, but the sample size is too low for full representation of the findings.

Table 2.5.1 shows wilderness encounters sampling locations for 2008.

Wilderness Encounter Sampling Locations
1B Zone – Trailed Travel
Moraine Dome to Echo Valley
Echo Valley to Merced Lake Ranger Station
Merced Lake Ranger Station to Washburn Lake
Washburn Lake to Junction

Results

The following tables and graphs present the results of wilderness encounter monitoring in 2004 - 2008. Table 2.5.2 shows the percent of time the standard was met.

Table 2.5.2 shows the percent of time standard met for years 2004 - 2008.

Trail Segment	Percent of Time (hours) Standard Met
2004	75.0%
2005	85.7%
2006	62.1%
2007	78.8%
2008	48.3%
Total (All Years)	70.7%

Table 2.5.3 presents the percent of time that the standard was met along the four trail segments for years 2004 - 2008.

Table 2.5.3 shos the percent of time that the standard was met for specific trail segments.

Trail Segment	2004	2005	2006	2007	2008	All Years
Moraine Dome – Echo Valley	60.0%	72.2%	64.3%	71.4%	0%	65.1%
Echo Valley – Merced Lake Ranger Station	71.4%	88.5%	58.6%	76.9%	45.5%	67.0%
Merced Lake Ranger Station – Washburn Lake	80.0%	100%	54.4%	83.3%	66.6%	76.3%
Washburn Lake - Junction	100%	100%	100%	100%	NA	100%

In the following Figures, the standard is displayed at the 80% with a bold red line. Points on or above the line indicate that the standard was met. Points below the line indicate that the standard was exceeded for that year.

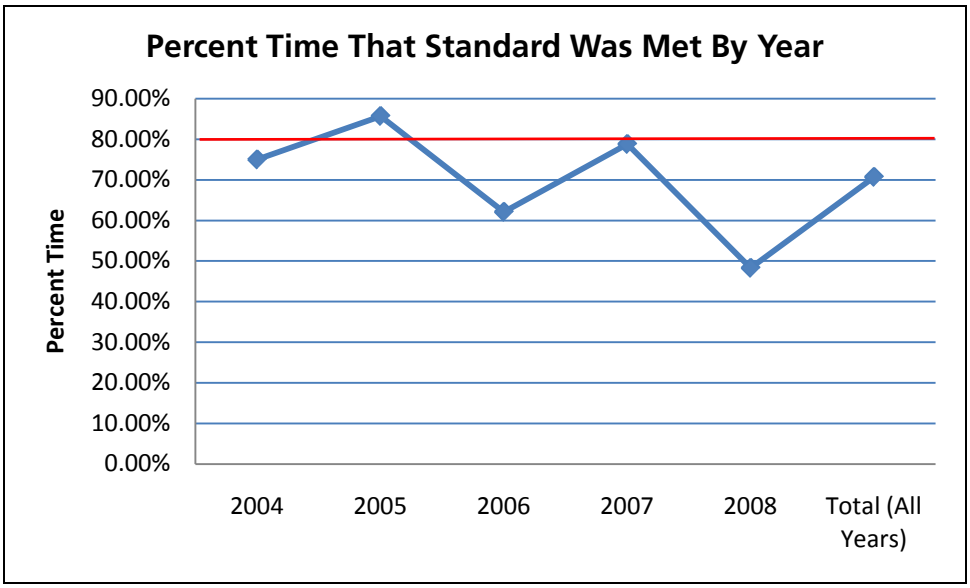


Figure 2.5.1 shows the percent of time that the standard was met by year and for all years.

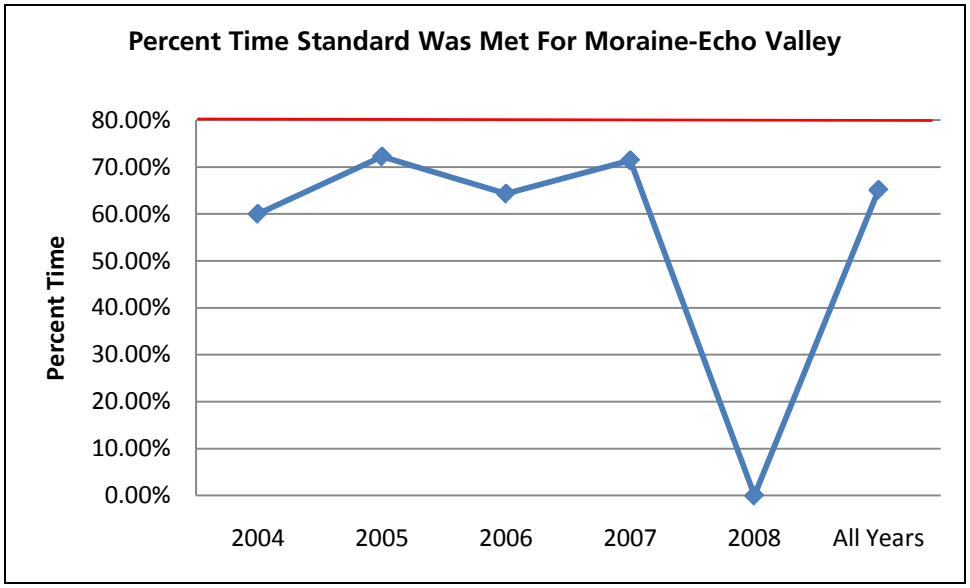


Figure 2.5.2 shows the percent of time that the standard was met by year and for all years for Moraine Dome to Echo Valley.

Figure 2.5.2 shows the Moraine Dome to Echo Valley trail segment standard was not met for all years. Figure 2.5.3 shows the Echo Valley to Merced Lake Ranger Station trail segment standard was met only one time in 2005 with 88.5%. Figure 2.5.4 shows the Merced Lake Ranger Station to Washburn Lake trail segment standard was met three out of four years. The Washburn Lake to Junction trail segment standard was met all four years with 100% compliance rate; however the sampling size for this section is quite low.

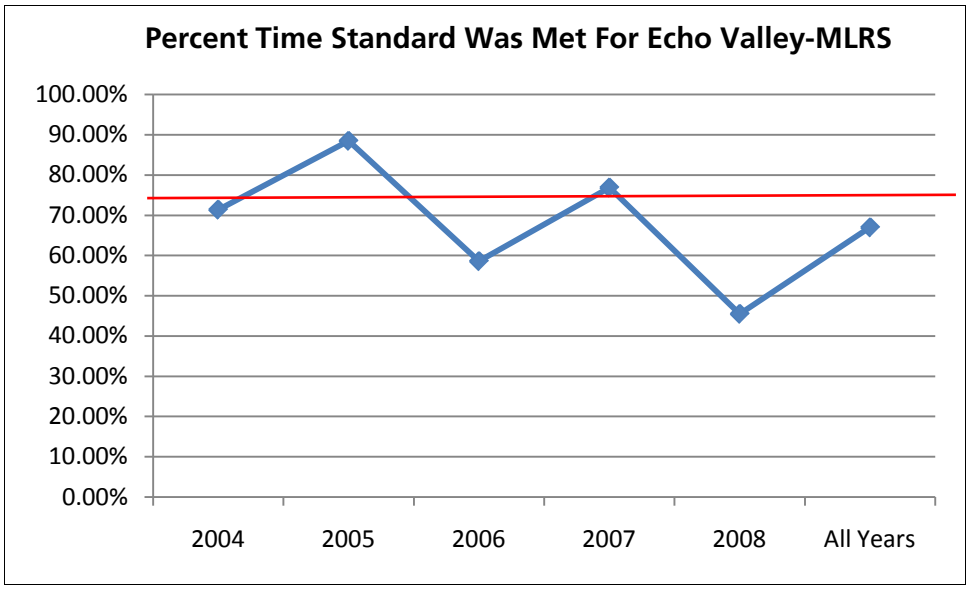


Figure 2.5.3 shows the [ercent of time that the standard was met by year and for all years for Echo Valley to Merced Lake Ranger Station.

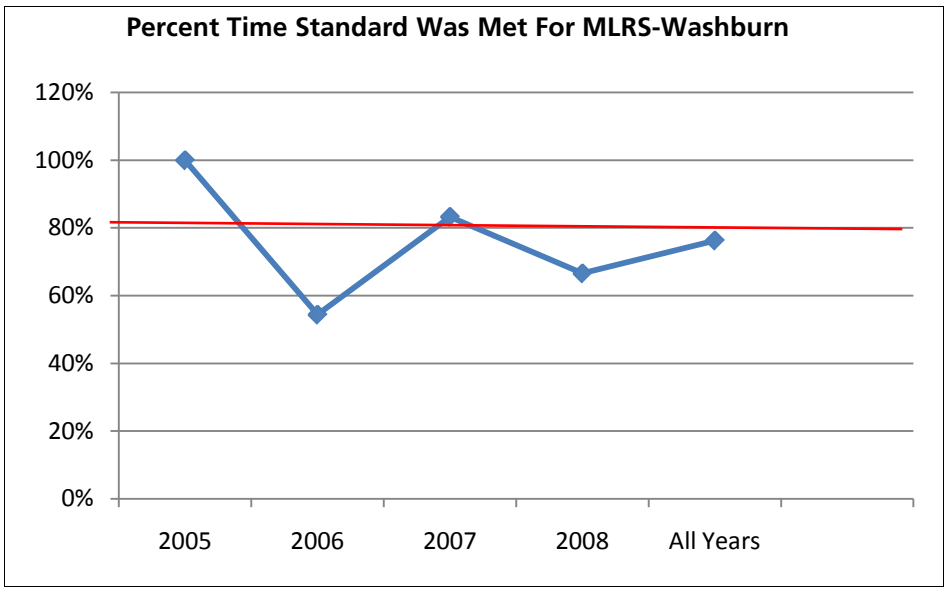


Figure 2.5.4 shows the percent of time that the standard was met by year and for all years for Merced Lake Ranger Station to Washburn Lake.

Discussion

Wilderness encounter monitoring in 2008 suggests that visitors frequently encounter more than one other party while hiking through the Merced Lake area of the river corridor. This includes the area from Moraine Dome to the Merced Lake Ranger Station a highly used travel corridor for hikers, backpackers, and stock users. Along this route lies the Merced Lake High Sierra Camp, a popular overnight destination. However, caution should be taken when attempting to extrapolate these findings to a larger population. A small sample size and the number of sampling locations employed in this monitoring effort limit the robustness of these data. Continued monitoring is necessary in order to grow this dataset and improve its representativeness. More frequent counts conducted by Wilderness and other staff may provide a means to increase the sample size. This indicator has suffered for the past two seasons of low sample size and inconsistent scheduling of data collections. In order to improve our confidence in this indicator for the upcoming years, we are placing significant efforts towards indicator improvement. In 2009, graduate students from the University of Idaho will conduct an in-depth study of encounter rates in the Tuolumne River Corridor. From this data, new sample sites will be selected, standards refined, and methods will be improved.

2.6 VISITOR USE/PEOPLE AT ONE TIME (PAOT) AT ATTRACTION SITES

This year's work included research findings from studies conducted during the 2008 season and details the Tioga Road corridor trailheads, Mariposa Grove, and Yosemite Valley visitor use studies. Data was collected by staff and interns working in the Visitor Use and Social Sciences branch. These studies expand the scope of the monitoring program by studying recreation use sites that have not been previously examined.

Tioga Road Corridor Trailheads

Multiple variables were collected to understand crowding/congestion at one time, length of stay, trail use, and visitation characteristics. Data were collected by observation at 15 minute intervals. Specifically, data were collected for the following variables:

- Number of people-at-one-time (PAOT)
    - Describes the number of people present at one time outside of their vehicle
- Number of vehicles present at one time (VAOT)
    - Describes the number of vehicles present at one time
- Vehicle type - categorized as:
    - Motorcycle
    - Private Vehicle (car, pickup, minivan)
    - Oversize vehicle (recreational vehicle, 15-passenger van)
    - Bus (commercial)
    - Other (park shuttle, utility/service vehicle, administrative vehicle)
- Vehicle occupancy rate (VOR)
    - Measures the number of people traveling in an individual vehicle
    - Collected in tandem with VAOT counts
- Vehicle based activity type – categorized as:
    - Pull off
    - Restroom only
    - Sightseeing
    - Stock
    - Picnicking
    - Day hiking
    - Backpacking (overnight)
- Length of stay (LOS)
    - Length of stay (LOS) was recorded for the first vehicle to enter the parking lot at the start of each sampling day immediately following the first PAOT and VAOT count
- Cumulative trailhead use by activity type – categorized as:
    - Day hiking
    - Overnight/backpacking
    - Stock

These data were collected with the intention of understanding trailhead conditions as part of a larger project funded by The Yosemite Fund to identify potential redesigns to the Tenaya Lake area. Trailheads (geographically west to east) that were sampled included:

1. Tamarack Flat Trailhead
2. Lukens Lake Trailhead
3. Yosemite Creek Trailhead
4. Ten Lakes Trailhead
5. Porcupine Flat Trailhead
6. May Lake Trailhead
7. Snow Creek Trailhead
8. Murphy Creek Trailhead
9. Sunrise Trailhead
10. Mono Pass Trailhead
11. Dana Meadow Parking Area (overflow parking for Gaylor Lakes Trailhead)
12. Gaylor Lakes Trailhead

As shown in Figure 2.6.1, the sampling locations are highlighted throughout the road corridor. The Tuolumne Meadows Trailhead locations were not included in this study as they are within the scope of another park planning effort, the Tuolumne River Plan. Additionally, Tenaya Lake Trailhead locations were included in this study though a separate planning effort is underway called the Tenaya Lake Redesign that will address Sunrise and Murphy Creek Trailheads.

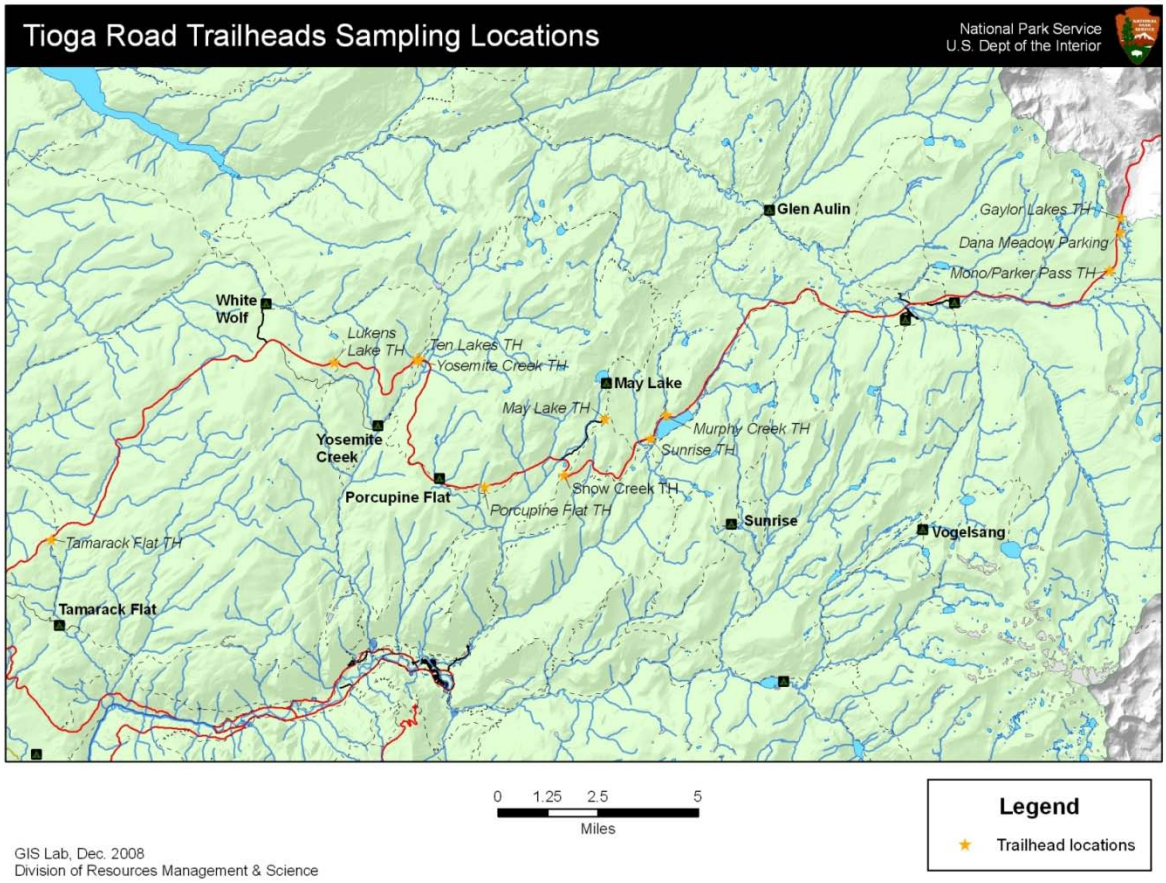


Figure 2.6.1 shows trailhead sampling locations along the Tioga Road.

RESULTS BY TRAILHEAD

(A) Tamarack Flat Trailhead

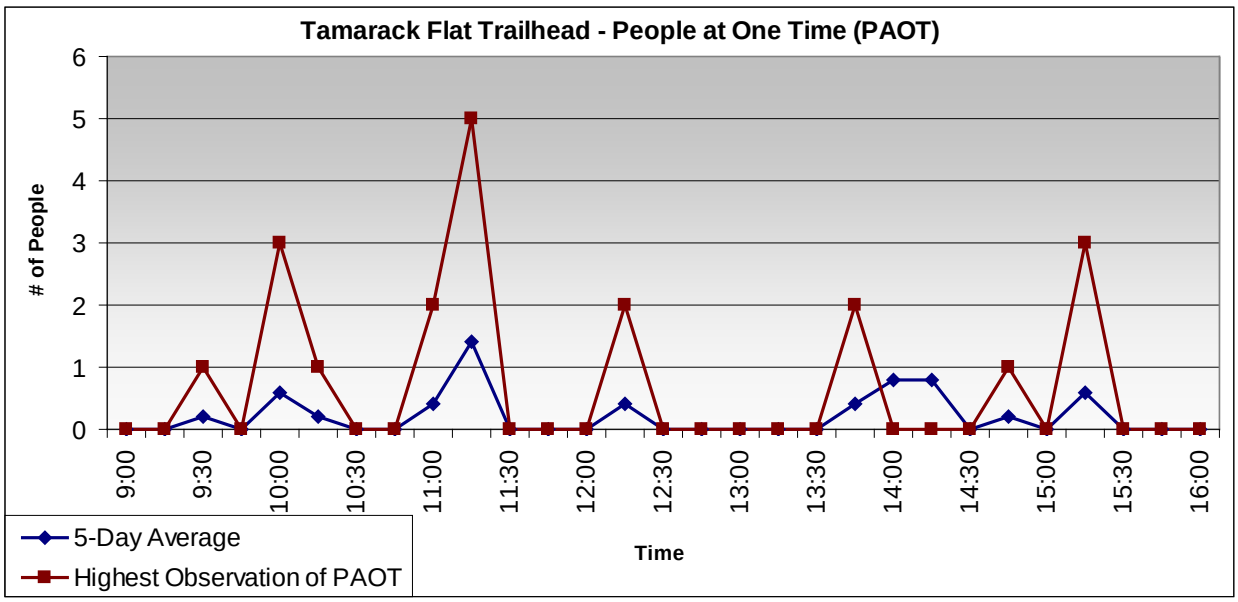


Figure 2.6.2 shows the highest and average number of people at one time, observed at the Tamarack Flat Trailhead.

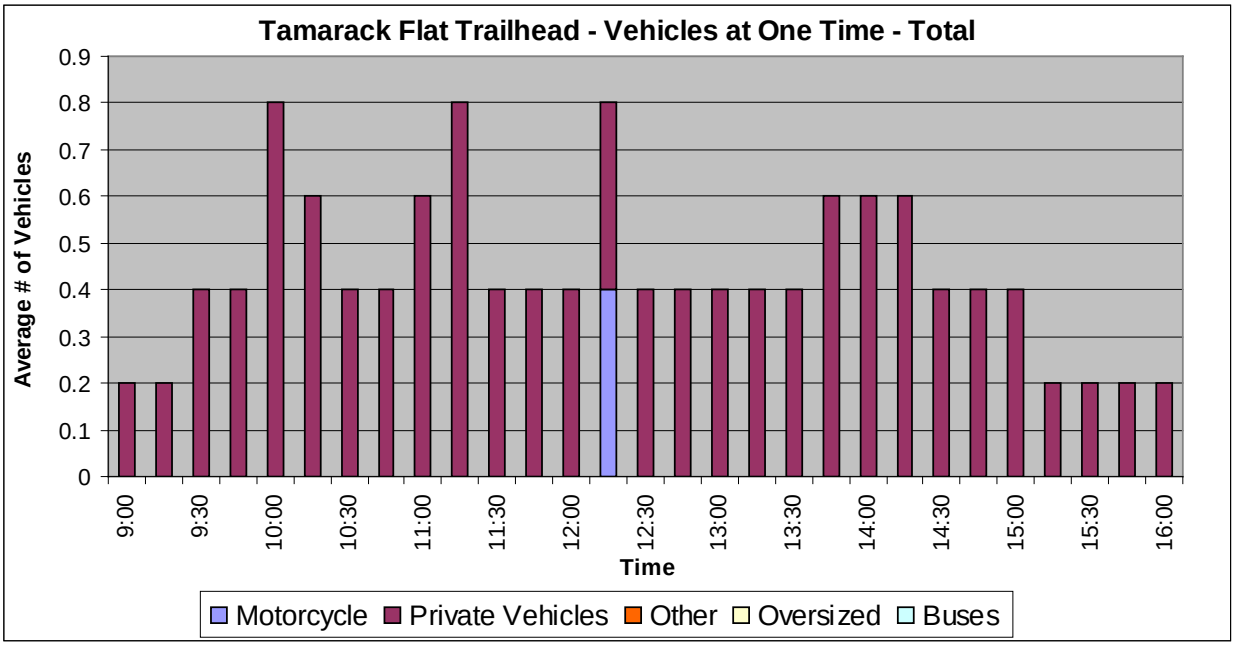


Figure 2.6.3 displays the Tamarack Flat Trailhead VAOT averages across all sampling days.

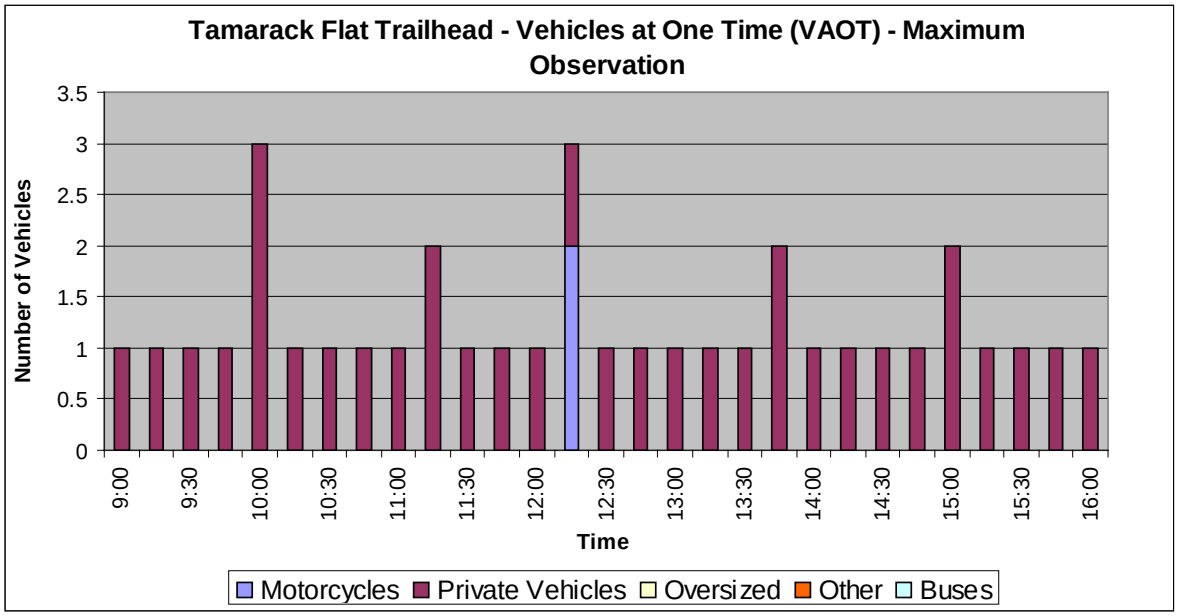


Figure 2.6.4 shows the maximum observations for Tamarack Flat Trailhead VAOT .

Table 2.6.1 shows the Tamarack Flat Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=30)**	**Weekend (N=6)**	**Weekday (N=24)**
Day Hiking	0	0	0
Pull Off/Drop Off	56.7	50	58.3
Restroom Only	0	0	0
Sightseeing	40	50	37.5
Picnicking	0	0	0
Overnight/Backpacking	3.3	0	4.2
Stock Use	0	0	0

Table 2.6.2 shows the average length of stay at Tamarack Flat Trailhead.

	Average Length of Stay (minutes/seconds)		
3.0% > 45 minutes	**Total (N=29)**	**Weekend (N=6)**	**Weekday (N=23)**
	5/18	6/30	5/0

Table 2.6.3 shows the trail use from Tamarack Flat Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Tamarack Flat	Day Hiking	100
(N=1)	Overnight/Backpacking	0
	Stock	0

(B) Lukens Lake Trailhead

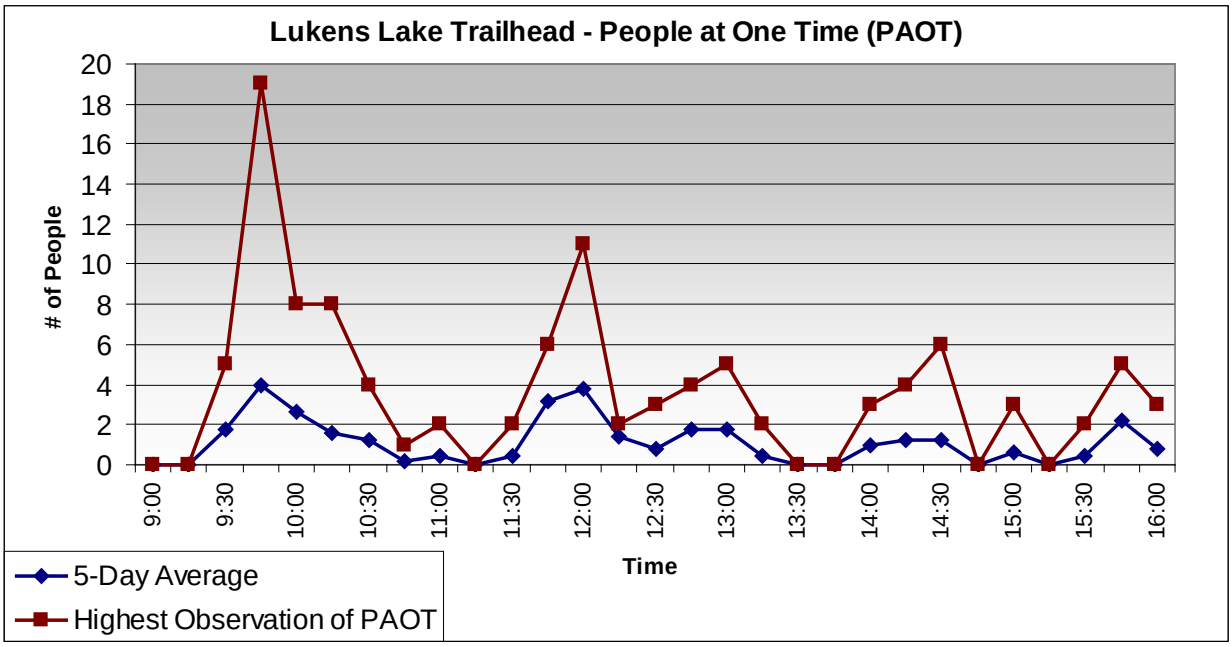


Figure 2.6.5 displays the highest observed and average PAOT at Lukens Lake Trailhead PAOT.

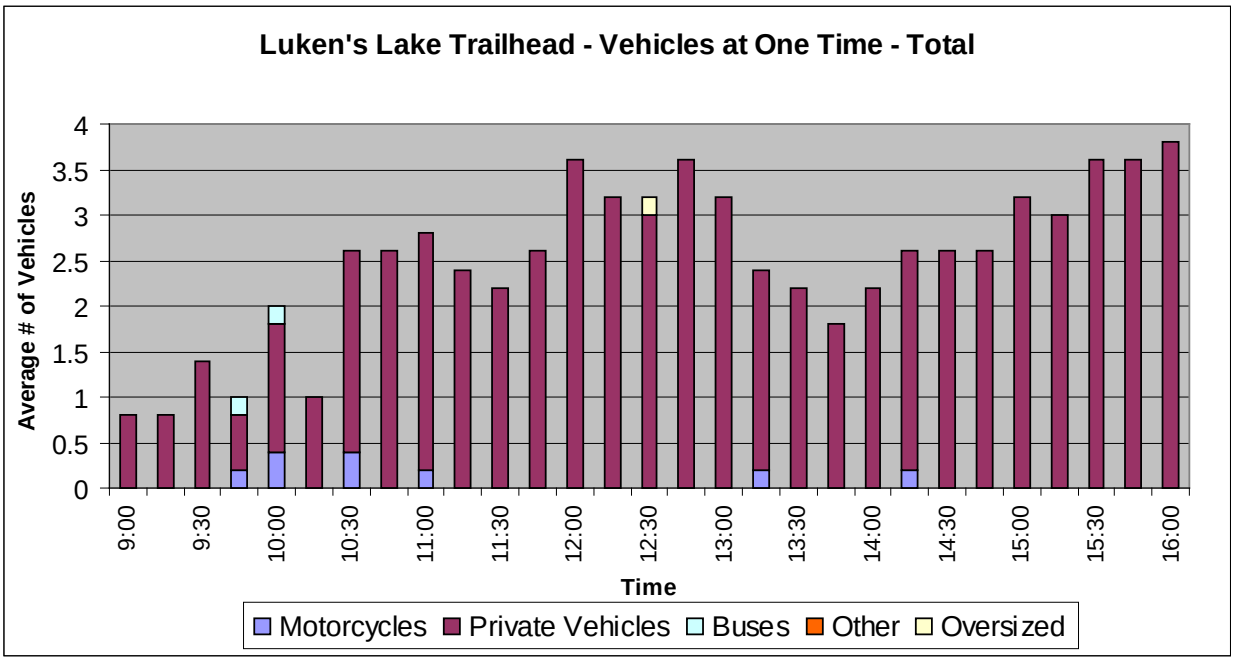


Figure 2.6.6 displays VAOT averages across all sampling days for the Lukens Lake Trailhead.

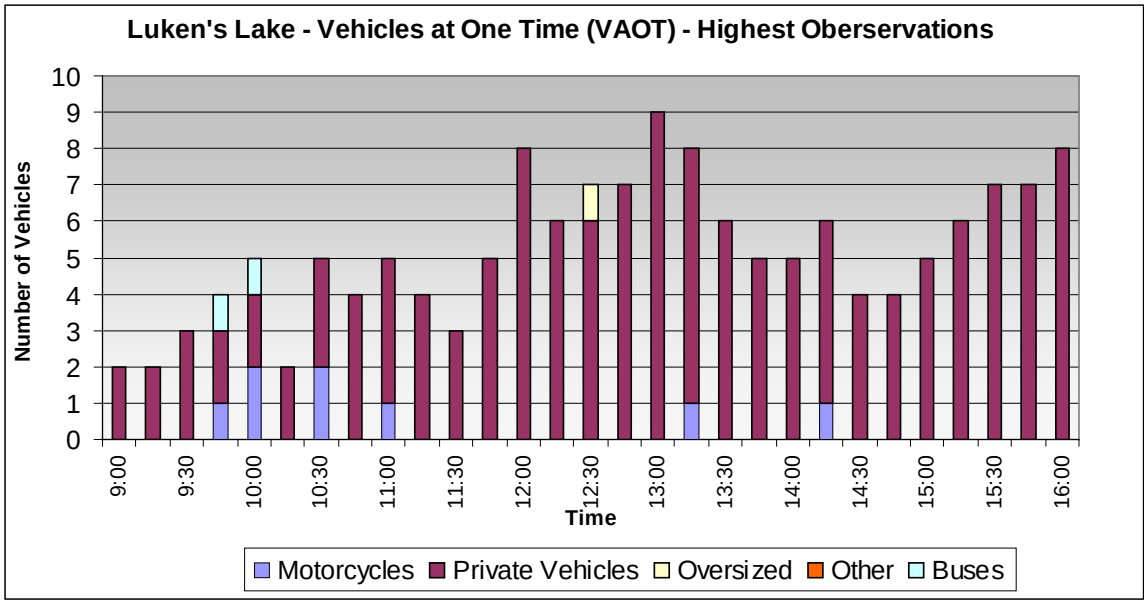


Figure 2.6.7 displays the maximum observations for VAOT at Lukens Lake Trailhead.

Table2.6.4 shows Lukens Lake Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=84)**	**Weekend (N=33)**	**Weekday (N=51)**
Day Hiking	28.6	27.3	29.4
Pull Off/Drop Off	67.9	72.7	64.7
Restroom Only	0	0	0
Sightseeing	2.4	0	3.9
Picnicking	1.2	0	2
Overnight/Backpacking	0	0	0
Stock Use	0	0	0

Table 2.6.5 shows average length of stay at Lukens Lake Trailhead.

	Average Length of Stay (minutes/seconds)		
25.9% > 45 minutes	**Total (N=63)**	**Weekend (N=26)**	**Weekday (N=37)**
	3/42	4/0	3/30

Table 2.6.6 displays trail use from Lukens Lake Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Yosemite Valley	Day Hiking	11.8
(N=34)	Overnight/Backpacking	88.2
	Stock	0
Trail to Lukens Lake	Day Hiking	100
(N=112)	Overnight/Backpacking	0
	Stock	0

(C) Yosemite Creek Trailhead

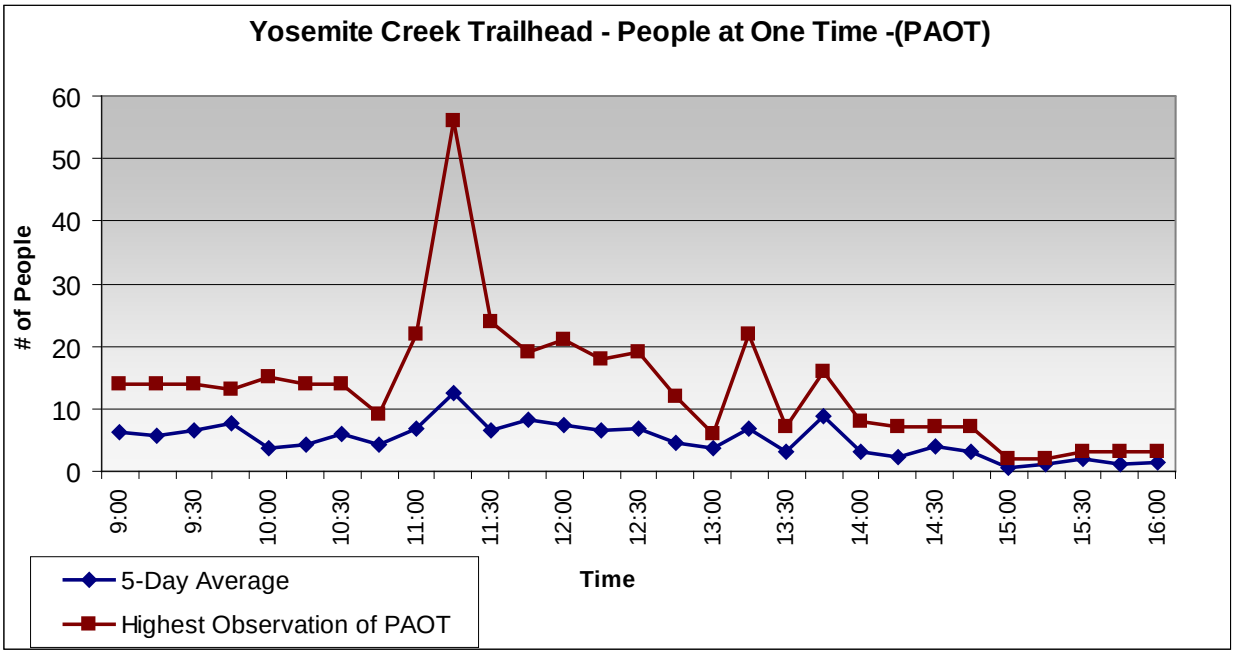


Figure 2.6.8 displays the highest observed and average PAOT at Yosemite Creek Trailhead.

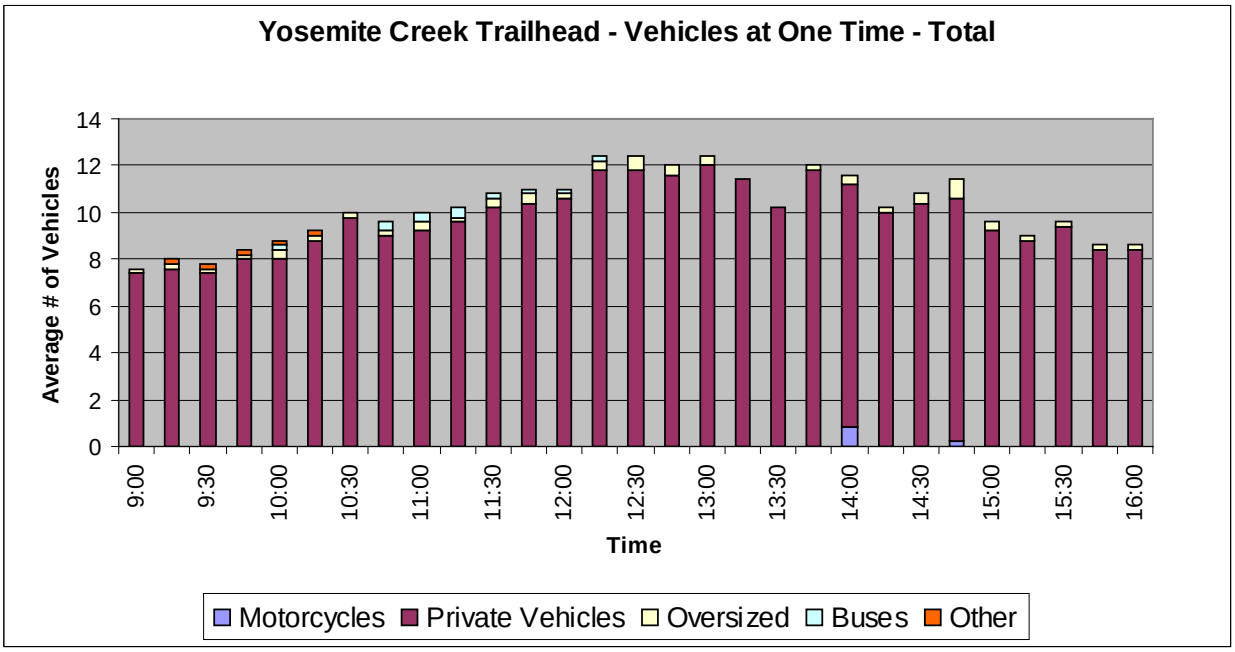


Figure 2.6.9 displays Yosemite Creek Trailhead VAOT averages across all sampling days.

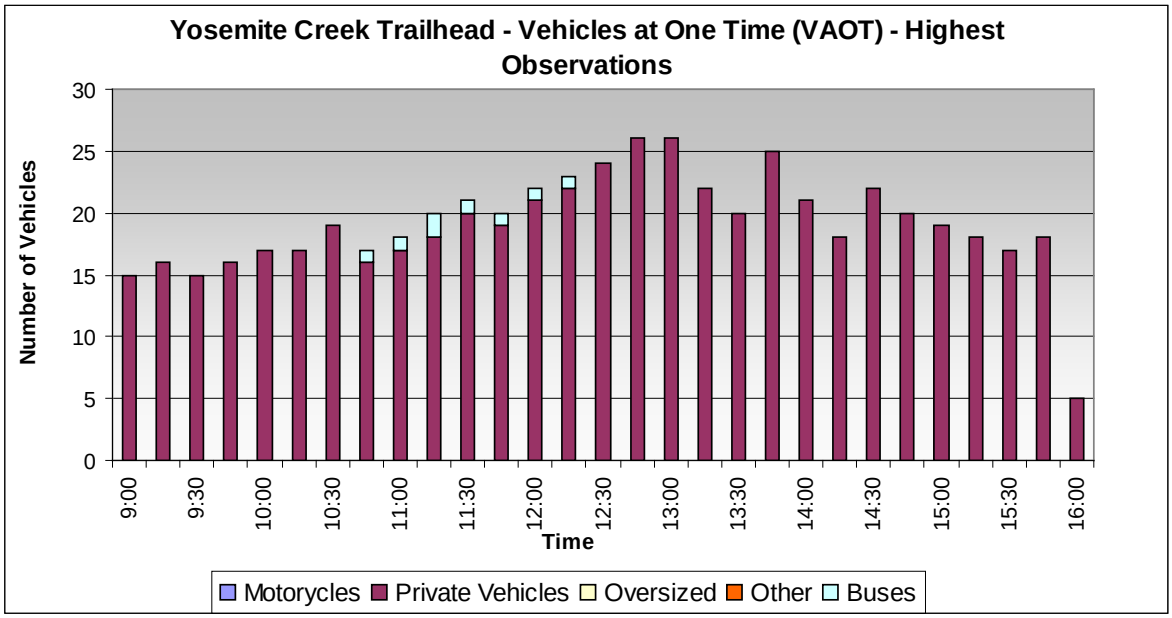


Figure 2.6.10 displays the maximum observations for VAOT at the Yosemite Creek Trailhead.

Table 2.6.7 displays Yosemite Creek Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
Day Hiking	4.8	8	2.7
Pull Off/Drop Off	15.3	10	18.9
Restroom Only	51.6	50	52.7
Sightseeing	21	20	21.6
Picnicking	4	4	4.1
Overnight/Backpacking	3.2	8	0
Stock Use	0	0	0

Table 2.6.8 displays the average length of stay at Yosemite Creek Trailhead.

	Average Length of Stay (minutes/seconds)		
10.5% > 45 minutes	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
	8/0	8/48	7/30

Table 2.6.9 shows the trail use from Yosemite Creek Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Yosemite Valley	Day Hiking	86.7
(N=30)	Overnight/Backpacking	13.3
	Stock	0

(D) Ten Lakes Trailhead

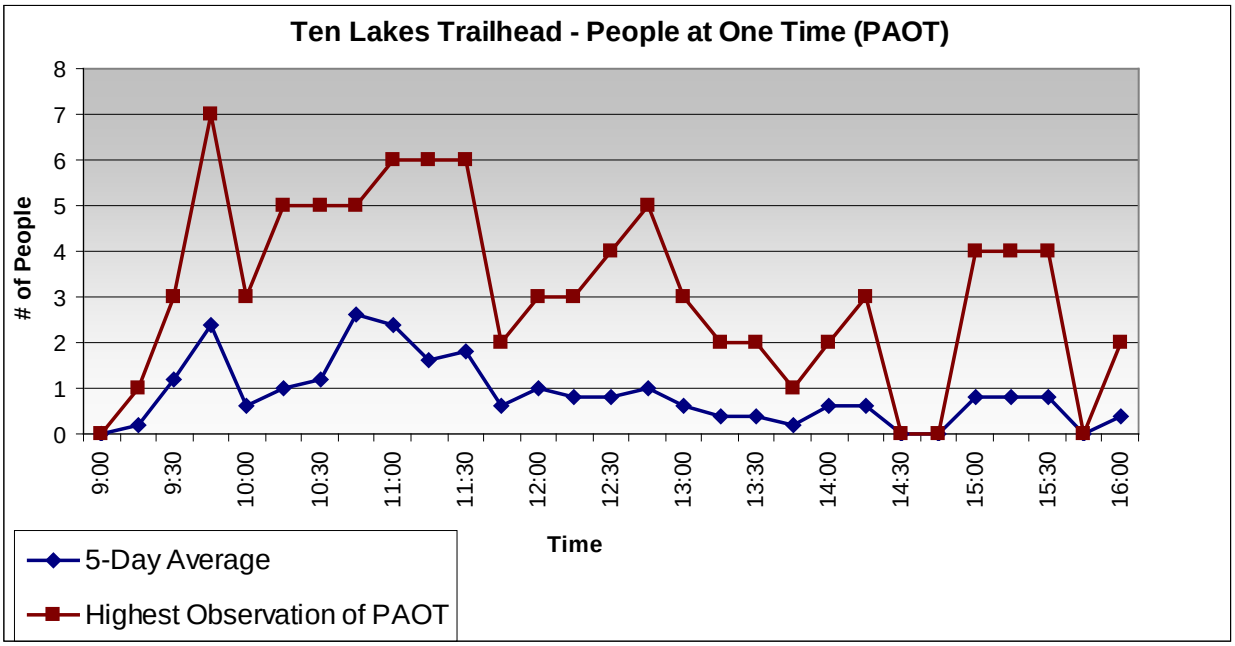


Figure 2.6.11 shows PAOT displaying highest observed and average at the Ten Lakes Trailhead.

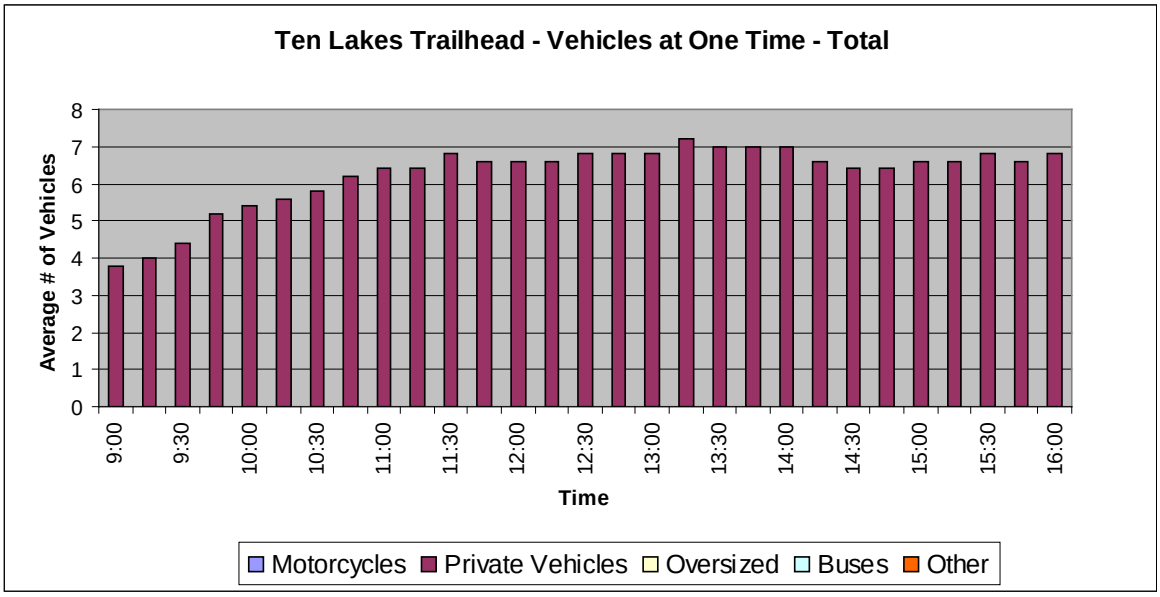


Figure 2.6.12 shows VAOT averages across all sampling days for the Ten Lakes Trailhead.

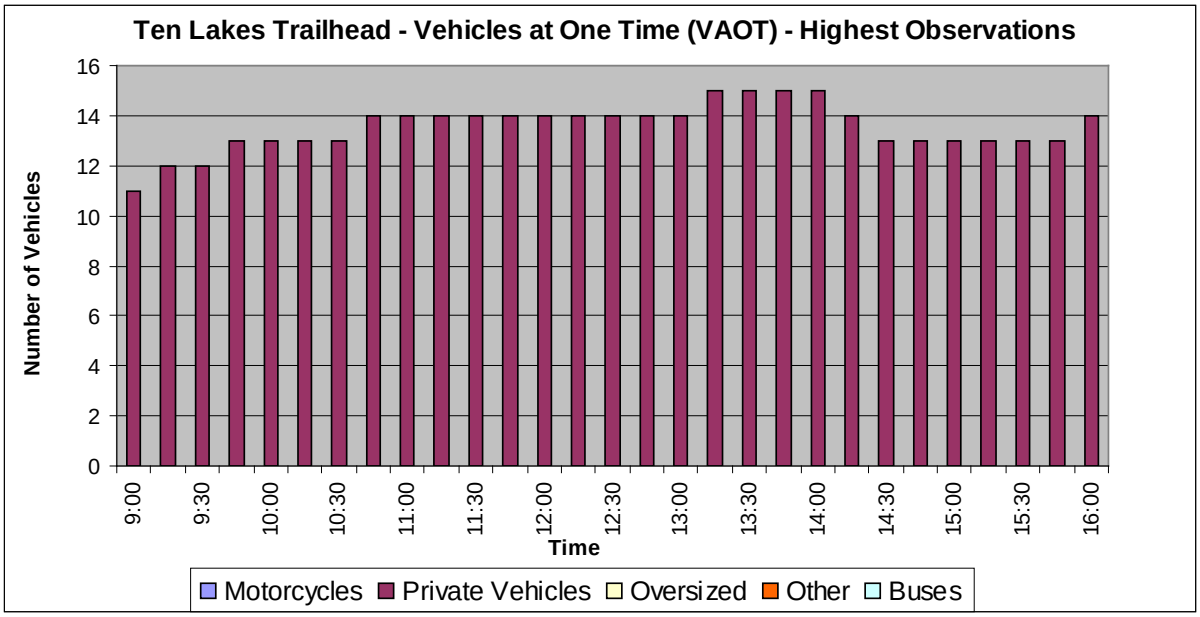


Figure 2.6.13 shows the maximum observations for VAOT at the Ten Lakes Trailhead.

Table 2.6.10 shows Ten Lakes Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
Day Hiking	22.7	33.3	15.4
Pull Off/Drop Off	13.6	22.2	7.7
Restroom Only	N/A	N/A	N/A
Sightseeing	22.7	11.1	30.8
Picnicking	0	0	0
Overnight/Backpacking	40.9	33.3	46.2
Stock Use	0	0	0

Table 2.6.11 displays the average length of stay at Ten Lakes Trailhead.

	Average Length of Stay (minutes/seconds)		
59.1% > 45 minutes	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
	7/54	8/0	7/48

Table 2.6.12 demonstrates trail use from Ten Lakes Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Yosemite Valley	Day Hiking	22.4
(N=76)	Overnight/Backpacking	77.6
	Stock	0

(E) Porcupine Flat Trailhead

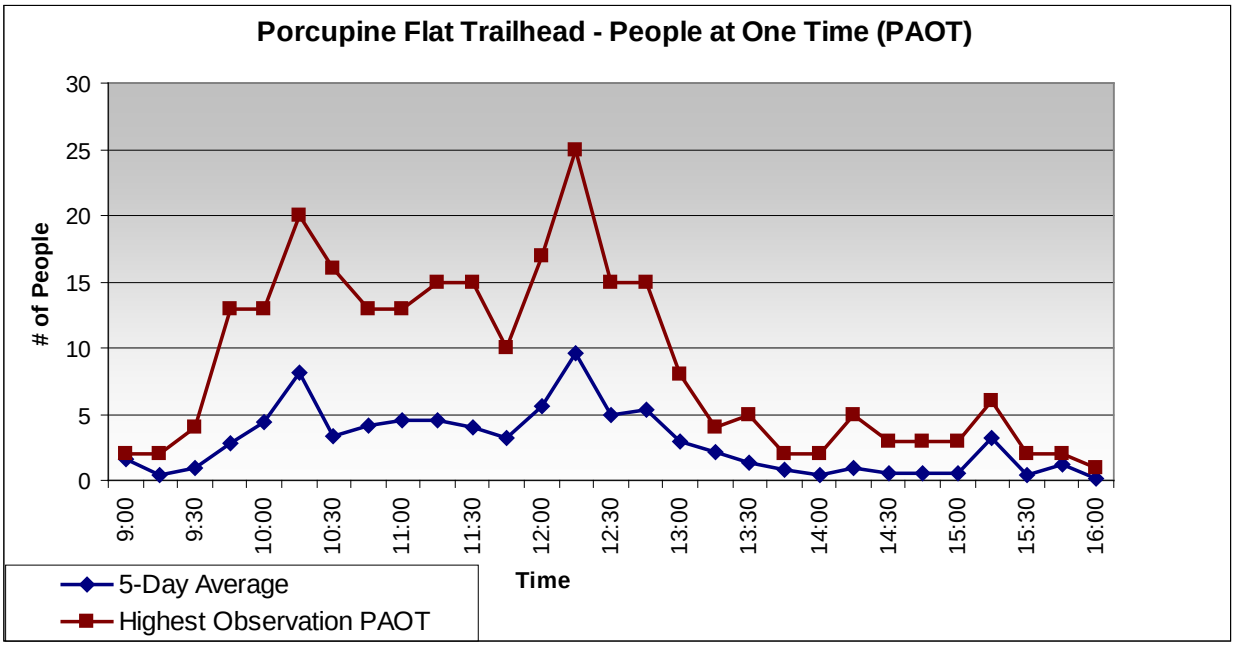


Figure 2.6.14 displays highest observed and average PAOT at Porcupine Flat Trailhead.

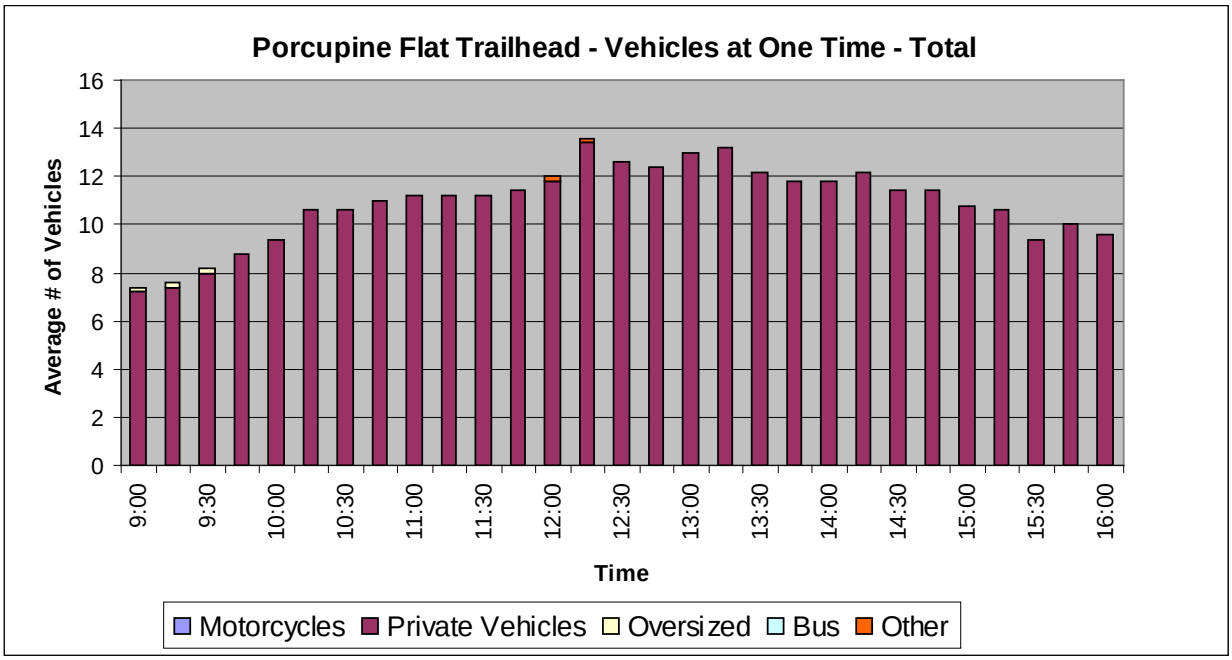


Figure 2.6.15 shows Porcupine Flat Trailhead VAOT averages across all sampling days.

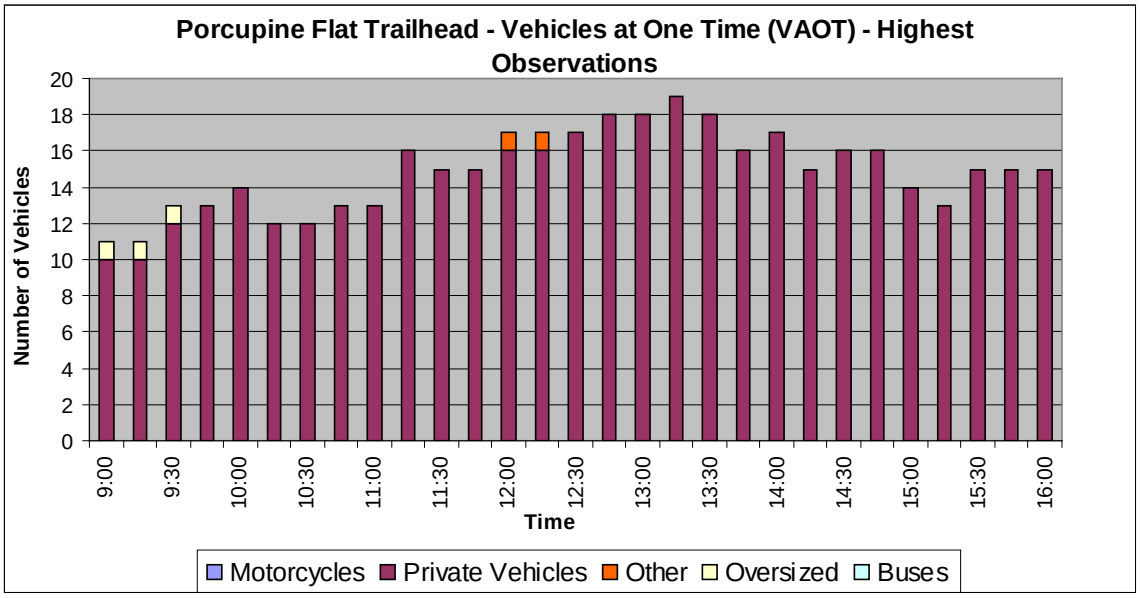


Figure 2.6.16 shows maximum observations of VAOT at the Porcupine Flat Trailhead.

Table 2.6.13 shows Porcupine Flat Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=147)**	**Weekend (N=58)**	**Weekday (N=89)**
Day Hiking	13.6	20.7	9
Pull Off/Drop Off	23.1	19	25.8
Restroom Only	49.7	50	49.4
Sightseeing	11.6	6.9	14.6
Overnight/Backpacking	2	3.4	1.1
Stock Use	0	0	0

Table 2.6.14 shows average length of stay at Porcupine Flat Trailhead.

	Average Length of Stay (minutes/seconds)		
15.0% > 45 minutes	**Total (N=125)**	**Weekend (N=44)**	**Weekday (N=81)**
	5/18	5/12	5/18

Table 2.6.15 shows trail use from Porcupine Flat Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Yosemite Valley	Day Hiking	85.3
(N=156)	Overnight/Backpacking	14.7
	Stock	0

(F) May Lake Trailhead

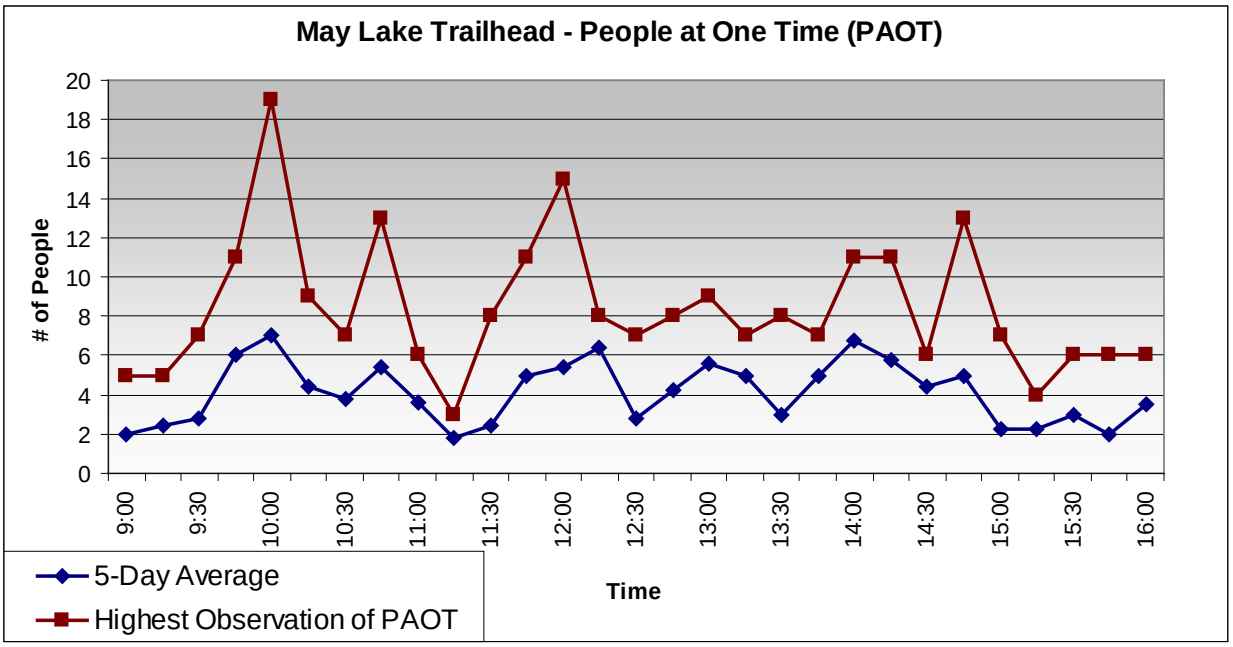


Figure 2.6.17. displays highest observed and average PAOT at May Lake Trailhead PAOT.

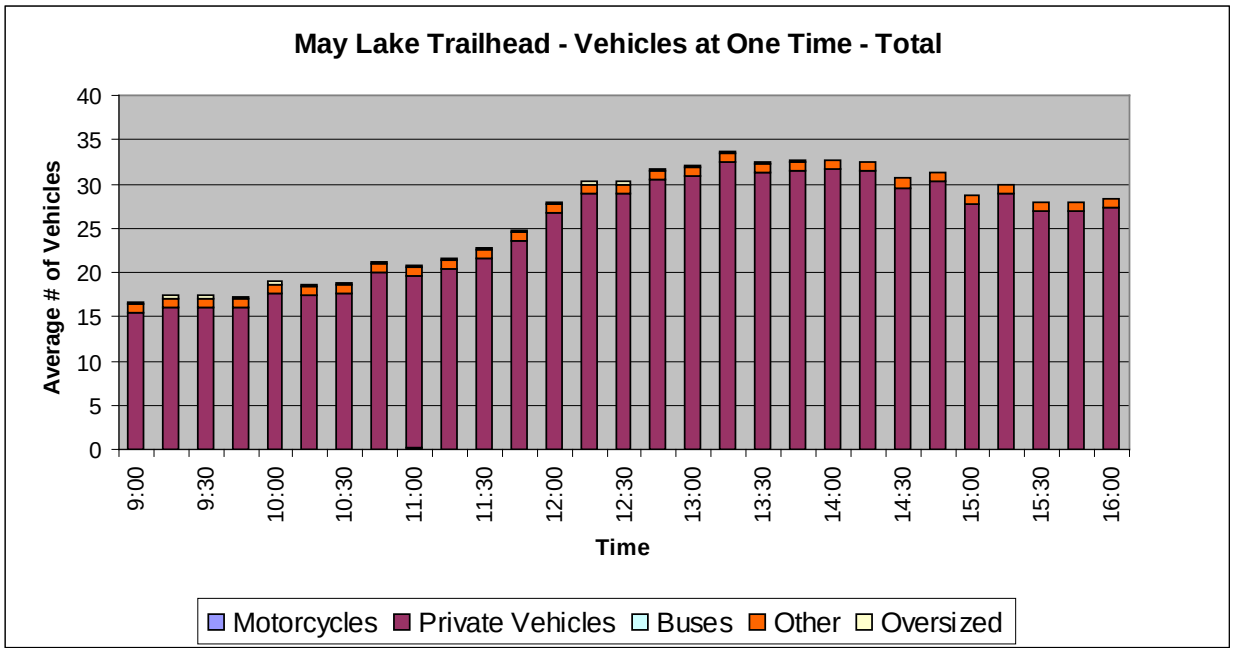


Figure 2.6.18 displays VAOT averages across all sampling days for May Lake Trailhead.

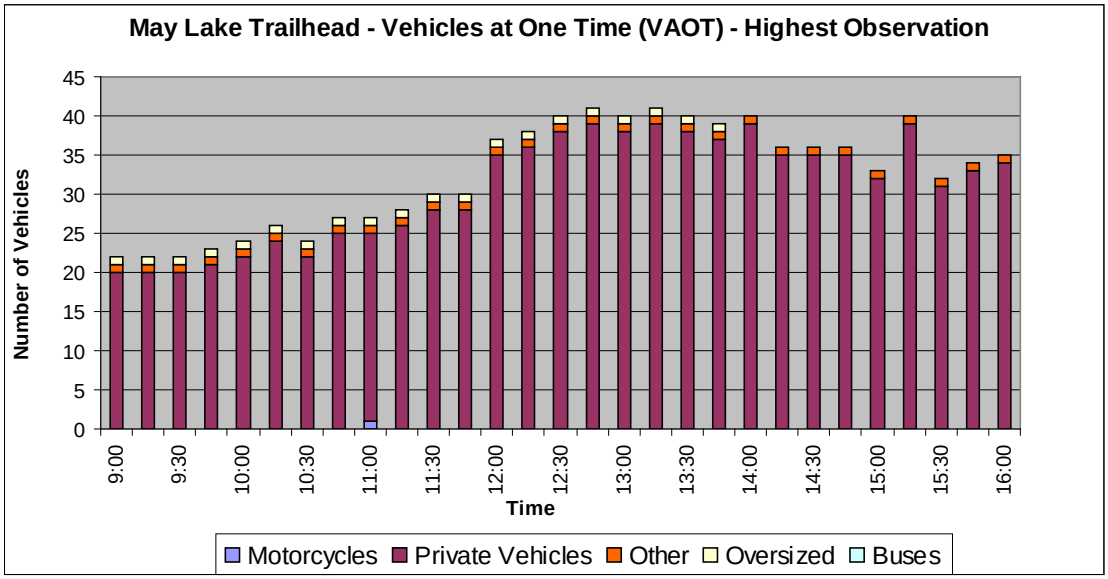


Figure 2.6.19. displays the maximum observations for VAOT at the May Lake Trailhead.

Table 2.6.16 shows May Lake Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
Day Hiking	86.6	87.3	86.2
Pull Off/Drop Off	3.5	1.8	4.6
Restroom Only	0.7	0	1.1
Sightseeing	1.4	1.8	1.1
Overnight/Backpacking	7.7	9.1	6.9
Stock Use	0	0	0

Table 2.6.17 shows the average length of stay at May Lake Trailhead.

	Average Length of Stay (minutes/seconds)		
95.7% > 45 minutes	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
	12/42	20/0	11/12

Table 2.6.18 shows the trail use from May Lake Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to May Lake	Day Hiking	85.8
(N=599)	Overnight/Backpacking	13.4
	Stock	0.8
Trail to Sunrise HSC	Day Hiking	53.5
(N=43)	Overnight/Backpacking	41.9
	Stock	4.7
**** Percentages by trail may not equal zero due to rounding.**		

(G) Snow Creek Trailhead

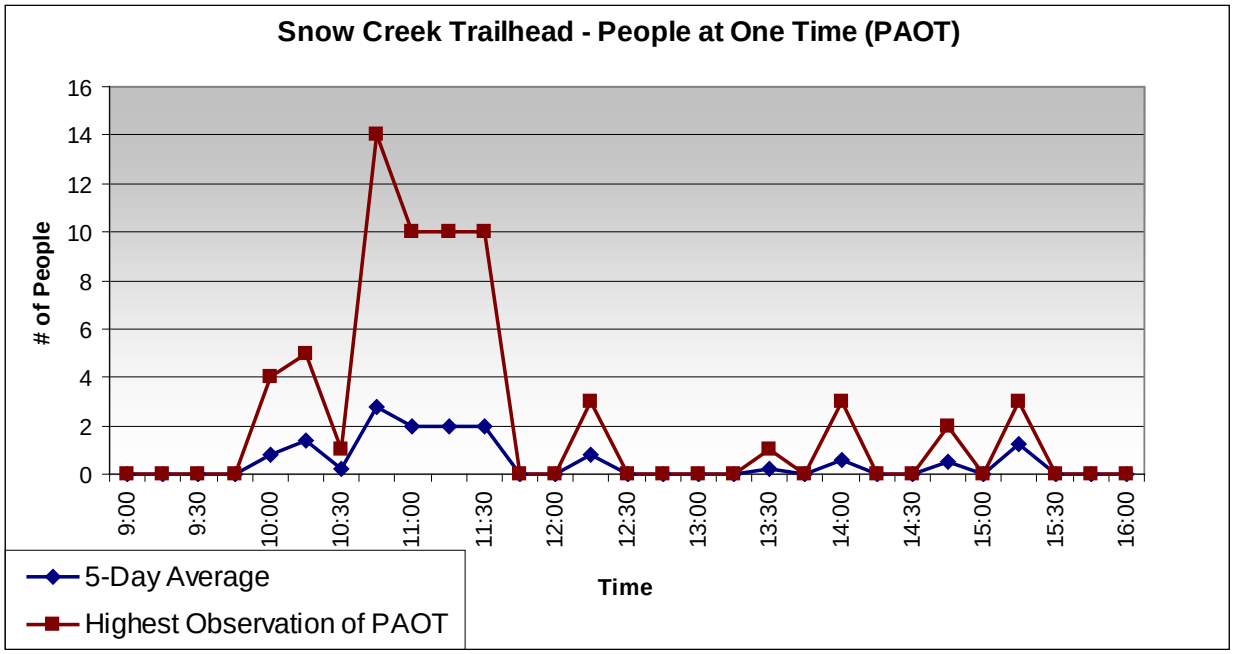


Figure 2.6.20 displays highest observed and average PAOT at Snow Creek Trailhead.

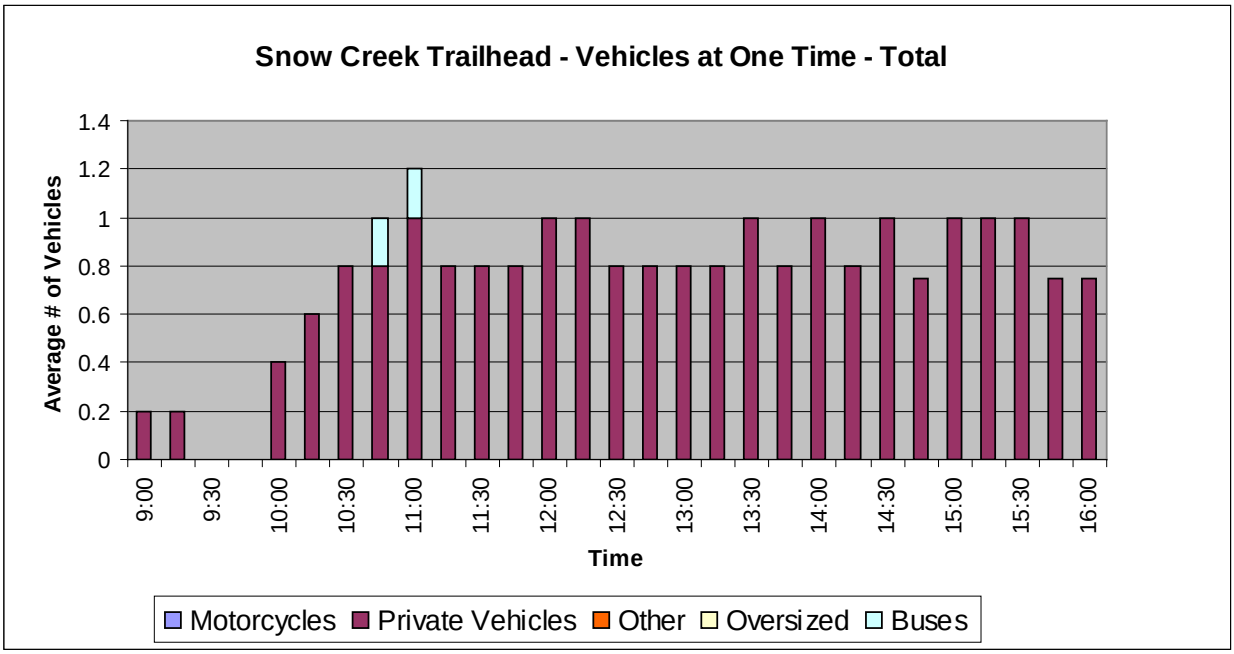


Figure 2.6.21 shows Snow Creek Trailhead VAOT averages across all sampling days.

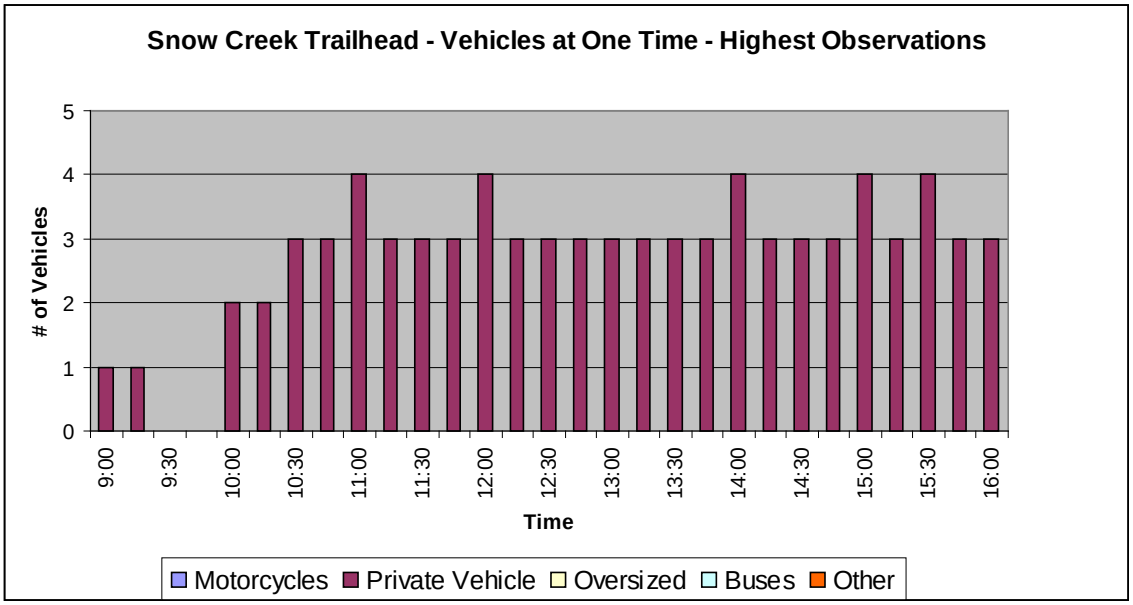


Figure 2.6.22 shows the maximum observations of VAOT for the Snow Creek Trailhead.

Table 2.6.19 shows Snow Creek Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
Day Hiking	4.8	0	8
Pull Off/Drop Off	73.8	58.8	84
Restroom Only	N/A	N/A	N/A
Sightseeing	19	35.3	8
Overnight/Backpacking	2.4	5.9	0
Stock Use	0	0	0

Table 2.6.20 shows average length of stay at Snow Creek Trailhead.

	Average Length of Stay (minutes/seconds)		
2.4% > 45 minutes	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
	5/18	7/48	3/30

Table 2.6.21 shows trail use from Snow Creek Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to May Lake TH	Day Hiking	47.4
(N=19)	Overnight/Backpacking	52.6
	Stock	0
Trail to Yosemite Valley	Day Hiking	100
(N=4)	Overnight/Backpacking	0
	Stock	0

(H) Sunrise Trailhead

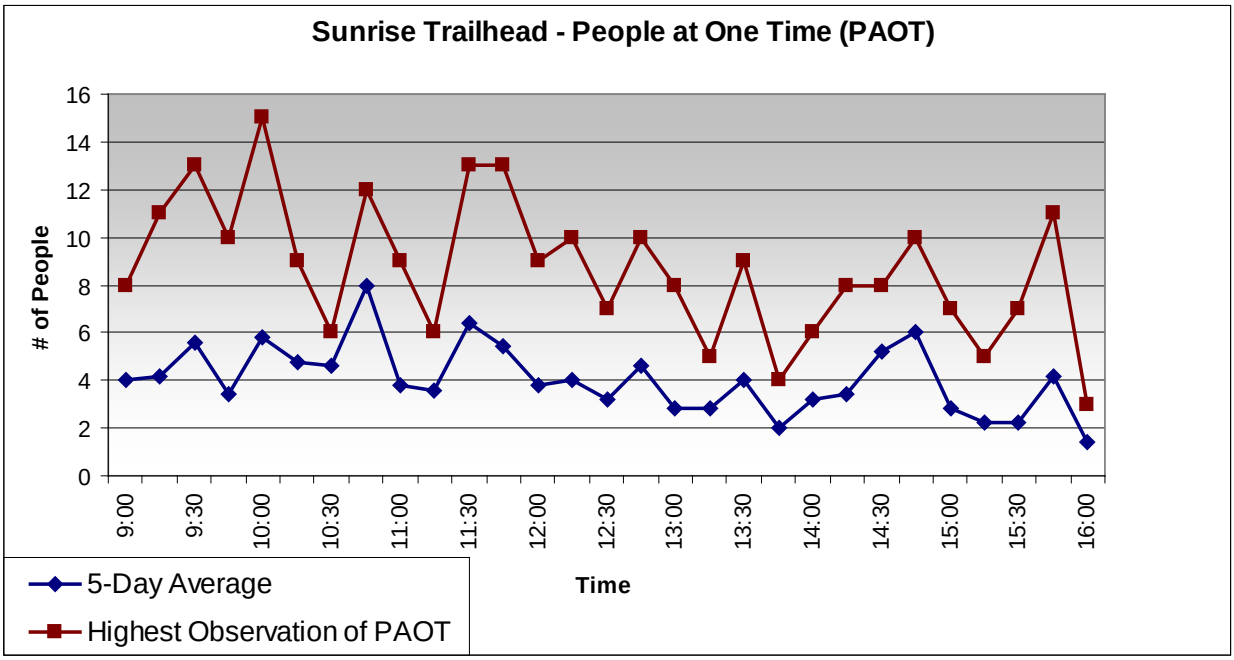


Figure 2.6.23 displays the highest observed and average PAOT for the Sunrise Trailhead.

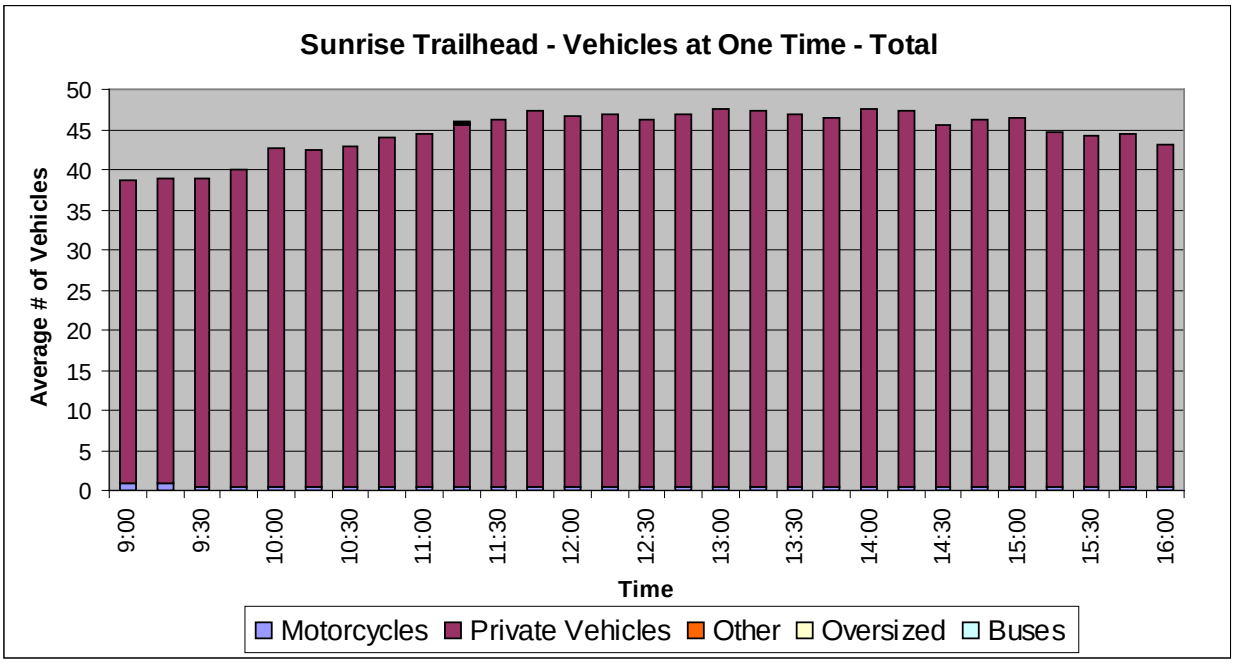


Figure 2.6.24 shows the Sunrise Trailhead VAOT averages across all sampling days.

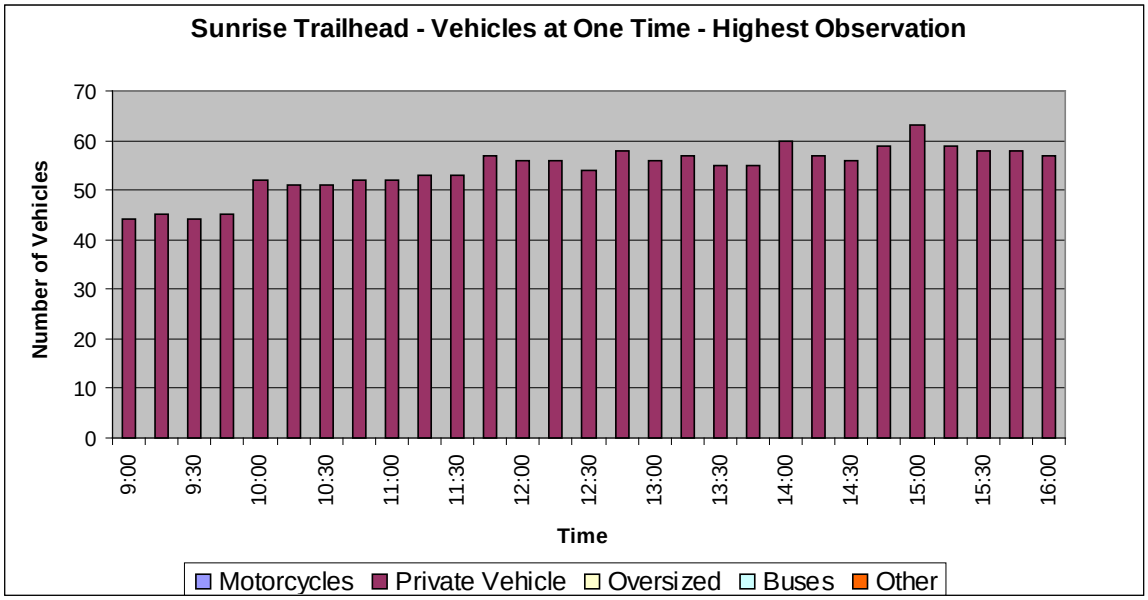


Figure 2.6.25 displays the maximum observations for VAOT at the Sunrise Trailhead.

Table 2.6.22 shows Sunrise Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
Day Hiking	17.9	24.2	13.7
Pull Off/Drop Off	51.2	48.5	52.9
Restroom Only	23.8	21.2	25.5
Sightseeing	4.8	6.1	3.9
Overnight/Backpacking	2.4	0	3.9
Stock Use	0	0	0

Table 2.6.23 shows average length of stay at Sunrise Trailhead.

	Average Length of Stay (minutes/seconds)		
20.2% > 45 minutes	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
	3/0	2/54	3/06

Table 2.6.24 shows trail use from Sunrise Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Sunrise HSC	Day Hiking	61.7
(N=405)	Overnight/Backpacking	35.6
	Stock	2.7
Trail to Yosemite Valley	Day Hiking	94.7
(N=19)	Overnight/Backpacking	0
	Stock	5.3
Trail to May Lake	Day Hiking	80
(N=10)	Overnight/Backpacking	20
	Stock	0

(I) Murphy Creek Trailhead

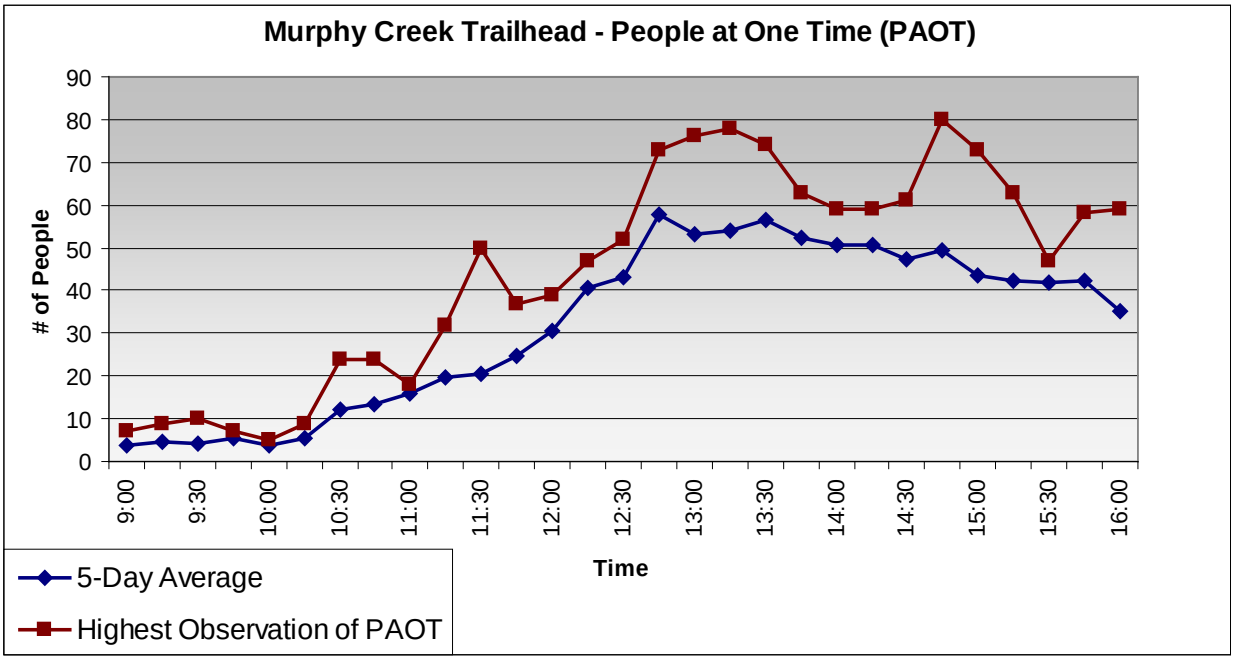


Figure 2.6.26 displays the highest observed and average PAOT for the Murphy Creek Trailhead.

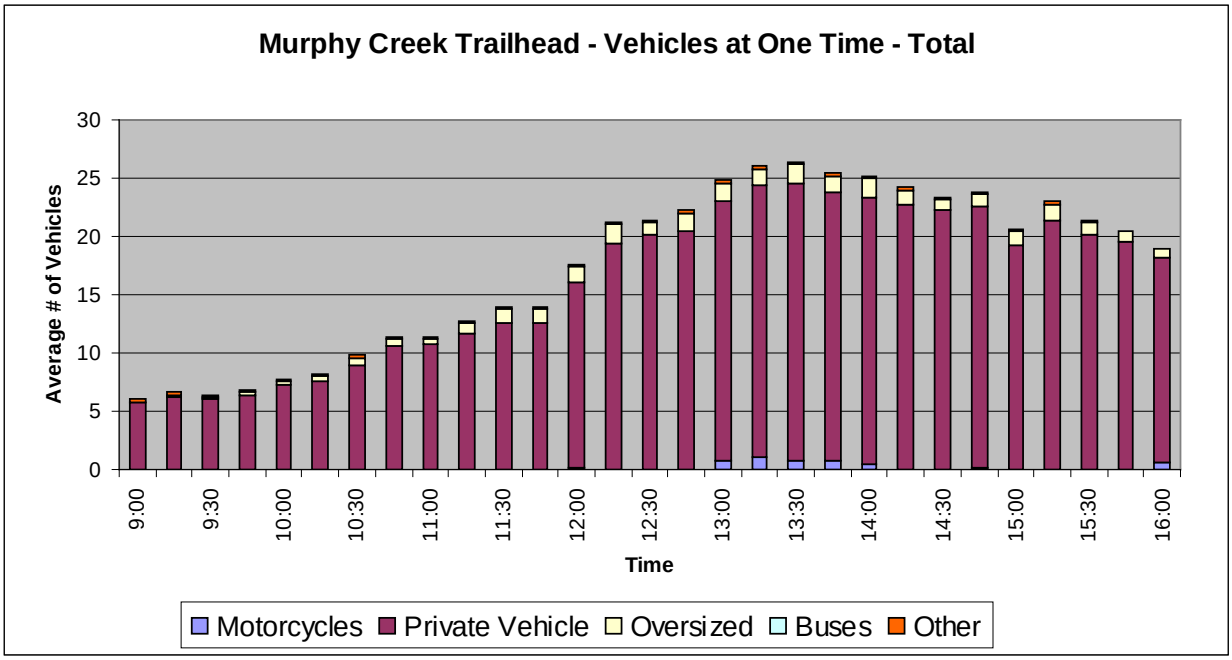


Figure 2.6.27 shows the Murphy Creek Trailhead VAOT averages across all sampling days

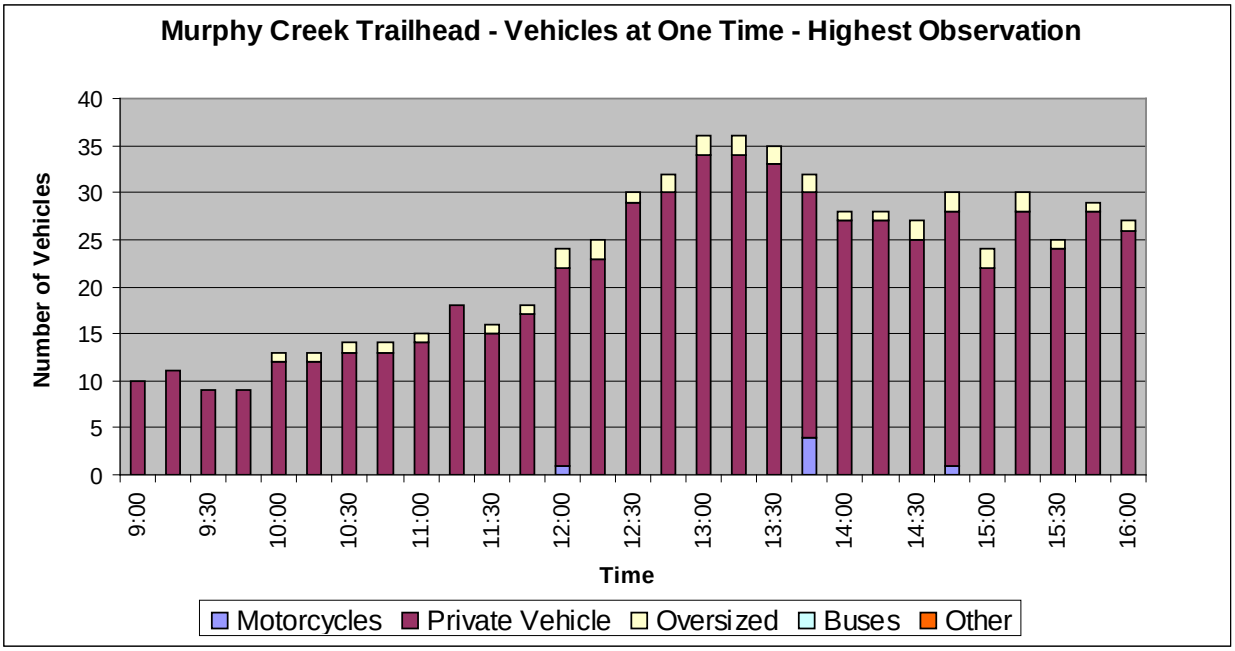


Figure 2.6.28 shows the maximum observations for VAOT at the Murphy Creek Trailhead.

Table 2.6.25 shows the Murphy Creek Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
Day Hiking	1.6	0	2.6
Pull Off/Drop Off	10.9	8	12.8
Restroom Only	26.6	24	28.2
Sightseeing	48.4	56	43.6
Picnicking	10.9	12	10.3
Overnight/Backpacking	1.6	0	2.6
Stock Use	0	0	0

Table 2.6.26 shows the average length of stay at Murphy Creek Trailhead.

	Average Length of Stay (minutes/seconds)		
31.3% > 45 minutes	**Total (N=124)**	**Weekend (N=50)**	**Weekday (N=74)**
	12/06	14/24	10/42

Table 2.6.27 shows the trail use from Murphy Creek Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Glen Aulin	Day Hiking	57.9
(N=57)	Overnight/Backpacking	42.1
	Stock	0

(J) Mono Pass Trailhead

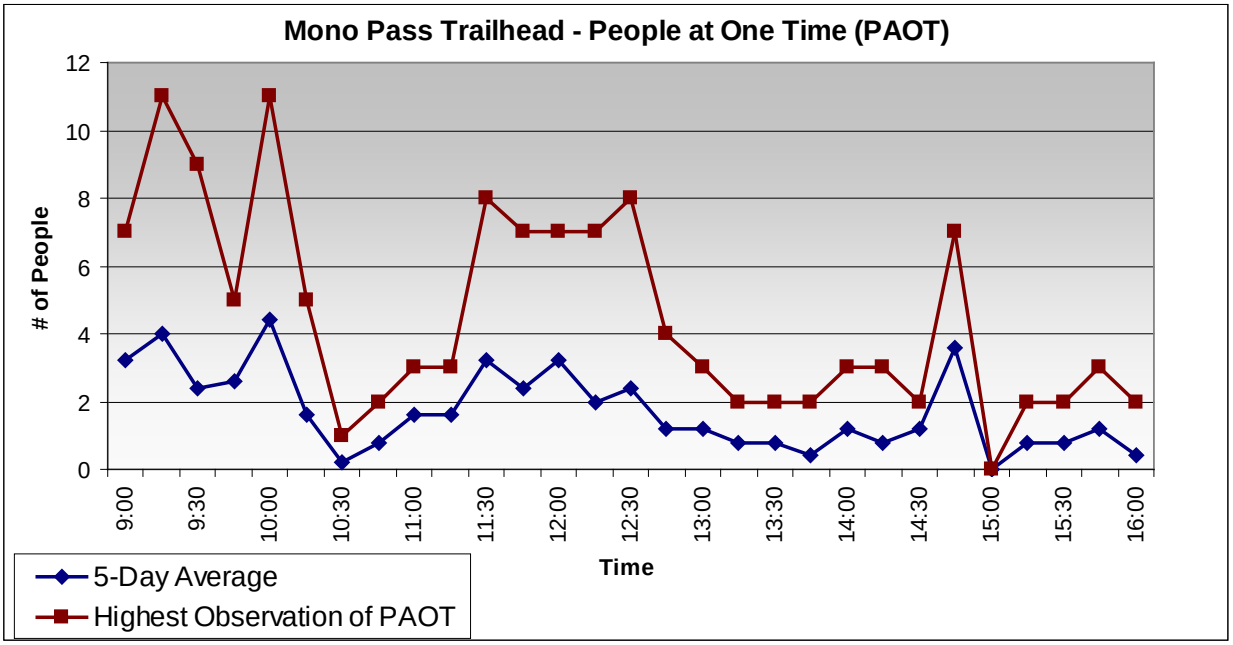
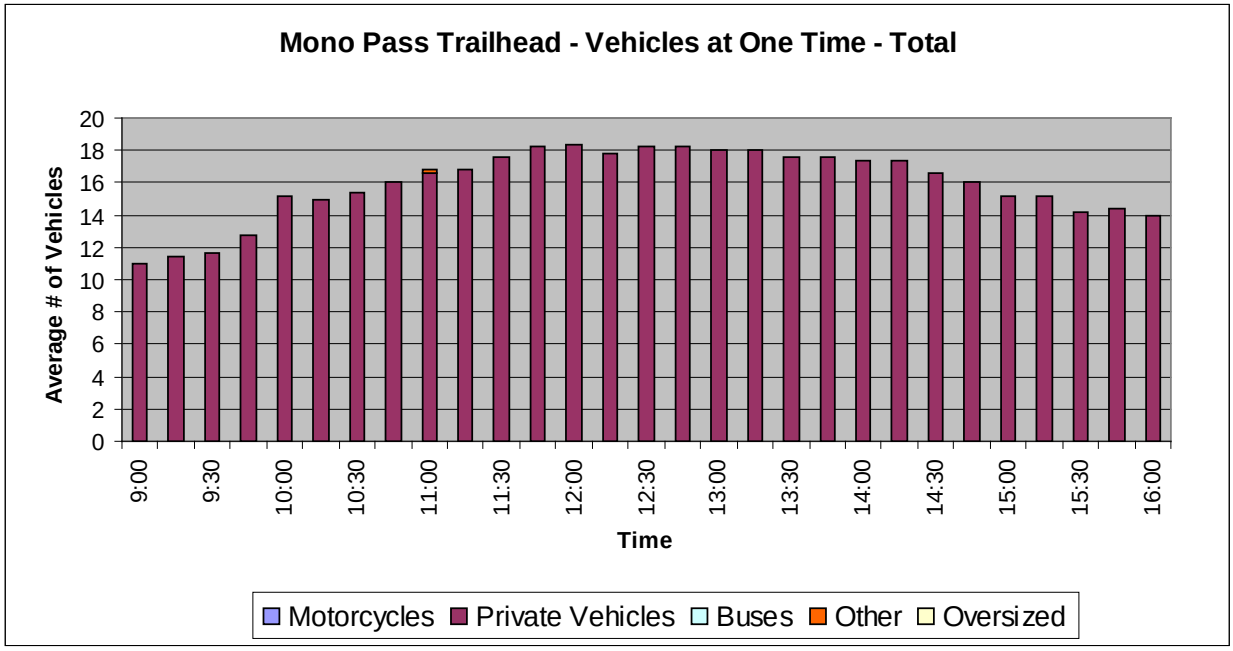


Figure 2.6.29 displays highest observed and average PAOT for Mono Pass Trailhead.

Figure 2.6.30 displays Mono Pass Trailhead VAOT across all sampling days.



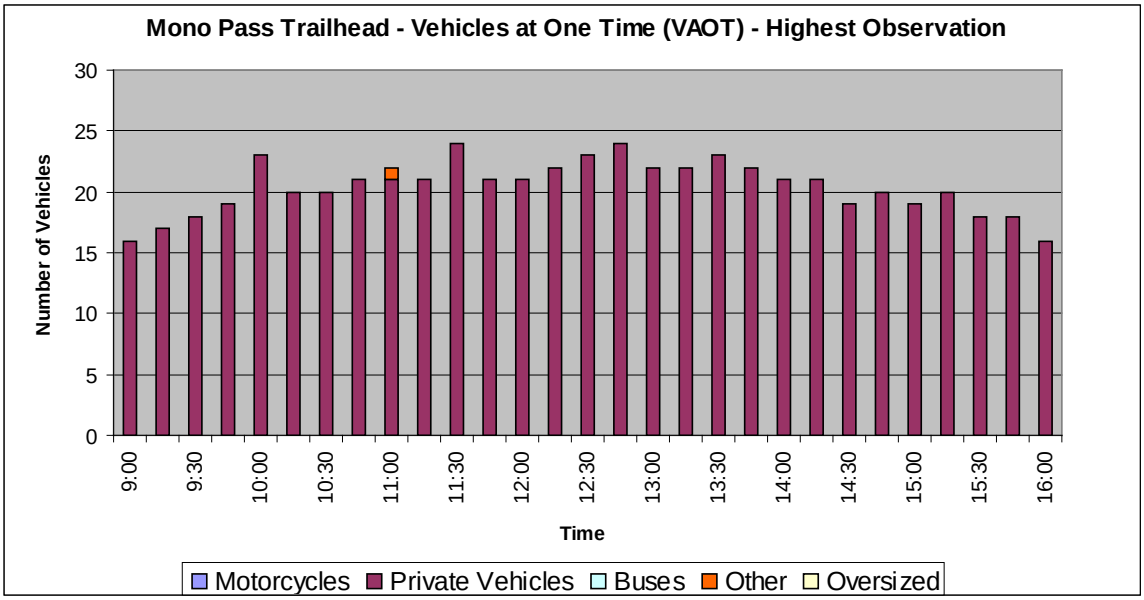


Figure 2.6.31 shows the maximum observations of VAOT for the Mono Pass Trailhead.

Table 2.6.28 shows the Mono Pass Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=121)**	**Weekend (N=49)**	**Weekday (N=72)**
Day Hiking	29.8	22.4	34.7
Pull Off/Drop Off	44.6	55.1	37.5
Restroom Only	13.2	10.2	15.3
Sightseeing	8.3	4.1	11.1
Overnight/Backpacking	4.1	8.2	1.4
Stock Use	0	0	0

Table 2.6.29 shows the average length of stay at Mono Pass Trailhead.

	Average Length of Stay (minutes/seconds)		
51.3% > 45 minutes	**Total (N=80)**	**Weekend (N=34)**	**Weekday (N=46)**
	3/36	3/36	3/36

Table 2.6.30 shows the trail use from Mono Pass Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Mono Pass	Day Hiking	78.4
(N=190)	Overnight/Backpacking	21.6
	Stock	0

(K) Dana Meadows Trailhead

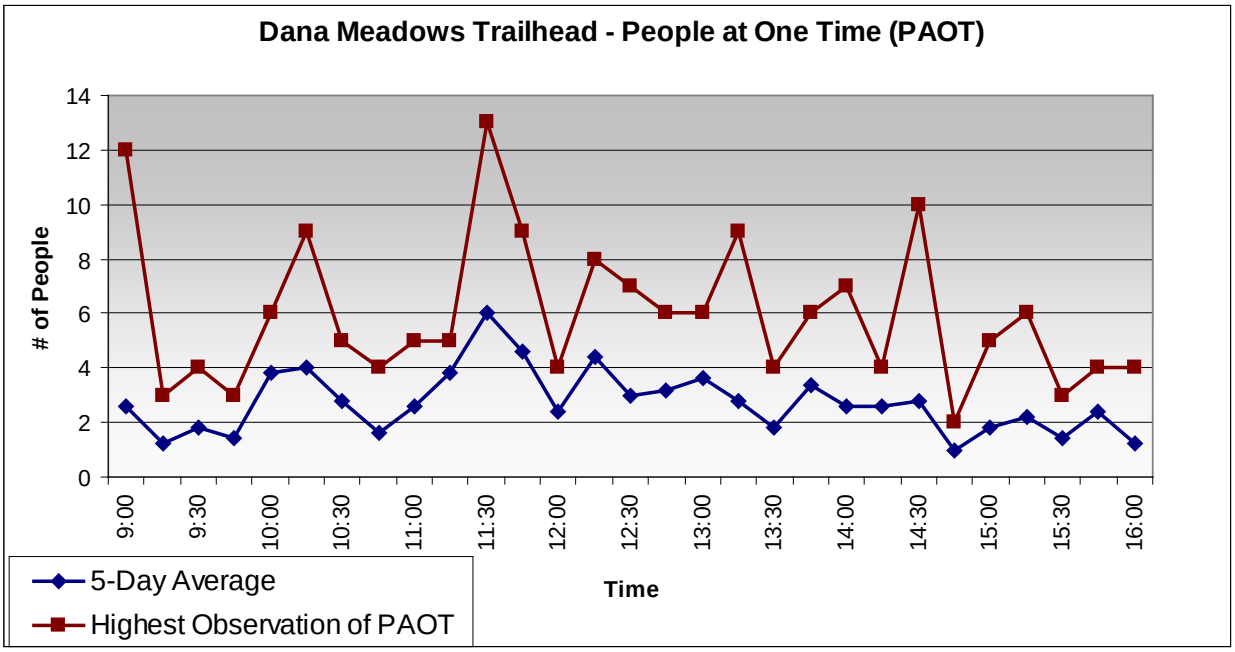


Figure 2.6.32 displays the highest observed and average PAOT for the Dana Meadows Trailhead.

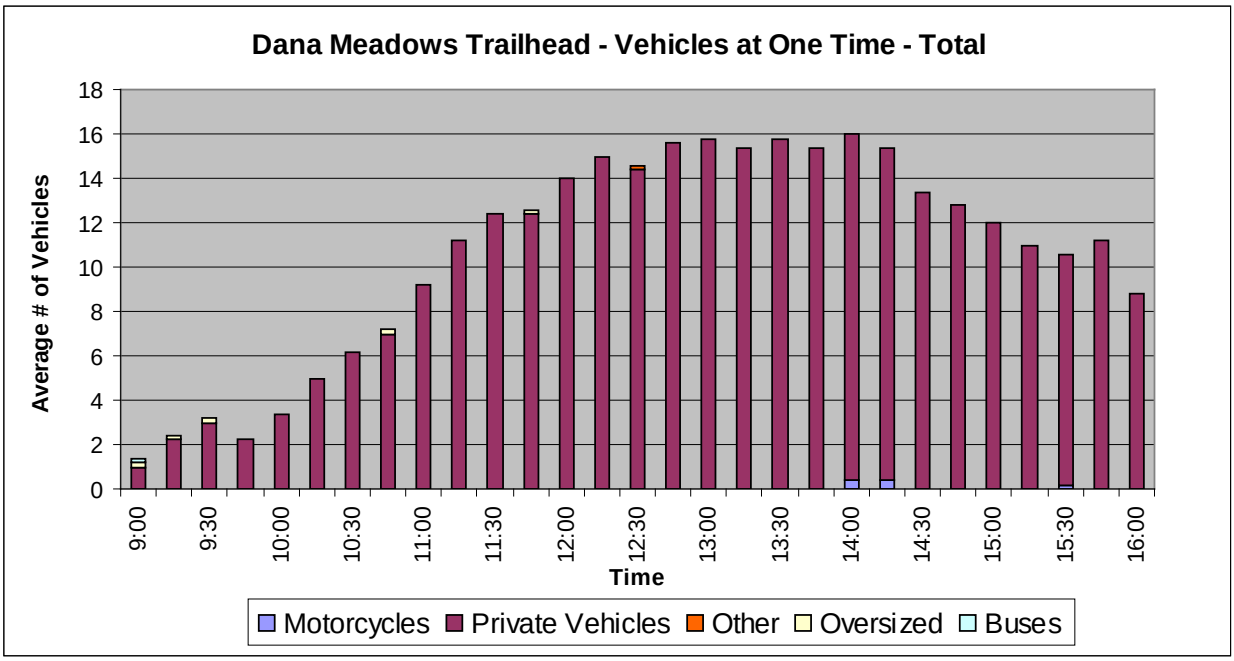


Figure 2.6.33 shows the Dana Meadows Trailhead VAOT averages across all sampling days.

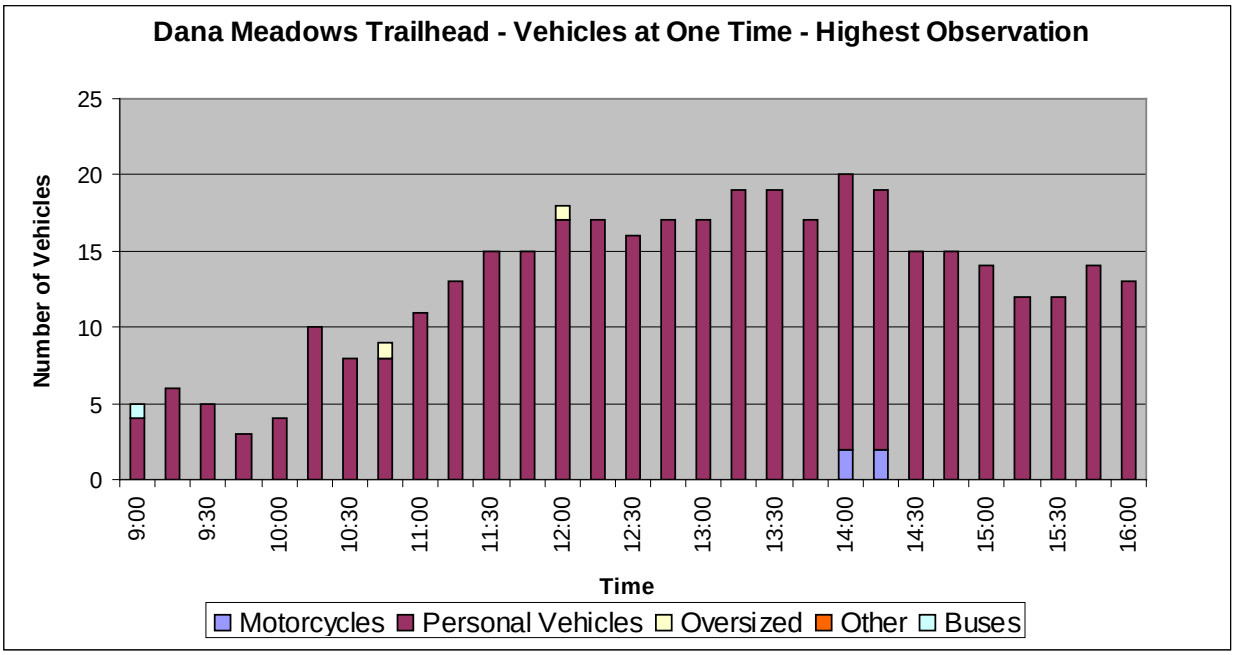


Figure 2.6.34 shows the maximum observations of VAOT for the Dana Meadows Trailhead.

Table 2.6.31 shows Dana Meadows Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=133)**	**Weekend (N=52)**	**Weekday (N=81)**
Day Hiking	12	13.5	11.1
Pull Off/Drop Off	31.6	30.8	32.1
Restroom Only	0	0	0
Sightseeing	56.4	55.8	56.8
Picnicking	0	0	0
Overnight/Backpacking	0	0	0
Stock Use	0	0	0

Table 2.6.32. shows the average length of stay at Dana Meadows Trailhead.

	Average Length of Stay (minutes/seconds)		
11.2% > 45 minutes	**Total (N=118)**	**Weekend (N=46)**	**Weekday (N=72)**
	5/12	6/0	4/42

(L) Gaylor Lakes Trailhead

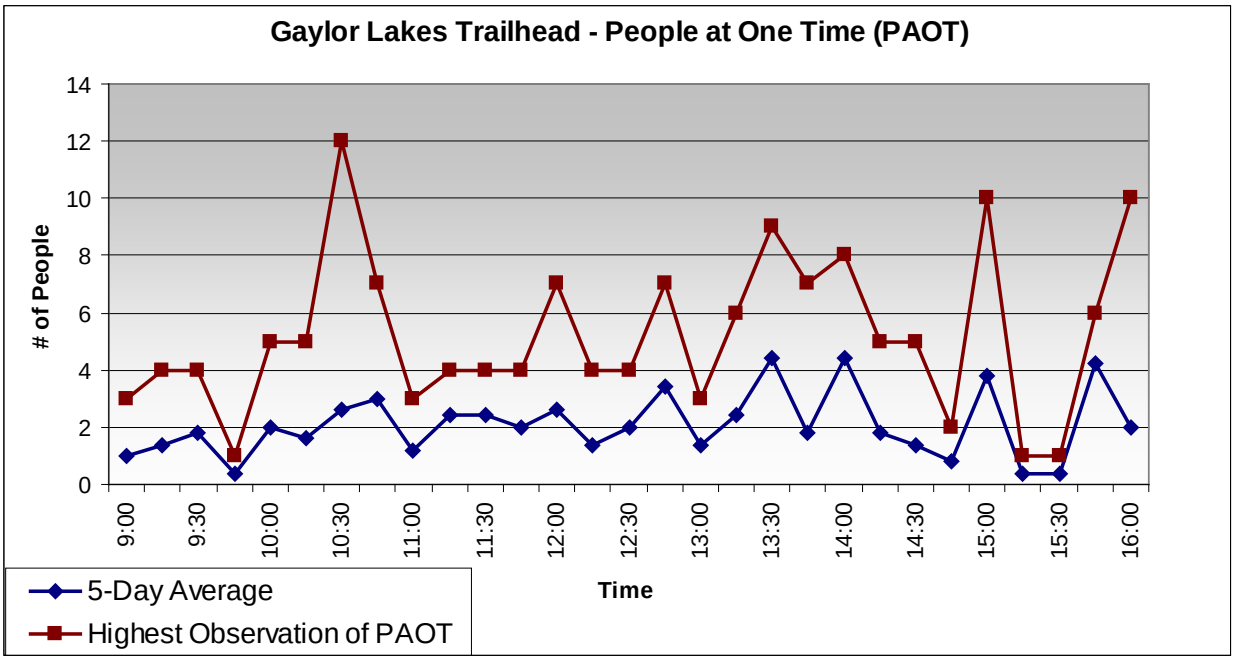


Figure 2.6.35 displays highest observed and average PAOT for the Gaylor Lakes Trailhead.

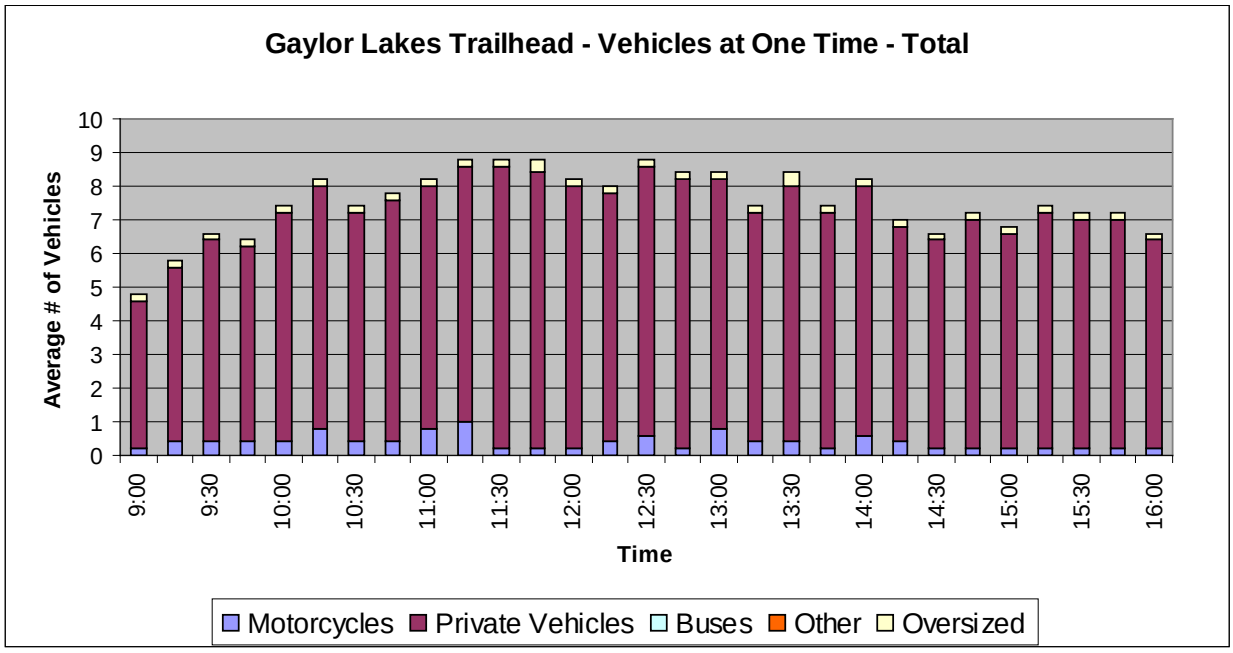


Figure 2.6.36 shows the Gaylor Lakes Trailhead VAOT average across all sampling days.

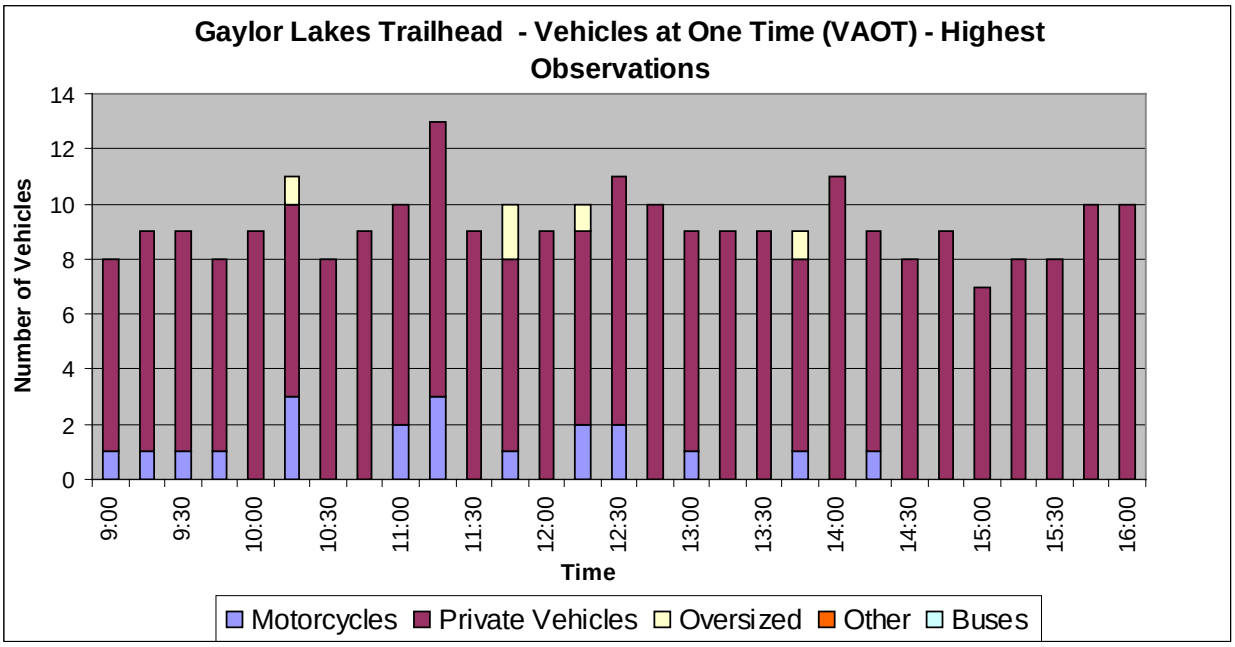


Figure 2.6.37 shows the maximum observations for VAOT at the Gaylor Lakes Trailhead.

Table 2.6.33. shows Gaylor Lakes Trailhead visitor characteristics.

	(%) Proportion of Trailhead Use		
Activity Type	**Total (N=115)**	**Weekend (N=53)**	**Weekday (N=62)**
Day Hiking	3.5	7.5	0
Pull Off/Drop Off	69.6	67.9	71
Restroom Only	20.9	15.1	25.8
Sightseeing	6.1	9.4	3.2
Overnight/Backpacking	0	0	0
Stock Use	0	0	0

Table 2.6.34 shows average length of stay at Gaylor Lakes Trailhead.

	Average Length of Stay (minutes/seconds)		
19.9% > 45 minutes	**Total (N=109)**	**Weekend (N=49)**	**Weekday (N=60)**
	4/18	4/30	4/06

Table 2.6.3 shows trail use from Gaylor Lakes Trailhead.

Trail	Activity	Proportion of Users (%) by Individuals
Trail to Mono Pass	Day Hiking	99.7
(N=314)	Overnight/Backpacking	0.3
	Stock	0

Table 2.6.36 shows Tioga Road trailhead vehicle occupancy rates and proportions by activity type.

Trailhead	Activity Type								N
	Vehicle occupancy rate (mean)	**Day hiking**	**Pull off and/or Drop off**	**Restroom use only**	**Sightseeing**	**Picnicking**	**Overnight/ Backpacking**	**Stock use**	
Tamarack Flat	2.3	0%	56.7%	N/A	40.0%	0%	3.3%	0%	30
Lukens Lake	2.5	28.6%	67.9%	N/A	2.4%	1.2%	0%	0%	84
Yosemite Creek	2.8	4.8%	15.3%	51.6%	21.0%	4.0%	3.2%	0%	124
Ten Lakes	2.5	22.7%	13.6%	N/A	22.7%	0%	40.9%	0%	22
Porcupine Flat	2.8	13.6%	23.1%	49.7%	11.6%	0%	2.0%	0%	147
May Lake	2.7	86.6%	3.5%	0.7%	1.4%	0%	7.7%	0%	142
Snow Creek	2.5	4.8%	73.8%	N/A	19.0%	0%	2.4%	0%	42
Sunrise	2.9	17.9%	51.2%	23.8%	4.8%	0%	2.4%	0%	84
Murphy Creek	2.7	1.6%	10.9%	26.6%	48.4%	10.9%	1.6%	0%	64
Mono Pass	2.7	29.8%	44.6%	13.2%	8.3%	0%	4.1%	0%	121
Dana Meadows	2.5	12.0%	31.6%	N/A	56.4%	0%	0%	0%	133
Gaylor Lakes	2.4	3.5%	69.6%	20.9%	6.1%	0%	0%	0%	115
Total	**2.6**	**22.7%**	**35.4%**	**19.4%**	**18.0%**	**1.2%**	**3.3%**	**0%**	**1108**

Some percentages do not equal 100 due to rounding

MARIPOSA GROVE VISITOR USE ESTIMATION

This section summarizes studies conducted during the summer of 2008 that documented existing visitor use conditions in the Mariposa Grove. Visitor use at trailheads and along trails was measured using automated visitor monitors while visitor use at the Museum and the Grizzly Giant Complex was measured by estimating visitors' length of stay, group size (at Grizzly Giant Complex), and the number of people at one time (PAOT).

(A) Visitor Use Estimation

To clarify the distinction between total visitor counts and counts of *arriving* visitors, the term "visitation" is used to refer to the number of *arriving* visitors counted at monitoring locations and "number of people" is used to refer to the *total* number of visitors counted passing a monitoring location regardless of direction of travel. Both daily and hourly visitor use estimates are reported as *visitation*.

Mariposa Grove Trailhead

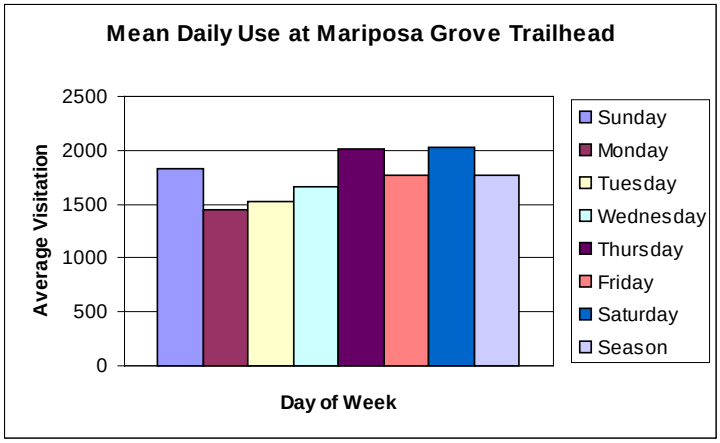
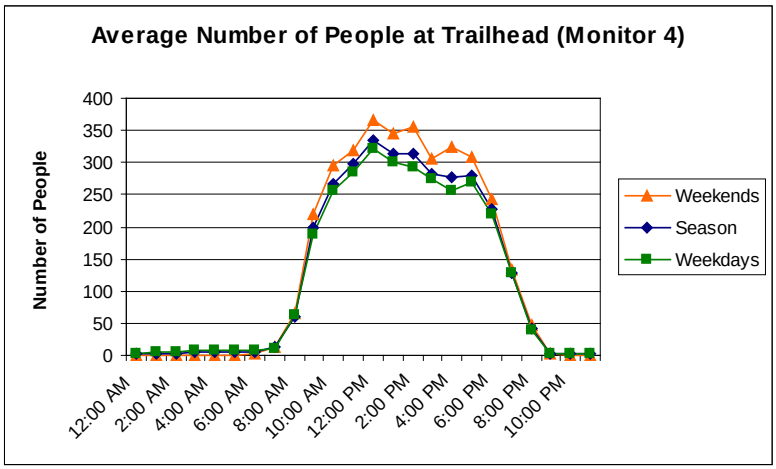


Figure 2.6.38 shows the mean daily visitation at Mariposa Grove Trailhead (monitor 4).

Figure



2.6.39 shows the hourly visitation at the Mariposa Grove Trailhead (monitor 4).

Outer Loop Trail

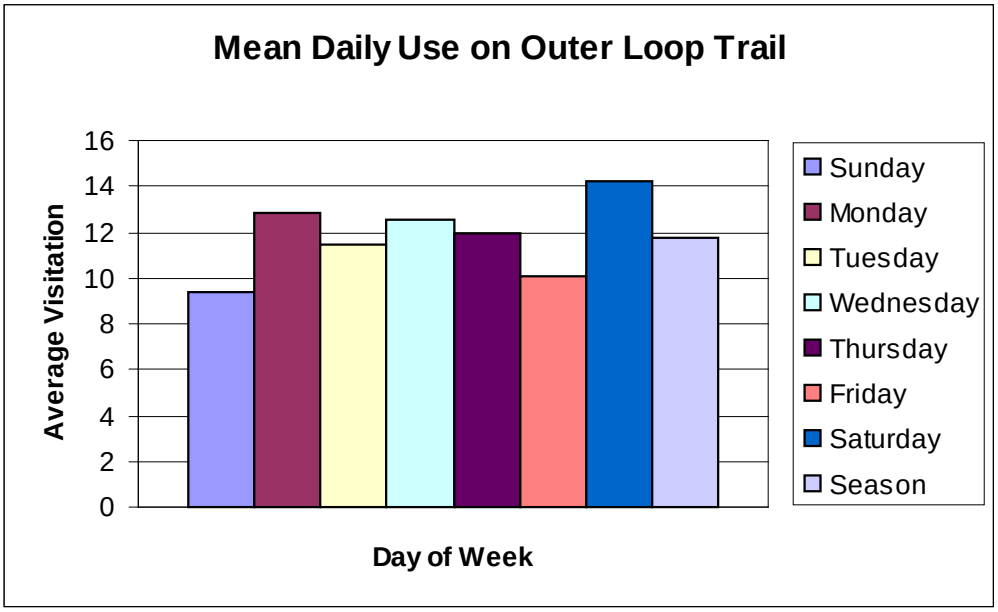


Figure 2.6.40 displays the mean daily visitation on the Outer Loop Trail (Unit 7).

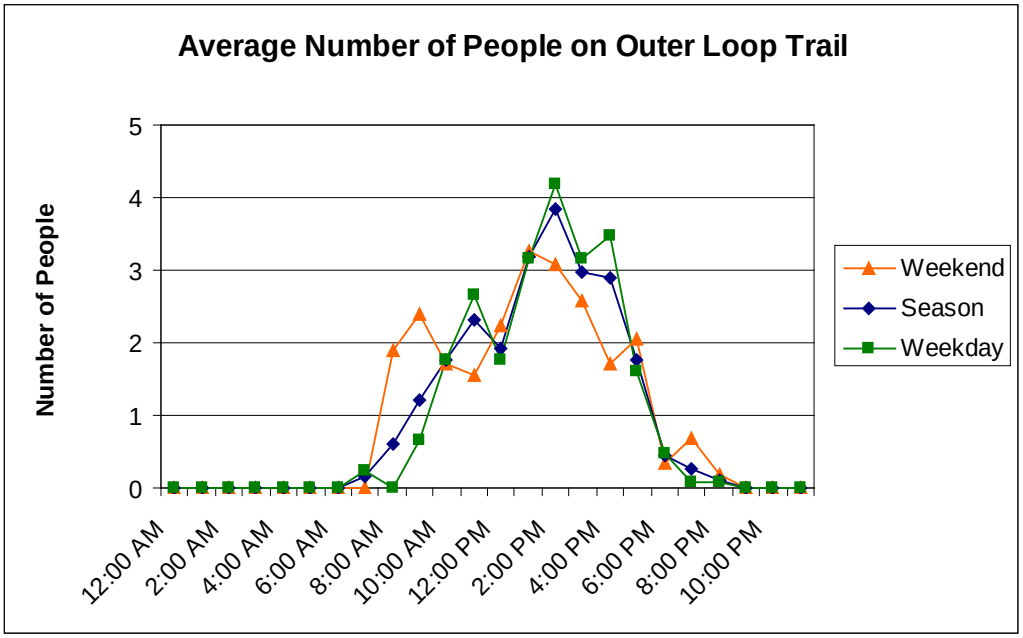


Figure 2.6.41 displays the hourly visitation on the Outer Loop Trail (Unit 7).

Faithful Couple Tree Junction

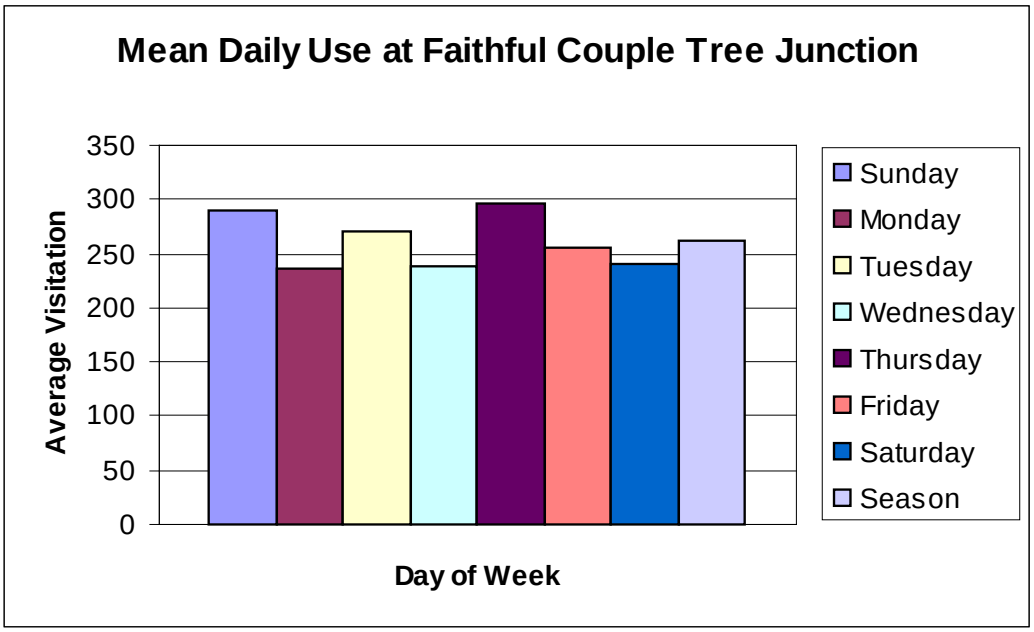


Figure 2.6.42 shows the mean daily visitation at Faithful Couple Tree Junction (monitor 8).

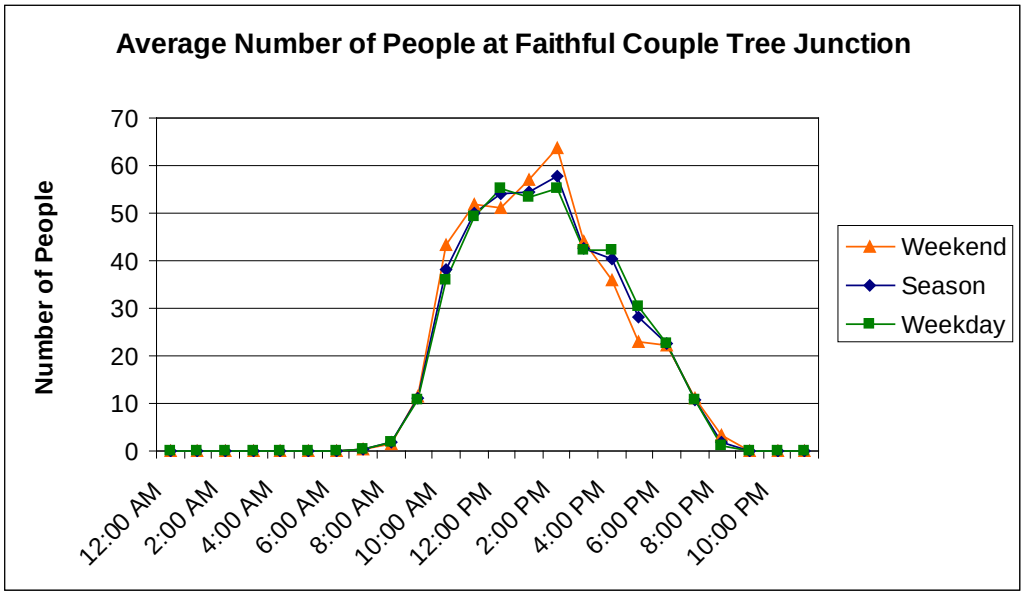


Figure 2.6.43 shows the hourly visitation at Faithful Couple Tree Junction (monitor 8).

Trail above the Museum

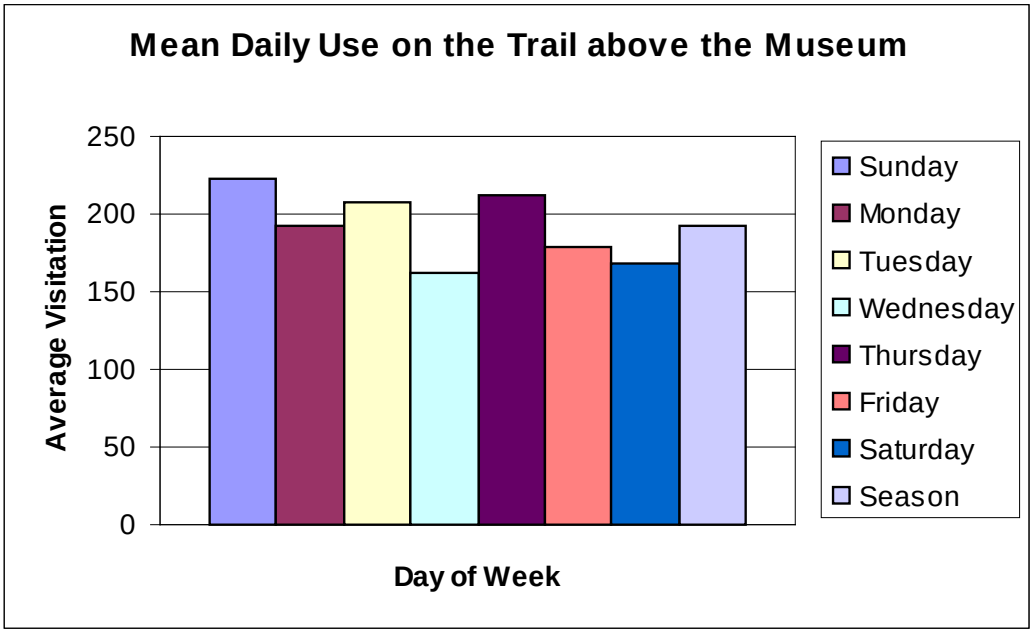


Figure 2.6.44 shows the mean daily visitation on the trail above the museum (monitor 6).

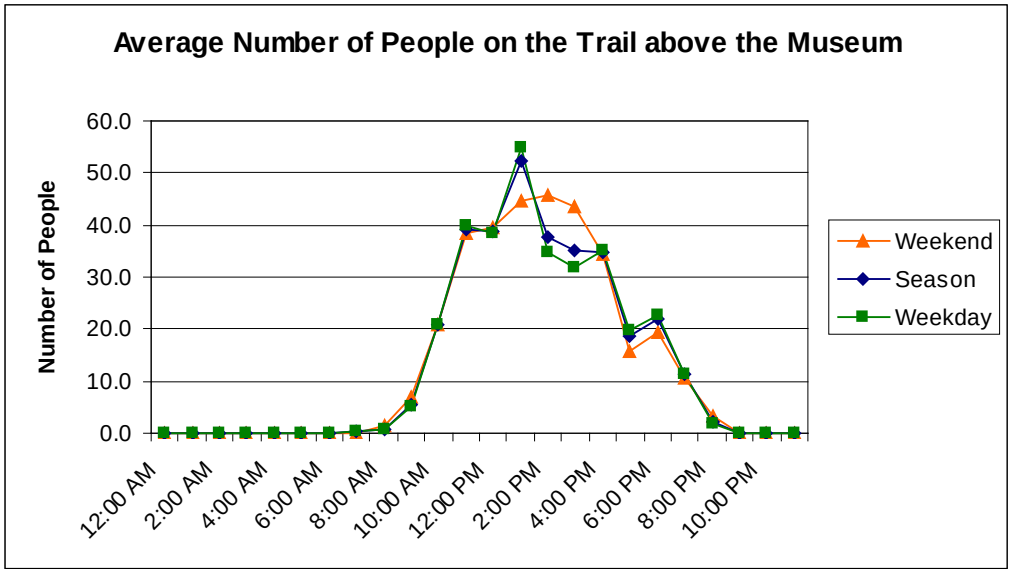


Figure 2.6.45 shows the hourly visitation on the trail above the museum (monitor 6).

Wawona Point Vista

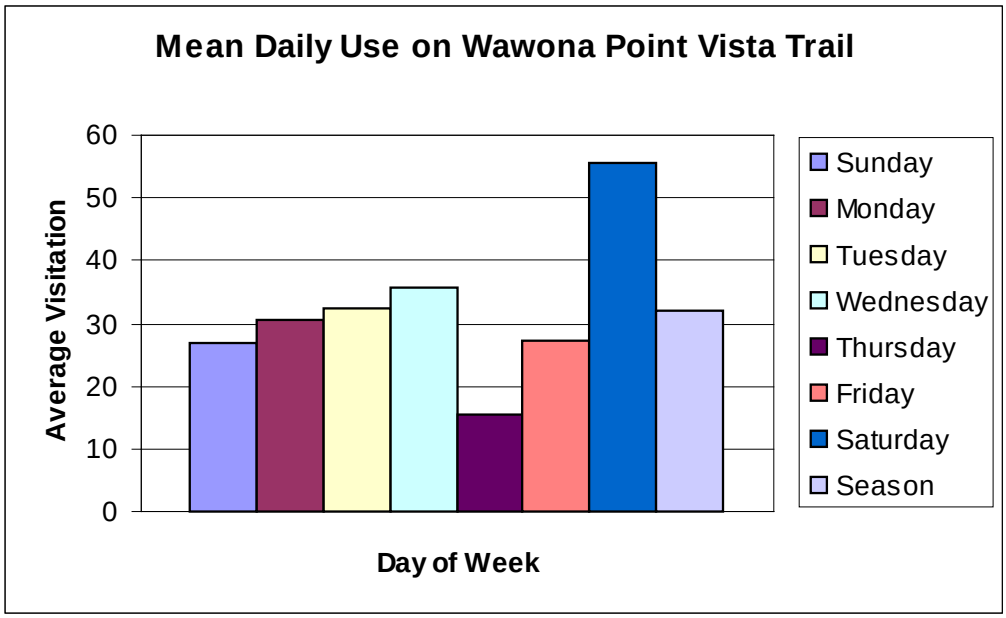


Figure 2.6.46 shows the mean daily visitation on the Wawona Point Vista Trail (Monitor 1).

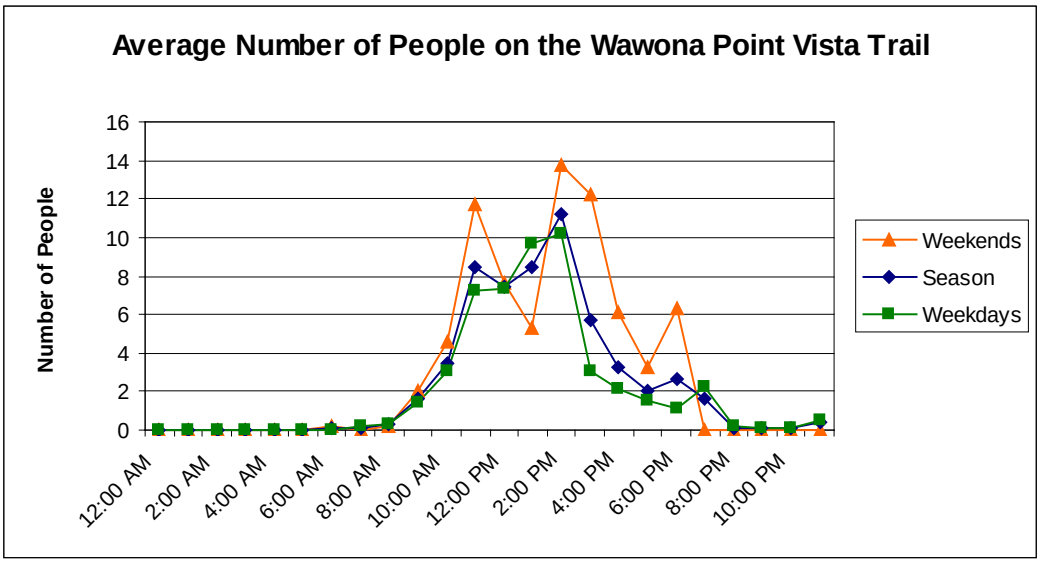


Figure 2.6.47 shows the hourly visitation on the Wawona Point Vista Trail (Monitor 1).

B) Crowding/Congestion variable results

Length of stay and group size

Table 2.6.37 shows the length of stay for the Museum and the Grizzly Giant Complex and group size for the Grizzly Giant Complex only.

Location	Weekend	Weekday	Total
Museum Length of stay (minutes)	7.7	4.9	5.6
Grizzly Giant Complex Length of stay (minutes)	12.7	12.1	12.4
Grizzly Giant Complex Group size (# of people)	4.2	4.0	4.1

Grizzly Giant Complex

Observation counts were conducted at the Grizzly Giant Complex on July 25th, 26th, 29th, 30th, and 31st. Average total sample of people at one time (PAOT) counts ranged between 27.8 and 72.8 people in the defined boundary for the Grizzly Giant Complex. Weekend use was, on average slightly higher than weekdays, as shown in Figure 18. Weekend PAOT counts ranged from 30.5 to 82.5. Weekday PAOT counts ranged from 25.7 to 75. On average, peak counts were observed between the noon to 1pm across both average weekend and weekday samples.

Maximum observations for PAOT at the Grizzly Giant ranged from 49 to 120, as shown in Figure 19. The highest observation occurred at noon. Though many peak counts were observed during the noon hour, it is also important to note that there is a significant drop at times within the hour, namely the 12:15pm interval.

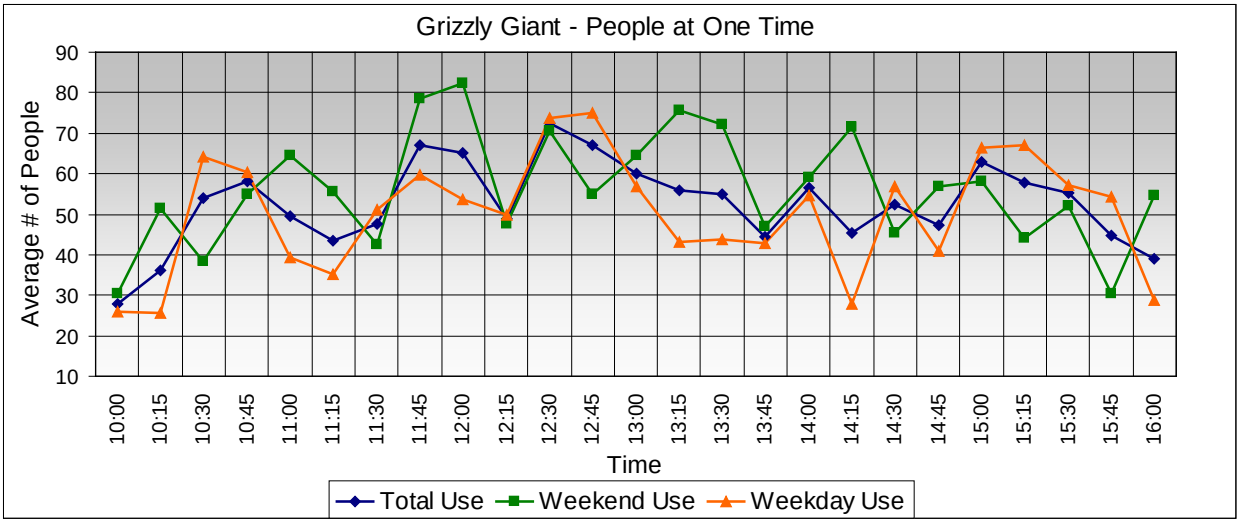


Figure 2.6.48 displays the average people at one time at the Grizzly Giant Complex.

Museum

Observation counts were conducted at the museum on July 25th, 26th, 29th, 30th, and 31st. The PAOT results at the museum displayed an extreme surge/drop effect across the day, as shown in Figure 20. These surges/drops correspond to the tram delivery that takes place at the museum. The average peak PAOT observation for the total and weekend sample days occurred at 2:15pm. The average PAOT peak observation on weekday sample days occurred at 12:15pm. Total average PAOT ranged from 1.4 to 32.6 people. Average weekend PAOT counts ranged from two to 34.5 people. Average weekday PAOT counts ranged from one to 30.3.

Maximum observations across all sample days ranged from four to 57 people. The highest observation across all sample days was 57 which occurred at 2:30pm on July 26th.

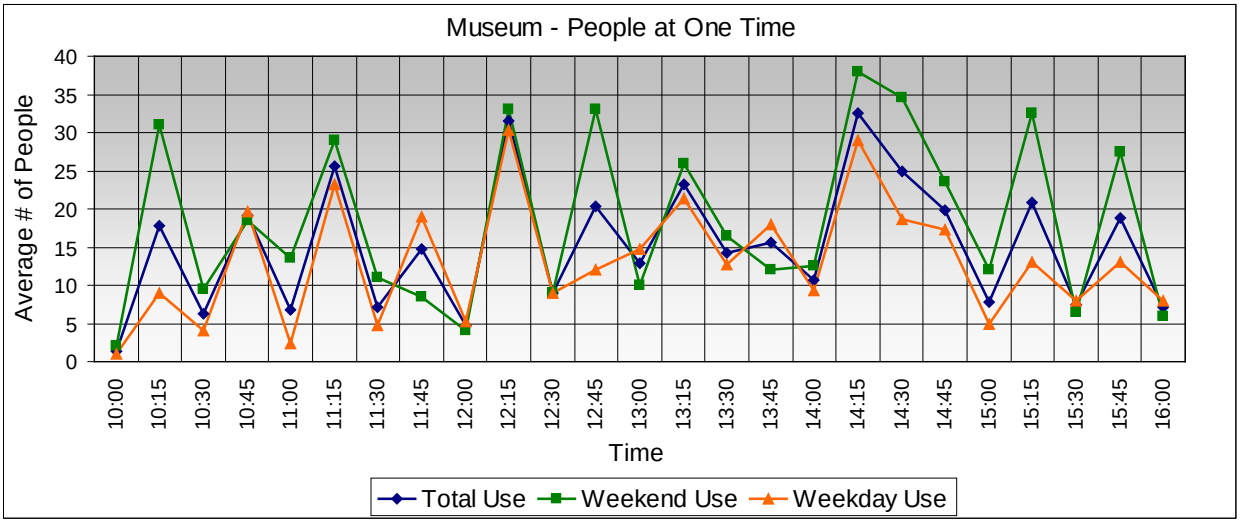


Figure 2.6.49 displays the average people at one time at the Museum.

YOSEMITE VALLEY PEOPLE-AT-ONE-TIME

This section summarizes studies that documented existing use conditions at key attraction sites in Yosemite Valley. PAOT was estimated by observation at Lower Yosemite Falls, Swinging Bridge, and Bridalveil Falls.

Yosemite Falls

PAOT data were collected at Yosemite Falls on June 9, 11, 17, and 23.

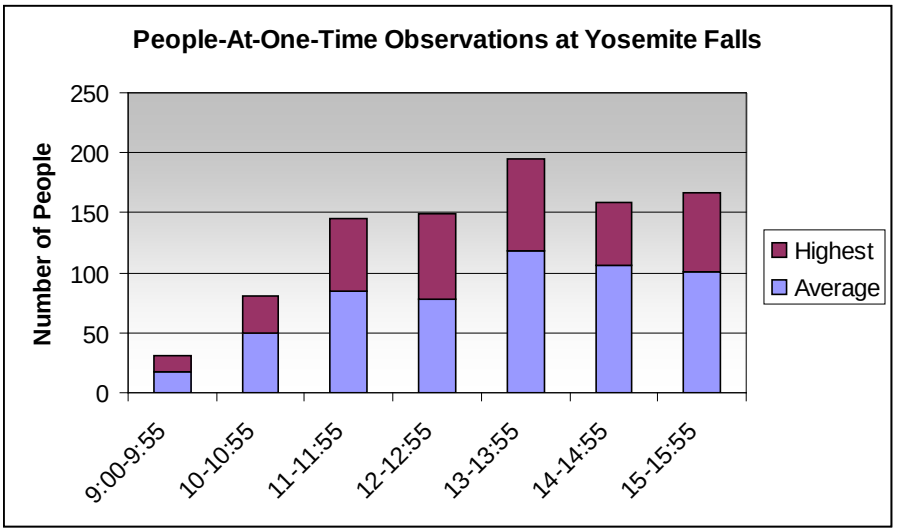


Figure 2.6.50 shows the average estimates and highest counts of PAOT at Yosemite Falls.

Swinging Bridge

PAOT data were collected at Swinging Bridge on June 11, 17, 23 and August 13.

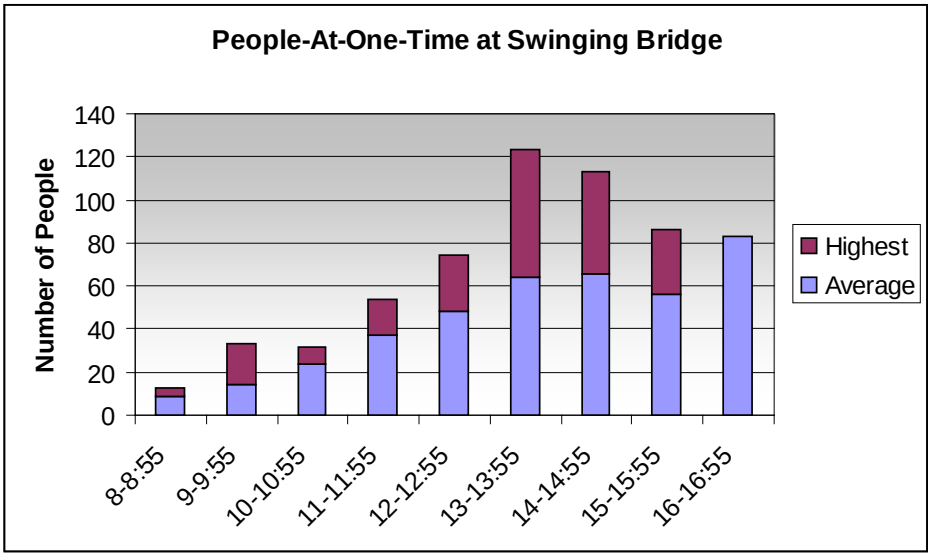


Figure 2.6.51 shows the average estimates and highest counts of PAOT at Swinging Bridge.

Bridalveil Falls

PAOT data were collected at Bridalveil Falls on June 9, 17, 23.

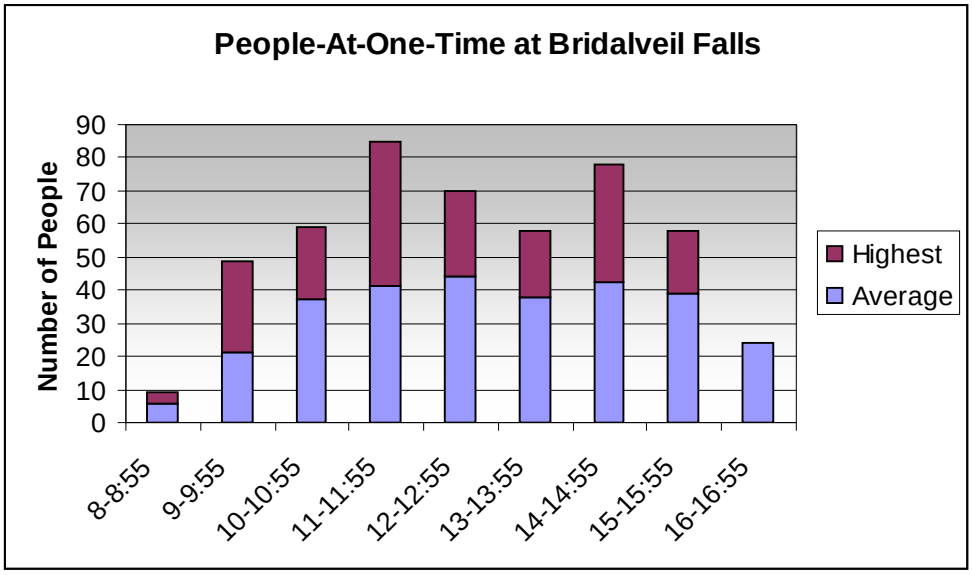


Figure 2.6.52 displays the average estimates and highest counts of PAOT at Bridalveil Falls.

2.7 ARCHEOLOGICAL SITE CONDITION

Archeological sites, recognized as part of the Cultural Outstandingly Remarkable Values (ORV) for the Merced and Tuolumne Wild and Scenic Rivers were monitored in 2008 under the User Capacity Management Monitoring Program (UCMMP) framework.

Measurement

Frequency, intensity, and type of visitor-related impacts within archeological site boundaries

Standards

Currently baseline data are being collected, upon which standards can be developed. Standards development is expected to follow once the metrics within the indicator are formalized and completed.

Sampling

The most complete and accurate listing of all of the archeological sites recorded within Yosemite National Park is located in the "Archeological Sites" data layer in the park's GIS database. Recorded archeological sites located within both the Merced River and the Tuolumne River corridors were queried according to the two proposed Wild and Scenic River Corridor boundaries. Previously documented archeological sites were divided across the two river corridors according to their estimated vulnerability, categorized into "high and low". Vulnerability was, in turn, estimated based on a calculated research potential of the site, determined from the site constituents, and the site's ability to answer important questions. The estimates of vulnerability and research potential were made based on information contained in the park's Archeological Sites Management Information System (ASMIS) database, and are considered preliminary and subject to change based on future research. High vulnerability would define a site that likely has medium to high data potential, and/or the constituents of the site would likely be impacted by most types of visitor use of a site. Low vulnerability would define a site that likely has low data potential, and the site constituents would not likely be negatively impacted by most types of visitor use. Briefly, disturbances or threats relative to visitor use that could impact the significance of common site types at the park are: trampling and soil compaction from intensive camping on a site and social trailing; artifact theft or movement; vandalism; fire ring construction; ground disturbance from latrine digging; and movement of rocks or features; or dismantling of features. Some explicit examples are theft or movement of diagnostic lithic artifacts at a lithic scatter that exhibits intensive prehistoric use, construction and use of a fire ring in a rock shelter where the soot from the fire impacts a pictograph on the wall, or construction of a fire ring using components of a rock ring feature or millingstone implements.

Dividing archeological sites by vulnerability was done in an effort to stratify site assessments based on a site's presumed data potential. A 14% sample of archeological sites was drawn from all of the previously documented sites in the two river corridors, resulting in 58 archeological sites selected to assess visitor-use impacts. Additionally, 10 sites in Yosemite Valley that were visited in 2007 were selected to monitor for changes in their condition (Table 2.7.1).

Background

The 2007 season focused on the development and pilot testing of protocols focused on quantifying visitor-use impacts on archeological sites, however did not attempt to link those impacts on archeological sites to the archeological site condition, data potential, or integrity with respect to the National Register of Historic Places (NRHP). A critical-feedback workshop held at Yosemite in January 2008 focused on tying the impacts to archeological sites directly to the impact to the site integrity.

Data Collection

The NRHP is a listing of historic properties brought about by the National Historic Preservation Act (NHPA). It contains a list of districts, sites, buildings, structures, and objects that are each determined to be of historic, cultural, architectural, archeological or engineering significance at the national, state, or local level. It was the intention of this season's monitoring program to link the impacts observed at archeological sites relative to visitor use, to the attendant impacts to the site's data potential and aspects of integrity, qualities than render sites eligible for the NRHP. What follows is a brief introduction to the National Register Criteria for significance, the seven aspects of integrity that a site must convey, and a concordance of the criteria and integrity with Yosemite-specific site types.

For an archeological site to be eligible for listing on the National Register, it must be significant for one or more of four criteria of evaluation: A) being a significant contribution to broad patterns of history, B) associated with the lives of significant people, C) embodies the distinctive characteristic of a type, period, or method of manufacture, or D) a site that has yielded or may be likely to yield information important to history or prehistory (Little et al. 2000).

Table 2.7.1 shows a list of Archeological sites monitored.

Merced River Corridor sites (n=33)	Tuolumne River Corridor sites (n=25)	Yosemite Valley Sites Selected to Monitor from 2007 (N=10)
CA-MAD-2331	CA-TUO-0111	CA-MRP-0064
CA-MAD-2362	CA-TUO-0119	CA-MRP-0069
CA-MAD-2363	CA-TUO-0150	CA-MRP-0072
CA-MAD-2364	CA-TUO-0500	CA-MRP-0078
CA-MRP-0008	CA-TUO-0501	CA-MRP-0242/H
CA-MRP-0052	CA-TUO-0507	CA-MRP-0291/0751
CA-MRP-0053	CA-TUO-2809	CA-MRP-0314
CA-MRP-0055/H	CA-TUO-2814/H	CA-MRP-0823
CA-MRP-0062	CA-TUO-2824	CA-MRP-1751H
CA-MRP-0063	CA-TUO-2834	CA-MRP-1873
CA-MRP-0076	CA-TUO-3823	
CA-MRP-0082/H	CA-TUO-3830	
CA-MRP-0159	CA-TUO-3844	
CA-MRP-0163	CA-TUO-3845	
CA-MRP-0186	CA-TUO-3848	
CA-MRP-0208	CA-TUO-3937/H	
CA-MRP-0216	CA-TUO-3944	
CA-MRP-0217/H	CA-TUO-4435	
CA-MRP-0218	CA-TUO-4436	
CA-MRP-0240/303/H	CA-TUO-4640	
CA-MRP-0251/H	CA-TUO-4663	
CA-MRP-0289	CA-TUO-4902/H	
CA-MRP-0304/H	CA-TUO-4904H	
CA-MRP-0308	YOSE 1992E-01	
CA-MRP-0320/H	YOSE 1994 C-03/CA-TUo-5059	
CA-MRP-0330		
CA-MRP-0733		
CA-MRP-0818/H		
CA-MRP-1314		
CA-MRP-1721H		
CA-MRP-1805		
CA-MRP-1833		
P-22-001648/CA-MRP-1967		

There are several archeological site types observed in Yosemite National Park that are significant under Criterion D. These sites can answer important questions regarding cultural chronology, settlement, economic patterns, demography, and social organization (Hull and Moratto 1999). Yosemite site types that have the potential to be significant under Criterion D are bedrock milling feature sites in instances where they are combined with other site types to form a large site with abundant site features, if they contain numerous mortars, or if they demonstrate intra-site patterning; artifact caches; lithic scatters if they are part of a large site with multiple features suggesting intensive use, contain stratigraphic deposits, or contain diagnostic tool types; rock art sites; historic dumps if they contain enough diagnostic material to answer important historical questions; prehistoric lithic quarries; roads or trails; prehistoric sites with architectural features; human burials; prehistoric hearths or pits; rockshelters or caves; prehistoric habitation debris; and sites containing multiple features in combinations of any of the above.

Additionally, the site must have the ability to convey its significance through one or more of the seven aspects of *integrity* (location, design, setting, materials, workmanship, feeling, and association) (Little et al. 2000). Integrity requirements for archeological sites significant under Criterion D relate directly to the types of research questions defined within the archeologist's research design. An archeological property must have multiple aspects of integrity that convey its significance in the above criteria. Archeological integrity may be *generally* demonstrated by:

- Spatial patterning of surface artifacts or features that represent differential uses or activities
- Spatial patterning of subsurface artifacts and features
- Lack of serious disturbance to the properties archeological deposits

Integrity cannot be thought of as a finite quality of a property; it is relative to the specific significance that the property conveys. Although it is possible to correlate the seven aspects of integrity with standard archeological surface site characteristics, those aspects are often unclear for evaluating the ability of an archeological property to convey significance under Criterion D. The integrity of archeological sites under Criterion D is judged relative to important information (research) potential. Research potential is the ability of the site to answer questions considered important to the region. Important research questions for Yosemite National Park have been outlined in the Park's *Synthesis and Research Design* (Hull and Moratto 1999). Archeological sites may contain a great deal of important information and yet have had some disturbance or extensive excavation.

Many sites at Yosemite National Park have not been subjected to formal study and therefore lack information relating to their significance, integrity, and their data potential. A 1999 report on the Ackerson Fire (Keefe et al. 1999) listed general information regarding site type data potential as a way to understand the site condition relative to what is known about the data potential of sites at Yosemite. This information was adapted to establish data potential, possible significance, integrity statements, and an estimated site vulnerability for those sites assessed under the UCMMP. The archeological condition assessments done for the current project consist of surface documentation only, and all recommendations or declarations of data potential and site vulnerability are considered preliminary and subject to change based on future research. However, these do represent best professional judgment based upon

observable site characteristics. Table 2.7.2 lists the definitions described in the Ackerson Fire project for research potential (Keefe et al. 1999:124).

Table 2.7.2 shows definitions for research (data) potential.

Estimated Data Potential	Example
Low	-Small sites containing minimal components or are lacking diagnostics -Bedrock Mortar sites lacking any additional features -Sparse lithic scatters with low debitage densities and no formal tools -Historical sites with few artifacts and no distinct features
Medium	-Deposits with multiple types of features or lithic deposits -Sites with numerous mortars, diagnostic artifacts -Sites with signs of extensive use -Sites with indications of probable subsurface deposits -Documented historical sites and historical sites with existing features and associated debris
High	-Sites with multiple and varied components in abundance -Rock shelters -Dense concentrations of lithic or historical debris, temporally diagnostic artifacts -Subsurface remains -Existing historical features or documented historical use by Native Americans -Single component sites with attributes that allow the site to answer one important research question may also contain high research potential

Field work was conducted from July 6, 2008 through September 4, 2008 by program archeologist Jessica Middleton and Student Conservation Association intern Mary Lee. Additionally, NPS archeological technician Emily Darko accompanied the program archeologist during site assessments for one week of fieldwork.

Sixty-eight archeological sites were visited during the 2008 field season. Data was collected at each site and recorded on an Archeological Sites Management Information (ASMIS) field form, supplemented with additional data collection specific to visitor-related impacts. Data collection was guided by the objectives discussed in the *2008 User Capacity Management Field Monitoring Guide* (NPS 2008b), toward the primary goal of determining the extent that archeological sites are being impacted by visitor use.

As a regular part of archeological research, inventory, and Section 106 of the National Historic Preservation Act (NHPA) compliance, Yosemite National Park utilizes a required management tool, the Archeological Sites Management Information System (ASMIS). For a definition and discussion of ASMIS, see the *2007 VERP Annual Summary Report*, or the *ASMIS 3.01 User Guide* (NPS 2007b and 2008a).

At Yosemite National Park, ASMIS information is collected as a regular part of ongoing archeological inventory. This inventory work is typically conducted in support of special-funded projects such as development proposals, wilderness restoration, and fire management actions; and is usually collected opportunistically on a project-by-project basis. Starting in 2007 Yosemite National Park began evaluating archeological sites as an indicator for the UCMMP. Seeing that important site condition information is already collected for all inventory work done at Yosemite National Park through ASMIS, it is important to utilize this program this within the

UCMMP framework to evaluate and monitor archeological site condition. As is discussed below, ASMIS data collection will continue to be augmented/supplemented with more focused, quantitative visitor-related impact data collection.

Archeological site condition is evaluated according to variables defined for ASMIS as *Good*, *Fair*, *Poor*, *Unknown*, and *Not Relocated* (for a definition of these conditions, see the *2007 VERP Annual Summary Report*, NPS 2008a). Archeological site condition according to the ASMIS definition is largely an estimate of current site stability. A more accurate description of the cumulative impacts at an archeological site is reflected in the site *Disturbance Severity Level*.

A site *Disturbance Severity Level* documents the cumulative negative effects of both threats and disturbances to the site's data potential for scientific research, as well as the physical stability of the site (Table 2.7.3).

Table 2.7.3. shows definitions for disturbance severity levels.

Severity Level	Definition [a]
Low	-No major disturbances present -Minor natural disturbances, such as limited slope wash or rodent activity not yet resulting in significant damage to the site. -In general < 15% of site impacted -Continuing effects are minimal and not resulting in significant damage to site
Moderate	-Disturbances are causing or a threat may soon cause significant site damage such as trail . construction or sporadic camping, moderate slope wash or rodent activity -The site or a portion thereof will likely be irretrievably lost if actions are not taken in 5 years -In general 15-50% of site area impacted
Severe	-Evidence of recurrent, intensive camping, illegal excavation or surface collection. -Sites in developed areas recurrently subjected to modern disturbances -Disturbances or threats to the site will cause significant damage, and the site or parts thereof will likely be irretrievably lost if actions are not taken in 2 years -In general >50% of site area impacted.
NA/Destroyed	-The site has been completely excavated or destroyed.

[a] *ASMIS 3.01 Data Dictionary*, NPS 2007a.

The following matrix (Table 2.7.4) was used to classify sites according to site condition, disturbance severity level, and specific disturbance effects on the resource. Disturbances and threats are measured first, then site condition is determined, then the overall site Disturbance Severity Level, which also takes into effect the threats to sites, is decided.

Table 2.7.4 shows matrix to determine site condition, Disturbance Severity Level, and disturbance effect on resource.

Disturbance Types	Spatial Extent of Disturbances in a Site Area (%)		Disturbance Effect on Resource (by each disturbance)	Site Condition	Disturbance Severity Level (includes threats)
Few types; Minimal damage	Less than 15%	Low	Negligible Effect	Good	Low
Some types; Moderate damage	15-50%	Moderate	Partial Loss: Repairable (PLR)	Fair	Moderate
Some-many types; Severe damage	More than 50%	Severe	Partial Loss: Irretrievable (PLI), or Total Loss: Irretrievable (TLI)	Poor	Severe
Not Applicable	95-100%	Destroyed	Total Loss: Irretrievable	Destroyed	Not Applicable

Adapted from NPS 2007c *Guidance*.

Collected Data

Baseline disturbance data were collected at each site selected. Baseline disturbance data collection consisted of a site visit with current observed threats and disturbances recorded in the field. Additionally, previous disturbances to each site listed in the ASMIS database were assessed to establish a complete history of disturbances to the site condition, data potential, and integrity. At each site visit, photo points were established at each site assessed, and photographs were taken of overall site conditions and any observed disturbances. Each site's proximity to an access point was recorded as falling into one of four categories as follows: within 50 meters, from 51 to 100 meters, from 101 to 500 meters, and over 501 meters away.

Various natural impacts were recorded including erosion, bioturbation, tree fall, and vegetation growth. Natural impacts were recorded as part of the ASMIS data collection, and while only indirectly related to visitor use, act as proxy indicators of site stability, and can serve as an early warning system to degradation of site data potential, significance, and integrity.

Several visitor-related impacts were assessed for each site visited, using ASMIS data values. Variables measured included:

- the presence of artifact collection piles (collector's piles)
- the presence of social or informal trails either on site or leading to the site,
- evidence of recent camping such as a fire ring, compacted soil, rearrangement of rocks or features, vegetation damage, trash
- evidence of park operations (facilities) work occurring as a direct result of visitor use of an area, such as trails maintenance or a trails camp, wilderness restoration work, or stock use.
- In addition to these variables, any evidence of violations of the Archaeological Resources Protection Act (ARPA) or vandalism was noted.

Table 2.7.5 lists all available values of disturbances and threats to choose from in ASMIS.

Table 2.7.5 shows a list of disturbances and threats-ASMIS[a].

Category	Disturbance/Threat	Category	Disturbance/Threat
Natural Forces	Animals Fire Fire - Hazard Fuel Buildup Pest Infestation Biological Degradation Structural Deterioration Vegetation Growth Erosion – General Erosion – Wind Erosion - Water Sedimentation Alluviation Colluviation Rock Fall Mass Wasting Flooding or Inundation Cryoturbation Bioturbation Tree Fall	Mineral Exploration/ Extraction	Extraction – Hardrock Extraction - Sand and Gravel Extraction - Mineral Materials Abandoned Mineral Operations Spoil Deposition Explosives Hazardous Waste
		Visitor Use/Visitation	Visitor use/visitation – General Use by Hikers or Horses Campfire Building Camping Caving Climbing Boating Off-road Vehicle Traffic Tenants/Occupants Arson Theft or Looting Unauthorized Collecting Unauthorized Research Vandalism Modification – artifact movement Social Trails
Park Operations	Concessioner Activities Dumping Fire Suppression/Control Improper Display/ Interpretation Technique Inappropriate Maintenance Techniques Inappropriate Preservation/Restoration Inappropriate Study Techniques Neglect Previous Scientific Research Transfer from NPS Control Exotic Plant Removal – manual or mechanical Park Operations – General Park Operations - Resource Management	Other Forces or Activities	Military – General Historic Graffiti Filming Commercial Vehicles Motorized Equipment Roof Fall Modification – Structural
		Agricultural Practices	Grazing/Trampling - Domestic Livestock Grazing/Trampling- Wildlife Timber Harvest/Logging Stock Watering
Development/Construction	Structures - Construct/Operate Road or Highway - Constr./Op. Railroad - Constr./Op. Trail - Constr./Op. Utilities - Constr./Op. Fencing-Construct/Operate		

[a] – From NPS 2007a.

Measurement

Table 2.7.6 depicts measurement of disturbances and threats observed within archeological site boundaries are those utilized for ASMIS data collection. These are qualitative in nature, however in an attempt to make the observations more objective, the qualitative class assigned to each disturbance was based on an estimate of percentage of the archeological site affected. The measurement for each threat or disturbance on an archeological site consists of assigning an effect on the resource (Negative, Partial loss Repairable (PLR), Partial loss Irretrievable (PLI), or

Total loss Irretrievable (TLI)); and a severity level of the effect (Low, Moderate, Severe). In a further attempt to quantify threats and disturbances, a score was assigned to each threat or disturbance for 1) the effect it had to the information potential of the archeological site (removal of archeological matrix, removal of artifacts/features, etc); 2) the severity of the disturbance or threat; 3) the extent of the disturbance; and 4) if the disturbance or threat observed was visitor-related, a weight factor of two was applied. These measurements resulted in an "impact score", which in turn was used along with the overall site condition and site vulnerability to determine the site *Disturbance Severity Level* and site *Inspection Schedule*. Additional information recorded at each site to supplement the standard ASMIS data collection were the landform, the depositional setting of the site, and the type of use the site is exposed to – both direct and secondary (e.g., camping, climbing, hiking, river recreation).

Table 2.7.6 shows a list of variables/observations measured at archeological sites.

Variable	Value	Points (if Applicable)
Current ASMIS Site Condition	Good	0
	Fair	1
	Poor	2
ASMIS Disturbance Severity Level	Low	2
	Moderate	4
	Severe	3
Proximity to Public Access Category	<100m	3
	100-500m	2
	500-1000m	1
	>1km	0
Proximity to Public Access	Distance to access point in meters (from GIS)	
Rock Art Presence/Absence	Yes	1
	No	
Features Presence/Absence	Yes	1
	No	
Natural and Visitor-related (weighted by 2) Impact Category Disturbances and Threats		
Effect on Integrity of Site	Removal of Archeological Matrix	2
	Removal of Feature/Artifact	2
	Destabilization of Feature or Element	2
	Destruction of Feature/Artifact	2
	Displacement of Feature/Artifact	2
	No Effect	
	Other	
Effect on Resource	Negligible	1
	Partial Loss Repairable	2
	Partial Loss Irretrievable	3
	Total Loss Irretrievable	4
Effect Level	Low	1
	Moderate	2
	Severe	3
	Destroyed	
Time Frame (if threat)	Immediate	2
	1 Year	1
	5, 10, 20 years	0

Monitoring/inspection schedule

A monitoring schedule was established following the guidance created for ASMIS, and based on the quantitative "impact score" that a site received for all of the indicators on the field form. This score is based on a combination of factors including, but not limited to site condition,

proximity to developed areas, and National Register eligibility. Sites that have more impacts and disturbances, or have the potential for impacts should be monitored more frequently than sites that do not. Accordingly, sites for this field season were placed into one of four monitoring priority categories – 5 years, 10 years, 15 years, and 15+ years (Table 2.7.7).

Table 2.7.7 displays guidance for determining inspection schedule for archeological sites.

Schedule	Definition [a]
5 Years	Those sites with current good, fair, or poor conditions that are 1) located in developed or remote areas of a park where they are likely to be impacted by humans or animals or by natural forces, or 2) have structural components which might require inspection and treatment as part of the Park Facilities Management Software System process. -Careful consideration should also be given to sites that are designated National Historic Landmarks, a contributing resource to a World Heritage Site, or those listed on the National Register, or those sites at which there is a good potential to find exposed human remains.
10 Years	Those sites with a current good or fair condition that 1) have a relatively low potential to be disturbed or threatened by natural, animal, or human forces; and 2) have good or fair documentation including location information; and/or have low data potential. -These tend to be in more remote settings where they are rarely if ever threatened or disturbed by humans.
15 (+) Years	Those sites with a current good or fair condition that 1) have a relatively low potential to be disturbed or threatened by natural, animal, or human forces; 2) have good or fair documentation, including location information; and 3) are in areas that are very remote and/or logistically very expensive to access. -It is strongly recommended that sites which meet these standards are assessed at least every 15 years, however, for a variety of logistic or financial reasons, the site condition may be assessed at a frequency greater than 15 years. -Sites that have been determined ineligible for the National Register may be included in this tier.

[a] - From NPS 2007c, *Guidance.*

Results

The following tables and graphs present the results of archeological site assessments and monitoring in 2008. Table 2.7.8. lists all of the impacts observed for each site visited. Figures 2.7.1 through 2.7.4 Illustrate descriptive information of all data collected in 2008. Out of the 68 sites visited, an ASMIS assessment were completed for all of them, documentation at three sites was updated to meet current Yosemite Archeology Office (YAO) standards (NPS 2007d), and one artifact was collected for curation at the Yosemite National Park Museum. The sites were located in the following geographic areas of the park: in the Merced River corridor - El Portal, Yosemite Valley, Wawona, and the South Fork; and in the Tuolumne River corridor - Tuolumne Meadows and Lyell Canyon.

Table 2.7.8 displays impacts from all sites visited in 2008.

	Disturbances									Threats					Condition/Severity/Inspection				
Site Number	**Erosion**	**Bioturbation**	**Tree Fall**	**Artifact Management**	**Social Trail**	**Climbing**	**Camping**	**Use By Horses**	**Other**	**Social Trails**	**Artifact Management**	**Visitor Use**	**Camping**	**Other**	**Condition**	**Severity Level**	**Vulnerability**	**Impact Score**	**Inspection Schedule**
CA-MAD-2331				X						X			X		Good	Moderate	High	17	5
CA-MAD-2362												X			Good	Low	Low	8	10
CA-MAD-2363									X^{A}					X	Good	Low	High	10	5
CA-MAD-2364			X									X			Good	Low	Low	9	10
CA-MRP-0008		X			X		X	X	X^{B},X^{V},X^{U},X^{N},X^{A},X^{W},X^{X},X^{R},X^{I},X^{D},X^{Y}					X	Poor	Severe	High	45	5
CA-MRP-0052	X	X	X					X	X^{C}, X^{D}, X^{X}			X			Fair	Severe	Low	26	5
CA-MRP-0053					X			X	X^{Z}, X^{X}			X			Good	Low	Low	10	10
CA-MRP-0055/H	X	X							X^{I}, X^{AA}, X^{X}, X^{N}, X^{E}			X		X	Good	Severe	High	30	5
CA-MRP-0062	X				X	X	X	X	X^{D}, X^{Y}, X^{BB}, X^{I}, X^{Z}, X^{X}, X^{B}, X^{F}, X^{G}						Poor	Severe	High	41	1
CA-MRP-0063	X	X			X	X	X	X	X^{E}, X^{I}, X^{N}					X	Poor	Severe	High	39	5
CA-MRP-0064	X	X			X	X		X	X^{X}, X^{V}, X^{H}, X^{I}						Poor	Severe	High	35	5
CA-MRP-0069	X		X					X	X^{N}, X^{K}, X^{I}			X			Good	Low	Low	10	10
CA-MRP-0072	X		X	X				X	X^{CC}, X^{N}, X^{X}						Good	Low	Low	6	10
CA-MRP-0076		X	X		X				X^{X}, X^{M}, X^{N}, X^{E}, X^{D}, X^{J}						Fair	Moderate	Low	23	5
CA-MRP-0078		X					X	X	X^{V}, X^{BB}, X^{K}	X		X			Good	Moderate	Low	18	5
CA-MRP-0082/H	X				X	X			X^{N}, X^{U}, X^{I}, X^{X}, X^{W}, X^{E}			X			Poor	Severe	Low	32	5
CA-MRP-0159	X	X	X		X				X^{L}, X^{DD}, X^{N}, X^{V}, X^{CC}, X^{A}			X		X	Fair	Severe	Low	27	5
CA-MRP-0163	X				X		X	X	X^{E}, X^{I}, X^{X}, X^{K}, X^{L}			X			Fair	Moderate	High	22	5
CA-MRP-0186				X	X		X	X	X^{V}, X^{U}, X^{N}, X^{BB}, X^{X}, X^{H}						Poor	Severe	Low		5
CA-MRP-0208							X		X^{X}			X		X	Good	Low	Low	5	10
CA-MRP-0216	X				X		X	X	X^{D}, X^{BB}, X^{Y}, X^{X}, X^{AA}					X	Good	Moderate	Low	18	5
CA-MRP-0217/H		X							X^{G}, X^{I}, X^{E}, X^{V}, X^{M}, X^{H}, X^{N}			X			Fair	Severe	High	33	5

	Disturbances									Threats					Condition/Severity/Inspection				
Site Number	Erosion	Bioturbation	Tree Fall	Artifact Movement	Social Trail	Climbing	Camping	Use By Horses	Other	Social Trails	Artifact Movement	Visitor Use	Camping	Other	Condition	Severity Level	Vulnerability	Impact Score	Inspection Schedule
CA-MRP-0218	X	X		X	X		X	X	X^{BB}, X^{D}, X^{Y}, X^{O}, X^{P}					X	Fair	Severe	High	40	5
CA-MRP-0240/303/H					X			X	X^{D}, X^{V}, X^{X}, X^{N}, X^{E}, X^{H}, X^{Q}, X^{I}			X			Fair	Severe	Low	31	5
CA-MRP-0242/H		X						X	X^{L}, X^{V}, X^{U}, $X^{AA}X^{I}$					X	Fair	Low	Low	10	5
CA-MRP-0251/H	X	X		X	X			X	X^{D}, X^{Y}, X^{AA}, X^{DD}, X^{E}, X^{R}, X^{I}						Fair	Severe	High	35	5
CA-MRP-0289	X				X		X	X	X^{BB}, X^{N}, X^{D}						Fair	Moderate	High	25	5
CA-MRP-0291/0751	X	X			X				X^{I}, X^{K}, X^{H}, X^{O}, X^{U}, X^{D}, X^{X}, X^{N}, X^{C}						Poor	Severe	Low	32	5
CA-MRP-0304/H					X			X	X^{D}			X			Good	Low	Low	10	10
CA-MRP-0308	X	X	X					X	X^{X}, X^{M}, X^{N}, X^{A}, X^{I}, X^{S}	X					Fair	Moderate	Low	22	5
CA-MRP-0314	X	X	X		X	X	X	X	X^{BB}, X^{K}, X^{D}						Good	Moderate	High	25	5
CA-MRP-0320/H			X		X			X	X^{X}, X^{D}			X			Fair	Moderate	Low	16	5
CA-MRP-0330	X								X^{AA}, X^{X}, X^{DD}			X		X	Poor	Severe	Low	18	5
CA-MRP-0733				X	X				X^{U}, X^{I}, X^{N}						Poor	Severe	Low	42	10
CA-MRP-0818/H			X						X^{D}, X^{V}, X^{H}, X^{M}			X			Good	Moderate	Low	14	10
CA-MRP-0823	X	X	X					X	X^{H}, X^{K}			X			Good	Low	Low	10	10
CA-MRP-1314	X								X^{E}, X^{Y}			X		X	Good	Moderate	High	17	5
CA-MRP-1721H	X	X			X				X^{M}, X^{EE}, X^{X}, X^{V}, X^{K}, X^{C}, X^{H}, X^{A}						Fair	Moderate	High	21	5
CA-MRP-1751H	X	X						X							Good	Low	High	9	10
CA-MRP-1805		X							X^{I}, X^{K}						Good	Low	Low	10	10
CA-MRP-1833	X	X			X			X	X^{H}, X^{AA}, A^{FF}					X	Fair	Severe	Low	31	10
CA-MRP-1873		X			X				X^{X}, X^{I}, X^{M}, X^{D}, X^{N}			X			Fair	Moderate	Low	35	5
CA-MRP-1967					X								X		Fair	Low	Low	10	10
CA-TUO-0111	X	X			X				X^{H}, X^{X}, X^{I}			X			Good	Moderate	High	22	5
CA-TUO-0119	X	X					X	X				X		X	Good	Low	Low	13	10
CA-TUO-0150	X	X											X		Good	Moderate	High	18	5
CA-TUO-0500	X	X	X						X^{X}, X^{D}, X^{E}						Good	Low	High	11	10
CA-TUO-0501	X	X			X			X	X^{Y}			X			Fair	Severe	Low	27	5

	Disturbances									Threats					Condition/Severity/Inspection				
Site Number	Erosion	Bioturbation	Tree Fall	Artifact Movement	Social Trail	Climbing	Camping	Use By Horses	Other	Social Trails	Artifact Movement	Visitor Use	Camping	Other	Condition	Severity Level	Vulnerability	Impact Score	Inspection Schedule
CA-TUO-0507	X				X			X	X^{X}, X^{Y}, X^{A}, X^{D}		X				Good	Moderate	Low	24	5
CA-TUO-2809	X			X					X^{V}, X^{N}	X					Poor	Moderate	Low	28	5
CA-TUO-2814/H	X							X	X^{H}, X^{X}, X^{D}			X			Good	Low	Low	13	10
CA-TUO-2824	X	X						X	X^{X}					X	Good	Low	High	13	10
CA-TUO-2834	X	X	X						X^{X}, X^{I}, X^{E}						Good	Low	High	8	5
CA-TUO-3823	X	X			X				X^{D}				X		Fair	Moderate	High	25	5
CA-TUO-3830	X	X													Good	Low	Low	4	10
CA-TUO-3844	X	X													Good	Moderate	Low	16	10
CA-TUO-3845	X	X			X		X		X^{Y}, X^{D}, X^{BB}, X^{R}, X^{E}, X^{T}				X		Fair	Severe	High	37	5
CA-TUO-3848	X	X					X		X^{BB}			X			Good	Moderate	High	21	5
CA-TUO-3937/H	X	X		X			X	X	X^{I}, X^{X}, X^{D}, X^{BB}			X			Poor	Moderate	High	23	5
CA-TUO-3944	X	X			X				X^{X}, X^{D}			X		X	Fair	Moderate	High	24	5
CA-TUO-4435	X			X											Poor	Moderate	Low	18	5
CA-TUO-4436	X								X^{E}, X^{D}, X^{Q}					X	Good	Moderate	High	17	10
CA-TUO-4640	X		X					X				X			Good	Low	Low	15	10
CA-TUO-4663	X									X			X		Good	Moderate	Low	21	5
CA-TUO-4902/H	X	X			X			X	X^{AA}, X^{BB}			X			Fair	Moderate	High	19	5
CA-TUO-4904H	X				X				X^{A}					X	Fair	Moderate	Low	18	5
YOSE 1992E-01		X	X	X	X				X^{X}, X^{D}, X^{H}			X			Poor	Severe	High	28	5
CA-TUO-5059	X				X										Good	Low	Low	12	10

Key: [A] – Vegetation Growth [B] – Vandalism [C] – Concession Activities [D] – Trail Construction [E] – Previous Scientific Research [F] – Trails Operation [G] – Waste Disposal [H] – Park Operations [I] – Road Construction [J] - Prescribed Burn [K] – Hazard Fuel Buildup [L] – Rock Fall [M] – Fire [N] – Utilities Construction [O] – Movement of Rock [P] – Charcoal [Q] – Wilderness Restoration [R] – Unauthorized Collecting [S] – Utilities Operations [T] – Inappropriate Restoration, [U] – Structure Construction, [V] – Development, [AA] – Flooding, [BB] – Campfire Building, [CC] – Biological Degradation, [DD] – Sedimentation, [EE] – Pest Infestation, [FF] – Motorized Equipment, [GG] – Grazing/Trampling

Site Condition and Disturbance Severity Levels

The majority of sites assessed were recorded in *Good* condition according to ASMIS definitions (n=33, 49%, Table 2.7.9). ASMIS site condition is only loosely associated with the visitor-related impacts to site integrity or the collective condition of the site. This is largely due to the fact that ASMIS site conditions are related to current site stability rather than cumulative level of disturbance.

A more appropriate measure of the cumulative condition of a site is its ASMIS *disturbance severity level* (Table 2.7.10.). This variable is the collective value of all threats and disturbances documented for a site. Disturbance severity levels were distributed somewhat evenly across all categories, with moderate disturbance severity levels observed the most frequently, at 40% (n=27) of sites assessed this season.

Table 2.7.9 displays current ASMIS Site condition

Site Condition	n	%
Good	33	49
Fair	22	32
Poor	13	19
Total	68	100

Table 2.7.10 displays current ASMIS site Disturbance Severity Level

Disturbance Severity Level	n	%
Low	21	31
Moderate	27	40
Severe	20	29
Total	68	100

Proximity

The proximity of each site monitored to an access point (trail, road) was determined from the Yosemite Archeology Offices' GIS database. This information was recorded for each site with the assumption that correlations can be determined between observed impacts and site proximities to access points. The distribution of frequency of sites falling into proximity categories are displayed below (Figure 2.7.1). As shown, sites were overwhelmingly located within 50 meters of an access point (n=52, 76%).

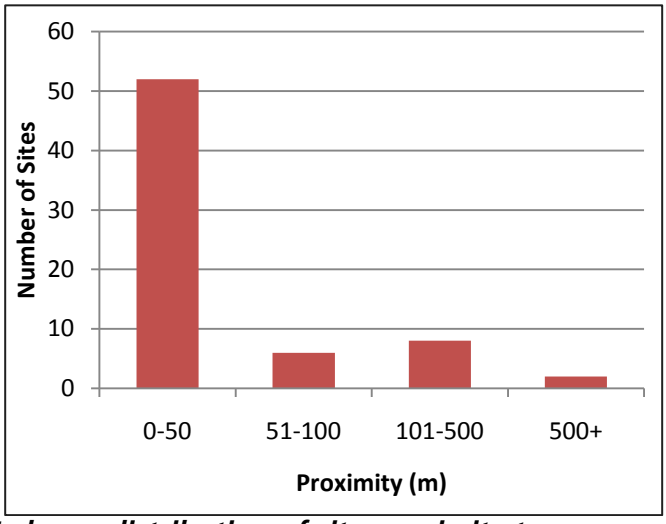


Figure 2.7.1 shows distribution of site proximity to access points, n=68.

Impacts

Only one archeological site visited in 2008 had no observable impacts. Figure 2.7.2 illustrates the distribution of the number of impacts observed at sites this year.

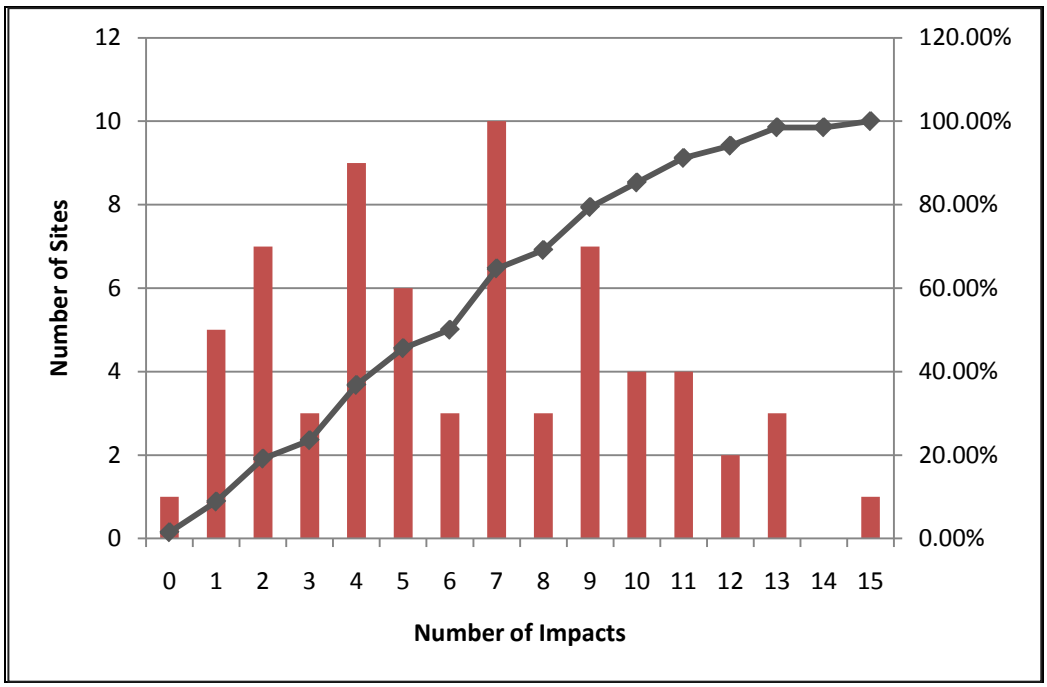


Figure 2.7.2 shows the distribution of the number of impacts per site whereas n=68.

Natural impacts were common at sites monitored this season, observed at 90% (n=61) of sites, only 7 sites had no observable natural impacts. Out of those sites that did contain natural impacts, erosion and bioturbation were the most prevalent types (n=48, 71% and n=34, 50% respectively), followed by tree fall, vegetation growth, and hazard fuel buildup (Table 2.7.11).

Table 2.7.11 shows observed natural impacts

Natural Impact	n	% of Sites
Erosion	48	71
Bioturbation	34	50
Tree Fall	15	22
Vegetation Growth	8	12
Hazard Fuel Buildup	8	12
Flooding	7	10
Animals	3	4
Rock Fall	3	4
Aggregation	2	3
Biological Degradation	2	3
Structural Deterioration	2	3
Fire	1	1
Natural Forces	1	1
Pest Infestation	1	1
Sedimentation	1	1

Visitor-related impacts were also prevalent on archeological sites, observed at 81% (n=55) of sites visited. Figure 2.7.3 illustrates the distribution of the number of visitor-related impacts observed on sites. Of those sites with visitor impacts present, the majority only contained one or two impacts. Table 2.7.12 displays the range of observed disturbances on archeological sites. As can be seen, the disturbance observed the most frequently within archeological site boundaries is use by hikers/horses. This is a somewhat ambiguous value in the ASMIS database that can indicate either social trailing or stock use. In most instances, this is used to depict social trail presence. The addition of the value social trail was not added to the ASMIS database until 2008, therefore, it is impossible to determine whether past use of use by hikers/horses indicates the presence of social trails or stock use. The second most frequent impact observed on site is social trailing (n=34), occurring on 50% of sites visited this season. Visitor use, another ambiguous term indicating general visitor presence on a site, has been recorded on 44% of the 68 sites assessed this season. Other commonly observed visitor-related impacts were camping, campfire building, and theft/looting. Table 2.7.13 lists recorded impacts on sites that are not clearly caused by natural or visitor-related forces. These include construction impacts such as road construction and utilities construction; park operations impacts including trail maintenance, resource management, scientific research, or fire suppression; and a third impact, artifact movement from unknown causes. In most instances of artifact movement on a site, the cause cannot be determined because artifacts can easily move as a result of erosion, bioturbation, freeze/thaw actions, as well as removal and movement due to visitor collection.

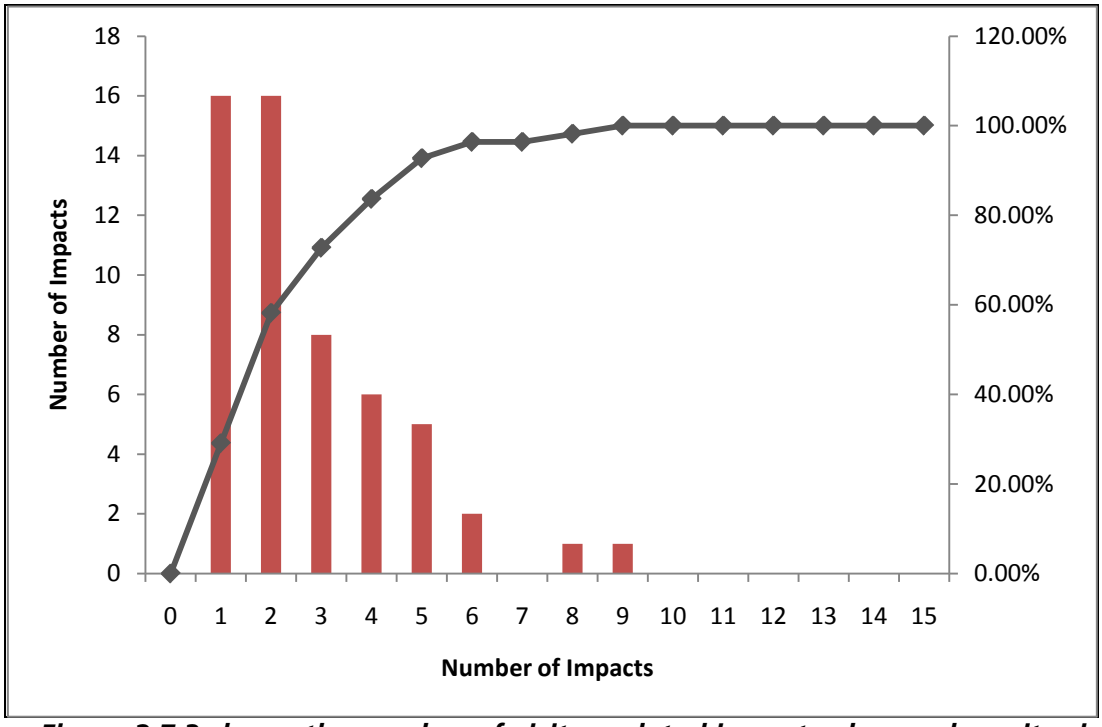


Figure 2.7.3 shows the number of visitor-related impacts observed on sites in2008 whereas n=55.

Table 2.7.12. shows observed visitor-related impacts.

Impact	Effect Level to Resource	n	Total Number	%
Use by Hikers/Horses	Negligible	23		
	Partial Loss-Repairable	12	35	51
Social Trail	Negligible	14		
	Partial Loss – Repairable	19		
	Partial Loss – Irretrievable	1	34	50
Visitor Use	Negligible	27		
	Partial Loss – Repairable	3	30	44
Camping	Negligible	13		
	Partial Loss-Repairable	2	15	22
Campfire Building	Negligible	9		
	Partial Loss-Repairable	2	11	16
Theft/Looting	Partial Loss – Irretrievable	7		
	Total Loss - Irretrievable	2	9	13
Climbing	Negligible	5	5	7
Unauthorized Collection	Partial Loss – Irretrievable	2		
	Total Loss - Irretrievable	1	3	4
Artifact Movement	Partial Loss-Repairable	2	2	3
Vegetation Damage	Negligible	2	2	3
Waste Disposal	Negligible	2	2	3
Grazing/Trampling	Partial Loss-Repairable	1	1	1
Vandalism	Negligible	1	1	1
Motorized Equipment	Partial Loss-Repairable	1	1	1

Table 2.7.13 displays other observed impacts.

Other Impact	n	% of Sites
Construction	62	91
Park Operations	61	90
Artifact Movement-unknown cause	8	12

As stated earlier, the most important aspect of disturbances to archeological sites is not the presence of the disturbance alone, but the impact that disturbance has to the archeological integrity and significance to the data potential of the site. Table 2.7.14 lists the effect to integrity for all baseline disturbances present on sites assessed in 2008. The most common impact to the integrity of archeological sites is from the displacement of artifacts or archeological features; caused by natural forces on 88% of sites visited this season, and caused by visitor forces on 71% of sites.

Table 2.7.14 displays the effects to aspect of site integrity for all disturbances observed on sites.

Impact Category	Effect to Integrity	# of Instances	# of Sites	% of Sites
Natural	Removal of Archeological Matrix	0	0	
	Removal of Artifact/Feature/Element	7	6	9
	Destabilization of Feature/Artifact/Element	0	0	0
	Destruction of Artifact/Feature	0	0	0
	Displacement of Artifact/Feature	**109**	**60**	**88**
	No Effect	0	0	0
	Other	20	16	24
Visitor	Removal of Archeological Matrix	1	1	1
	Removal of Artifact/Feature/Element	12	9	13
	Destabilization of Feature/Artifact/Element	0	0	0
	Destruction of Artifact/Feature	0	0	0
	Displacement of Artifact/Feature	**95**	**48**	**71**
	No Effect	0	0	0
	Other	42	21	31

Table 2.7.15 lists the range of visitor-related threats observed within site boundaries in 2008. A threat is defined as "a detectable condition that will predict disturbances" (NPS 2007a). Threats are important to record, as they will develop into disturbances if not quickly mitigated. As shown, the most common threat observed is visitor use, recorded at 30 archeological sites. This is a somewhat ambiguous term used to represent a variety of activities from trampling – leading to soil compaction, to general presence of people on a site.

Table 2.7.15 shows the types of threats observed on sites.

Threat	# of Sites	% of Sites
Social Trail	5	7
Artifact Movement	1	1
Visitor Use	30	44
Camping	6	9
Modification-Structural	1	1
Unauthorized Collection	3	4
Motorized Equipment	1	1
Vandalism	1	1

Impact Scores

Each site received an aggregate impact score based on the points assigned (see Table 2.7.6) to baseline threats and disturbances within archeological site boundaries, weighted by a factor of two for visitor-related impacts. Figure 2.7.4 shows the distribution of impact scores. The visitor impact score was used to determine the site *Disturbance Severity Level* and the site *Inspection Schedule*.

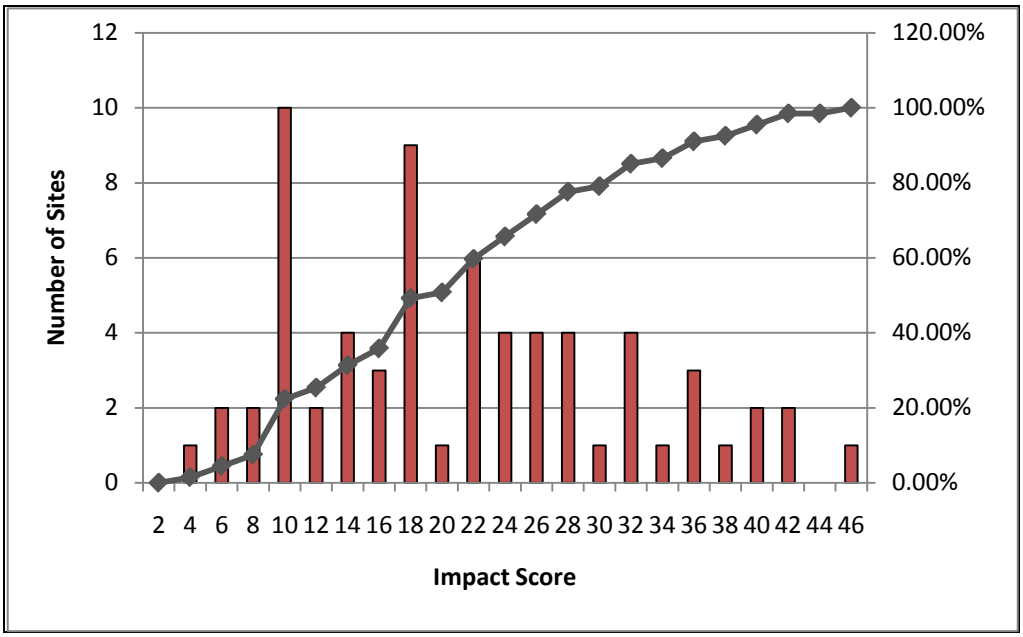


Figure 2.7.4 shows the distribution of impact scores at each site wherea n=68.

Table 2.7.16 lists the range of the types of direct use seen on or near an archeological site. This is not the same as disturbances observed on site, but a category of use the site does receive or is likely to receive based on proximity to attraction sites, wilderness, trailheads, residential areas, etc.. The predominant use observed on a site was hiking, followed by park operations.

Table 2.7.16 shows the types of direct use observed on sites.

Use	# of Sites	% of Sites
None	19	28
Camping	4	6
Climbing	1	1
Hiking	22	32
Park Operations	14	21
Parking	1	1
Picnicking	2	3
Residential	1	1
River Recreation	3	4
Sightseeing	1	1

Analysis

As was shown earlier in Table 2.7.12, the presence of social trails on sites is fairly widespread. Table 2.7.17 lists categories (number) of social trails on sites. The majority of sites that were impacted by social trails, contained one or two trails on site (n=28, 41%), while only six sites (9%) contained more than two social trails. In an attempt to explore possible correlations between impacts to sites and factors such as proximity to an access point, the presence of social trails was charted against the proximity of the site from an access point. Figure 2.7.5 illustrates the distribution of observed social trails on sites, grouped by the site proximity to an access point. As can be seen, sites that are within 100 meters of an access point contain more social trails. Further, the six sites that contained more than two social trails were all located within 100 meters of an access point, and only seven sites located over 100 m away from an access point contained social trails at all.

Table 2.7.17 displays the number of social trails observed on sites.

Category	# of Sites	% of Sites
None	34	50
1 – 2	28	41
More than 2	6	9
Total	68	100

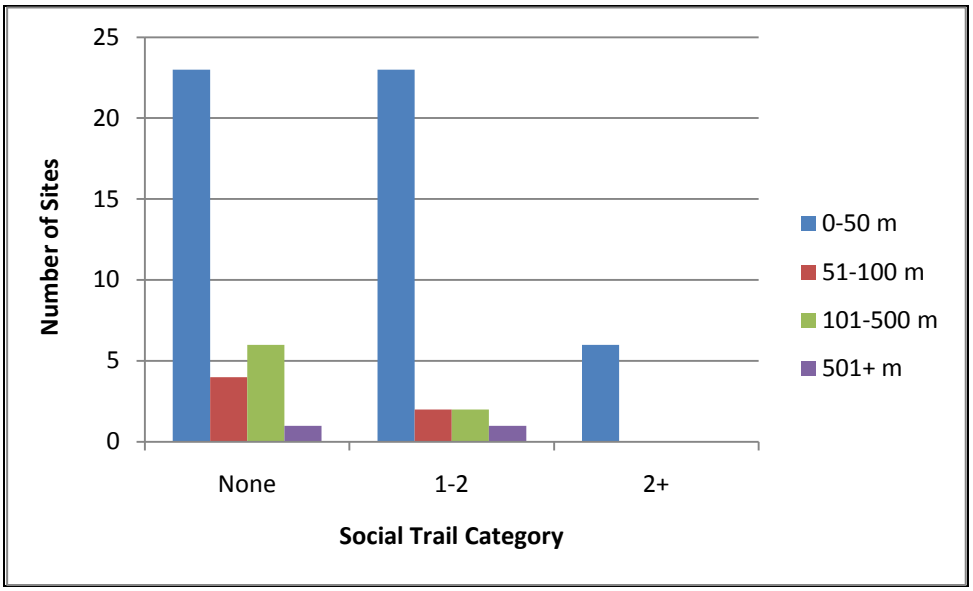
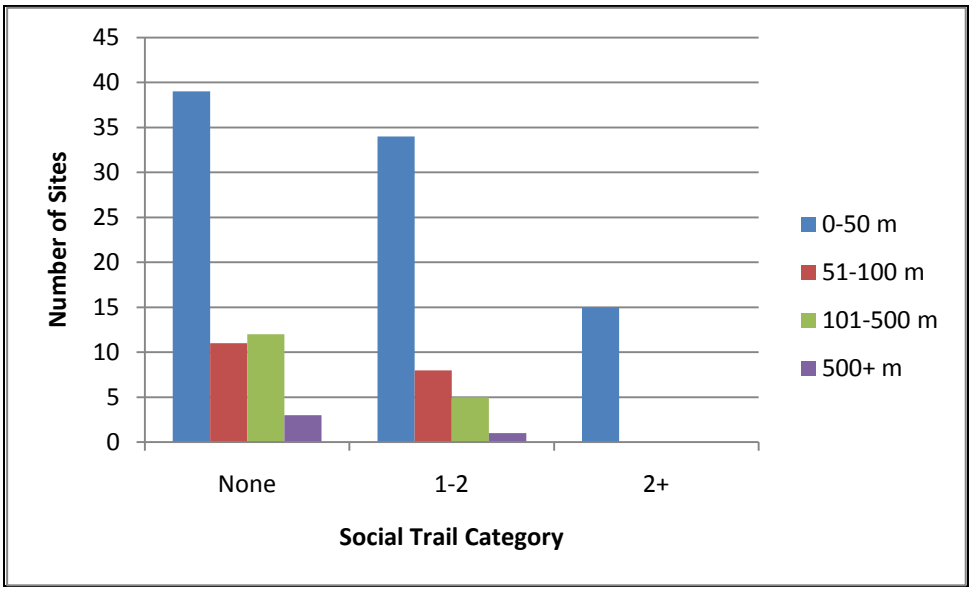


Figure 2.7.5 shows social trail presence by proximity to access in 2008 whereas n=68.

Combining the information collected in 2008 with that collected in 2007 demonstrates promising correlations (Figure 2.7.6). No site within the past two seasons that is more than 50 meters away from an access point has contained more than two social trails.

Figure 2.7.6 shows the presence of social trails by proximity to access in 2007 and 2008 whereas n=138.



In an attempt to further investigate the possible correlations between the condition and cumulative disturbance levels at sites, and proximity to an access point, site disturbance severity level was plotted against site proximity (Figure 2.7.7). As can be seen, a higher percentage of sites located within 50 meters of an access point are more disturbed than those located over 50 meters away from an access point. Additionally, as Figure 2.7.8 illustrates, a higher percentage of sites located within 50 meters of an access point are in Fair to Poor condition. Combining these data with those collected in 2007 shows similar trends (Figures 2.7.9. and 2.7.10.)

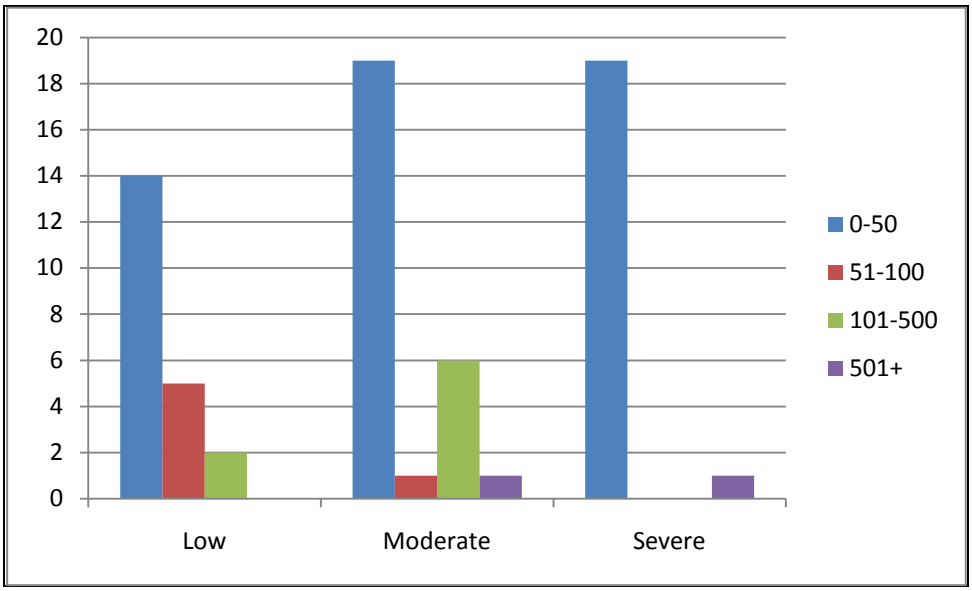


Figure 2.7.7. shows site Disturbance Severity Level by proximity to access in 2008 whereas n=68.

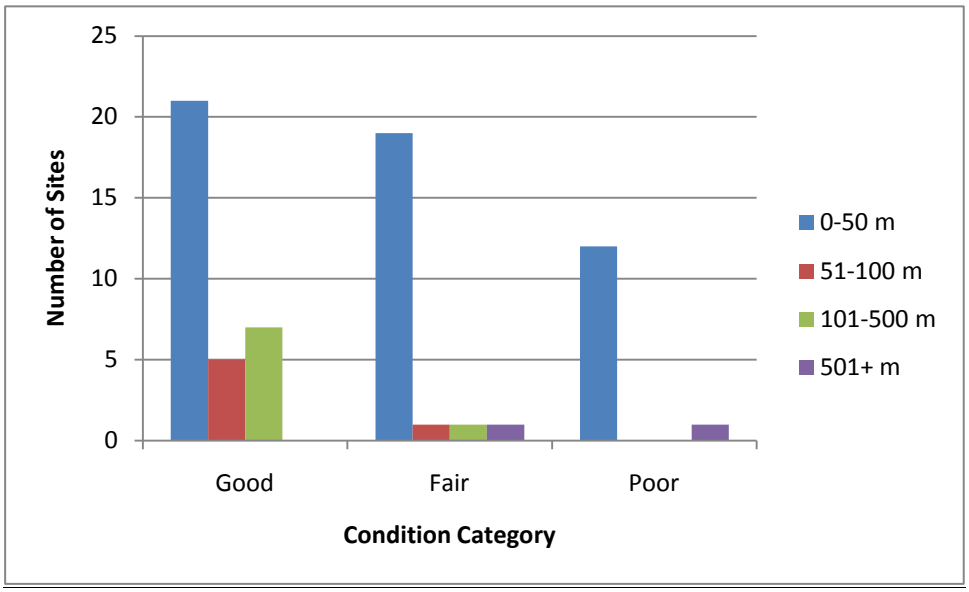


Figure 2.7.8 shows site condition by proximity to access in 2008 whereas n=68.

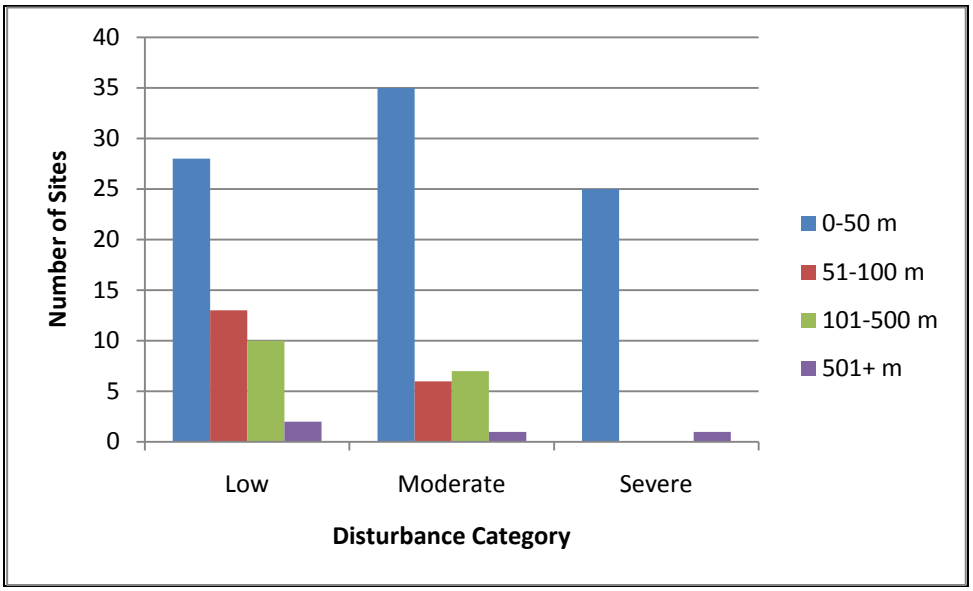


Figure 2.7.9 shows site Disturbance Severity Level by proximity in 2007 and 2008 whereas n=128.

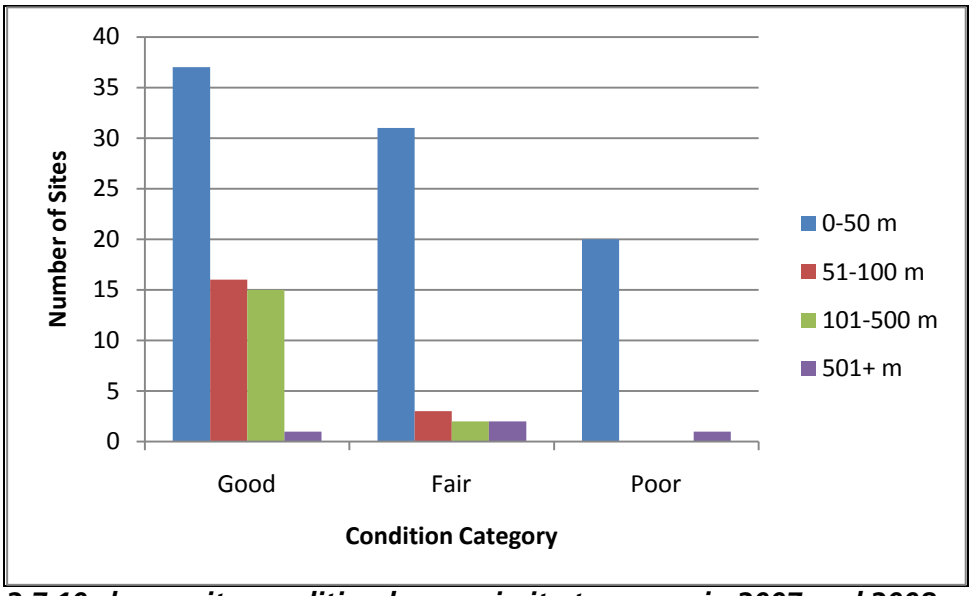


Figure 2.7.10 shows site condition by proximity to access in 2007 and 2008 whereas n=128.

Monitoring

Table 2.7.18 gives condition information, and a description of site type and impacts for the 10 sites in Yosemite Valley that were visited in 2007, and then monitored in 2008. No site had an

increase in impacts from the year before, however all sites exhibited ongoing impacts from the previous year, primarily from erosion, bioturbation, and continuous use of social trails.

Table 2.7.18 shows Yosemite Valley sites monitored in 2008.

Site	ASMIS Condition Past	ASMIS Condition Current	Disturbance Severity Level	Comments
CA-MRP-0064	Poor	Poor	Severe	Prehistoric site consisting of three bedrock milling features, a rock alcove, and very light obsidian lithic scatter. According to the 1986 site record, only three obsidian flakes were observed on the site which had already been extremely disturbed. The 2007 update notes that a granite block had been placed on top of Feature 1. The pestles around Feature 2 were not relocated and only one flake was observed. The 2008 visit observed over 100 campfire grates piled along the side of the road south of Features 1 and 2, and no obsidian flakes were observed. The site is in poor condition with a disturbance severity level of severe. The site area and its surrounding environment have been used by park personnel as a storage lot and have been heavily impacted with vehicles and machinery. Other disturbances include extensive erosion, bioturbation, road construction, social trails, and evidence of bouldering. Considering the high vulnerability and high data potential of the site, the inspection schedule was determined to be for 5 years. The disturbances observed in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-0069	Good	Good	Low	Prehistoric site consisting of three bedrock milling boulders. The site is currently in good condition with a disturbance severity level of low. Observed disturbances were erosion and tree fall. General visitation is a threat. The site has low vulnerability and low estimated data potential. The site inspection schedule is set at 10 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-0072	Good	Good	Low	Prehistoric site consisting of a single bedrock milling feature and three artifacts. In 2007 the site was revisited and only one pestle was found in an intermittent drainage adjacent to the feature. The site is in good condition with observable disturbances of fallen trees and water erosion, mostly due to the drainage that cuts along all sides of Feature 1. There is also a telephone cable that runs northwest above the feature. The disturbance severity level of the site is low as is the estimated site vulnerability and estimated data potential of the site. The documented inspection schedule for the site was determined to be 10 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-0078	Good	Good	Moderate	Prehistoric site consisting of two bedrock milling features. The site is in good condition. The disturbance severity level is moderate. Disturbances observed were bioturbation and burn piles. The burn piles appear to be the same observed piles from the 2007 assessment. This could potentially be hazard fuel buildup since there is also dense duff in the area. General visitor use is a threat to the site. The estimated site vulnerability is low. The estimated data potential is also low. The inspection schedule score is for 5 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.

Site	ASMIS Condition Past	ASMIS Condition Current	Disturbance Severity Level	Comments
CA-MRP-0242/H	Poor	Fair	Low	Multi-component site consisting of a single granite milling feature, lithic scatter, historic scatter, and remnants of a historic NPS building (removed in 2004). Obsidian flakes were observed in 1975. The site is in fair condition. Observed disturbances were of road/highway operations with Highway 140 directly south of the feature and bioturbation around Feature 1. The disturbance severity level is low as is the estimated site vulnerability. The estimated data potential of the site is medium. The inspection schedule for the site is 5 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed. This is the only site monitored to have an increase in the site condition, largely a result of site stability.
CA-MRP-0291/751	Poor	Poor	Severe	Prehistoric site consisting of two granite milling boulders and sparse lithic scatter. The site is in poor condition with a disturbance severity level of severe. Observed disturbances are general park operations, general erosion, and social trails. General visitor use is a potential threat. It is within a housing area adjacent to Ahwahnee hotel and associated buildings. A dirt road cuts through the archaeological site and various utility lines also run through the area. In 1986 an additional mortar feature was removed from the site during construction. The estimated data potential and site vulnerability is low. The inspection schedule was determined to be 5 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-0314	Good	Good	Moderate	Prehistoric site consisting of four bedrock milling features and light lithic scatter. The site is currently in good condition, but has a disturbance severity level of severe. Observed disturbances in the site were of stock use, trails construction, bioturbation, evidence of bouldering and climbing, soil compaction due to social trails, and fallen trees. The site is highly vulnerable and has high data potential. The inspection schedule for the site is for 5 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-0823	Good	Good	Low	Prehistoric site consisting of a single bedrock milling feature with four mortar cups. The site is in good condition and noted disturbances were tree fall and bioturbation. General visitor use is a potential threat. The disturbance severity level is low as is the estimated site vulnerability and the estimated data potential for the site. The calculated inspection schedule is for 10 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-1751H	Good	Good	Low	Historic site consisting of historic trash scatter located southeast of the edge of Woskey pond and meadow. The site is in good condition. Observed disturbances were erosion and bioturbation. The disturbance severity level is low. The estimated site vulnerability is high and the estimated data potential is medium. The inspection schedule was determined to be for 10 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were observed.
CA-MRP-1873	Fair	Fair	Moderate	Multicomponent site consisting of subsurface lithic scatter and historic trash. The site is in fair condition with a severe disturbance severity level, and with observed disturbances of a distinct social trail, utilities/construction with the road present in the center of the site, and bioturbation. General visitor use within the entire area is a potential threat. The inspection schedule set for the site in 5 years. Observed disturbances in 2007 were ongoing in 2008, although no new disturbances were

Site	ASMIS Condition Past	ASMIS Condition Current	Disturbance Severity Level	Comments
				observed.

Discussion

Baseline archeological site condition was assessed at 58 sites this field season, and 10 sites were monitored for changes in condition since the 2007 field season. Most sites contained both natural and visitor-related impacts. The most prevalent forms of disturbances observed in 2008 proved to be erosion and social trailing. Initial attempts to demonstrate correlations between impacts observed on-site and variables such as a site proximity to an access point reveal the presence of possible relationships. Initial data analysis suggests that sites that are located closer to access points tend toward having more social trails present. Additionally, sites that are located some distance away from access points (more than 500 m away, tend toward having lower disturbance severity levels and higher site conditions. Further data collection will allow for more refined analyses.

Conclusion

While ASMIS data collection is on the whole subjective, refinement of this program at the national level continues to improve the usability and efficacy of the collection protocols. Though refinements in protocol will likely occur in future seasons, continuing efforts on the part of the archeology staff to ensure that the data is collected in a more objective way by means of augmenting standard ASMIS data collection will ensure future seasons of consistent and valid assessments of archeological site condition and integrity.

Future seasons will further explore the development of standards. It is anticipated that subsequent to continued baseline data collection, statistical analysis will be undertaken on all collected data to inform on what metrics should continue to be utilized; and to begin to elucidate trends in impact data at archeological sites. Additional recommendations include ongoing evaluation of the validity of measurements, and further refinement of a sampling strategy that integrates visitor use data.

2.8 PARKING AVAILABILITY

Transportation has long played an important role in the National Park System (Percival 1999). Transportation issues have recently been studied at such parks as Yellowstone (Mings et al. 1992), Smoky Mountains (Sims et al. 2005), Blue Ridge Parkway (Vallier et al. 2003) as well as in Yosemite (Nelson and Tumlin 2000, YOSE 1999, White et al. 2006).

The vast majority of visitors to Yosemite arrive in private vehicles, and more than a million vehicles enter Yosemite Valley each year, resulting in significant traffic congestion. Traffic congestion can cause a variety of impacts to the Merced River's Outstandingly Remarkable Values including the natural and cultural resources as well as the quality of the visitor experience. Specific impacts include increased travel and waiting times, wildlife depredation, air pollution, noise, vegetation loss, and others. Therefore, an indicator was piloted in 2005 measuring the availability of parking facilities at the day use parking area. Parking availability has served as an indicator of overall traffic congestion in Yosemite Valley and, therefore, has served as an early warning sign suggestive of the extent to which the Merced River's Outstandingly Remarkable Values are affected by human vehicular use. In 2008, we have combined this indicator with other ongoing traffic research. This will greatly improve our understanding of this indicator and generate improved data collection and analysis. There is no data to present at this time for 2008.

3.0 PROGRAM EVALUATION

The monitoring of indicator variables as described in this document is part of an on-going program to ensure the quality of park resources and visitor experiences. As mentioned earlier in this report, the User Capacity Management Monitoring Program is a planning and management process that focuses on visitor use. The VERP Handbook (NPS 1997) suggests that, "visitor use management begins with a plan, but it continues as a cyclical process involving monitoring, evaluation, and taking action to make adjustments." Monitoring is essential to "close the loop" in this overall process and ultimately inform management actions. Evaluative measures are, therefore, essential to continued User Capacity Management Monitoring Program development and implementation, and to ensure that this program is indeed effective.

4.0 SUMMARY

The data and information presented in this report is intended to inform planning and management decisions regarding visitor use and its impact to the Merced River's Outstandingly Remarkable Values within Yosemite National Park. This report has provided a descriptive presentation of results. Though still a young program, measuring and monitoring indicator variables has already provided park planners and managers with valuable scientific data and information to inform their decision making. The utility of this data and information, however, is not limited to the analyses reported here. Rather, additional analysis and synthesis of the data may be conducted in the future to verify results, test additional hypotheses, and otherwise further inform planning and management efforts on a continual basis. The User Capacity Management Monitoring Program is an integral component of a broader adaptive visitor use management process. It is intended to evolve over time as new information, technologies, and methods are made available. This report helps to build the institutional memory that ensures this process continues.

Lastly, park managers have a variety of tools available to them to address visitor use and its impact to the park. Results contained in this report will provide important information to help managers

select the best tools to affect desired outcomes. This "informed management action" closes the loop of the User Capacity Management Monitoring Program framework and the process continues.

APPENDICES

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APPENDIX A: REFERENCES

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APPENDIX B: LIST OF ACRONYMS

ANOVA	Analysis of Variance
ASMIS	Archeological Sites Management Information Systems
BPLD	Bear Patrol Log Database

°C	Degrees Centigrade.
CMP	(Merced Wild and Scenic River) Comprehensive Management Plan
DO	Dissolved Oxygen
DOQs	Digital Orthophotos
GIS	Geographic Information System
GPS	Global Positioning System
ft.	Foot
HBMP	Human-Bear Management Program
km	Kilometer
l	Liter
m	Meter
MDL	Method Detection Limit
mg/l	Milligram per Liter
ml	Milliliter
mm	Millimeter
MLRS	Merced Lake Ranger Station
MPN	Most Probable Number (of bacterial colonies)
NO3 + NO2	Nitrate plus Nitrite
NPS	National Park Service
NWQL	National Water Quality Laboratory
PDA	Personal Data Assistant
PAOT	People at one time
pH	Potential Hydrogen
SOP	Standard Operating Procedure
TDN	Total Dissolved Nitrogen
TDP	Total Dissolved Phosphorous
TP	Total Phosphorous
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
µS/cm	Micro-Siemens (a measure of electrical conductivity)
UCMMP	User Capacity Management Monitoring Program
VOG	Vehicles On the Ground
WIMS	Wilderness Impacts Monitoring System

APPENDIX C: LIST OF PREPARERS AND CONTRIBUTORS

PREPARERS

- Andrew Ackerman, Recreation Technician, Visitor Use and Social Sciences Branch, Resources Management and Science, Yosemite National Park
- Crystal Elliot, Biological Science Technician, Vegetation and Ecological Restoration, Resources Management and Science, Yosemite National Park
- David Henderson, Traffic Management Supervisor, Visitor Protection, Yosemite National Park
- Marci Jones, Biological Science Technician, Vegetation and Ecological Restoration Branch, Resources Management and Science, Yosemite National Park
- Laura Kirn, Branch Chief, Archeology and Anthropology Branch, Resources Management and Science, Yosemite National Park
- Dr. Steve Lawson, Social Scientist, Department of Forestry, Natural Resource Recreation, Virginia Polytechnic Institute
- Dr. Yu-Fai Leung, Recreation Ecologist, College of Natural Resources, Parks, Recreation and Tourism Management , North Carolina State University
- Allison Lucas, User Capacity Management Monitoring Program, Monitoring Program Assistant, Visitor Use and Social Science Branch, Resources Management and Science, Yosemite National Park
- Bret Meldrum, User Capacity Management Monitoring Program, Program Coordinator, Resources Management and Science, Yosemite National Park
- Jessica Middleton, Archeologist, Archeology and Anthropology Branch, Resources Management and Science, Yosemite National Park
- Todd Newburger, Biologist, Visitor Use and Social Science Branch, Resources Management and Science, Yosemite National Park
- Christal Niederer, Biological Science Technician, Vegetation and Ecological Restoration Branch, Resources Management and Science, Yosemite National Park
- Joe Meyer, Branch Chief, Physical Science and GIS, Resources Management and Science, Yosemite National Park
- Dr. Peter Newman, Social Scientist, Department of Natural Resource Recreation and Tourism, Colorado State University
- Dr. Niki Stephanie Nicholas, Chief, Resources Management and Science, Yosemite National Park
- Jim Roche, Hydrologist, Physical Science and GIS, Resources Management and Science, Yosemite National Park
- Victoria Seher, Wildlife Biologist, Wildlife Management, Resources Management and Science, Yosemite National Park
- Judi Weaser, Branch Chief, Vegetation and Ecological Restoration, Resources Management and Science, Yosemite National Park

Appendix D. Impact Totals from all Archaeological Sites Visited

	Natural Impacts							Visitor Use Impacts															Monitoring priority	
	Erosion	Bioturbarion	Rock Fall	Tree Fall	Vegetation Growth	Other	Condition Class	Collection Pile	Social Trail	Fire Ring	Rearrangement of	Rearrangement of	Soil Compaction	Vegetation	Trash	Other	Stock	Trails	Wilderness	Other	Vandalism	Condition Class	Monitoring Score	Priority in Years
MRP-0049	X	X	X				MOD															NO	7	5-7
MRP-0064	X	X					MIN				X	X	X		X					X		EXTR	11	2-5
MRP-0069				X			MIN													X		MIN	5	5-7
MRP-0072	X			X			MIN															NO	5	5-7
MRP-0078							NO															NO	5	5-7
MRP-0080	X	X		X			MOD	X	X	X			X	X	X	X	X	X			X	EXT	14	1-2
MRP-0083/H	X	X					MIN			X			X					X				HIGH	9	5-7
MRP-0088		X					MIN											X				MIN	6	5-7
MRP-0169	X			X			MIN		X	X					X							HIGH	10	2-5
MRP-0190/0191		X		X		X	MIN		X	X			X				X					SEV	12	2-5
MRP-0212	X			X			MOD															NO	6	5-7
MRP-0213	X	X		X	X		MOD															NO	6	5-7
MRP-0242/H						X	MIN												X			MIN	9	5-7
MRP-0291/0751	X	X					MIN		X				X	X	X		X			X		SEV	10	2-5
MRP-0292/0293/H		X	X				MOD		X				X		X		X	X	X			SEV	14	1-2
MRP-0314	X	X		X			MOD		X				X		X	X		X	X			HIGH	10	2-5
MRP-0336	X	X					MIN		X	X	X	X			X		X					EXTR	13	2-5
MRP-0355	X						MIN															NO	9	5-7
MRP-0645	X	X					MOD		X							X						MOD	9	5-7
MRP-0655		X					MIN		X					X						X		HIGH	9	5-7
MRP-0734H	X	X					MOD									X						MIN	10	2-5
MRP-0735		X		X			MIN															NO	6	5-7
MRP-0737	X	X					MOD		X											X		MOD	11	2-5
MRP-0810		X					MIN													X		MIN	6	5-7
MRP-0823				X			MIN													X		MIN	6	5-7

	Natural Impacts							Visitor Use Impacts															Monitoring priority	
	Erosion	Bioturbarion	Rock Fall	Tree Fall	Vegetation Growth	Other	Condition Class	Collection Pile	Social Trail	Fire Ring	Rearrangement of	Rearrangement of	Soil Compaction	Vegetation	Trash	Other	Stock	Trails	Wilderness	Other	Vandalism	Condition Class	Monitoring Score	Priority in Years
MRP-0827/H		X		X			MIN												X			MIN	7	5-7
MRP-1366/H	X	X					MIN		X		X				X					X		SEV	12	2-5
MRP-1529H							NO															NO	4	5-7
MRP-1572/H	X	X		X			MIN															NO	5	5-7
MRP-1746H		X		X	X		MOD															NO	6	5-7
MRP-1751H	X			X			MOD															NO	4	5-7
MRP-1816		X					MIN		X										X			SEV	9	5-7
TUO-0022	X	X					MOD		X	X			X				X	X	X	X		SEV	12	2-5
TUO-0047	X	X		X			MIN		X													MOD	5	5-7
TUO-0115	X	X					MIN		X					X								MOD	9	5-7
TUO-0132	X						MIN															NO	2	10
TUO-0134	X	X					MOD		X				X	X	X				X			SEV	11	2-5
TUO-0179/2829	X	X					MIN		X		X											MOD	8	5-7
TUO-0201	X	X					MIN															NO	3	2-5
YOSE2007H-01	X						MIN															NO	3	2-5
TUO-0494	X	X					MIN															NO	5	5-7
TUO-0495/H	X	X					MIN			X												MIN	4	5-7
TUO-0497	X	X					MIN															NO	4	5-7
TUO-0527/H	X	X		X			MIN															NO	6	5-7
TUO-0734	X	X		X			MIN		X	X					X							MOD	6	5-7
TUO-0737	X	X	X			X	MOD		X	X		X		X	X		X	X	X			EXTR	12	2-5
TUO-0738		X		X			MIN		X			X	X				X	X				SEV	9	5-7
TUO-0765	X	X					MIN		X													MIN	7	5-7
TUO-2811	X	X					MOD		X	X		X	X	X	X					X		EXT	13	2-5
TUO-2815/H	X	X		X			MOD													X		MIN	8	5-7
TUO-2822	X	X					MIN				X											MIN	6	5-7
TUO-2832	X	X					MIN															NO	4	5-7

	Natural Impacts							Visitor Use Impacts															Monitoring priority	
	Erosion	Bioturbarion	Rock Fall	Tree Fall	Vegetation Growth	Other	Condition Class	Collection Pile	Social Trail	Fire Ring	Rearrangement of	Rearrangement of	Soil Compaction	Vegetation	Trash	Other	Stock	Trails	Wilderness	Other	Vandalism	Condition Class	Monitoring Score	Priority in Years
TUO-2835	X	X		X			MOD					X										MIN	7	5-7
TUO-2836	X						MIN								X					X		MIN	6	5-7
TUO-3838	X	X		X			MOD			X		X	X	X	X				X			HIGH	8	5-7
TUO-3843	X	X		X			MOD										X					MIN	5	5-7
TUO-3934H		X		X			MIN	X	X	X	X		X		X		X	X				EXTR	12	2-5
TUO-3987	X				X		MOD		X	X		X										HIGH	8	5-7
TUO-3994	X	X		X			MOD								X							MIN	4	5-7
TUO-4070							NO															NO	4	5-7
TUO-4257	X						MIN										X					MIN	6	5-7
TUO-4440	X	X					MIN															NO	3	10
TUO-4488				X			MIN		X	X		X							X			HIGH	8	5-7
TUO-4510	X	X		X			MIN		X	X									X			HIGH	7	5-7
TUO-4888	X	X					MIN										X					MIN	5	5-7
TUO-4903	X	X					MIN															NO	6	5-7
P-22-001645	X	X					MIN		X	X	X	X			X							HIGH	6	5-7
P-22-001687		X			X		MIN											X				MIN	6	5-7
P-22-1682	X			X			MIN			X					X							MIN	6	5-7
YOSE1994L-01		X		X			MIN		X													HIGH	8	5-7

Appendix E: Archaeological Site Management Information System (ASMIS) Site Condition Definitions

GOOD - The site, at the first condition assessment or during the time interval since its last condition assessment, shows no evidence of noticeable deterioration by natural forces and/or human activities. The site is considered currently stable and its present archeological values are not threatened. No adjustments to the currently prescribed site treatments are required in the near future to maintain the site's present condition.

FAIR - The site, at the first condition assessment or during the time interval since its last condition assessment, shows evidence of deterioration by natural forces and/or human activities. If the identified impacts continue without the appropriate corrective treatment, the site will degrade to a poor condition and the site's data potential for historical or scientific research will be lowered.

POOR - The site, at the first condition assessment or during the time interval since its last condition assessment, shows evidence of severe deterioration by natural forces and/or human activities. If the identified impacts continue without the appropriate corrective treatment, the site is likely to undergo further degradation and the site's data potential for historical or scientific research will be lost.

DESTROYED - The site's formal condition assessment resulted in a professional determination that the site was destroyed or so severely damaged that the data potential/scientific research value was deemed insufficient to warrant further archeological monitoring or investigation. A destroyed site is excluded from Government Performance and Results Act (GPRA) and other national level reporting requirements and is recorded in ASMIS in the Local Resource Type field.

INUNDATED-UNCERTAIN – The deposits and condition of an inundated site, formerly in a terrestrial setting, are obscured and cannot be accurately assessed due to factors such as water turbidity or natural lack of clarity, wave action, growth of aquatic vegetation, and other conditions. Application of standard methods to assess the condition of an inundated site is not possible in these circumstances.

NOT RELOCATED–UNKNOWN - The location where the site was last documented was visited, but the site could not be relocated. Based on best professional judgment that considers standard site types in the park, geography, topography, site documentation, and other pertinent factors, the area is deemed to most likely be the location of the site. Further testing may be required to determine the site location. [NPS 2006:46, 2007a, 2007b].