

INTRODUCTION AND OVERVIEW

This study estimates the economic contributions from a restored Hetch Hetchy Valley in Yosemite National Park, including both the economic value of outdoor recreation activity that would be available and the existence value that would be provided by the restoration of Hetch Hetchy Valley. It also estimates the expenditures that would be associated with visitation to Hetch Hetchy Valley.

This report is not a benefit-cost analysis of restoring Hetch Hetchy Valley. It does not address the costs of system improvements necessary to replace the water supply and electric power benefits which Hetch Hetchy Reservoir makes possible and on which San Francisco and other Bay Area communities depend.¹ This report also makes no assumptions regarding how Hetch Hetchy Valley would be restored or how it would be managed by the National Park Service.

The analysis involves three parts, presented in the three sections of this report. The first section summarizes available information to understand how people would use and value a restored Hetch Hetchy. The second section builds from this characterization of use opportunities to identify the types of recreation activity that would likely occur in a restored Hetch Hetchy, and calculates their likely economic value. The third section also builds from the first section review of the public's interest in a restored Hetch Hetchy, and combines this with



A restored Hetch Hetchy would revive recreational activity to the valley. (Courtesy of Unsplash. Photo by Alberto Casetta.)

data and an understanding of passive-use values that have been estimated with survey-based stated preference tools for other outstanding natural resources.

The analysis does not involve collection of new, primary data. Extensive user data exist for Yosemite National Park. Federal agencies, as well as peer-reviewed academic studies, provide complementary data on outdoor recreation behavior patterns, associated expenditures, and resulting consumer

¹ Client Restore Hetch Hetchy's mission statement reads "The mission of Restore Hetch Hetchy is *to return the Hetch Hetchy Valley in Yosemite National Park to its natural splendor — while continuing to meet the water and power needs of all communities that depend on the Tuolumne River*. Additionally, Restore Hetch Hetchy recommends that system improvements be in place before the reservoir is emptied.

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ECONorthwest prepared this report for Restore Hetch Hetchy. It received substantial assistance from Restore Hetch Hetchy staff, board members, and other former National Park Service senior staff. Other researchers, firms, agencies, and staff contributed to other research that this report relied on.

That assistance notwithstanding, ECONorthwest is responsible for the content of this report. The staff at ECONorthwest prepared this report based on their general knowledge of economic valuation, natural resource values, recreation values, and total economic value techniques. The work also relied heavily and information derived from government agencies, private statistical services, the reports

of others, interviews of individuals, or other sources believed to be reliable. ECONorthwest has not independently verified the accuracy of all such information, and makes no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute the authors' current opinions, which may change as more information becomes available.

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ABOUT

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surplus values. The application of these data via established economic methods applying benefits transfer provides an understanding of the overall likely economic value of outdoor recreation that would occur in a restored Hetch Hetchy. Passive-use survey data do not exist specific for a restored Hetch Hetchy. However, a review of existing studies, which did gather and analyze such data for other resources, along with consideration of how those resources compare to a restored Hetch Hetchy, provides insight into the likely range of passive-use values that a restored Hetch Hetchy would provide.

The analyses in this study do not provide comprehensive estimates of the total economic value of a restored Hetch Hetchy that would be possible with an extensive effort to collect and analyze primary data via survey instruments targeted specifically at Hetch Hetchy. Such an exercise would be prohibitively time and resource intensive given the constraints of this analysis and the international population of visitors to Yosemite National Park. This analysis applies the best available information and quantitative data with respect to the recreational use and passive-use values of a restored Hetch Hetchy Valley.

The analyses in this study do not provide a comprehensive estimation of the net benefit to society of actions to restore Hetch Hetchy. Estimating the overall social welfare would involve consideration of the direct costs and opportunity costs required to provide a restored Hetch Hetchy. Therefore

This study by ECONorthwest makes a convincing case that there could be substantial economic benefits if Hetch Hetchy were to be restored, including recreation benefits for millions of visitors from California and elsewhere. They would be attracted by the same types of recreation opportunities as at Yosemite, but with less congestion. In addition, others who might not themselves visit would place significant economic value on the restoration of an iconic element in California's environmental heritage.

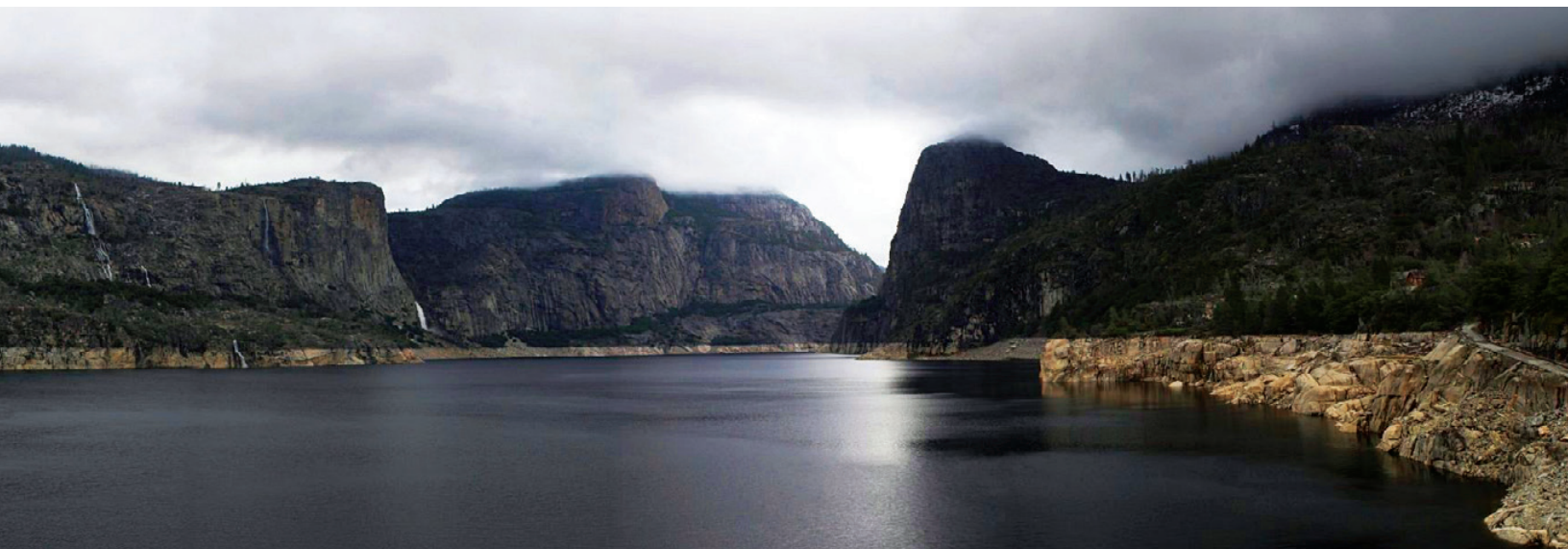
— MICHAEL HANEMANN

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this analysis alone is not sufficient to consider the general economic question of whether the benefits of restoring Hetch Hetchy exceed the costs. This analysis does, however, attempt to review and apply the best available information for consideration of the benefits of restoration to society.

Purpose and Background

This report summarizes economic analyses designed to improve understanding of the economic benefits that would be provided by emptying Hetch Hetchy Reservoir, re-establishing a functional riparian corridor and channel for the Tuolumne River, and providing outdoor recreation opportunities in Hetch



Recreation at Hetch Hetchy is limited as the valley is buried under a reservoir and access to the area is restricted. (Photo by Spreck Rosekrans)

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Hetchy Valley. This study investigates the general issue of overall economic value provided by restoration of a riparian valley in Hetch Hetchy, and specifically addresses two target research questions:

1. What is the economic value of outdoor recreation opportunities provided by a restored Hetch Hetchy Valley?
2. What is the passive-use value provided by a restored Hetch Hetchy Valley?

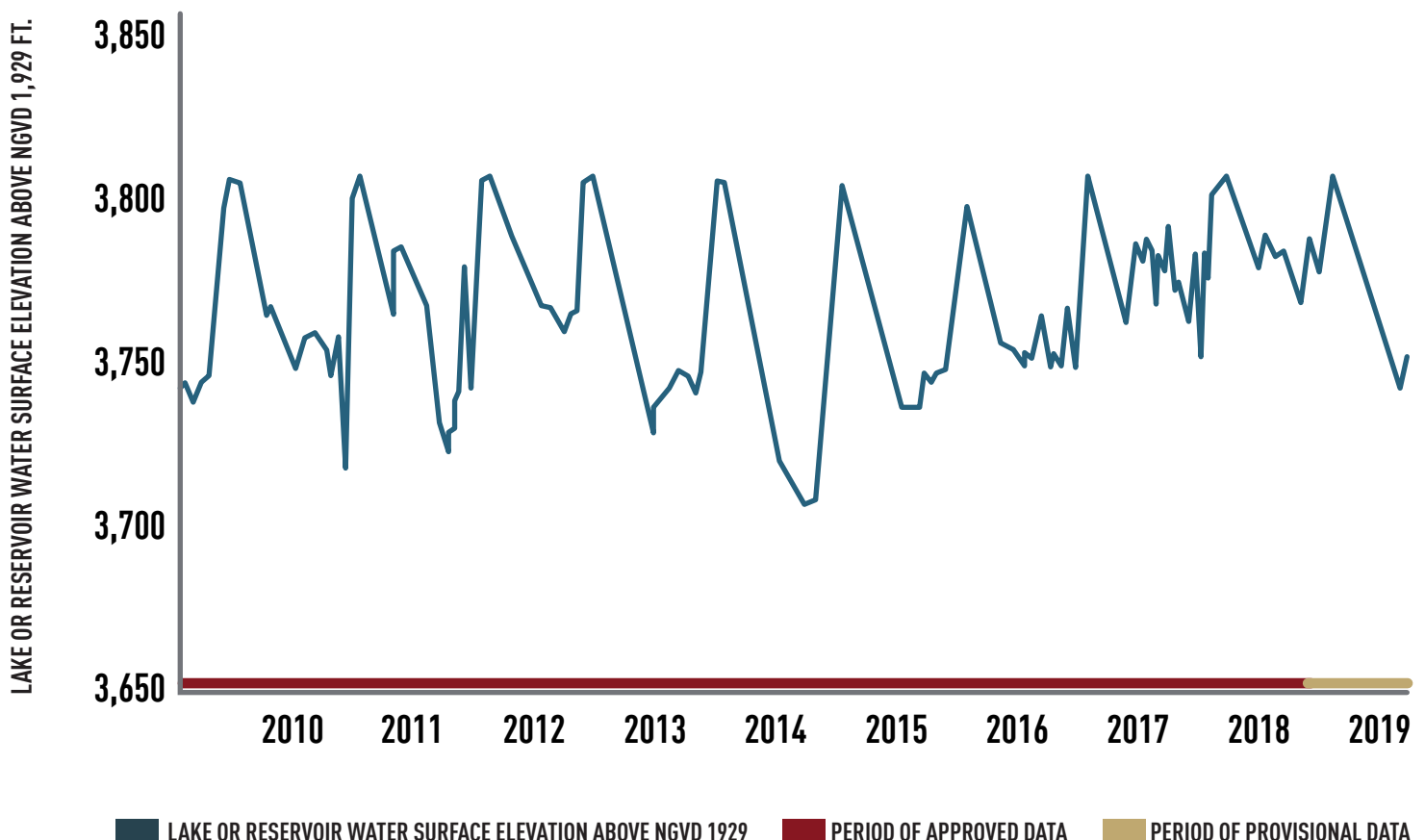
Currently, Hetch Hetchy Valley is flooded, serving as a water-storage reservoir for the city of San Francisco, formed by O'Shaughnessy Dam. The dam was completed in 1923. Hetch

FIGURE 1.



View of Hetch Hetchy Reservoir from O'Shaughnessy Dam. (Source: M. Buckley)

FIGURE 2. HETCH HETCHY RESERVOIR WATER SURFACE HEIGHT



Source: United States Geological Survey. 2019. USGS 11275500 HETCH HETCHY RES A HETCH HETCHY CA. National Water Information System.
Retrieved from: http://waterdata.usgs.gov/nwis/uv?site_no=11275500

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Hetchy Reservoir is operated by the San Francisco Public Utilities Commission (SFPUC) primarily for water supply but its releases are also used to generate hydroelectric power downstream. Hetch Hetchy Reservoir has a storage capacity of 360,000 acre-feet, the dam is 312 feet high, and the reservoir surface area is three square miles.² Hetch Hetchy Reservoir is eight miles long.³ Figure 1 provides a current picture of Hetch Hetchy Reservoir as viewed from the top of O'Shaughnessy Dam. The water level in Hetch Hetchy Reservoir fluctuates as a result of its water supply operations. Figure 2 provides a plot of reservoir surface height between 2009 and 2018.

Hetch Hetchy Reservoir and its surrounding areas are currently part of Yosemite National Park, but access is reduced relative to the remainder of the park. While most of Yosemite National Park allows 24-hour access, the gate to access Hetch Hetchy area is open during limited daytime hours only (overnight camping options exist for those accessing the backcountry with wilderness permits). There are currently no overnight options within Hetch Hetchy area, apart from backcountry camping. No swimming or boating on the reservoir is currently

FIGURE 4.



allowed. There are a few trails on the north side of the reservoir which pass by waterfalls and lead to the backcountry.

Prior to the dam, Hetch Hetchy Valley was inhabited by Native Americans for over 6,000 years.⁴ Portions of Yosemite National Park were set aside for protection by the U.S. Congress in a bill signed by Abraham Lincoln on June 30, 1864, and Yosemite National Park, including Hetch Hetchy Valley, was created by Congress on October 1, 1890.⁵ Prior to the dam completion, Hetch Hetchy Valley was characterized by steep glacier-carved cliffs similar to Yosemite Valley, with open grassy meadows (Figure 3).

Yosemite Valley, the next major river valley immediately to the south of Hetch Hetchy Valley, generally seems to be more densely wooded than available images represent for Hetch Hetchy Valley prior to flooding (Figure 4). Yosemite Valley is at 3,868 feet in elevation, while Hetch Hetchy Valley's floor is slightly lower at 3,783 feet.⁶ Hetch Hetchy Valley is approximately 30 miles from Yosemite Valley, 150 miles from Sacramento, and 180 miles from San Francisco by road.

FIGURE 3.



View across Hetch Hetchy Valley, early 1900s prior to damming. (Courtesy of Wikipedia)

² California Department of Water Resources. 2014. *Dams Within the Jurisdiction of California*. Retrieved from <http://www.water.ca.gov/damsafety/docs/Jurisdictional2014.pdf>.

³ National Park Service. 2007. *Hetch Hetchy Site Bulletin*. Retrieved from <http://www.nps.gov/yose/planyourvisit/upload/hetchhetchy-sitebull.pdf>.

⁴ *ibid.*

⁵ Righter, R. W. 2005. *The Battle Over Hetch Hetchy: America's Most Controversial Dam and the Birth of Modern Environmentalism*. Oxford University Press.

⁶ U.S. Geological Survey. 2015. Geographic Names Information System.

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Historical Significance

Efforts to protect Hetch Hetchy Valley have featured prominently at the national scale since the 19th century. John Muir's earliest entreaties to appreciate and protect the area refer to it as the "Tuolumne Yosemite," as the two valleys seemed so similar and equally valuable to him.⁷ Albert Bierstadt of the Hudson River School, the famous painter of the American West, painted multiple scenes from Hetch Hetchy Valley in the late 19th century.



John Muir (Courtesy of Wikipedia. Photo by Francis M. Fritz, 1907.)

John Muir, founder of the Sierra Club, spearheaded the fight to protect Hetch Hetchy Valley. The debate over damming Hetch Hetchy for San Francisco's water supply drew national attention. At least 96 newspapers provided editorials criticizing the plan to dam Hetch Hetchy as inconsistent with the best interest of Americans as a whole, and inconsistent with the intentions of park protections.⁸

Senators received thousands of letters from across the country opposing the dam.⁹ Historian William Cronon, when tracing the origins of the movement to recognize and protect wilderness areas, noted:

"Hetch Hetchy became the battle cry of an emerging movement to preserve wilderness".¹⁰

The damming of Hetch Hetchy also contributed to efforts by Congress to strengthen national park designation with the creation of the National Park Service in 1916.¹¹ Historian Robert Righter argues that John Muir's struggles over Hetch Hetchy were the origin of the movement to protect the environment.

This literature and related events indicate that Hetch Hetchy's connection to the origins of the concept of wilderness scarcity



Looking Down Yosemite Valley. (Courtesy of Wikipedia, Birmingham Museum of Art. Painting by Albert Bierstadt.)

and protection of outstanding natural resources gives it historical significance. Hetch Hetchy is symbolically connected to subsequent struggles elsewhere to protect wilderness and natural resources. David Brower, when negotiating as head of the Sierra Club to protect the Grand Canyon from damming, referenced and related Muir's struggles over Hetch Hetchy.¹² The historical significance of the damming of Hetch Hetchy Valley is relevant both to potential visitors as well as to understanding its importance to people who may or may not ever visit but still maintain strong preferences for its restoration.

Economic Value Categories

Figure 5 summarizes the major categories of economic value for market and non-market goods and services in general.¹³ This concept of total economic value drives the overall framework. The left side of the figure shows use value, which is perhaps the clearest type of economic value. Direct use value describes the value associated with the direct use of a good or service, such as using a stream to spend a day fishing. Indirect use value describes the goods and services that precede direct goods and services, such as the aquatic habitat that nurtures and provides refuge for fish pursued elsewhere.

⁷ Muir, J. 1912. The Yosemite. Chapter 16, Hetch Hetchy Valley.

⁸ The National Committee for the Preservation of the Yosemite National Park. 1913. Comments of the United States Press on the Invasion of the Yosemite National Park, Bulletin no. 2. New York.

⁹ Hanson, J. 2011. The Hetch Hetchy Letters. Center of the American West.

¹⁰ Cronon, W. 1996. The Trouble with Wilderness: or, Getting Back to the Wrong Nature. Environmental History, 7-28.

¹¹ Righter, R. W. 2005. The Battle Over Hetch Hetchy: America's Most Controversial Dam and the Birth of Modern Environmentalism. Oxford University Press.

¹² McPhee, J. 1971. Encounters with the Archdruid. Macmillan.

¹³ U.S. Environmental Protection Agency. 2010. Guidelines for Preparing Economic Analyses. December. <http://yosemite.epa.gov/ee/epa/eed.nsf/pages/guidelines.html>.

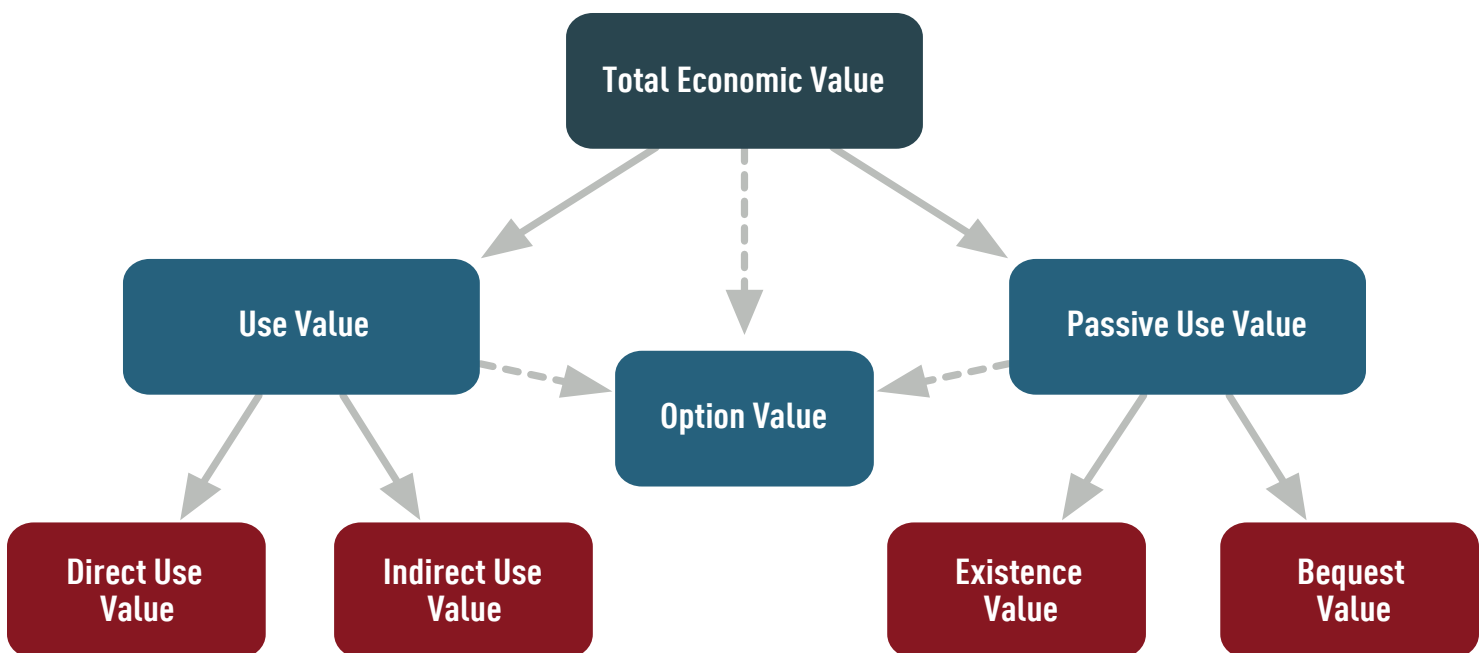
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The right side of the figure shows passive-use value, which represents values that exist when there is no direct or indirect use by the individual experiencing the benefit, such as a preference for the existence of pandas in the wild by someone unlikely to ever see a panda in its habitat.¹⁴ Passive-use values (sometimes called non-use) are less obvious than use values but (in some instances) can represent a greater total value because they incorporate demands and benefits from a potentially much larger population. The figure separates passive-use value into two categories. One, existence value, comes from people's desire for the continued existence of some effect such as survival of a species, landscape, or some other aspect of an ecosystem — or of the ecosystem as a whole — without any contact or use of the good or service.¹⁵ The other, bequest value, arises because people want to ensure that the ecosystem will be available for service and enjoyment by future generations.¹⁶ Typically, these passive-use values are described in terms of an individual's willingness to pay for an object's current or future existence.

The middle of the figure shows another component of the total value, known as option value.¹⁷ Option value refers to the benefit of maintaining an opportunity to derive services from a resource in the future. It can originate from either side of the figure. Market prices sometimes provide information that is useful for quantifying option values, but typically do not do so for non-market goods and services such as public goods.

Passive-use values can come in several forms. There are many ways that people can experience passive-use benefits, including moral and altruistic behavior, vicarious uses, stewardship, intergenerational responsibilities, and even intrinsic values, independent of human welfare, of certain things like the welfare of sentient wildlife.¹⁸ Relatedly, resources can be important even when they are not necessarily going to be used, because of uncertainty about the future and irreversibility of some environmental degradation.¹⁹

FIGURE 5. TOTAL ECONOMIC VALUE



(Source: ECONorthwest.)

¹⁴ U.S. Environmental Protection Agency. 2010. Guidelines for Preparing Economic Analyses. December. <http://yosemite.epa.gov/ee/epa/eed.nsf/pages/guidelines.html>.

¹⁵ Ibid.

¹⁶ Ibid.

¹⁷ National Research Council. 2009. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. National Academies Press. Washington, D.C.

¹⁸ Turner, R.K. 2000. *The place of economic values in environmental valuation*. In: Bateman, I.J., Willis, K.G. (Eds.), *Valuing Environmental Preferences*. Oxford University Press, Oxford, pp. 19–41.

¹⁹ Arrow, Kenneth J., and Fisher, Anthony C. 1974. *Environmental Preservation, Uncertainty, and Irreversibility*, *Quarterly Journal of Economics*, 88 (May): 312–319.

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Overview of Methods

Benefits Transfer

The primary economic methodology for the analysis of values for a restored Hetch Hetchy Valley in this study is benefits transfer. Benefits transfer involves using information from studies of values elsewhere and, upon review, calibration and alignment of effects, applying those benefits to the target case. Because Hetch Hetchy Valley is not available, actual observation and measurement of use or appreciation is not possible. Furthermore, for passive use values as described below, direct stated preference techniques are the only available technique. While it is possible to develop stated-preference based value estimates prior to the availability of a resource and associated benefit, these efforts typically require intensive survey techniques, conducted with input from public agencies and stakeholders, and are beyond the scope of this study. A nationwide stated preference study typically would cost several hundred thousand dollars.²⁰



(Courtesy of Unsplash. Photo by Cam DiCecca.)

The U.S. Environmental Protection Agency, in its *Guidelines for Preparing Economic Analyses* provides a useful discussion of how to conduct benefit transfer studies:

Benefit transfer refers to the use of estimated non-market values of environmental quality changes from one study in the evaluation of a different policy that is of interest to the analyst. The case under consideration for a new policy is referred to as the — policy case. Cases from which estimates are obtained are referred to as — study cases. A benefit transfer study identifies stated or revealed preference study cases that sufficiently relate to the policy context and transfers their results to the policy case.

Benefit transfer is necessary when it is infeasible to conduct an original study focused directly on the policy case. Original studies are time consuming and expensive; benefit transfer can reduce both the time and financial resources required to develop estimates of a proposed policy's benefits. While benefit transfer should only be used as a last resort and a clear justification for using this approach over conducting original valuation studies should be provided, the reality is that benefit transfer is one of the most common approaches for completing a benefit-cost analysis at EPA.²¹

Fundamentally the analyses in this study rely upon calculation of revealed and stated preferences and associated economic value from other cases. Benefit transfer is a common economic technique and often the only feasible approach. Furthermore, extensive assessment of the actual demand and supply characteristics facing the case at hand allows careful and appropriate transfer of value of results from elsewhere. The U.S. EPA's economic guidelines specify that benefit transfer analyses include 1) description of the policy case, 2) selection of relevant study cases, and 3) transfer of values, typically at an appropriate unit value scale, such as user day or household. The beneficiary population, mechanism of value capture (e.g. recreation activity), and quality of the experience should be appropriately scaled for differences between the study cases and the policy case context.

²⁰ Survey techniques can be used to estimate visitation-based use values as well, but similarly require a valid survey of the population of potential visitors, requiring a similarly expensive national or even international survey.

²¹ U.S. Environmental Protection Agency. 2010. Guidelines for Preparing Economic Analyses. December. <http://yosemite.epa.gov/ee/epa/eed.nsf/pages/guidelines.html>.

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Recreation and Tourism Use Value

A restored Hetch Hetchy Valley would provide extensive opportunities for outdoor recreation. Recreationists often derive economic benefits from outdoor recreational activities that exceed what they pay to participate. This net economic benefit (benefits minus costs), which economists call consumer surplus, represents a real increase in recreationists' economic well-being.

Typically, the value of recreation is represented in two ways: (1) through revealed preferences by tracking recreation-related expenditures, and (2) through stated preferences by asking individuals how much in total they would be willing to pay to participate in a specific activity (e.g., a day spent fishing). The existing literature commonly uses dollars per recreation user-day to describe these values. A recreation user-day represents one individual participating in a specific type of recreation activity for the typical activity length during one day.

Many factors — especially the ease of access, congestion, quality, and quantity — influence the value individuals derive from outdoor recreation. A hiker, for example, may derive more benefit if she spends a day in relative solitude on a lengthy, undisrupted trail than on a short and crowded trail. Yosemite is notoriously crowded and is itself a scarce resource,²² and restoring Hetch Hetchy Valley would increase access and availability for some recreational opportunities, decrease congestion on others, and otherwise increase the quality and quantities of recreational opportunities, so more users would take advantage of the opportunities and those who do would derive more enjoyment from them. Decreased congestion means that other areas would experience improved recreation experiences as well. Increased availability can also increase overall demand for all opportunities in a region, as it becomes a worthwhile travel destination for more people, over an increased total area.

This analysis uses information regarding detailed recreational use data for Yosemite National Park, combined with consideration of the specific characteristics of a restored Hetch Hetchy Valley, to estimate likely types and levels of use. Upon



Parts of Yosemite Valley can be crowded, especially in summer, but it still possible to find relative solitude. The same would be true in a restored Hetch Hetchy Valley. (Courtesy of Unsplash. Photo by Jordan Pulmano.)

identifying and quantifying types and levels of use, federal agency data are available to estimate typical expenditures by activity-type, and corresponding net benefits to users after these expenditures. The appropriate net benefits beyond costs are consumer surplus.

Existence/Passive-use Value

For some iconic, unique and remarkable natural resources — such as rivers, mountains, forests, and wildlife populations — people experience benefits simply from the knowledge that the resource exists in some desirable condition. These passive-use values can be particularly challenging to calculate, but they can also be the largest share of the total economic value for a natural resource that is not primarily appreciated through consumption. Passive-use value also can include option value, which represents the benefit of having the option to use a resource even if that option is never exercised, and bequest value, which represents the benefit of the resource's availability for future generations.

²² The topic of congestion and associated effects on visitor experience and the natural environment is addressed in depth in the Yosemite Valley Plan (National Park Service. 2000. *Final Yosemite Valley Plan: Supplemental Environmental Impact Statement*. Retrieved from: <http://www.nps.gov/yose/learn/management/upload/yvp.pdf>) and the Tuolumne River Plan/DEIS (National Park Service. 2014. *Tuolumne Wild and Scenic River Final Comprehensive Management Plan and Environmental Impact Statement*. Executive Summary. Retrieved from http://www.nps.gov/yose/getinvolved/trp_feis.htm).

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The Office of Management and Budget provides guidance to Federal agencies on development of regulatory analyses via Circular A-4.²³ Circular A-4 recognizes that proposed regulations require analysis to understand the consequences. As initial overall guidance, it states:

*Benefit-cost analysis is a primary tool used for regulatory analysis. Where all benefits and costs can be quantified and expressed in monetary units, benefit-cost analysis provides decision makers with a clear indication of the most efficient alternative, that is, the alternative that generates the largest net benefits to society (ignoring distributional effects). This is useful information for decision makers and the public to receive, even when economic efficiency is not the only or the overriding public policy objective.*²⁴

This overall guidance indicates that all benefits and costs should be considered, and it recognizes that for a balanced trade-off analysis, a common metric, dollars, is most appropriate:

*When important benefits and costs cannot be expressed in monetary units, BCA is less useful, and it can even be misleading, because the calculation of net benefits in such cases does not provide a full evaluation of all relevant benefits and costs.*²⁵



(Courtesy of Unsplash. Photo by Julian Bialowas.)

Circular A-4 recognizes that benefit-cost analysis can lead to incorrect decisions if it does not include a complete valuation of all benefits and costs.

U.S. EPA provides guidance for conducting economic analysis via *Guidelines for Preparing Economic Analyses*.²⁶ It directly references Circular A-4, and reiterates the importance of capturing all benefits and costs, including passive-use values:

Non-use value is the value that individuals may attach to the mere knowledge of the existence of a good or resource, as opposed to enjoying its direct use. It can be motivated for a variety of reasons, including bequest values for future generations, existence values and values of paternalistic altruism for others' enjoyment of the resource.

Passive-use values often must be monetized

Circular A-4 recognizes that benefit-cost analysis can lead to incorrect decisions if it does not include a complete valuation of all benefits and costs:

*When important benefits and costs cannot be expressed in monetary units, BCA is less useful, and it can even be misleading, because the calculation of net benefits in such cases does not provide a full evaluation of all relevant benefits and costs. ... You should monetize quantitative estimates whenever possible.*²⁷

OMB and EPA understand that they must account for the full bundle of benefits and costs associated with a policy decision. Public goods must be of particular focus because they are not valued by other means. Government must recognize values of public goods because protection and provision of these goods is a fundamental purpose. Tracing back to Adam Smith's *Wealth of Nations*, the original tenet of free-market capitalism, Smith gives only three purposes for government, the third being this protection and provision of public goods:

According to the system of natural liberty, the sovereign has only three duties to attend to; three duties of

²³ Office of Management and Budget. 2003. Circular A-4. http://www.whitehouse.gov/omb/circulars_a004_a-4.

²⁴ OMB Circular A-4.

²⁵ OMB Circular A-4.

²⁶ U.S. Environmental Protection Agency. 2010. *Guidelines for Preparing Economic Analyses*. December. <http://yosemite.epa.gov/ee/epa/eed.nsf/pages/guidelines.html>.

²⁷ OMB Circular A-4

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great importance, indeed, but plain and intelligible to common understandings: first, the duty of protecting the society from the violence and invasion of other independent societies; secondly, the duty of protecting, as far as possible, every member of the society from the injustice or oppression of every other member of it, or the duty of establishing an exact administration of justice; and, thirdly, the duty of erecting and maintaining certain public works and certain public institutions, which it can never be for the interest of any individual, or small number of individuals, to erect and maintain; because the profit could never repay the experience to any individual, or small number of individuals, though it may frequently do much more than repay it to a great society.²⁸

Stated preference surveys are a necessary and reliable tool for evaluating benefits and costs

Economists employ stated preference techniques because they are the only means to capture passive-use values. The need for an approach for such a challenging but important set of values means that stated preference techniques have been used, tested, and scrutinized for decades by all manner of experts.

OMB states:

Stated Preference Methods (SPM) have been developed and used in the peer-reviewed literature to estimate both “use” and “non-use” values of goods and services. They have also been widely used in regulatory analyses by Federal agencies, in part, because these methods can be creatively employed to address a wide variety of goods and services that are not easy to study through revealed preference methods ... A stated-preference study may be the only way to obtain quantitative information about non-use values ...²⁹

Similarly, EPA states:

Furthermore, if a significant portion of the benefits for ecological changes are thought to consist of non-use values rather than use values, analysts may need to rely more heavily on stated preference methods when estimating ecological benefits.³⁰

Revealed preference methods cannot capture non-use values, such as those associated with the existence of biological diversity. This is because it is not possible to use data on market transactions or any other observed choices to estimate the value of goods that leave no behavioral trail in their enjoyment; in such cases only stated preference methods can provide estimates of willingness to pay or accept (Freeman 2003). More generally, stated preference methods may be employed when researchers want to identify the widest possible spectrum of values, both use and non-use (e.g., Loomis et al. 2000).³¹

The distinguishing feature of stated preference (SP) methods compared to revealed preference (RP) methods is that SP methods rely on data drawn from people’s responses to hypothetical questions while RP methods rely on observations of actual choices. SP methods use surveys that ask respondents to consider one or a series of hypothetical scenarios that describe a potential change in a non-market good. The advantages of SP methods include their ability to estimate non-use values and to incorporate hypothetical scenarios that closely correspond to a policy case.³²

Stated preference studies originally were primarily based on contingent valuation (CV), which involves eliciting a willingness-to-pay for some hypothetical outcome. Ciriacy-Wantrup in 1947 originally proposed the contingent valuation method to measure the benefits of soil erosion prevention.³³ Ciriacy-Wantrup asks if the prevention generates some extra

²⁸ Smith, A. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Ed. R. H. Campbell and A. S. Skinner. 2 vols. Glasgow Edition of the Works and Correspondence of Adam Smith 2. Oxford U. Press, 1976.

²⁹ OMB Circular A-4.

³⁰ USEPA. Guidelines for Preparing Economic Analyses.

³¹ USEPA. Guidelines for Preparing Economic Analyses; Freeman, A.M., III. 2003; *The Measurement of Environmental and Resource Values: Theory and Methods*. 2d Edition. Washington, DC: Resources for the Future; Loomis, J., P. Kent, L. Strange, K. Fausch, and A. Covich.. 2000. Measuring the Total Economic Value of Restoring Ecosystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. *Ecological Economics* 33: 103-117.

³² USEPA. Guidelines for Preparing Economic Analyses.

³³ Ciriacy-Wantrup, S.V. 1947. “Capital Returns from Soil-Conservation Practices.” *Journal of Farm Economics* 29(4): 1181-1196.

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market benefits that are public goods in nature and proposes to estimate these benefits by eliciting the individuals' willingness to pay through a survey method.³⁴ However, Davis (1963) was the first to use the CV empirically when he used questionnaires to estimate the benefits of outdoor recreation in a Maine backwoods area.³⁵ Following his work, Ridker (1967) used CV in studies of air pollution benefits.³⁶

In 1979 the Water Resources Council, in its Principles and Standards for Water and Related Land Resources Planning in the Federal Register, recommended CV as a preferred method for valuing recreation benefits.³⁷

In general, the more direct trade-offs associated with choice experiments have made them particularly attractive in recent years. Choice experiments (or choice modeling) involve providing respondents various sets of goods and services with varying attributes, and allowing them to show their preferences. Differences in the sets allow estimation of values.³⁸

Passive, or non-use values are relevant to trade-offs involving scarce resources, and influence decisions and behaviors. These values are a catch-all for forms of benefits that don't involve direct consumption or use of a resource. They can take many forms. People make contributions to families and animals experiencing misfortune they will never meet, even in countries they will never visit, such as through the Red Cross. It is important to many people to know that elephants, gorillas, and tigers still wander the wild, even if unseen. U.S. citizens donate money to causes that don't affect them directly, pay higher prices for purchases that support social and environmental goals in distant places, and vote for politicians and policies that are costly and do not provide direct benefits to themselves. Not every passive-use value though provides opportunities to express and provide support by individuals. This is the fundamental market failure facing public goods and common property.



Wapama Falls (Courtesy of Wikipedia.)

There are many ways we have familiarity with passive-use values in our daily lives. We feel responsible for stewardship of others and important resources, we experience a warm glow from moral, ethical, altruistic actions, and we appreciate vicarious use value from the welfare of others. Passive-use values, while varying from person to person, are a fundamental component of our value systems.³⁹

The very non-consumptive nature of passive-use values dictates that there is no limit on the number of people that can experience them. Consequently, in matters where passive-use values are significant, through sheer numbers they can strongly outweigh opportunities for direct use values. When we think of passive-use values we typically first think of existence values, the importance of knowing that something exists in some particular condition, but it can also include benefits that are related to use values. Option value refers to the importance of maintaining an option, a use or non-use opportunity. While it's a familiar tool in stock markets, it's also relevant to our decisions to save for the future, invest in insurance, use preventative healthcare, or pack a raincoat even if the sky is blue. Similarly, bequest value represents the importance of maintaining resources and options for future

³⁴ Portney, P. R. 1994. The contingent valuation debate: why economists should care. *The Journal of Economic Perspectives*, 8(4), 3-17.

³⁵ Davis, R.K. 1963. *The Value of Outdoor Recreation: An Economic study of the Maine Woods* PhD dissertation, Harvard University.

³⁶ Ridker, Ronald G., and Henning, John A., 1967. The Determinants of Residential Property Values with Special Reference to Air Pollution. *The Review of Economics and Statistics*, 49(2):246-57.

³⁷ Alberini, A., & Kahn, J. R. (Eds.). 2009. *Handbook on contingent valuation*. Edward Elgar Publishing.

³⁸ Hanley, N., Mourato, S., & Wright, R. E. 2001. Choice Modelling Approaches: A Superior Alternative for Environmental Valuation?. *Journal of economic surveys*, 15(3), 435-462.

³⁹ Carson, R.T., N.E. Flores and R.C. Mitchell. 1999. "The Theory and Measurement of Passive Use Value," in *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the USA, EC, and Developing Countries*, edited by I.J. Bateman and K.G. Willis. New York: Oxford University Press.

FRAMEWORK AND METHODS

generations; people that don't even exist yet and concerns they might have.⁴⁰

Economic analysis is concerned with understanding trade-offs for scarce resources. Therefore, trade-offs must be in common metrics so as to make apples-to-apples comparisons. If all benefits and costs for a specific policy question are evaluated qualitatively, or even quantitatively but non-monetarily, such as acres of wetlands or number of salmon, monetary valuation might not be necessary. But when non-market, passive-use benefits are compared to financial expenditures, passive-use values must be monetized. Particularly for complex scientific phenomena, and large numbers such as benefits spread across a large and diverse community, qualitative descriptions alone can be too vague or obtuse to provide a real and balanced point of comparison to large financial costs. Both OMB and EPA guidance recognize this challenge, and recommend all available qualitative and quantitative information be made available for assessment when non-market values are at stake. EPA states in its Guidelines:

Estimating benefits in monetary terms allows the comparison of different types of benefits in the same units, and it allows the calculation of net benefits — the sum of all monetized benefits minus the sum of all monetized costs — so that proposed policy changes can be compared to each other and to the baseline scenario.



(Courtesy of Unsplash. Photo by Nick Jio.)

A consequence of recognizing the importance of passive-use values is accepting the challenge of identifying, verifying, and valuing them. While we see behaviors and expenditures that hint at their existence, such as donations, voting patterns, and environmentally and socially responsible purchases, it can be difficult to isolate the importance of particular resources or estimate the comprehensive set of passive-use values to an entire population. Economists agree that stated preference techniques are the only available tool for fully capturing value estimates for passive-use values. The EPA states in their Guidelines:

“Revealed preference methods cannot capture non-use values, such as those associated with the existence of biological diversity ... stated preference methods may be employed when researchers want to identify the widest possible spectrum of values, both use and non-use.”

OMB dedicates a full section of its guidelines on regulatory analysis (Circular A-4) to important considerations when designing stated preference techniques. These both demonstrate that while stated preference techniques must be implemented carefully to generate valid results, they are crucial and necessary to the general objective of considering all benefits and costs.

This necessary importance of stated preference techniques has instigated intensive research and review both among academics and government officials. This repeated evaluation and critique has generated a strong body of guidance on when and how to appropriately conduct stated preference valuation studies, and how to interpret their results. A key peer review of stated preference techniques arose in 1993 out of the Exxon Valdez oil spill. A panel of some of the most prominent economists, including two economic Nobel laureates, reviewed contingent valuation (a specific type of stated preference), established that the methodology is robust, and outlined criteria for proper use. Since this review, researchers have continuously refined methods for implementing stated preference techniques so as to systematically remove sources of bias and error.⁴¹

⁴⁰ National Research Council. 2009. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. National Academies Press. Washington, D.C.

⁴¹ Loomis, J. (2011), What's To Know About Hypothetical Bias In Stated Preference Valuation Studies?. *Journal of Economic Surveys*, 25: 363–370.

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Stated preference techniques have come to be used widely for consideration of both use and passive-use values.⁴² For many important natural resource questions, stated preference techniques are the only means to provide a complete picture.

At their core, governmental regulations are necessary when unregulated activity, typically via markets and private sector behavior, have generated outcomes that are suboptimal to society. This fundamental role for government, to protect and provide public goods and common resources when markets fail to do so, traces back to Adam Smith and the first discussions of capitalism in his *Wealth of Nations*. A regulatory context driven by the potential for market failure cannot by definition be evaluated via only market-based revealed expenditures.



(Courtesy of Unsplash. Photo by Patrick Robert Doyle.)

Other Potential Benefits

Existing research on Hetch Hetchy as well as observation of activity at Yosemite National Park suggest other categories of benefits would likely accrue with restoration. In the National Park Service's Final Tuolumne River Plan/EIS they identify the river corridor's benefits in the park to be:

- Biological Values
- Geologic Values
- Cultural Values
- Scenic Values
- Recreational Values⁴³

This analysis addresses recreational values explicitly, and recreational value data for Yosemite National Park are closely related to scenic and potentially cultural values. It is uncertain to what extent existence value analyses address the remaining values. A well-crafted stated preference study could attempt to elicit values associated with appreciation for restoration, protection, and maintenance of biological and geological processes, as well as cultural values. The iconic and historic role that Hetch Hetchy Valley has played in the history of the West, the National Park system, and environmental movements likely heightens these values for some people. It is difficult to separate scenic values from recreational values, although the two often reinforce each other. Similarly, the non-consumptive appreciation for natural and historical characteristics of a restored Hetch Hetchy Valley would be difficult to separate from other passive-use values.

Interviews with former Yosemite National Park superintendents and a regional director suggest that the cultural values, including Native American resources, could be substantial. They also suggested strong interest from a scientific perspective in the restoration process and research opportunities it would provide.

⁴² National Research Council. 2009. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. National Academies Press. Washington, D.C.

⁴³ National Park Service. 2014. *Tuolumne Wild and Scenic River Final Comprehensive Management Plan and Environmental Impact Statement*. Executive Summary. Retrieved from http://www.nps.gov/yose/getinvolved/trp_feis.htm.

RECREATIONAL VALUE OF A RESTORED HETCH HETCHY VALLEY

The restoration of Hetch Hetchy Valley would fundamentally alter the characteristics of the area as a recreational resource, with a number of expected outcomes:

- An increase in the types, quantity, and quality of outdoor recreation opportunities.
- An increase in the number of recreational visitors to the site, relative to current conditions.
- A change in the mix of recreational uses occurring at the site, with associated changes in the total value of recreation.

Other potential effects include:

- Changes in the number of visitors visiting the park as a whole.
- Changes in visitation to other parts of the park.
- Changes in the quality of recreational experiences in other parts of the park.

Interviews with former superintendents of Yosemite National Park as well as a former director of the region for the Park Service all suggested that a restored Hetch Hetchy Valley would generally be welcomed by the Park Service as a new management responsibility, and that it would be managed to highlight its natural characteristics.⁴⁴ This would result in less overall development in terms of concessions and built infrastructure. Such a decision though, in light of the high demand for and use of Yosemite Valley and the park overall, suggests a determination that it would be more valuable in a less-intensive use than Yosemite Valley.

This analysis does not specify a particular management and development plan for a restored Hetch Hetchy Valley. This analysis assumes similar usage to current park management for similar areas. If the Park Service determines that its management priorities would emphasize less intensive use



(Courtesy of Unsplash. Photo by Greysen Johnson.)

and less development than currently occurs in the Yosemite Valley, the pattern of economic value derived from recreation in a restored Hetch Hetchy Valley would look different in several ways:

- Recreation participants likely would spend less on developed recreation fees and services, and retain more value as consumer surplus.
- Without similar levels of developed infrastructure, Hetch Hetchy Valley would support fewer overall trips.
- Retaining the landscape in a less-developed state would enhance passive use values by preserving the natural character and ecosystems.

Existing Hetch Hetchy Visitation and Projections

It is difficult to accurately predict visitation levels for any given recreational resource, even for recreational resources with abundant data. Participation in outdoor recreation is influenced by a wide variety of social, lifestyle, and demographic factors.⁴⁵ Actual visitation levels will fluctuate in accordance with short-term trends, such as economic recessions and changes in travel costs, and longer-term

⁴⁴ Personal communication with former Yosemite National Park Superintendents Bob Binnewies (December 11, 2014) and BJ Griffin (December 12, 2014) and former Pacific West Regional Director for the National Park Service (December 15, 2014).

⁴⁵ Cordell, H.K. 2012. Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station; Bowker et al. 2012. Outdoor recreation participation in the United States: projections to 2060: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-GTR-160. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

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trends, such as population and demographic changes, and shifts in tastes and preferences.

Currently, hiking and fishing are permitted within Hetch Hetchy area. No boating or swimming is allowed, time-of-day access is restricted (depending on time of year), and limited parking is available in select roadside areas. When parking capacity is reached, visitors must wait at the entrance station until a vehicle leaves. An average of 44,181 visitors (recreational and non-recreational) come to Hetch Hetchy every year.⁴⁶ Visitor use at Hetch Hetchy typically starts to pick up in March, peaks in May and early June, and starts to decline in November. Monthly visitor numbers often drop into the hundreds between December and February. There is currently no public transportation available to reach the Hetch Hetchy area.

Estimating the potential recreational value of a unique, iconic resource that does not currently “exist” or have any existing recreation measurement presents an even greater analytical challenge. Despite the considerable amount of research that has been conducted on the potential effects of restoring Hetch Hetchy Valley, only one study has estimated potential recreational usage.⁴⁷ The study, prepared by the California State Assembly Office of Research in 1988, provides a range

of estimates based on potential development scenarios and associated visitor capacity:

- **Low Development Scenario:** Minimal additional visitor facilities would be built. Public transportation and/or new parking would be added. Camping in adjacent areas would be allowed.
- **Medium Development Scenario:** improvements to transportation infrastructure alone (road improvements, shuttle services, and additional parking capacity).
- **High Development Scenario:** major overnight facilities (built in nearby Poopenaut Valley or along the access road) and transportation into the valley.

Improved information regarding patterns of recreational visitation within Yosemite Park has made more precise estimation approaches possible.

Estimating Visits to Hetch Hetchy Valley

A common approach to predicting recreational use and visitation of a proposed recreation site is to identify existing areas or sites that have similar characteristics.⁴⁸ Despite the fact that Hetch Hetchy Valley is unique in many respects, reasonable analogs — in terms of the natural features present,

TABLE 1. PREVIOUS ESTIMATES OF RECREATIONAL USE AT A RESTORED HETCH HETCHY VALLEY

VISITATION METRIC	LOW DEVELOPMENT SCENARIO	MEDIUM DEVELOPMENT SCENARIO	HIGH DEVELOPMENT SCENARIO
Visitor Days	400,000	600,000	1,000,000
Average Daily Visitor Days	1,100	1,650	2,700
Visitors	244,620	366,930	611,550

Source: Visitors day estimates from Assembly Office of Research, 1988.
Note: Visitors were calculated using the average number of 1.64 visitor days per visitor, from NPS annual statistics.

⁴⁶ National Park Service. 2013. Tuolumne Wild and Scenic River Draft Comprehensive Management Plan and Environmental Impact Statement — Volume 2. http://home.nps.gov/yose/learn/management/upload/TRP-DEIS_Volume_2-January2013.pdf

⁴⁷ Assembly Office of Research. 1988. *Restoring Hetch Hetchy*. California State Legislature, State Capitol: Sacramento, California 95814.

⁴⁸ The accuracy of demand estimates for Hetch Hetchy Valley depend on similarities with the study sites chosen (in this case, Yosemite Valley and the park as a whole). To estimate the number of occasions of an activity (typically measured as visitors, trips or days), relevant parameters that should be similar include, prices paid by users (travel costs including direct variable costs and travel time costs), characteristics of a site (such as parking and overnight facilities), socioeconomic characteristics of the user population, and the pool of substitute sites. Rosenberger, Randall S.; Loomis, John B. 2001. *Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan (2000 revision)*. Gen. Tech. Rep. RMRS-GTR-72. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station

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geographic area, and likely visitor population — exist nearby, in other areas of the park. Visitation experiences to Hetch Hetchy Valley would be similar enough to existing activities and experiences that current data should be sufficient to characterize the range of activity and experience. Yosemite Valley, in particular — based on physical features and potential level of public recognition and awareness — and Yosemite National Park as a whole (especially in terms of its user population), are appropriate study areas.

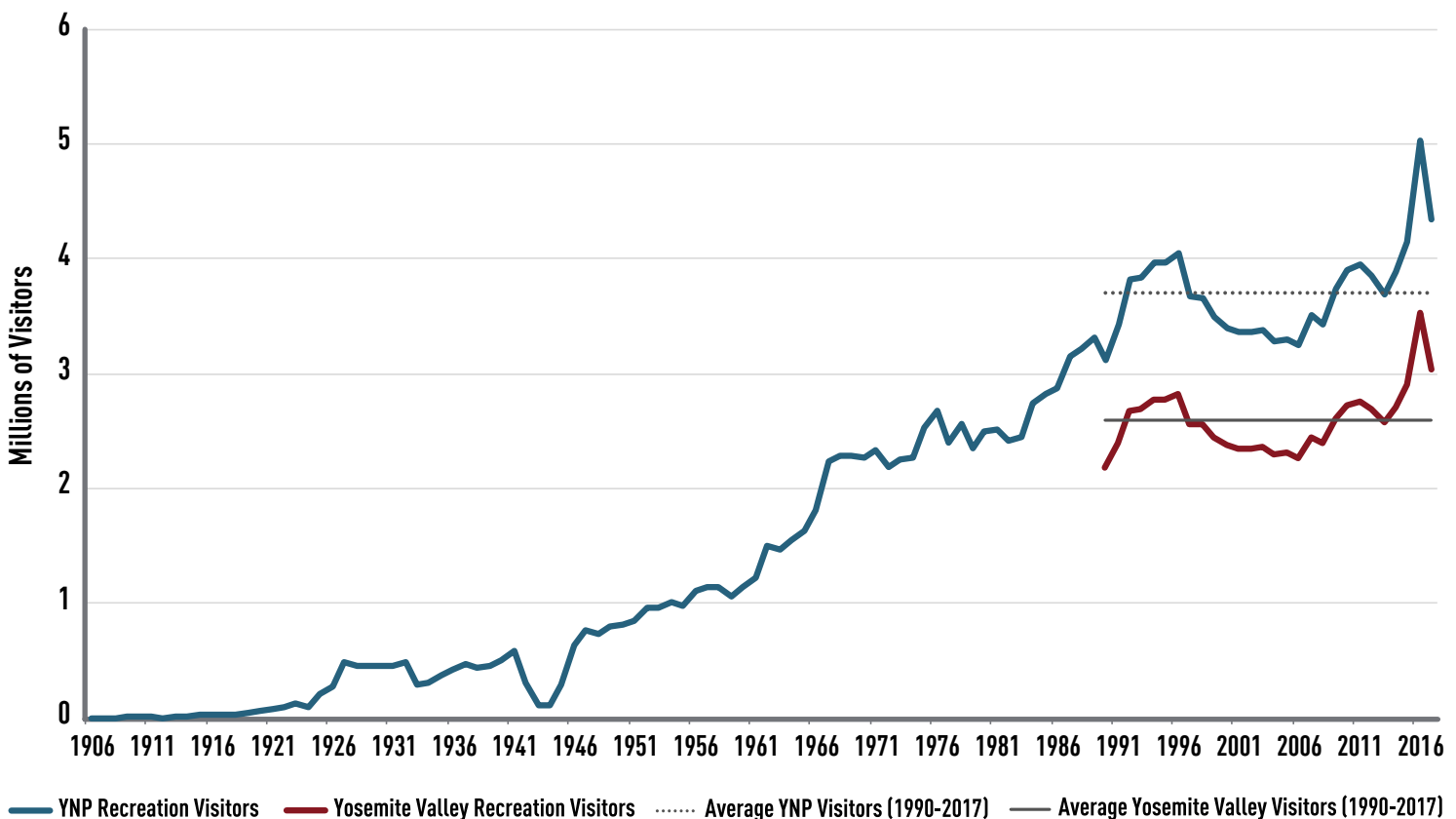
This analysis does not assume that restoration would result in construction of roads, buildings, or other infrastructure within the Hetch Hetchy Valley. Rather, it assumes only that

facilities in the area would be developed to accommodate restoration and that the National Park Service would develop a management plan with public input.

This analysis relies upon data produced by Yosemite NP Visitor Services Project (VSP) surveys, economic impact estimates published by the National Park Service, and National Park Service Public Use Statistics.⁴⁹

The Park Service publishes annual visit estimates for the park as a whole (Figure 6), but does not routinely collect or report information about the number of people visiting specific areas or sites within the park.

FIGURE 6. ANNUAL VISITS TO YOSEMITE NATIONAL PARK (1906 TO 2017) AND ESTIMATED VISITS TO YOSEMITE VALLEY (1990 TO 2017)



Source: ECONorthwest with data from the National Park Service 2019.

Note: Yosemite Valley visitation estimation as described in the text. Note complete 2018 visitation data were not available as of this writing.

⁴⁹ Le, Y., E. Papadogiannaki, N. Holmes, and S.J. Hollenhorst. 2008. *Yosemite National Park Visitor Study, Winter 2008*. Visitor Services Project Report #198. Moscow, ID: National Park Service and University of Idaho, Cooperative Park Studies Unit.; Blotkamp, A., B. Meldrum, W. Morse, and S.J. Hollenhorst. 2010. *Yosemite National Park Visitor Study, Summer 2009*. Visitor Services Project Report #215. Moscow, ID: National Park Service and University of Idaho, Cooperative Park Studies Unit.; Cook, P. S. 2011. "Impacts of visitor spending on the local economy: Yosemite National Park, 2009." Natural Resource Report NPS; National Park Service. 2014. *National Park Service Visitor Use Statistics*. Retrieved from: <https://irma.nps.gov/Stats/>

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According to the VSP surveys, roughly 70 percent of all visitors to Yosemite National Park visit Yosemite Valley (the blue line in the Figure 6).⁵⁰ Yosemite Valley is larger in terms of acreage available for recreation and development of recreation facilities. To put Hetch Hetchy Valley's size in perspective, the California Resources Agency noted that ... Yosemite Valley and Hetch Hetchy Valley are roughly the same length at approximately seven miles long. According to NPS staff, the primary difference is width. The average width of Yosemite Valley is approximately one mile, while the average width of Hetch Hetchy Valley is just over a half-mile. To appropriately account for the difference in size, recreation data must be scaled accordingly:

YOSEMITE VALLEY VISITORS

$$= [\text{AVG. \# OF VISITORS TO YOSEMITE NATIONAL PARK 1990-2018}] \times 70\% \\ = 2,598,000$$

Yosemite Valley is larger in terms of acreage available for recreation and development of recreation facilities. To put Hetch Hetchy Valley's size in perspective, the California Resources Agency noted that:

*... Yosemite Valley and Hetch Hetchy Valley are roughly the same length at approximately seven miles long. According to NPS staff, the primary difference is width. The average width of Yosemite Valley is approximately one mile, while the average width of Hetch Hetchy Valley is just over a half-mile.*⁵¹



This study makes no assumption about vehicle access in a restored Hetch Hetchy Valley. (Courtesy of Unsplash. Photo by Hanson Lu.)

To appropriately account for the difference in size, recreation data must be scaled accordingly:

$$\begin{aligned} &\text{HETCHY HETCHY'S} \\ &\text{ACREAGE COMPARED} \\ &\text{TO YOSEMITE VALLEY'S} \\ &= \frac{\text{HETCHY HETCHY VALLEY FLOOR}}{\text{YOSEMITE VALLEY FLOOR}} \\ &= \frac{\sim 1,100 \text{ ACRES}^{52}}{\sim 2,200 \text{ ACRES}^{53}} \\ &= 0.50 \end{aligned}$$

National Park Service economic impact estimates, reported for Yosemite most recently in 2009, are produced using the Money Generation Model 2 (MGM2).⁵⁴ The MGM2 model divides visitors into segments to account for differences in spending and time spent in the park, across distinct user groups. Seven segments were established for Yosemite National Park visitors based on reported trip characteristics and lodging expenditures:⁵⁵

⁵⁰ Other surveys have indicated that use is higher than 70 percent during parts of the season. According to a comprehensive study conducted by Yosemite Area Regional Transportation System (YARTS) in 1998, for example, 96 percent of all winter visitors to the park visit Yosemite Valley (Ross, Michael. 1998. *YARTS Survey Provides New Insights*. Yosemite Area Regional Transportation Strategy Survey). The Winter 2008 VSP survey did not report Yosemite Valley as a destination, so it is not possible to compare directly to the Summer 2009 survey. For consistency, 70 percent was used across the year, but available information indicates that this is likely a conservative estimate.

⁵¹ California Resources Agency. 2006. Hetch Hetchy Restoration Study. Sacramento, California.

⁵² Hetch Hetchy Valley and reservoir encompass 1,970 acres, in total (Bogdan, Ken, and Cynthia Patton. "Is Restoration of Hetch Hetchy Valley Feasible." *Environs* 12 (1988): 19.). The valley floor itself is roughly 1,100 acres (Committee on the Public Lands of the House of Representatives, *San Francisco and the Hetch Hetchy Reservoir S2575 Hearing*, H. J. Res. 184, Washington Government Printing Office 1908; Cederborg, Mark. Hanford Applied Restoration and Conservation. 2005. Unpublished Data)

⁵³ Yosemite Valley encompasses roughly 3,800 acres, in total (http://en.wikipedia.org/wiki/Yosemite_Valley#cite_note-CHL-2). The 4,000-foot contour in the Valley, coinciding roughly with the foot of the talus slopes, contains 2,200 acres (Heady, Harold F., and Paul J. Zinke. *Vegetational changes in Yosemite Valley*. No. 5. Department of the Interior, 1978.)

⁵⁴ Cook, P. S. 2011. *Impacts of visitor spending on the local economy: Yosemite National Park, 2009*. Natural Resource Report NPS; Stynes, D. J., D.B. Propst, W. Chang, and Y. Sun. 2007. NPS Money Generation Model – Version 2 (MGM2).

⁵⁵ These are park-wide shares (percentage); visitor segment shares likely vary at specific sites within the park.

⁵⁶ National Park Service. 2014. *Tuolumne Wild and Scenic River Final Comprehensive Management Plan and Environmental Impact Statement*. Executive Summary. Retrieved from http://www.nps.gov/yose/getinvolved/trp_feis.htm; National Park Service 2014. *National Park Service Visitor Use Statistics*. Retrieved from: <https://irma.nps.gov/Stats/>; National Park Service. 2000. *Final Yosemite Valley Plan: Supplemental Environmental Impact Statement*. Retrieved from: <http://www.nps.gov/yose/learn/management/upload/yvp.pdf>

RECREATIONAL VALUE OF A RESTORED HETCH HETCHY VALLEY



- **Local:** Visitors from the local region (within 50 miles), not staying overnight inside the park.
- **Day trip:** Visitors from outside the local region (farther than 50 miles from the park), not staying overnight within 50 miles of the park.
- **Motel-in:** Visitors that stay at lodges or cabins inside the park.
- **Camp-in:** Visitors that camp inside the park.
- **Motel-out:** Visitors staying in motels outside the park (within 50 miles of the park).
- **Camp-out:** Visitors that camp outside the park (within 50 miles of the park).
- **Other overnight:** Visitors staying overnight in the area but not reporting any lodging expenses. This segment includes visitors staying with friends or relatives or in other unpaid lodging.

Visit and trip characteristics associated with each of these visitor segments are shown in Table 2.

Recreational use and value are reported for several areas and development scenarios in the following sections:

- **Yosemite Valley:** Existing data used for scaling (i.e., estimates from annual visitation statistics) and estimating potential visits to Hetch Hetchy Valley, across various development scenarios⁵⁶

Hetch Hetchy Valley Development Scenarios

- **Full Day + Full Night:** Hetch Hetchy Valley restored to the level that Yosemite Valley is now, controlling for the fact that Hetch Hetchy Valley is half the size of Yosemite Valley.
- **Full Day + ½ Night:** Hetch Hetchy Valley with day use comparable to Yosemite Valley, but half the overnight capacity, per acre. Note this lodging may be located near to, but not within, Hetch Hetchy Valley.
- **Full Day + No Night:** Hetch Hetchy Valley with day use comparable to Yosemite Valley, per acre, but no overnight capacity (i.e. no camping or lodges).
- **½ Day + ½ Night:** Hetch Hetchy Valley with roughly half the day use and overnight capacity of Yosemite Valley, per acre. Note this lodging may be located near to, but not within, Hetch Hetchy Valley.
- **½ Day + No Night:** Hetch Hetchy Valley with roughly half the day use capacity of Yosemite Valley, per acre, and no overnight capacity (i.e. no camping or lodges).
- **Hetch Hetchy Reservoir (Current):** Hetch Hetchy Valley with primary use as a water storage facility, and minimal recreational visitation.

TABLE 2. SELECTED VISIT/TRIP CHARACTERISTICS BY SEGMENT, 2009

CHARACTERISTIC	LOCAL	DAY TRIP	MOTEL-IN	CAMP-IN	MOTEL-OUT	CAMP-OUT	OTHER OVERNIGHT	ALL VISITORS
Visitor segment share (park entries)	4.0%	24.0%	11.5%	9.5%	36.5%	4.0%	10.5%	100%
Average visitor group size	2.2	3	3.5	3.5	3.1	3.8	2.8	3.2
Length of stay (days or nights)	1	1	2.4	2.8	2.2	3.1	2.5	2.4
Re-entry rate (park entries per trip)	1.1	1.1	1.1	1.3	1.7	1.9	1.4	1.4
Percent primary purpose trips	100%	64%	90%	98%	79%	58%	61%	77%

Source: Cook 2011.

Note: The Hetch Hetchy Reservoir (Current) scenario was estimated based on the fact that the site has no appreciable overnight capacity, and that all visitors (long term average of 44,181 according to the Tuolumne Wild and Scenic River plan) are day visitors. These visitors were allocated to the applicable visitor segments using the relative proportions in Table 1.

RECREATIONAL VALUE OF RESTORED HETCH HETCHY VALLEY

The 2.6 million estimated average annual recreation visits to Yosemite Valley from 1990 to 2018 were allocated to the seven segments using the visit segment shares in Table 2, and applied to the various Hetch Hetchy development scenarios according to the specifications listed above (Table 3).⁵⁷

On a site basis, ‘local’, ‘day trip’, ‘motel-out’, ‘camp-out’, and ‘other overnight’ would be counted as day visitors, because



Yosemite Valley (Courtesy of Unsplash. Photo by Nathan Dumlao.)

they do not spend the night at the site (or the park) itself. ‘Motel-in’ and ‘camp-in’ would be counted as overnight visitors if they stayed overnight in the park. These last two segments were applied in a site context to estimate the effects of facility development. ‘Motel-in’ and ‘camp-in’ were used as proxies for the number of people that would stay near Hetch Hetchy Valley itself, and this number of visitors was reduced in scenarios that involve less development of overnight facilities. Zeros for these two segments should not be taken to mean that visitors to Hetch Hetchy would not stay elsewhere in the park.

The ‘Full Day and Full Night’ scenario — assuming Hetch Hetchy developed at levels similar to Yosemite Valley — scaled down Yosemite Valley visitors by a factor of 0.5 (the proportion based on acreage). The other Hetch Hetchy scenarios are based on reductions to certain visitor segments, relative to this baseline estimate. Figure 7 summarizes the visitation estimates by scenario.

TABLE 3. AVERAGE ANNUAL VISITATION ESTIMATES

METRIC	YOSEMITE VALLEY	HETCH HETCHY VALLEY DEVELOPMENT SCENARIOS					HETCH HETCHY RESERVOIR (CURRENT)
		FULL DAY + FULL NIGHT:	FULL DAY + ½ NIGHT:	FULL DAY + NO NIGHT:	½ DAY + ½ NIGHT:	½ DAY + NO NIGHT:	
TOTAL ANNUAL VISITORS							
Local	103,907	51,953	51,953	51,953	25,977	25,977	2,237
Day Trip	623,439	311,720	311,720	311,720	155,860	155,860	13,422
Motel-out	948,147	474,074	474,074	474,074	237,037	237,037	20,413
Camp-out	103,907	51,953	51,953	51,953	25,977	25,977	2,237
Other Overnight	272,755	136,377	136,377	136,377	68,189	68,189	5,872
Motel-in	298,731	149,366	74,683	0	74,683	0	0
Camp-in	246,778	123,389	61,695	0	61,695	0	0
TOTAL	2,597,663	1,298,832	1,162,454	1,026,077	649,416	513,039	44,181

Source: ECONorthwest with data from National Park Service 1990 to 2018.

Note: The Hetch Hetchy Reservoir (Current) scenario was estimated based on the fact that the site has no appreciable overnight capacity, and that all visitors (long term average of 44,181 according to the Tuolumne Wild and Scenic River plan) are day visitors. These visitors were allocated to the applicable visitor segments using the relative proportions in Table 1.

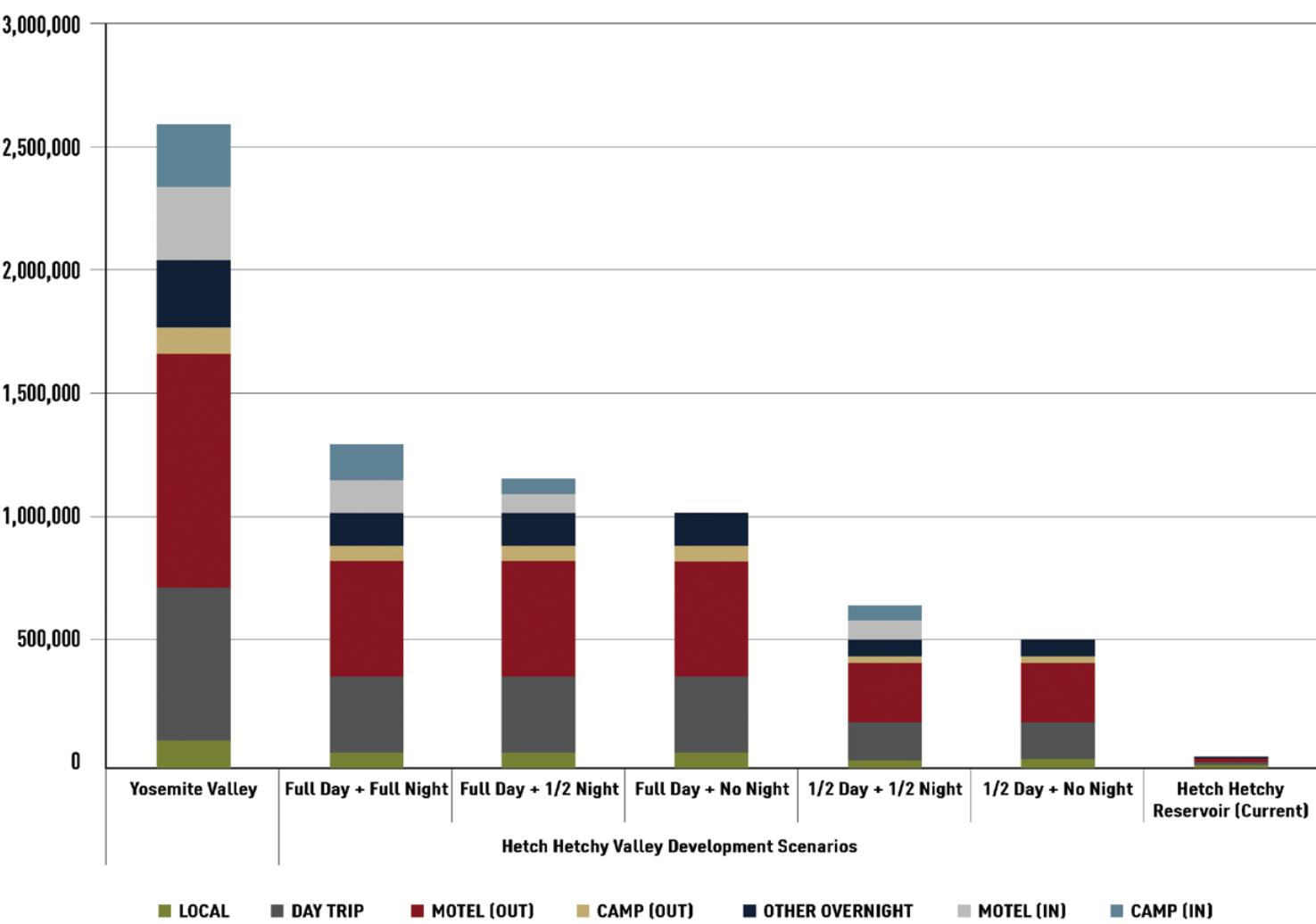
⁵⁷ Visitor use estimates reported in the Yosemite Valley Plan indicate that, during the summer months, day visitors make up roughly 63 percent of all visitors to the Valley, while the remaining 37 percent stay overnight in the Valley itself. The VSP day segments, meanwhile, make up 79 percent of all visitors, while motel-in and camp-in segments make up the remaining 21 percent (Table 2). Use levels for the ‘motel-in’ and ‘camp-in’ segments in Yosemite Valley, shown in Table 3, are therefore lower than actual usage. Applying the VSP segment shares observed at a park-wide scale to Yosemite Valley produces day visitor estimates 20 percent higher than what we’d expect from visitor use statistics reported in the Yosemite Valley Plan, while the number of overnight visitors is roughly 75 percent less. Given that the overnight ‘in’ segments spend more than their respective out of park counterparts (Cook, P. S. 2011. *Impacts of visitor spending on the local economy: Yosemite National Park, 2009*. Natural Resource Report NPS), the method used in this analysis produces a conservative estimate of spending. If Hetch Hetchy were to be developed as Yosemite is now, it would be more appropriate to adjust the day and overnight segments accordingly (which would increase total spending estimates). However, given the lack of existing development scenarios for Hetch Hetchy Valley, park-wide visitation patterns were deemed most appropriate for this analysis. Note December 2018 data were not available as of this writing.

RECREATIONAL VALUE OF RESTORED HETCH HETCHY VALLEY



Yosemite Valley is considered the “Mecca” for rock climbers from around the world. Access to Hetch Hetchy’s cliffs is impractical due to limited visiting hours and paucity of trails. Above: World Champion climber Hans Florine with Jayme Moye and Fiona Thornevell atop Yosemite’s El Capitan. (Photo by Steve Rokks)

FIGURE 7. AVERAGE ANNUAL VISITATION ESTIMATES



Source: ECONorthwest with data from National Park Service 1990 to 2018.
Note: The current Hetch Hetchy scenario was estimated based on the fact that the site has no appreciable overnight capacity, and that all visitors (long term average of 44,181 according to the Tuolumne Wild and Scenic River plan) are day visitors. These visitors were allocated to the applicable visitor segments using relative proportions in Table 1.

RECREATIONAL VALUE OF RESTORED HETCH HETCHY VALLEY

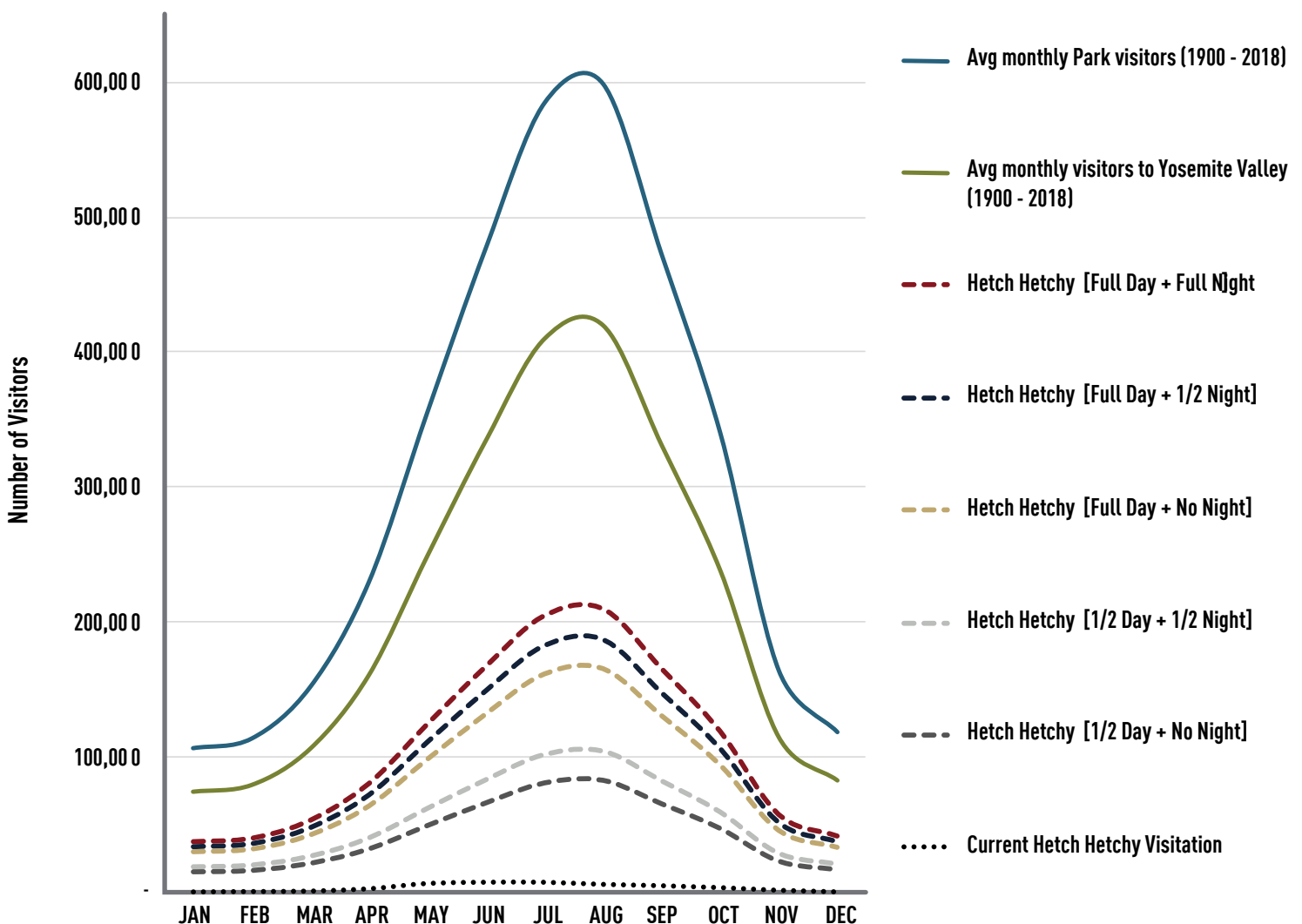
Figure 8 illustrates seasonal patterns and relative magnitudes of use across the various areas and scenarios. At times, Yosemite National Park reaches functional capacity, as congestion leads to long delays and traffic that does not move for extended periods. As another comparison, on average 585,000 people visited Tuolumne Meadows every year between 1990 and 2014 (as indicated by traffic counts at Tioga Pass, and the average of 2.9 people per car used in the Yosemite Valley Plan). Visitation drops to extremely low levels between November and May, coinciding with pass closures. If the site (which is roughly 1,500

acres in size) were at lower elevation and could remain open to use year-round — like Hetch Hetchy and Yosemite Valley — and displayed the seasonal visitation patterns of the park as a whole (Figure 8), then visitation could reach an estimated 1 million people and 1.5 million visitor days per year.

Long-Term Visitation Potential

The U.S. Forest Service has developed long-term outdoor recreation participation projections.⁵⁸ Following recent trends in Yosemite NP, visitation, either since 1980 or 1990,

FIGURE 8. ANNUAL DISTRIBUTION AND MAGNITUDE OF RECREATIONAL VISITATION ACROSS DEVELOPMENT SCENARIOS



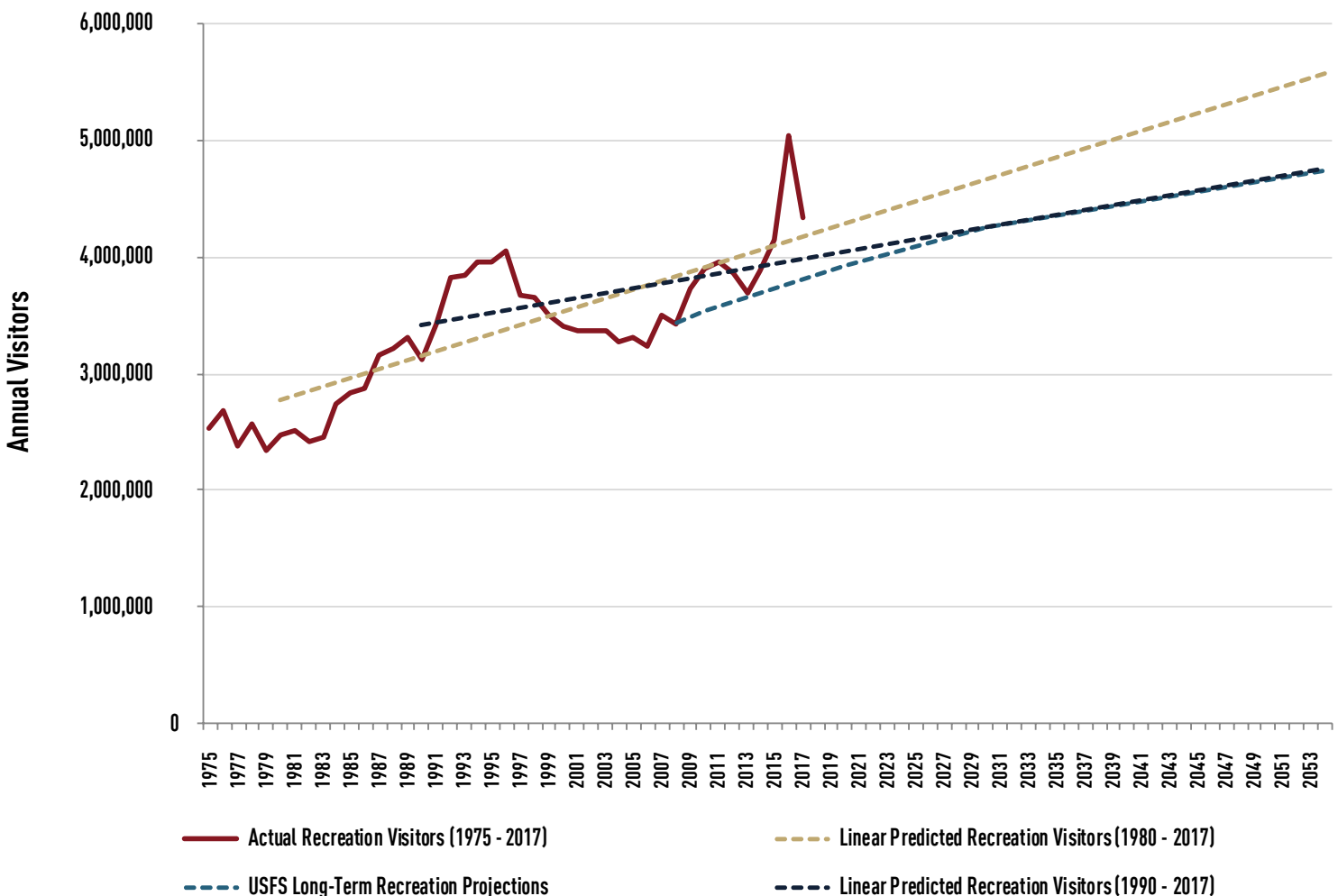
Source: ECONorthwest with data from National Park Service 1990 to 2018. Estimated annual visits were distributed across the season based on NPS Public Use Statistics estimates of overall visitation to the park, by month. December is 1990-2017.

RECREATIONAL VALUE OF RESTORED HETCH HETCHY VALLEY

is respectively less than or greater than that based on the USFS general national trend projections (Figure 9). The USFS estimates take into account predicted population and income growth levels over the next century, as well as trends for specific activities. The trend shown here is based on projections for nature viewing. All long-term usage estimates presented in this report utilize the USFS forecast long-term increase, unless otherwise noted.

For Hetch Hetchy Valley, visitation and use subsequent to initiation of restoration activities would likely generate somewhat unique patterns. There would likely be a short-term high level of interest due to the publicity that would likely occur. This has occurred elsewhere with dam removals or new designations for public lands. Subsequently, there would likely be a gradual shift from interest in observing the restoration process to more normalized visitation similar to other portions of the park, especially Yosemite Valley.

FIGURE 9. PREDICTED YOSEMITE NATIONAL PARK VISITATION OVER TIME



Source: ECONorthwest with data from National Park Service and Cordell 2012.

⁵⁸ This analysis uses the most conservative of the projections, B2. The most applicable RPA category was 'Viewing nature — viewing or photographing birds, other wildlife, natural scenery, flowers, etc. or gathering mushrooms, berries, etc.' Cordell, H.K. 2012. *Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment*. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

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Expected Hetch Hetchy Visitation Expenditures

NPS visitor surveys estimated expenditures of visitor groups inside the park and within 50 miles of the park. The Yosemite Impact study calculated spending averages on a visitor group trip basis for each segment.⁵⁹ Recreation visits for each area/ scenario (Table 3) were converted to visitor group trips by dividing recreation visits by the average visitor group size and park entry rate for each segment (Table 2). All results have been adjusted using the Consumer Price Index to estimate spending patterns for the baseline year of 2017.

Some visitors did not make the trip to the area primarily to visit the park. Spending directly attributed to the park visit was estimated by counting all spending for trips where the park was the primary reason for the trip.

As in the Yosemite Impact study (2009), if the park was not the primary destination, one night of spending was counted for non-primary purpose overnight trips and spending for a local day trip was counted for non-primary day trips. All spending inside the park was counted, but all spending by local visitors outside the park was excluded.

It is also important to note that not all spending of people that visit Yosemite Valley or a restored Hetch Hetchy can necessarily be attributed to the site itself. While visitor surveys have made it possible to estimate the number of visitors that came primarily to visit the park itself, it is not possible to estimate the proportion of these visitors that visited the park because of specific areas within the park (e.g. came to visit Yosemite Valley, specifically) or, rather, the number of people that would

TABLE 4. DIRECT EXPENDITURES
Associated with Recreation for Hetch Hetchy Visitation Scenarios

METRIC	YOSEMITE VALLEY	HETCH HETCHY VALLEY DEVELOPMENT SCENARIOS					HETCH HETCHY RESERVOIR (CURRENT)
		FULL DAY + FULL NIGHT:	FULL DAY + ½ NIGHT:	FULL DAY + NO NIGHT:	½ DAY + ½ NIGHT:	½ DAY + NO NIGHT:	
TOTAL ANNUAL VISITOR GROUP TRIPS							
Local	40,479	20,239	20,239	20,239	10,120	10,120	871
Day Trip	188,594	94,297	94,297	94,297	47,149	47,149	4,060
Motel-in	75,708	37,854	18,927	-	18,927	-	-
Camp-in	53,988	26,994	13,497	-	13,497	-	-
Motel-out	182,078	91,039	91,039	91,039	45,520	45,520	3,920
Camp-out	14,805	7,402	7,402	7,402	3,701	3,701	319
Other Overnight	67,648	33,824	33,824	33,824	16,912	16,912	1,456
TOTAL	623,300	311,650	279,226	246,802	155,825	123,401	10,627
TOTAL ANNUAL VISITOR SPENDING (\$ Millions)							
Inside Park	\$124.4	\$62.2	\$40.3	\$18.4	\$31.1	\$9.2	\$0.8
Outside Park	\$129.6	\$64.8	\$61.8	\$58.8	\$32.4	\$29.4	\$2.5
TOTAL	\$254.0	\$127.0	\$102.1	\$77.1	\$63.5	\$38.6	\$3.3
50-yr NPV No Discounting	\$15,035	\$7,518	\$6,042	\$4,566	\$3,759	\$2,283	\$197
50-yr NPV Discounted at 3%	\$7,713	\$3,857	\$3,099	\$2,342	\$1,928	\$1,171	\$101

Source: ECONorthwest with data from National Park Service and Cook et al. 2011.

⁵⁹ Cook, P. S. 2011. "Impacts of visitor spending on the local economy: Yosemite National Park, 2009." Natural Resource Report NPS.

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not have come to the park if not for the existence of a specific site. That said, this analysis does not apply any multipliers for additional ripples of this spending by businesses and workers receiving the expenditures, as is common in economic impact analysis. Inclusion of such multiplier effects would increase the overall expenditures substantially.

Annual visitor spending across the identified scenarios ranges from \$39 to \$127 million as a result of Hetch Hetchy visitors. The 50-year summed value of these expenditures, discounted at 3 percent, would range from \$1.2 to \$3.9 billion.

Consumer Surplus of Hetch Hetchy Visitation

According to the U.S. Water Resources Council guidelines, recreation benefits of those who choose to use a new or expanded site should be based on estimates of increased consumer surplus.⁶⁰ Consumer surplus represents the net economic benefit of a recreation activity, after deducting market-based costs associated with it (such as spending on equipment, food, gas, etc., captured in the expenditure estimates reported above). Consumer surplus values do not represent dollars exchanged, but, rather, the user willingness-

**TABLE 5. PRIMARY ACTIVITIES
During Visits to Yosemite National Park**

PRIMARY ACTIVITY	% OF VISITORS
Viewing scenery	41%
Day hiking	27%
Taking scenic drive	11%
Camping in developed campground	5%
Overnight backpacking	3%
Bicycling	2%
Creative arts	1%
Rock climbing	1%
Picnicking	1%
Staying in park lodging	1%
Nature study	1%
Attending ranger-led programs	1%
Wildlife viewing/birdwatching	<1%
Eating in the park restaurant	<1%
Other	6%

Source: Blotkamp, A., B. Meldrum, W. Morse, and S.J. Hollenhorst. 2010. *Yosemite National Park Visitor Study, Summer 2009*. Visitor Services Project Report #215. Moscow, ID: National Park Service and University of Idaho, Cooperative Park Studies Unit

TABLE 6. CONSUMER SURPLUS

Associated with Various Recreational Activities (in Pacific Coast Region, per person, per visitor day, \$2017)

ACTIVITY	# OF STUDIES	MINIMUM	MEAN	MAXIMUM
Sightseeing	4	\$6.85	\$26.55	\$79.61
Hiking	49	\$0.52	\$30.44	\$169.80
Downhill Skiing	1	\$32.85	\$32.85	\$32.85
Swimming	4	\$7.94	\$35.75	\$77.16
Floatboating/Rafting/Canoing	4	\$33.03	\$36.47	\$38.75
General Recreation	9	\$1.86	\$42.38	\$164.50
Fishing	15	\$5.80	\$58.11	\$135.59
Cross-country Skiing	1	\$63.38	\$63.38	\$63.38
Mountain Biking	16	\$41.53	\$65.08	\$103.15
Backpacking	6	\$35.13	\$68.25	\$105.25
Picnicking	3	\$19.90	\$84.13	\$186.99
Wildlife Viewing	23	\$9.29	\$94.95	\$455.72
Other Recreation	1	\$97.56	\$97.56	\$97.56
Camping	4	\$9.76	\$136.70	\$294.13

Source: Loomis, John B. 2005. "Updated outdoor recreation use values on national forests and other public lands."

⁶⁰ Water Resources Council (US). 1983. *Economic and environmental principles and guidelines for water and related land resources implementation studies*. Water Resources Council.; Walsh, Richard G., and Lynde O. Gilliam. 1982. *Benefits of wilderness expansion with excess demand for Indian Peaks*. Western Journal of Agricultural Economics: 1-12.

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to-pay, over and above what they actually do pay for the experience or ability to use the site.

Consumer surplus represents the benefit beyond expenditures, and is particularly relevant for natural resources such as national parks where markets do not determine costs of the experience provided by the resource itself. Based on existing studies to estimate consumer surplus values for outdoor recreation, the average value per day varies by activity. The single most reported activity among visitors to Yosemite National Park is sightseeing or scenery viewing (Table 5). The

U.S. Forest Service provides data on compiled, region-specific estimates for consumer surplus value ranges by activity type (Table 6). The ranges for consumer surplus values can vary by orders of magnitude from the lowest to the highest values for each activity type. This makes sense because not all experiences are created equal, and consumer surplus is fundamentally in the eye of the beholder.

The consumer surplus values are based on estimates for a full day of an experience. If a visit involves only a half-day, it also involves only half of the daily consumer surplus estimate.

TABLE 7. CONSUMER SURPLUS for Hetch Hetchy Visitation Scenarios

METRIC	YOSEMITE VALLEY	HETCH HETCHY VALLEY DEVELOPMENT SCENARIOS					HETCH HETCHY RESERVOIR (CURRENT)
		FULL DAY + FULL NIGHT:	FULL DAY + ½ NIGHT:	FULL DAY + NO NIGHT:	½ DAY + ½ NIGHT:	½ DAY + NO NIGHT:	
TOTAL ANNUAL VISITORS							
TOTAL	2,597,663	1,298,832	1,162,454	1,026,077	649,416	513,039	44,181
TOTAL ANNUAL VISITOR DAYS							
Local	76,198	38,099	38,099	38,099	19,050	19,050	1,640
Day Trip	457,189	228,594	228,594	228,594	114,297	114,297	9,843
Motel-in	525,767	262,884	131,442	0	131,442	0	0
Camp-in	506,718	253,359	126,679	0	126,679	0	0
Motel-out	1,529,677	764,839	764,839	764,839	382,419	382,419	32,933
Camp-out	236,214	118,107	118,107	118,107	59,054	59,054	5,085
Other Overnight	500,050	250,025	250,025	250,025	125,013	125,013	10,766
TOTAL	3,831,813	1,915,907	1,657,785	1,399,664	957,953	699,832	60,267
TOTAL ANNUAL CONSUMER SURPLUS (\$ Millions)							
Low (sightseeing; \$6.85/visitor day)	\$26.3	\$13.1	\$11.4	\$9.6	\$6.6	\$4.8	\$0.4
Medium (sightseeing; \$26.55/visitor day)	\$101.7	\$50.9	\$44.0	\$37.2	\$25.4	\$18.6	\$1.6
High (sightseeing; \$79.61/visitor day)	\$305.0	\$152.5	\$132.0	\$111.4	\$76.3	\$55.7	\$4.8
50-yr NPV - Medium CS No Discounting	\$6,023	\$3,011	\$2,606	\$2,200	\$1,506	\$1,100	\$95
50-yr NPV - Medium CS Discounted at 3%	\$3,090	\$1,545	\$1,337	\$1,129	\$772	\$564	\$49
50-yr NPV - High CS No Discounting	-	\$9,029	\$7,813	\$6,596	\$4,515	\$3,298	\$284
50-yr NPV - High CS Discounted at 3%	-	\$4,632	\$4,008	\$3,384	\$2,316	\$1,692	\$146

Source: ECONorthwest with data from the National Park Service and Loomis 2005.

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Applying the values for sightseeing provides a range from \$5 to \$305 million in annual consumer surplus resulting from Hetch Hetchy Valley visitation (Table 7). This is a conservative estimate as sightseeing surplus values are below average across the activities, and below other activities that would be available, such as hiking and backpacking. The values summed and discounted over 50 years for the medium level surplus value, including increasing activity over time, would be \$564 to \$1.6 billion in consumer surplus value.

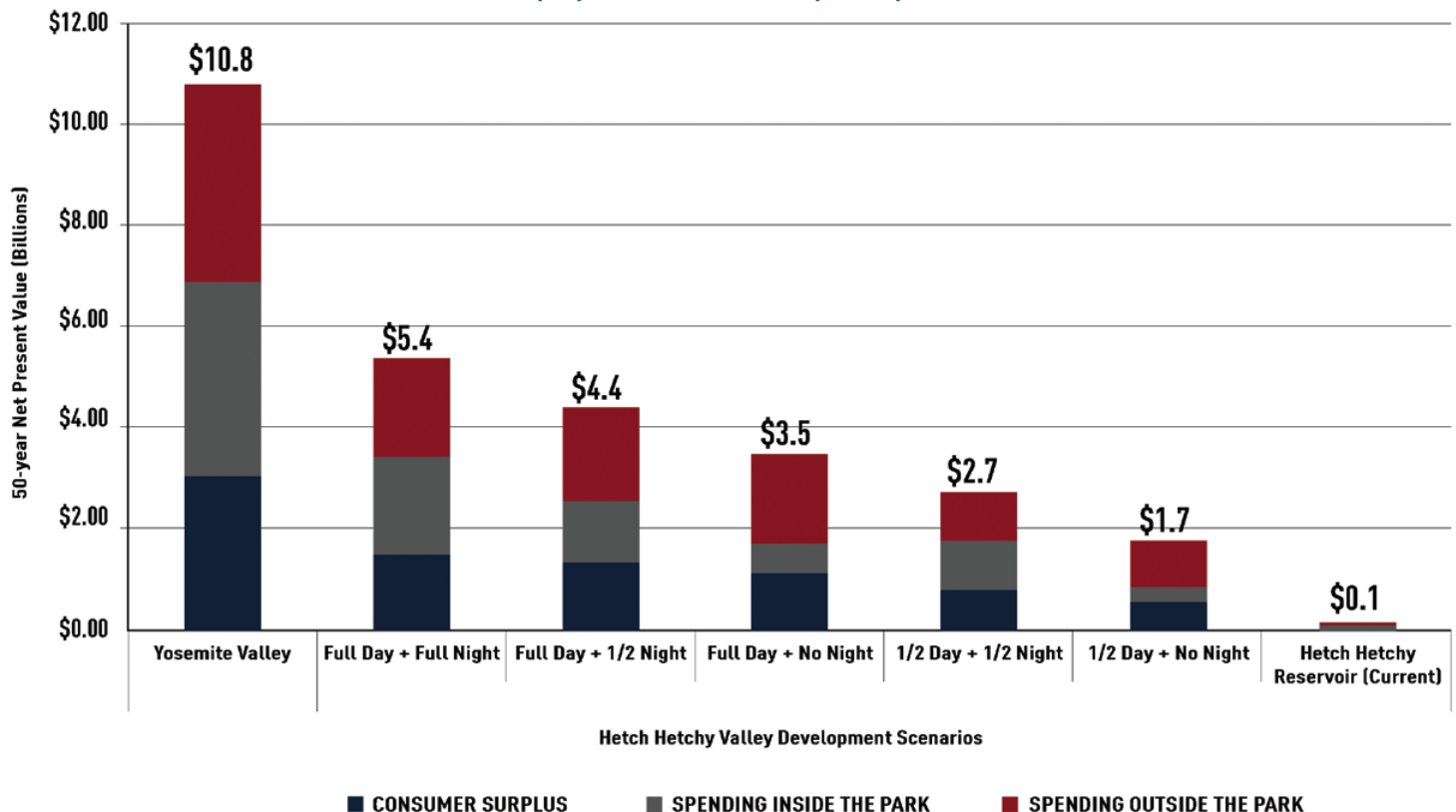
Consumer surplus values in this section are also discounted at a 3 percent rate, given the broad social value and low substitutability of the benefits. We also present some results without discounting for consideration. The intergenerational nature of benefits potentially accruing from a restored Hetch Hetchy Valley suggest some would want to place equal weight on future benefits as near-term. Considering though the costs of investments necessary to achieve these benefits from a current perspective, discounting is appropriate. This analysis

does not include any assumptions regarding years of delay before the benefits begin to accrue.

It is arguable that the unique geological and historical characteristics for Hetch Hetchy Valley would generate surplus values at the highest end of the spectrum. Considering the potential for activities generating more average value than general sightseeing strengthens this argument. And accounting for the important potential intergenerational nature of the benefits, discounting future values is debatable. Undiscounted the medium surplus values would range up to \$3 billion over 50 years. Using the high surplus values would increase the 50 year sum (undiscounted) up to \$9 billion in net benefit value to visitors (\$4.6 billion discounted).

An additional dimension to consider is the relationship between development, visitation levels, and consumer surplus. Economic evaluation of the Yosemite Management Plan, completed by economist Richard Walsh in 1982, suggested that

FIGURE 10. 50-YR NET PRESENT VALUE OF DEVELOPMENT SCENARIOS
(with projected increases in participation)



Source: ECONorthwest with data from sources cited previously. Consumer surplus values based on mean sightseeing trip value.

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TABLE 8. RECREATION USE ECONOMIC VALUE RESULTS SUMMARY

CATEGORY	METRIC	YOSEMITE VALLEY	HETCH HETCHY VALLEY DEVELOPMENT SCENARIOS					HETCH HETCHY RESERVOIR (CURRENT)
			FULL DAY + FULL NIGHT:	FULL DAY + ½ NIGHT:	FULL DAY + NO NIGHT:	½ DAY + ½ NIGHT:	½ DAY + NO NIGHT:	
VISITATION	Total Annual Visitors	2,597,663	1,298,832	1,162,454	1,026,077	649,416	513,039	44,181
	Total Annual Visitor Days	3,831,813	1,915,907	1,657,785	1,399,664	957,953	699,832	60,267
	Total Annual Visitor Group Trips	623,300	311,650	279,226	246,802	155,825	123,401	10,627
CONSUMER SURPLUS (Mean Trip Value)	Total Annual Consumer Surplus (\$ Millions)	\$36-\$1,746	\$18-\$873	\$15-\$755	\$13-\$638	\$9-\$437	\$6-\$319	\$1-\$27
	Static Annual Visitation: 50-yr NPV No Disc.	\$5,087	\$2,544	\$2,201	\$1,858	\$1,272	\$929	\$80
	Static Annual Visitation: 50-yr NPV	\$2,697	\$1,348	\$1,167	\$985	\$674	\$492	\$42
	Projected Participation Increases: 50-yr NPV No Disc.	\$6,023	\$3,011	\$2,606	\$2,200	\$1,506	\$1,100	\$95
	Projected Participation Increases: 50-yr NPV	\$3,090	\$1,545	\$1,337	\$1,129	\$772	\$564	\$49
DIRECT VISITOR SPENDING	Total Annual Visitor Spending (\$ Millions)	\$254	\$127	\$102	\$77	\$64	\$39	\$3
	Inside Park	\$124	\$62	\$40	\$18	\$31	\$9	\$1
	Outside Park	\$130	\$65	\$62	\$59	\$32	\$29	\$3
	Static Annual Visitation: 50-yr NPV No Disc.	\$12,701	\$5,104	\$3,857	\$3,175	\$1,928	\$166	\$6,350
	Static Annual Visitation: 50-yr NPV	\$6,732	\$2,705	\$2,044	\$1,683	\$1,022	\$88	\$3,366
	Projected Participation Increases: 50-yr NPV No Disc.	\$15,035	\$7,518	\$6,042	\$4,566	\$3,759	\$2,283	\$197
	Projected Participation Increases: 50-yr NPV	\$7,713	\$3,857	\$3,099	\$2,342	\$1,928	\$1,171	\$101
GROSS ECONOMIC VALUE (Spending & Consumer Surplus)	Static: Total 50-yr NPV (\$ Millions) No Disc.	\$17,788	\$7,647	\$6,058	\$5,034	\$3,200	\$1,095	\$6,430
	Static Annual Visitation: Total 50-yr NPV	\$9,428	\$4,053	\$3,211	\$2,668	\$1,696	\$581	\$3,408
	Increases: Total 50-yr NPV No Disc.	\$21,058	\$10,529	\$8,647	\$6,765	\$5,265	\$3,383	\$291
	Increases: Total 50-yr NPV	\$10,803	\$5,401	\$4,436	\$3,471	\$2,701	\$1,735	\$149
DIRECT VISITOR SPENDING	Consumer Surplus, No Disc.	\$18,059	\$9,029	\$7,813	\$6,596	\$4,515	\$3,298	\$284
	Gross Economic Value	\$33,094	\$16,547	\$13,855	\$11,162	\$8,274	\$5,581	\$481

Source: ECONorthwest with data from sources cited previously

Notes: All consumer surplus estimates were calculated using the mean value shown in Error! Reference source not found. But for the upper end high values at the bottom of the table. All Net Present Values (NPVs) were calculated using a discount rate of 3.00% unless listed as "No Disc." meaning no discounting of future values.

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higher levels of development in Yosemite Valley and the Park as a whole would result in lower quality recreation experiences and low consumer surplus values, per visitor day. Consumer surplus is highly dependent on crowding and congestion, and decreasing congestion creates higher benefits per visitor day.⁶¹ Walsh and Gilliam (1982) subsequently demonstrated that total willingness-to-pay increased as a function of decreasing congestion in the Indian Peaks Wilderness Area of Colorado. If visitors substitute a 'new' site for an existing site, the consumer surplus of the remaining visitors who do not substitute might increase.⁶²

These findings have implications for the Hetch Hetchy development scenarios that might be pursued. Though not explicitly modeled, we would expect individual willingness-to-pay to decline as the number of visits increases. This might shift the relative proportion of users experiencing the high, medium and low values reported in Table 6. In low-development scenarios for Hetch Hetchy Valley, fewer people might visit (due to less visitor support infrastructure) but that those who do visit value their trip more highly. Conversely, in high development scenarios, more people may have access to Hetch Hetchy Valley, but individual willingness-to-pay is lower. Similar effects might be observed in other areas of the park, where congestion is even slightly relieved as a result of the development of Hetch Hetchy Valley.

Recreation Value Summary

A visitor to Hetch Hetchy Valley would choose to visit because the benefits of the experience are greater than the costs. This gain or pleasure is the difference between costs and benefits. The 50-year discounted net economic benefit to visitors (consumer surplus) that would be attributable to a restored Hetch Hetchy Valley based upon the data, assumptions, and calculations described in this section would be \$0.6 to \$3 billion or more. While not all expenditures would occur within the park, from the visitor's perspective, they are costs of the experience. Therefore, the gross value (total use value) of the visits would be equal to the surplus value plus the expenditures. Across the described scenarios, this gross economic use

value of these experiences to visitors would range from \$1.7 to \$5.4 billion, discounted over 50 years (Table 8, Figure 10). Considering the unique and intergenerational nature of the benefits potentially provided by visiting a restored Hetch Hetchy Valley, the total benefit could extend above \$10 billion.

Literature Review of Increases in Total Recreation Visits to Yosemite National Park

There is some potential concern that the values associated with visitation to Hetch Hetchy would simply be a reallocation of visits from elsewhere in the park. The high levels of congestion in Yosemite National Park, and the extensive deliberation concerning restrictions on use levels in the park demonstrate that the park is a limited and scarce resource that cannot always meet the level of demand.⁶³ Furthermore, the long-term upward trend in visitation (Figure 6) suggests existing capacity (supply) constraints will only worsen. With greater supply of recreation opportunities, and greater diversity of recreation opportunities, both demand and visitation for Yosemite National Park as a whole would likely increase. As described earlier, interviews with past park leadership suggest that Hetch Hetchy Valley would likely be managed for relatively low-intensity uses to preserve the natural characteristics. This decision would be based upon a determination that such use is more valuable than what would be provided with intensive development. Such emphasis on the quality of the experience and low user numbers further bolster the likelihood that the opportunities to utilize Hetch Hetchy Valley would generally be in high demand. This would suggest that low usage targets correspond to high trip surplus value for Hetch Hetchy Valley. A decision to manage for low-intensity development would suggest an assessment that such usage is more valuable than high-intensity usage. Under such conditions, the value should therefore be equal to or greater than the estimates in this analysis based on high-intensity use.

Furthermore, other national parks have provided examples of increases in total visitor numbers when improvements occur, rather than simply shifting users from existing area of the park to new or improved areas.

⁶¹ Walsh 1982. *An Economic Evaluation of the General Management Plan For Yosemite National Park*. (n.d.). Retrieved January 27, 2015, from <http://www.cwi.colostate.edu/publications/tr/19.pdf>

⁶² Walsh, R. G., & Gilliam, L. O. 1982. *Benefits of wilderness expansion with excess demand for Indian Peaks*. Western Journal of Agricultural Economics, 1-12.

⁶³ See congestion and use limit discussions in Yosemite Valley Plan - National Park Service. 2000. *Final Yosemite Valley Plan: Supplemental Environmental Impact Statement*. Retrieved from: <http://www.nps.gov/yose/learn/management/upload/yvp.pdf> and the Tuolumne River Plan/DEIS (National Park Service. 2014. Tuolumne Wild and Scenic River Final Comprehensive Management Plan and Environmental Impact Statement. Executive Summary. Retrieved from http://www.nps.gov/yose/getinvolved/trp_feis.htm).

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(Courtesy of Unsplash. Photo by Michael Mazzone.)

Wolves in Yellowstone

The estimated percentage increase in Yellowstone visitation attributable to wolves ranges from 1.5 percent in the spring season to nearly 5% in the fall. On an annual basis, 3.7 percent of Park visitation (approximately 130,000 visitors in 2014) is due solely to the presence of wolves.⁶⁴

Dam Removal on the Elwha River

Surveys indicate that recreation and tourism visitation to the Elwha River drainage area will increase following dam removal and river restoration. While post-removal visitation statistics have not yet been published, Loomis (1996) predicted that the action would annually bring roughly 301,258 new visitors (and 507,084 new visitor trips) from inside the U.S. alone.⁶⁵

National Park Designation

Researchers at Colorado State University examined eight National Monument to National Park conversions between 1979 and 2000 and found that, all else remaining the same, a site can expect an estimated 11,642 new visitors annually from the act of converting a National Monument to a National Park alone. While the paper focused on impacts of park designation, the authors also investigated whether such designations could affect visitation at similar sites given potential “fungibility” in visitation patterns:

Park visitors may simply be substituting their visit to the “new” park for visits that would have occurred otherwise in an “old” park. In such a case, the regional benefit/cost analysis would exaggerate the national benefit/cost impact. The net national economic impact may converge toward zero if all new park visitors so substituted, with welfare impacts potentially even becoming negative if visits from a site in a less-advantaged region were channeled to a more advantaged region.

However, they concluded that redesignation effects did not appear to occur solely at the expense of visitation to alternative sites:

... redesignation does not in fact divert visitation from other sites but rather adds net new visitors to the NPS system. Such additions can most easily be visualized as vacation travelers specifically targeting regional National Parks, with a redesignation simply adding the new park to many such lists.⁶⁶

The substantial share of visitors to Yosemite National Park from outside the region suggests that increased visitation would not be solely to the detriment of visitation levels at other regional amenities. In the 2009 summer visitor survey for Yosemite National Park, 47 percent of the sample were from California as a whole, 28 percent were from elsewhere in the United States, and 25 percent were from other countries.⁶⁷



(Courtesy of Unsplash. Photo by Roberto Nickson.)

⁶⁴ Wolf Recovery in Yellowstone: Park Visitor Attitudes, Expenditures, and Economic Impacts. (n.d.). Retrieved January 21, 2015, from <http://www.georgewright.org/251duffield.pdf>

⁶⁵ Loomis, J. 1996. Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey. *Water Resources Research*, 32(2):441-447. Bureau of Reclamation, Lower Elwha S’Klallam Tribe and National Park Service. 1995. Elwha River Restoration Project: Economic Analysis.

⁶⁶ Weiler, S., & Seidl, A. 2004. What’s in a Name? Extracting Econometric Drivers to Assess The Impact of National Park Designation. *Journal of Regional Science*, 44(2), 245-262.

⁶⁷ Blotkamp, A., B. Meldrum, W. Morse, and S.J. Hollenhorst. 2010. Yosemite National Park Visitor Study, Summer 2009. Visitor Services Project Report #215. Moscow, ID: National Park Service and University of Idaho, Cooperative Park Studies Unit.

PASSIVE-USE VALUE OF A RESTORED HETCH HETCHY VALLEY

Economic theory holds that the total value of restoring Hetch Hetchy includes both use and passive-use values (Figure 5).⁶⁸ Coming to any conclusion about the value of the benefits of restoration without considering passive-use value would likely underestimate the total value of restoration actions. Guidance from the U.S. Department of Interior for assessing damages to natural resources provides a framework for researchers to gauge when to consider passive-use value. In particular, research suggests that passive-use value is most likely to be greater where the resource in question is unique or of national importance:

*... an injury to a common natural resource with many substitutes (e.g., a typical small stream), may not generate large non-use values, particularly for those residing outside the area where the injury occurred, even if the recovery takes a long time. However, a permanent injury to a unique resource (e.g., the Grand Canyon) may generate significant non-use values, even for those residing in areas far removed geographically from the site where the injury occurred.*⁶⁹

Many researchers have studied the values people place on, for instance, free-flowing rivers, the existence of native fish populations, and restoring ecosystems for current and future generations. From this work has come research methods, grounded in peer-reviewed science, to answer the question that is the basis for measuring the economic value of natural resources. The fundamental question is: how much money would it take to make someone indifferent between two outcomes? To answer this question, researchers have developed two other questions: *a) How much would that person be willing to accept (WTA) to lose something of value?; and, b) How much would that person be willing to pay (WTP) to gain something of value?*

After using these research techniques to estimate damages from the *Exxon Valdez* oil spill, the U.S. government convened a Blue Ribbon Panel to review the state of the science and develop recommendations for future researchers to follow in developing WTP surveys. In 1993, the panel released a set of best practices to ensure WTP values are as credible and reliable as possible.⁷⁰ Since landmark uses in California's Mono Lake water allocation decision and the *Exxon Valdez* oil spill damage calculations in the late 1980s and early 1990s, the results of WTP studies have gained more widespread consideration in policy decisions.⁷¹ These techniques are routinely applied to estimate damages from environmental injuries, have been used in the context of the National Environmental Planning Act (NEPA) to inform federal environmental management decisions, and are included as one method of analysis by the Environmental Protection Agency in its *Guidelines for Preparing Economic Analyses*.⁷²

No one has conducted an original study to directly quantify the passive-use value of restoring Hetch Hetchy Valley. Without an original survey (stated preference) study, consistent with the Blue Ribbon Panel's guidance and ensuing economic literature, we can consider the results of existing studies, whether they are relevant to the Hetch Hetchy context, and if so, what they tell us about the passive-use value of a restored Hetch Hetchy Valley. By evaluating how people have responded to existing passive-use studies, we can get a sense of how they might respond to a comprehensive study specific to Hetch Hetchy.

The most important requirements for benefit transfer, or application of economic benefit values from one study involving primary (original) data collection to another context, are the similarity of the resource and effect on that resource, and the similarity of the surveyed population. Fortunately, there are several studies with relevance to the Hetch Hetchy

⁶⁸ Tietenberg, T. and L. Lewis (2009). *Environmental & Natural Resource Economics*. Boston, MA, Pearson Education, Inc. pp. 37-39.

⁶⁹ U.S. Department of the Interior. 1991. Natural Resource Damage Assessment: Notice of Proposed Rulemaking. Federal Register 56(82):19752-19773.

⁷⁰ Arrow, K. et al. 1993. *Report of the NOAA Panel on Contingent Valuation*. National Oceanic and Atmospheric Administration. January 11. Retrieved March 9, 2015, from <http://www.darrp.noaa.gov/library/pdf/cvblue.pdf>

⁷¹ For example, WTP estimates have been used in decisions to reintroduce wolves to Yellowstone National Park (U.S. Department of the Interior, Fish and Wildlife Service. Final Environmental Impact Statement. The reintroduction of gray wolves in Yellowstone National Park and Central Idaho.), restore ecological flows to the Colorado River through the Grand Canyon (U.S. Bureau of Reclamation. 1995. *Operations of Glen Canyon Dam: Final Environmental Impact Statement*), and remove dams on the Elwha River in Olympic National Park (Loomis, J.B. 1996. "Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey." *Water Resources Research* 32(2): 441-447).

⁷² U.S. Environmental Protection Agency, Office of the Administrator (EPA). 2010. *Guidelines for Preparing Economic Analyses*. Report No. EPA-240-R-10-001. December. Retrieved March 12, 2015, from <http://yosemite.epa.gov/EE%5Cepa%5Ceed.nsf/webpages/Guidelines.html>

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context. We identified a set of peer-reviewed and government-published studies that value resources and actions similar in scale, scope, and substance to restoring Hetch Hetchy. The studies we analyze in more detail are:

- Klamath Basin Restoration, 2012.⁷³
- Elwha and Glines Dam Removal, 1996.⁷⁴
- National Park Visibility Preservation, 1990.⁷⁵
- Mono Lake Preservation, 1987.⁷⁶
- Grand Canyon Flow Augmentation, 1999.⁷⁷
- South Platte River Restoration, 2000.⁷⁸

Although collectively these studies were conducted over a period spanning 25 years, they employ methodologies that are consistent with the Blue Ribbon Panel's recommendations, advance state-of-the-art techniques in value estimation, and were peer reviewed or otherwise critiqued by experts.⁷⁹

- **Klamath Basin Restoration:** This study, the most recent conducted in the set of studies identified, surveyed households in counties adjacent to the Klamath Basin, households in Oregon and California, and households across the U.S. The WTP question asked respondents to imagine how they would vote if presented with two options: No Action and an Action Plan to improve the Klamath Basin containing a variety of actions, including dam removal, water sharing agreements, and fish habitat restoration. Survey respondents were informed that their household expenses would go up and they would have less to spend on other things each year for 20 years, by the amount presented in the survey. A specific amount, drawn from a set amounts ranging from \$12 to \$168 per year was proposed to respondents. From the survey

results, researchers calculated per-household WTP for three groups of respondents, representing the local area, the region (Oregon and California) and the remainder of the U.S. Researchers also calculated an aggregate WTP over 20 years.

- **Elwha and Glines Dams Removal:** This study surveyed households in Washington State and across the U.S. The WTP question asked respondents to vote on a referendum that would increase federal taxes over the next 10 years to remove both dams and restore the river and fish populations to a specific level. A specific amount of increased taxes, drawn from a set amounts ranging from \$3 to \$190 per year was proposed to respondents. From the survey results, researchers calculated annual per-household WTP and total annual WTP for both Washington residents and the remainder of the U.S. population.
- **National Park Visibility Preservation:** This study surveyed households in five states about their WTP for air quality improvements in national parks in one of several regions across the U.S., including California. The WTP question stated that with air pollution controls, average visibility conditions would improve at all national parks in a given region. It then asked how much the household would be willing to pay in increased taxes and prices to have average visibility conditions improve from one level to a higher level. The WTP amounts ranged from \$0 to \$750 per year. From the survey results, researchers calculated annual per-household WTP for visibility improvements of varying degrees. The researchers used other questions on the survey to separate out components of value from total WTP, including option value, bequest value, and existence value. The results in the tables show only the existence value portion of total WTP.

⁷³ Mansfield, et al. 2012. Klamath River Restoration Non-use Value Survey. January 19.

⁷⁴ Loomis, J.B. 1996. "Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey." *Water Resources Research* 32(2): 441-447.

⁷⁵ Chestnut, L.G. and R.D. Rowe. 1990. *Preservation Values for Visibility Protection at the National Parks*. Draft Final Report. U.S. Environmental Protection Agency, Office of Air Planning and Standards, Economic Analysis Branch and National Park Service, Air Quality Management Division. February 16.

⁷⁶ Loomis, J.B. 1987. "Balancing Public Trust Resources of Mono Lake and Los Angeles' Water Right: An Economic Approach." *Water Resources Research*

⁷⁷ Welsh, M.P., R.C. Bishop, M.L. Phillips. 1999. *Valuing Grand Canyon Riparian Resources*. May 14.

⁷⁸ Loomis, J. et al. 2000. "Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey." *Ecological Economics* 33: 103-117.

⁷⁹ The Chestnut and Rowe study of National Park visibility preservation is only available as a "draft final report" and contains a disclaimer that "this report has neither been reviewed nor approved by the U.S. Environmental Protection Agency for publication as an EPA report." However, the EPA relied on it to estimate the value of visibility improvements at Grand Canyon National Park to justify a 1991 regulatory action. Subsequent to this action, the General Accounting Office reviewed the study (Bachman, J.T. 1998. Appendix III, Contingent Valuation Studies Used to Value Visibility Improvements at the Grand Canyon National Park. *Air Pollution: Estimated Benefits and Costs of the Navajo Generating Station's Emissions Limit*. GAO. Report to the Chairman, Subcommittee on Water and Power Resources, House of Representatives. January.)

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- **Mono Lake Preservation:** This study surveyed households in California about their WTP for the State of California and Los Angeles to develop water conservation practices and purchase replacement water from elsewhere so more water could flow into Mono Lake, maintaining the unique ecological features of the Lake. The WTP question stated that the household would experience an increase in their water bill (or rent) each month for the improvements to lake levels as shown on a map. The WTP amounts ranged from \$0.20 to \$100 per month. From the survey results, researchers calculated monthly and annual per-household WTP for improvements to lake levels.
- **Grand Canyon Flow Augmentation:** This study surveyed households across the U.S. and western households that receive power from Glen Canyon Dam about their WTP for proposals to change dam operations to improve downstream environmental conditions. The WTP question began by asking households how they would vote if the proposals cost them nothing, then asked them how they would vote if the proposals resulted in higher taxes (for the U.S. survey population) and higher utility bills (for the “market area” survey population). The price ranged from \$5 to \$200. From the survey results, researchers calculated annual per-household WTP for each survey population and total annual WTP.
- **South Platte River Restoration:** This study surveyed individuals living in households located in Colorado communities near the South Platte about their WTP to restore ecosystem services provided by the South Platte River, including dilution of wastewater, natural purification of water, erosion control, and habitat for fish and wildlife. These improvements would be realized by purchasing water from farmers and restoring natural riparian areas along 45 miles of the South Platte. The WTP question asked if respondents would vote for an increase in their water bill that would go toward a restoration fund to accomplish these things. The proposed increase in the bill ranged from \$1 to \$100. From the survey results, researchers calculated annual per-household WTP for each survey population and total annual WTP.



The pending dam removal on the Klamath River to restore fisheries is an example of the restoration efforts found to have a substantial willingness-to-pay among people with no plans to visit. (Courtesy of BLMOregon)

Collectively these studies have important similarities to the Hetch Hetchy context: restoration or comparable improvements to rivers or waterbodies with national or regional importance, similar geography and survey populations to those targeted for Hetch Hetchy, and hypothetical payment mechanisms that would be appropriate for a Hetch Hetchy study. Of particular interest for a passive-use study is the size of the population that would experience a benefit given the non-rival (unlimited) nature of this type of benefit.⁸⁰ These studies show that statewide, and even across the entire United States, a substantial share of people would be willing to pay for benefits of improving specific, distant rivers. The further away the respondent, the less likely they are to actively use the resource, although that potential does exist and it is generally most appropriate to avoid summing values from use studies such as the recreation values already described with the broader studies targeting passive-use value. It is important to note that these studies recognize and account for the large share of respondents who do not place any value on the target resource or restoration. In addition, there is accounting for non-respondents. For example, the most recent study for the Klamath River assumed non-respondents were zero values when applying to the overall population to estimate total value.

Furthermore, these studies show values for resources arguably of comparable or even less significance to the general public.

⁸⁰ Non-rival goods and services are not used up; one person's use does not hinder the ability for others to benefit as well.

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The Grand Canyon and Yosemite National Parks are both among most widely-known and scenic areas in the country and the world. But the others are likely less well-known or of less historical prominence from an environmental perspective. The effect of salmon population benefits for the Klamath and Elwha River studies are important to note, in that no similar population effects are likely with Hetch Hetchy. But the scenic, use, and historical values associated with Hetch Hetchy are much potentially more prominent than the Klamath or Elwha Rivers.

Given the outstanding and rare natural characteristics of Hetch Hetchy Valley, and its prominent historical role in consideration and protection of natural resources, it is quite possible and even likely that an original survey of the WTP to restore Hetch Hetchy would produce average per-household WTP values within the range of these studies, particularly at the national scale. These other studies do not generally address changes to a resource as dramatic as the restoration of Hetch Hetchy Valley. The dam removal studies are the closest examples, but they do not involve a resource inside a national park with the scenic characteristics and historical prominence of Hetch Hetchy Valley. Some factors that may be useful in considering how relevant these studies might be to Hetch Hetchy include:⁸¹

- The time between primary collection and transfer.
- The characteristics of the population that values the resource.
- The characteristics of the geographical location.
- The quantity and quality of the environmental good/service.
- The characteristics of the use of the resource.

The characteristics of the studies that inform each of these factors are described in Table 10. Although these studies all include similarities to Hetch Hetchy (e.g., dam removal, river restoration, etc.), no study site exhibits the same alignment of circumstances surrounding Hetch Hetchy including the level of change (e.g., the Grand Canyon studies are relatively minor improvements while the dam removal studies are for areas of less national prominence).



Yosemite National Park (Courtesy of Unsplash. Photo by Fred Kearney.)

Table 9 summarizes the average household and total willingness to pay values from each of the studies. All report average annual per-household WTP, but they do not all report the same geographic or population aggregate or total WTP value over time. The table's bottom line provides aggregate value estimates based on the household WTP values applied over 20 years. The aggregate values over time include population growth projections. For the two indicated studies that do not include national WTP values, the state and local values are applied to the corresponding geographies for Hetch Hetchy as indicated (California and San Francisco Bay counties). This analysis uses an annual household-level WTP, quantified over a 20-year period using a 3 percent discount rate. Twenty years is a typical timeframe for benefit calculations over time in stated preference studies, in part because it avoids extension of preferences beyond foreseeable conditions for the respondent generation. Three percent is an appropriate representative social discount rate given the low substitutability of these kinds of resources with financial assets and the intergenerational relevance of the benefits. The recent recommendation for discount rate analyses for use by federal agencies in assessing water projects is 2.750 percent, based on returns to marketable securities of the United States.⁸² This 20-year NPV results in all studies producing WTP values in the billions of dollars. The smallest total WTP result, for the South Platte River, only includes households for

⁸¹ Spash, C.L. and Vatn, A. 2006. "Transferring Environmental Value Estimates: Issues and Alternatives." *Ecological Economics* 60: 379-388.

⁸² Bureau of Reclamation. 2018. Change in Discount Rate for Water Resources Planning. Federal Register. <https://www.federalregister.gov/documents/2018/01/10/2018-00251/change-in-discount-rate-for-water-resourcesplanning>. January 10.

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a small area adjacent to the river itself.⁸³ However, the per-household average annual WTP is at the high end of the range shown by this group of studies. In reality benefits for actions in these studies as with Hetch Hetchy restoration would extend beyond 20 years, and there are many economic arguments that discounting across generations should be done lightly for intergenerational equity considerations.⁸⁴ To the extent that these values are relevant beyond 20 years and with reduced discount rates for those extended timeframes, these benefit values would underestimate the total value. This analysis uses projections of the number of households in California over 20 years, based on state population projections by the California Department of Finance.⁸⁵

Based upon these data, a value equivalent to the National Park visibility study would total \$10.9 billion over 20 years for California state residents as a whole. The value based on the Elwha study household value would be \$25.6 billion, based upon the Klamath study would be \$50.9 billion, and based upon the Mono Lake study would be \$72.8 billion. These assume the study values on average apply for households across the state of California. The Klamath and Elwha studies found lower values for the immediately local populations. To represent a local area, the San Francisco Bay Area represents approximately 19 percent of the state population.⁸⁶ The strongest divergence between statewide and local willingness-to-pay was found in the Klamath study, in which local values were 57 percent of

TABLE 9. SUMMARY OF WILLINGNESS TO PAY BY STUDY

	Klamath Basin Restoration (Mansfield et al. 2012)	Mono Lake Preservation (Loomis 1987)	Grand Canyon Flow Augmentation (Welsh et al. 1999)	Elwha and Glines Dam Removal (Loomis 1996)	South Platte River Restoration (Loomis et al. 2000)	National Park Visibility Preservation (Chestnut & Rowe 1990)
Survey Year	2011	1985	1994-1995	1994-1995	1998	1988
Valuation Team	20 years	Indefinite	Indefinite	10 years	Indefinite	Indefinite
Local Annual Avg. HH WTP	\$133	Not Surveyed	\$40-\$52	\$96	\$381	\$50
Statewide Annual Avg HH WTP	\$233	\$334	Not Surveyed	\$118	Not Surveyed	\$50
U.S. Annual Avg. HH WTP	\$233	Not Surveyed	\$25-\$37	\$110	Not Surveyed	\$34
Total Annual Benefits	\$3.3-\$5.7 billion ¹	\$3.5-\$7.9 billion ²	\$4.1-\$6.2 billion ³	\$3.1-\$6.2 billion	\$28-\$107 million ⁴	Not Reported
Illustrative NPV Over 20 Years, 3% Discount Rate	\$90 billion ¹	\$53-\$118 billion ²	\$39-\$54 billion ³	\$46-\$93 billion	\$420 million-\$1.6 billion ⁴	\$55-\$75 billion

Source: ECONorthwest, with data from cited studies.

Notes: Values in 2017 dollars. HH = household, Avg = average, NPV = present value indicating that future values are discounted

¹ Approximation, based on 95% confidence interval total aggregate 20-year present value total for local, state, and national population, divided by 20. \$90 billion is total 20-year NPV reported in study adjusted to 2017 dollars and adjusted to exclude non-response share from overall population.

² Applied only to California households.

³ Includes only the benefits associated with the U.S. survey population. Including the market area at the higher WTP in the total annual benefits would increase total benefits and illustrative NPV over 20 years.

⁴ Applied only to local households (San Francisco Bay).

⁸³ The author acknowledges the narrow boundaries set by the study design, and in a benefit-cost analysis of the restoration actions, offers that "If one were to include all the households living in the entire South Platte river watershed, WTP would exceed the costs by an order of magnitude." (Loomis et al. 2000 pg. 115)

⁸⁴ Arrow, K., Cropper, M., Gollier, C., Groom, B., Heal, G., Newell, R., Nordhaus, W., Pindyck, R., Pizer, W., Portney, P. and Sterner, T., 2014. Should governments use a declining discount rate in project analysis? *Review of Environmental Economics and Policy*. 8(2). Pp. 145-163.

⁸⁵ California Department of Finance. 2014. State and County Total Population Projections, 2010-2060. <http://www.dof.ca.gov/research/demographic/reports/projections/P-1/>. Conversion of population estimates to household estimates based on the average household size in California for the most recent available census data of 2.94 individuals per household (2009-2013) – U.S. Census Bureau. 2015. State and County QuickFacts. California. <http://quickfacts.census.gov/qfd/states/06000.html>.

⁸⁶ Calculation based upon 2010 Census San Francisco Bay Area population as a percentage of 2010 Census California state population. San Francisco Bay Area is defined as the total population for the nine counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma. Bay Area Census. 2015. San Francisco Bay Area. <http://www.bayareacensus.ca.gov/bayarea.htm>.

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the statewide value. Applying this 57 percent reduction to 19 percent of the state population reduces the range on these values for California residents applying the Klamath WTP from \$10.9 to \$72.3 billion to \$10.0 to \$66.8 billion.

A similar approach is used to estimate values based on nationwide household willingness-to-pay values from

these studies.⁸⁷ Taking population projections for the entire United States and subtracting out the California household projections, nationwide annual household willingness-to-pay estimates for the studies are applied in Table 9. Overall these studies find total values in the tens to hundreds of billions of dollars over the lifespan of the restoration or improvement.

TABLE 10. DETAIL FOR STUDIES INCLUDED IN LITERATURE REVIEW

	ELWHA AND GLINES DAM REMOVAL (LOOMIS 1996)			KLAMATH BASIN RESTORATION (MANSFIELD ET AL. 2012)		
SURVEY POPULATION	Clallam County Households	Remainder of Washington Households	Remainder of U.S. Households	12 Countries Adjacent to Klamath River	Remainder Oregon and California Households	Remainder of U.S. Households
RESOURCE LOCATION	Washington State			Southern Oregon and Northern California		
SURVEY YEAR	1994-1995			2011		
BENEFITS VALUED	Removal of the two dams from the Elwha River, restoration of the river to its natural pre-dam state, and associated increases in four species of salmon and steelhead.			Total value (including non-use value) of restoring the Klamath River Basin through dam removal, water sharing agreements and improvements in fish habitat. Several scenarios of improvements were presented to survey respondents, with different combinations of benefits in each category.		
USE LEVEL	Olympic National Park received 3+ million visitors in mid-1990s; Traffic count at ELWHA increased substantially after dam removal.			Commercial fishing, farmland irrigation, hydroelectric power, recreation and tourism, and Tribal cultural practices are all identified uses in the basin. Of Klamath Area respondents, 40.7 indicated they took a recreation trip to the Klamath in the past 12 months. 7.3% of OR-CA and 1.3% of Rest of US.		
PAYMENT VEHICLE	Increase in federal taxes			Increase in household costs		
TIME HORIZON	Annual payments over 10 years			Annual payments over 20 years		
NON-ZERO RESPONSE RATE (PERCENT WILLING TO PAY SOMETHING)	37.9%	52.5%	50.9%	54.70%	71.30%	66.30%
MEAN ANNUAL HOUSEHOLD WTP (2017\$) ¹	\$96	\$118	\$110	\$133	\$233	\$233
CONFIDENCE INTERVAL (2017\$) ¹	\$33-\$531 (90%)	\$96-\$158 (90%)	\$89-\$147 (90%)	\$86-\$180 (95%)	\$176-\$290 (95%)	\$171-\$296 (95%)
TOTAL ANNUAL VALUE ESTIMATE (2017\$) ¹	Not Reported	\$152-\$223 million (Clallam + Remainder of WA Households)	5.6-\$10.1 billion (WA + Remainder of U.S. Households)	Not Reported		
AGGREGATE NPV OF ANNUAL HOUSEHOLD WTP (2017\$) ¹	Not Reported			\$233 million	\$10 billion	\$80 billion

Source: ECONorthwest, with data from sources described in text.

Notes: ¹ Values converted from the study year to 2017 dollars using the CPI and rounded. Klamath values based on 20 years.

⁸⁷ National population projections based upon: U.S. Census Bureau. 2014. U.S. Population Projections: 2014-2060. <http://www.census.gov/population/projections/data/national/2014.html>. Conversion to households based on 2.63 individuals per household U.S. Census Bureau. 2015. State and County QuickFacts. California. <http://quickfacts.census.gov/qfd/states/06000.html>.

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Yosemite National Park (Courtesy of Unsplash. Photo by Christian Joudrey.)

TABLE 10. DETAIL FOR STUDIES INCLUDED IN LITERATURE REVIEW (Continued)

	NATIONAL PARK VISIBILITY PRESERVATION (CHESTNUT & ROWE 1990)		MONO LAKE PRESERVATION (LOOMIS 1987)
SURVEY POPULATION	California Households	Households Residing in AZ, CA, MO, NY, VA	California Households
RESOURCE LOCATION	California, Focusing on Yosemite National Park		Eastern California
SURVEY YEAR	1988		1985
BENEFITS VALUED	Improvement in average visibility conditions in National Parks in California (including Yosemite, which was used in pictures shown to survey respondents demonstrate visibility changes for the California region) from current average visibility conditions to almost no haze.		Lake level, corresponding to five characteristics: 1) ease or difficulty of recreational access to lake; 2) salinity of lake and implications for bird food source (brine shrimp); 3) suitability of habitat for gull nesting; 4) total bird populations and species diversity; and 5) severity of dust storms and scenic visibility. Several scenarios of improvements were presented to survey respondents.
USE LEVEL	Yosemite National Park was the 3rd most visited National Park in the U.S. in 2014, with diverse visitation from across the U.S. and the world. ⁸⁸		Rural, remote resource, Mono Lake Tufa State Natural Reserve
PAYMENT VEHICLE	Increase in taxes and prices (for e.g., electricity, transportation)		Increase payment for monthly water bill
TIME HORIZON	No limit specified		No limit specified
NON-ZERO RESPONSE RATE (PERCENT WILLING TO PAY SOMETHING)	83%		Not reported
MEAN ANNUAL HOUSEHOLD WTP (2014\$) ¹	\$50 per year (Existence Value)	\$34 per year (Existence Value)	\$334 per year (Conservative Assumptions)
CONFIDENCE INTERVAL (2017\$) ¹	\$31-\$70	\$28-\$42	Not reported
TOTAL ANNUAL VALUE ESTIMATE (2017\$) ¹	Not reported		\$3.5 billion-\$7.9 billion per year
AGGREGATE NPV OF ANNUAL HOUSEHOLD WTP (2017\$) ¹	Not reported		Not reported

Source: ECONorthwest, with data from sources described in text.

Notes: ¹ Values converted from the study year to 2017 dollars using the CPI and rounded to the nearest dollar.

⁸⁸ National Parks Conservation Association. 2015. *Ten Most Visited National Parks*. Retrieved March 12, 2015, from <http://www.npca.org/exploring-ourparks/visitation.html>

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Grand Canyon (Courtesy of Unsplash. Photo by Morais.)

TABLE 10. DETAIL FOR STUDIES INCLUDED IN LITERATURE REVIEW (Continued)

	Grand Canyon Riparian Resources (Welsh et al. 1999)		South Platte River Restoration (Loomis et al. 2000)
Survey Population	Electricity “Market Area” Households	U.S. Households	Households in towns on or near South Platte river
Resource Location	Arizona		Colorado
Survey Year	1994-1995		1998
Benefits Valued	Changes in Glen Canyon dam operations to produce different levels of flow in the Colorado River through Grand Canyon with varying ecological improvements (representing the range of effects in NEPA alternatives): moderate fluctuating flow; low fluctuating flow; and seasonally adjusted steady flow.		Restoring ecosystem services provided by the South Platte river, including dilution of wastewater, Natural purification of water, Erosion control, and habitat for fish and wildlife. This would be accomplished by purchasing water from farmers and restoring natural riparian areas along 45 miles of the South Platte.
Use Level	The Grand Canyon National Park was the 2nd most visited National Park in the U.S. in 2014 (Yosemite was 3rd). ⁸⁹ Visitation to the Colorado River and riparian areas in the Canyon is primarily by recreational boaters, a small subset of total visitors to the park each year.		The South Platte River provides water supply and conveyance for irrigated agriculture and municipal systems near Denver, Colorado.
Payment Vehicle	Increase payment for utility bills	Increase in federal taxes	Increase in water bill for restoration fund
Time Horizon	No limit specified		No limit specified
Non-Zero Response Rate (Percent willing to pay something)	Not reported		100% (\$1 or more)
Mean Annual Household WTP (2014\$) ¹	\$40-\$52	\$25-\$37	\$381
Confidence Interval (2017\$) ¹	\$30-\$68	\$17-\$54	\$371-\$392
Total Annual Value Estimate (2017\$) ¹	\$112-\$147 million per year	\$4.1-\$6.2 billion per year	\$28-\$107 million per year
Aggregate NPV of Annual Household WTP (2017\$) ¹	Not reported		Not reported

Source: ECONorthwest, with data from sources described in text.

Notes: ¹ Values converted from the study year to 2017 dollars using the CPI and rounded to the nearest dollar.

⁸⁹ National Parks Conservation Association. 2015. *Ten Most Visited National Parks*. Retrieved March 12, 2015, from <http://www.npca.org/exploring-ourparks/visitation.html>

HABITAT VALUE OF A RESTORED HETCH HETCHY VALLEY

Restoration of Hetch Hetchy Valley has the potential to provide over 1,000 acres of scarce wetland, riparian and meadow habitat. High intensity recreational development would reduce these habitat values, but interviews with park leadership described earlier suggest that development would be low intensity. Therefore, there is potential for double-counting if considering recreational use values as estimated in this analysis as well as habitat values. Furthermore, it is particularly difficult to isolate habitat values from passive-use values, so there would be potential for double-counting with those value estimates as well. This difficulty arises because respondents for passive-use value survey instruments addressing natural resources typically emphasize the ecological improvements that would occur.

Nevertheless, it is important to recognize that from an ecological perspective, Hetch Hetchy Valley can provide valuable habitat. A study commissioned and utilized by the San Francisco Public Utility Commission to assess damages from the Rim Fire that occurred within the Hetch Hetchy watershed found values as high as \$35,000 per acre per year for these habitat types, with total environmental benefit losses due to the fire, including carbon storage, of over \$1 billion.⁹⁰ This suggests San Francisco sees validity to benefit estimates of this magnitude for the habitat values alone available in the vicinity of Yosemite National Park.



(Courtesy of Unsplash. Photo by Hosea-Georgeson.)



Restoration would create opportunities for fishing in Hetch Hetchy Valley as well as upstream reaches of the Tuolumne River and its side streams. (Courtesy of Echo Cooperative)

The management plan for Tuolumne River Wild and Scenic River corridor, as well as the biological opinion on the plan issued by the U.S. Fish and Wildlife Service reference the threatened Yosemite Toad and the endangered Sierra Nevada Yellow-Legged Frog within the corridor.⁹¹ The National Fish and Wildlife Foundation developed a business plan to restore Sierra Nevada meadows based on several valuable services they provide, including habitat for listed species but also including water quality improvements, erosion prevention, and flow improvements.⁹² They identify a need for over \$200 million to accomplish goals on 200,000 to 300,000 acres of Sierra Nevada meadows.

Identifying and estimating the ecological benefits of restoring Hetch Hetchy Valley are beyond the scope of this analysis. Furthermore, biological and ecological expertise would be necessary to assess the potential benefits. Nevertheless, it is highly likely that restoring Hetch Hetchy Valley would provide habitat and other ecological benefits that are scarce and the focus of restoration and conservation efforts throughout the Sierra Nevada. Existing regional studies suggest habitat value benefits over the first decade of restoration alone as potentially worth more than \$100 million.

⁹⁰ Batker, D., Z. Christin, R. Schmidt, and I. Torre. 2013. Preliminary Assessment: The Economic Impact of the 2013 Rim Fire on Natural Lands. <http://www.eartheconomics.org/FileLibrary/file/Reports/Earth%20Economics%20Rim%20Fire%20Report%2011.27.2013.pdf>

⁹¹ Tuolumne River Plan/DEIS (National Park Service. 2014. *Tuolumne Wild and Scenic River Final Comprehensive Management Plan and Environmental Impact Statement*. Executive Summary. Retrieved from http://www.nps.gov/yose/getinvolved/trp_feis.htm); U.S. Fish and Wildlife Service. 2014. Biological Opinion on the Tuolumne Wild and Scenic River Plan. http://www.nps.gov/yose/learn/management/upload/20140620_TRP_Biological-Opinion_FINAL-1.pdf

⁹² National Fish and Wildlife Foundation. 2010. Sierra Nevada Meadow Restoration Business Plan. http://www.nfwf.org/sierranevada/Documents/Sierra_Meadow_Restoration_business_plan.pdf

SUMMARY AND CONCLUSION

The historical, geographical, scenic, and natural characteristics of Hetch Hetchy Valley suggest that restoration would generate substantial demand to visit, recreate, study, and generally enjoy the area. Furthermore, these characteristics in consideration of several comparable studies regarding passive-use values suggest that restoration would also be valuable to a large portion of the general public across California and the United States as a whole, even if they do not expect to visit. The data, studies, and analyses described in this report suggest that restoring Hetch Hetchy Valley would provide benefits worth many billions of dollars to society.

- **Net economic benefits** (consumer surplus) of recreational use would likely be \$1.5 to \$3 billion, or up to \$9 billion without discounting, assuming the high trip values.
- **Total gross economic use value** (expenditures plus consumer surplus) increase these values to \$2 to \$5 billion, or up to \$16.5 billion without discounting, assuming the high trip values.
- **When including passive-use values, quantifiable total economic values for restoring Hetch Hetchy** could expand deeper into the tens of billions of dollars when considering just California households, or \$100 billion when considering national households. Passive-use values of a restored Hetch Hetchy Valley would likely accrue to people outside of the United States as well.



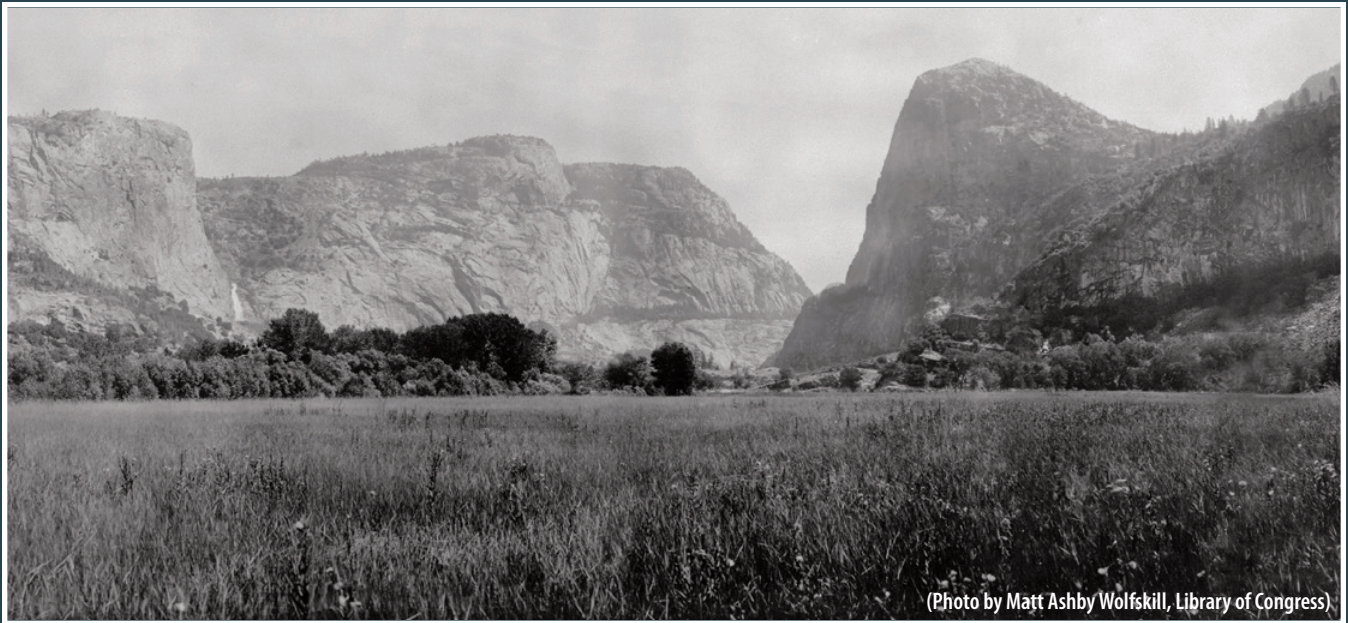
The specific means and outcome of efforts to restore Hetch Hetchy Valley would dictate the actual ways people could enjoy it, and the number of people who would receive those benefits. And the magnitude of these potential benefits certainly suggest restoration should be seriously considered. A more detailed and extensive national survey, independently administered with collaborative and broad participation from government and stakeholders, to better understand both visitation and passive-use values is warranted. Available evidence indicates from an economic perspective that the idea of restoring Hetch Hetchy Valley deserves consideration.

(Courtesy of Unsplash. Photo by Morgan David de Lossy.)





Yosemite Valley (Courtesy of Unsplash. Photo by Johannes Andersson.)



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