

Zion National Park: Enhancing Visitor Experience Through Improved Transportation

by

Jonathan Upchurch, P.E., P.T.O.E. and Tyler Hoskins, P.E.

Abstract

In the year 2000 Zion National Park introduced the Zion Canyon Shuttle to transport visitors into Zion Canyon while alleviating traffic congestion and improving visitor experience. Now in its 14th season of operation, the Shuttle is successfully accomplishing those goals and receives kudos from Park visitors.

Continued and increasing popularity of Zion National Park – now with 2.8 million visitors annually - has created new transportation challenges at the gateway to the Park. At the gateway area visitors arrive to the Park, usually via private automobile, and change mode to ride shuttle transportation into Zion Canyon. The challenges include waiting times of 10 to 22 minutes at the park's primary entrance station on many summer days, parking lots at the Park visitor center that are routinely filled to capacity between 11:30 a.m. and 2:30 p.m. on most summer days (forcing visitors to park their vehicles on the streets of Springdale - the Park's gateway community), insufficient parking for recreational vehicles, inadequate wayfinding for motorists and pedestrians, visitor crowding, and a variety of related issues.

This paper offers analyses of the primary transportation issues and describes alternatives for improving transportation and, in turn, visitor experience. The needed entrance station capacity to avoid queuing and waiting times is presented, along with alternatives for providing that level of capacity. An evaluation of parking demand and parking alternatives that are being considered by the Park are described.

Introduction

“Visitor Experience” is a concept and term widely used throughout the National Park Service. The agency wants visitors to have a great experience in national parks so that they will return again and again, to the same or other parks, and hold a strongly positive image of national parks and the scenic, cultural, and historic resources that are protected therein.

From a transportation standpoint anyone can think of many experiences that would be negative: a long waiting time to pass through the entrance station; roadway signing that makes it hard to find a destination in the park; difficulty in finding a parking place; a long waiting time for arrival and boarding of a shuttle bus; or a shuttle bus that is crowded (standing room only), hot, or otherwise uncomfortable. Visitor experience is also affected by the number of people in one place at one time (crowding on trails, for example), the quality of ranger interpretive programs, and a visitor's experience in lodging, at a campground, in a dining facility or at other visitor services.

The primary destination at Zion National Park is a narrow canyon, up to 4000 feet deep, carved in sandstone rock by the Virgin River. A roadway leads to the mouth of Zion Canyon and a scenic drive follows the river for a distance of about six miles, ending at a point where the canyon becomes so narrow that there is no longer room for a roadway. In the late-1990's, during peak season, visitors did not have a good visitor experience driving up Zion Canyon. There were too many vehicles on the roadway, parking was grossly inadequate compared to demand, natural resources were being damaged by vehicles parking in undesignated areas, air quality was poor, and noise pollution was heard in abundance. One visitor, who started driving up the canyon and never did find a parking space while driving six miles in and six miles out, referred to the experience as “a giant conga line”.

In the year 2000 Zion National Park introduced the Zion Canyon Shuttle to transport visitors into Zion Canyon while alleviating traffic congestion and improving visitor experience. Now, from late March until the end of October, visitors are not allowed to drive their personal vehicles on the six mile scenic drive. Instead, visitors are able to park their vehicles at the Zion Visitor Center (about two miles from the beginning of the scenic drive), board a shuttle bus, and ride up the canyon to eight different shuttle bus stops. Traffic and parking congestion along the six mile scenic drive no longer exist, air quality is much improved, noise pollution is low, and wildlife has re-emerged.



Increasing popularity of Zion National Park – now with 2.8 million visitors annually - has created new transportation challenges at the gateway to the Park, at and near the Park visitor center. This paper describes those challenges, how those problems were evaluated, and potential solutions. By characterizing and understanding the problems via traffic engineering study techniques, potential solutions were identified that solve the problems and minimize cost and adverse impacts.

Entrance Station Congestion

The primary entrance to Zion National Park is via the gateway community of Springdale, Utah, a town that lies immediately outside the Park. At this location, referred to as the South Entrance, over 468,000 vehicles entered the Park in 2011. Each of these vehicles must be processed to either pay an entrance fee or show that the visitor already holds an entry credential, be provided with information about the Park (map and Park newspaper), and be provided an opportunity to ask questions. Two lanes handle incoming vehicles, which are processed by National Park Service staff.

On busy days queueing and waiting is common at the South Entrance Station. Like any “bottleneck”, the arrival rate of vehicles is greater than the processing rate of the entrance station. It is simply a very specialized highway capacity problem. On the busiest days of the year there are accounts of queues two-thirds of a mile long with 35 minute waiting times to enter the Park. Queues this long back up far into Springdale on a two-lane, two-way roadway and interfere with access to tourist-oriented businesses. The queues also interfere with operation of a shuttle bus system that serves Springdale with access to the Park.

Using information and techniques developed by Upchurch at Arches, Mesa Verde, and Grand Canyon National Parks, it was determined that the current capacity of the Zion South Entrance is about 194 vehicles per hour. In comparison, the highest volume day in 2011 was Monday, May 30 when 3,056 vehicles passed through the entrance station. It is no surprise that there is congestion!



Clearly, improvements are needed at the South Entrance Station to increase its capacity and relieve congestion. Zion National Park would like to relieve congestion during the peak hour

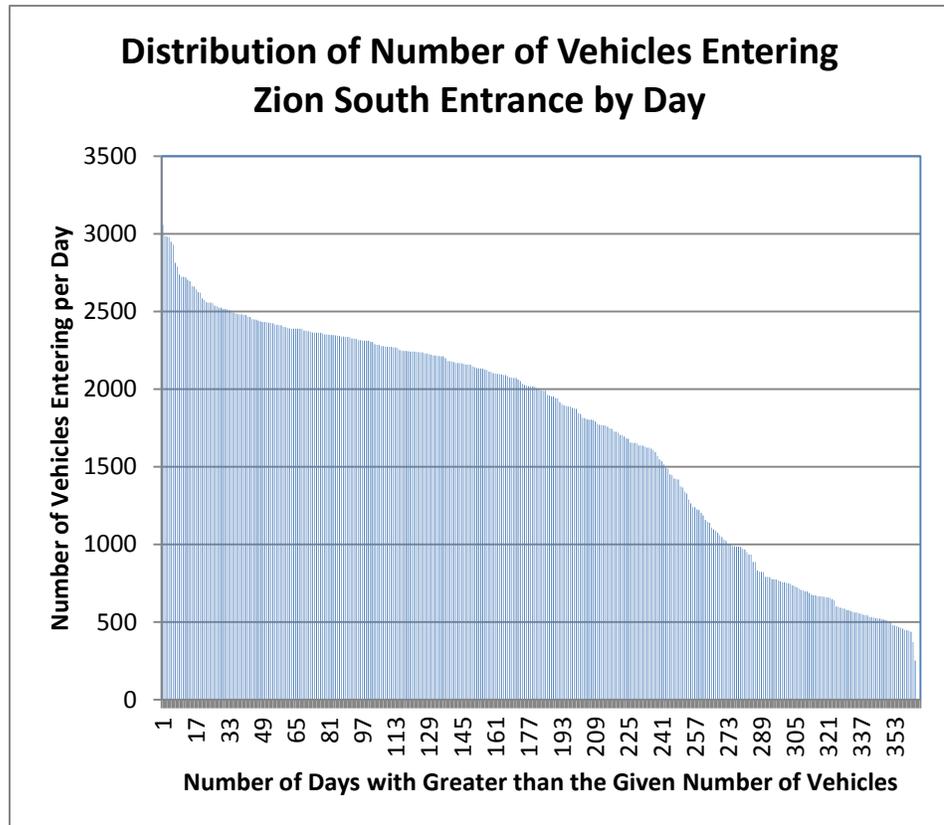
on most days of the year and would like to accommodate an increase in future visitation. What level of future demand should a new facility be designed to accommodate?

To answer this question, Zion National Park made three decisions.

The first decision was to select the peak hour of the day as the analysis time period. On July 7th, 2012, 10:00 a.m. to 11:00 a.m. was the one-hour long period that had the greatest number of vehicles arriving at the end of the entrance station queue. While the time of day at which the peak hour occurs may vary from one day to another, the intent is to be able to serve demand during the peak hour of the day.

The second decision was to select a “design day” for the South Entrance Station. Parks typically do not design facilities to accommodate the very highest day of visitation that is expected each year. It is not practical or economical to do so. Parks typically select a “design day” that is anywhere from the 5th highest to the 10th highest day of the year.

The adjacent figure illustrates the days of the year from the highest to lowest and reveals an inflection point at which the number of vehicles (visitation) jumps for a handful of high volume days of the year.



Zion National Park chose to use the 13th highest day of the year as the “design day”. This selection indicates that Park staff are willing to accept congestion and the need to implement traffic management measures on the 12 highest days of visitation each year. Those days include days that occur on the Memorial Day, Labor Day, and Fourth of July weekends.

The third decision was to decide for what level of future visitation the Park wants to design a new entrance station facility. If the Park invests in new entrance station facilities, it will want a facility that will serve for years and years to come without requiring additional improvements. What level of future visitation should be assumed to assure a facility that will avoid congestion for several years?

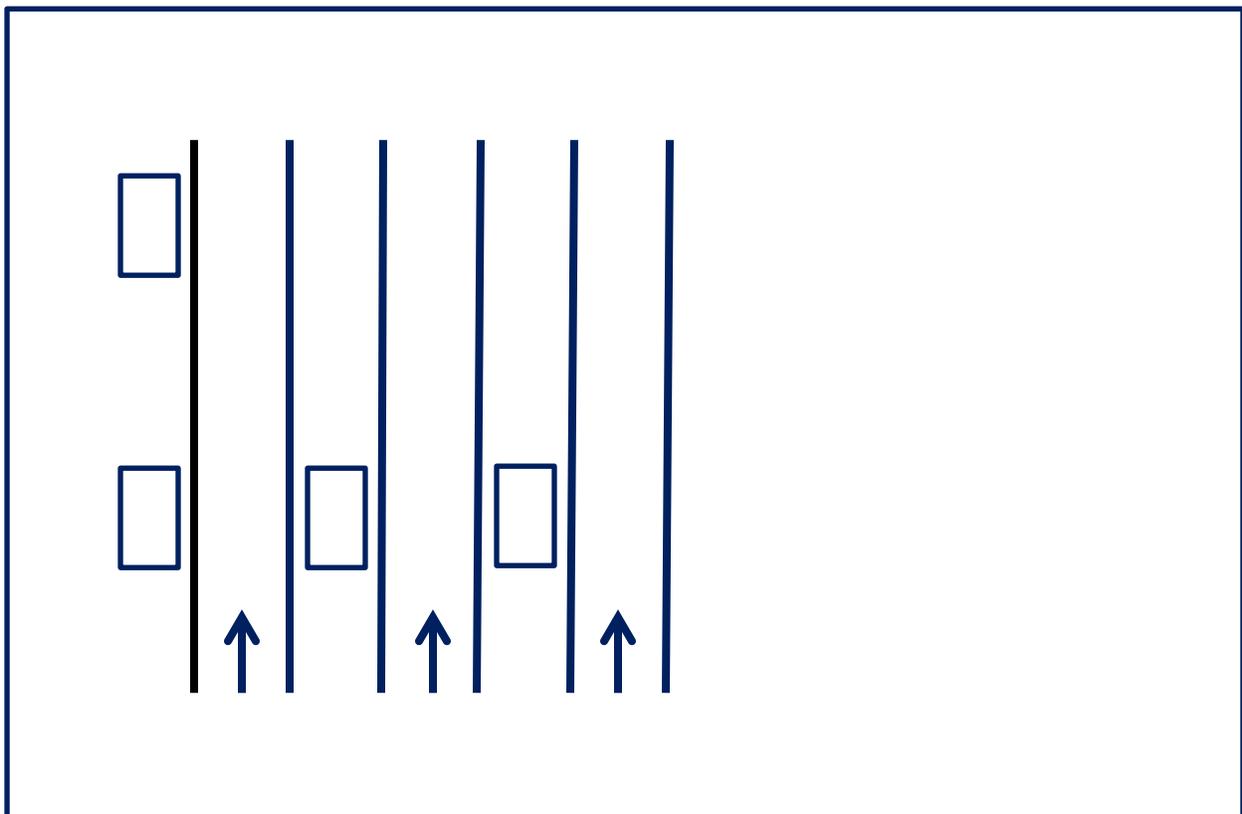
Zion National Park chose to use a level of future visitation that is 20 percent higher than in 2011. Based on recent growth in visitation, a 20 percent increase should accommodate several years of additional growth.

In terms of vehicles per hour arriving at the entrance station, what level of demand do these three decisions represent? The needed capacity to accommodate peak hour arrivals on the 13th highest day of the year and a 20 percent increase in visitation (over 2011) is 314 vehicles per hour. This compares to an existing capacity of about 194 vehicles per hour.

Through an analysis, several different configurations of the entrance station were identified that could provide the needed increase in capacity. The increase could be accomplished by adding lanes, providing an express lane for employees and visitors who already hold an entry credential, by “stacking” a lane (putting two fee collection booths upstream and downstream to serve to vehicles simultaneously), or some combination of the above. At a workshop involving many Park staff, Zion National Park selected three alternatives for consideration as planning proceeds for entrance station improvements.

Although a final decision has not yet been made, the alternative (Alternative G, see figure below) currently receiving the most attention would have three lanes. One lane would be a regular lane that could serve any vehicle entering the Park. A second lane would be an express lane that would serve any Park staff and official vehicles as well as any visitors who already hold an entry credential (visitors who do not have to purchase an entry credential). This lane would provide expedited entry to these customers, allowing them to bypass queues and thus have a shorter waiting time. A third lane would be a “stacked” lane that could process two vehicles simultaneously (the left hand lane in the figure, showing two booths for fee collection). The capacity of this configuration would be 364 vehicles per hour, well in excess of the 314 vehicles per hour associated with a 20 percent increase in visitation.

ALTERNATIVE G – 1 STACKED LANE PLUS 1 REGULAR LANE PLUS STAFFED EXPRESS AND EMPLOYEE LANE



Parking Congestion

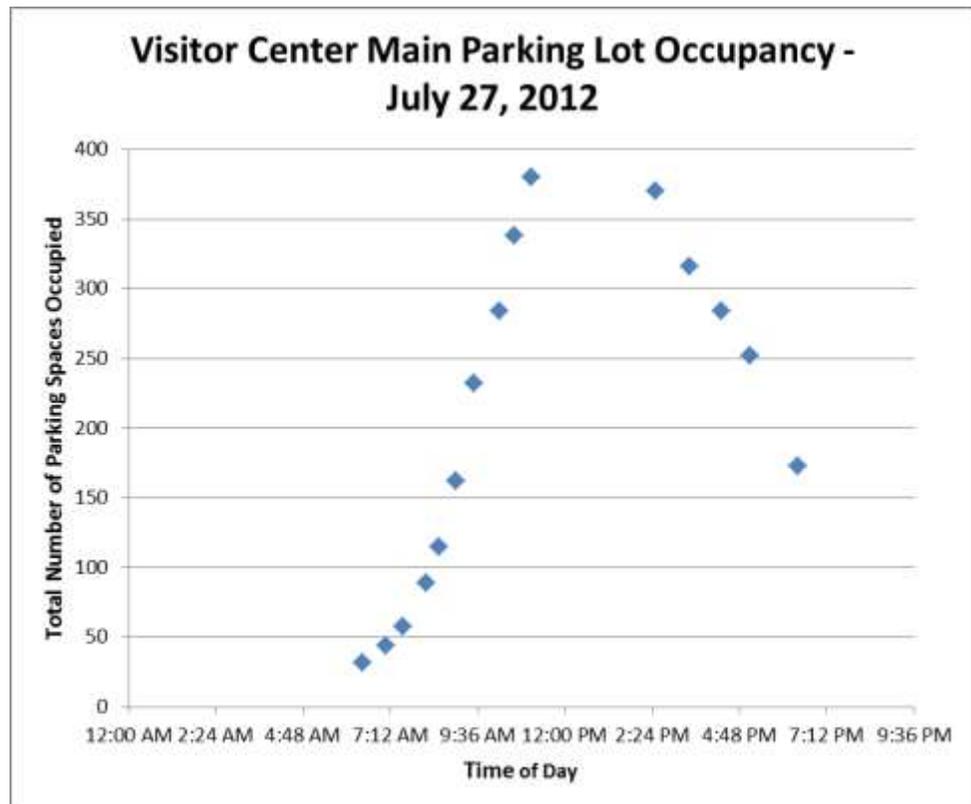
After passing through the South Entrance, many visitors proceed to the nearby visitor center. The visitor center serves as a source of information and includes exhibits and a bookstore. The visitor center also serves as the boarding point for the Zion Canyon Shuttle that takes visitors up Zion Canyon. Most visitors who go to the visitor center will, after parking their vehicle and visiting the visitor center, board the shuttle to visit Zion Canyon.

Two parking lots currently serve the visitor center. The main visitor center parking lot has 387 parking spaces and an overflow lot has about 127 parking spaces. The main visitor center parking lot and the overflow lot regularly fill to capacity. When this happens, visitors are encouraged to park their vehicles in the gateway community of Springdale. Zion actively manages the parking through the following steps.

1. The two parking lots are periodically monitored during late morning hours to determine if they are full or nearly full.
2. When the parking lots are nearly full, sandwich board signs are deployed advising visitors to park in the gateway community of Springdale (just outside the Park entrance). This can occur as early as 10:30 a.m. Fee collection staff at the South Entrance Station also encourage visitors to turn around and park in Springdale.
3. The two parking lots are periodically monitored during early afternoon hours to determine if empty spaces have become available.
4. When it is obvious that the parking lots are emptying faster than additional vehicles are arriving, the sandwich board signs are removed. This typically occurs in mid-afternoon.

How much of a parking shortfall exists at the visitor center? This is not necessarily an easy question to answer. In part, the answer depends on the level of visitation that Zion wants to accommodate. And, because visitation varies from day to day, there is a challenge in having a large enough sample size to understand what level of parking demand is associated with a given level of visitation.

Fortunately, Zion has a record of the time of day at which the parking lots became full and were “closed” and the time of day at which parking lots were

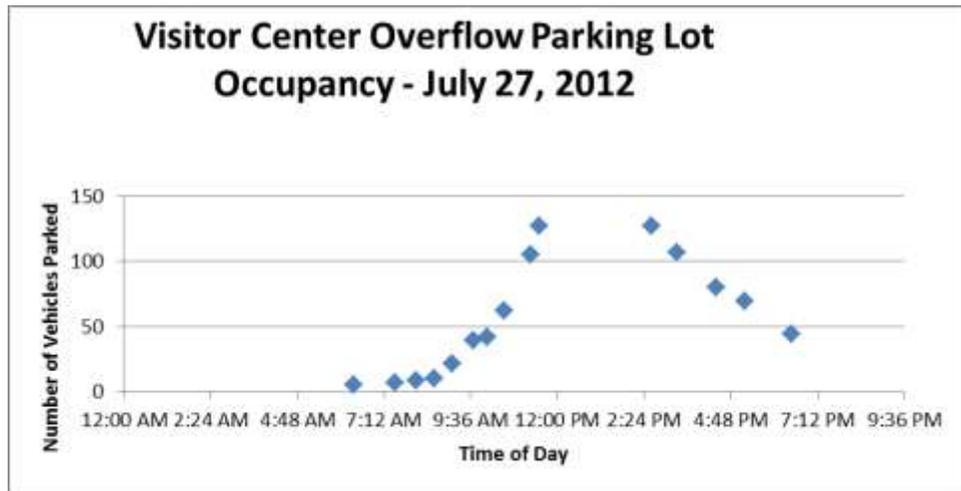


“re-opened”. In 2012 the parking lots became full on 109 out of the 153 days from April 1 through September 3. A shortage of parking is a frequent occurrence.

The term “parking occupancy” refers to the percentage of parking spaces that are occupied. The term represents how “full” is a parking lot. On July 27 parking occupancy of the main visitor center parking lot and the overflow lot were monitored at half-hour intervals. The accompanying figures illustrate how the tide of vehicles flows in during the morning hours, fills the parking lot, and then flows out in the afternoon.

The main visitor center parking lot has a total of 387 marked parking spaces, comprised of 355 regular spaces, 12 handicapped spaces, and 20 RV spaces. On July 27 this parking lot became full at about 11:00 a.m. and spaces began to open up at about 2:30 p.m.

The overflow parking lot does not have marked parking spaces (the surface is gravel), but it is observed to hold about 127 regular vehicles. On July 27 this parking lot became full at about 11:30 a.m. and spaces began to open up at about 2:30 p.m. As a



frame of reference, 2660 vehicles entered the Park at the South Entrance on this date, a visitation level that is equivalent to the sixteenth highest day in 2011.

The next figure illustrates the time of day at which parking lots filled as a function of the number of vehicles entering at the South Entrance Station. This data is for the 109 days between April 1 and September 3, 2012 on which the parking lots were “closed” because they were full.

In general, the higher the visitation on a given day (represented by the number of vehicles entering the Park at the South Entrance), the earlier the parking lots become full. The diagonal trend line is fitted to the 109 data points.

When visitation is below 2000 entering vehicles per day, the parking lots almost never fill. When visitation is above 2000 entering vehicles, the parking lots eventually fill, sometimes later in the day and, when visitation is higher, earlier in the day. The data show that the 514 parking spaces in the two parking lots are sufficient when visitation is at or below 2000 entering vehicles per day and when visitors behave as they do now. An important point is that some visitors leave their vehicles in Springdale because they know that there is a parking shortage within the Park.

How many additional parking spaces would be needed, currently, to satisfy parking demand on the 13th highest day of the year? Right now it appears that 26 parking spaces for every 100 daily vehicles entering the Park will meet parking demand (this is the same ratio as 514 parking spaces per 2000 entering vehicles). The 13th highest day of the year currently has 2704 vehicles entering at the South Entrance. Therefore, to accommodate a visitation of 2704 entering vehicles there would need to be 703 parking spaces, or about 190 more than currently exist. (2704 entering vehicles x 26 parking spaces per 100 entering vehicles = 703 parking spaces) Again, this assumes that visitor behavior does not change. If visitors



perceive that there is no longer a shortage of parking within the Park, fewer visitors will leave their vehicles in Springdale and latent demand will cause total parking demand to exceed capacity. If Zion wants to accommodate a 20 percent increase in visitation (as is being done for the South Entrance Station), then 844 parking spaces would be needed.

In addition to a shortage of general parking, there is also a shortage of parking for recreational vehicles (RVs). The main visitor center parking lot has 20 RV parking spaces. On one typical summer day, 26 RVs were occupying the 20 spaces. Additional RVs were observed cruising through the parking lot, seeking a parking space when no spaces were available.

Zion National Park is currently considering alternatives that would increase the total parking near the visitor center to a total of 615 to 795 parking spaces.

Additional Issues

There are several locations along the route from the South Entrance Station to the visitor center that have challenging roadway geometrics and operational issues. These locations make it harder for visitors who are unfamiliar with the area to navigate to the visitor center. The first location is the short merge area that currently exists between the two-lane entrance station and a right turn to the visitor center. Some visitors fail to make the right turn because of the short distance. An additional challenge is that large trucks occasionally arrive at the entrance station and learn that, because of the truck size and a roadway tunnel a few miles up the road, that they cannot continue into the Park and must turn around. Currently there is no

geometrically adequate location near the entrance station for large trucks to turn around and frequently trucks block traffic while they make a five point turn.

The second location is in the vicinity of the bridge over the Virgin River and adjacent to the overflow parking lot where much pedestrian crossing activity takes place. Although there are designated crosswalks, most pedestrians cross the roadway at other locations. The mix of pedestrian and vehicular traffic is a safety issue, especially during busy times. In addition to not using the crosswalks, pedestrians will also walk along the narrow shoulder of the roadway and walk into the intersections that are being used by the shuttle buses and vehicles to accommodate visitors. This creates undue delay to the vehicles on the roadway that must then navigate around the pedestrians.

The third location is the configuration of the intersection at the entrance to the visitor center main parking lot. The west leg of the intersection is at a skew to the intersection and creates confusion in entering and exiting the parking lot. The visitor center parking lot also has a poor circulation pattern and requires visitors to traverse longer distances in the parking lot to find an empty space.

In order to remedy all of these geometric challenges and operational issues, the National Park Service sought our help to develop solutions. Several options were developed and narrowed down to two through discussions with Park staff. These options, along with entrance station improvements, expanded parking, and traffic inputs were modeled in VISSIM. The model simulated both current traffic flow and future traffic flow with physical improvements in place. Animation of improved traffic conditions will be used to convince Park Service decision-makers that visitor experience can be improved with adequate funding.

Summary

A very successful Zion Canyon Shuttle system has relieved traffic and parking congestion and other adverse impacts within Zion Canyon. With continued growth in visitation, transportation issues have now developed near the Park entrance and visitor center – the locations where visitors enter the Park and leave their private vehicles to board the Zion Canyon shuttle. By characterizing and understanding these problems via traffic engineering study techniques, potential solutions were identified that solve the problems and minimize cost and adverse impacts. By now planning, designing, and implementing solutions, Zion National Park will improve visitor experience.

Author Contact Information

Jonathan Upchurch, P.E., P.T.O.E.
Transportation Engineering Consultant
1910 North Cochise Way
Ivins, UT 84738
435-673-2290
upchurch@ecs.umass.edu

Tyler Hoskins, P.E.
Southwest Consulting Services
435 East Tabernacle, Suite 302
St. George, UT 84770
435-986-3622
tyler@scs-eng.com