

# Evaluation of an Adaptive Traffic Signal System

## *BEFORE & AFTER STUDY*

*Crow Canyon Road and Bollinger Canyon Road in San Ramon, California*

*Prepared for:*

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## Evaluation of an Adaptive Traffic Signal System: CROW CANYON ROAD AND BOLLINGER CANYON ROAD IN SAN RAMON, CALIFORNIA

### 1.0 INTRODUCTION

This report is intended to evaluate the traffic operational effectiveness of the adaptive traffic signal system installed on Bollinger Canyon Road and Crow Canyon Road. The evaluation was based on comparison of traffic operational field data collected both before and after deployment of the adaptive signal system. Measures of effectiveness compared between periods before and after system implementation included travel time, stop frequency, stopped delay, minor-street delay, traffic speed profile, fuel consumption, and emissions.

#### 1.1 Background

The City of San Ramon has engaged with Rhythm Engineering to provide the InSync Adaptive Traffic Management System for deployment along two corridors:

- Bollinger Canyon Road – between Sunset Drive, which is about 0.3 miles east of Interstate 680, and Alcosta Boulevard
- Crow Canyon Road – between Crow Canyon Place, which is about 0.2 miles east of Interstate 680, and Tahiti Drive/El Capitan Drive

The InSync adaptive traffic signal system was installed in August 2010, to reduce travel time and delay along the corridor, as well as the fuel consumption, vehicle emissions and the average number of stops.

#### 1.2 Organization of This Report

Section 2, explains the measures of effectiveness for both the before and after system installation. The methods by which these were obtained are explained in further detail within this section. The discussion includes travel time runs, minor street delay studies, and volume counts.

Section 3 presents the results and analysis of the field studies including the statistical comparison of travel time, the fuel consumption, emissions, minor street delay, number of stops and time spent in congestion between the before and after periods.

Section 4 presents the conclusions of the study.

## 2.0 DATA COLLECTION

The corridor along Bollinger Canyon Road includes five signalized intersections between Sunset Drive and Alcosta Boulevard as shown below:

1. Sunset Drive & Bollinger Canyon Road
2. Camino Ramon & Bollinger Canyon Road
3. Iron Horse Trail & Bollinger Canyon Road
4. Market Place & Bollinger Canyon Road
5. Alcosta Boulevard & Bollinger Canyon Road

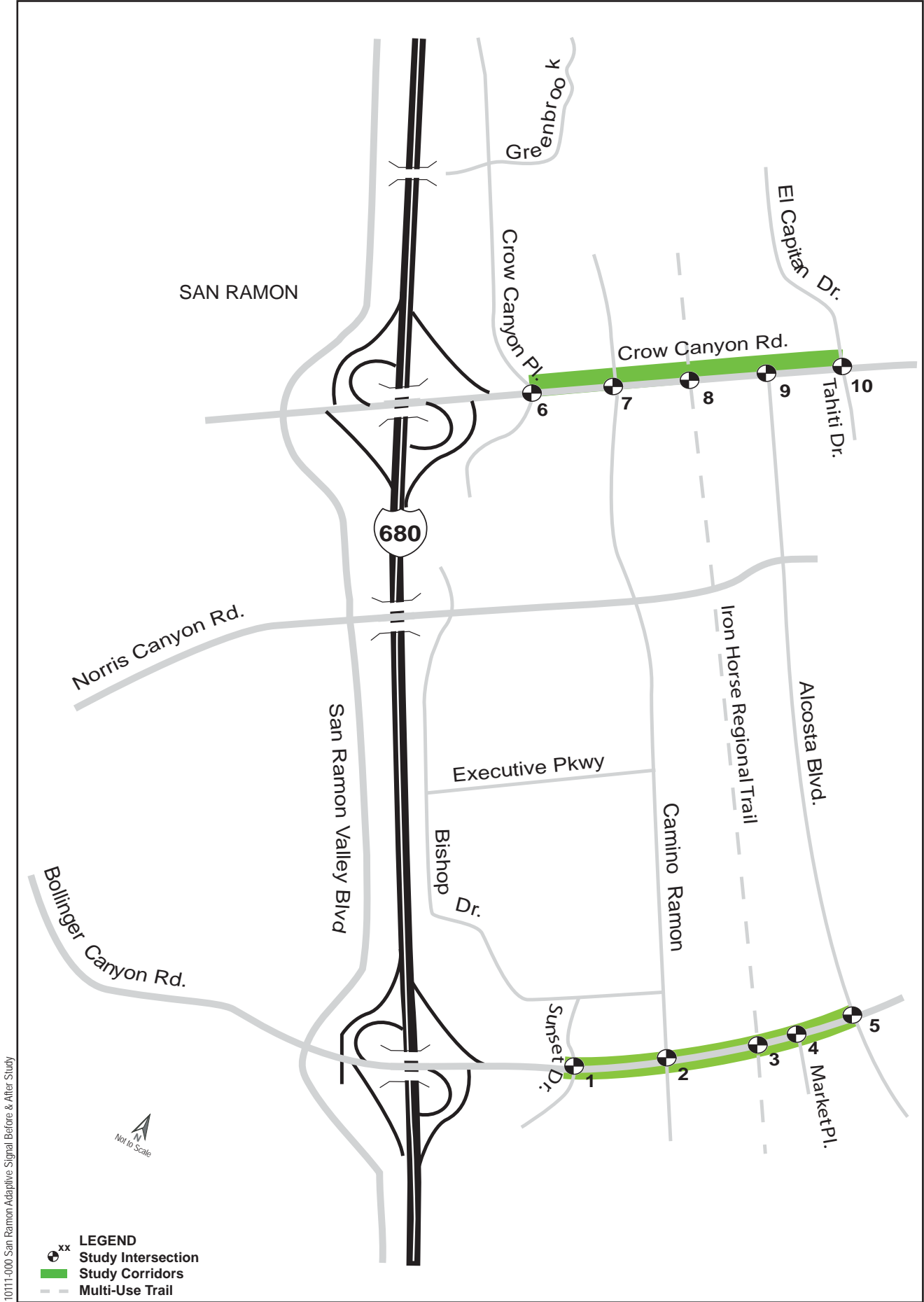
The corridor is approximately 0.55 mile in length, and the signal spacing varies from about 350 and 1,000 feet.

The corridor along Crow Canyon Road includes five signalized intersections also between Crow Canyon Place and Tahiti Drive/El Capitan Drive as shown below:

6. Crow Canyon Place & Crow Canyon Road
7. Camino Ramon & Crow Canyon Road
8. Iron Horse Trail & Crow Canyon Road
9. Alcosta Boulevard & Crow Canyon Road
10. Tahiti Drive/El Capitan Drive & Crow Canyon Road

The corridor is approximately 0.59 mile in length, and the signal spacing varies between around 700 and 900 feet.

**Figure 1** shows a map of both corridors with each study intersection labeled.



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FIGURE 1  
Study Area

## 2.1 Field Study Description

Field data was collected along the study corridors in July 2010 prior to the installation of the InSync system. The data collected during this period was used as the baseline for comparing measures of effectiveness. Data was collected again in September 2010 after the InSync system was installed and had been in operation for several weeks.

The July 2010 survey was conducted while school was not in session. This differs from the September 2010 survey which was conducted during the school year. This difference is noteworthy because the traffic demands and patterns typically vary depending on whether or not schools are in session and if there are any schools near the study area. The implications of this condition will be discussed in further detail in Section 4.0 of this report.

Field studies included the following data collection activities for both corridors:

- **Travel Time Runs** – through the corridor in both directions during four time-of-day periods (7:00 to 9:00 AM, 9:00 to 11:00 AM, 11:30 AM to 1:30 PM and 4:30 to 6:30 PM) on Tuesday, Wednesday, and Thursday from July 13<sup>th</sup>-15<sup>th</sup>, 2010 before system installation and on Tuesday, Wednesday, and Thursday from September 14<sup>th</sup>-16<sup>th</sup>, 2010 after system installation.
- **Minor Street Delay** – using the HCM method on the northbound and southbound approaches of two intersections along each study corridor (Sunset Drive and Alcosta Boulevard at Bollinger Canyon Road; Crow Canyon Place and Camino Ramon at Crow Canyon Road). Each approach was observed during the same four time-of-day periods as for Travel time runs (7:00 to 9:00 AM, 9:00 to 11:00 AM, 11:30 AM to 1:30 PM and 4:30 to 6:30 PM) on Thursday, July 15<sup>th</sup>, 2010 to represent the before system installation and on Thursday, September 16<sup>th</sup>, 2010 to represent the after system installation.
- **Traffic Volumes** – Bi-directional 3-day counts at two locations along each corridor (Just east of Crow Canyon Place and between Alcosta Boulevard and Tahiti Drive/El Capitan Drive at Crow Canyon Road; between Sunset Drive and Camino Ramon and between Market Place and Alcosta Boulevard at Bollinger Canyon Road) on Tuesday, Wednesday and Thursday July 13<sup>th</sup> – 15<sup>th</sup>, 2010 before system installation and on Tuesday, Wednesday, and Thursday from September 14<sup>th</sup>-16<sup>th</sup>, 2010 after system installation.

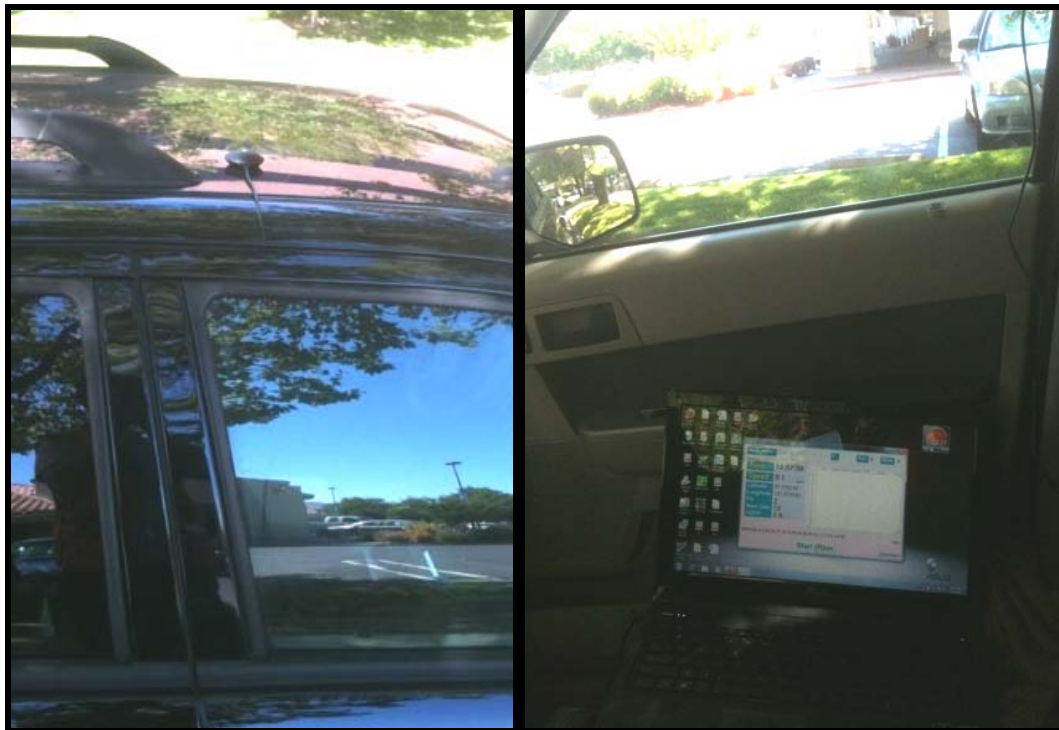
## 2.2 Travel Time Runs

The travel time study involved measuring the time required for each of a series of vehicle runs through each study corridor. Four vehicle runs in each direction of travel

were conducted on each of three (3) days (Tuesday, Wednesday and Thursday) during each of the following time periods:

- AM Peak (7:00 to 9:00 AM)
- AM Off-Peak (9:00 to 11:00 AM)
- Midday Peak (11:30 AM to 1:30 PM)
- PM Peak (4:30 to 6:30 PM)

Travel times were measured using a standard portable laptop computer operating the PC-Travel software connected to a roof mounted GPS receiver, as shown in **Figure 2**. This system is essentially “hands-free” allowing the operator to focus their attention on driving the vehicle while the laptop and GPS receiver records the vehicle trajectory and position data at one second intervals.



**FIGURE 2 GPS DATA COLLECTION HARDWARE**

The drivers conducting the travel time runs inserted their vehicles as a “floating car” into the traffic streams along the study corridors. These drivers were instructed to drive with the flow of traffic and to pass as many cars as they are passed by. This technique should ensure that the information gathered by the travel time collection vehicles does indeed represent the average vehicle traveling through the corridor.

**Table 1** shows the number of travel time runs that were completed during each of the time periods, in each direction, for each study corridor.

Travel time results are presented in **Section 3**.

**TABLE 1 NUMBER OF COMPLETED TRAVEL TIME RUNS**

Direction	Test Period	Number of Completed Travel Time Runs			
		AM Peak (7 - 9AM)	AM Off-Peak (9 - 11 AM)	Midday Peak (11:30AM – 1:30 PM)	PM Peak (4:30PM - 6:30PM)
Bollinger Canyon Road					
Eastbound	Before	12	12	12	12
	After	12	12	12	12
Westbound	Before	12	12	12	12
	After	12	12	12	12
Crow Canyon Road					
Eastbound	Before	12	12	12	12
	After	12	12	12	12
Westbound	Before	12	12	12	12
	After	12	12	12	12

Source: DKS Associates, September 2010

### 2.3 Minor Street Delay

Minor street delay was measured for minor street approaches at two selected intersections along each study corridor on the same day as the travel time runs and during the following four hours: 7:30-8:30AM, 9:30-10:30AM, 12:00-1:00 PM and 5:00-6:00 PM. The minor streets delay studies were conducted at the following intersections:

- Sunset Drive at Bollinger Canyon Road
- Alcosta Boulevard at Bollinger Canyon Road
- Crow Canyon Place at Crow Canyon Road
- Camino Ramon at Crow Canyon Road

Minor street delays were estimated based on the methodology described in the *Highway Capacity Manual* (HCM, Chapter 16). Based on this method, in order to estimate the minor-street delay directly, at regular intervals between 10 and 20 seconds, the number of vehicles in queue needs to be recorded during a defined survey period. In addition, all the vehicles that arrived within the survey period need to be defined as either “stopped vehicles” or “through vehicles” at each interval.

In this study, a 16-second interval and a 60-minute study period were defined. The measurement was done by using video cameras mounted on temporary poles and aimed toward each minor street approach. These cameras were set up to record all the vehicular activities on the minor street approaches at the four intersections. **Figure 3** shows one of these cameras and its temporary set-up. The post-processing involved staff viewing the video and documenting the number of vehicles-in-queue and defining each vehicle that approached the intersection as either “stopped” or “through”. The video footage is available for additional analysis, if required.

Results of the Minor Street Delay study are presented in **Section 3**.



**FIGURE 3 VIDEO CAMERA HARDWARE ON SUNSET DR/BOLLINGER CANYON RD**

## **2.4 Traffic Volume Counts**

Traffic volume counts were conducted using road tubes in both the eastbound and westbound directions at four locations along both study corridors. The following locations were counted:

- Along Crow Canyon Road just east of Crow Canyon Place
- Along Crow Canyon Road between Alcosta Boulevard and Tahiti Drive/El Capitan Drive
- Along Bollinger Canyon Road between Sunset Drive and Camino Ramon
- Along Bollinger Canyon Road between Market Place and Alcosta Boulevard

Traffic counts were conducted continuously for three days at these locations to establish the general traffic environment and to provide a point of comparison between the before period and after periods for this study.

Traffic volumes were collected for this study from Tuesday, July 13<sup>th</sup>, 2010 to Thursday, July 15<sup>th</sup>, 2010 before the system installation and from Tuesday, September 14<sup>th</sup>, 2010 to Thursday, September 16<sup>th</sup>, 2010 after system installation. **Figure 4** shows one of the roadway tubes in position. Results of traffic volume counts are presented in **Table 2**.



**FIGURE 4 ROADWAY TUBE COUNTER HARDWARE**

**TABLE 2 COMPARISONS OF TRAFFIC COUNTS**

Direction	Location	Test Period	Observed Average Traffic Count			
			AM Peak (7-9 am)	AM off-peak (9-11 am)	Midday Peak (11:30 am-1:30pm)	PM Peak (4:30 pm-6:30 pm)
Bollinger Canyon Road						
Eastbound	Between Sunset Dr and Camino Ramon	Before	3165	2293	2452	3296
		After	2944	2134	2277	3792
		% Diff.	-7.0%	-6.9%	-7.1%	15.0%
	Between Market Pl and Alcosta Blvd	Before	989	1309	1871	3050
		After	1108	1391	1745	3500
		% Diff.	12.0%	6.3%	-6.7%	14.8%
Westbound	Between Sunset Dr and Camino Ramon	Before	3213	2361	2634	3038
		After	3497	2264	2522	3325
		% Diff.	8.8%	-4.1%	-4.3%	9.4%
	Between Market Pl and Alcosta Blvd	Before	2884	2184	1930	1549
		After	2641	1665	1348	1286
		% Diff.	-8.4%	-23.8%	-30.2%	-17.0%
Crow Canyon Road						
Eastbound	East of Crow Canyon Pl	Before	2612	2212	2314	2809
		After	2687	2245	2309	2907
		% Diff.	2.9%	1.5%	-0.2%	3.5%
	Between Alcosta Blvd and El Capitan Dr	Before	1093	1507	2247	3807
		After	1135	1344	2058	3896
		% Diff.	3.8%	-10.8%	-8.4%	2.3%
Westbound	East of Crow Canyon Pl	Before	2580	2406	2676	2856
		After	2710	2289	2412	3082
		% Diff.	5.0%	-4.9%	-9.9%	7.9%
	Between Alcosta Blvd and El Capitan Dr	Before	2821	2020	1827	1491
		After	3672	2360	1990	2042
		% Diff.	30%	17%	9%	37%

Source: DKS Associates, September 2010

## 3.0 RESULTS

In preparation for completing a before and after study analyzing the performance of the InSync system along these two study corridors, measures of effectiveness are identified, documented and discussed in this section. Comparisons of the before and after data will be made by direction of travel, study corridor and time of day.

### 3.1 Measure of Effectiveness Definitions

This section contains a brief description of the measures of effectiveness used for this study.

**Travel Time** – The time (in seconds) for the data collection vehicle to travel through the corridor from the center of the first intersection to the center of the last intersection.

**Number of Stops** – The number of times where the data collection vehicle was traveling at a speed less than or equal to 5 MPH along the corridor.

**Average Speed** – The measured distance from the center of the first intersection to the center of the last intersection of the corridor divided by the average travel time to traverse the corridor, expressed in MPH.

**Total Delay** – The actual travel time through the corridor for each run minus the time it would have taken if the vehicle were to travel unimpeded through the same distance at the posted speed limit of 40 MPH. Total Delay includes time spent during deceleration as the vehicle approaches the back of a queue or a red signal phase, acceleration away from the signal to get back to free flow speed, and the time spent stopped during a red phase.

**Stopped Time** – The amount of time (in seconds) where the data collection vehicle was traveling at a speed less than or equal to 5 MPH along the corridor.

**Congested Time** – Similar to stopped time, the amount of time spent (in seconds) per run where the data collection vehicle was traveling at a speed less than or equal to either 20 or 30 MPH. For this study, two speeds were chosen as thresholds representing different steps of congestion.

**Fuel Consumption** – The fuel consumption in gallons for a typical passenger car is estimated by the PC-Travel software. This value is not explicitly measured, but is approximated based on speed and acceleration data collected by the PC-Travel software.

**Emissions** – The emissions of carbon monoxide (CO), and oxides of nitrogen (NO<sub>x</sub>), measured in grams, as estimated by the PC-Travel software. These values are not

explicitly measured, but are approximated based on speed and acceleration data collected by the PC-Travel software.

The overall results for all measures of effectiveness are shown in **Table 3** through **Table 6** for each corridor on each direction.

### **3.2 Travel Time through the Corridor**

The total travel time for each run through the corridor was used as the primary measure of effectiveness. The travel time through each corridor was averaged over all the runs for a given time period, and direction of travel.

**TABLE 3 SUMMARY OF BOLLINGER CANYON ROAD EASTBOUND TRAVEL TIME RUNS**

Time Period	Test Period	Average Travel Time	Average Number of Stops	Average Speed	Average Delay	Average Time <=5mph	Average Time <=20mph	Average Time <=30mph	Average Fuel Consumption	Average HC	Average CO	Average Nox
		(sec)	(No.)	(mph)	(sec)	(sec)	(sec)	(sec)	(gal)	(g)	(g)	(g)
AM Peak (7 - 9AM)	Before	86.7	1.1	22.6	38.3	28.9	35.7	43.8	0.035	3.75	39.92	2.40
	After	64.0	0.2	29.6	15.6	11.9	13.0	17.7	0.028	2.83	33.58	1.75
	% Diff.	-26.2%	-81.8%	31.0%	-59.3%	-58.8%	-63.6%	-59.6%	-20.0%	-24.5%	-15.9%	-27.1%
AM Off-Peak (9 - 11 AM)	Before	70.6	0.7	27.8	21.9	11.9	18.8	29.8	0.030	3.03	31.24	1.97
	After	64.5	0.6	29.3	16.9	8.3	14.1	23.9	0.031	3.44	37.77	2.45
	% Diff.	-8.6%	-14.3%	5.4%	-22.8%	-30.3%	-25.0%	-19.8%	3.3%	13.5%	20.9%	24.4%
Midday Peak (11:30AM - 1:30 PM)	Before	114.1	1.5	17.1	64.4	45.2	60.4	80.4	0.039	4.18	39.12	2.47
	After	71.8	0.7	26.4	23.0	9.6	17.4	35.2	0.032	3.59	36.10	2.53
	% Diff.	-37.1%	-53.3%	54.4%	-64.3%	-78.8%	-71.2%	-56.2%	-17.9%	-14.1%	-7.7%	2.4%
PM Peak (4:30 - 6:30PM)	Before	79.5	0.6	24.6	30.1	17.8	26.4	41.1	0.032	3.36	34.37	2.15
	After	83.9	0.6	22.6	35.6	22.6	29.9	47.5	0.032	3.39	34.74	2.10
	% Diff.	5.5%	0.0%	-8.1%	18.3%	27.0%	13.3%	15.6%	0.0%	0.9%	1.1%	-2.3%

Source: DKS Associates, September 2010

**TABLE 4 SUMMARY OF BOLLINGER CANYON ROAD WESTBOUND TRAVEL TIME RUNS**

Time Period	Test Period	Average Travel Time	Average Number of Stops	Average Speed	Average Delay	Average Time <=5mph	Average Time <=20mph	Average Time <=30mph	Average Fuel Consumption	Average HC	Average CO	Average Nox
		(sec)	(No.)	(mph)	(sec)	(sec)	(sec)	(sec)	(gal)	(g)	(g)	(g)
AM Peak (7 - 9AM)	Before	108.5	2.0	17.9	59.1	41.3	57.5	72.5	0.040	4.41	40.69	2.85
	After	69.9	0.4	26.8	22.7	12.9	18.3	29.7	0.031	3.45	36.92	2.37
	% Diff.	-35.6%	-80.0%	49.7%	-61.6%	-68.8%	-68.2%	-59.0%	-22.5%	-21.8%	-9.3%	-16.8%
AM Off-Peak (9 - 11 AM)	Before	84.2	1.0	23.2	35.5	24.4	34.1	42.3	0.034	3.6	37.53	2.31
	After	79.5	1.0	23.6	32.8	23.0	31.9	40.2	0.037	4.29	45.40	3.06
	% Diff.	-5.6%	0.0%	1.7%	-7.6%	-5.7%	-6.5%	-5.0%	8.8%	19.2%	21.0%	32.5%
Midday Peak (11:30AM - 1:30 PM)	Before	102	1.3	19.0	53.9	39.5	52.7	64.4	0.038	4.24	41.86	2.70
	After	73.7	0.5	25.6	25.5	19.0	22.4	29.0	0.031	3.21	34.68	2.04
	% Diff.	-27.7%	-61.5%	34.7%	-52.7%	-51.9%	-57.5%	-55.0%	-18.4%	-24.3%	-17.2%	-24.4%
PM Peak (4:30 - 6:30PM)	Before	145.7	2.2	13.4	96.5	73.7	93.4	115.6	0.047	5.22	45.72	3.06
	After	72.5	0.6	26.0	24.3	12.6	20.8	32.8	0.030	3.26	33.35	2.16
	% Diff.	-50.2%	-72.7%	94.0%	-74.8%	-82.9%	-77.7%	-71.6%	-36.2%	-37.5%	-27.1%	-29.4%

Source: DKS Associates, September 2010

**TABLE 5 SUMMARY OF CROW CANYON ROAD EASTBOUND TRAVEL TIME RUNS**

Time Period	Test Period	Average Travel Time	Average Number of Stops	Average Speed	Average Delay	Average Time <=5mph	Average Time <=20mph	Average Time <=30mph	Average Fuel Consumption	Average HC	Average CO	Average Nox
		(sec)	(No.)	(mph)	(sec)	(sec)	(sec)	(sec)	(gal)	(g)	(g)	(g)
AM Peak (7 - 9AM)	Before	86.1	1.2	24.4	36.3	22.6	33.7	48.4	0.041	4.71	49.15	3.42
	After	70.0	0.7	29.6	19.0	10.2	16.7	24.9	0.035	3.94	43.49	2.86
	% Diff.	-18.7%	-41.7%	21.3%	-47.7%	-54.9%	-50.4%	-48.6%	-14.6%	-16.3%	-11.5%	-16.4%
AM Off-Peak (9 - 11 AM)	Before	95.6	1.6	22.0	44.1	26.6	40.5	58.8	0.043	5.03	48.84	3.67
	After	65.9	0.5	31.6	14.9	7.5	13.3	21.3	0.036	4.16	47.47	3.13
	% Diff.	-31.1%	-68.8%	43.6%	-66.2%	-71.8%	-67.2%	-63.8%	-16.3%	-17.3%	-2.8%	-14.7%
Midday Peak (11:30AM - 1:30 PM)	Before	108.6	1.6	19.5	56.7	41.8	54.5	69.3	0.043	4.83	48.78	3.17
	After	83.3	0.7	25.1	31.3	18.4	28.8	40.3	0.036	4.16	44.01	2.89
	% Diff.	-23.3%	-56.3%	28.7%	-44.8%	-56.0%	-47.2%	-41.8%	-16.3%	-13.9%	-9.8%	-8.8%
PM Peak (4:30 - 6:30PM)	Before	90.9	1.0	22.9	40.8	28.5	37.5	52.1	0.040	4.53	47.04	3.14
	After	90.9	1.0	22.9	39.2	25.4	35.6	48.8	0.038	4.26	42.79	2.91
	% Diff.	0.0%	0.0%	0.0%	-3.9%	-10.9%	-5.1%	-6.3%	-5.0%	-6.0%	-9.0%	-7.3%

Source: DKS Associates, September 2010

**TABLE 6 SUMMARY OF CROW CANYON ROAD WESTBOUND TRAVEL TIME RUNS**

Time Period	Test Period	Average Travel Time	Average Number of Stops	Average Speed	Average Delay	Average Time <=5mph	Average Time <=20mph	Average Time <=30mph	Average Fuel Consumption	Average HC	Average CO	Average Nox
		(sec)	(No.)	(mph)	(sec)	(sec)	(sec)	(sec)	(gal)	(g)	(g)	(g)
AM Peak (7 - 9AM)	Before	102.6	1.0	20.1	53.1	40.6	49.8	64.9	0.037	3.70	39.24	2.06
	After	57.0	0.2	33.9	8.1	3.0	6.0	11.1	0.026	2.45	28.98	1.52
	% Diff.	-44.4%	-80.0%	68.7%	-84.7%	-92.6%	-88.0%	-82.9%	-29.7%	-33.8%	-26.1%	-26.2%
AM Off-Peak (9 - 11 AM)	Before	92.8	1.2	22.3	42.9	26.9	39.9	57.9	0.037	3.81	39.18	2.39
	After	74.2	0.5	26.1	25.9	20.8	26.2	31.1	0.032	3.19	37.14	1.96
	% Diff.	-20.0%	-58.3%	17.0%	-39.6%	-22.7%	-34.3%	-46.3%	-13.5%	-16.3%	-5.2%	-18.0%
Midday Peak (11:30AM - 1:30 PM)	Before	139.3	1.9	14.8	88.5	67.0	87.8	109.1	0.046	4.92	46.13	2.79
	After	79.1	1.0	24.7	31.0	23.6	30.9	37.7	0.032	3.06	34.38	1.79
	% Diff.	-43.2%	-47.4%	66.9%	-65.0%	-64.8%	-64.8%	-65.4%	-30.4%	-37.8%	-25.5%	-35.8%
PM Peak (4:30 - 6:30PM)	Before	157.6	2.7	13.2	106.9	80.8	110.3	126.9	0.049	5.12	47.81	2.70
	After	108.6	1.3	18.0	60.2	46.5	60.3	69.7	0.038	3.83	38.50	2.13
	% Diff.	-31.1%	-51.9%	36.4%	-43.7%	-42.5%	-45.3%	-45.1%	-22.4%	-25.2%	-19.5%	-21.1%

Source: DKS Associates, September 2010

### **3.3 Delay at Individual Intersections**

Delay was measured along the major street approaches at each intersection. It should be mentioned that the delay caused by any particular intersection may extend to the neighboring upstream intersection. A vehicle may be accelerating from the one signal when it is then has to decelerate for the next signal before reaching the free flow speed. Because these signals are closely spaced and operate as a network of intersections, it may be impossible to truly isolate the delay caused by individual signals.

Vehicles arriving at the study corridor may be influenced by the coordinated signals directly upstream of the first study intersection. For this reason, the delay was intentionally -- at each of the leading intersections for each study corridor.

For this study it will not be necessary to evaluate each signal independently as each corridor is being evaluated as a series of signals along a network.

The delay at every signal, except where noted, was averaged over all the runs for a given time period, study corridor and direction of travel. These are summarized in **Table 7 and 8**.

**TABLE 7 APPROACH DELAY ALONG BOLLINGER CANYON RD BY INTERSECTION**

Direction	Intersection	Test Period	Average Delay (seconds)			
			AM Peak (7 - 9AM)	AM Off-Peak (9 - 11 AM)	Midday Peak (11:30AM - 1:30 PM)	PM Peak (4:30 - 6:30PM)
Eastbound	Sunset Dr *	Before	--	--	--	--
		After	--	--	--	--
		% Diff.	--	--	--	--
	Camino Ramon	Before	6.8	2.5	15.8	14.2
		After	2.1	1.5	6.2	21.9
		% Diff.	-69.1%	-40.0%	-60.8%	54.2%
	Iron Horse Trail	Before	10.7	9.1	15.0	5.7
		After	5.4	11.5	10.6	3.3
		% Diff.	-49.5%	26.4%	-29.3%	-42.1%
	Market P	Before	3.4	7.4	3.3	3.3
		After	0.4	3.1	4.6	1.9
		% Diff.	-88.2%	-58.1%	39.4%	-42.4%
	Alcosta Blvd	Before	17.3	2.9	30.4	6.9
		After	7.7	0.7	1.5	8.2
		% Diff.	-55.5%	-75.9%	-95.1%	18.8%
Westbound	Alcosta Blvd *	Before	--	--	--	--
		After	--	--	--	--
		% Diff.	--	--	--	--
	Market Pl	Before	3.6	3.3	5.9	4.9
		After	14.4	7.3	9.3	3.0
		% Diff.	300.0%	121.2%	57.6%	-38.8%
	Iron Horse Trail	Before	0.3	0.4	3.0	2.3
		After	1.7	10.5	1.9	3.2
		% Diff.	466.7%	2525.0%	-36.7%	39.1%
	Camino Ramon	Before	29.9	14.0	22.1	48.8
		After	4.4	13.6	5.1	2.8
		% Diff.	-85.3%	-2.9%	-76.9%	-94.3%
	Sunset Dr	Before	25.3	17.8	22.9	40.5
		After	2.2	1.5	9.1	15.4
		% Diff.	-91.3%	-91.6%	-60.3%	-62.0%

Source: DKS Associates, September 2010

Note: \* denotes locations where delay is not reported.

**TABLE 8 APPROACH DELAY ALONG CROW CANYON RD BY INTERSECTION**

Direction	Intersection	Test Period	Average Delay (seconds)			
			AM Peak (7 - 9AM)	AM Off-Peak (9 - 11 AM)	Midday Peak (11:30AM - 1:30 PM)	PM Peak (4:30 - 6:30PM)
Eastbound	Crow Canyon PI *	Before	--	--	--	--
		After	--	--	--	--
		% Diff.	--	--	--	--
	Camino Ramon	Before	30.1	30.2	37.3	37.4
		After	13.0	13.2	28.2	32.3
		% Diff.	-56.8%	-56.3%	-24.4%	-13.6%
	Iron Horse Trail	Before	1.5	1.8	1.5	3.0
		After	1.0	0.9	2.4	1.7
		% Diff.	-33.3%	-50.0%	60.0%	-43.3%
	Alcosta Blvd	Before	2.1	5.2	4.8	0.3
		After	4.3	0.6	0.1	1.0
		% Diff.	104.8%	-88.5%	-97.9%	233.3%
	Tahiti Dr	Before	2.6	6.9	13.1	0.1
		After	0.7	0.2	0.6	4.2
		% Diff.	-73.1%	-97.1%	-95.4%	4100.0%
Westbound	Tahiti Dr *	Before	--	--	--	--
		After	--	--	--	--
		% Diff.	--	--	--	--
	Alcosta Blvd	Before	2.4	7.2	10.5	5.4
		After	1.7	20.9	7.2	38.5
		% Diff.	-29.2%	190.3%	-31.4%	613.0%
	Iron Horse Trail	Before	2.3	2.8	0.8	2.1
		After	1.1	0.4	4.8	6.0
		% Diff.	-52.2%	-85.7%	500.0%	185.7%
	Camino Ramon	Before	39.4	22.4	54.7	36.5
		After	0.4	3.3	2.9	0.9
		% Diff.	-99.0%	-85.3%	-94.7%	-97.5%
	Crow Canyon PI	Before	9.0	10.5	22.5	69.9
		After	4.9	1.4	16.4	14.8
		% Diff.	-45.6%	-86.7%	-27.1%	-78.8%

Source: DKS Associates, September 2010

Note: \* denotes locations where delay is not reported.

### 3.4 Number of Stops Along Corridor

The number of times the data collection vehicle stopped was recorded during each data collection run.

The number of stops that occurred for each travel time run were averaged over all the runs for a given time period, direction of travel and study corridor. These are summarized in **Table 9**.

**TABLE 9 SUMMARY AVERAGE NUMBER OF STOPS**

Time Period	Test Period	Average Number of Stops			
		Bollinger Canyon Road		Crow Canyon Road	
		Eastbound	Westbound	Eastbound	Westbound
AM Peak (7 - 9AM)	Before	1.1	2.0	1.2	1.0
	After	0.2	0.4	0.7	0.2
	% Diff.	-81.8%	-80.0%	-41.7%	-80.0%
AM Off-Peak (9 - 11 AM)	Before	0.7	1.0	1.6	1.2
	After	0.6	1.0	0.5	0.5
	% Diff.	-14.3%	0.0%	-68.8%	-58.3%
Midday Peak (11:30AM – 1:30 PM)	Before	1.5	1.3	1.6	1.9
	After	0.7	0.5	0.7	1.0
	% Diff.	-53.3%	-61.5%	-56.3%	-47.4%
PM Peak (4:30 - 6:30PM)	Before	0.6	2.2	1.0	2.7
	After	0.6	0.6	1.0	1.3
	% Diff.	0.0%	-72.7%	0.0%	-51.9%

Source: DKS Associates, September 2010

### 3.5 Congestion

For this study, the corridor was considered congested, if the data collection vehicle was traveling at a speed less than or equal to Level of Service E (LOS E). The HCM defines these corridors as Class II Urban Streets with free flow speeds between 35 to 45 MPH. According to Exhibit 15-2 of the current edition of the HCM, LOS E for this corridor translates to speeds of approximately 13-17 MPH. For the purpose of this study, any speed at or less than 20 MPH was considered LOS E (or worse) and therefore considered to be congested. Similarly, any speed less than or equal to 30 MPH was also documented representing an intermediate speed between congestion and free flow speed where the typical driver would begin to perceive an increase in delay.

**Table 10** presents the average time (in seconds) the vehicle spent in congestion for each set of travel time runs by corridor, direction of travel and time of day.

**TABLE 10 AVERAGE TIME SPENT IN CONGESTION**

Direction	Time Period	Test Period	Bollinger Canyon Road			Crow Canyon Road		
			Average Time ≤5mph	Average Time ≤20mph	Average Time ≤30mph	Average Time ≤5mph	Average Time ≤20mph	Average Time ≤30mph
			(Seconds)					
Eastbound	AM Peak (7 - 9AM)	Before	28.9	35.7	43.8	22.6	33.7	48.4
		After	11.9	13.0	17.7	10.2	16.7	24.9
		% Diff.	-58.8%	-63.6%	-59.6%	-54.9%	-50.4%	-48.6%
	AM Off-Peak (9 - 11 AM)	Before	11.9	18.8	29.8	26.6	40.5	58.8
		After	8.3	14.1	23.9	7.5	13.3	21.3
		% Diff.	-30.3%	-25.0%	-19.8%	-71.8%	-67.2%	-63.8%
	Midday Peak (11:30 AM - 1:30 PM)	Before	45.2	60.4	80.4	41.8	54.5	69.3
		After	9.6	17.4	35.2	18.4	28.8	40.3
		% Diff.	-78.8%	-71.2%	-56.2%	-56.0%	-47.2%	-41.8%
	PM Peak (4:30 - 6:30PM)	Before	17.8	26.4	41.1	28.5	37.5	52.1
		After	22.6	29.9	47.5	25.4	35.6	48.8
		% Diff.	27.0%	13.3%	15.6%	-10.9%	-5.1%	-6.3%
Westbound	AM Peak (7 - 9AM)	Before	41.3	57.5	72.5	40.6	49.8	64.9
		After	12.9	18.3	29.7	3.0	6.0	11.1
		% Diff.	-68.8%	-68.2%	-59.0%	-92.6%	-88.0%	-82.9%
	AM Off-Peak (9 - 11 AM)	Before	24.4	34.1	42.3	26.9	39.9	57.9
		After	23.0	31.9	40.2	20.8	26.2	31.1
		% Diff.	-5.7%	-6.5%	-5.0%	-22.7%	-34.3%	-46.3%
	Midday Peak (11:30 AM - 1:30 PM)	Before	39.5	52.7	64.4	67.0	87.8	109.1
		After	19.0	22.4	29.0	23.6	30.9	37.7
		% Diff.	-51.9%	-57.5%	-55.0%	-64.8%	-64.8%	-65.4%
	PM Peak (4:30 - 6:30PM)	Before	73.7	93.4	115.6	80.8	110.3	126.9
		After	12.6	20.8	32.8	46.5	60.3	69.7
		% Diff.	-82.9%	-77.7%	-71.6%	-42.5%	-45.3%	-45.1%

Source: DKS Associates, September 2010

### **3.6 Fuel Consumption and Emissions**

The fuel consumption and emissions released are not directly measured. To document the actual fuel consumption and emissions generated would require much more complicated procedures and equipment than is available at the time of this study. Instead, these values are estimated by the PC-Travel software. The estimates are based on trajectory data through each corridor, which are computed by comparing the difference in instantaneous position recorded at one second intervals. The values shown are calculated for the data collection vehicle only and are therefore very small.

The estimated fuel consumption and emission values for each travel time run were averaged over all the runs for a given time period, direction of travel and study corridor. These are summarized in **Table 11 and 12**

**TABLE 11 SUMMARY OF FUEL CONSUMPTION AND EMISSIONS**

Direction	Time Period	Test Period	Bollinger Canyon Road			
			Average Fuel Consumption	Average HC	Average CO	Average No <sub>x</sub>
			(gal)	(g)	(g)	(g)
Eastbound	AM Peak (7 - 9AM)	Before	0.035	3.75	39.92	2.40
		After	0.028	2.83	33.58	1.75
		% Diff.	-20.0%	-24.5%	-15.9%	-27.1%
	AM Off-Peak (9 - 11 AM)	Before	0.030	3.03	31.24	1.97
		After	0.031	3.44	37.77	2.45
		% Diff.	3.3%	13.5%	20.9%	24.4%
	Midday Peak (11:30 AM - 1:30 PM)	Before	0.039	4.18	39.12	2.47
		After	0.032	3.59	36.10	2.53
		% Diff.	-17.9%	-14.1%	-7.7%	2.4%
	PM Peak (4:30 - 6:30PM)	Before	0.032	3.36	34.37	2.15
		After	0.032	3.39	34.74	2.10
		% Diff.	0.0%	0.9%	1.1%	-2.3%
Westbound	AM Peak (7 - 9AM)	Before	0.040	4.41	40.69	2.85
		After	0.031	3.45	36.92	2.37
		% Diff.	-22.5%	-21.8%	-9.3%	-16.8%
	AM Off-Peak (9 - 11 AM)	Before	0.034	3.60	37.53	2.31
		After	0.037	4.29	45.40	3.06
		% Diff.	8.8%	19.2%	21.0%	32.5%
	Midday Peak (11:30AM - 1:30 PM)	Before	0.038	4.24	41.86	2.70
		After	0.031	3.21	34.68	2.04
		% Diff.	-18.4%	-24.3%	-17.2%	-24.4%
	PM Peak (4:30 - 6:30PM)	Before	0.047	5.22	45.72	3.06
		After	0.030	3.26	33.35	2.16
		% Diff.	-36.2%	-37.5%	-27.1%	-29.4%

Source: DKS Associates, September 2010

**TABLE 12 SUMMARY OF FUEL CONSUMPTION AND EMISSIONS**

Direction	Time Period	Test Period	Crow Canyon Road			
			Average Fuel Consumption	Average HC	Average CO	Average No <sub>x</sub>
			(gal)	(g)	(g)	(g)
Eastbound	AM Peak (7 - 9AM)	Before	0.041	4.71	49.15	3.42
		After	0.035	3.94	43.49	2.86
		% Diff.	-14.6%	-16.3%	-11.5%	-16.4%
	AM Off-Peak (9 - 11 AM)	Before	0.043	5.03	48.84	3.67
		After	0.036	4.16	47.47	3.13
		% Diff.	-16.3%	-17.3%	-2.8%	-14.7%
	Midday Peak (11:30 AM - 1:30 PM)	Before	0.043	4.83	48.78	3.17
		After	0.036	4.16	44.01	2.89
		% Diff.	-16.3%	-13.9%	-9.8%	-8.8%
	PM Peak (4:30 - 6:30PM)	Before	0.040	4.53	47.04	3.14
		After	0.038	4.26	42.79	2.91
		% Diff.	-5.0%	-6.0%	-9.0%	-7.3%
Westbound	AM Peak (7 - 9AM)	Before	0.037	3.70	39.24	2.06
		After	0.026	2.45	28.98	1.52
		% Diff.	-29.7%	-33.8%	-26.1%	-26.2%
	AM Off-Peak (9 - 11 AM)	Before	0.037	3.81	39.18	2.39
		After	0.032	3.19	37.14	1.96
		% Diff.	-13.5%	-16.3%	-5.2%	-18.0%
	Midday Peak (11:30AM - 1:30 PM)	Before	0.046	4.92	46.13	2.79
		After	0.032	3.06	34.38	1.79
		% Diff.	-30.4%	-37.8%	-25.5%	-35.8%
	PM Peak (4:30 - 6:30PM)	Before	0.049	5.12	47.81	2.70
		After	0.038	3.83	38.50	2.13
		% Diff.	-22.4%	-25.2%	-19.5%	-21.1%

Source: DKS Associates, September 2010

### **3.7 Minor Street Delay**

The HCM method of calculating approach delay at a signalized intersection was used to measure minor street delay at four intersections (eight approaches at two intersections each along Crow Canyon Road and Bollinger Canyon Road) during the AM Peak, AM Off-Peak, Midday Peak and PM peak.

**Table 13** and **Table 14** show the average delay per vehicle measured at the northbound and southbound approaches at four intersections during the four time-of-day periods, respectively. The same information is shown in graphical format in **Figures 5** through **8**.

**TABLE 13 MINOR STREET DELAY AT BOLLINGER CANYON ROAD INTERSECTIONS**

Approach Direction	Test Period	Average Number of Observed Vehicles				Average Delay per Vehicle (sec) *				Percentage of Total Vehicles That Stopped			
		AM Peak	AM Off-Peak	Midday Peak	PM Peak	AM Peak	AM Off-Peak	Midday Peak	PM Peak	AM Peak	AM Off-Peak	Midday Peak	PM Peak
<b>Sunset Drive</b>													
<b>NB</b>	Before	76	93	231	805	30.4	29.1	25.3	24.6	85.5%	87.1%	80.5%	86.1%
	After	149	109	443	1382	17.3	17	12.8	17.4	57.1%	49.6%	45.4%	47.1%
	% Diff.	96.1%	17.2%	91.8%	71.7%	-43.1%	-41.6%	-49.4%	-29.3%	-33.2%	-43.1%	-43.6%	-45.3%
<b>SB</b>	Before	271	398	678	985	23.5	16.9	18.4	17.7	66.1%	71.1%	62.2%	56.5%
	After	225	372	732	1036	34.2	18.4	27.6	38.7	78.2%	71.8%	72.8%	95.8%
	% Diff.	-17.0%	-6.5%	8.0%	5.2%	45.5%	8.9%	50.0%	118.6%	18.3%	1.0%	17.0%	69.6%
<b>Alcosta Boulevard</b>													
<b>NB</b>	Before	1003	629	658	579	17	14.8	18.4	20.2	74.8%	79.8%	79.5%	79.4%
	After	916	529	510	699	21.8	32.9	31.8	35.9	72.6%	82.4%	80.0%	80.0%
	% Diff.	-8.7%	-15.9%	-22.5%	20.7%	28.2%	122.3%	72.8%	77.7%	-2.9%	3.3%	0.6%	0.8%
<b>SB</b>	Before	302	519	792	735	22.1	17.4	23.3	20.2	77.5%	84.8%	78.8%	83.4%
	After	545	463	465	679	26.8	27.8	33.5	29	82.9%	89.4%	81.2%	83.8%
	% Diff.	80.5%	-10.8%	-41.3%	-7.6%	21.3%	59.8%	43.8%	43.6%	7.0%	5.4%	3.0%	0.5%

Note: \*Delays were calculated based on methodology in HCM 2000, Chapter 16

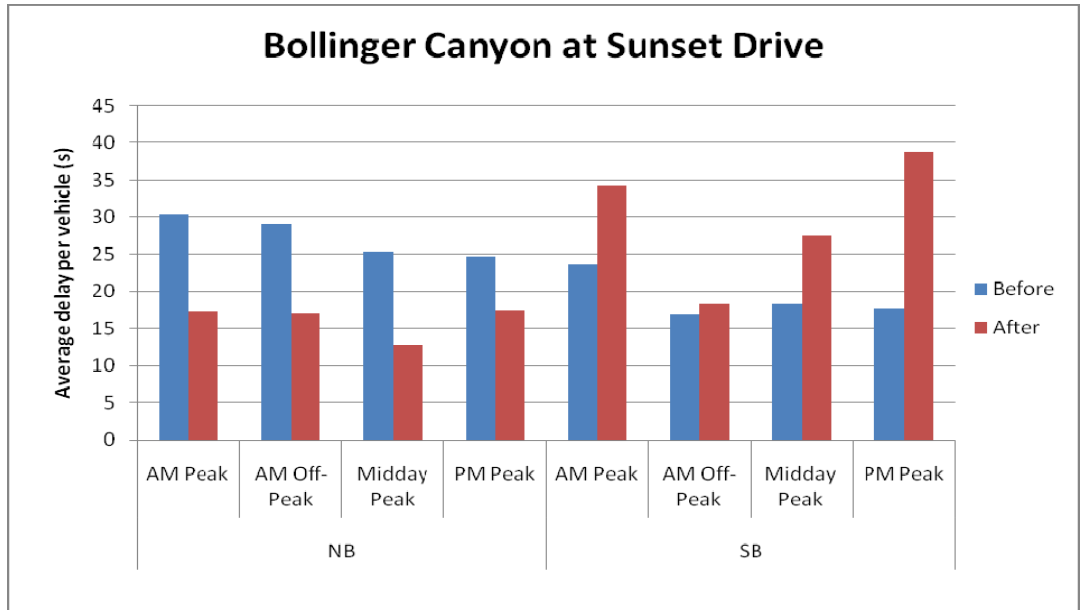
Source: DKS Associates, September 2010

**TABLE 14 MINOR STREET DELAY AT CROW CANYON ROAD INTERSECTIONS**

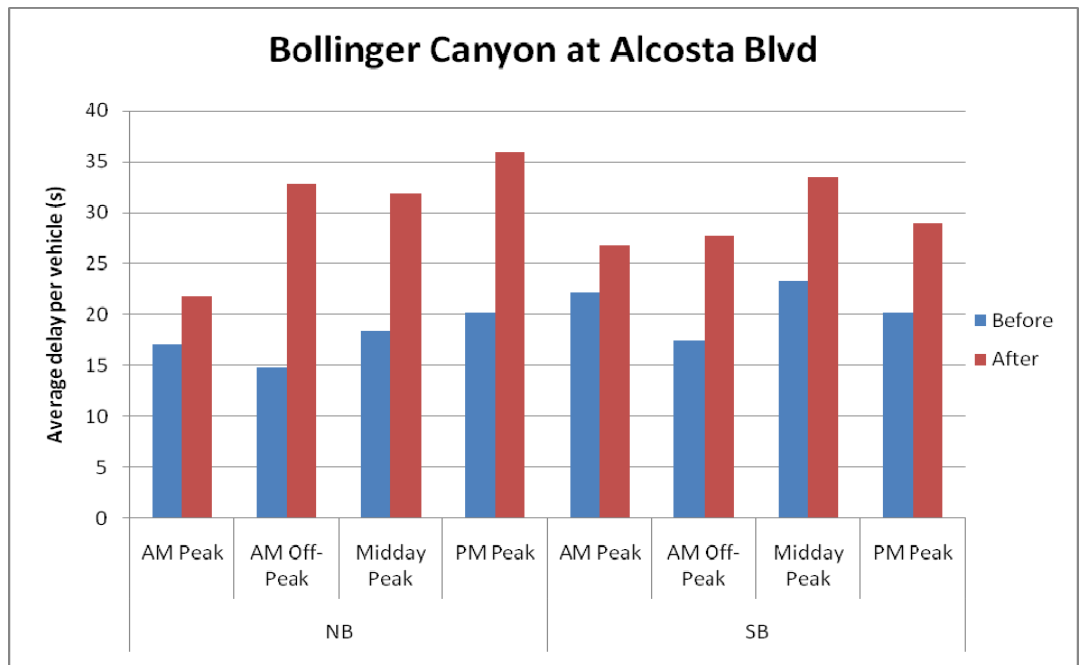
Approach Direction	Test Period	Average Number of Observed Vehicles				Average Delay per Vehicle (sec) *				Percentage of Total Vehicles That Stopped			
		AM Peak	AM Off-Peak	Midday Peak	PM Peak	AM Peak	AM Off-Peak	Midday Peak	PM Peak	AM Peak	AM Off-Peak	Midday Peak	PM Peak
<b>Crow Canyon Place</b>													
NB	Before	452	719	736	1073	19.1	20.2	37.0	16.3	48.5%	46.5%	88.5%	33.2%
	After	452	369	659	621	21.2	19	21.2	20.2	68.1%	71.0%	69.8%	65.7%
	% Diff.	0.0%	-48.7%	-10.5%	-42.1%	11.0%	-5.9%	-42.7%	23.9%	40.4%	52.7%	-21.1%	97.9%
SB	Before	418	382	589	1133	22.6	26.2	33.7	13.4	80.9%	79.1%	89.5%	38.5%
	After	253	445	812	930	28.7	24.4	16.9	19.3	82.6%	83.4%	76.2%	82.6%
	% Diff.	-39.5%	16.5%	37.9%	-17.9%	27.0%	-6.9%	-49.9%	44.0%	2.1%	5.4%	-14.9%	114.5%
<b>Camino Ramon</b>													
NB	Before	324	646	1247	1835	22.8	22.3	20.2	18.3	50.6%	50.6%	48.0%	48.4%
	After	168	309	562	777	37.7	35.2	33.4	19.3	88.7%	80.9%	82.2%	77.7%
	% Diff.	-48.1%	-52.2%	-54.9%	-57.7%	65.4%	57.8%	65.3%	5.5%	75.3%	59.9%	71.3%	60.5%
SB	Before	220	293	618	586	37	35.9	34.4	37.2	86.4%	88.4%	72.7%	75.3%
	After	213	335	626	687	33.4	40.5	30.5	26.8	90.1%	88.9%	85.1%	83.2%
	% Diff.	-3.2%	14.3%	1.3%	17.2%	-9.7%	12.8%	-11.3%	-28.0%	4.3%	0.6%	17.1%	10.5%

Note: \*Delays were calculated based on methodology in HCM 2000, Chapter 16

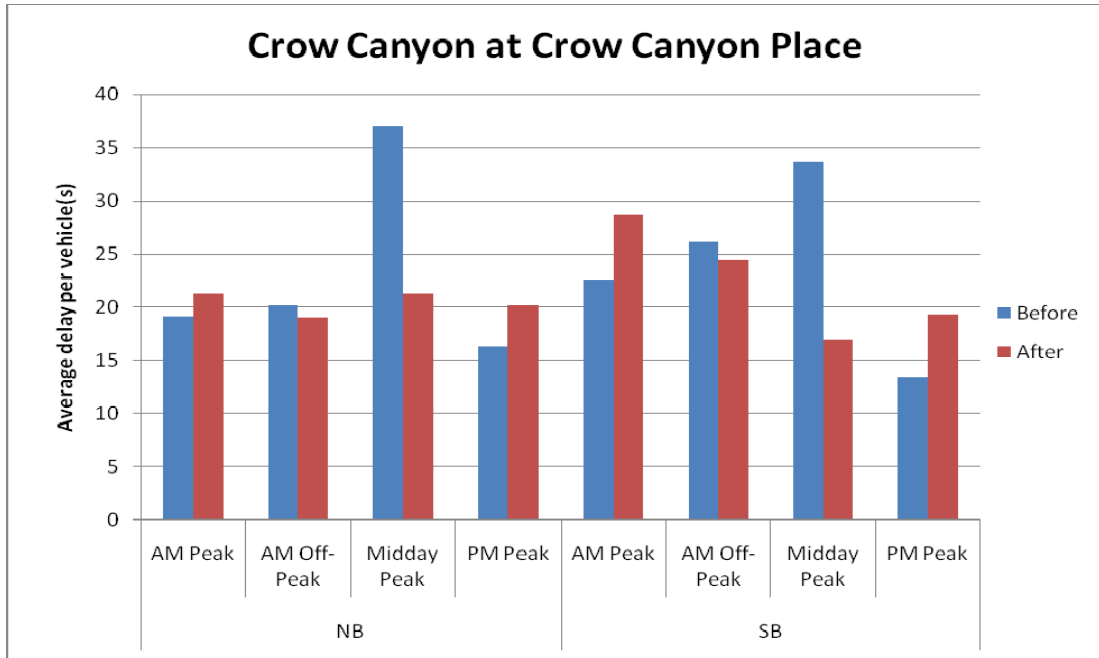
Source: DKS Associates, September 2010



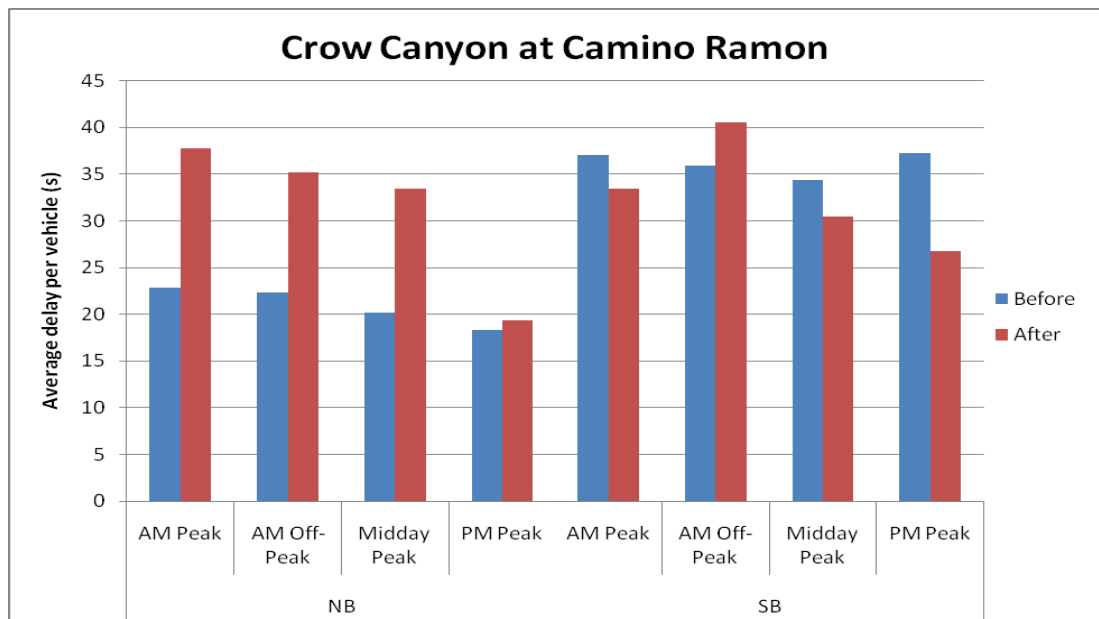
**FIGURE 5 MINOR-STREET DELAY PER VEHICLE AT BOLLINGER CANYON/SUNSET DR BY APPROACH DIRECTION, STUDY PERIODS AND TIME OF DAY**



**FIGURE 6 MINOR-STREET DELAY PER VEHICLE BOLLINGER CANYON & ALCOSTA BLVD BY APPROACH DIRECTION, STUDY PERIODS AND TIME OF DAY**



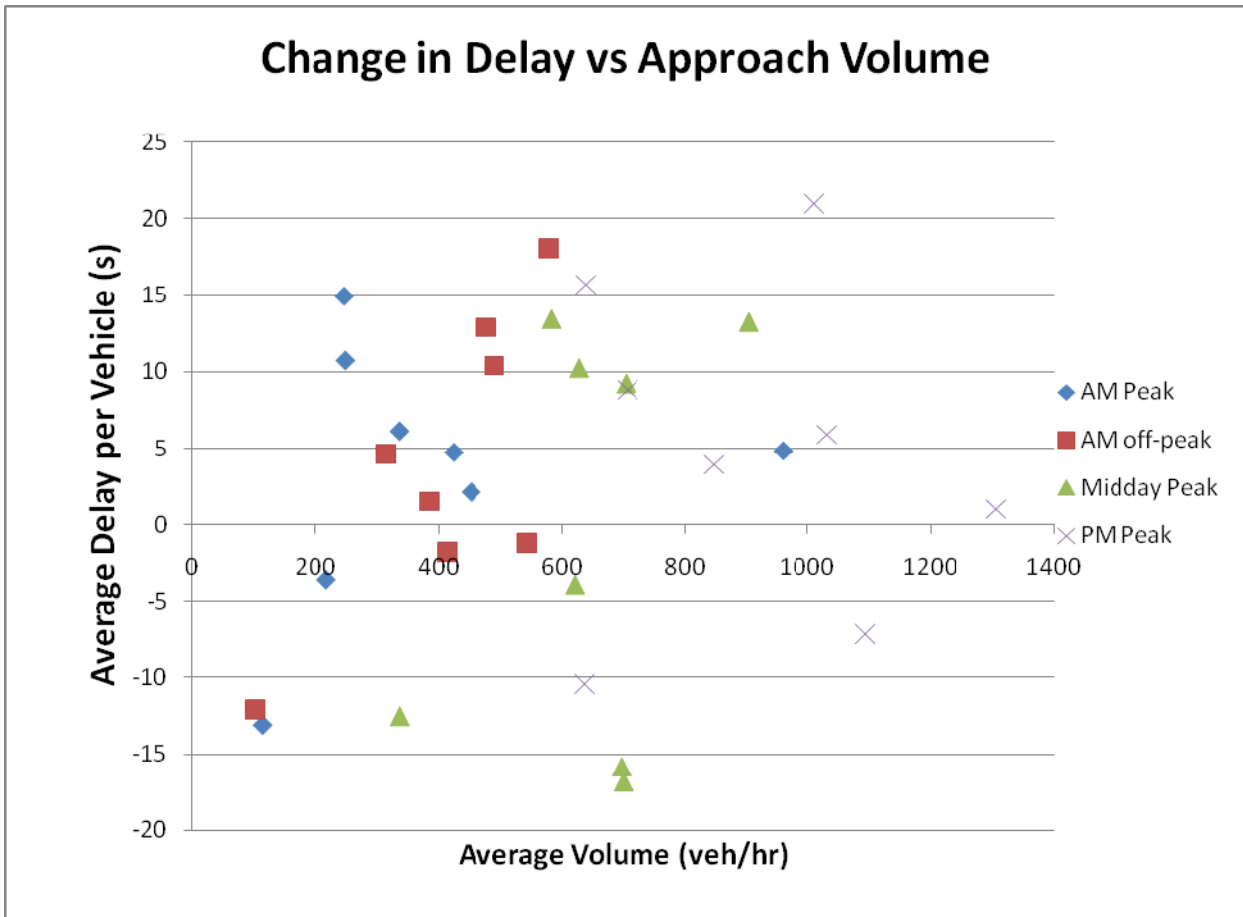
**FIGURE 7 MINOR-STREET DELAY PER VEHICLE CROW CANYON/CANYON PL BY APPROACH DIRECTION, STUDY PERIODS AND TIME OF DAY**



**FIGURE 8 MINOR-STREET DELAY PER VEHICLE CROW CANYON/CAMINO RAMON BY APPROACH DIRECTION, STUDY PERIODS AND TIME OF DAY**

### 3.8 Minor Street Approach Volume-Delay Relationship

The relationship between the approach volume and the change in delay from the before periods to the after periods was also considered. The change in delay is plotted against the average before and after approach volume. This is plotted in **Figure 9** and no trend is apparent. The plot shows the change in delay ranges from -17 to 21 seconds per vehicle.



**FIGURE 9 APPROACH VOLUME VERSUS CHANGE IN AVERAGE DELAY PER VEHICLE FOR MINOR-STREET APPROACHES**

## 4.0 RESULTS AND CONCLUSIONS

The overall results show a significant reduction in system-wide travel times and stops under the InSync Adaptive System.

The following conclusions are drawn from the comparison of corridor performance before and after the installation of the InSync Adaptive Traffic Management System.

### 4.1 Travel Time and Major Approach Delay

The average travel times along the study corridors are reduced by as much as 73.2 seconds (50.2%, PM Peak, Westbound Bollinger Canyon Rd) and at least by 4.7 seconds (5.6%, AM Off-Peak, Westbound Bollinger Canyon Rd) and average approach delay improved by as much as 61.1 seconds (74.8%, PM Peak, Westbound Bollinger Canyon Rd) and at least by 1.6 seconds (3.9%, PM Peak, Eastbound Crow Canyon Rd).

The travel time and major approach delay along the corridors improves for every study period except for the following:

- PM Peak – Eastbound Bollinger Canyon Rd and
- PM Peak – Eastbound Crow Canyon Rd

The eastbound PM Peak travel time and approach delay along Bollinger Canyon Road experienced an increase in average travel time of 4.4 seconds (5.5%) and average eastbound delay of 5.5 seconds (18.3%). However, traffic demands during the after period were approximately 500 vehicles greater (~14.9%) than the demands during the before period. This difference in vehicle demands may have directly contributed to the increase in average travel time and delay.

The eastbound PM Peak travel time and approach delay along Crow Canyon Road experienced no change in average travel time and average eastbound delay. However, traffic demands during this after period were marginally greater (~2.3-3.5%) than the demands during the before period. This change in traffic demand suggests that the InSync Adaptive Signal System does indeed perform favorably when compared to the before conditions.

## 4.2 Stops, Fuel Consumption, and Emissions

The average number of stops after the installation of the InSync System along these two corridors were, at worst, the same, and at best are reduced by as much as 0.9 stops (81.8%, Eastbound AM Peak, Bollinger Canyon Rd).

The average fuel consumed along the corridors improves for every study period except for the following:

- AM Off-Peak – Eastbound Crow Canyon Rd (increase of 0.001 gallons, 3.3%)
- PM Peak – Eastbound Crow Canyon Rd (no change, 0.0%) and
- AM Off-Peak – Westbound Bollinger Canyon Rd (increase of 0.003 gallons, 8.8%)

The change in average fuel consumption is estimated to range from an increase of 0.003 gallons (8.8%, Westbound AM Off-Peak, Bollinger Canyon Rd) to a decrease of 0.014 gallons (30.4%, Westbound Midday Peak, Crow Canyon Rd).

Estimated emissions (HC, CO, NO<sub>x</sub>) decreased by as much as 0.9% (Eastbound PM Peak, Bollinger Canyon Rd) to 37.8% (Westbound Midday Peak, Crow Canyon Rd) for all periods and directions except at the following:

- AM Off-Peak– Eastbound Bollinger Canyon Rd;
- Midday Peak – Eastbound Bollinger Canyon Rd;
- PM Peak – Eastbound Bollinger Canyon Rd and
- AM Off-Peak – Westbound Bollinger Canyon Rd

## 4.3 Time Spent in Congestion

The average time spent in congestion along the corridors was reduced by as much as 37.6 seconds (92.6%, AM Peak, Westbound Crow Canyon Rd) for each study period.

The average time spent in congestion along the corridors improves for every study period and direction except for the following:

- PM Peak – Eastbound Bollinger Canyon Rd and
- PM Peak – Eastbound Crow Canyon Rd

The eastbound PM Peak time spent traveling at speeds below 5 mph, 20 mph and 30 mph, along Bollinger Canyon Road increased in by 4.8 seconds (27.0%), 3.5 seconds (13.3%) and 6.4 seconds (15.6%), respectively. However, traffic demands during the after period were approximately 500 vehicles greater (~14.9%) than the demands during the before period. This

difference in vehicle demands may have directly contributed to the increase in the time spent in congestion.

The eastbound PM Peak travel time and approach delay along Crow Canyon Road experienced no change in the time spent traveling at speeds below 5 mph, 20 mph, and 30 mph. However, traffic demands during this after period were marginally greater (~2.3-3.5%) than the demands during the before period. This change in traffic demand suggests that the InSync Adaptive Signal System does indeed perform favorably when compared to the before conditions.

#### **4.4 Minor Street Delay**

The average vehicle delay along the corridor decreases by approximately 27.7 seconds per vehicle. The average vehicle delay at observed minor streets increases by approximately 3.0 seconds per vehicle. On the average, approximately 2,400 vehicles per period travel along each corridor. Similarly, approximately 600 vehicles per period were observed at each minor street. The benefits of decreased delay along the mainline are far greater than the detriment of the increased delay at the minor streets.

The average delay per vehicle at minor streets experienced a range of changes both increasing and decreasing of average delay. The range of changes include a decreased delay of 16.8 seconds per vehicle (49.9%, southbound approach, Crow Canyon Place/Crow Canyon Road, midday peak) and an increased delay of 18.1 seconds per vehicle (122.3%, northbound approach, Alcosta Blvd/Bollinger Canyon Rd, AM Off-Peak).

The minor street delay at Alcosta Blvd/Bollinger Canyon Rd increased for every period. This increased delay may in part be due to the additional school related traffic from the Iron Horse Middle School located at 12601 Alcosta Blvd. This school was not in session during the July 2010 survey.

#### **4.5 Traffic Counts**

A review of the observed traffic along the corridors reveals no trends. At some locations the traffic demands increases by as much as 15.0% (3,296 to 3,792 vehicles per period, Eastbound Bollinger Canyon Rd, PM Peak) and at other locations decreases by as much as 30.2% (1,930 to 1,348 vehicles per period, Westbound Bollinger Canyon Rd, Midday Peak). These changes in traffic demands may have contributed, in part, to the measured changes in average corridor travel time and delay results of this study.

**Appendix A**  
Speed-Distance and Time-Space Diagrams  
for Travel Time Runs

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**Appendix A-1**  
Before Period  
Bollinger Canyon Road Eastbound

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Before Period  
Bollinger Canyon Road Eastbound

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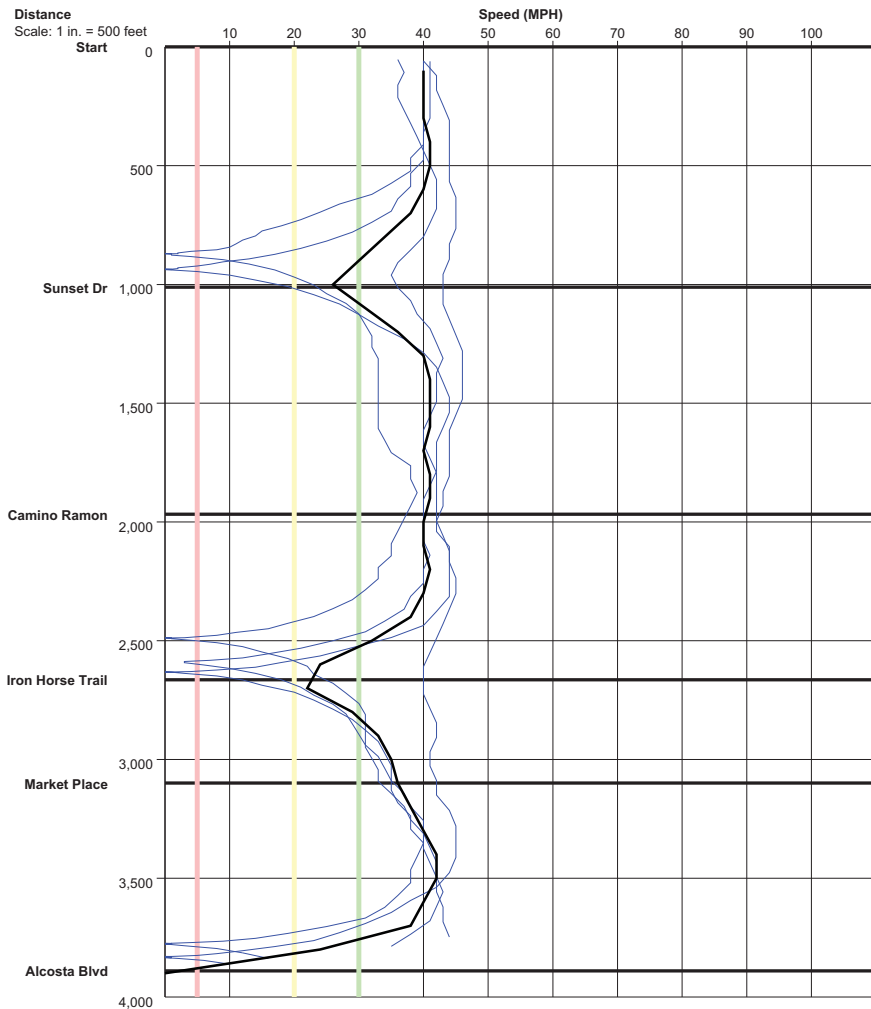
A.M. Peak (7:00 to 9:00 AM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger EB AM - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

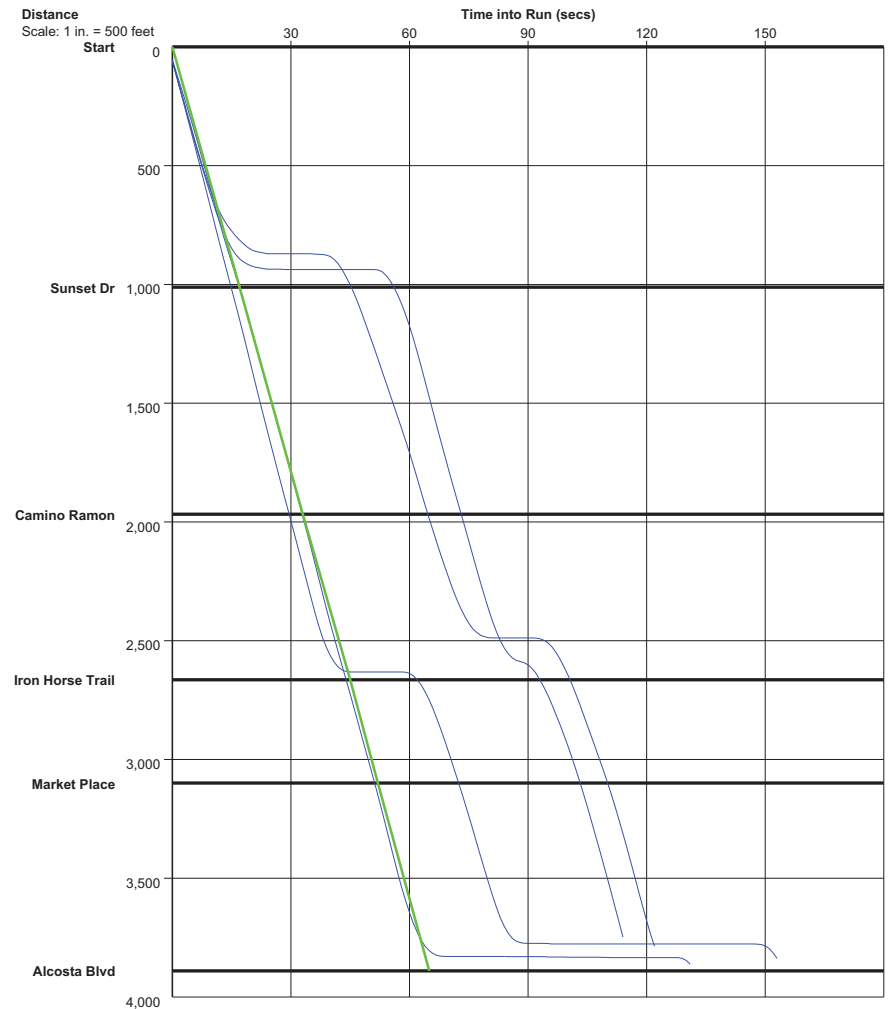


### Bollinger Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger EB AM - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

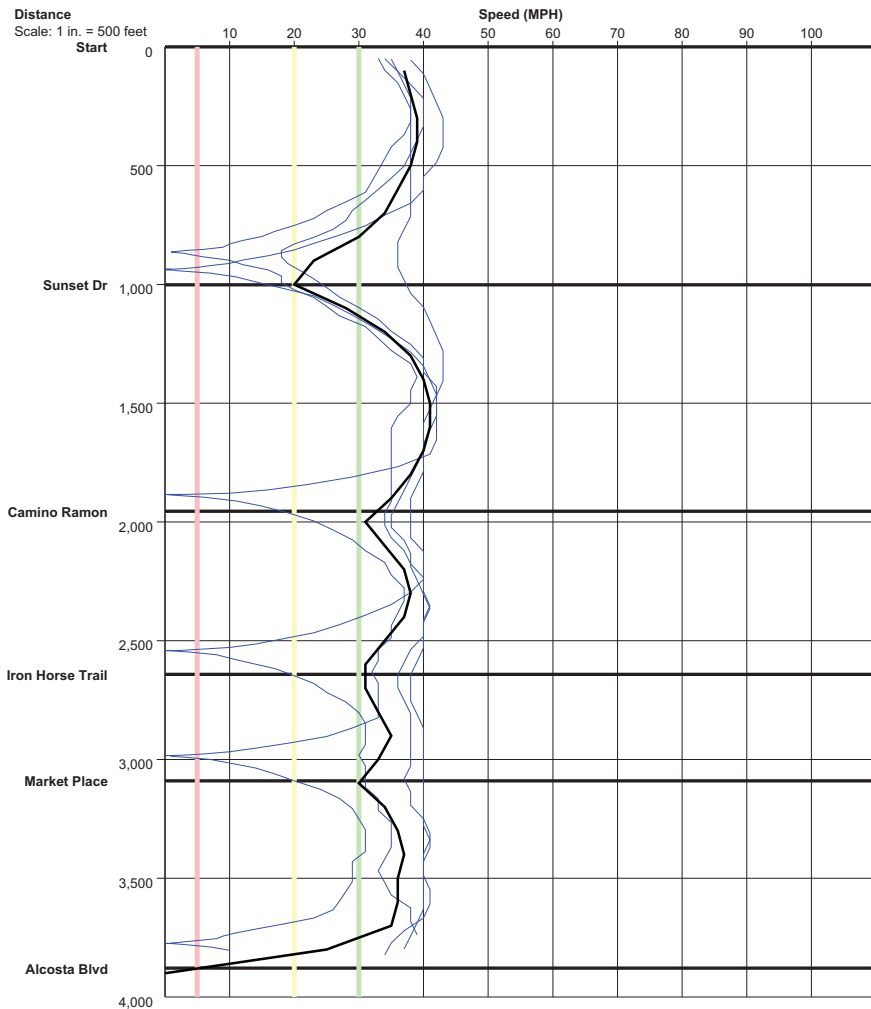


### Bollinger Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger EB AM - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

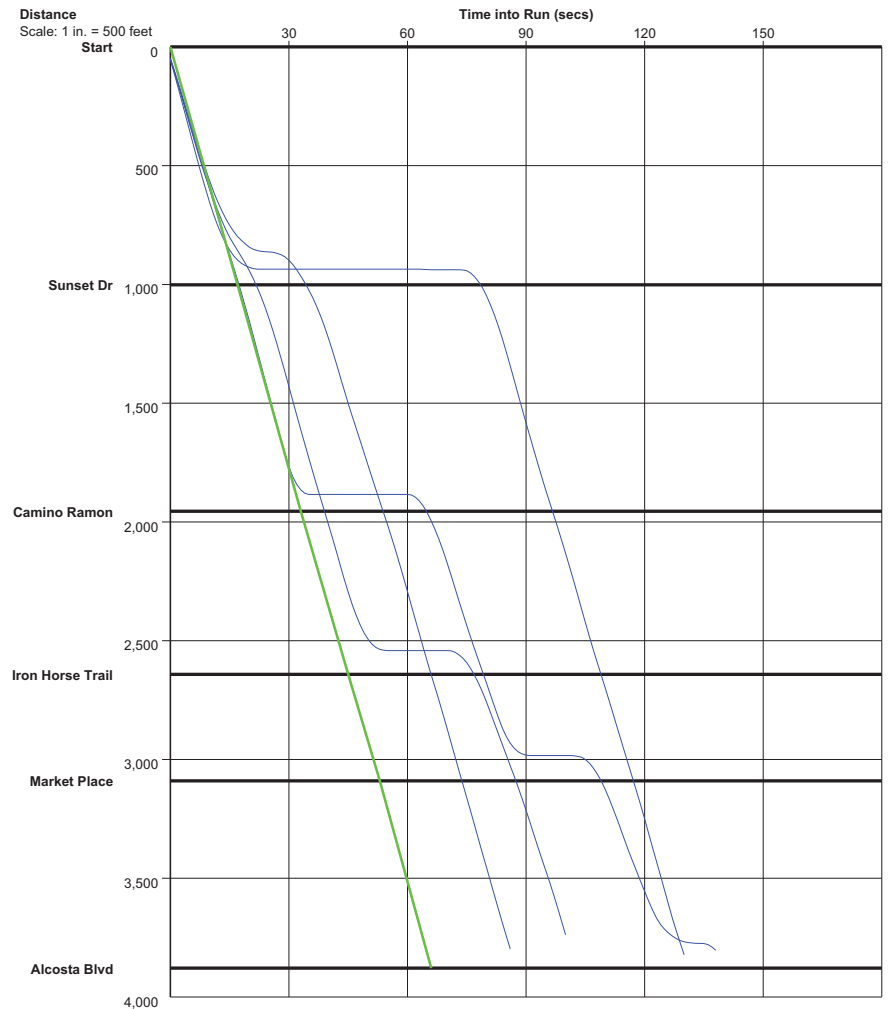


### Bollinger Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger EB AM - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

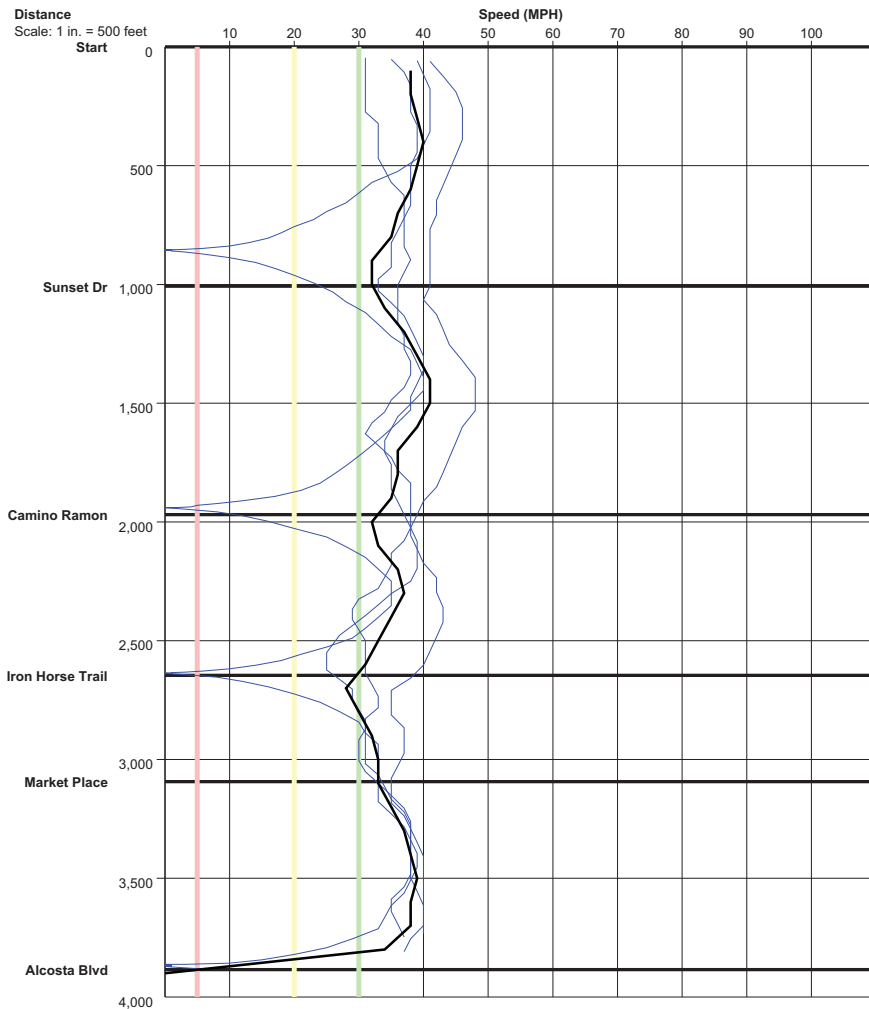


### Bollinger Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger EB AM - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

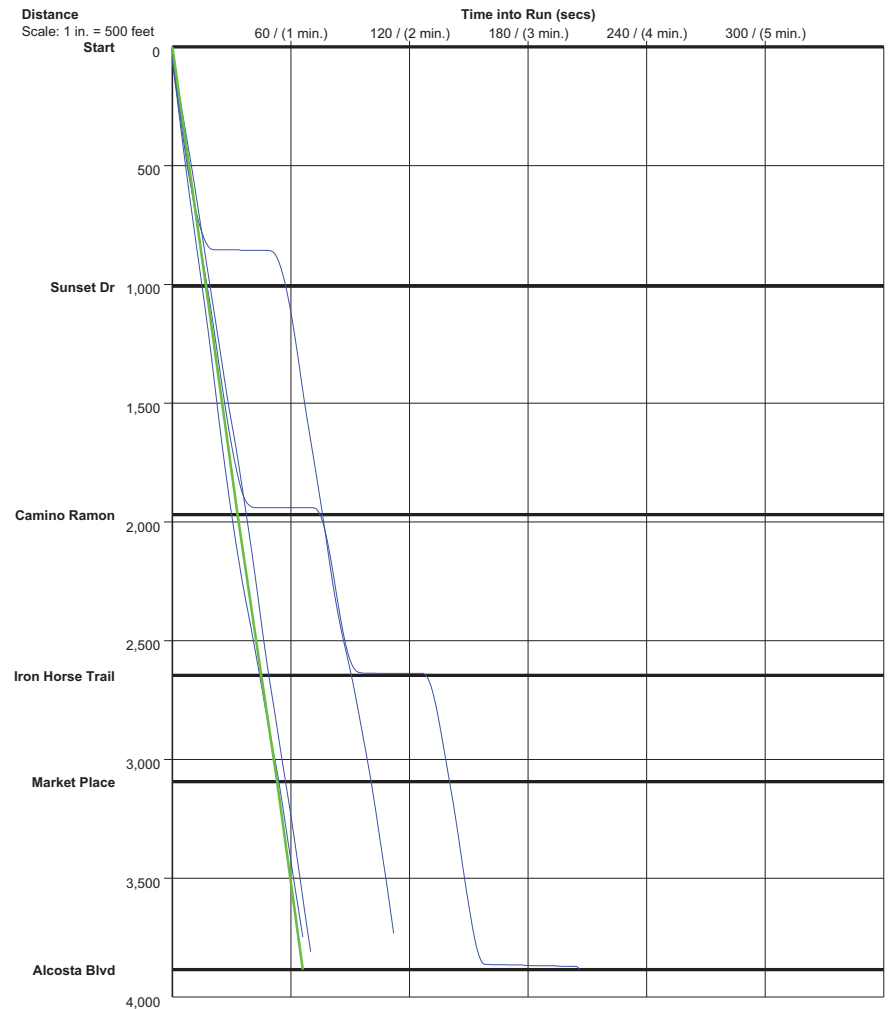


### Bollinger Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger EB AM - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Before Period  
Bollinger Canyon Road Eastbound

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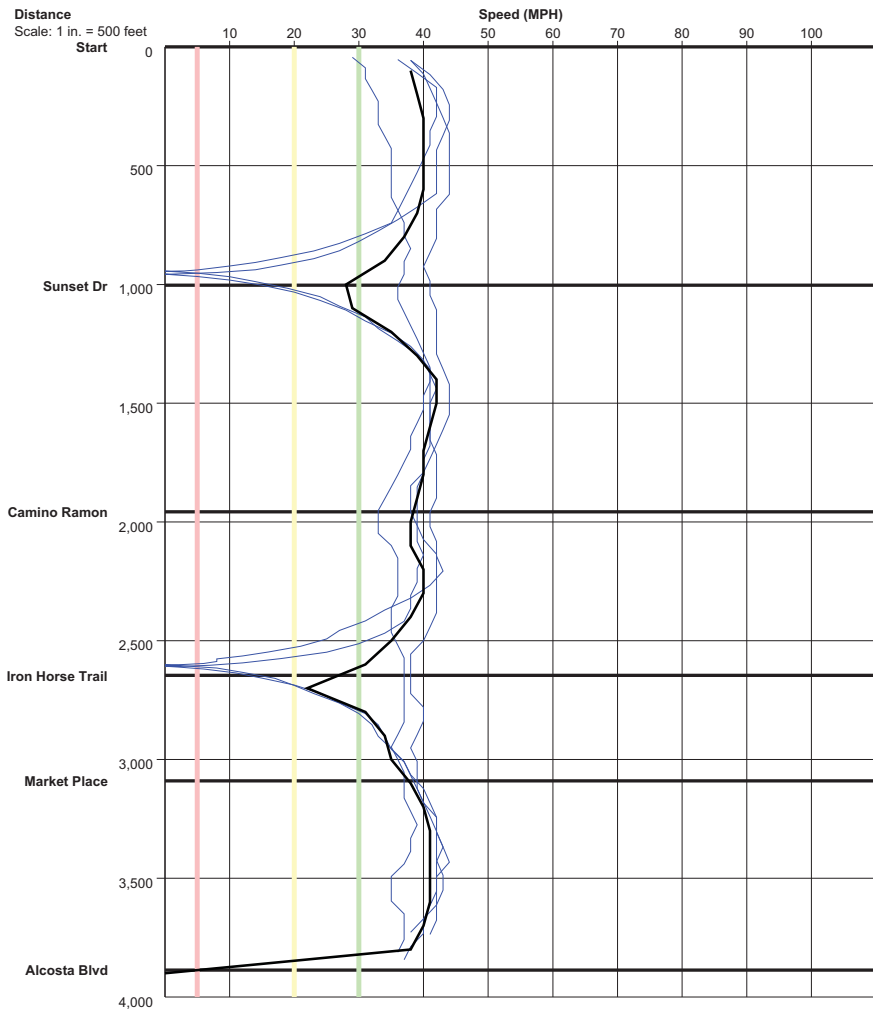
A.M. Off-Peak (9:00 to 11:00 AM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger EB AM OP - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

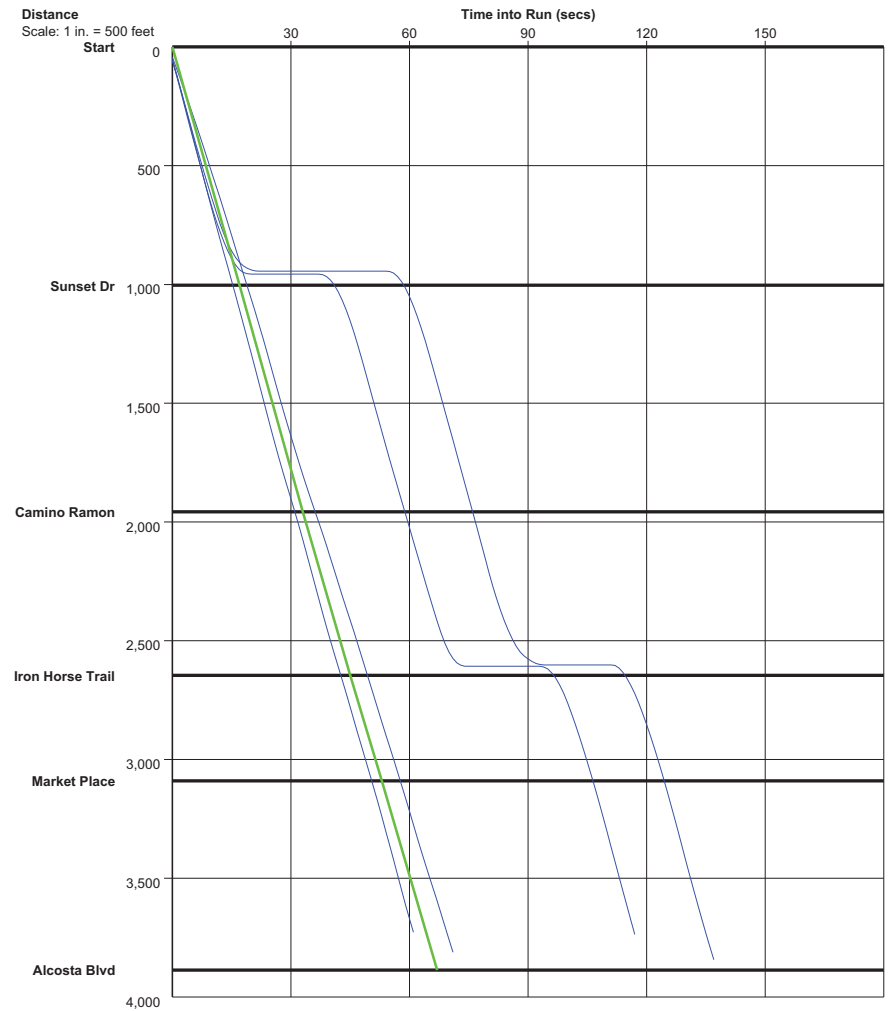


### Bollinger Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger EB AM OP - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

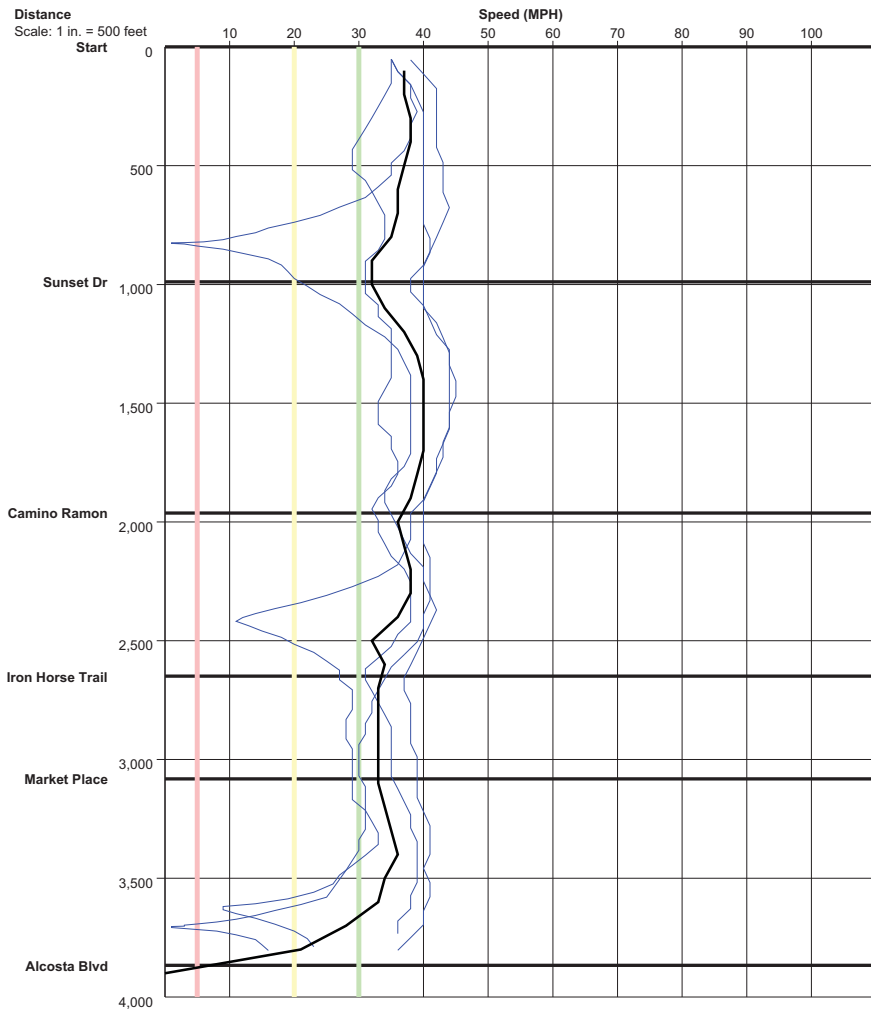


### Bollinger Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger EB AM OP - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

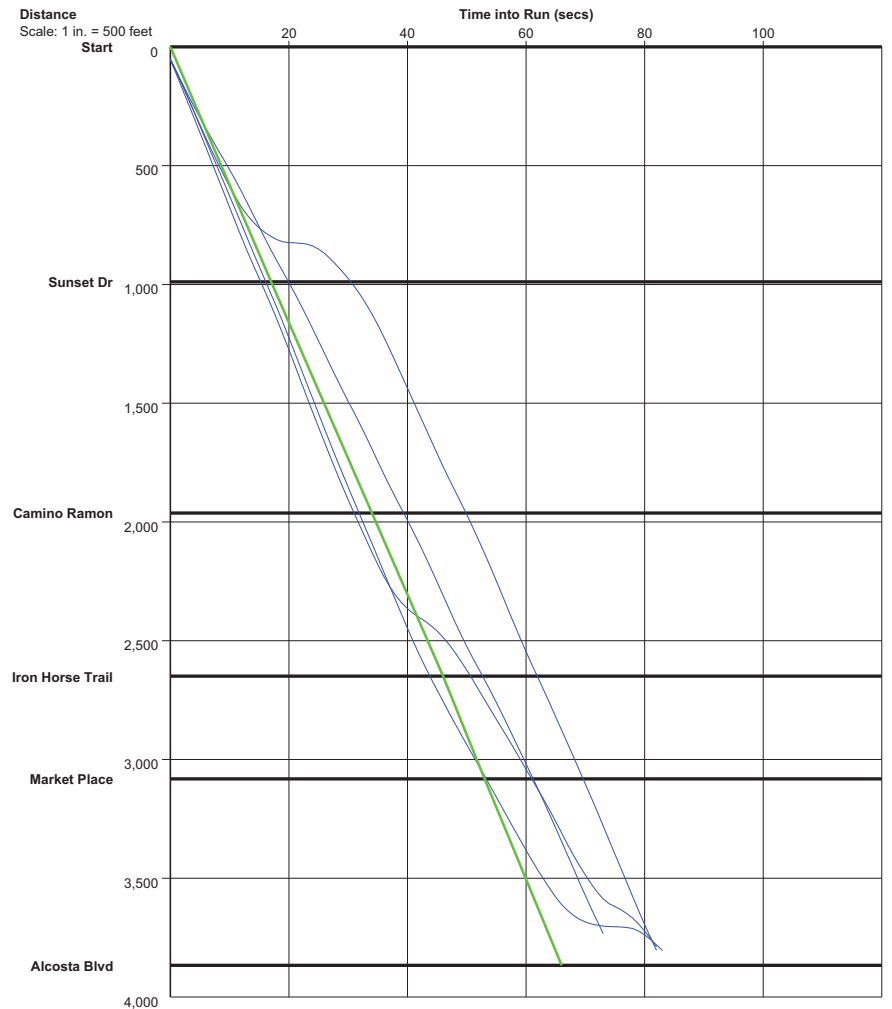


### Bollinger Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger EB AM OP - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

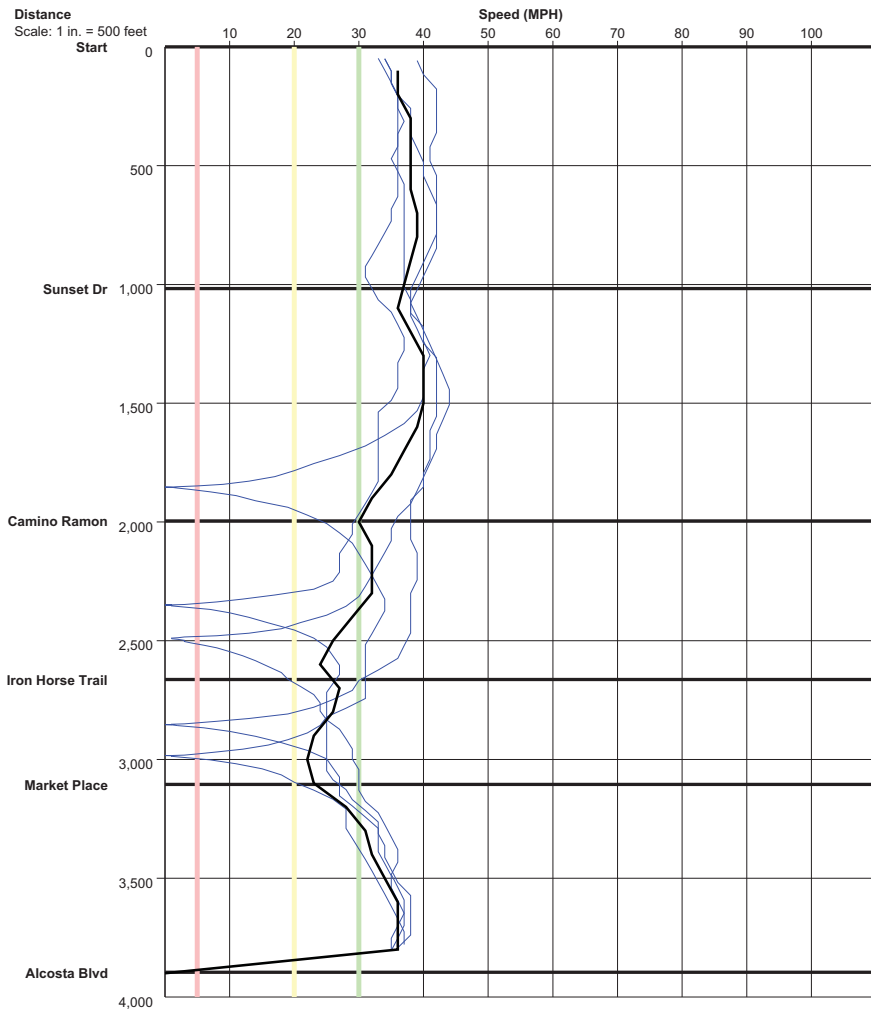


### Bollinger Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger EB AM OP - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

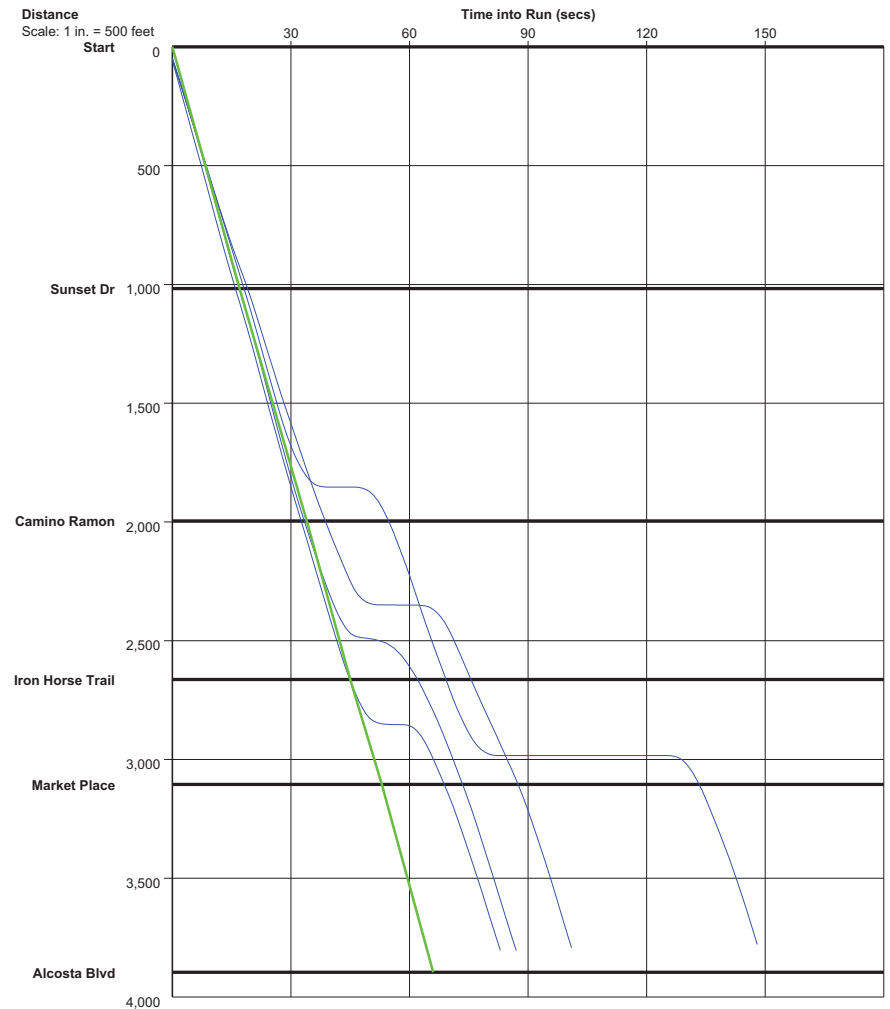


### Bollinger Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger EB AM OP - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Before Period  
Bollinger Canyon Road Eastbound

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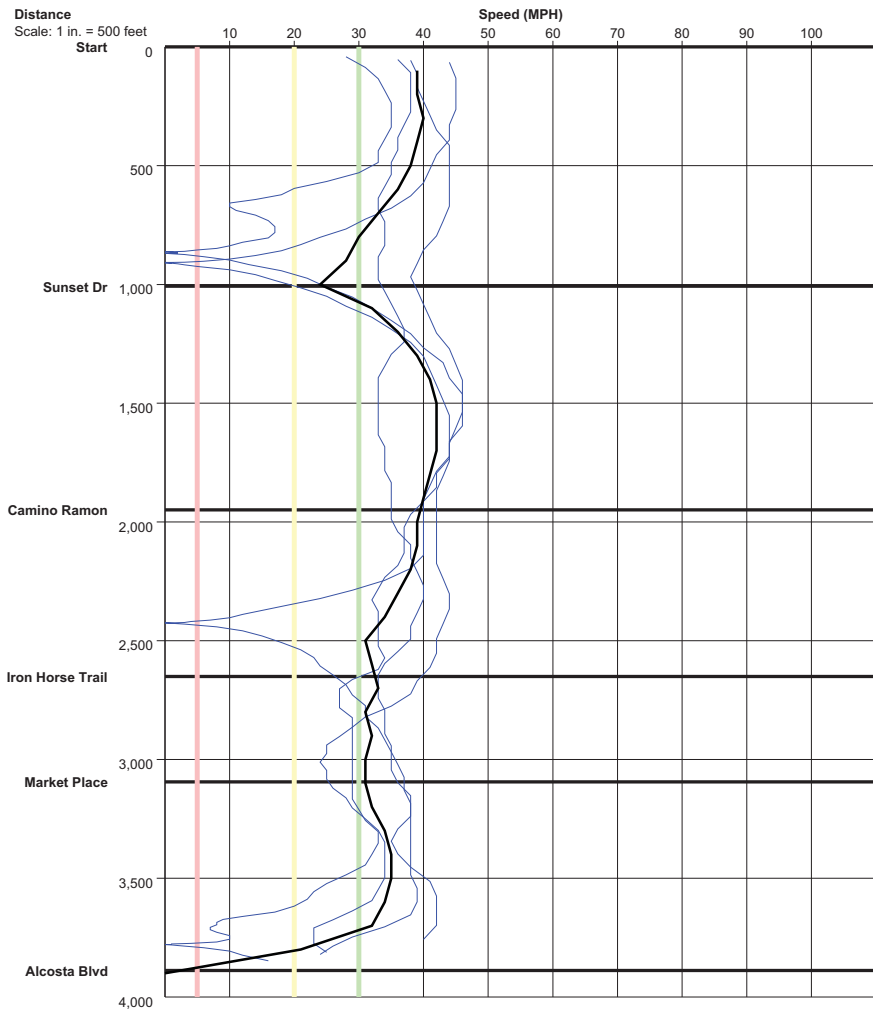
Midday Peak (11:30 AM to 1:30 PM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger EB MID - Day 1**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

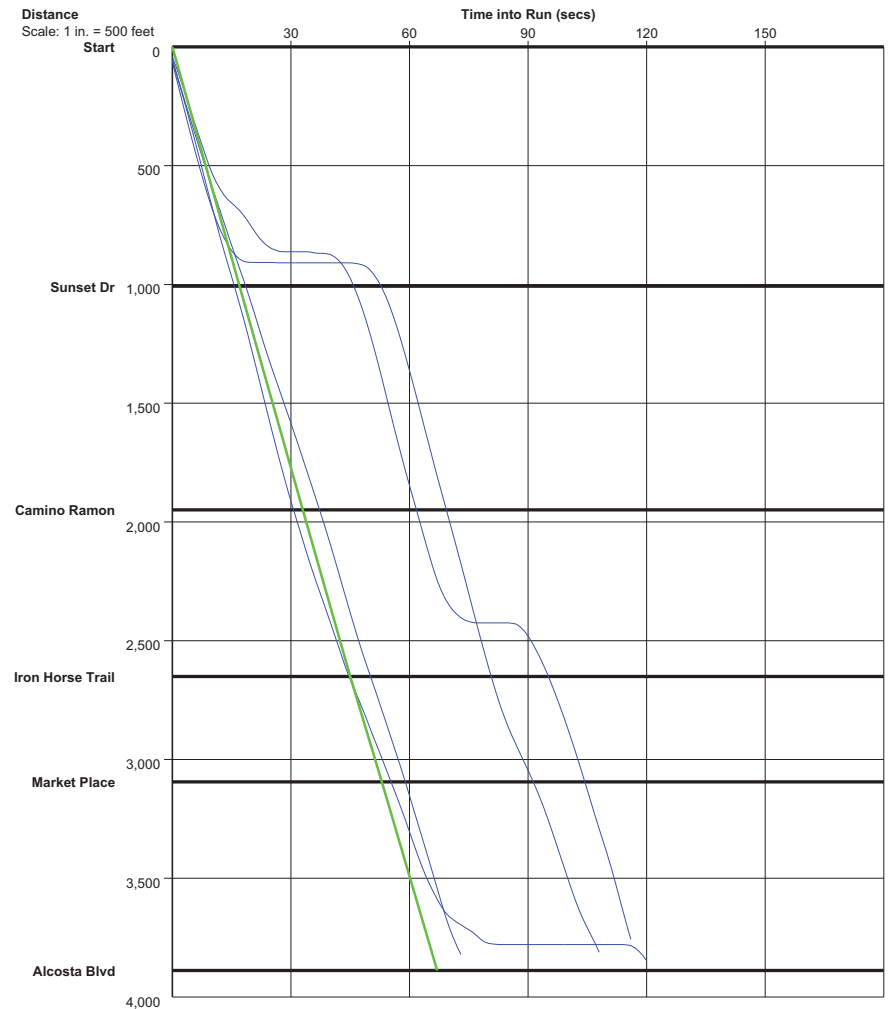


### Bollinger Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger EB MID - Day 1**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

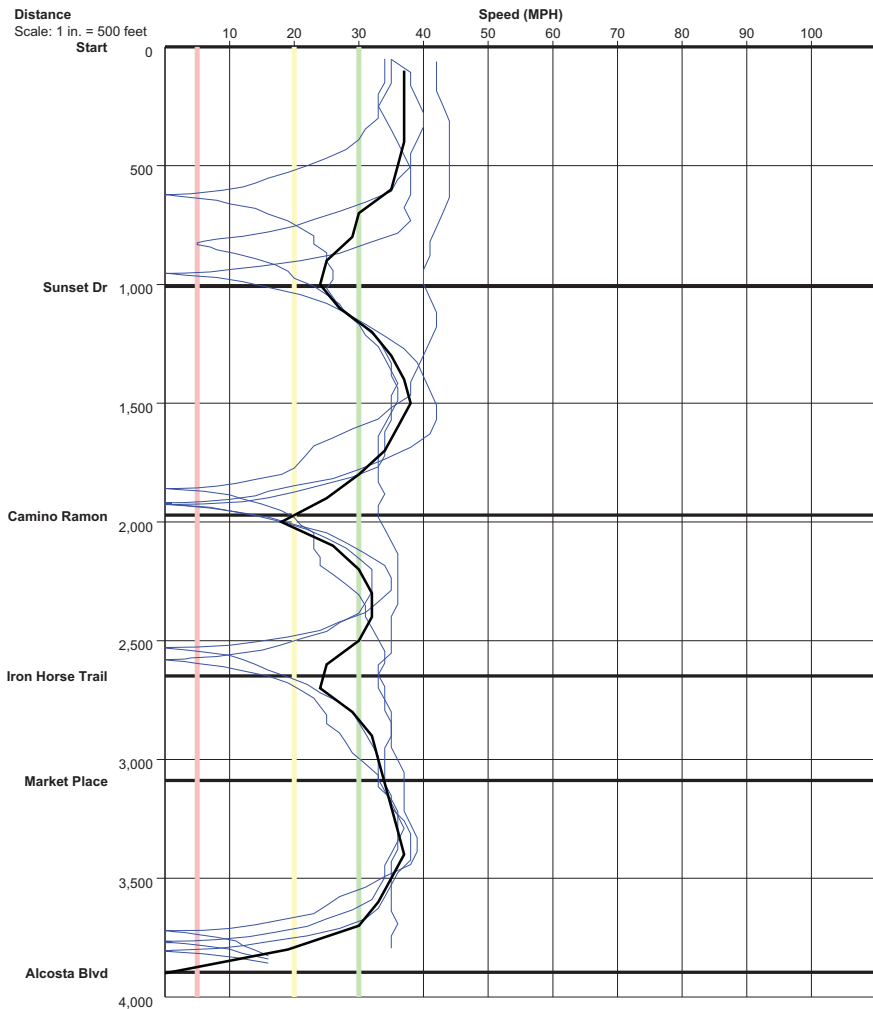


### Bollinger Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger EB MID - Day 2**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

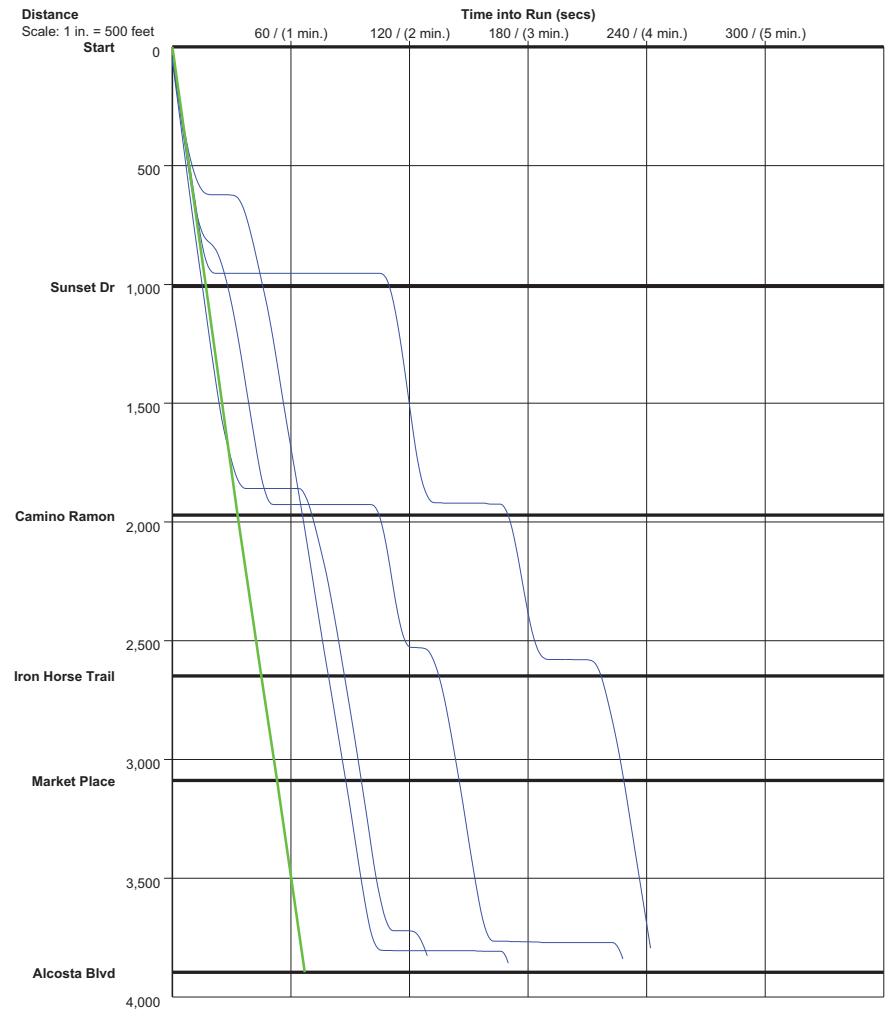


### Bollinger Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger EB MID - Day 2**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



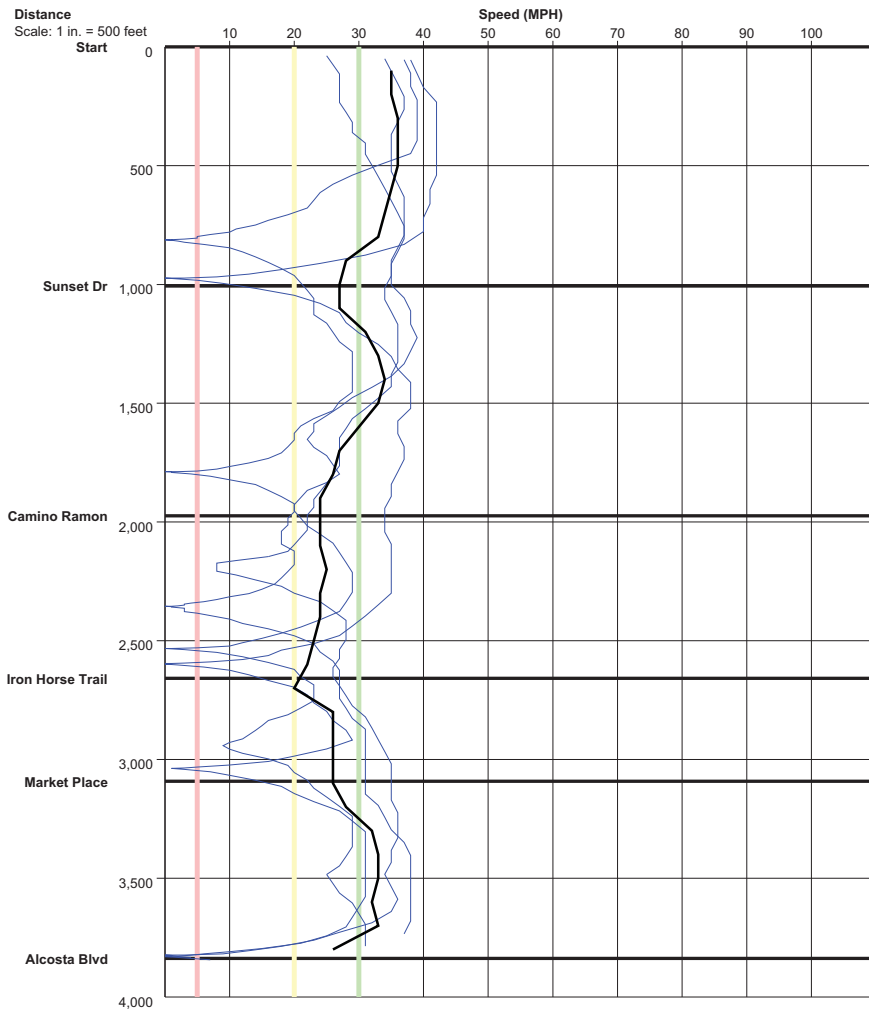
Solid Line is Normal Speed of 40 MPH

### Bollinger Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger EB MID - Day 3**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

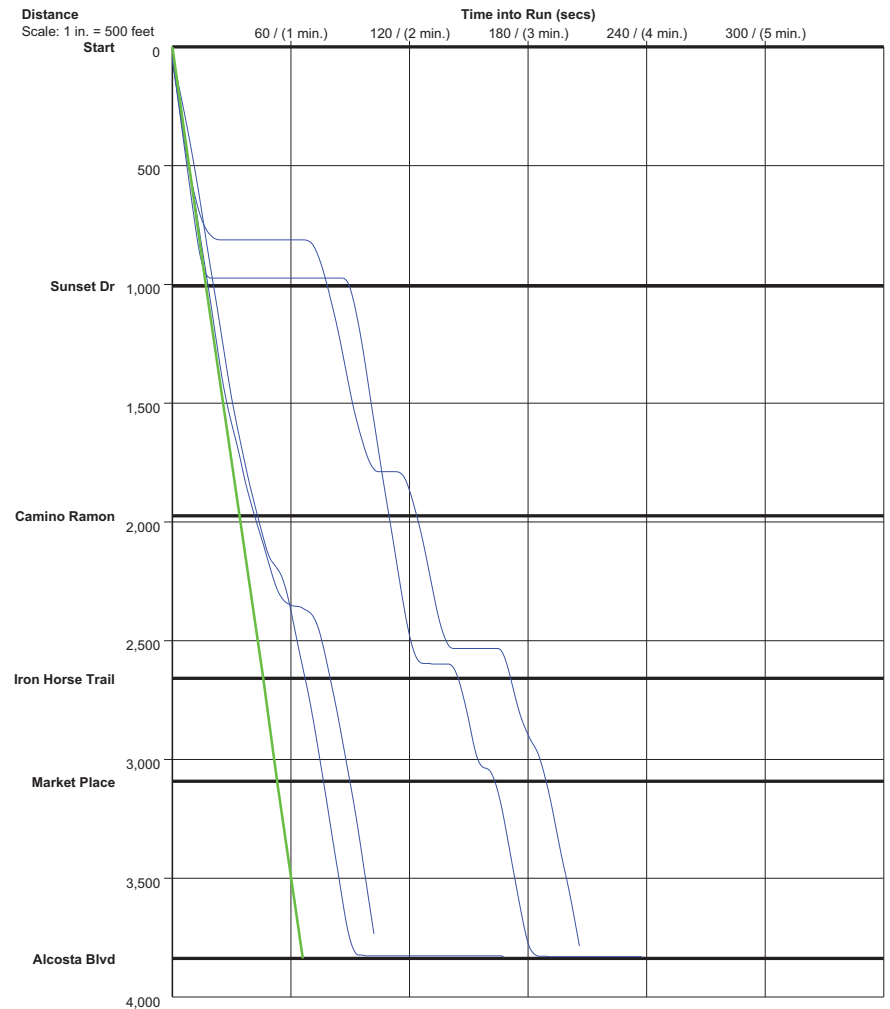


### Bollinger Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger EB MID - Day 3**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Before Period  
Bollinger Canyon Road Eastbound

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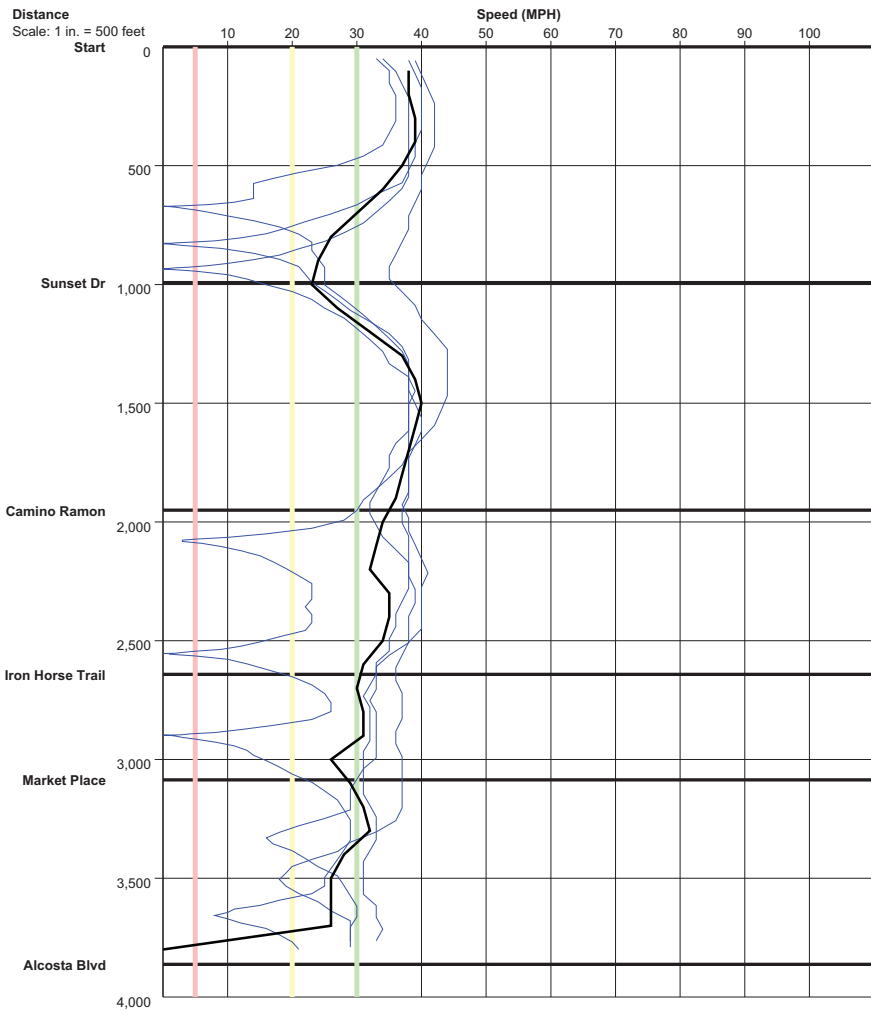
P.M. Peak (4:30 to 6:30 PM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger EB PM - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

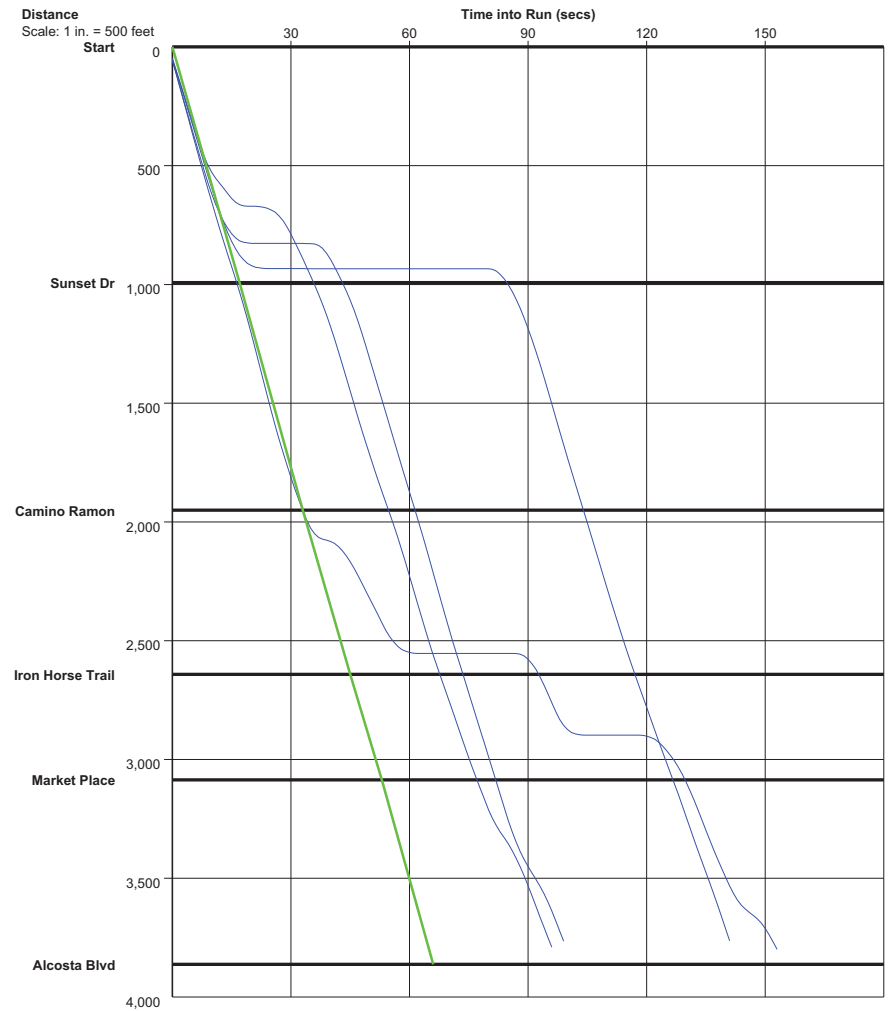


### Bollinger Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger EB PM - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

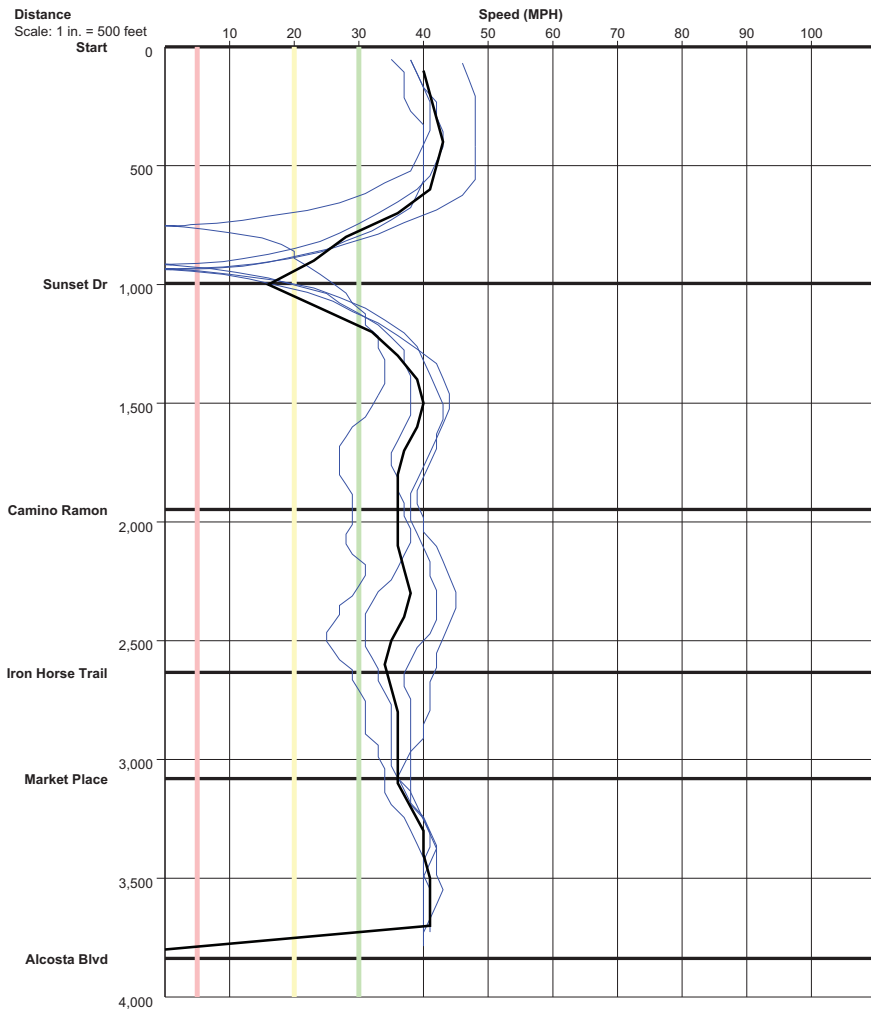


### Bollinger Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger EB PM - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

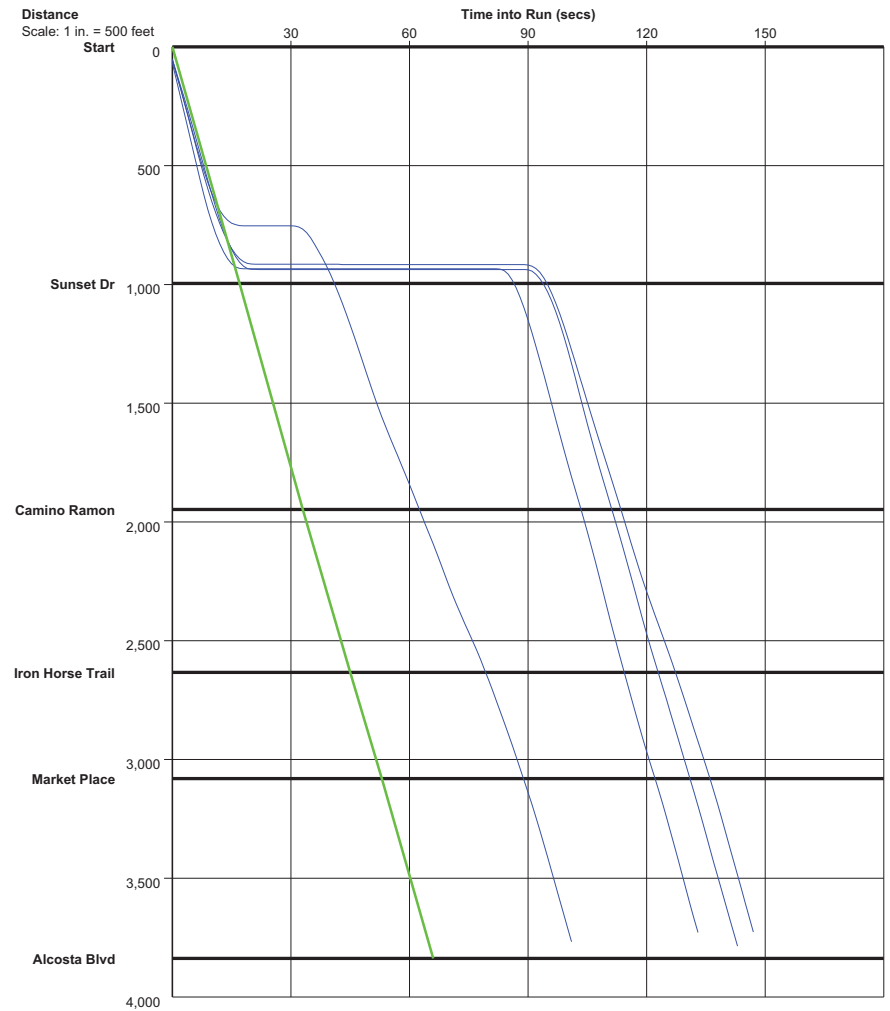


### Bollinger Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger EB PM - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

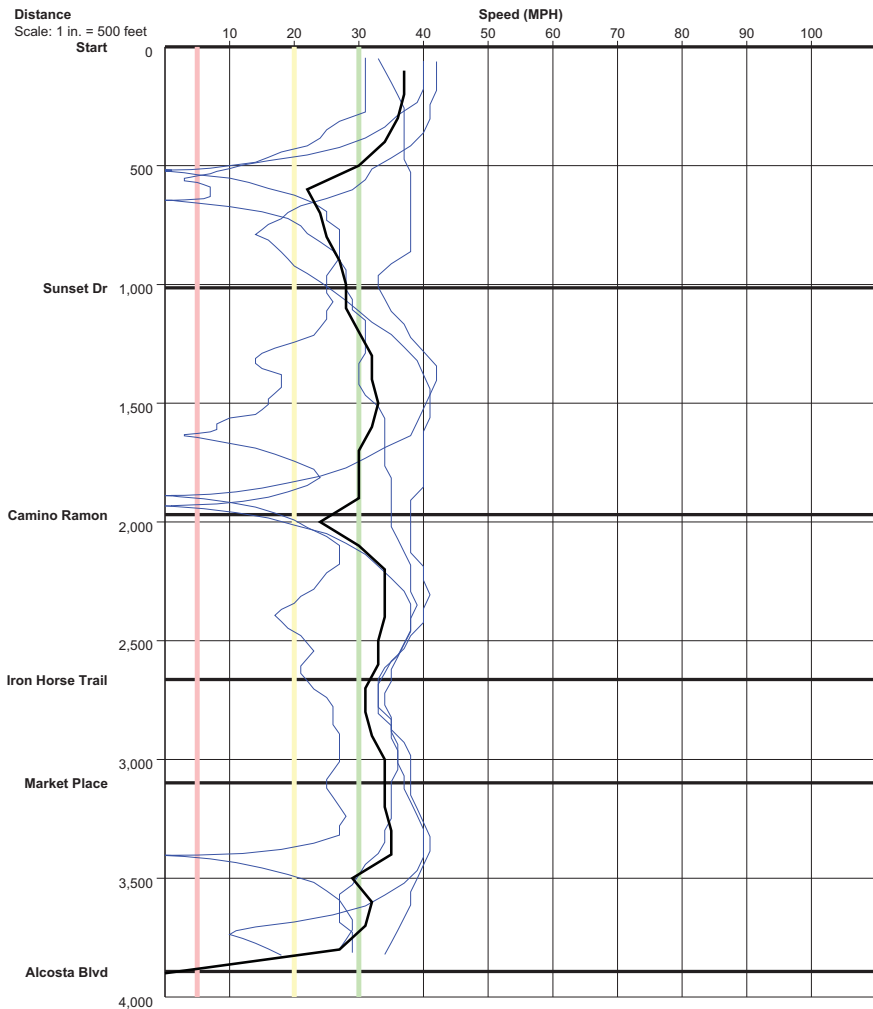


### Bollinger Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger EB PM - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

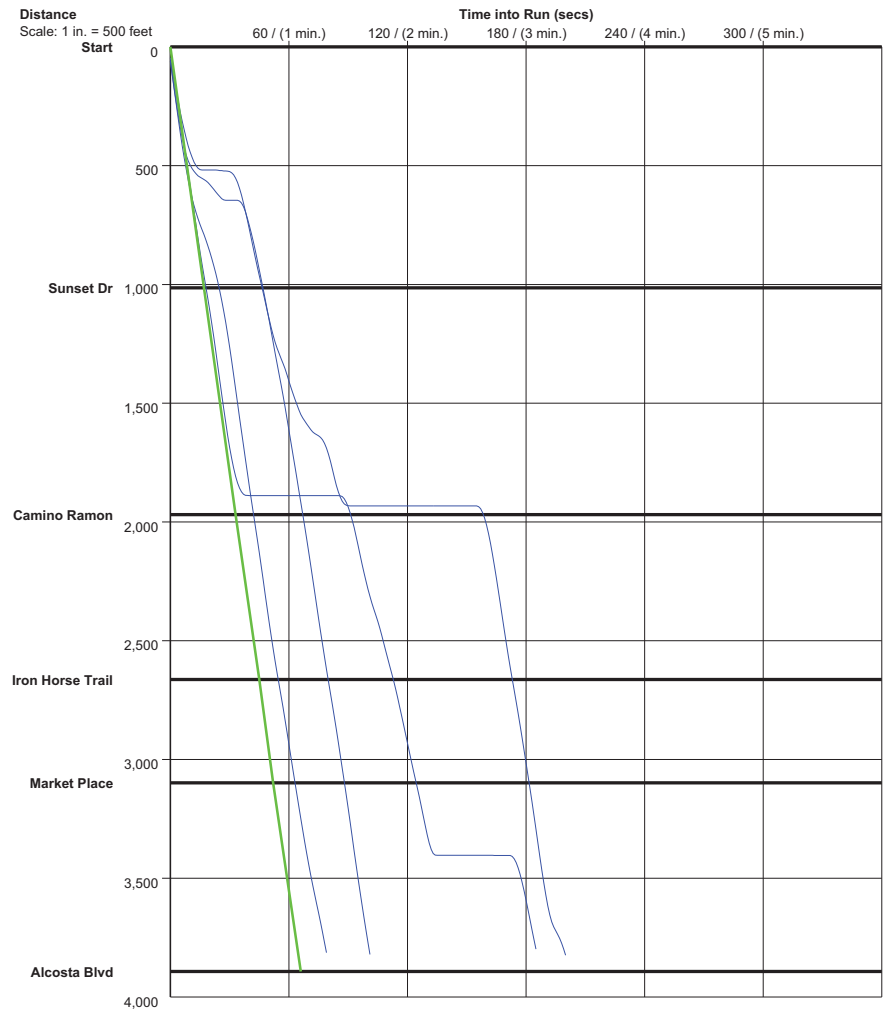


### Bollinger Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger EB PM - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

**Appendix A-2**  
Before Period  
Bollinger Canyon Road Westbound

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Before Period  
Bollinger Canyon Road Westbound

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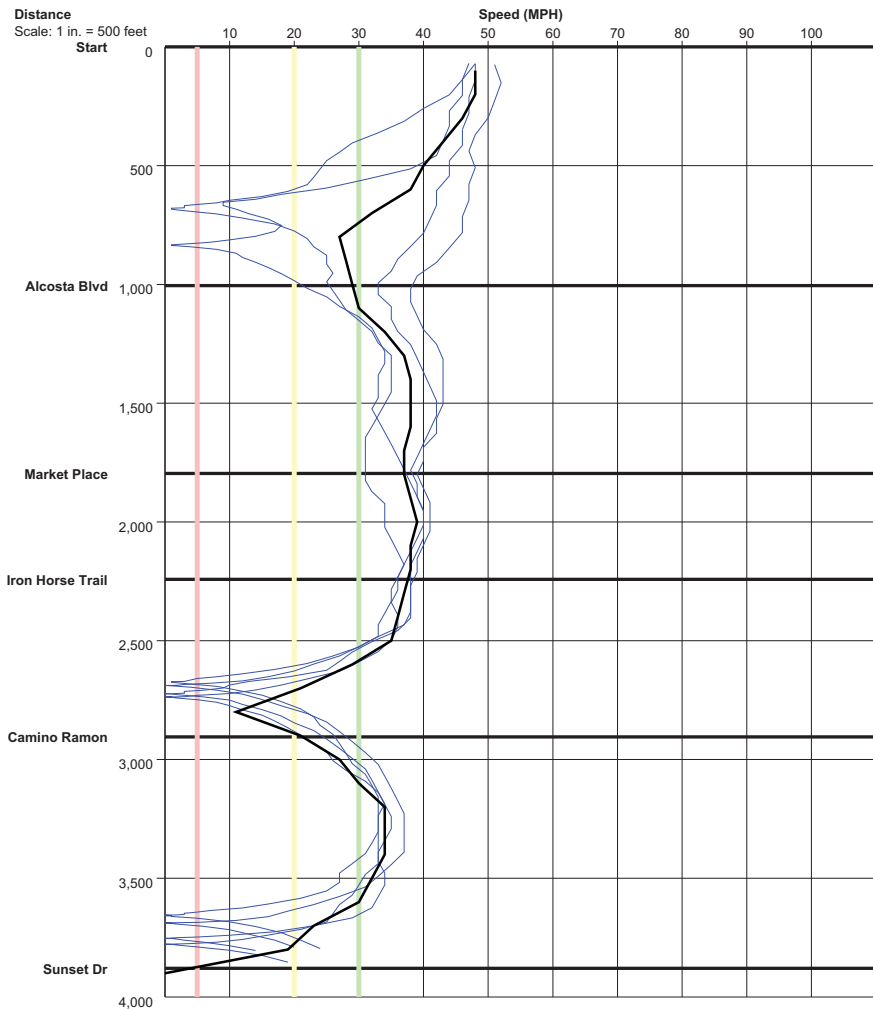
A.M. Peak (7:00 to 9:00 AM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger WB AM - Day 1**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

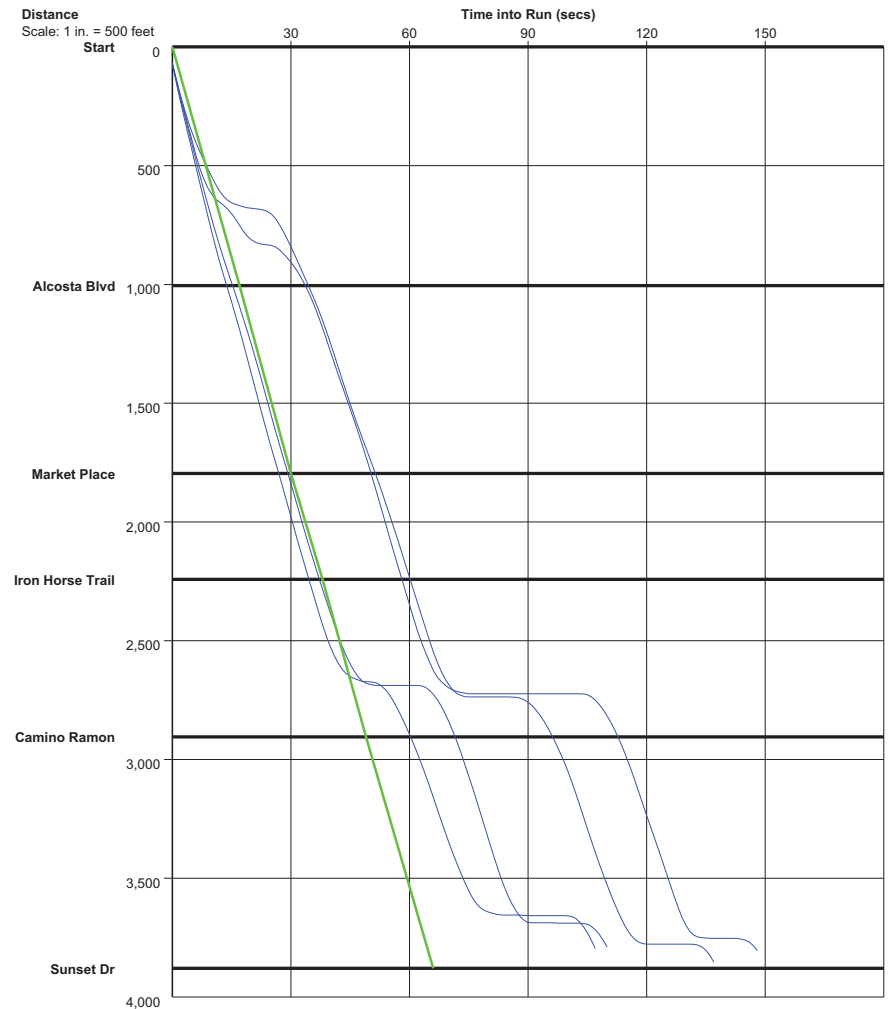


### Bollinger Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger WB AM - Day 1**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

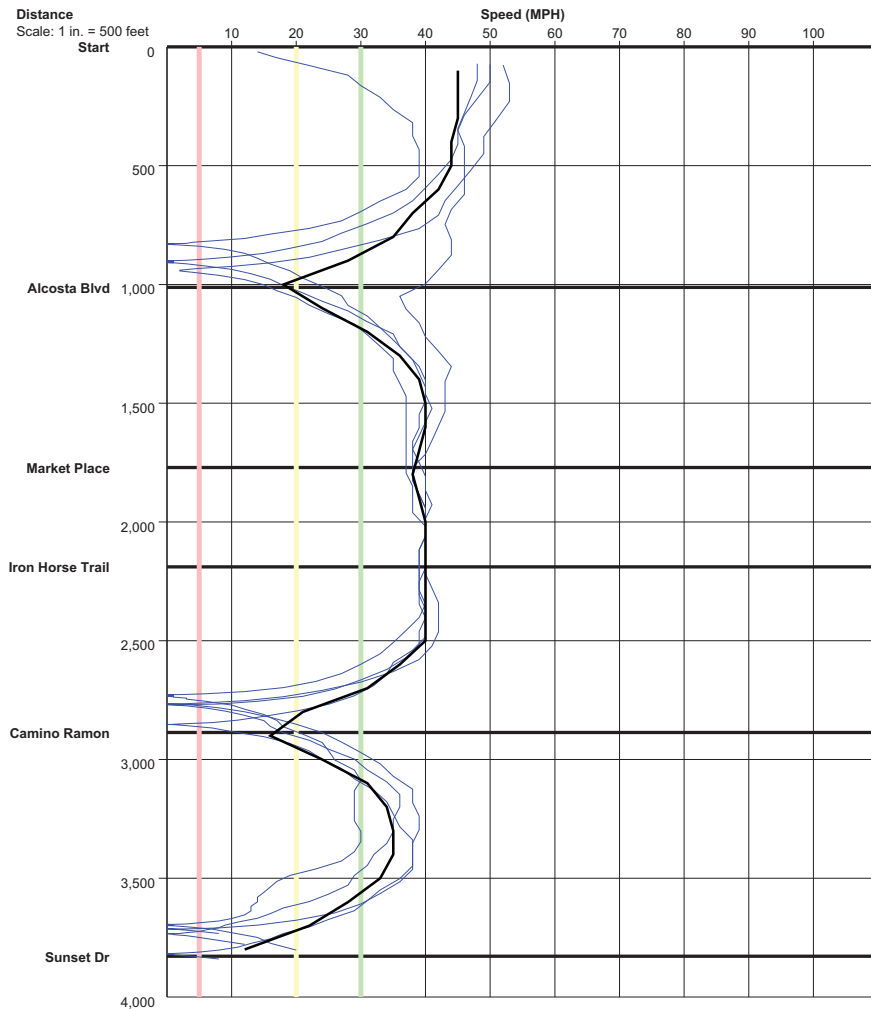


### Bollinger Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger WB AM - Day 2**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

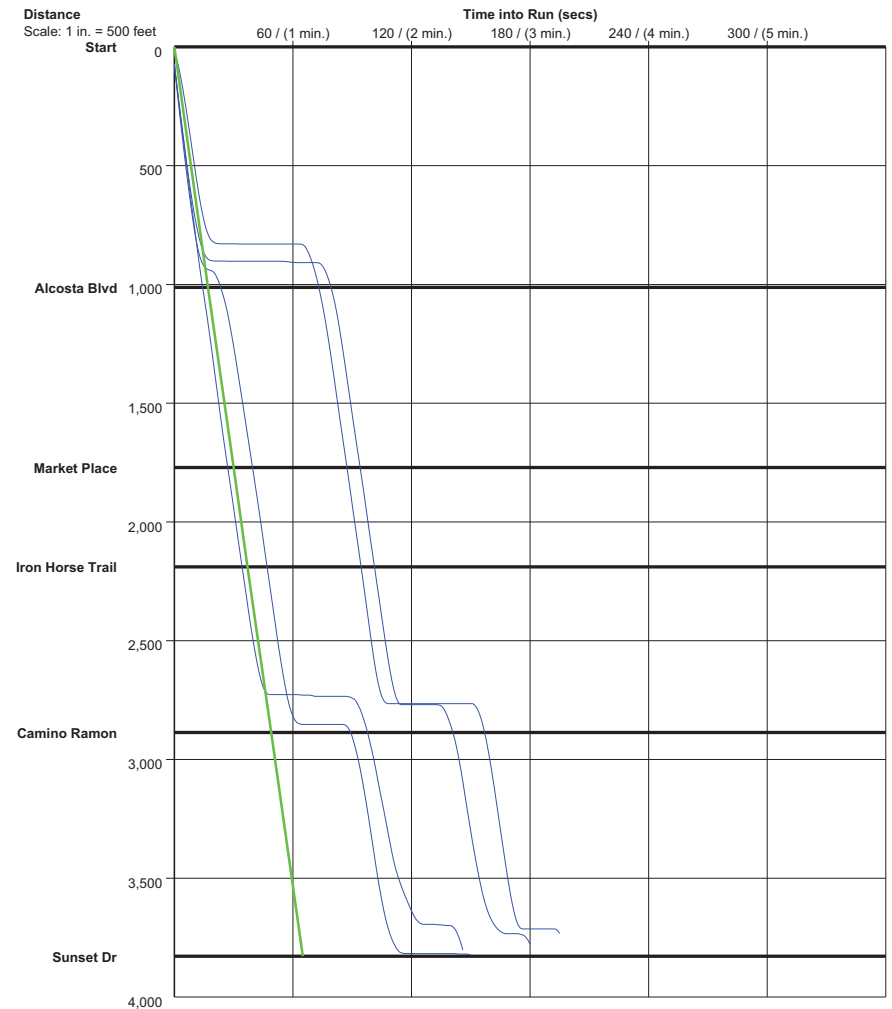


### Bollinger Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger WB AM - Day 2**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



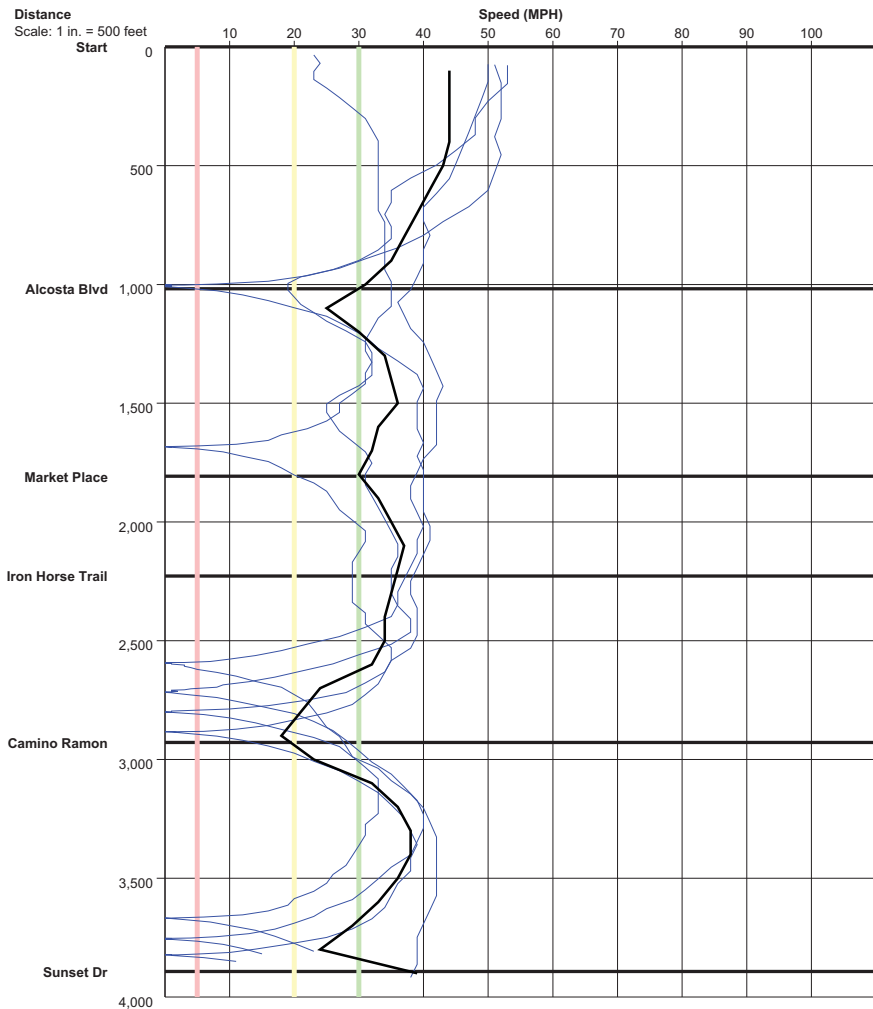
Solid Line is Normal Speed of 40 MPH

### Bollinger Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger WB AM - Day 3**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

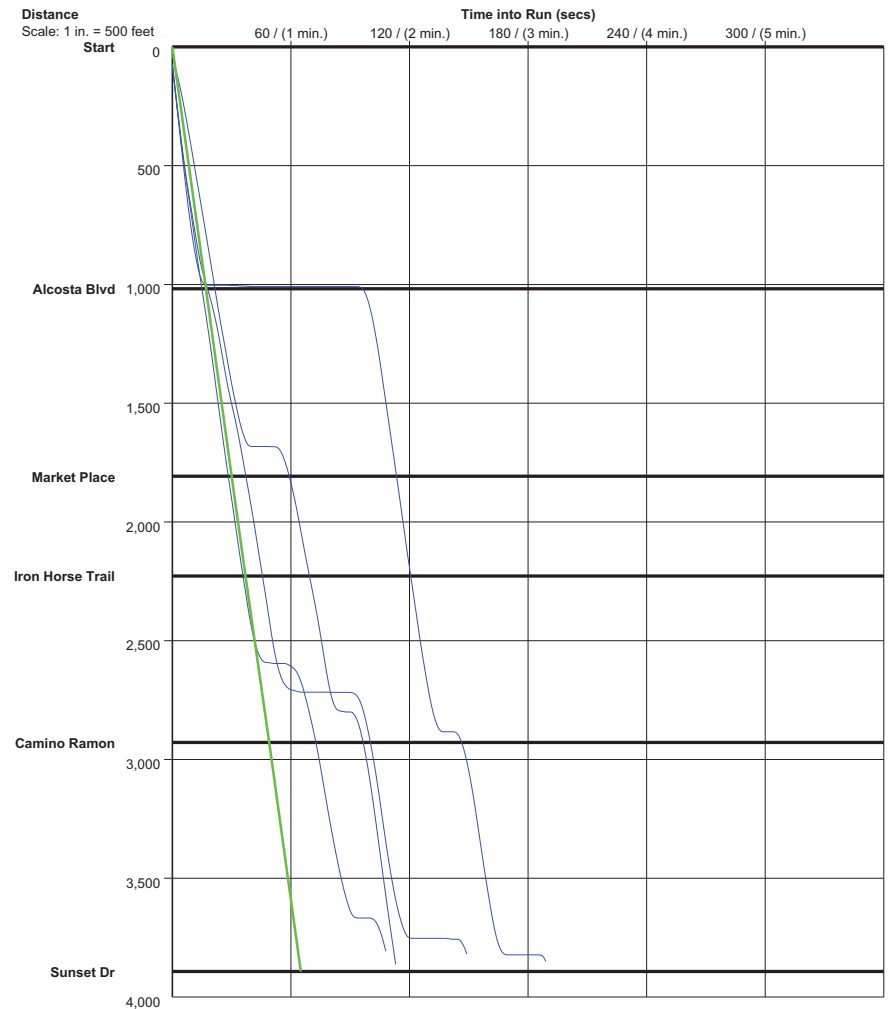


### Bollinger Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger WB AM - Day 3**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Before Period  
Bollinger Canyon Road Westbound

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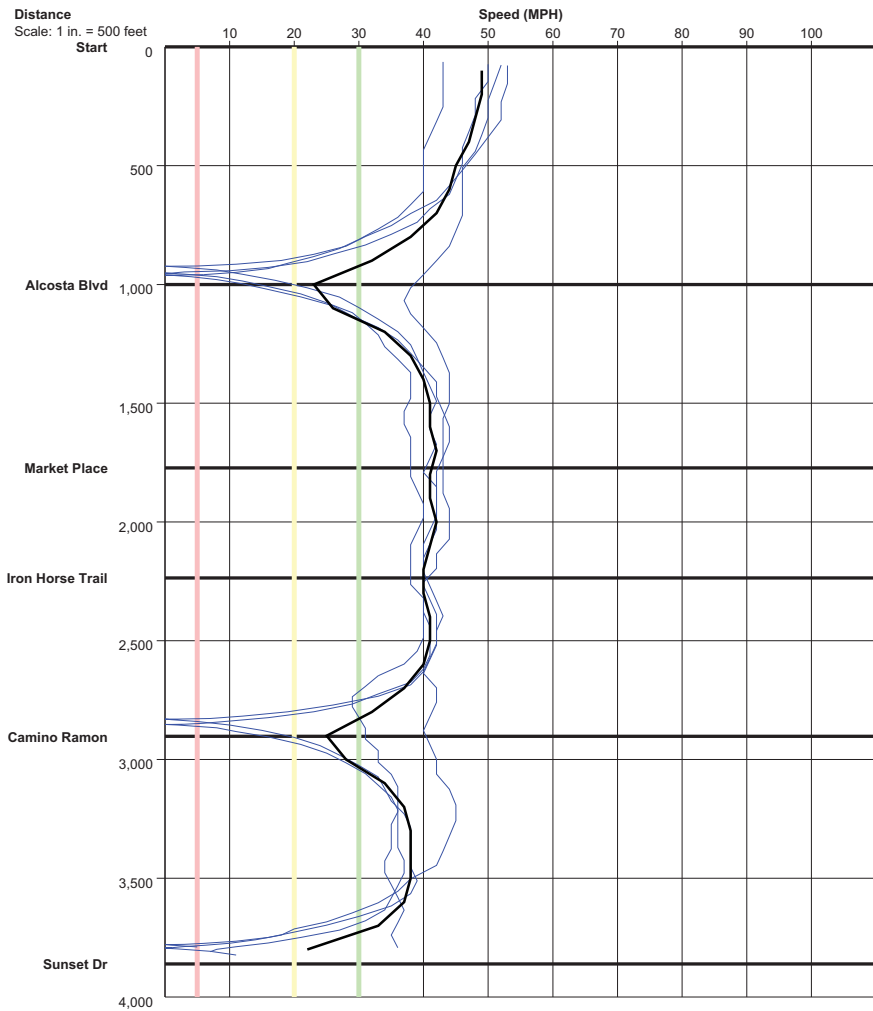
A.M. Off-Peak (9:00 to 11:00 AM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger WB AM OP - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

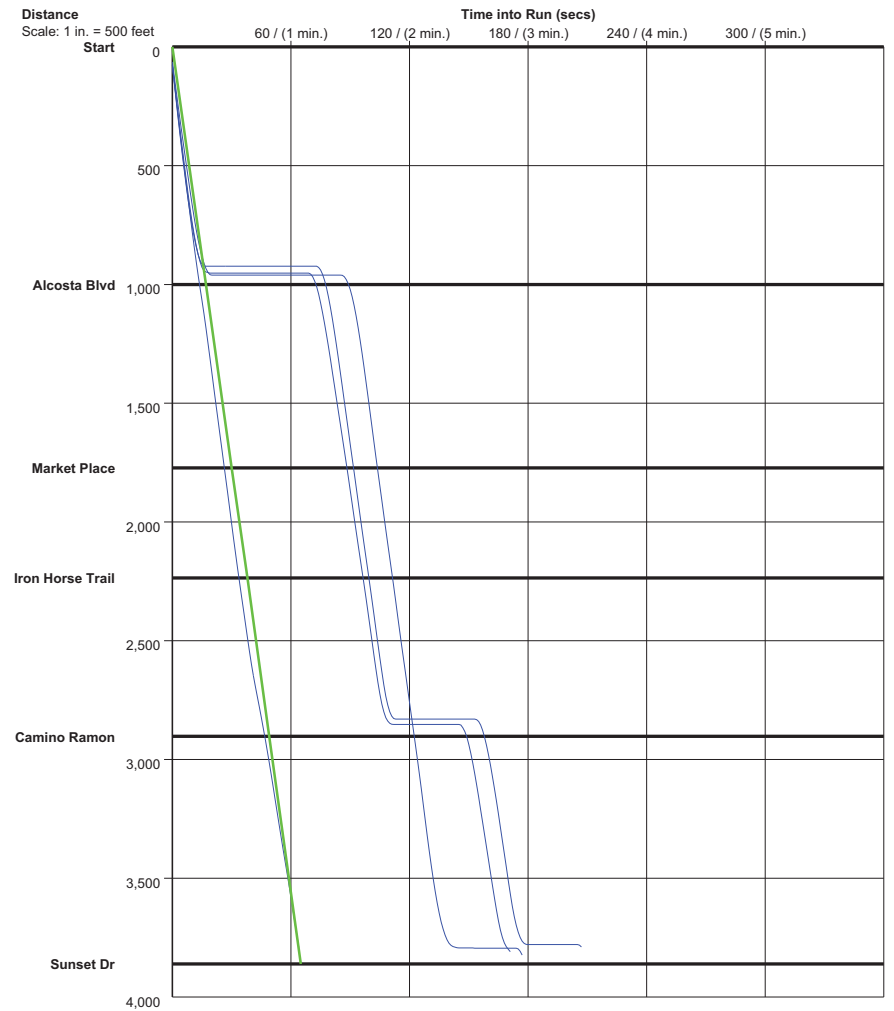


### Bollinger Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger WB AM OP - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

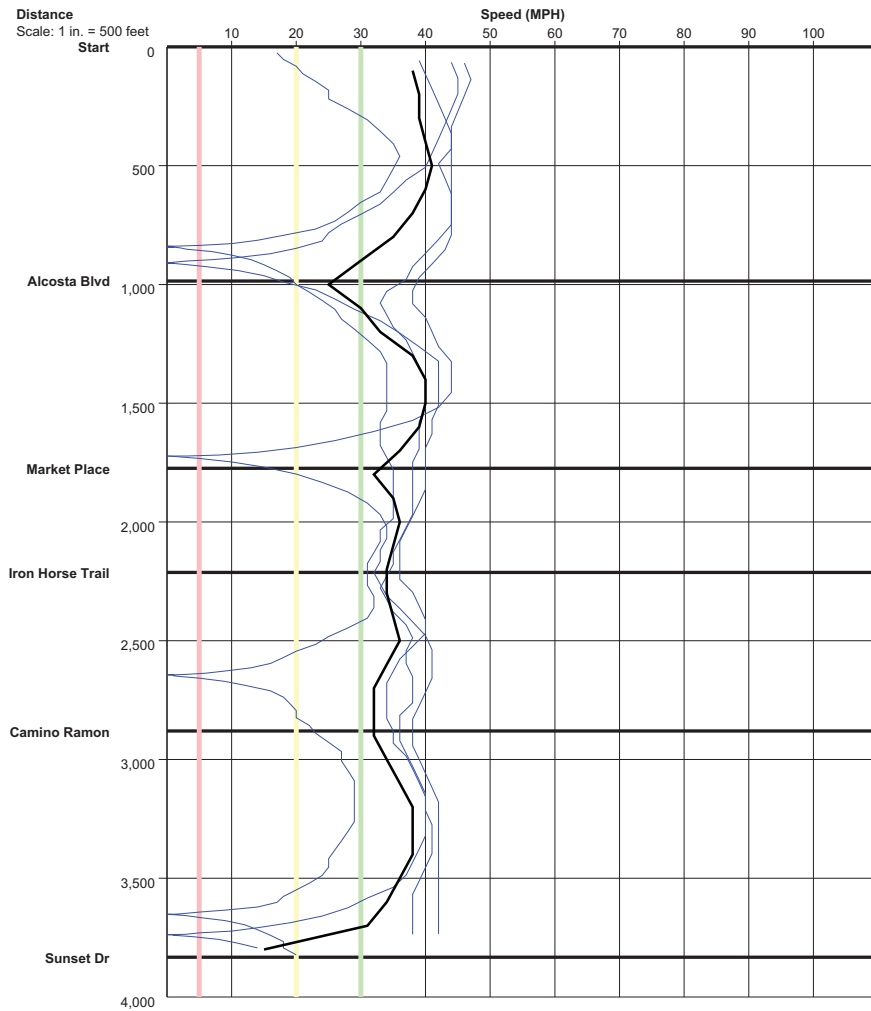


### Bollinger Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger WB AM OP - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

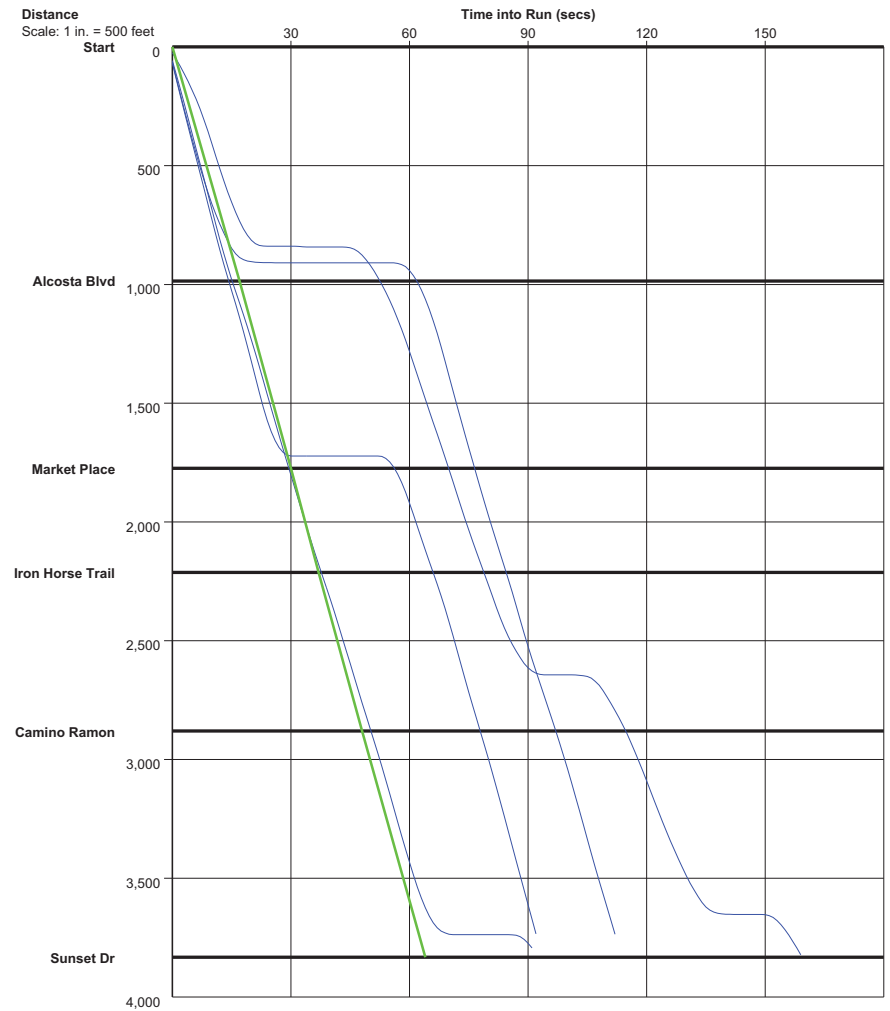


### Bollinger Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger WB AM OP - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

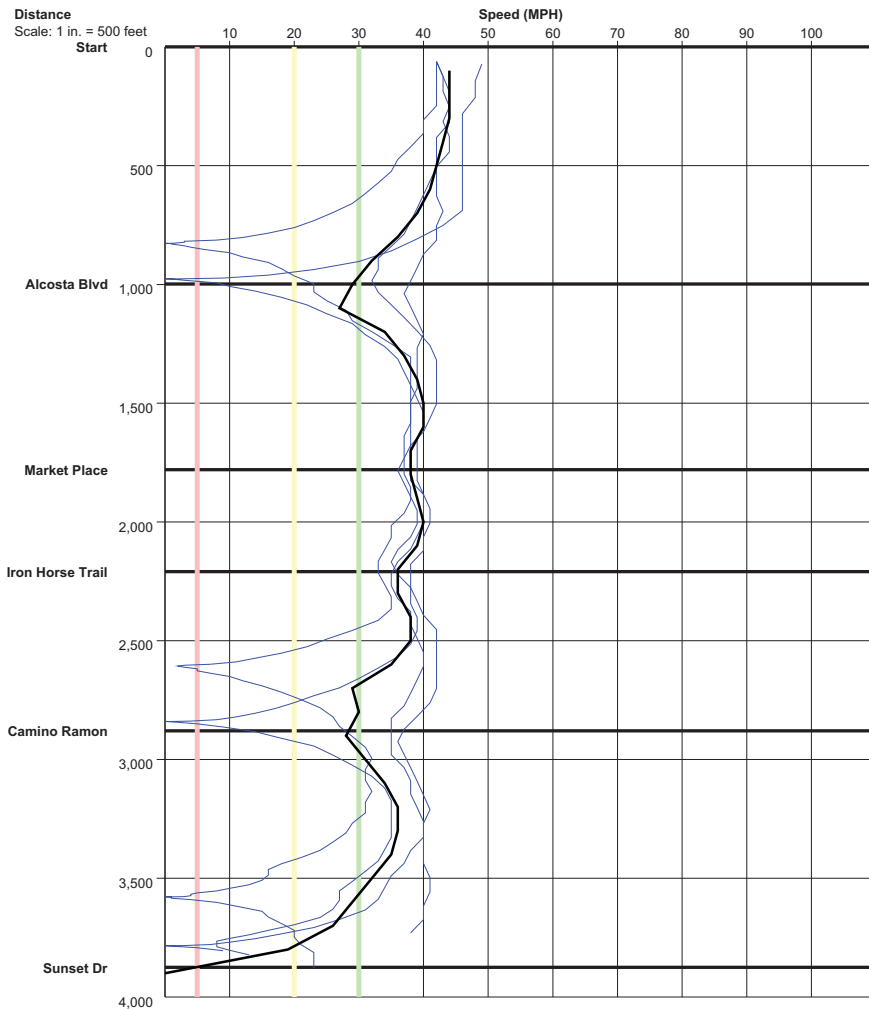


### Bollinger Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger WB AM OP - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

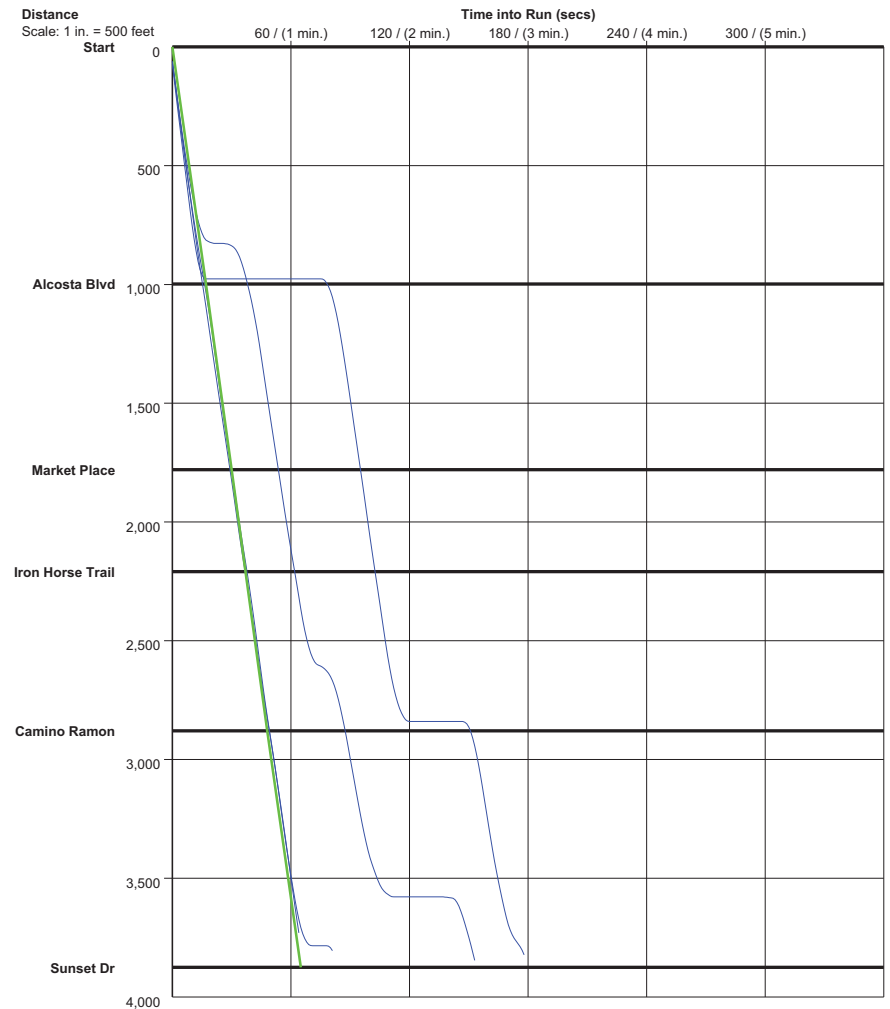


### Bollinger Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger WB AM OP - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Before Period  
Bollinger Canyon Road Westbound

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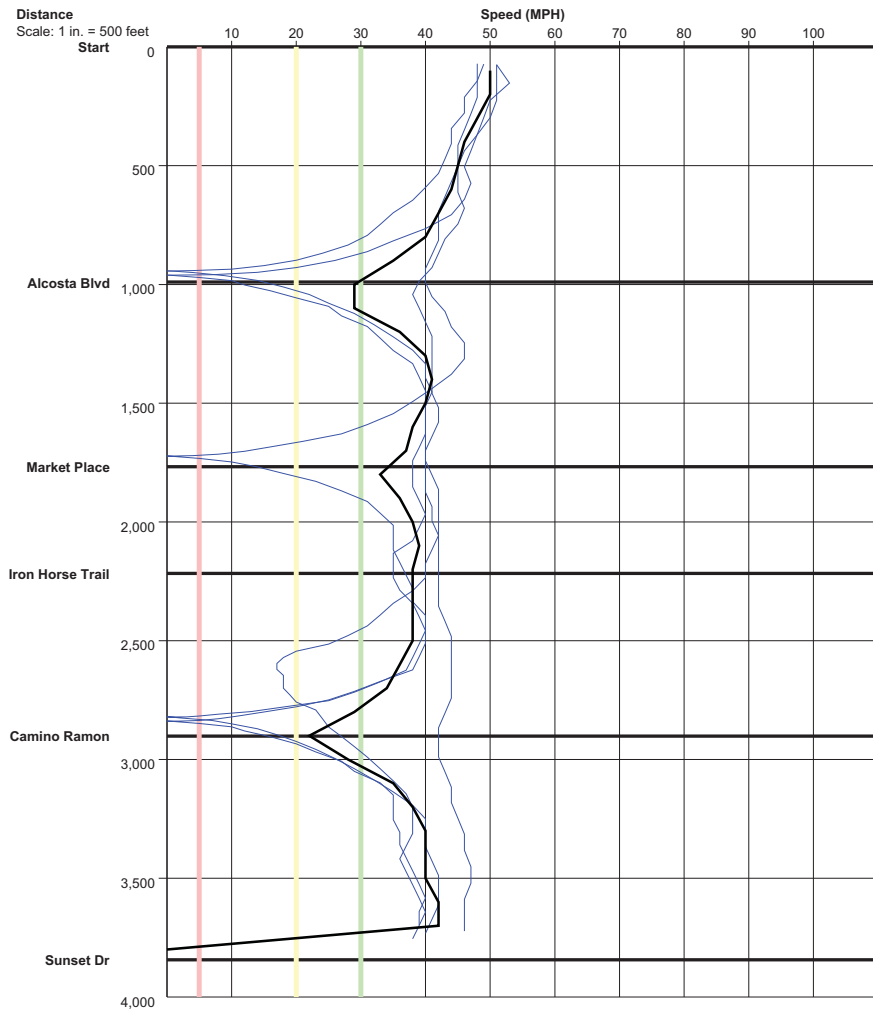
Midday Peak (11:30 AM to 1:30 PM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger WB MID - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

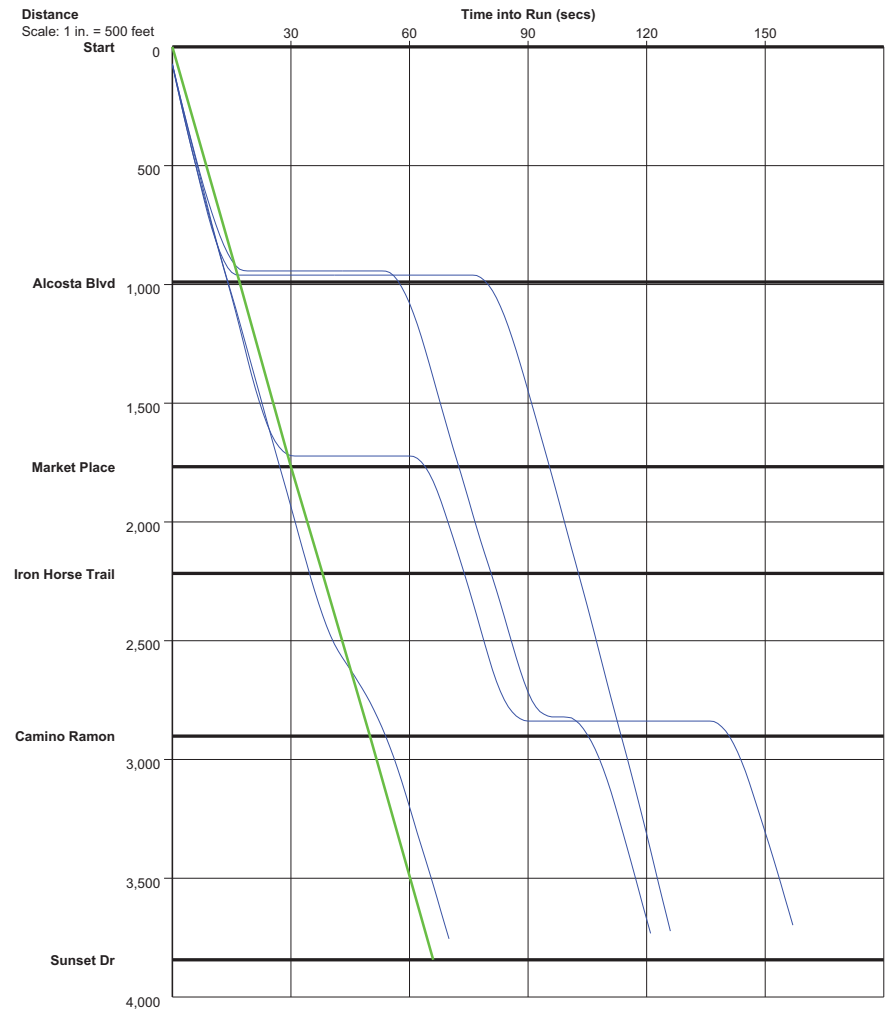


### Bollinger Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger WB MID - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

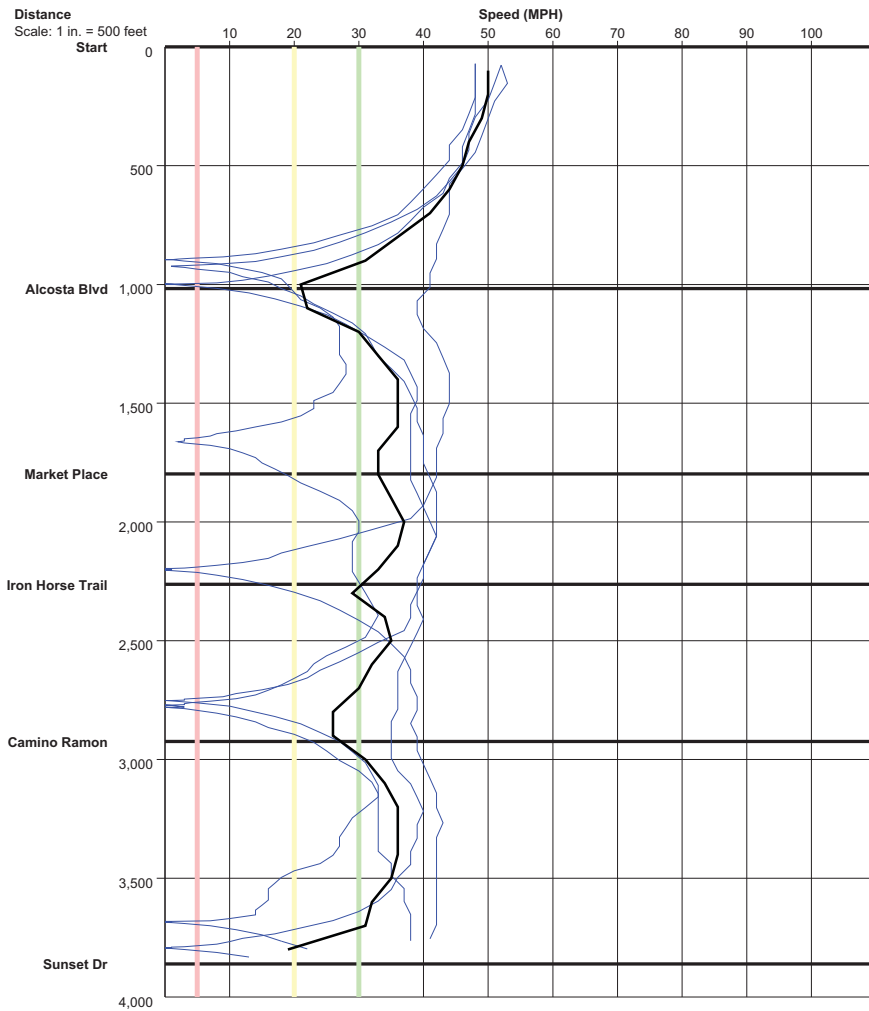


### Bollinger Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger WB MID - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

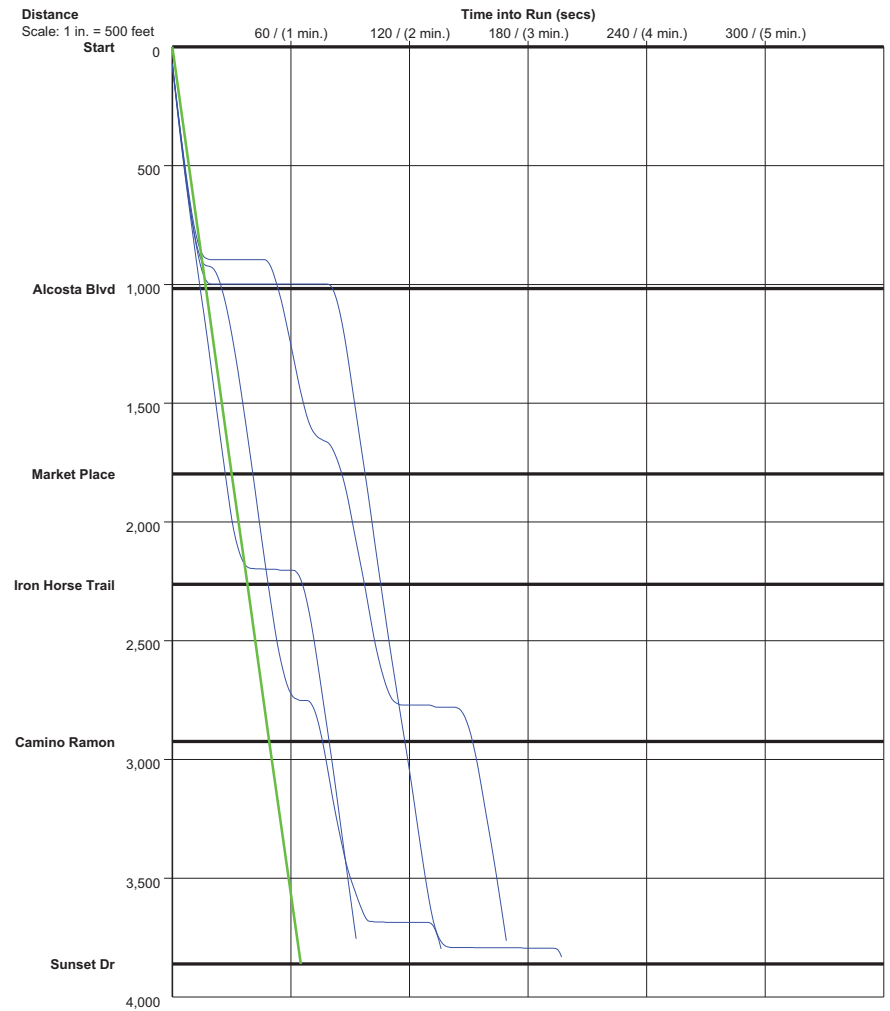


### Bollinger Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger WB MID - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

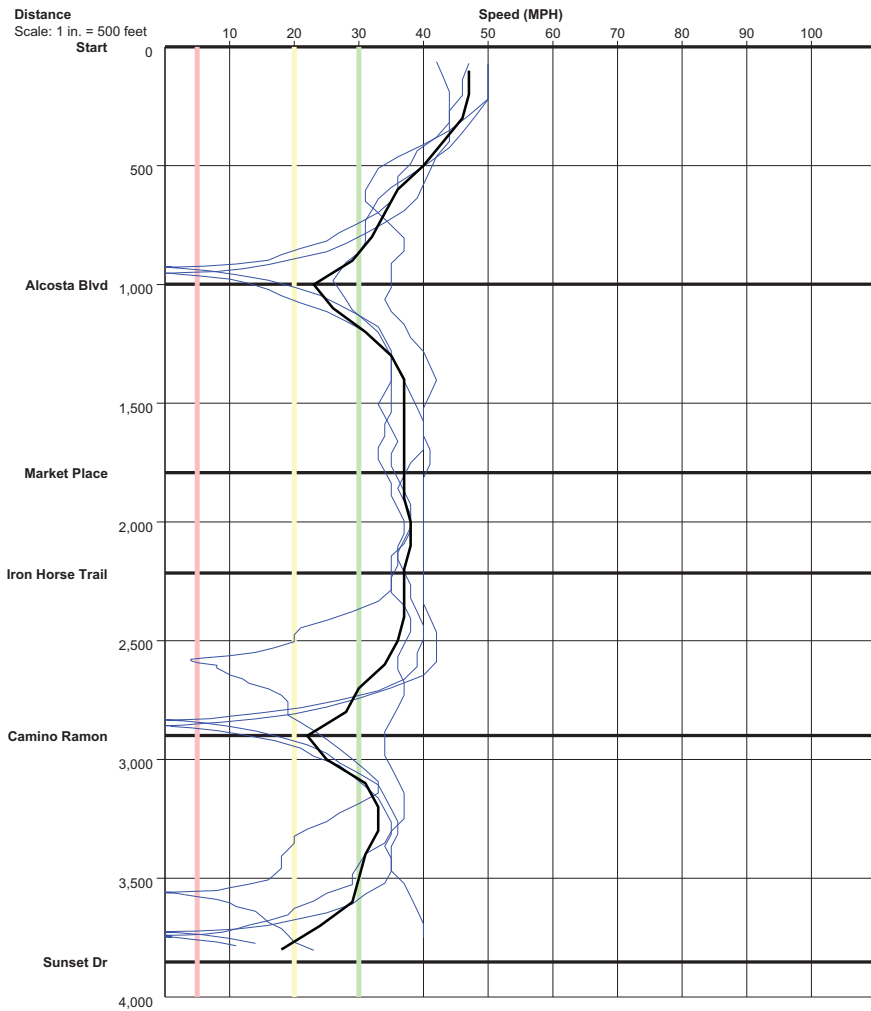


### Bollinger Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger WB MID - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

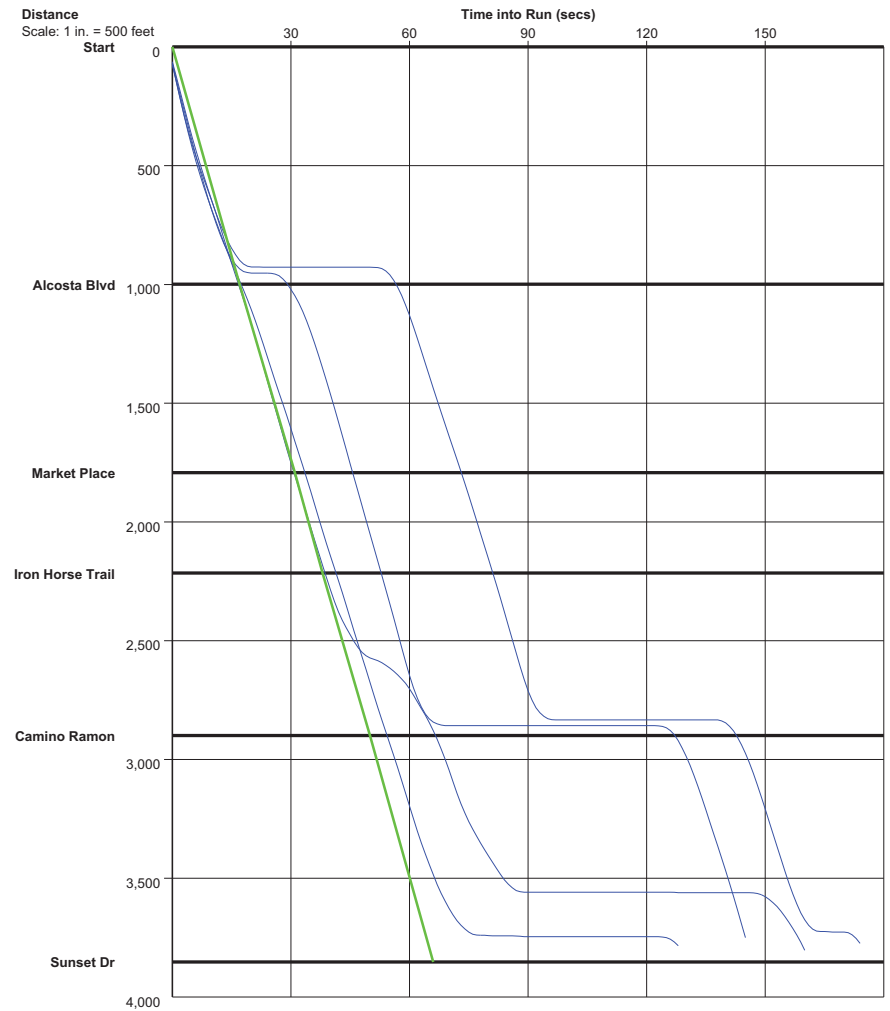


### Bollinger Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger WB MID - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Before Period  
Bollinger Canyon Road Westbound

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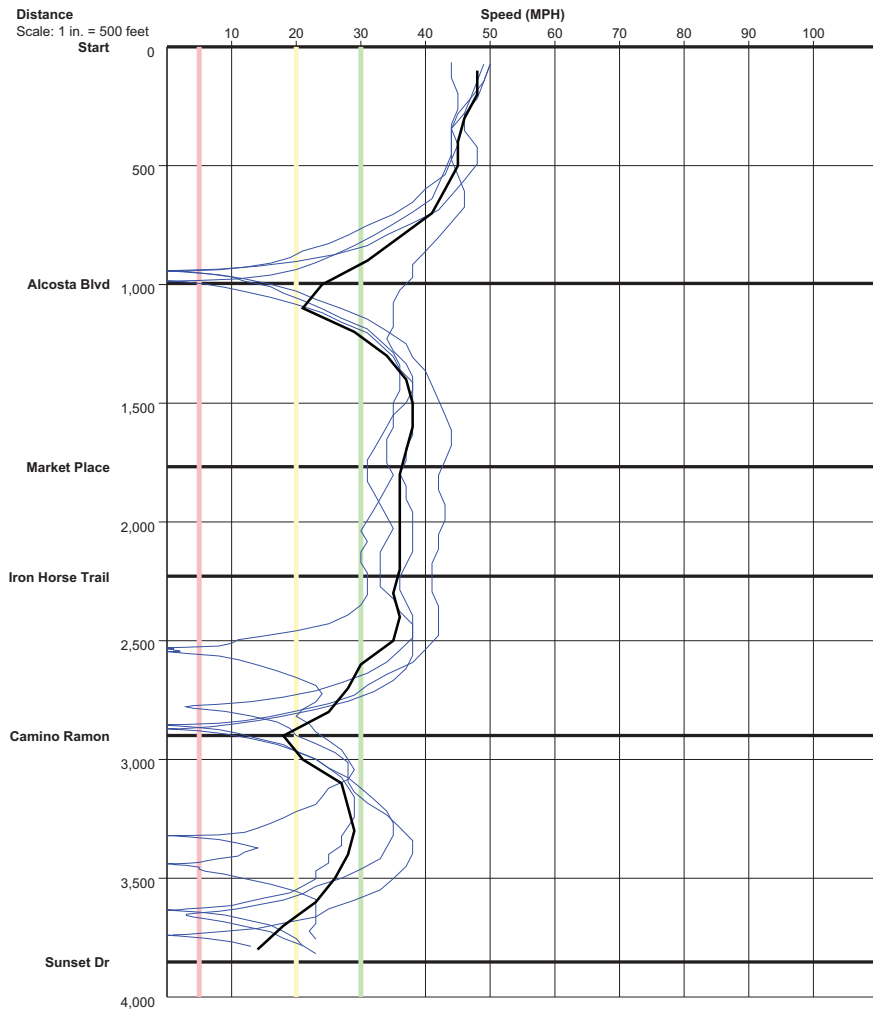
P.M. Peak (4:30 to 6:30 PM)

### Bollinger Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger WB PM - Day 1**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

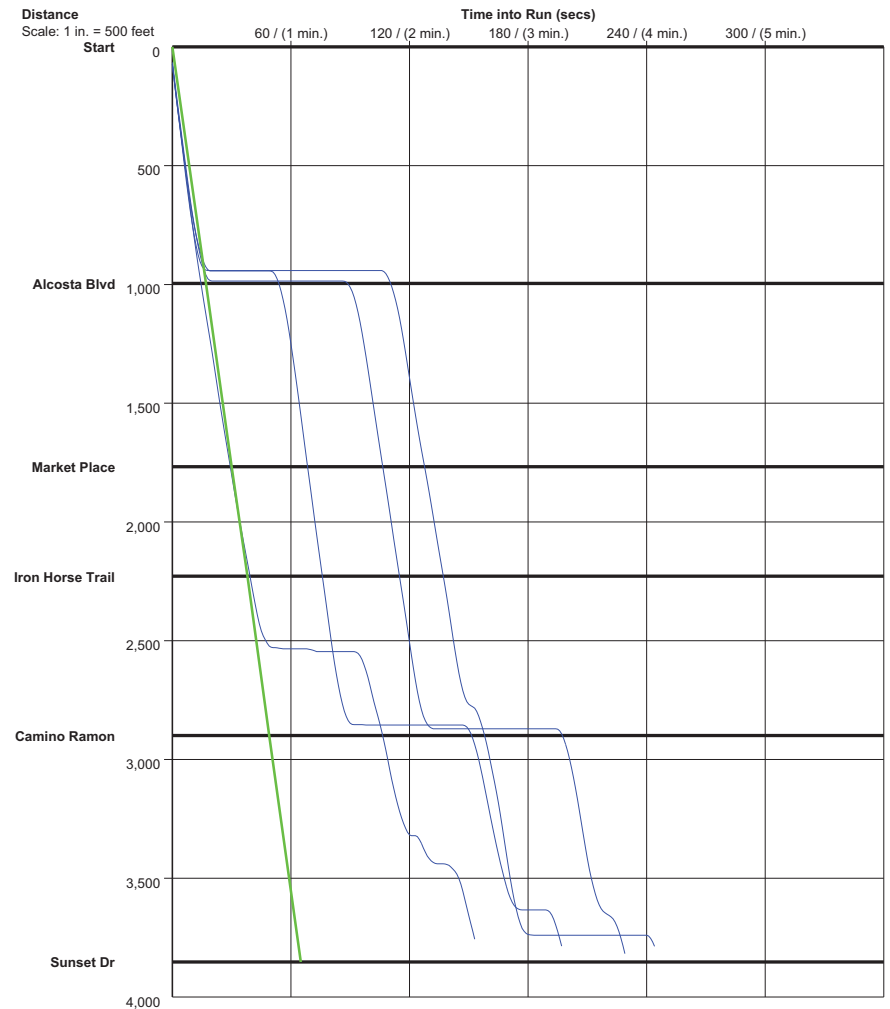


### Bollinger Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger WB PM - Day 1**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

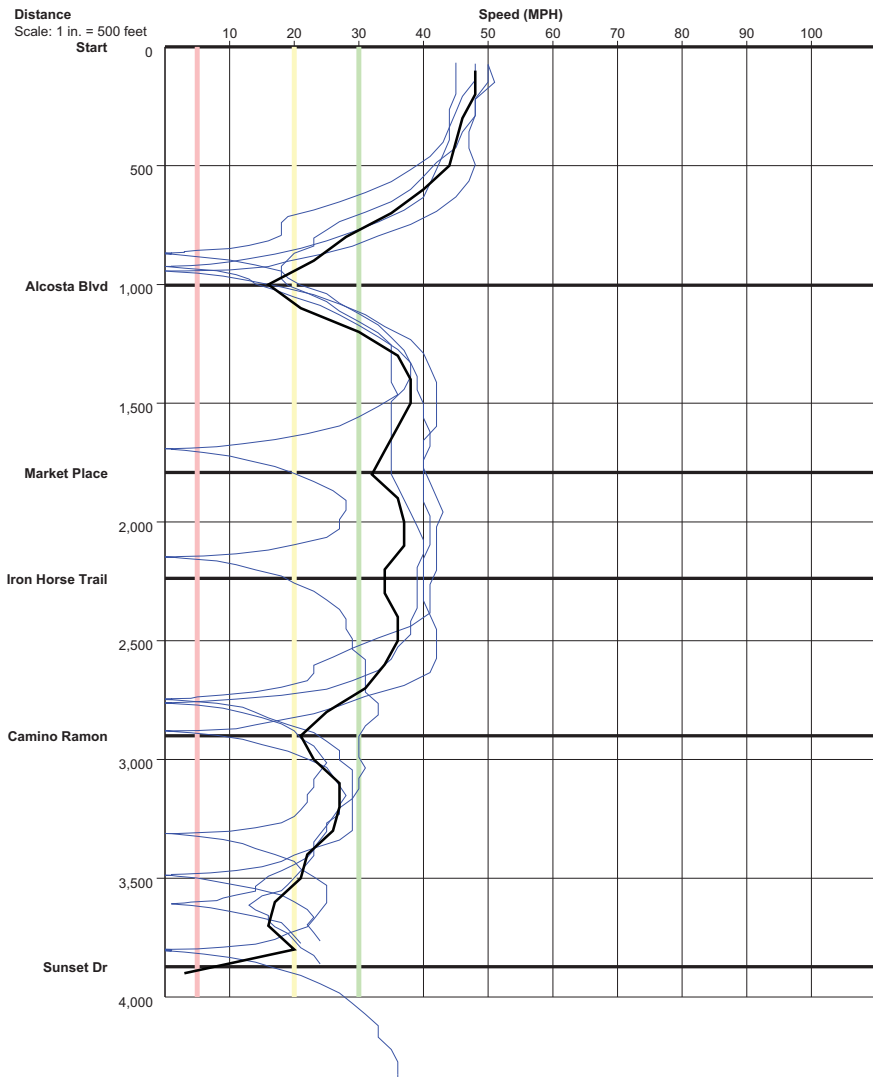


### Bollinger Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger WB PM - Day 2**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

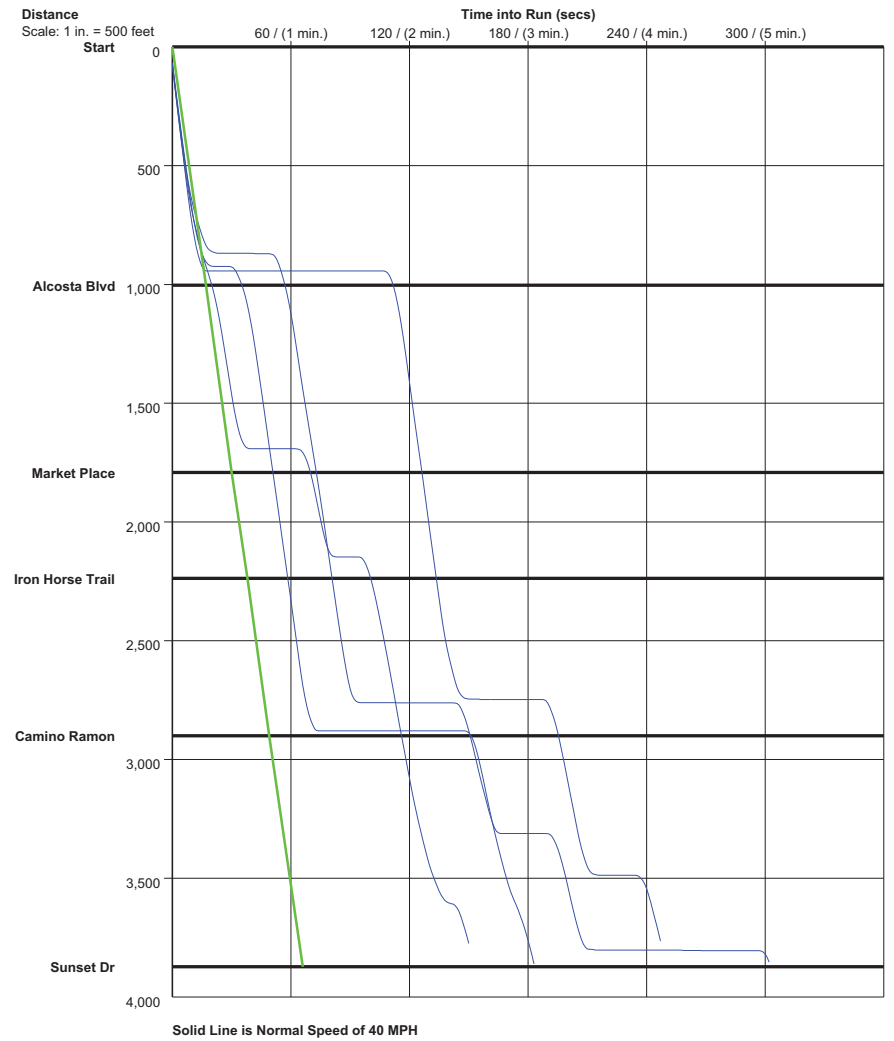


### Bollinger Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger WB PM - Day 2**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

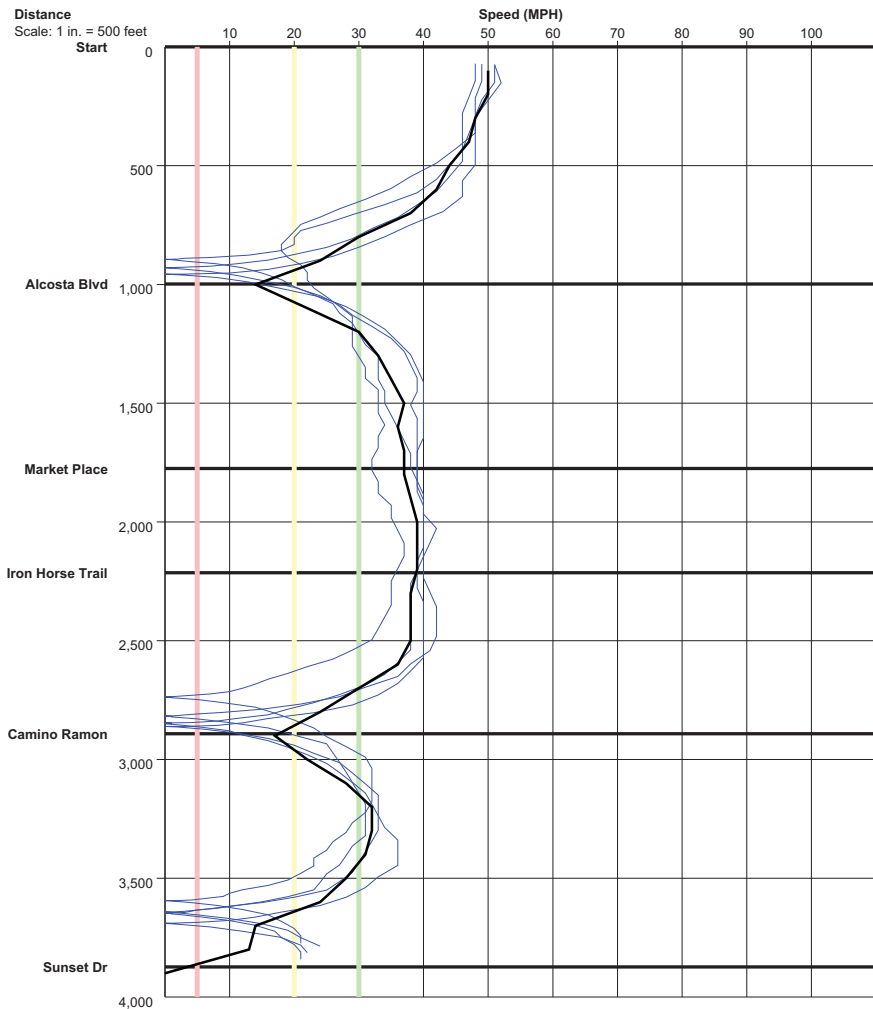


### Bollinger Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger WB PM - Day 3**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

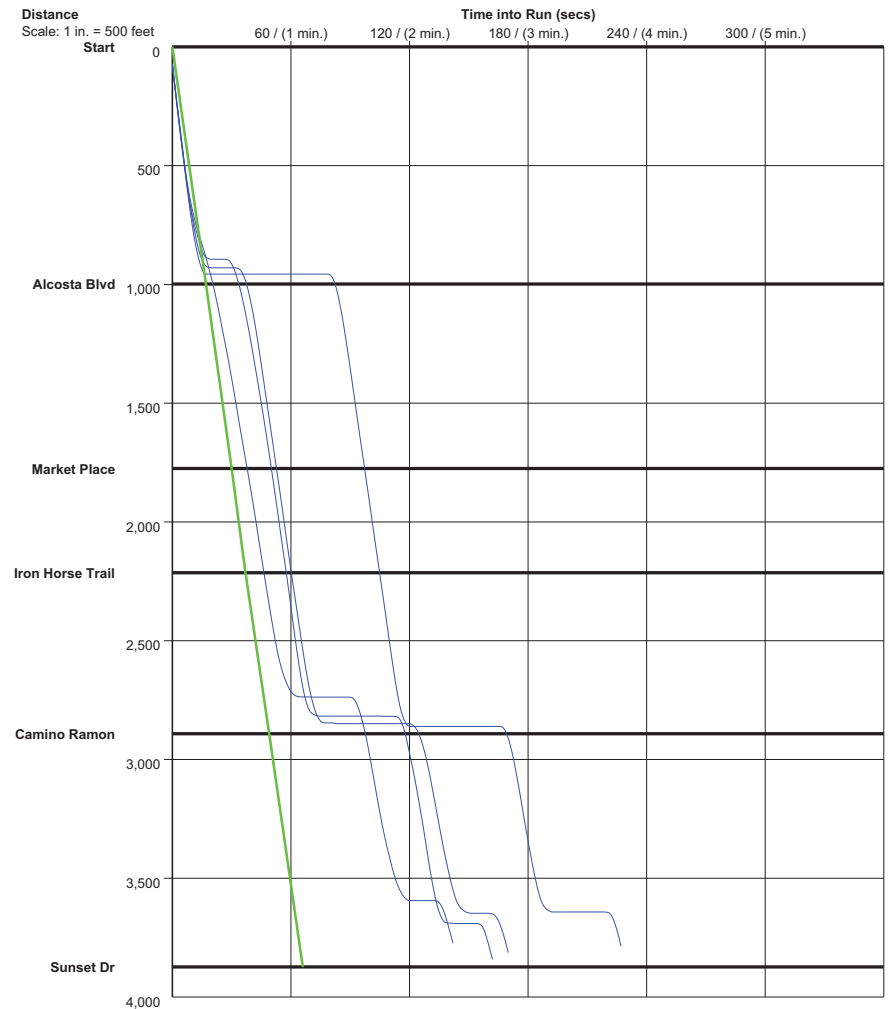


### Bollinger Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger WB PM - Day 3**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

**Appendix A-3**  
Before Period  
Crow Canyon Road Eastbound

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Before Period  
Crow Canyon Road Eastbound

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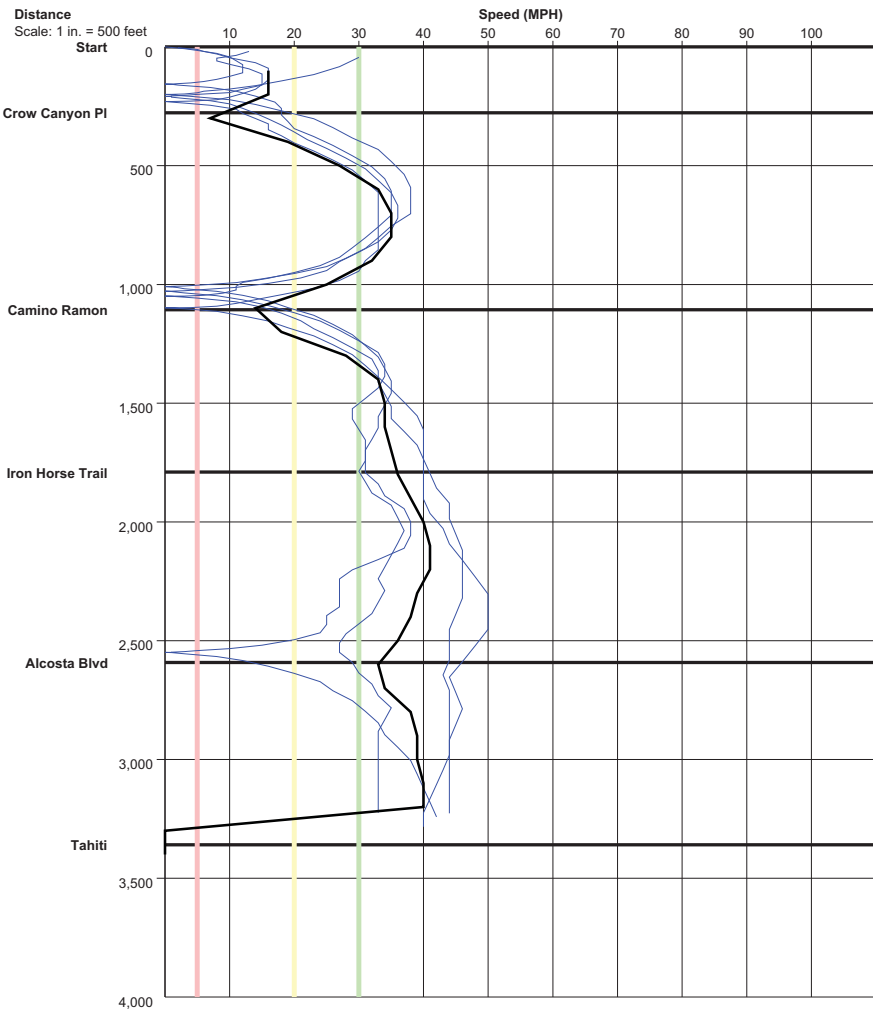
A.M. Peak (7:00 to 9:00 AM)

### Crow Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

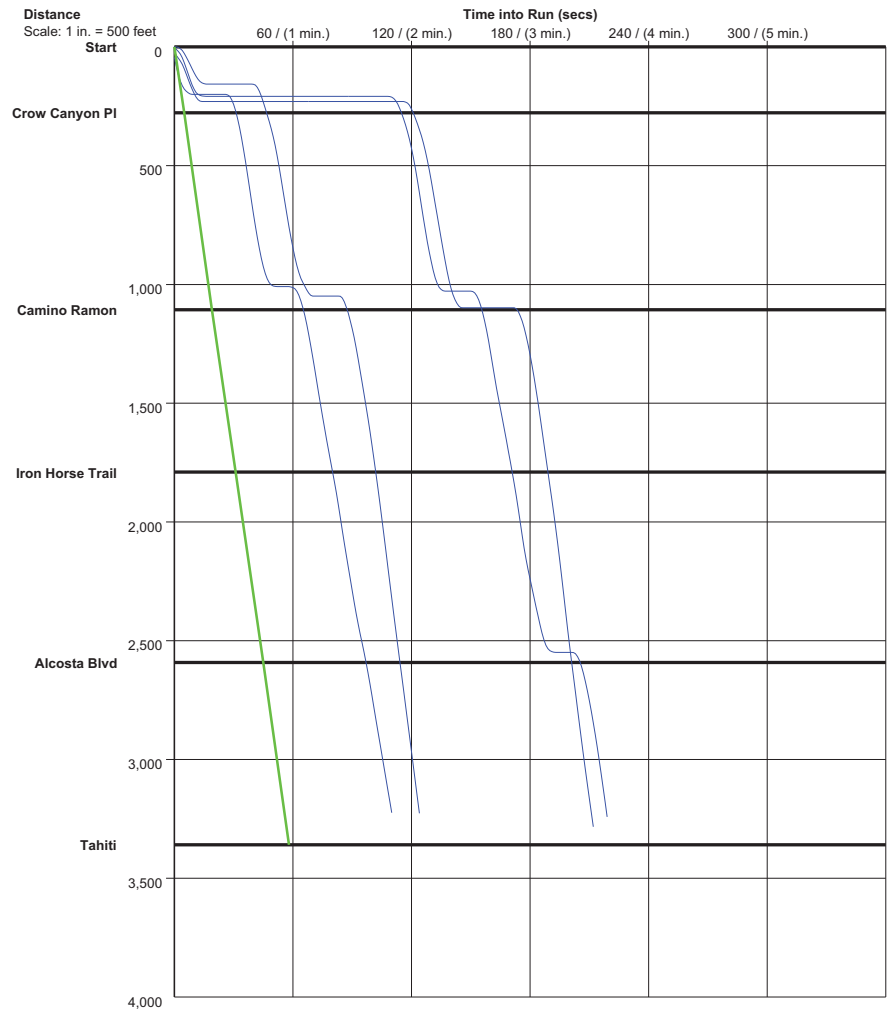


### Crow Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



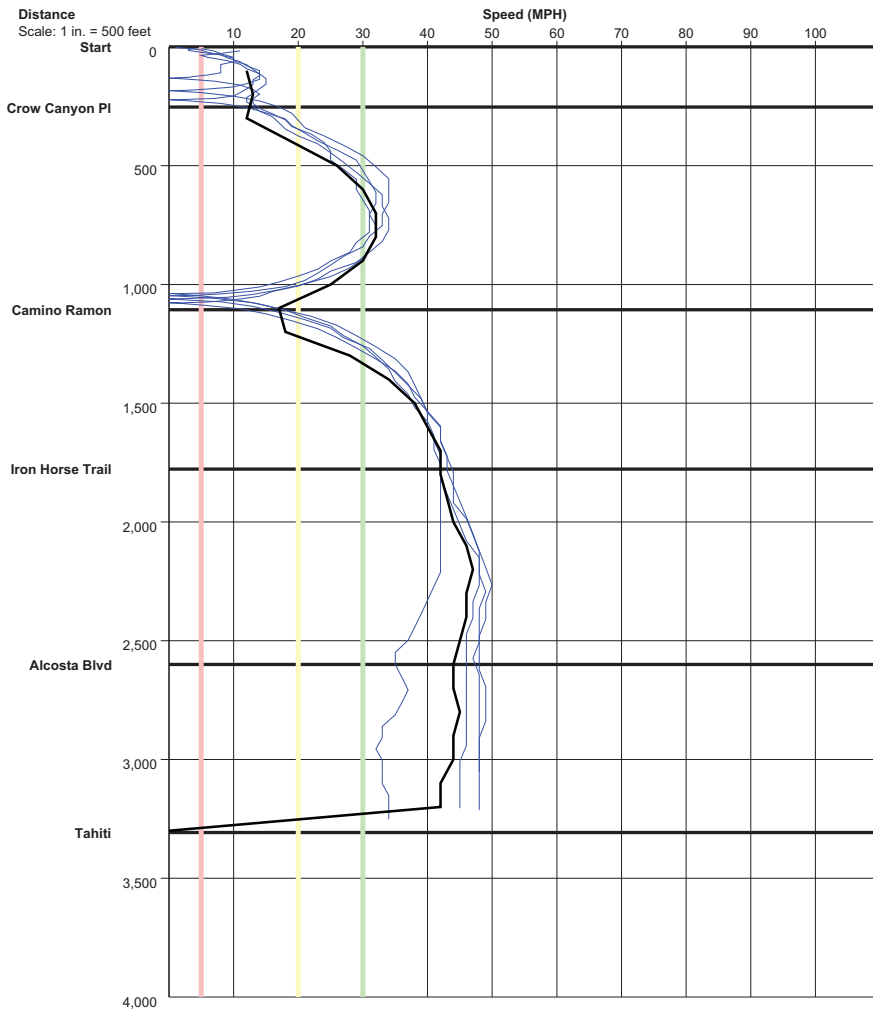
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : Crow Canyon EB AM - Day 2  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

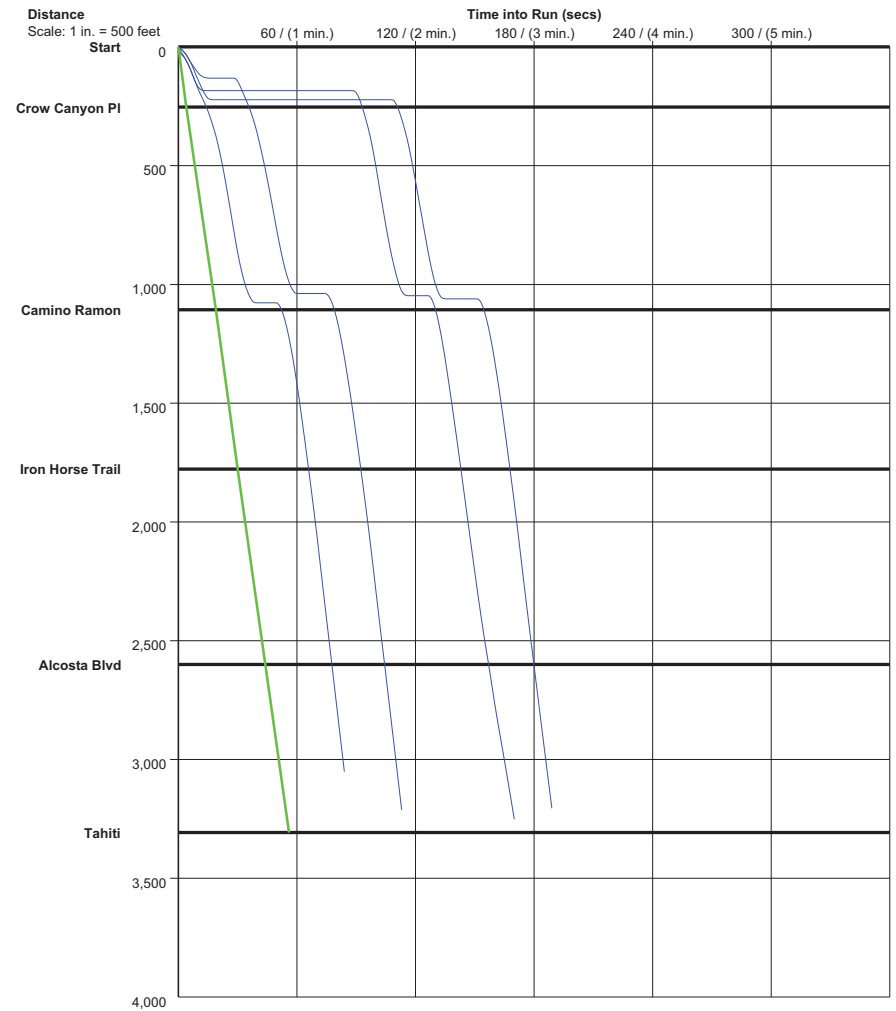


### Crow Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : Crow Canyon EB AM - Day 2  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



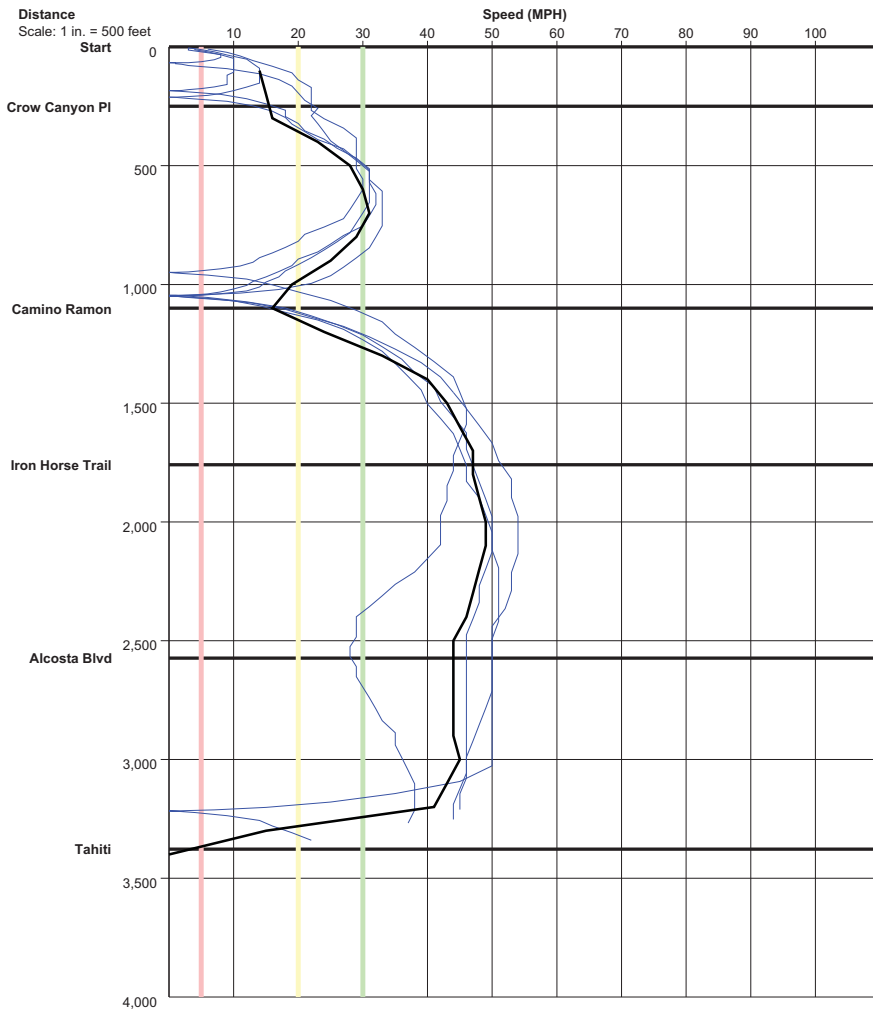
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM - Day 3**  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

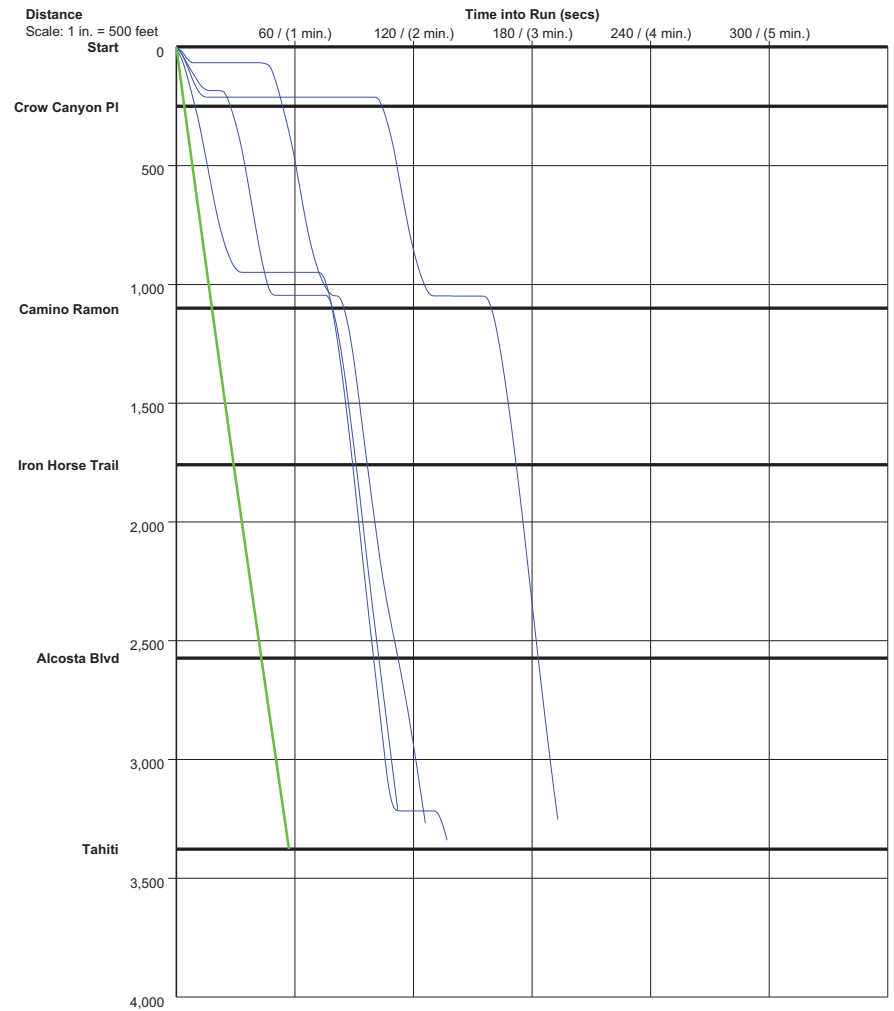


### Crow Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM - Day 3**  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

Before Period  
Crow Canyon Road Eastbound

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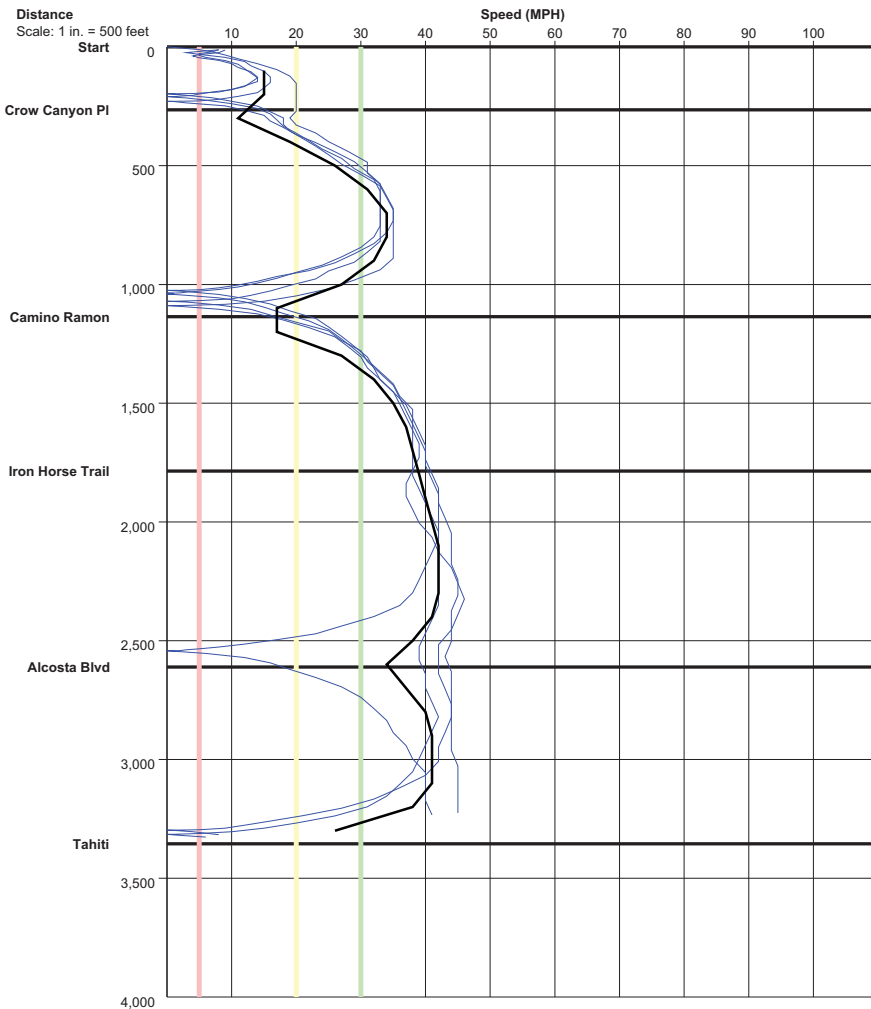
A.M. Off-Peak (9:00 to 11:00 AM)

### Crow Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM OP - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

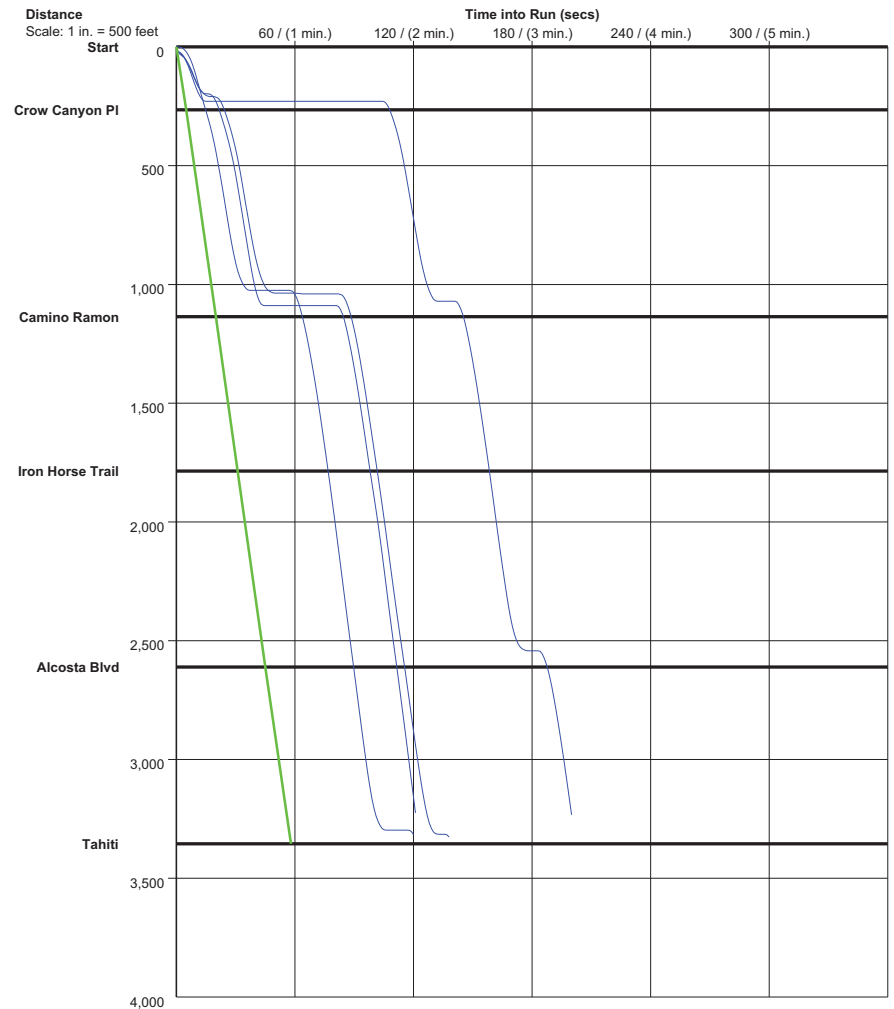


### Crow Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM OP - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



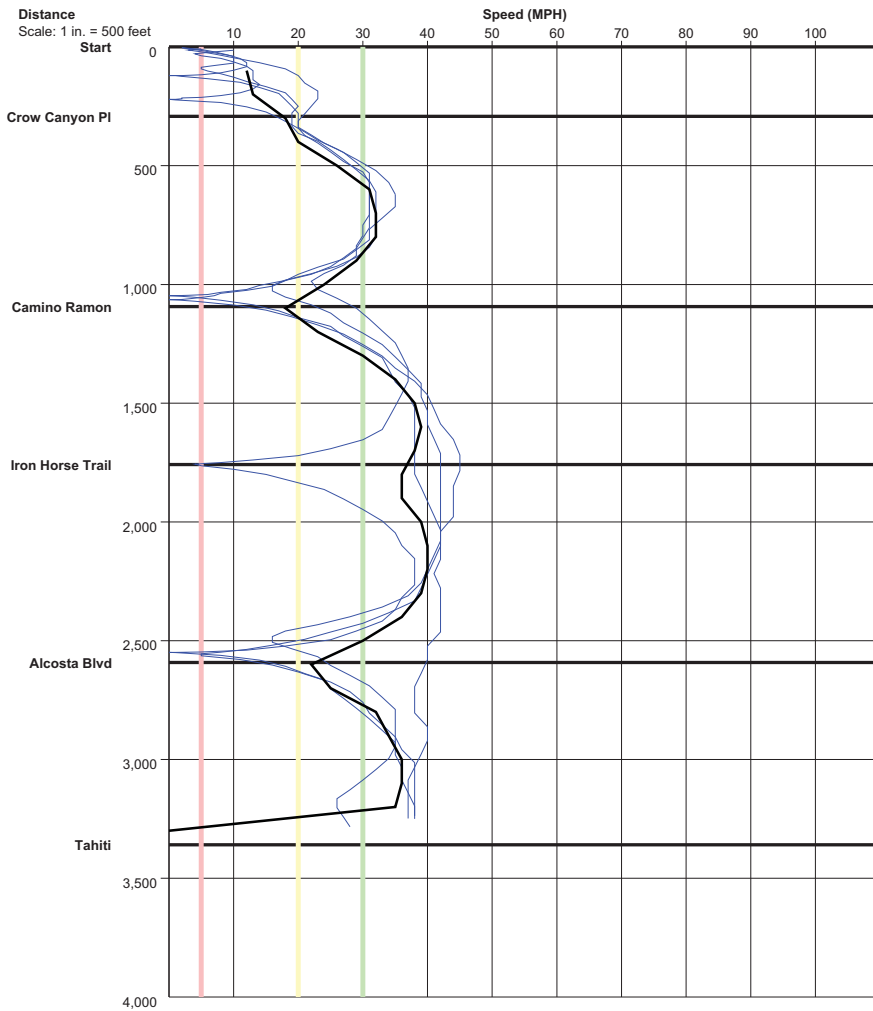
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM OP - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

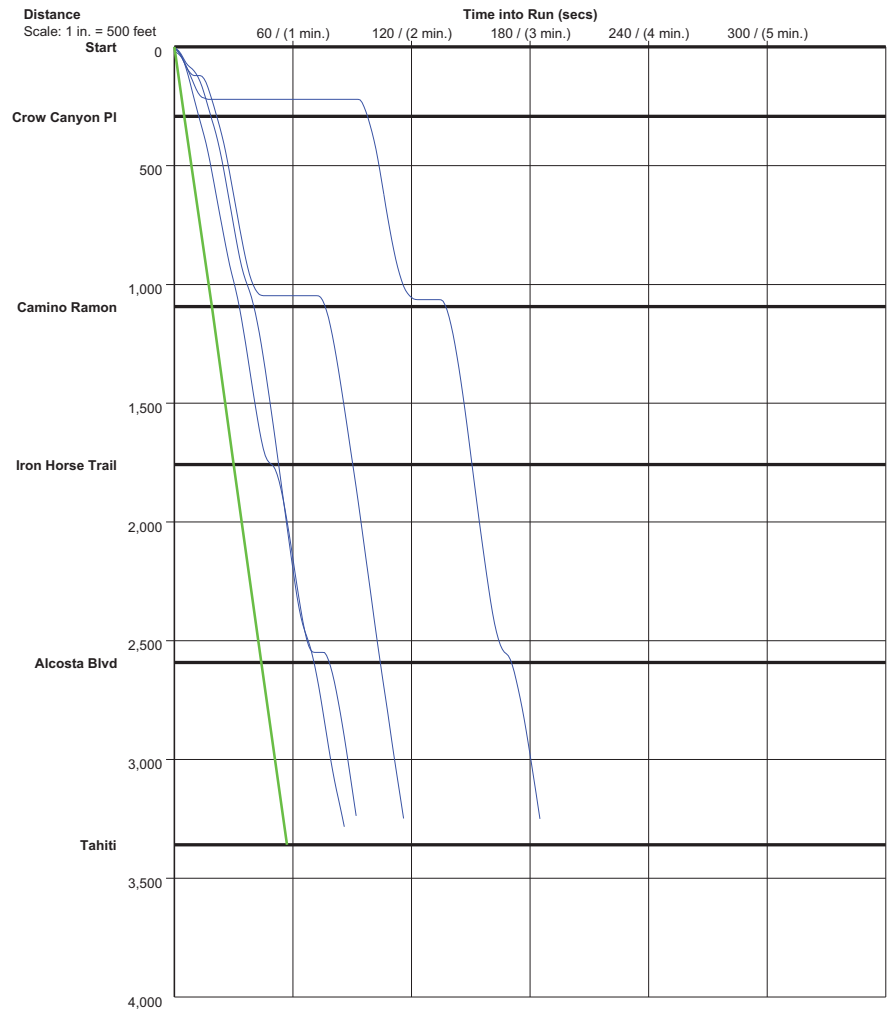


### Crow Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM OP - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

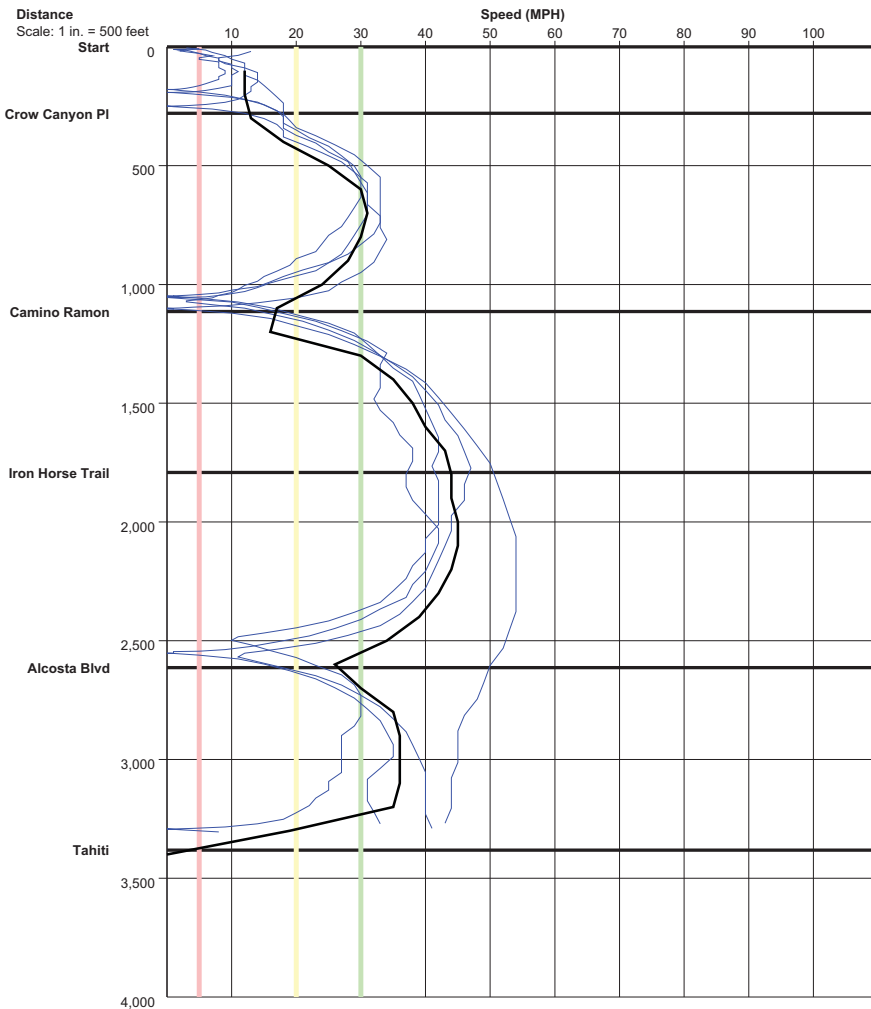


### Crow Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM OP - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

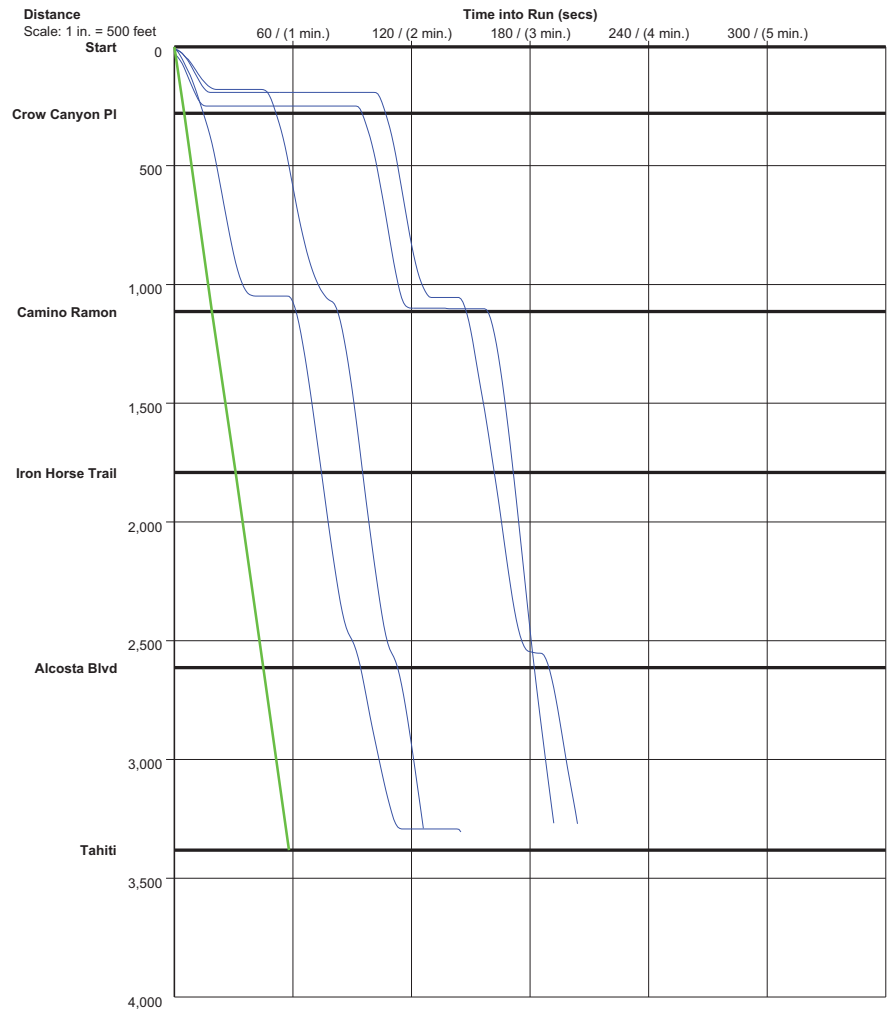


### Crow Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Crow Canyon EB AM OP - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

Before Period  
Crow Canyon Road Eastbound

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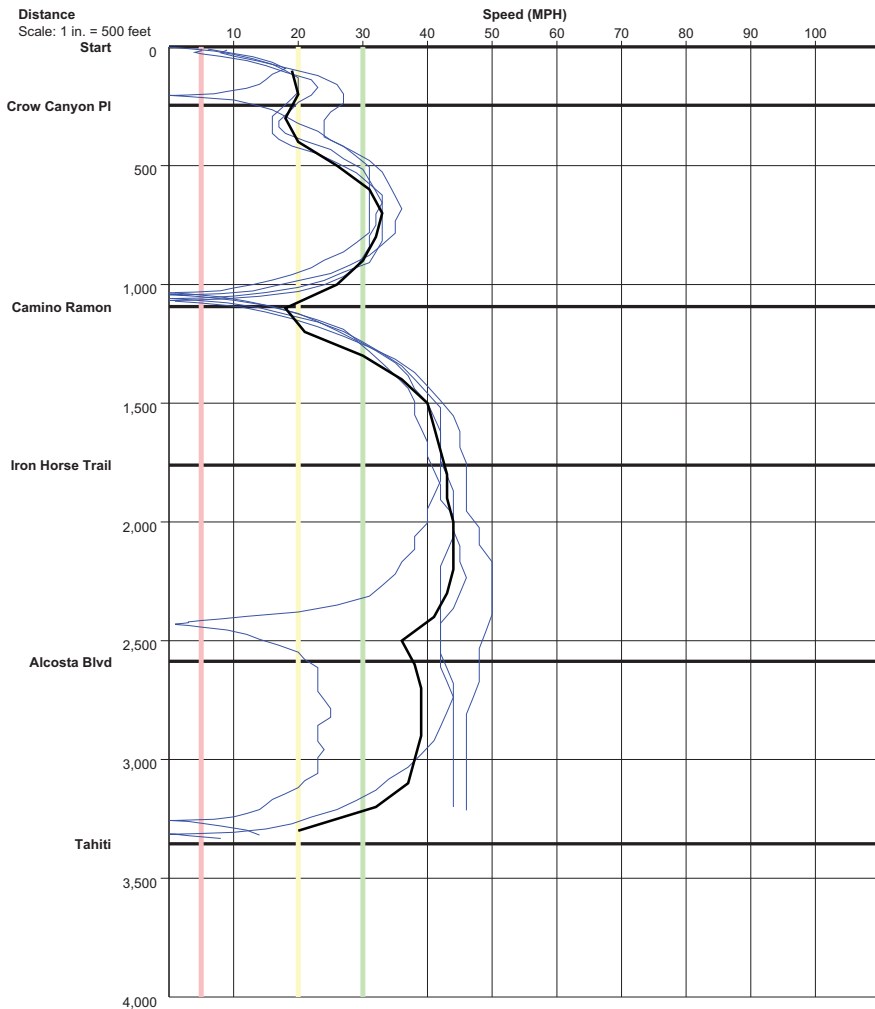
Midday Peak (11:30 AM to 1:30 PM)

### Crow Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon EB MID - Day 1  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

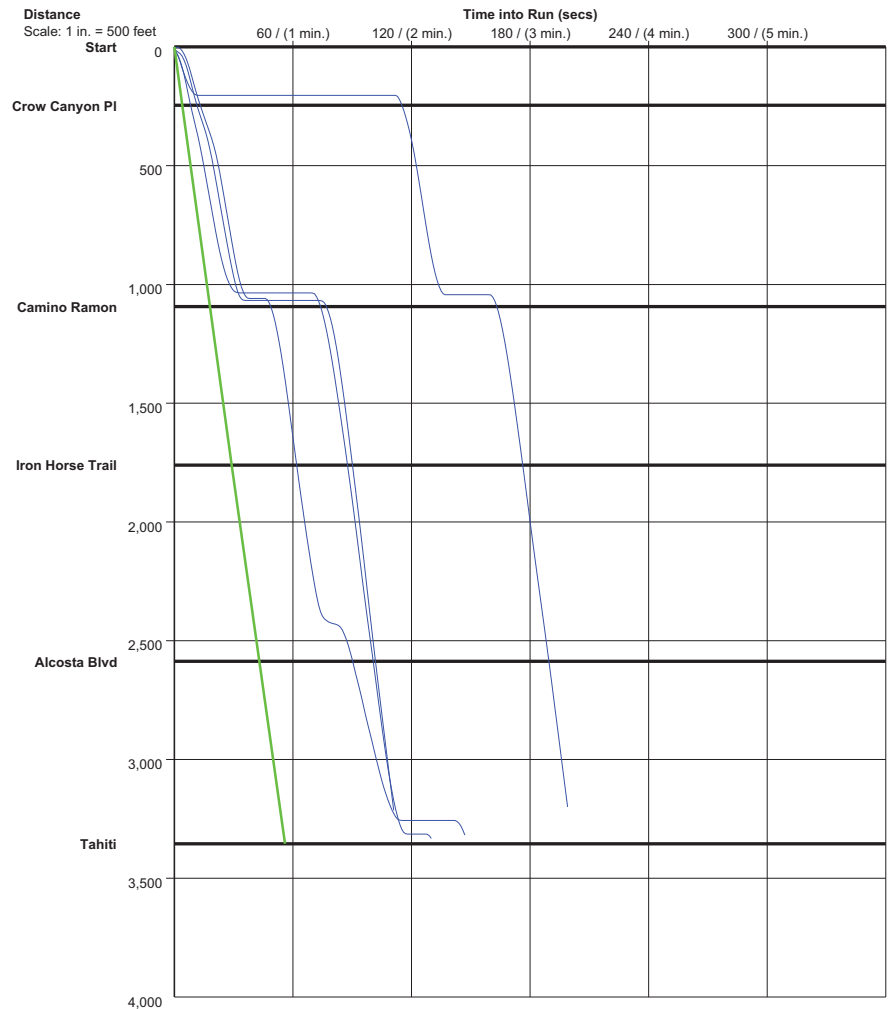


### Crow Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon EB MID - Day 1  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



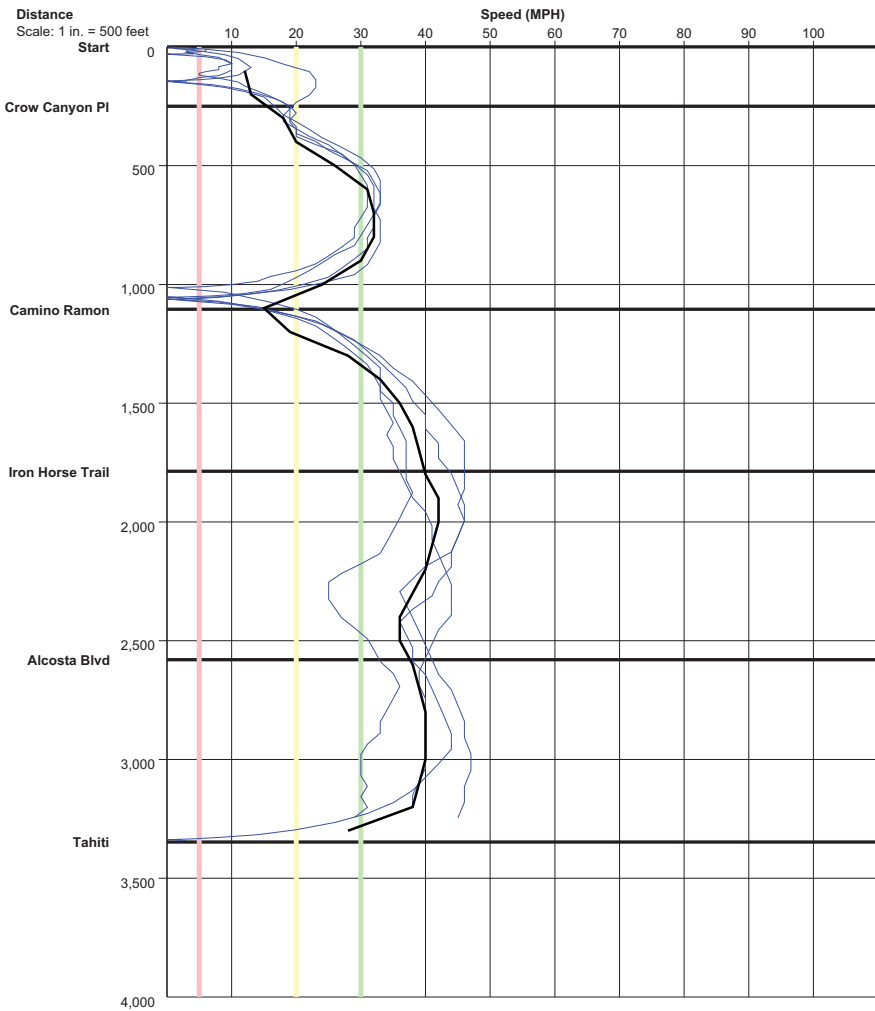
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon EB MID - Day 2  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

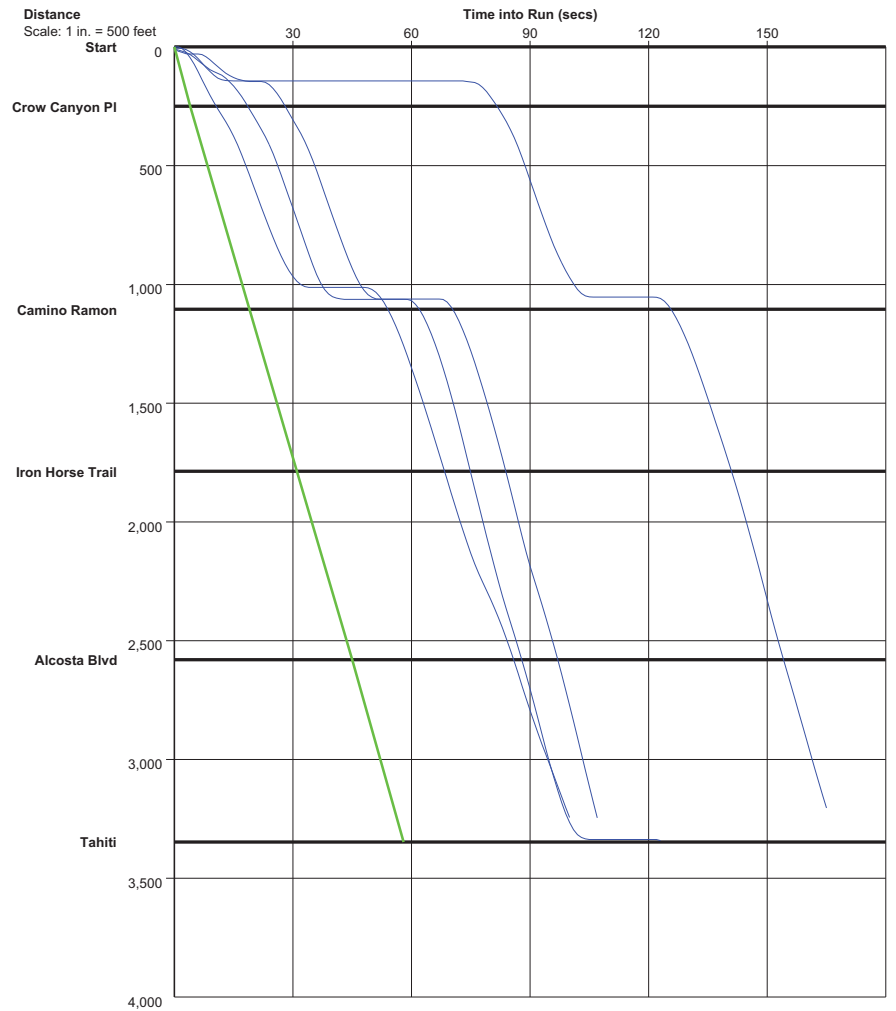


### Crow Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon EB MID - Day 2  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

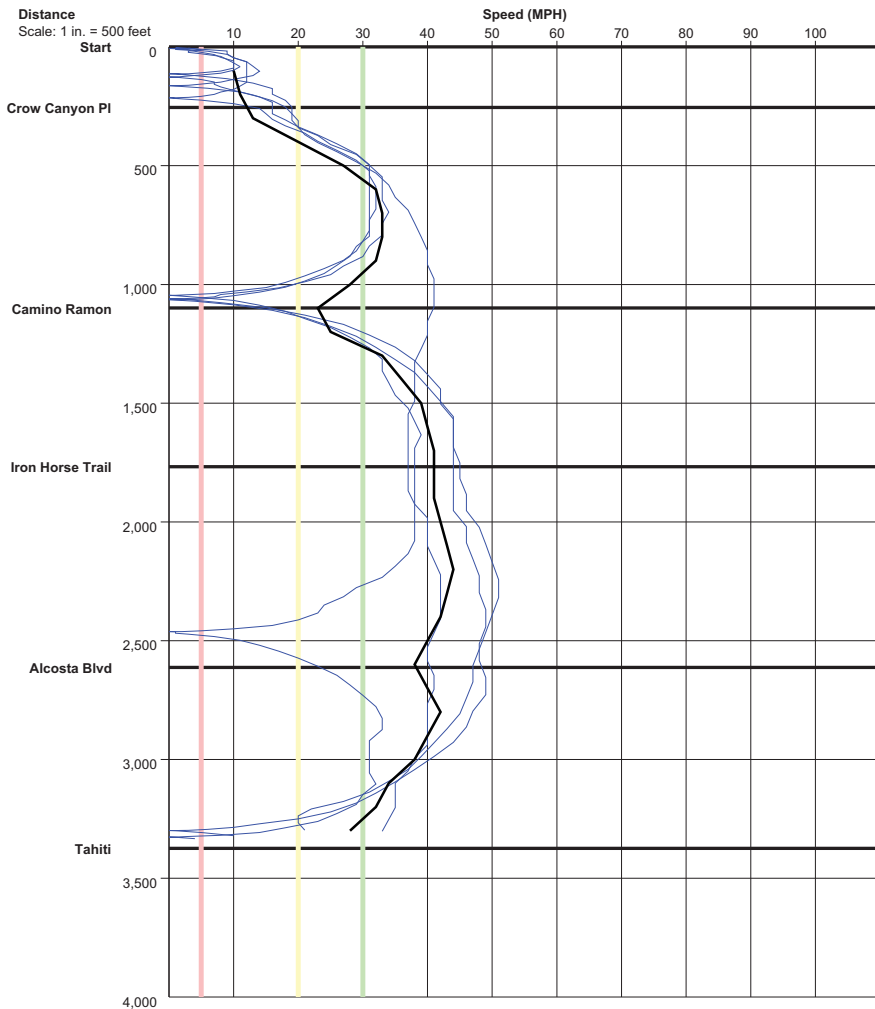


### Crow Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon EB MID - Day 3  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

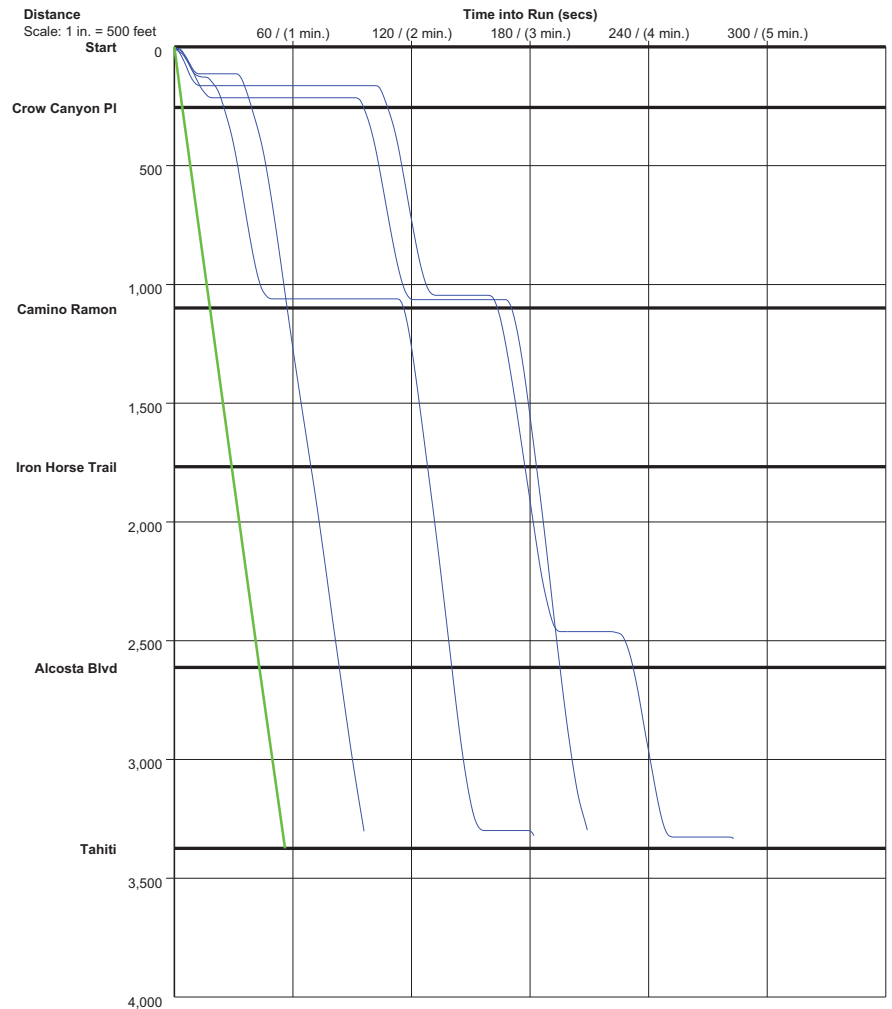


### Crow Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon EB MID - Day 3  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Before Period  
Crow Canyon Road Eastbound

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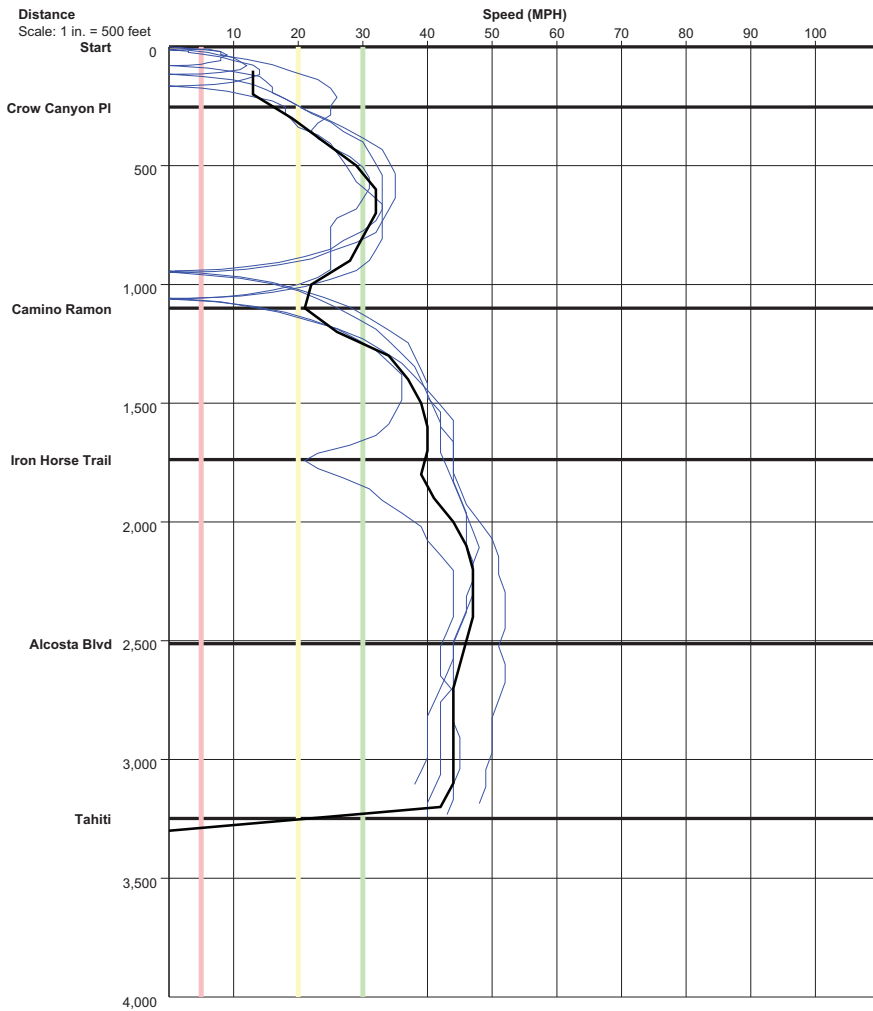
P.M. Peak (4:30 to 6:30 PM)

### Crow Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : Crow Canyon EB PM - Day 1  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

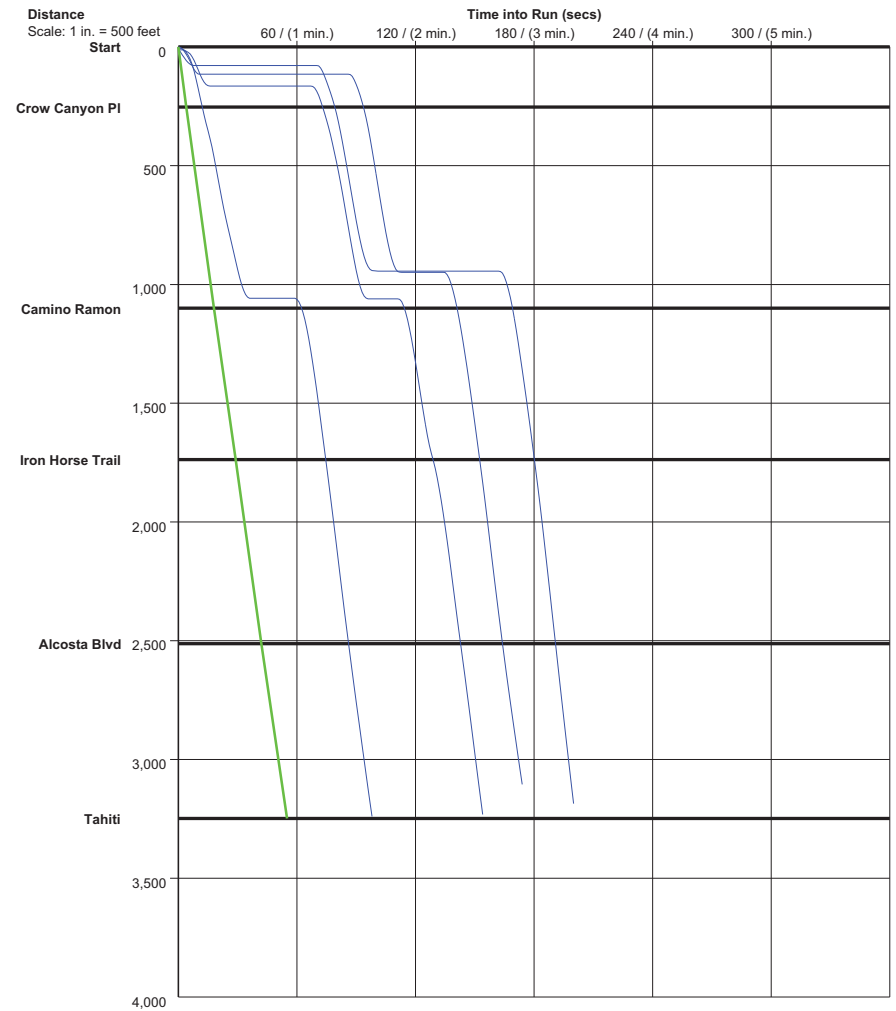


### Crow Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : Crow Canyon EB PM - Day 1  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

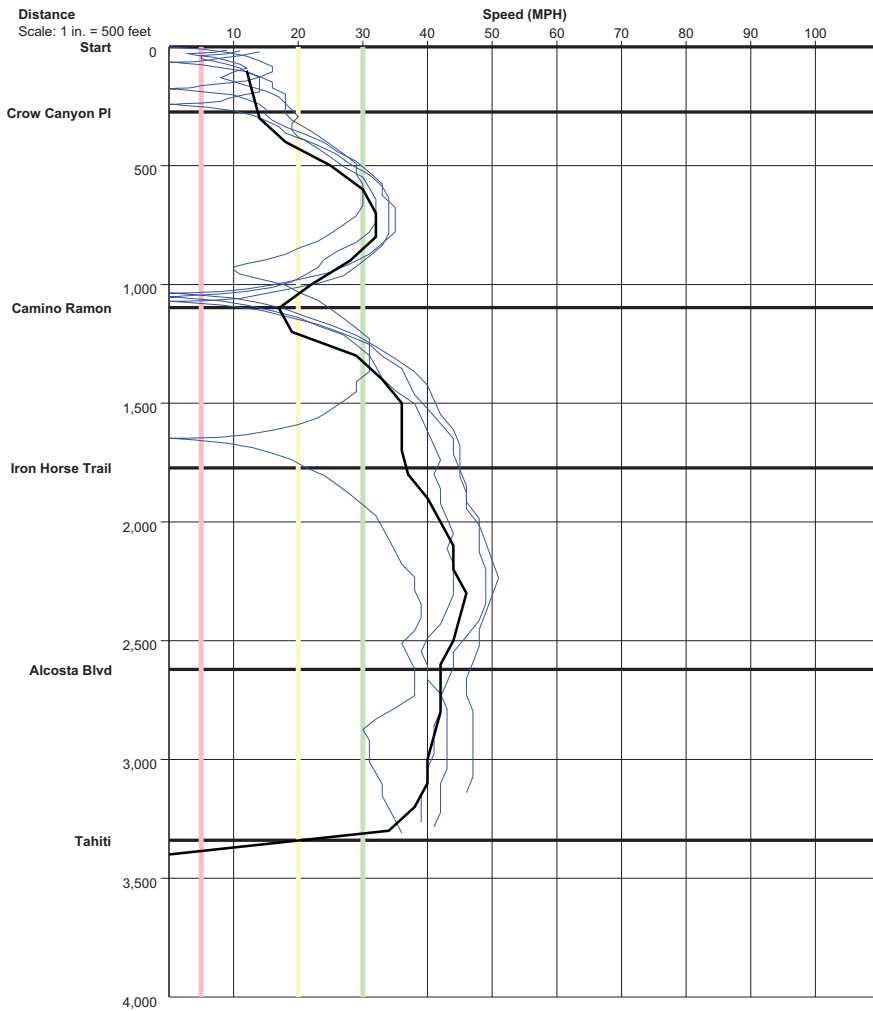


### Crow Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : Crow Canyon EB PM - Day 2  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

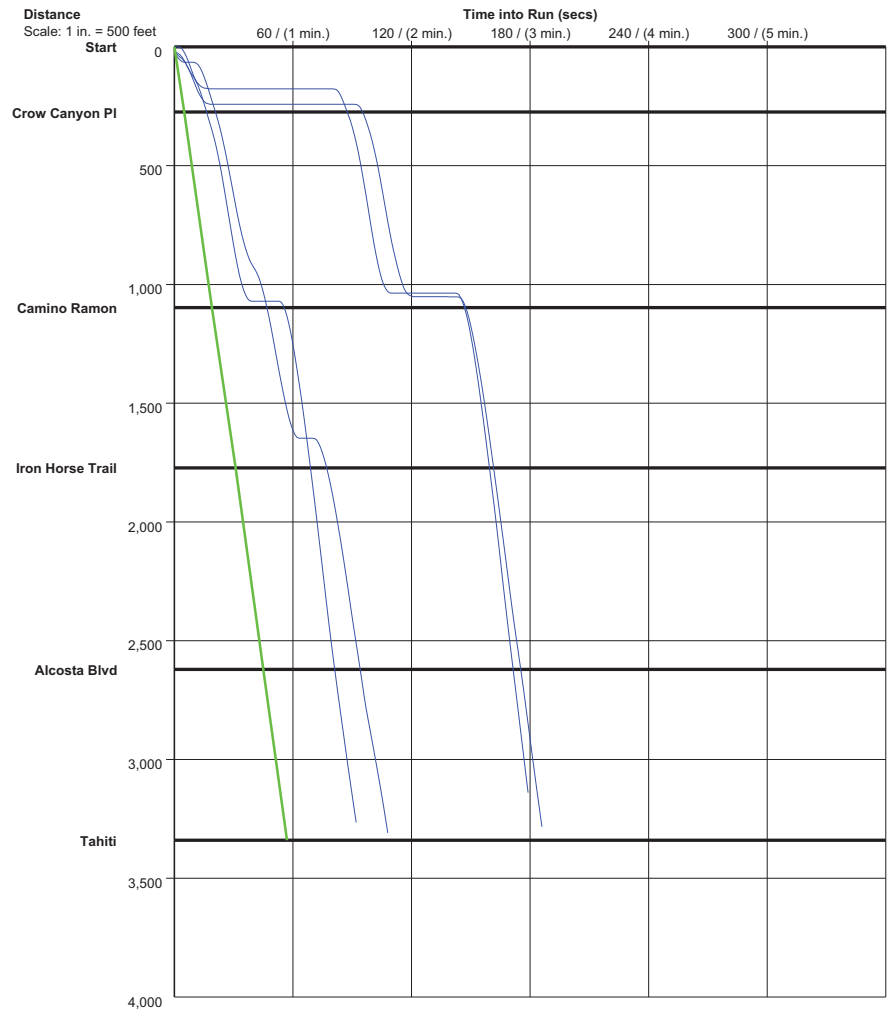


### Crow Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : Crow Canyon EB PM - Day 2  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

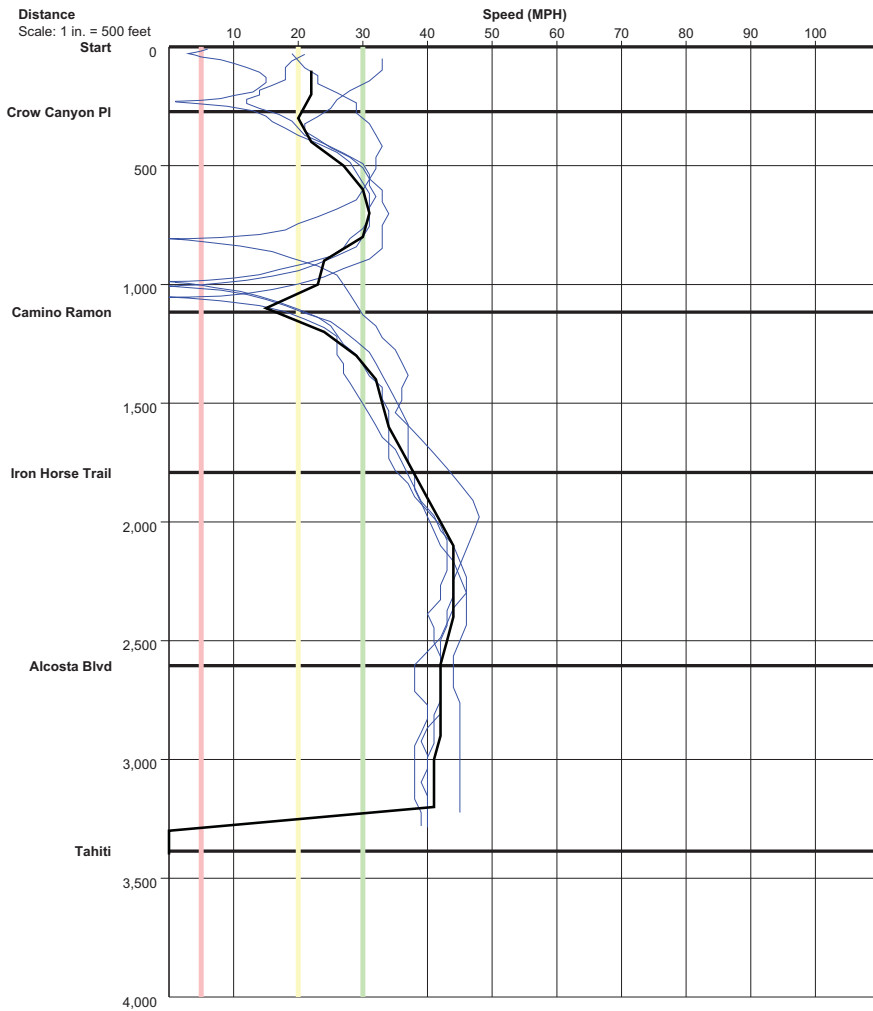


### Crow Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : Crow Canyon EB PM - Day 3  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

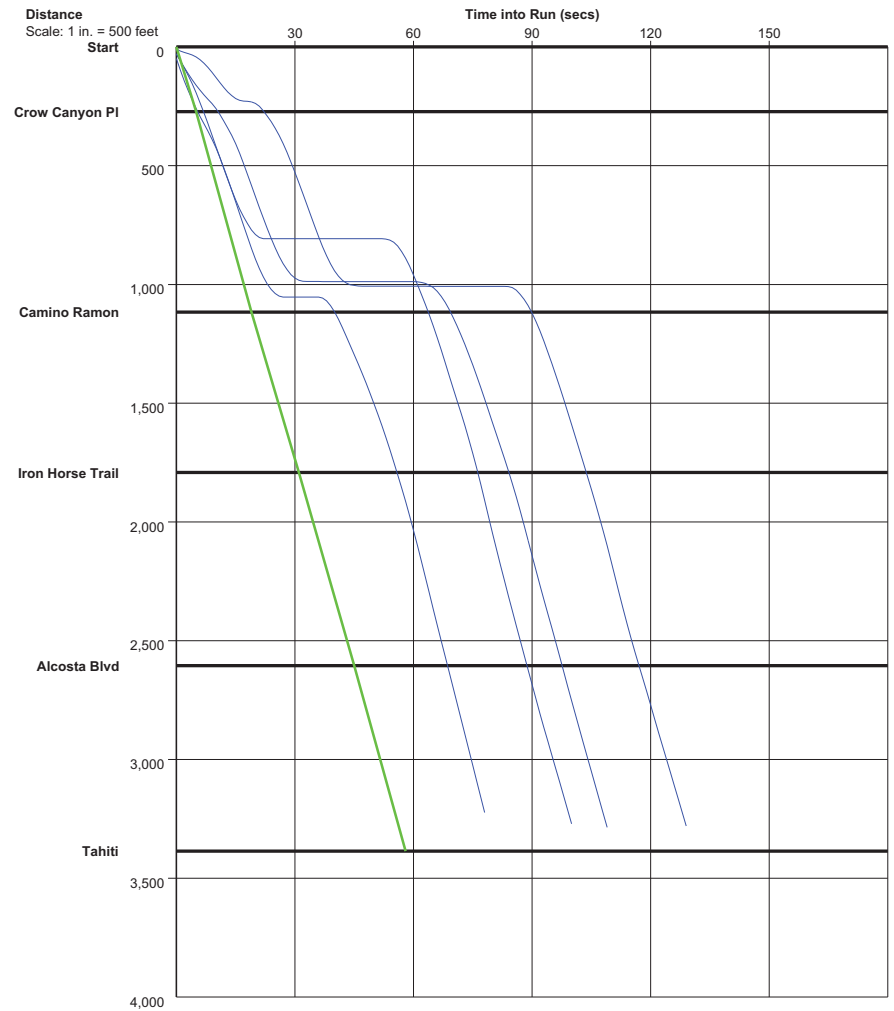


### Crow Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : Crow Canyon EB PM - Day 3  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



**Appendix A-4**  
Before Period  
Crow Canyon Road Westbound

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Before Period  
Crow Canyon Road Westbound

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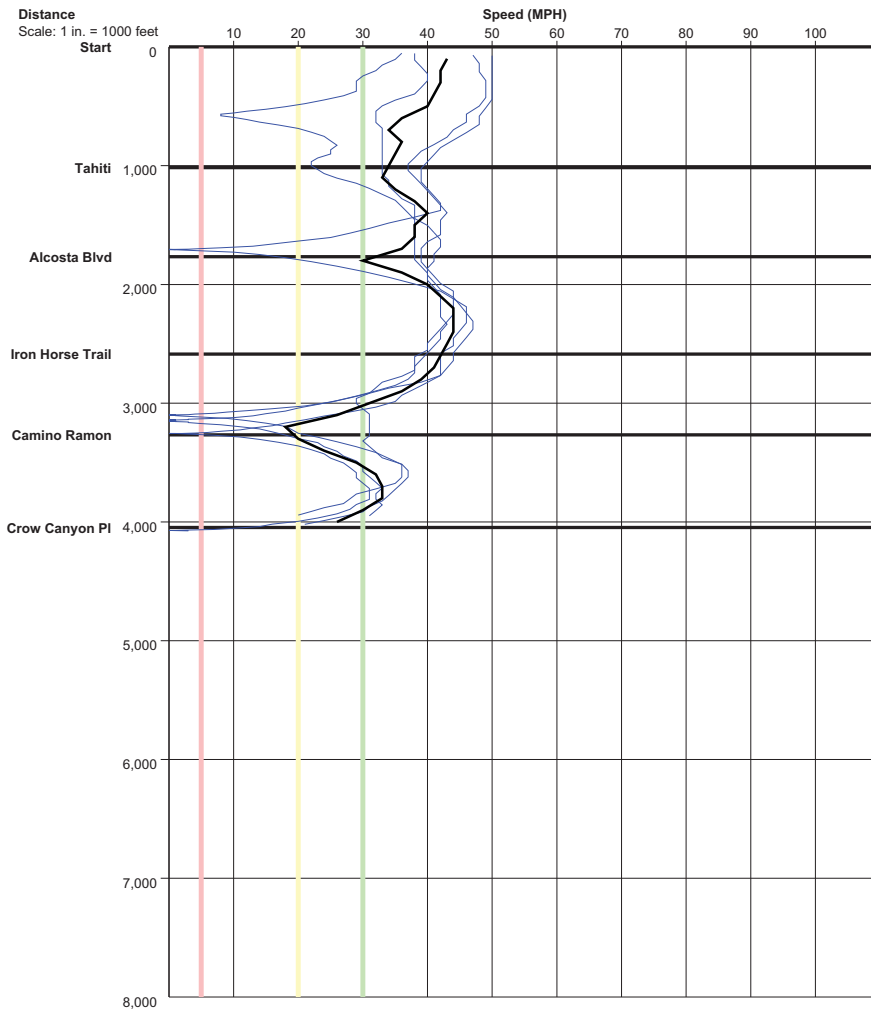
A.M. Peak (7:00 to 9:00 AM)

### Crow Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon WB AM - Day 1  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

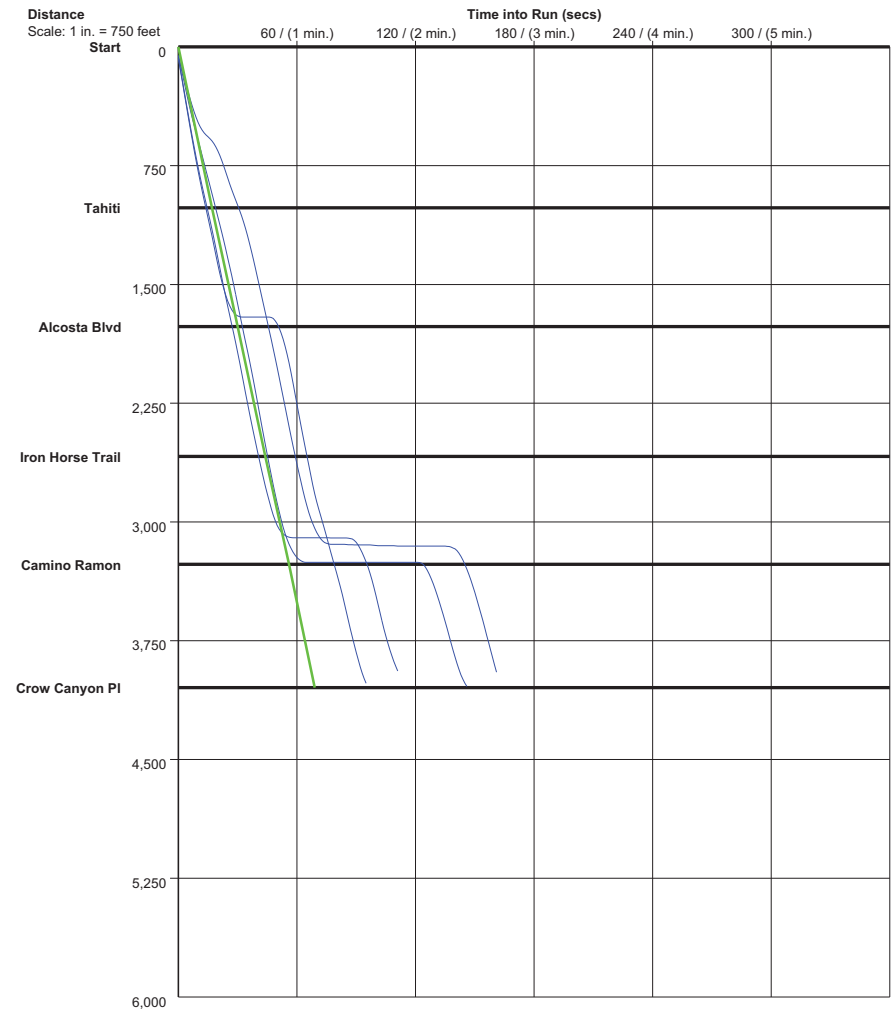


### Crow Canyon

Tuesday - July 13, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon WB AM - Day 1  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

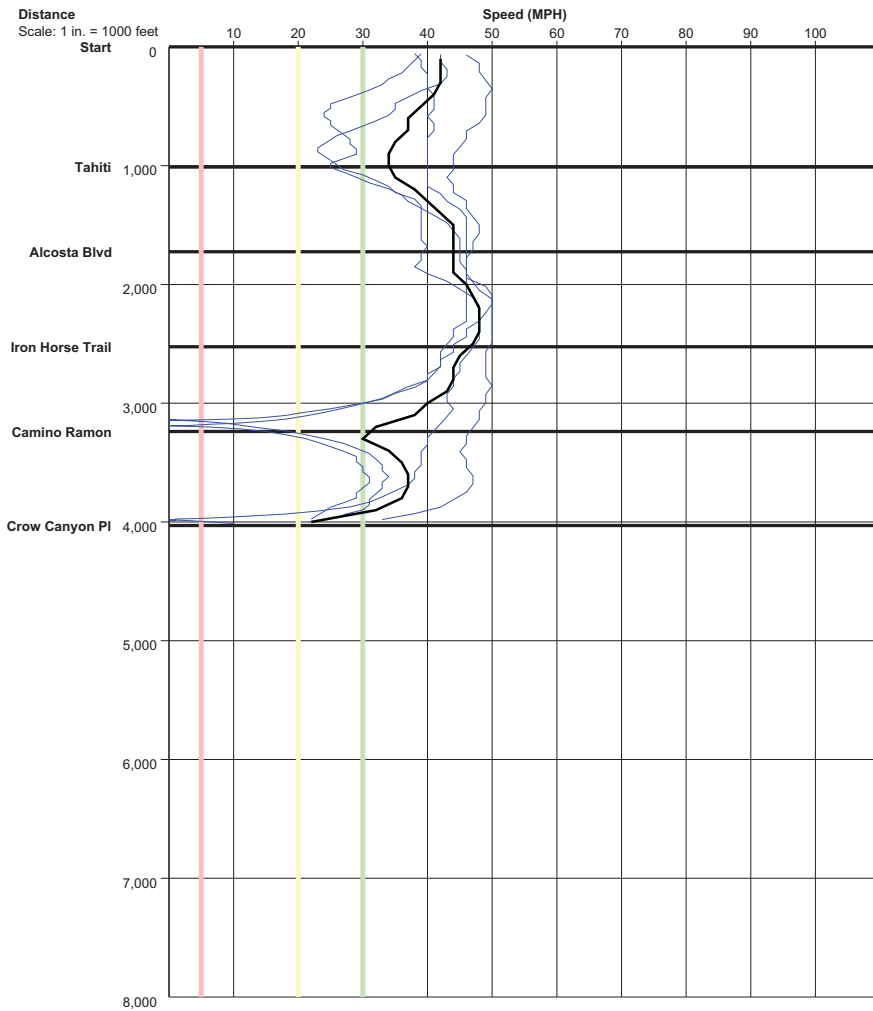


### Crow Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon WB AM - Day 2  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

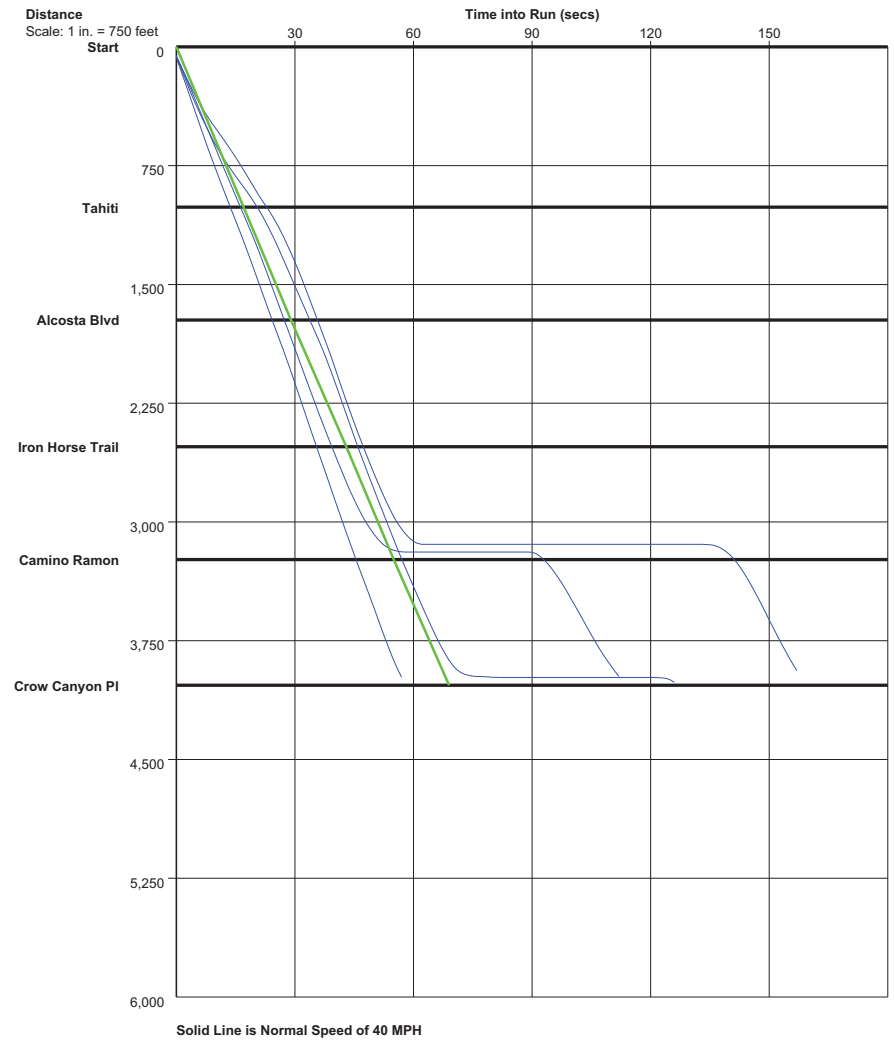


### Crow Canyon

Wednesday - July 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon WB AM - Day 2  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

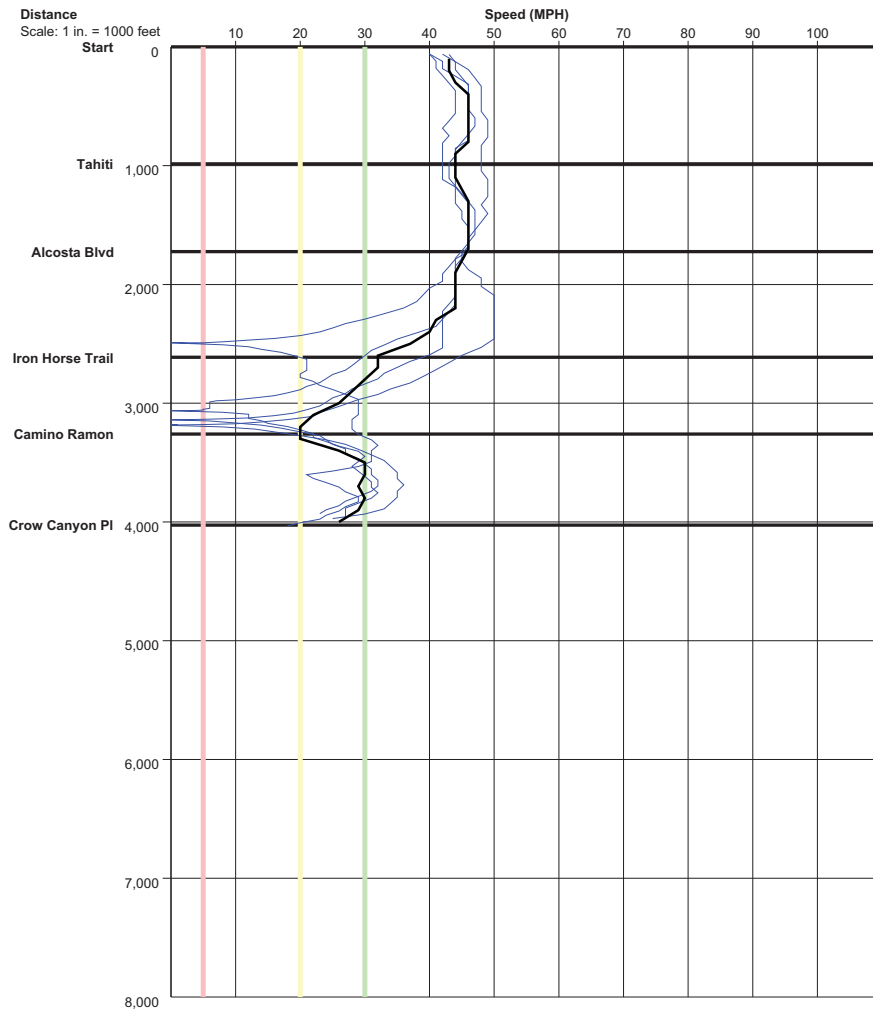


### Crow Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon WB AM - Day 3  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

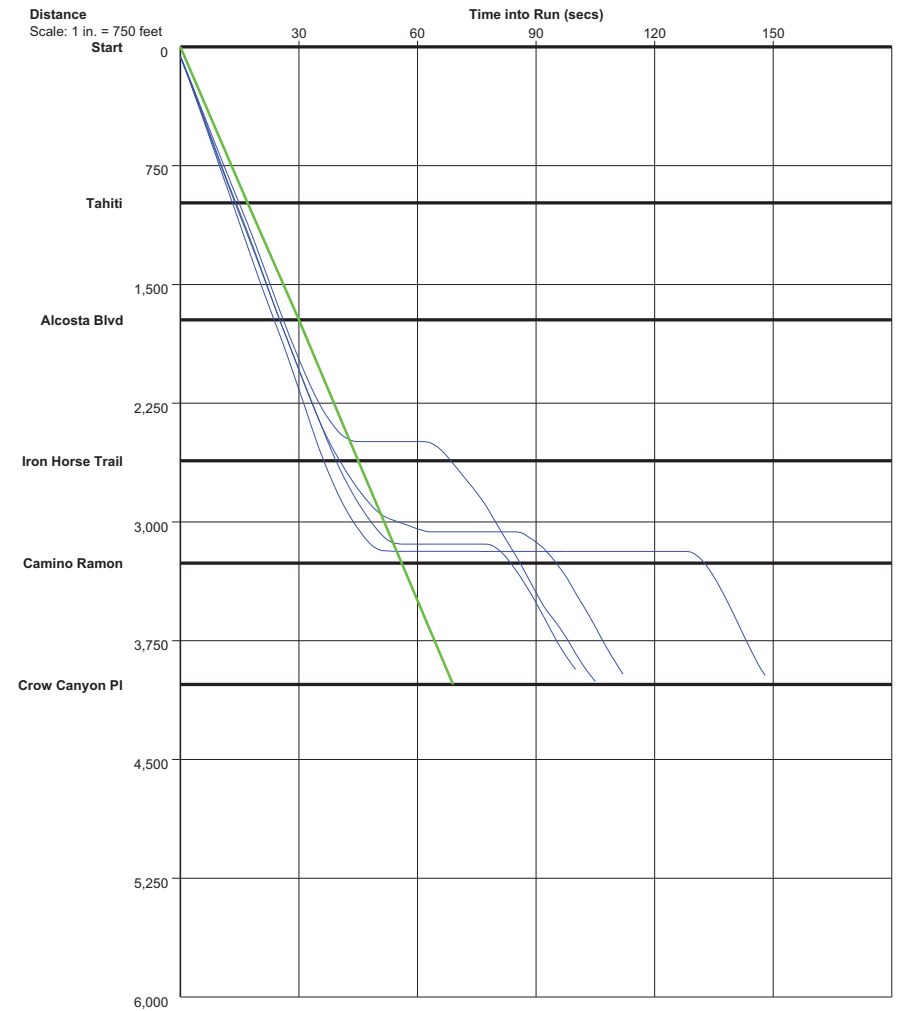


### Crow Canyon

Thursday - July 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon WB AM - Day 3  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Before Period  
Crow Canyon Road Westbound

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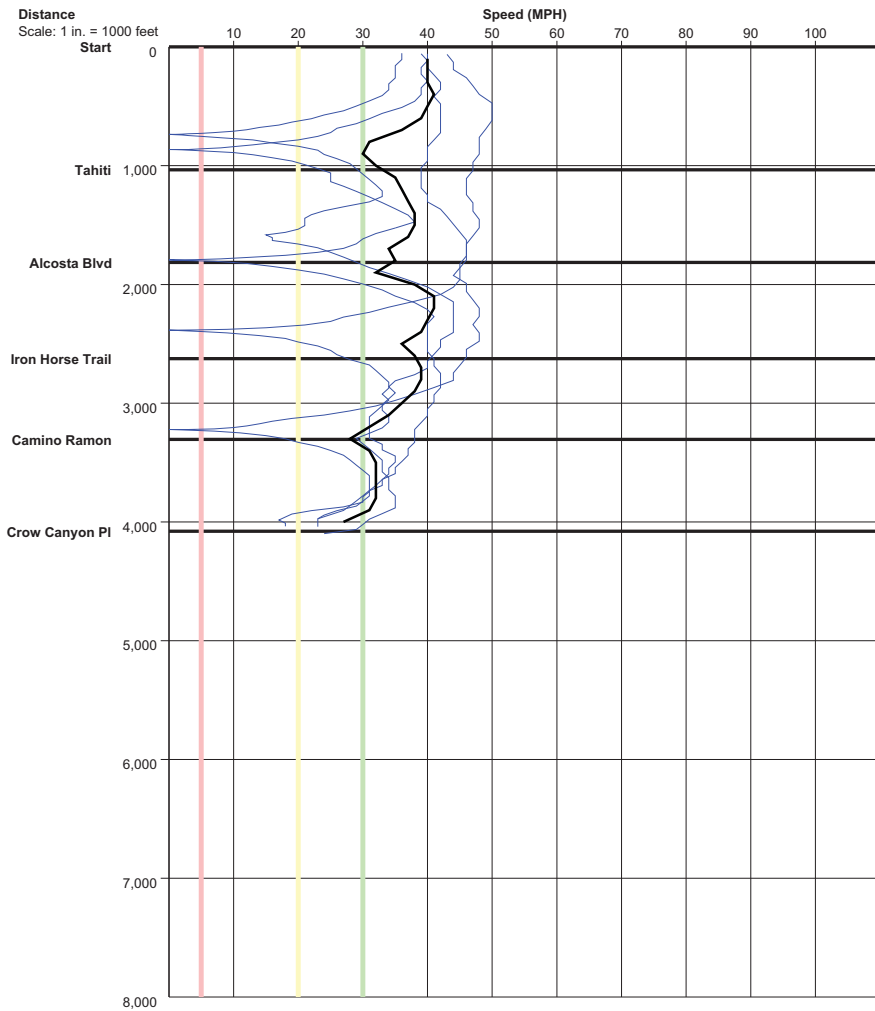
A.M. Off-Peak (9:00 to 11:00 AM)

### Crow Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon WB AM OP - Day 1  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

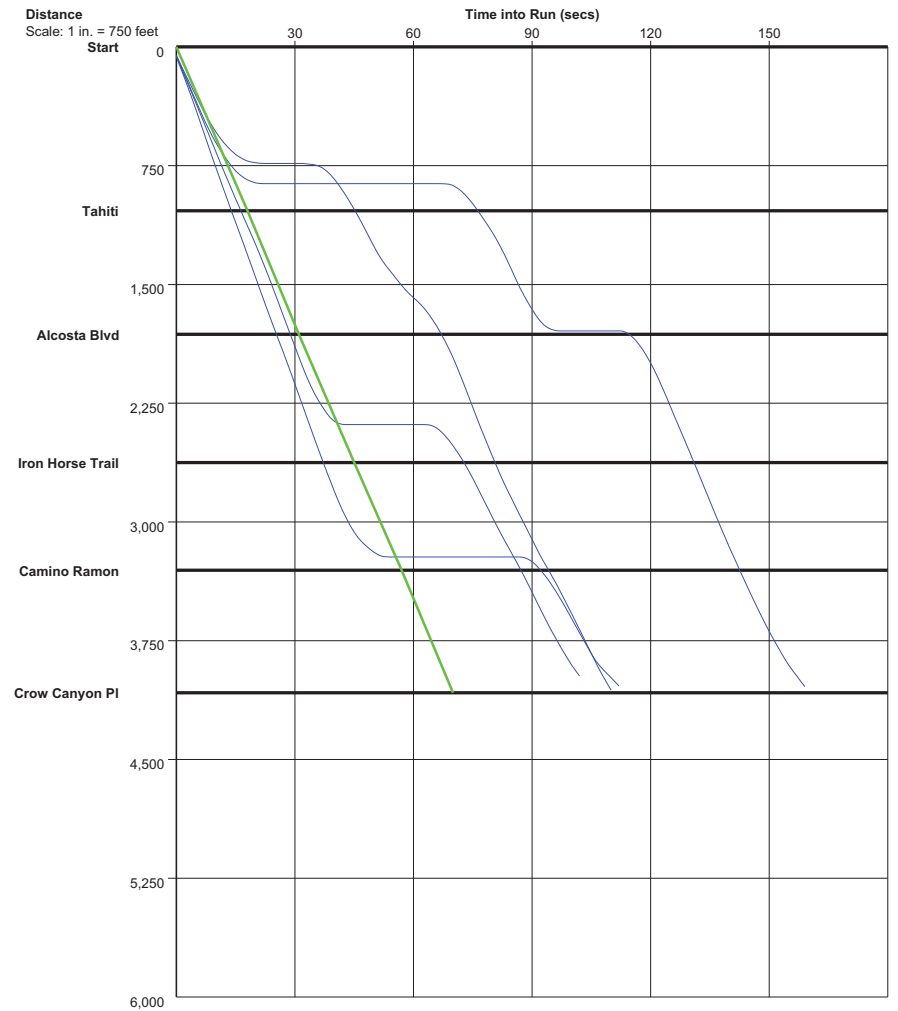


### Crow Canyon

Tuesday - July 13, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon WB AM OP - Day 1  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



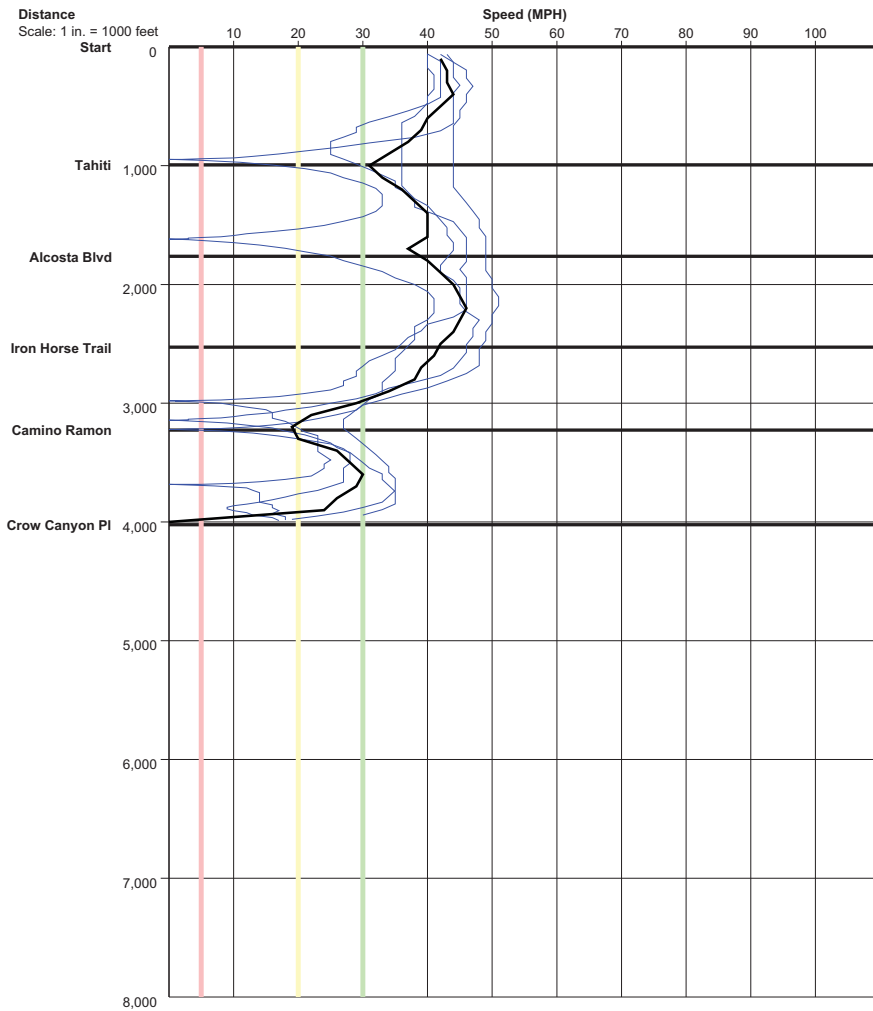
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon WB AM OP - Day 2  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

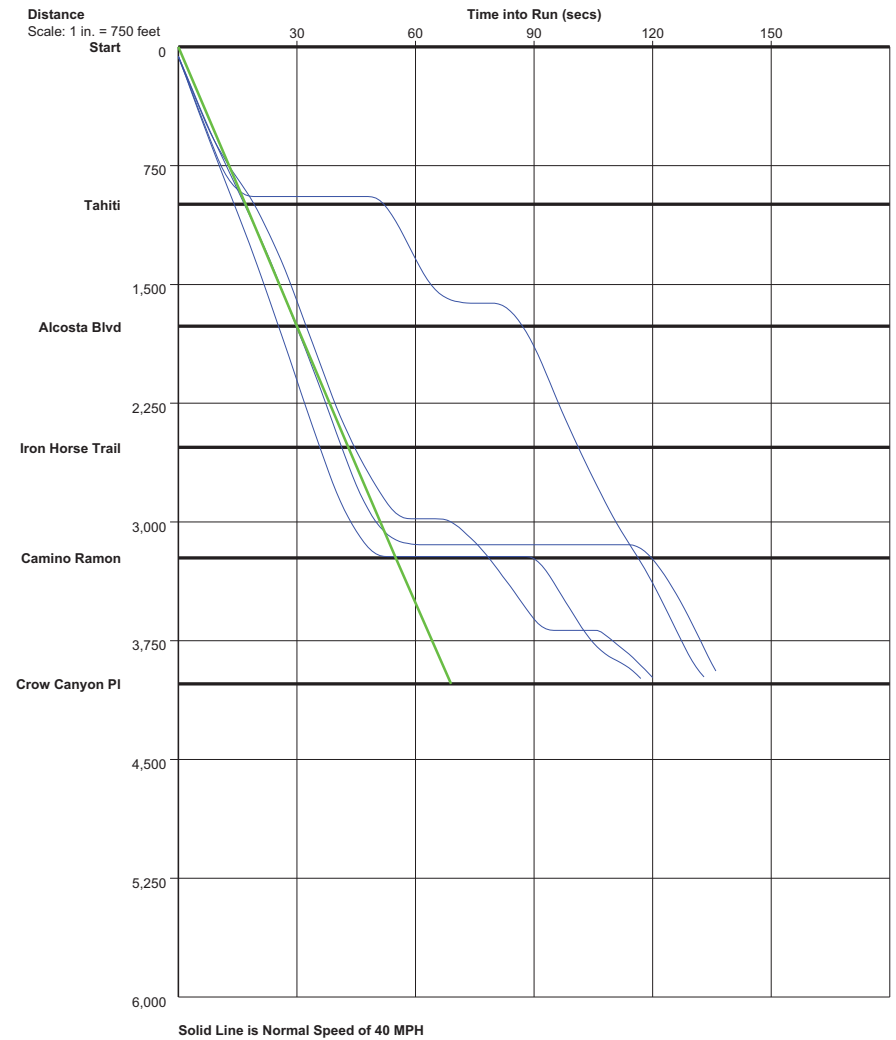


### Crow Canyon

Wednesday - July 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon WB AM OP - Day 2  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

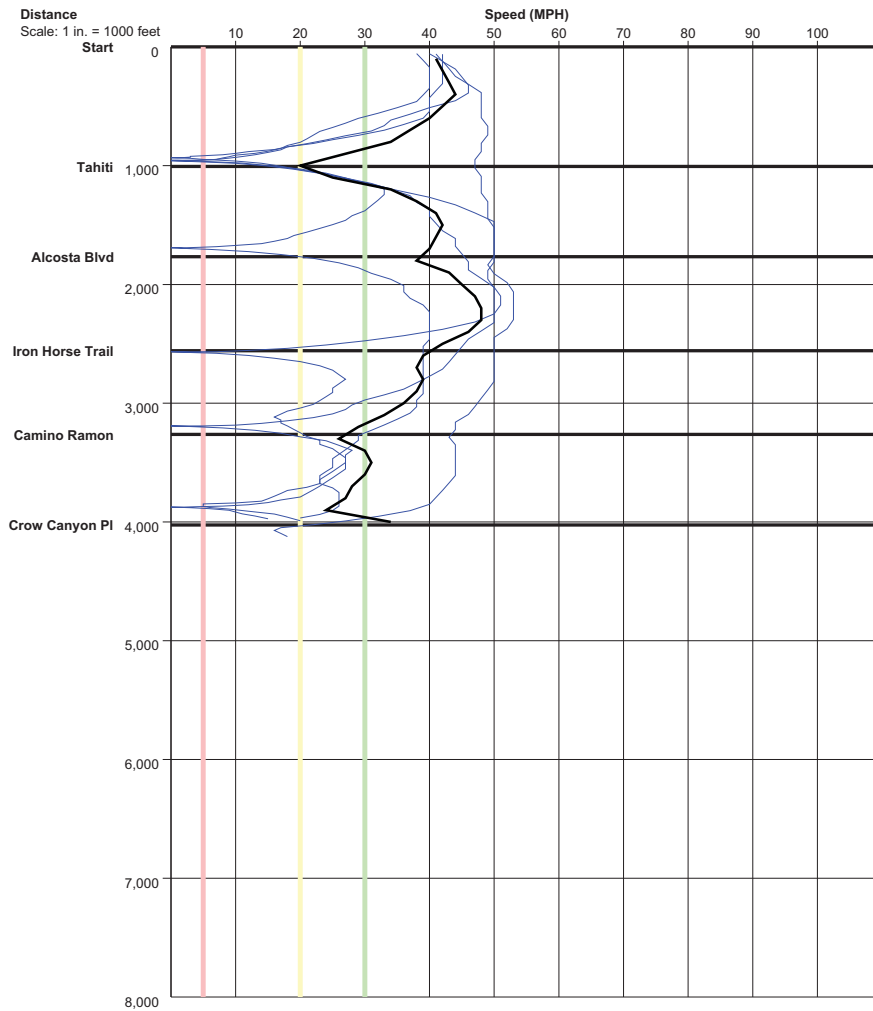


### Crow Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon WB AM OP - Day 3  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

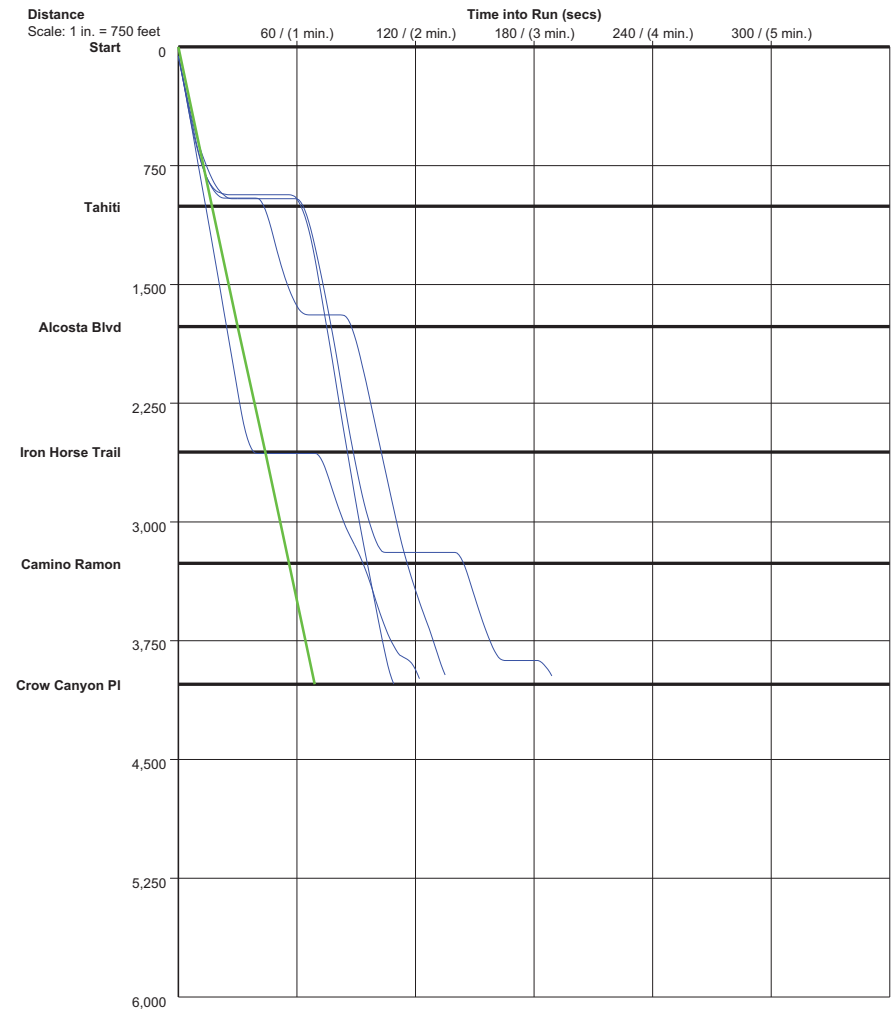


### Crow Canyon

Thursday - July 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon WB AM OP - Day 3  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

Before Period  
Crow Canyon Road Westbound

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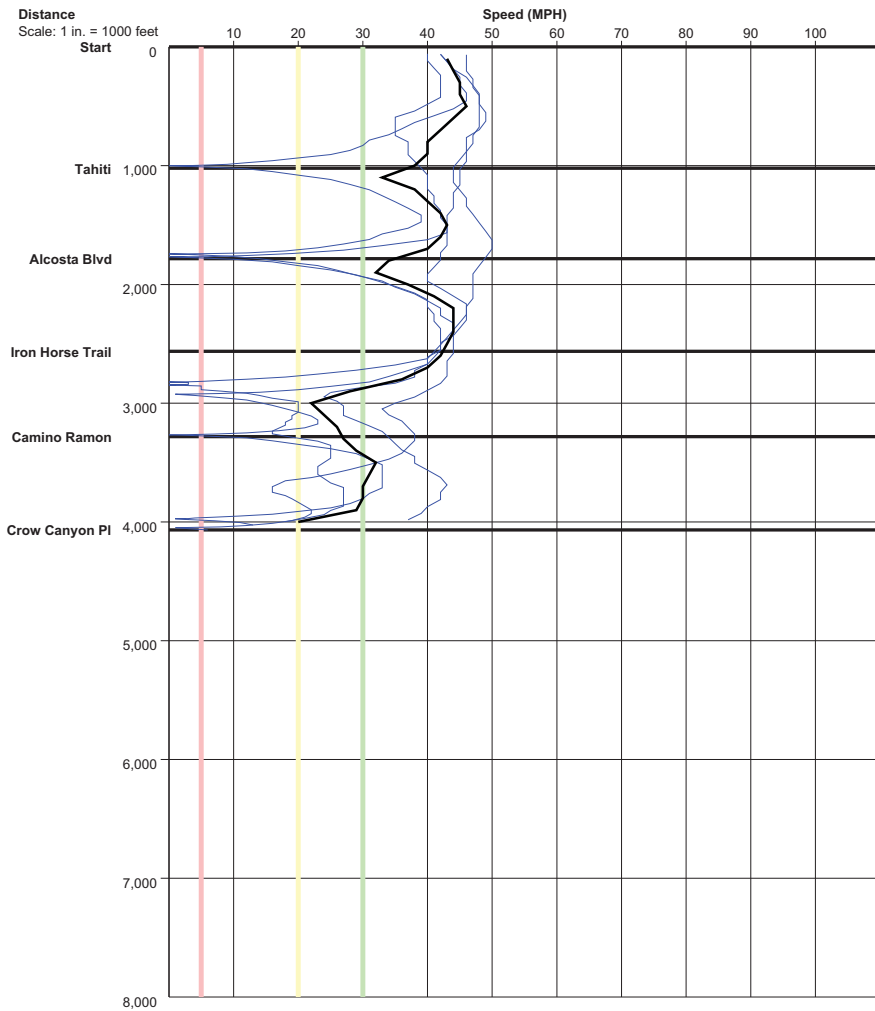
Midday Peak (11:30 AM to 1:30 PM)

### Crow Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Crow Canyon WB MID - Day 1**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

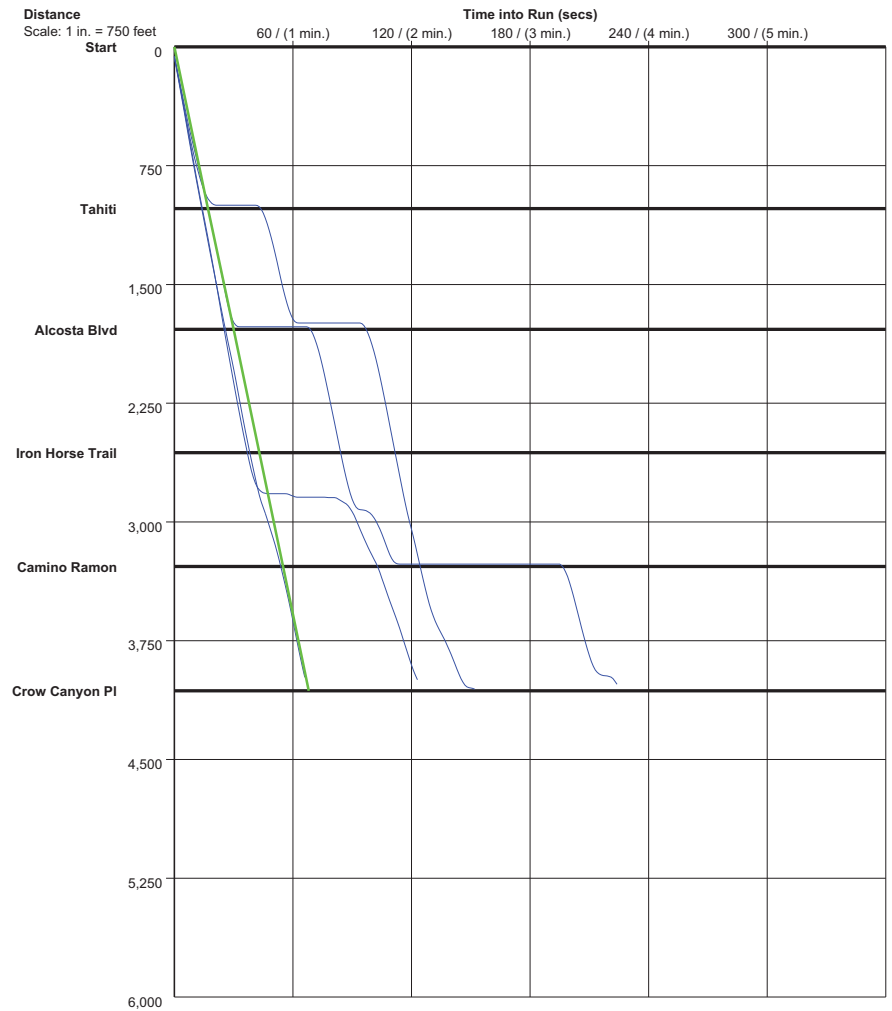


### Crow Canyon

Tuesday - July 13, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Crow Canyon WB MID - Day 1**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



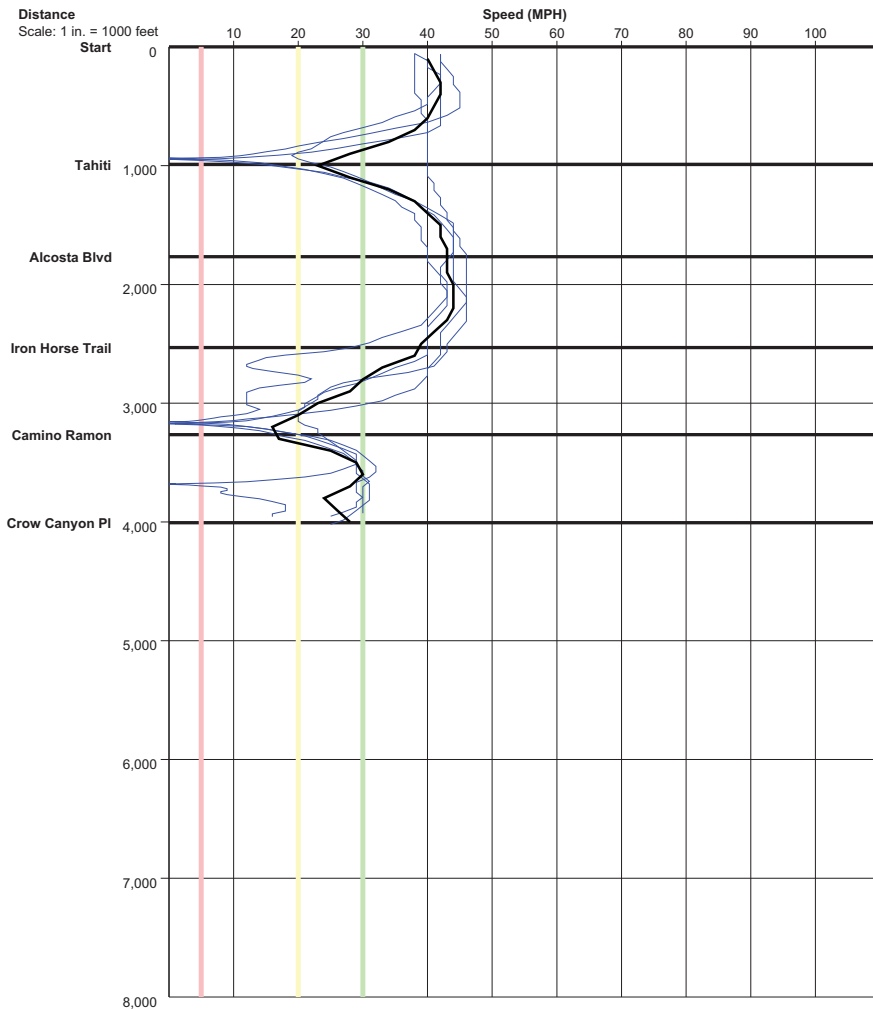
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Crow Canyon WB MID - Day 2**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

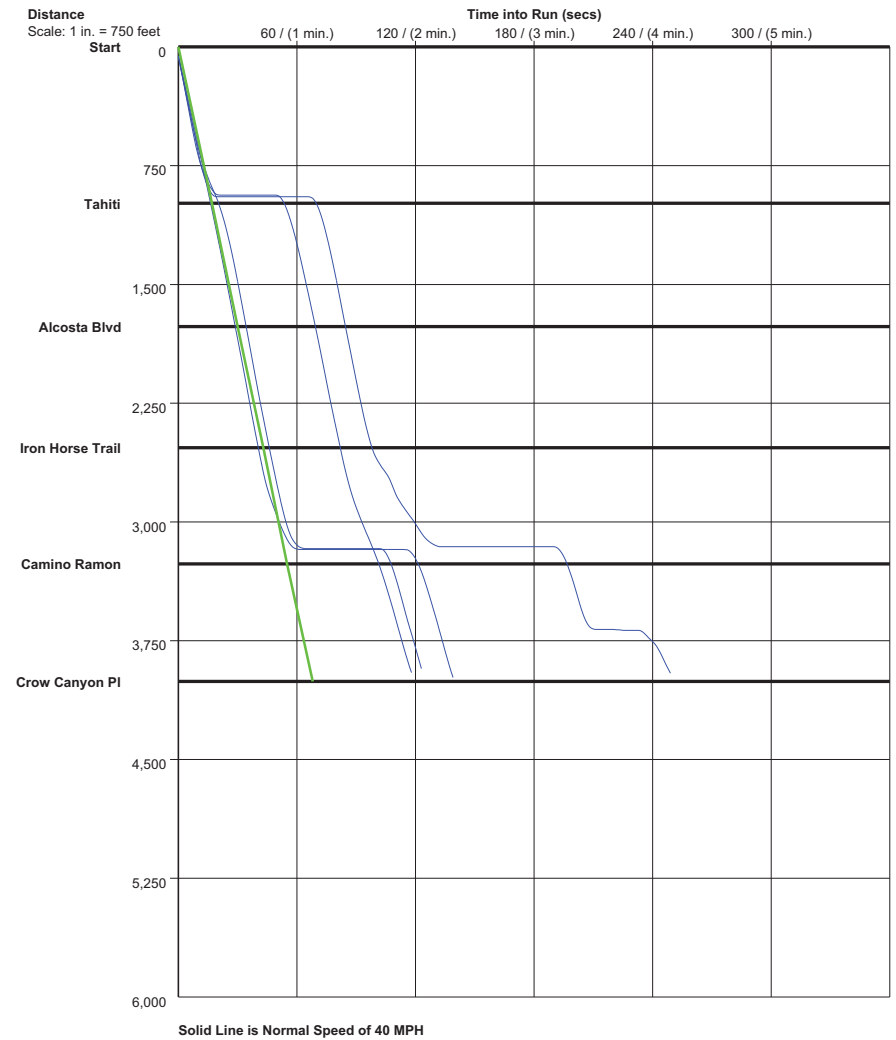


### Crow Canyon

Wednesday - July 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Crow Canyon WB MID - Day 2**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

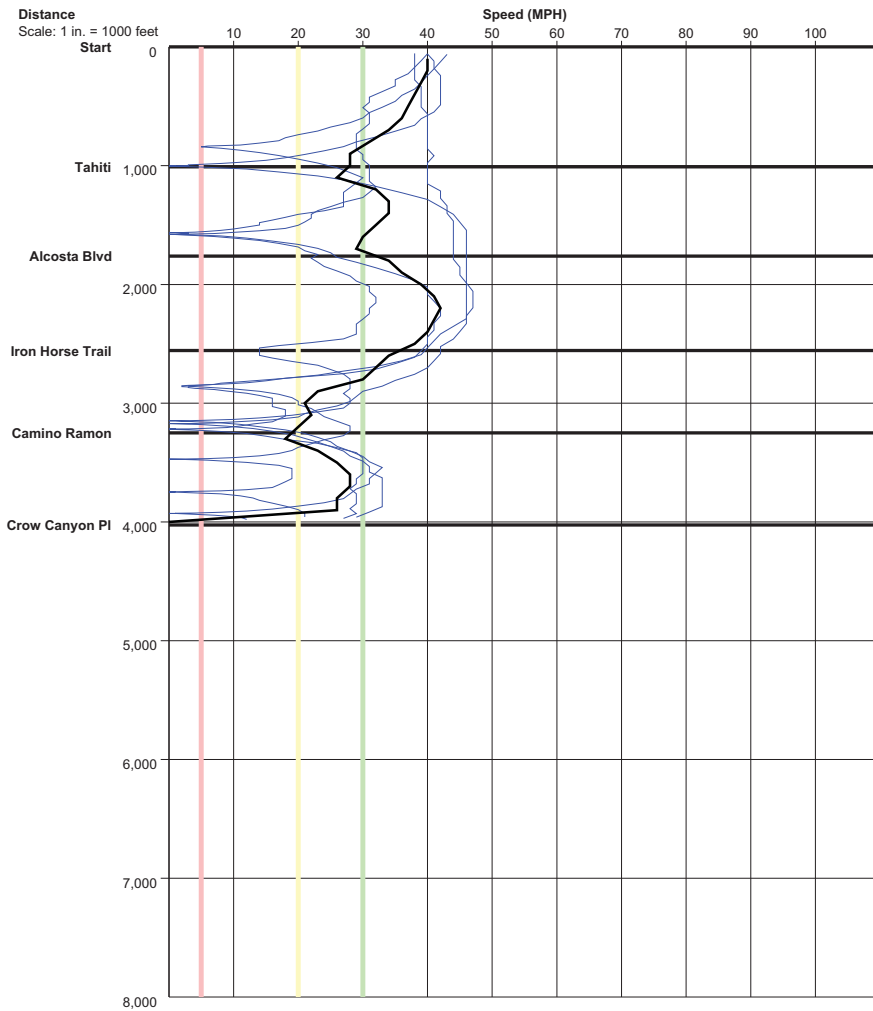


### Crow Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Crow Canyon WB MID - Day 3**  
Study Date : **7/17/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

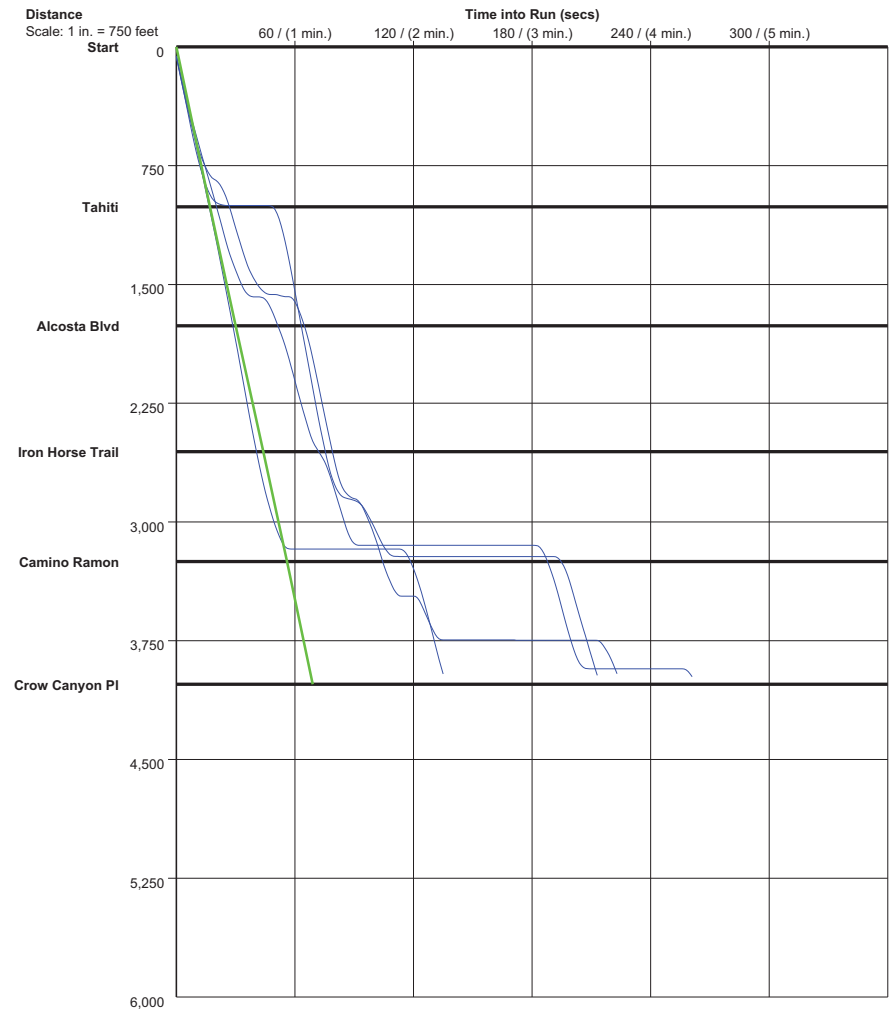


### Crow Canyon

Thursday - July 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Crow Canyon WB MID - Day 3**  
Study Date : **7/17/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

Before Period  
Crow Canyon Road Westbound

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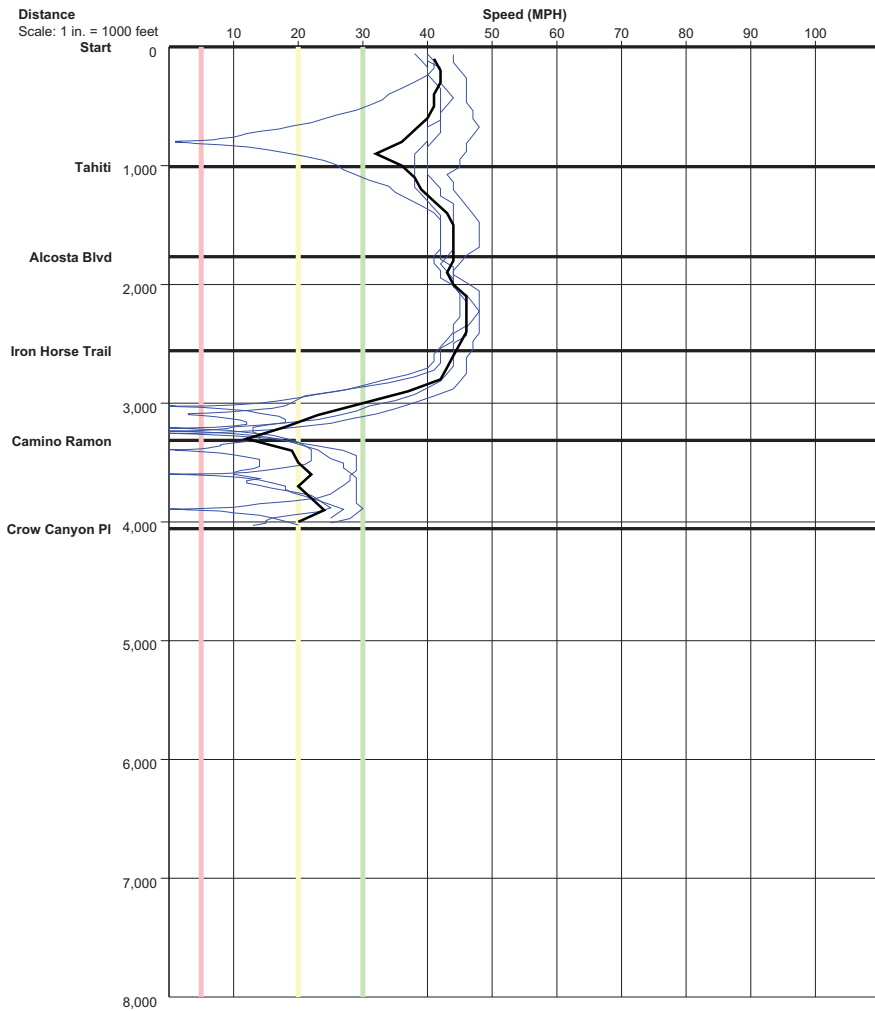
P.M. Peak (4:30 to 6:30 PM)

### Crow Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : Crow Canyon WB PM - Day 1  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

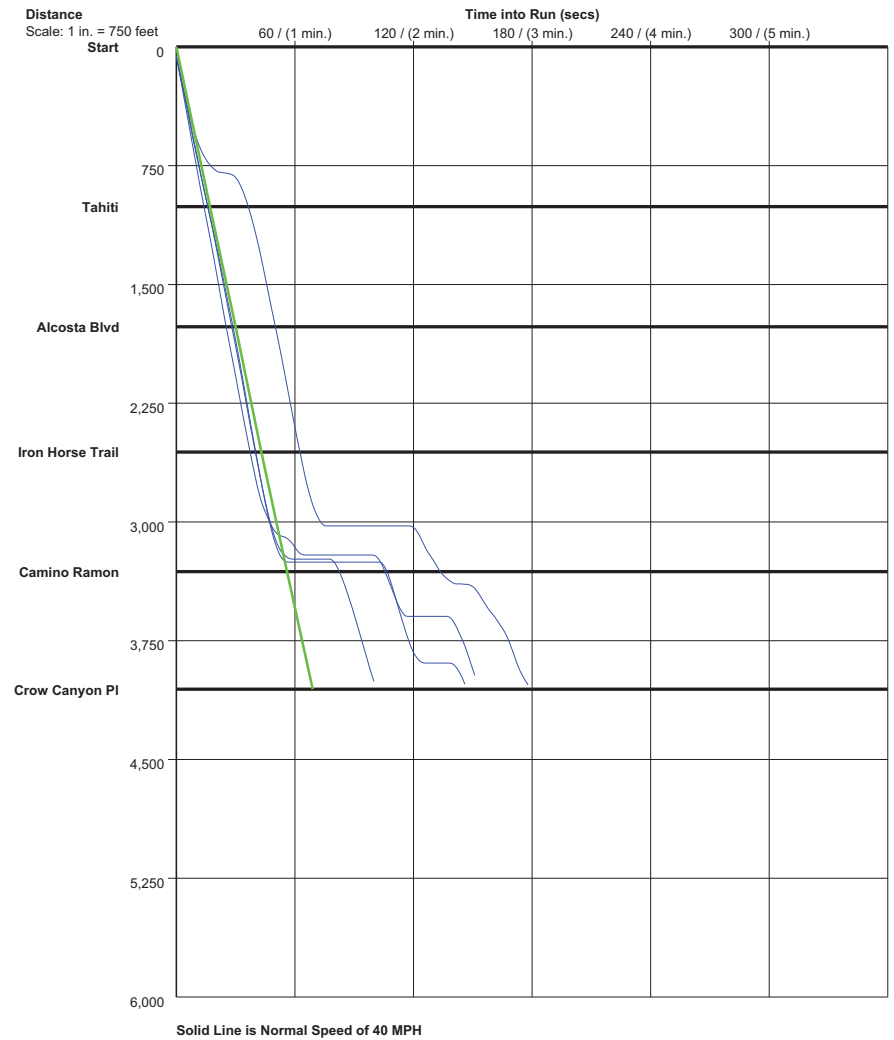


### Crow Canyon

Tuesday - July 13, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : Crow Canyon WB PM - Day 1  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

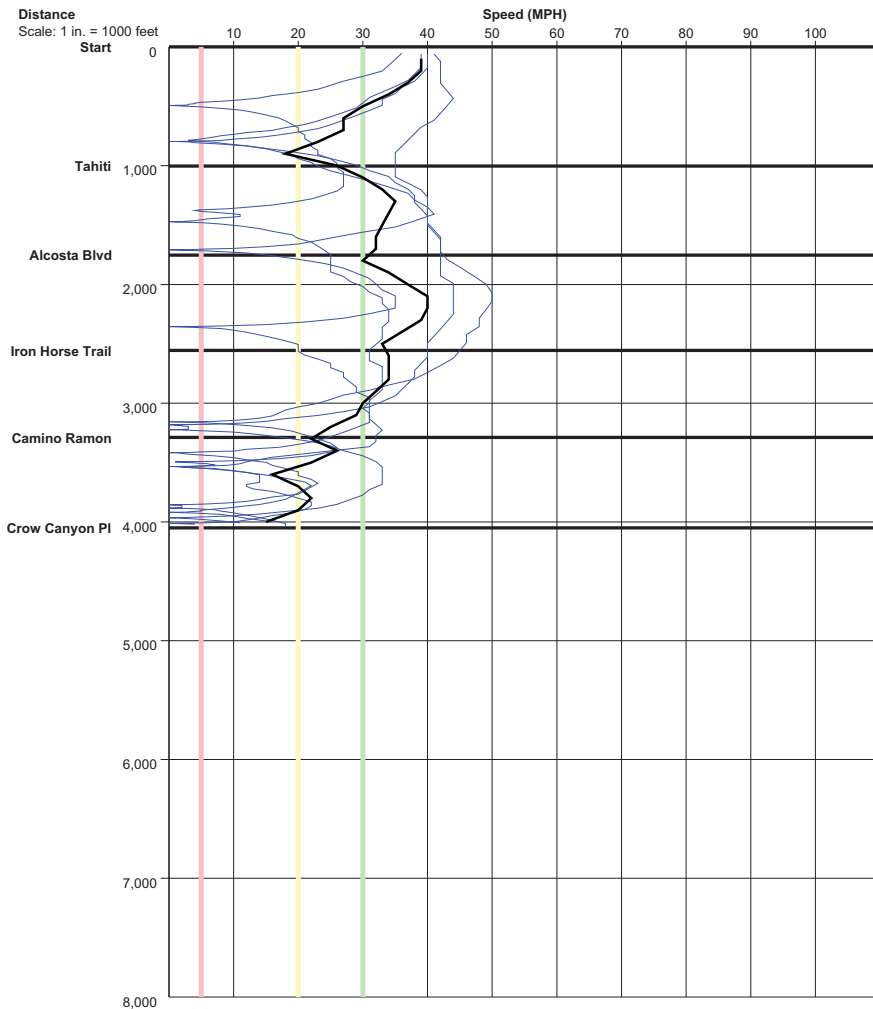


### Crow Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : Crow Canyon WB PM - Day 2  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

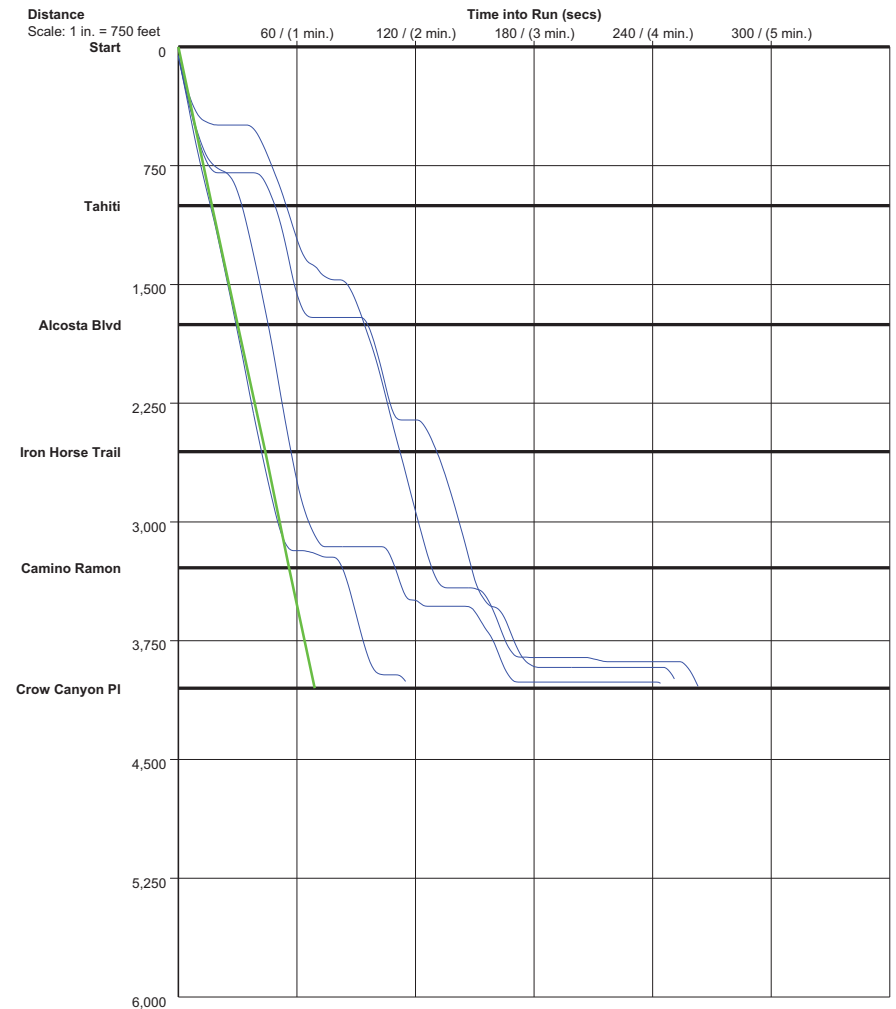


### Crow Canyon

Wednesday - July 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : Crow Canyon WB PM - Day 2  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



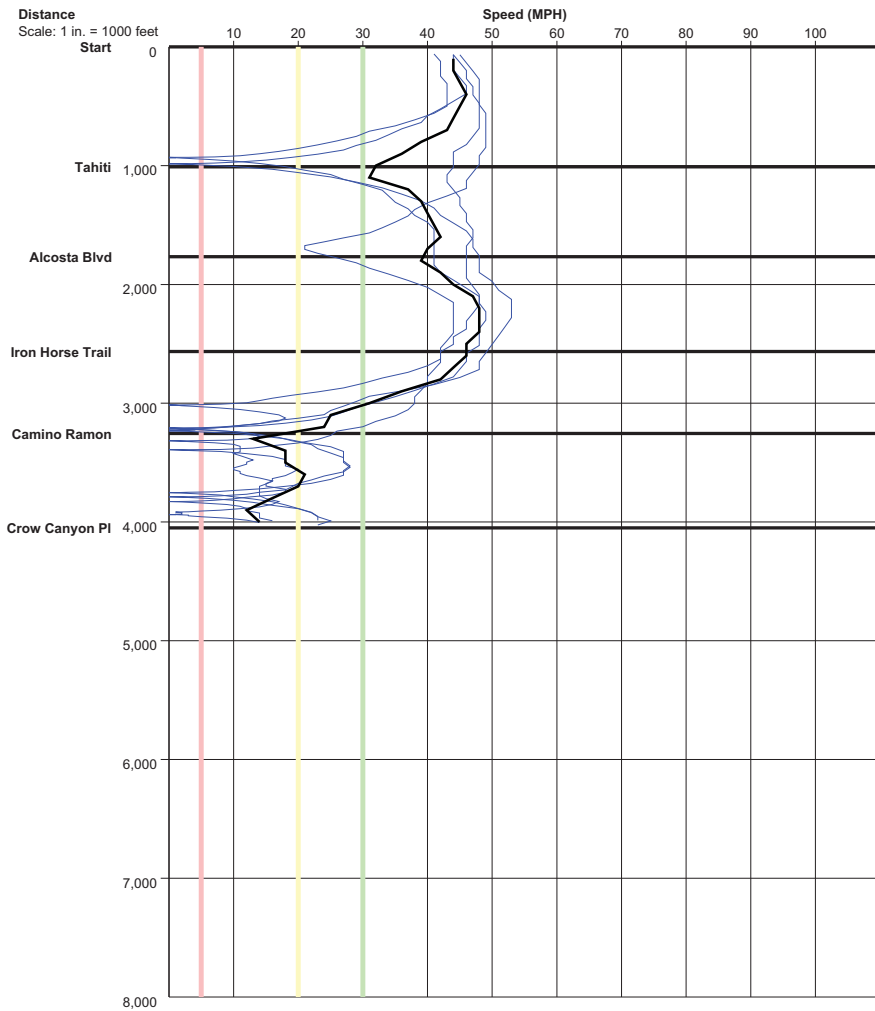
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : Crow Canyon WB PM - Day 3  
Study Date : 7/17/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

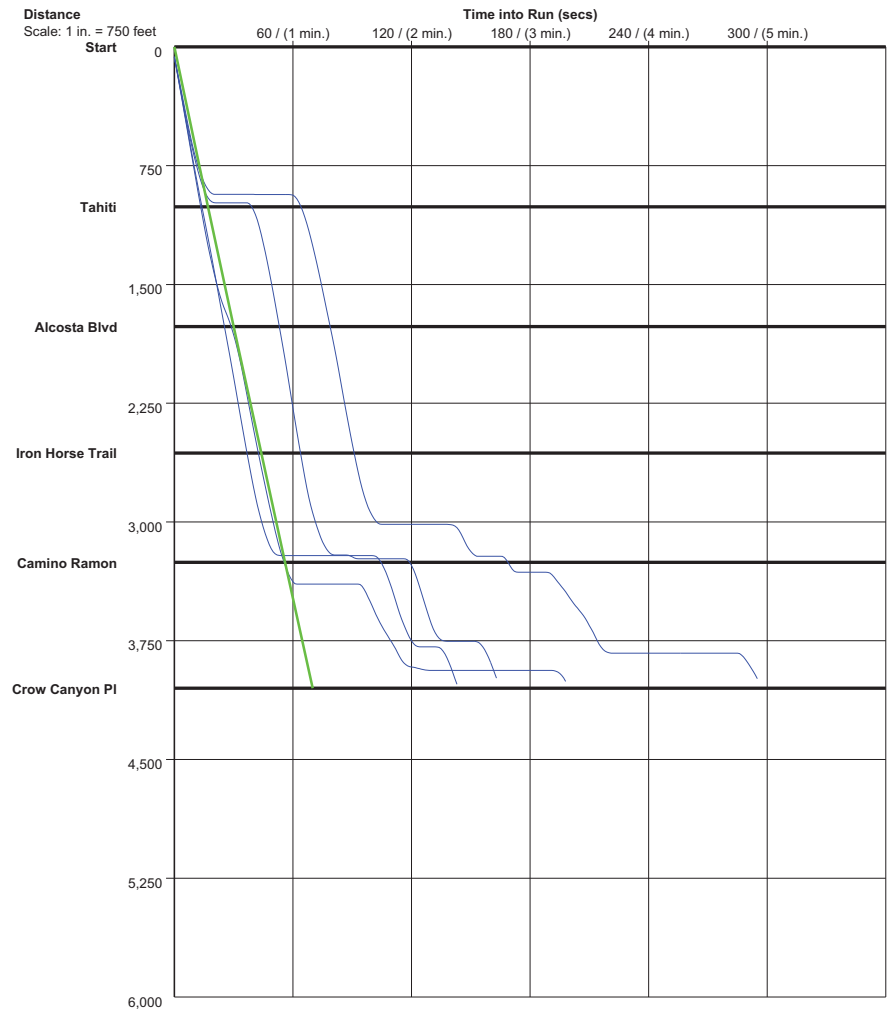


### Crow Canyon

Thursday - July 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : Crow Canyon WB PM - Day 3  
Study Date : 7/17/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



**Appendix A-5**  
After Period  
Bollinger Canyon Road Eastbound

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After Period  
Bollinger Canyon Road Eastbound

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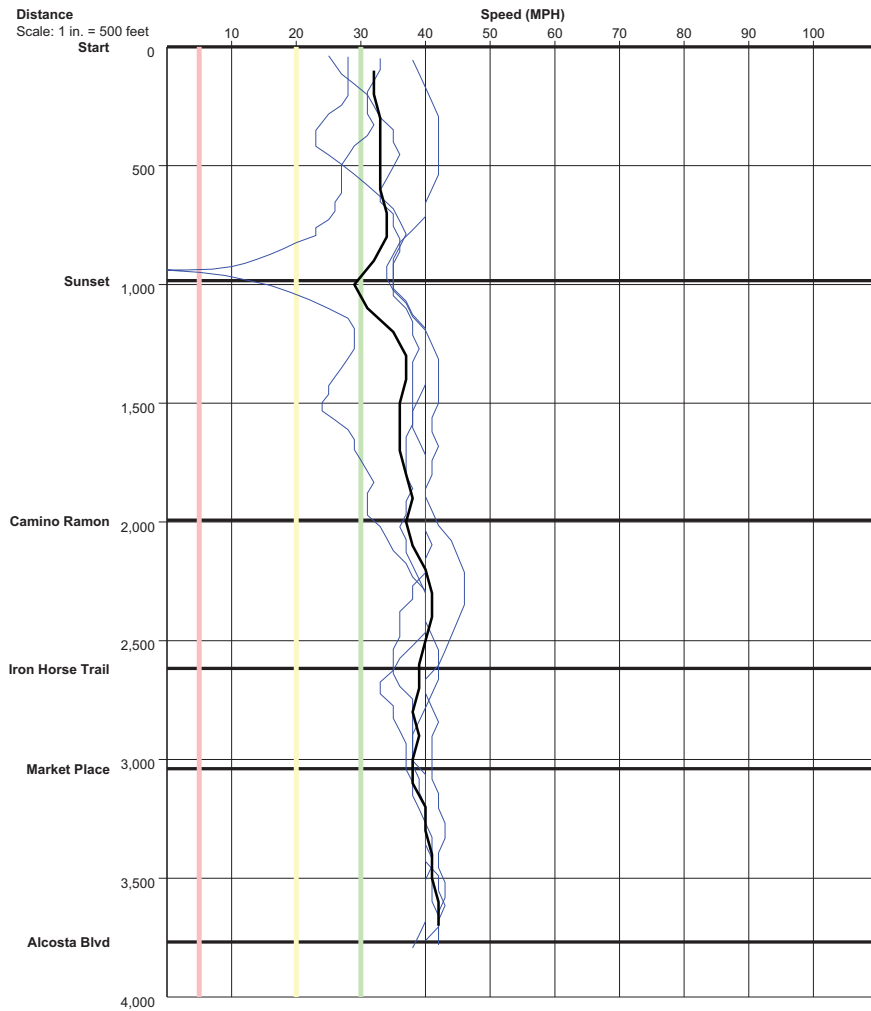
A.M. Peak (7:00 to 9:00 AM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

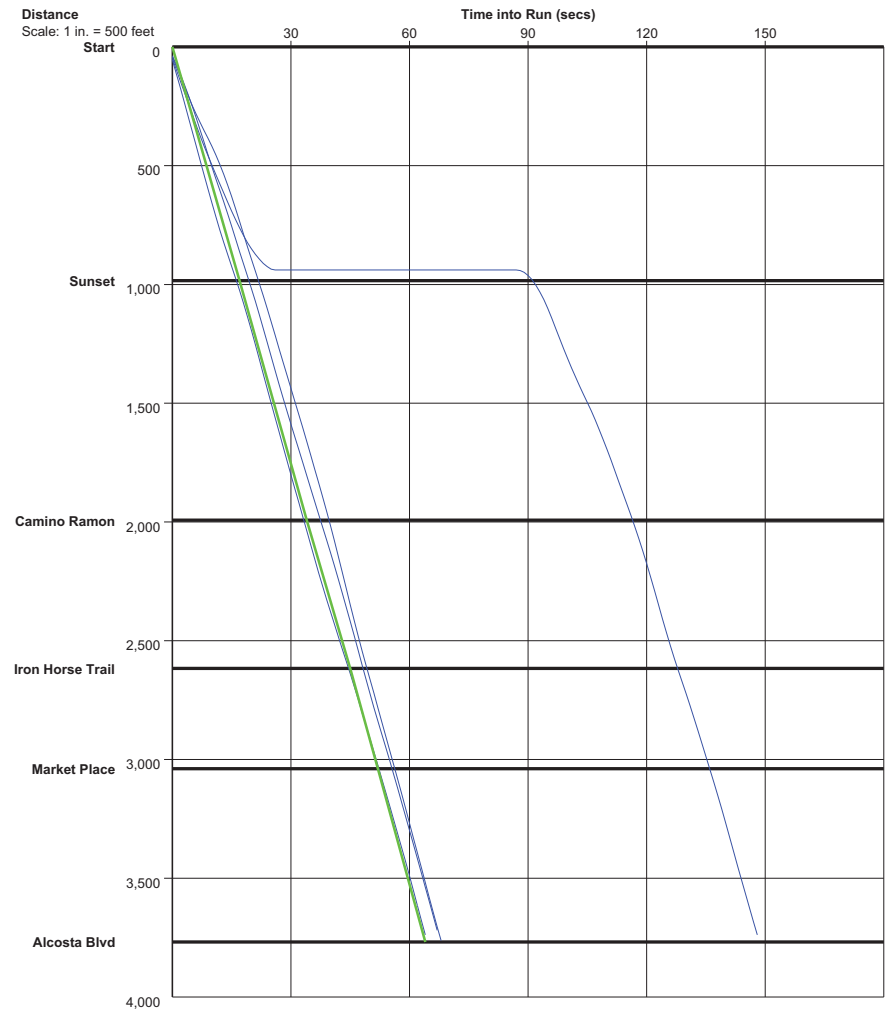


### Bollinger Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

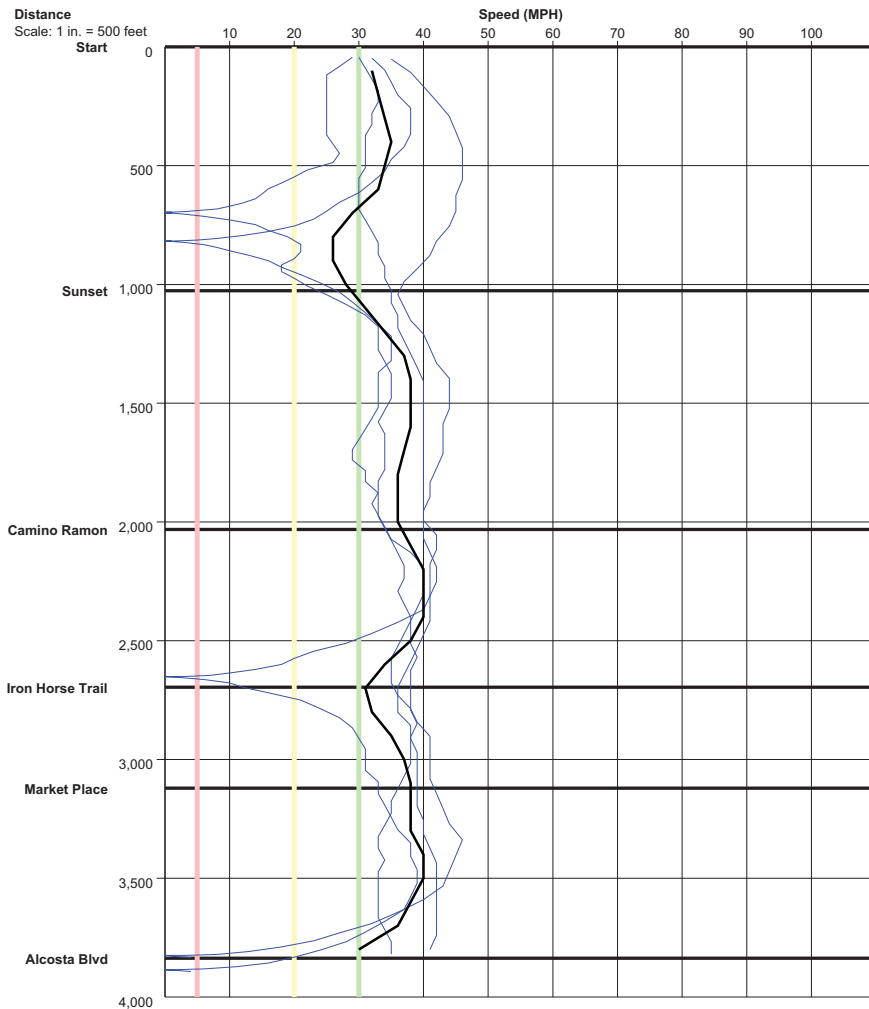


### Bollinger Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

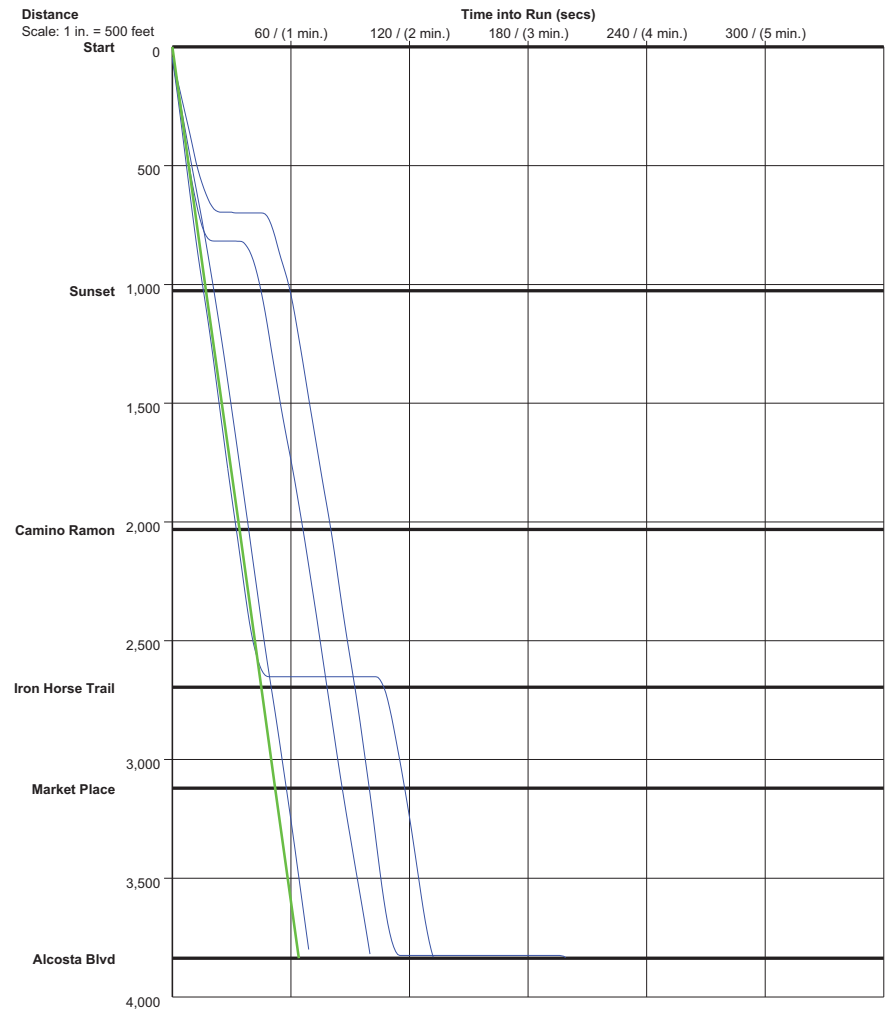


### Bollinger Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

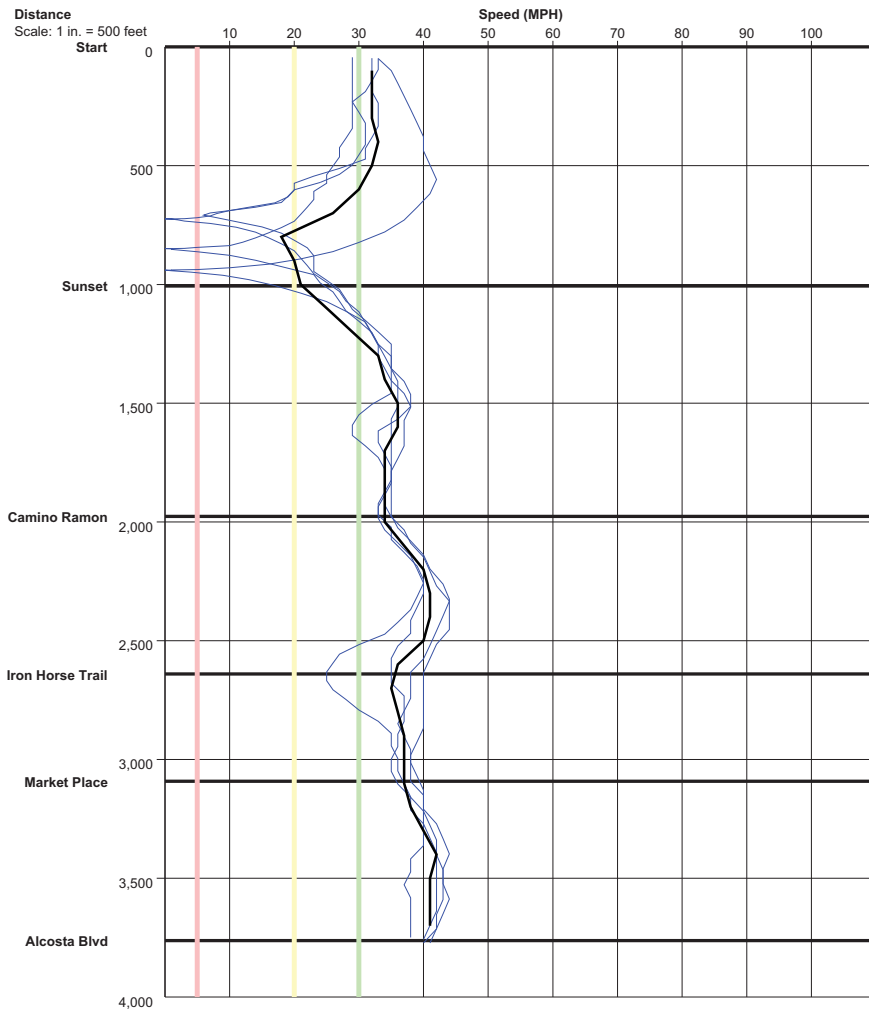


### Bollinger Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

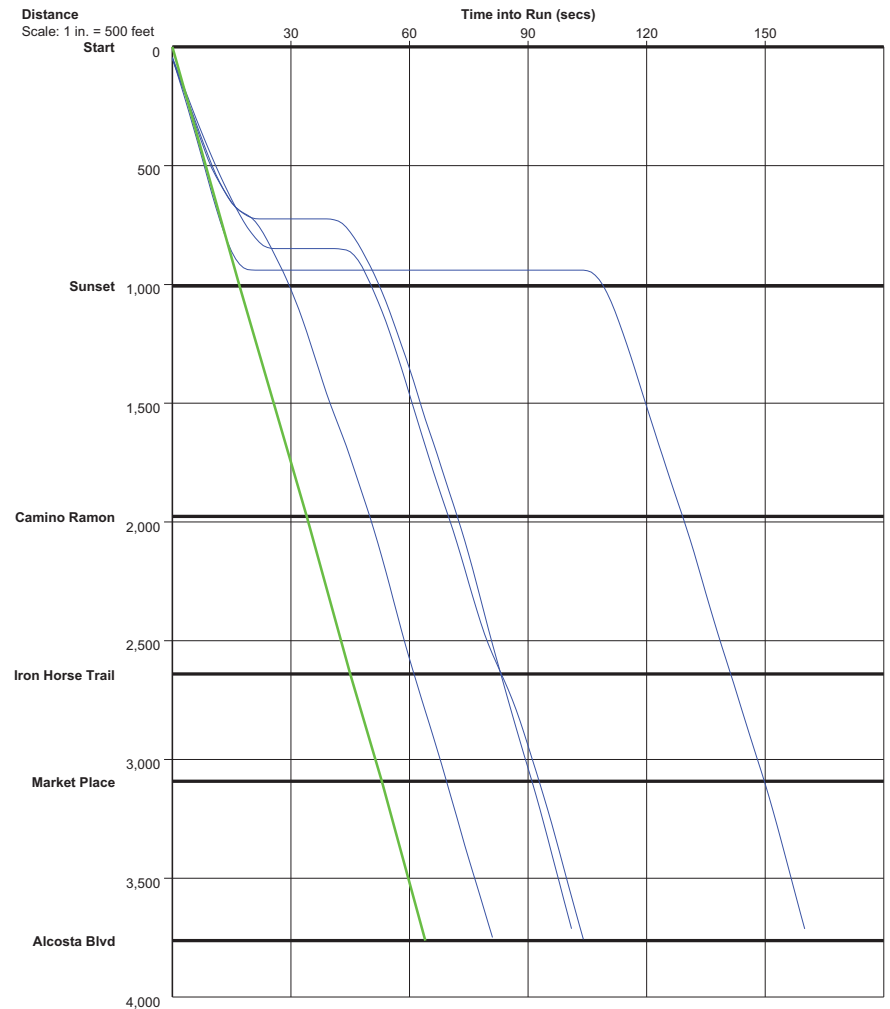


### Bollinger Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



After Period  
Bollinger Canyon Road Eastbound

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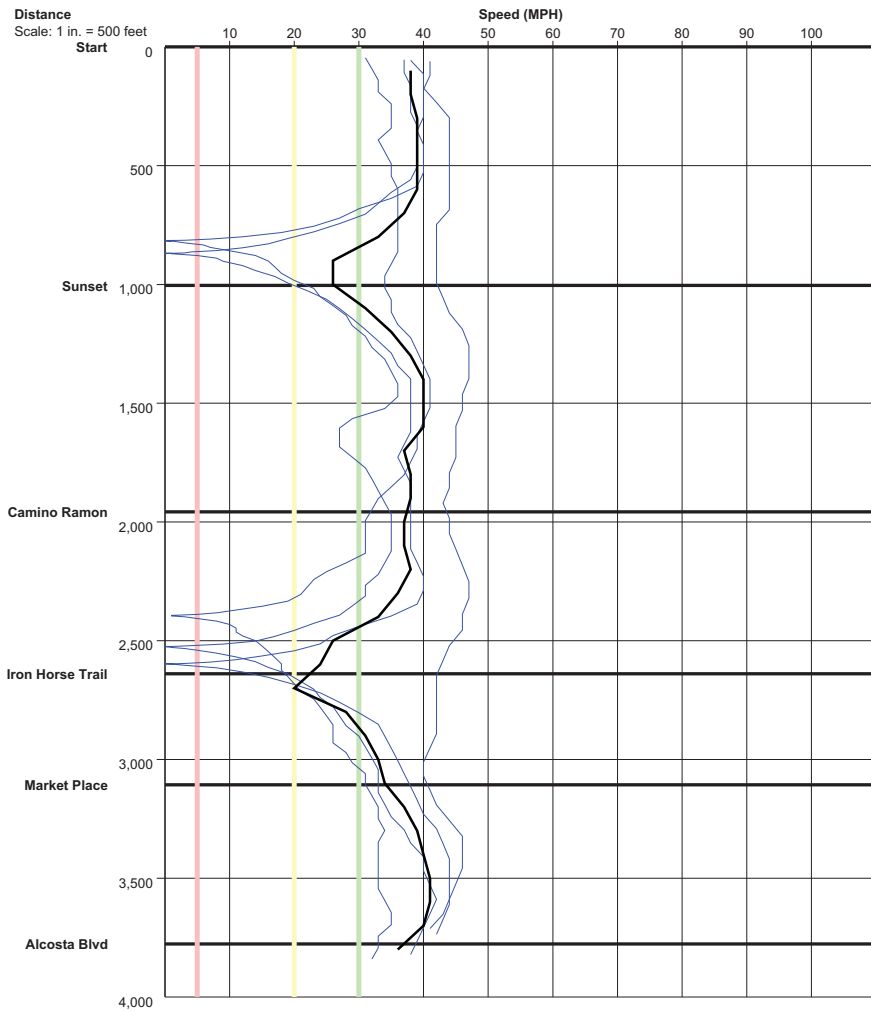
A.M. Off-Peak (9:00 to 11:00 AM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM OP D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

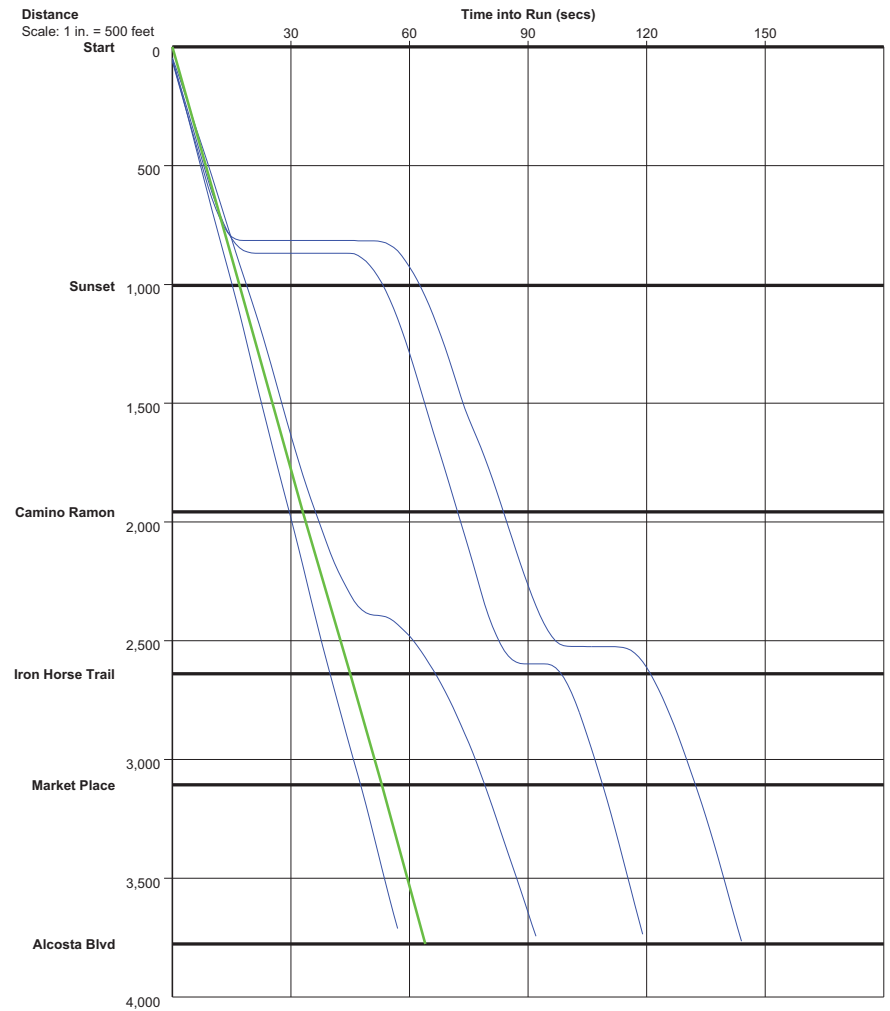


### Bollinger Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM OP D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

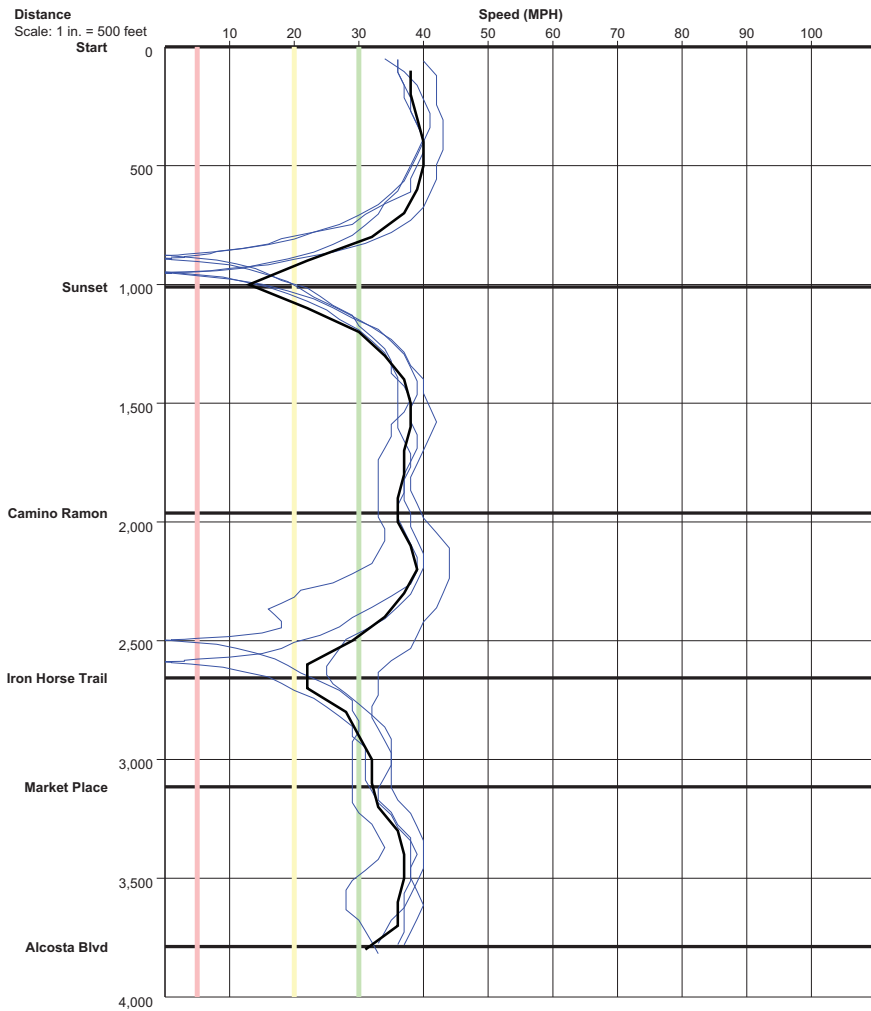


### Bollinger Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM OP D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

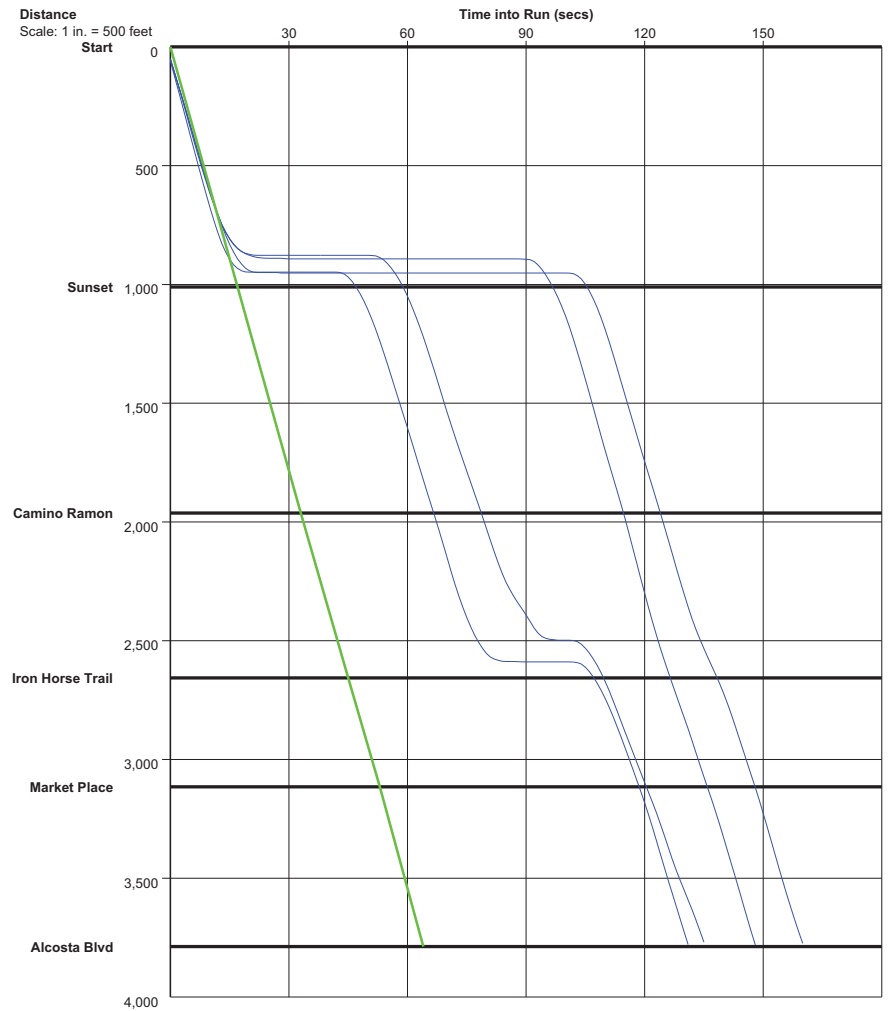


### Bollinger Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM OP D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



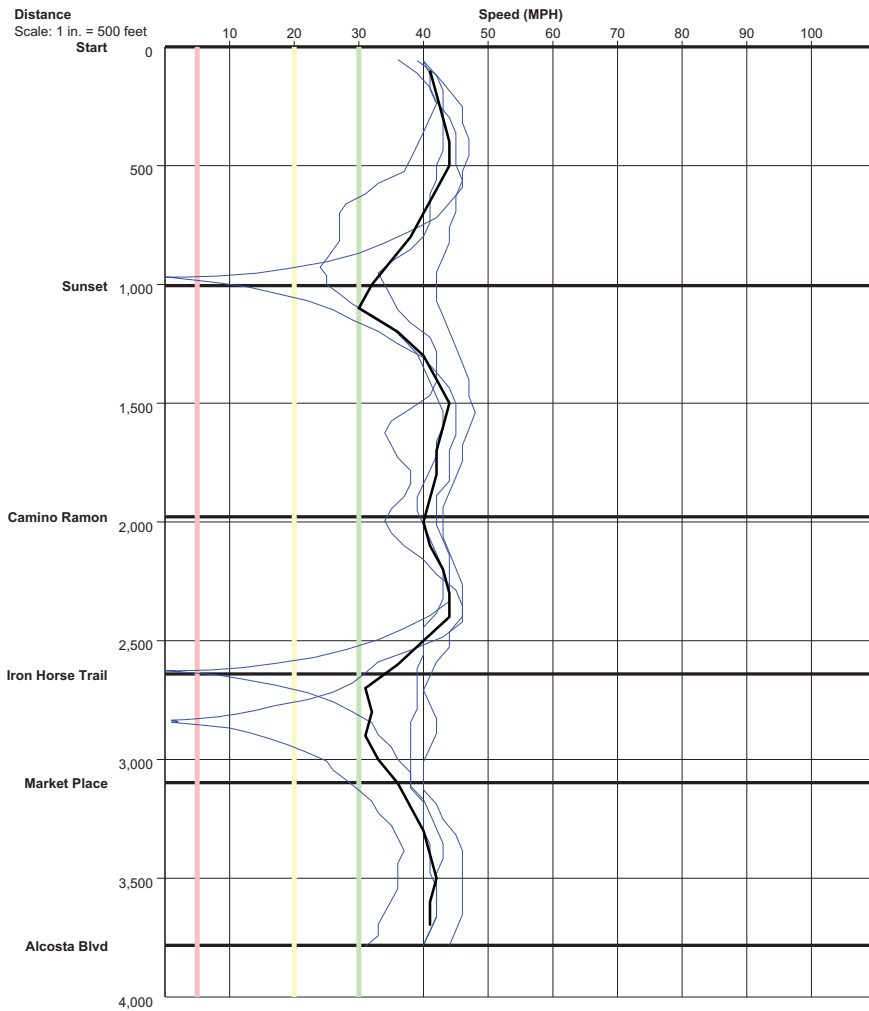
Solid Line is Normal Speed of 40 MPH

### Bollinger Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM OP D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

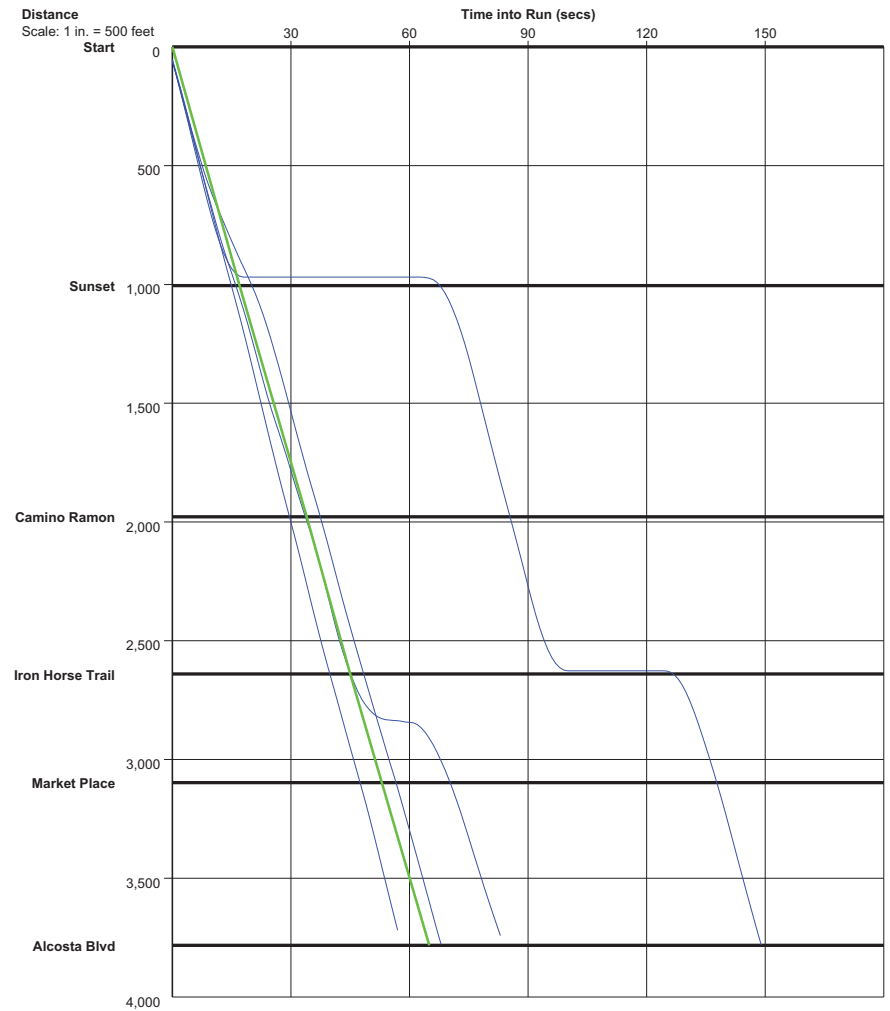


### Bollinger Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : **Bollinger - EB - AM OP D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



After Period  
Bollinger Canyon Road Eastbound

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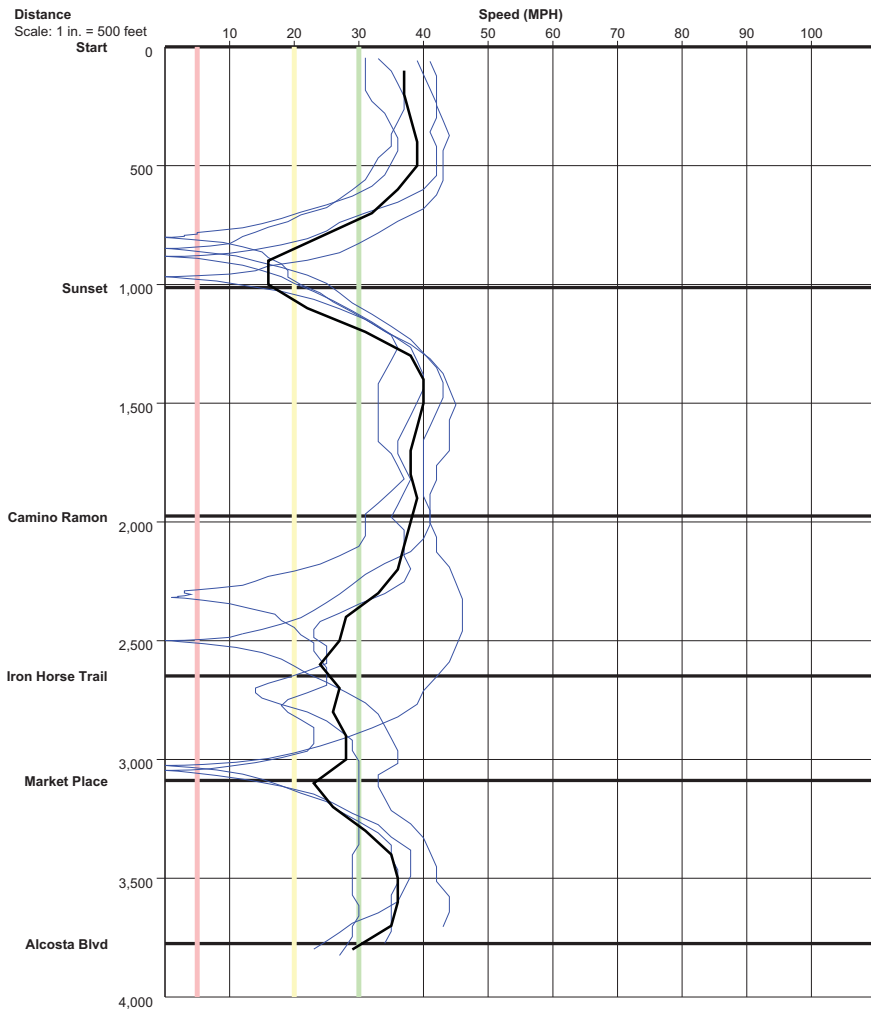
Midday Peak (11:30 AM to 1:30 PM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger - EB - MID D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

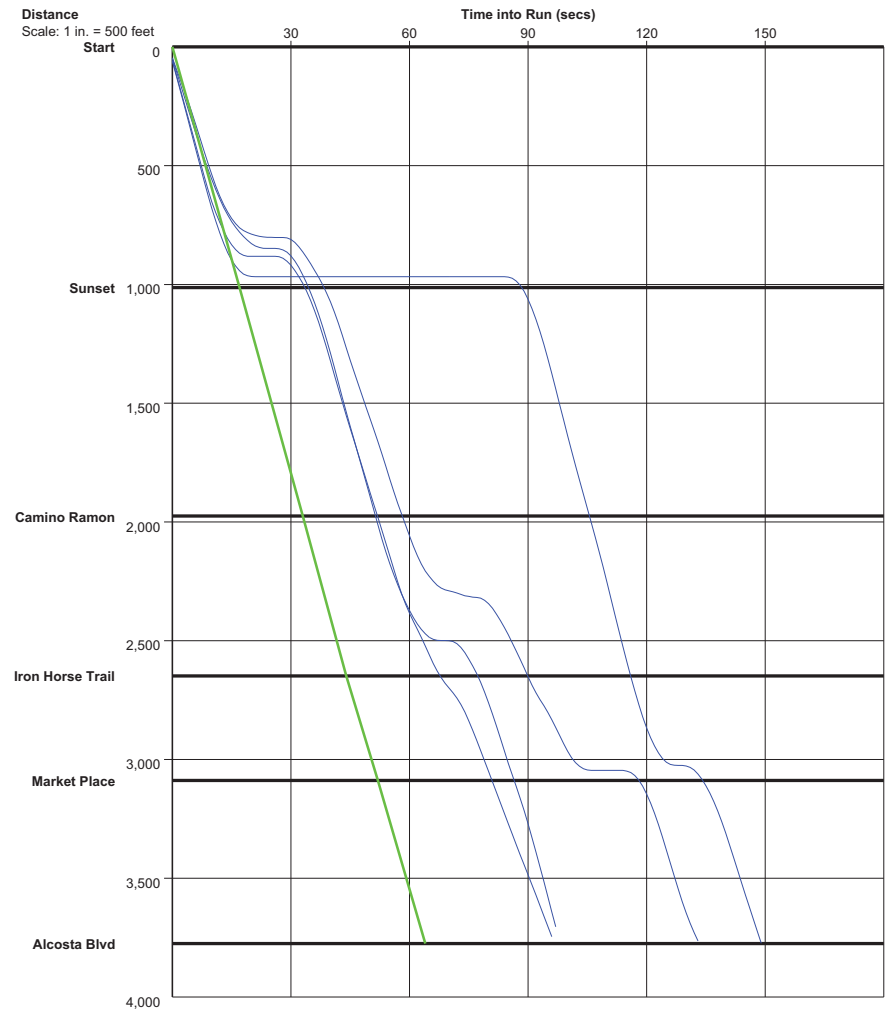


### Bollinger Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger - EB - MID D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



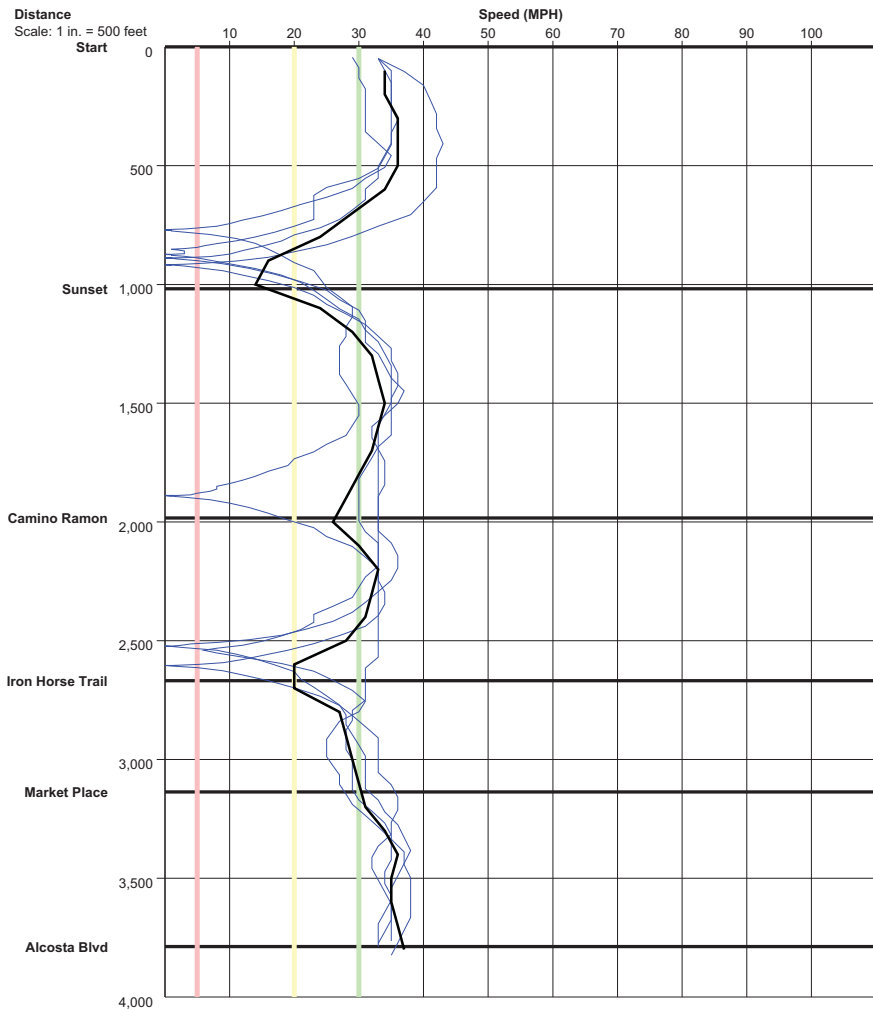
Solid Line is Normal Speed of 40 MPH

### Bollinger Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger - EB - MID D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

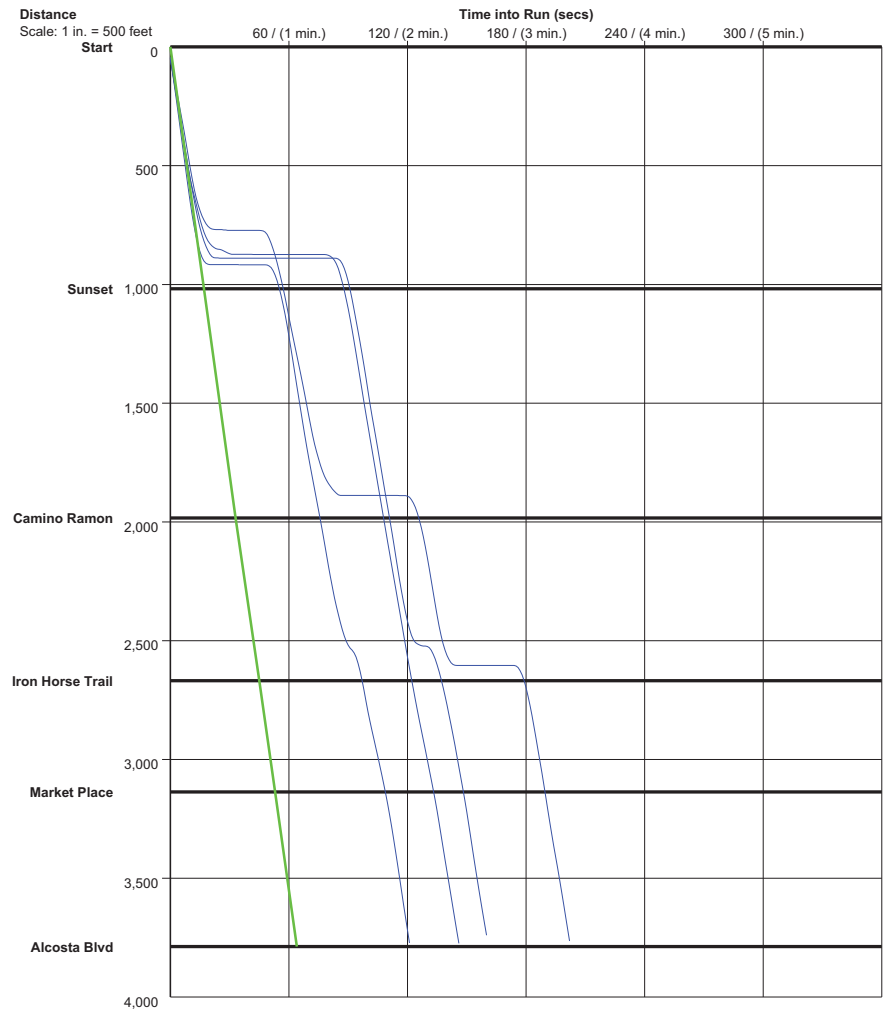


### Bollinger Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger - EB - MID D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

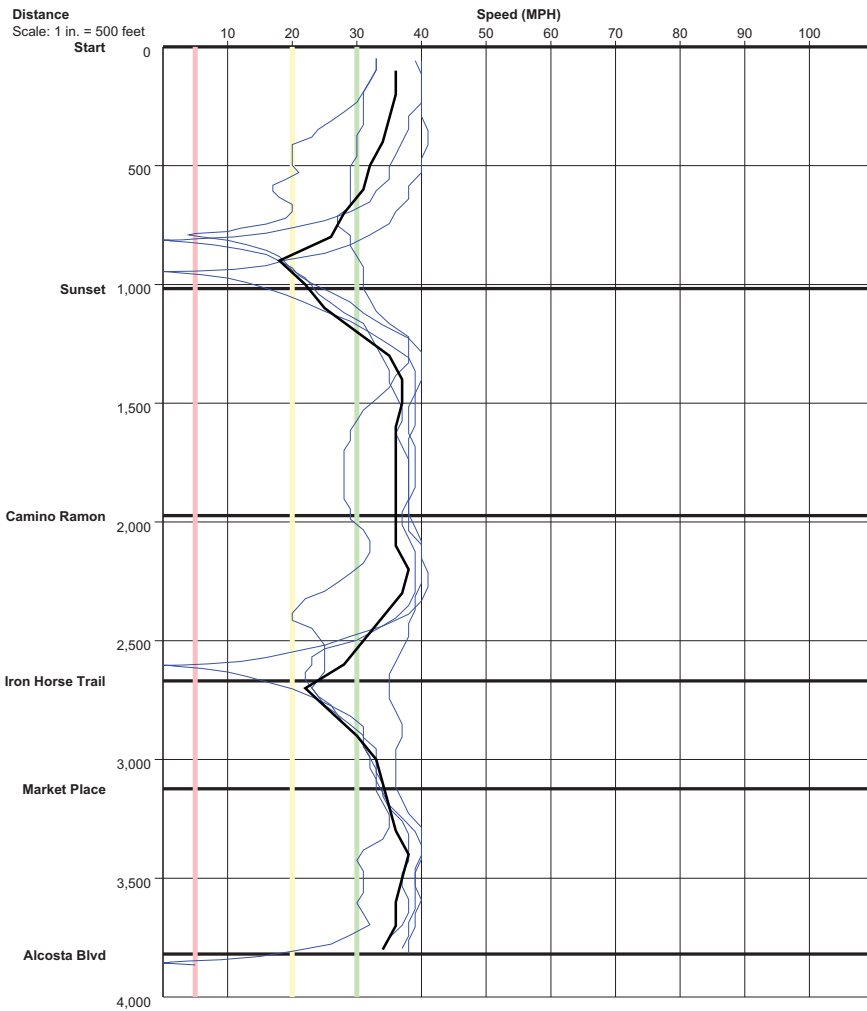


### Bollinger Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger - EB - MID D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

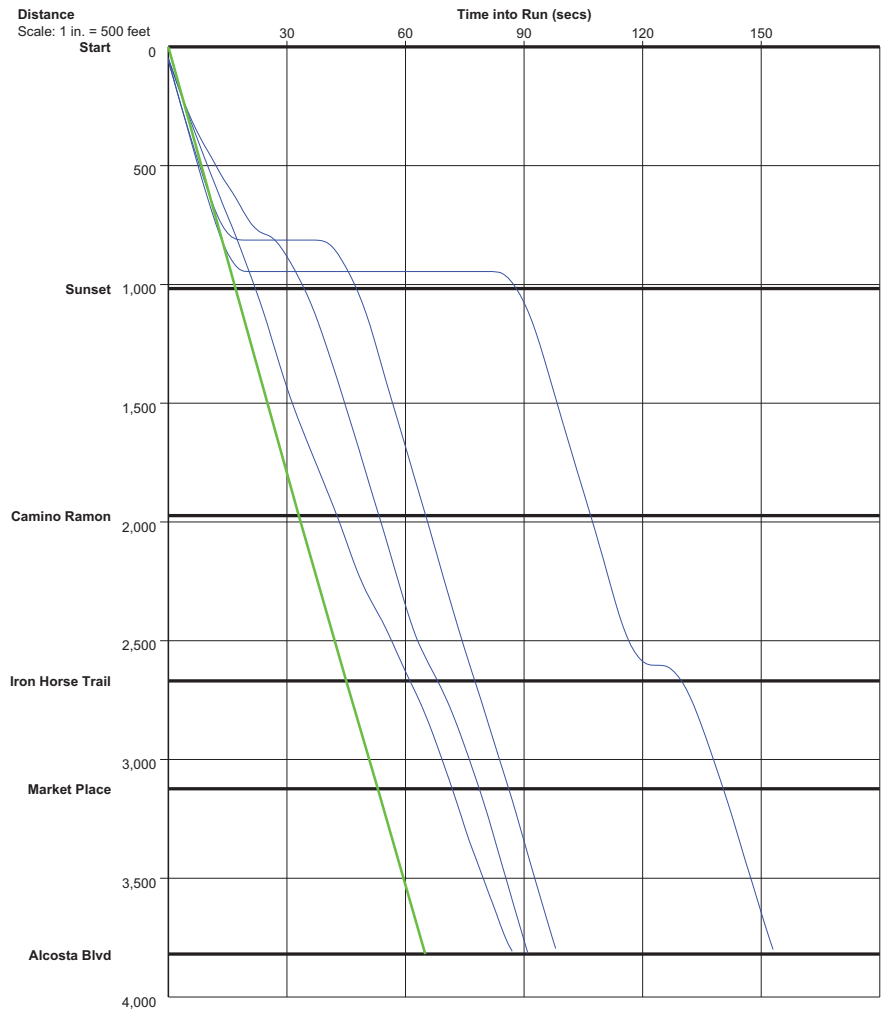


### Bollinger Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : **Bollinger - EB - MID D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



After Period  
Bollinger Canyon Road Eastbound

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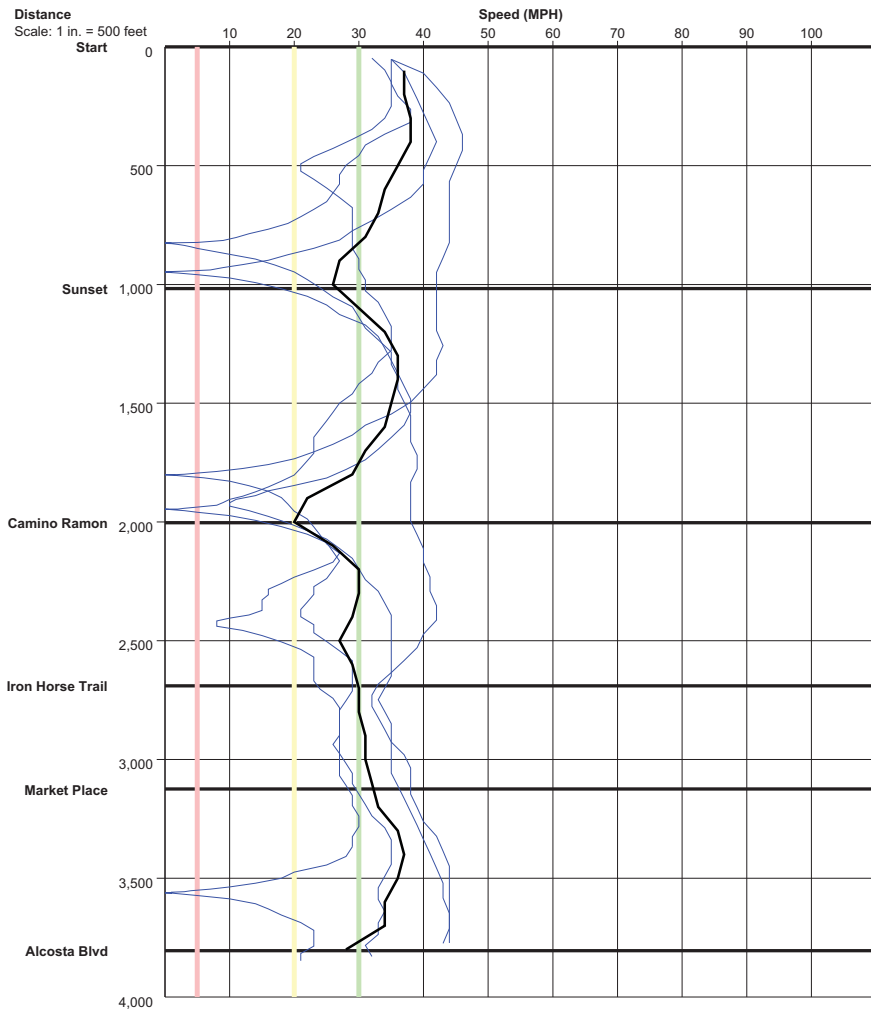
P.M. Peak (4:30 to 6:30 PM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger - EB - PM D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

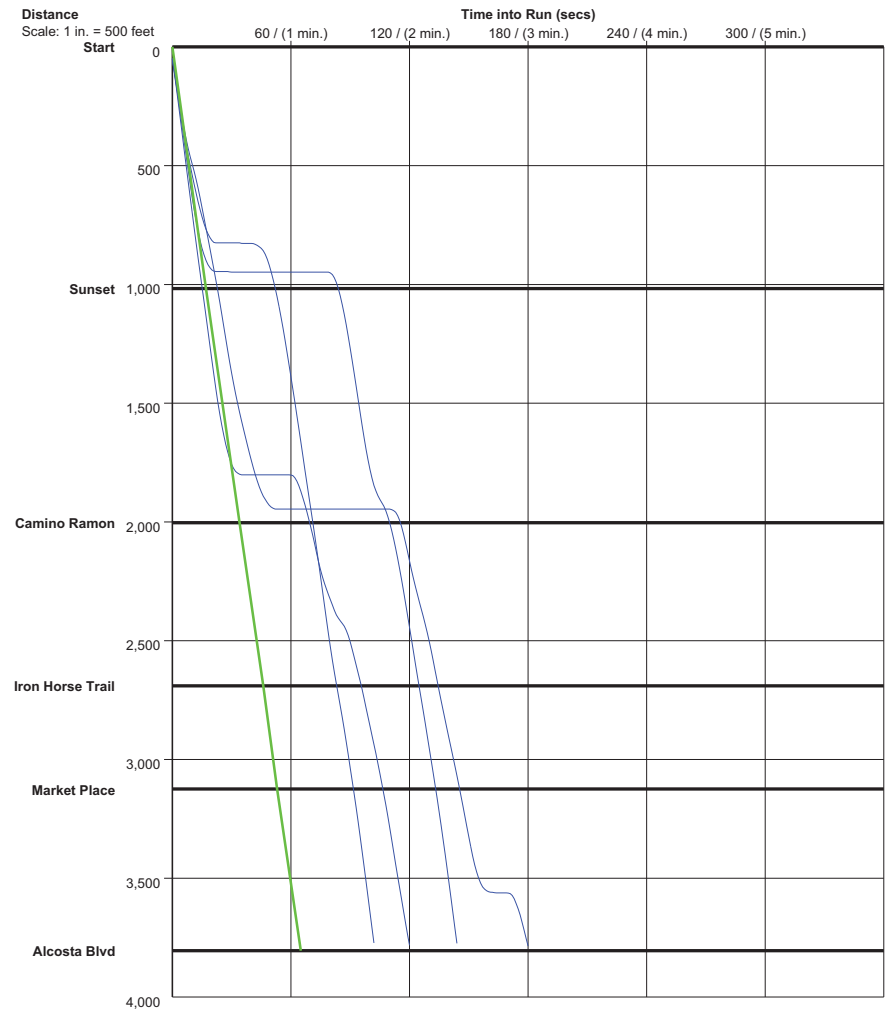


### Bollinger Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger - EB - PM D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

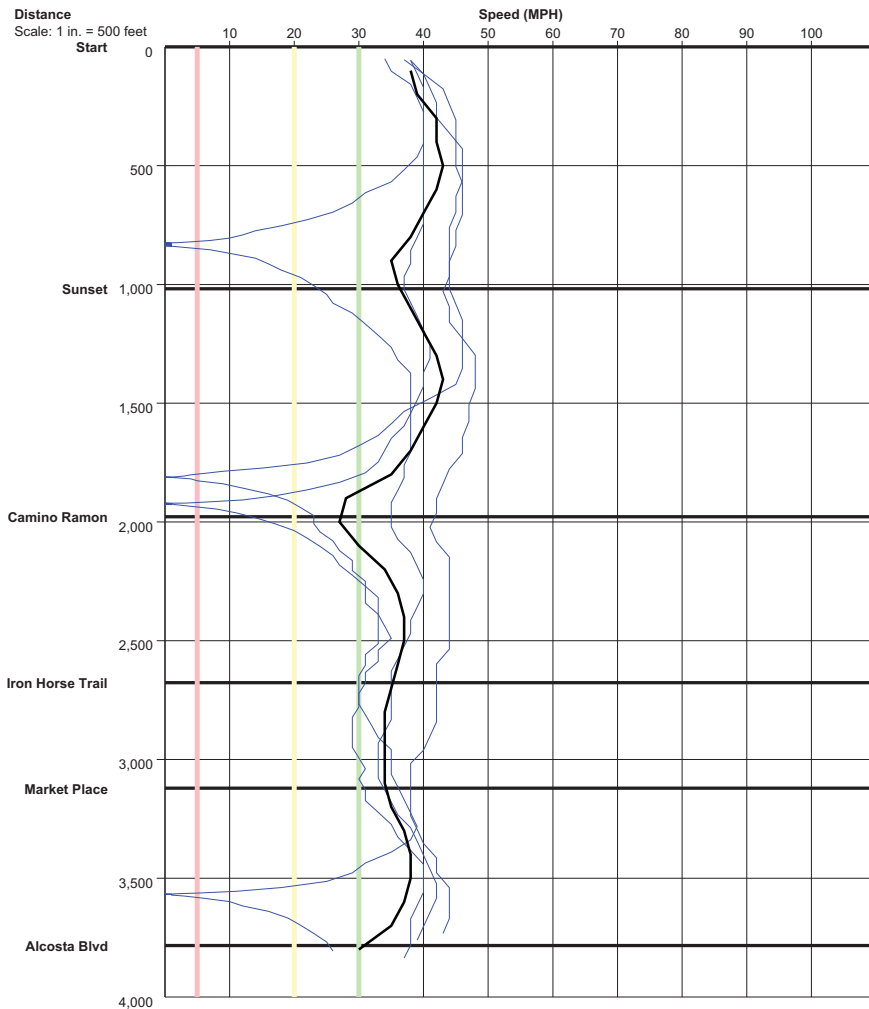


### Bollinger Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger - EB - PM D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

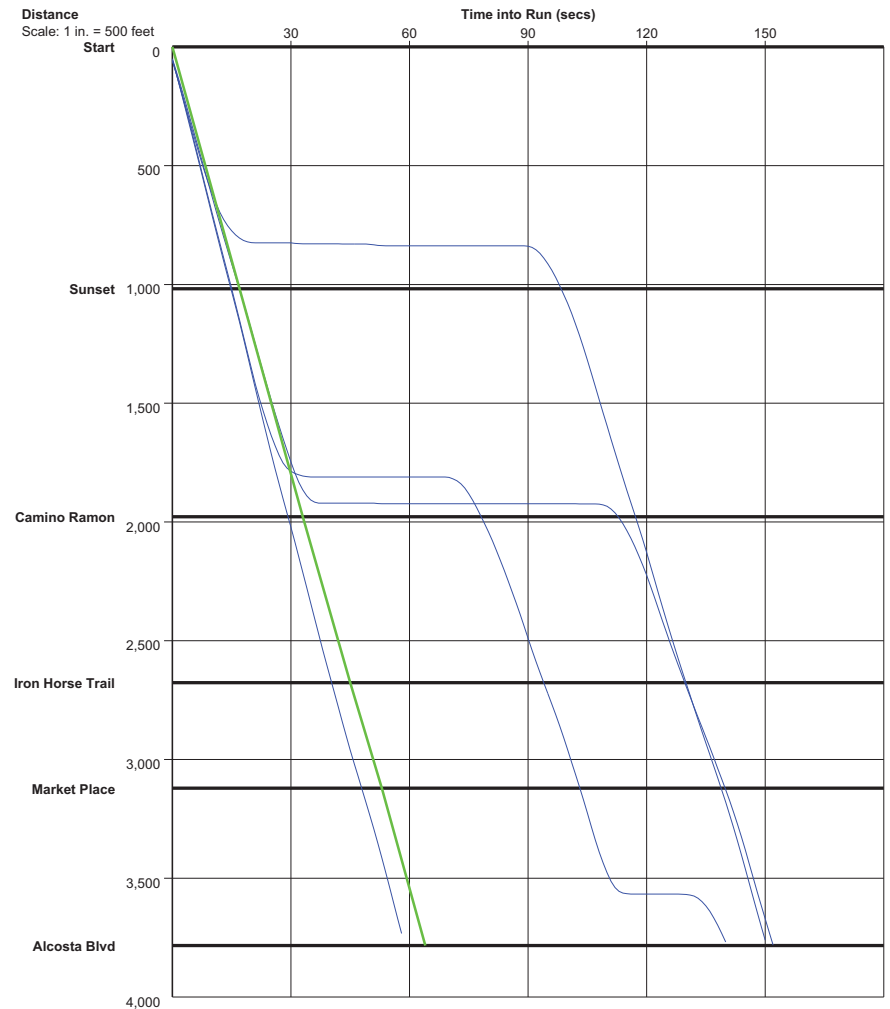


### Bollinger Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger - EB - PM D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

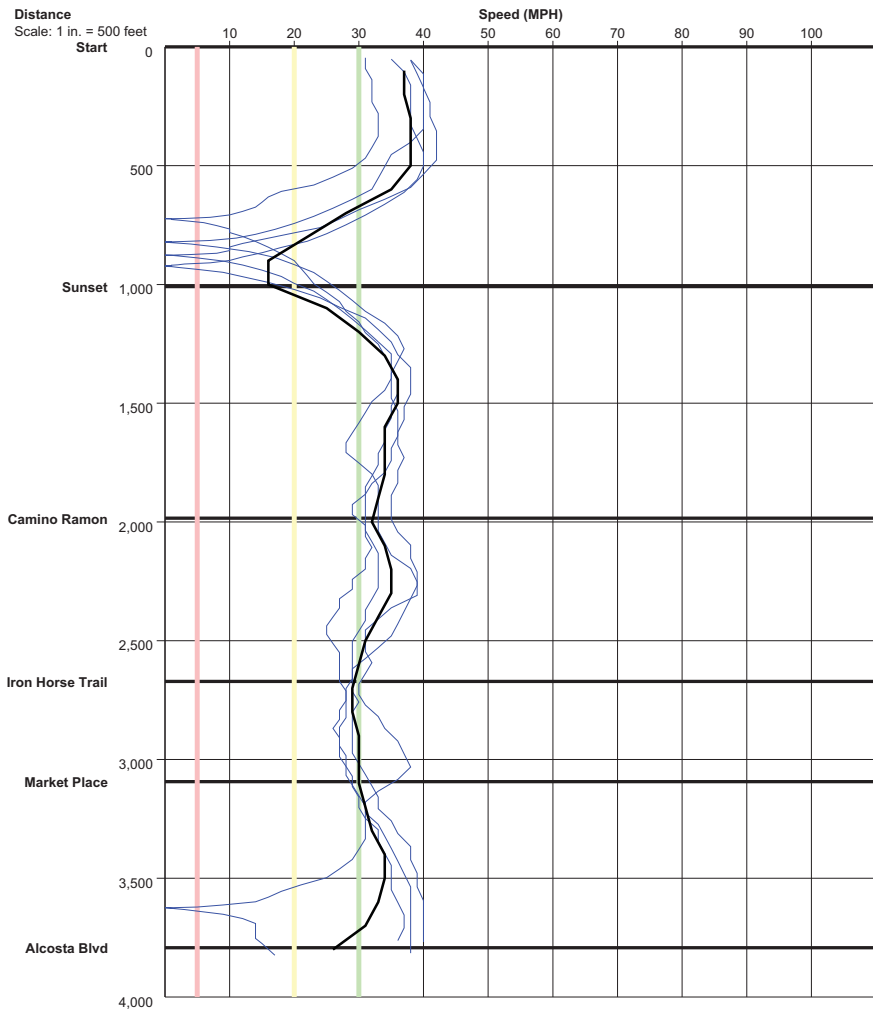


### Bollinger Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger - EB - PM D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

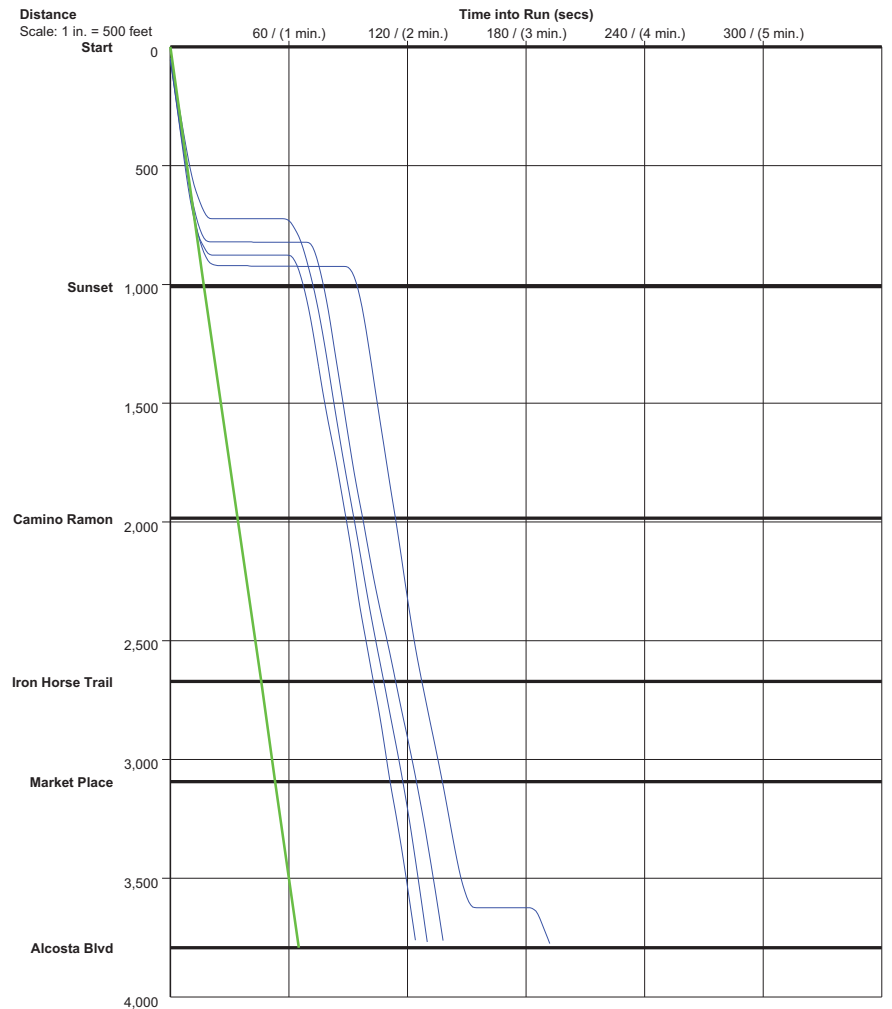


### Bollinger Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Bollinger - EB - PM D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



**Appendix A-6**  
After Period  
Bollinger Canyon Road Westbound

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After Period  
Bollinger Canyon Road Westbound

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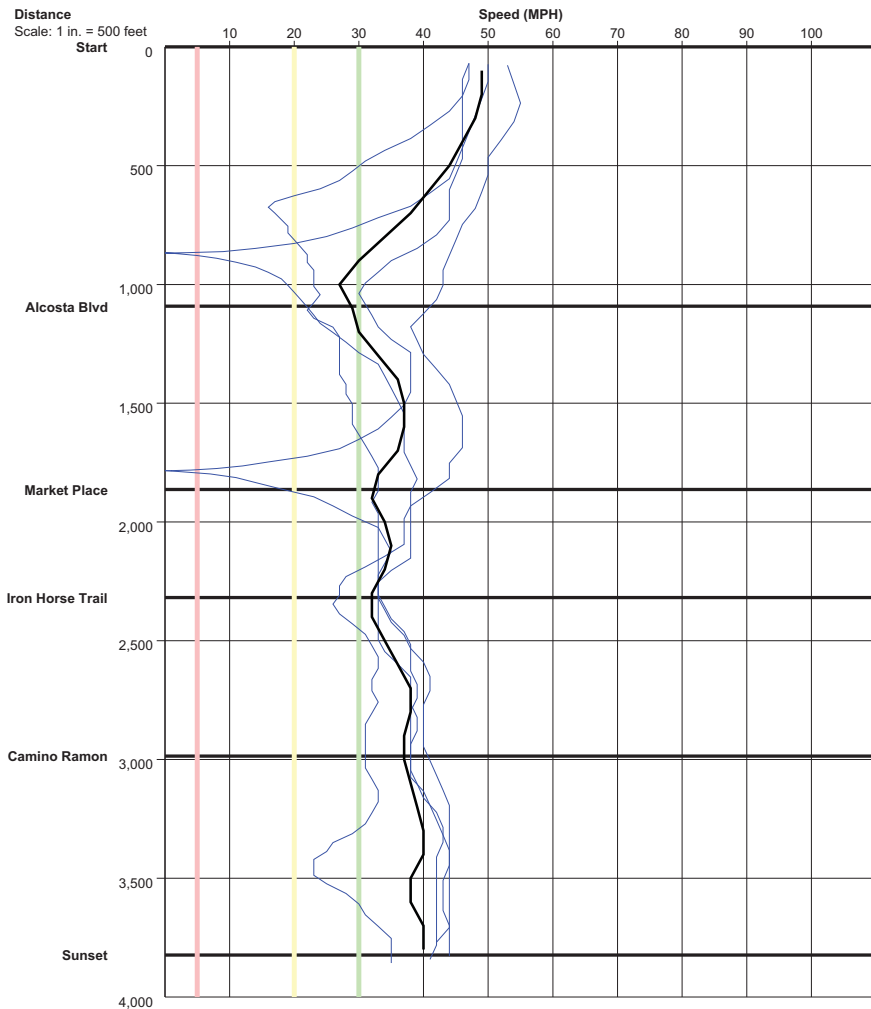
A.M. Peak (7:00 to 9:00 AM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger - WB - AM D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

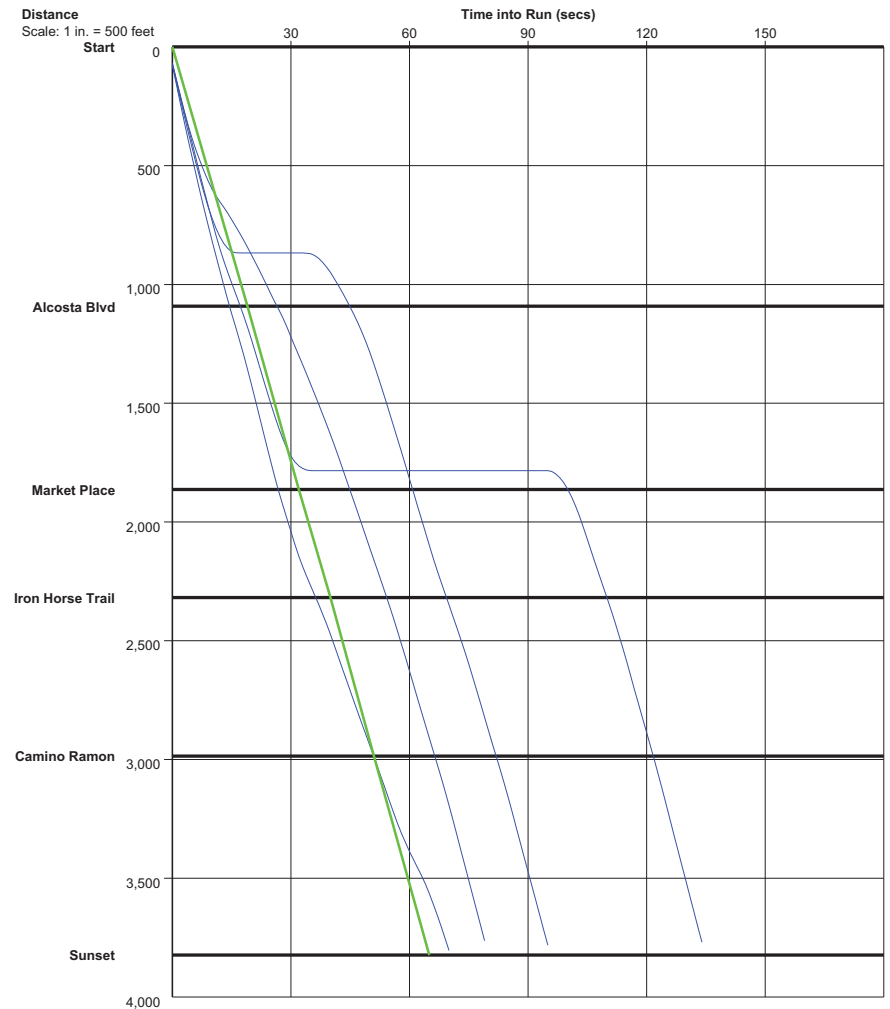


### Bollinger Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger - WB - AM D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

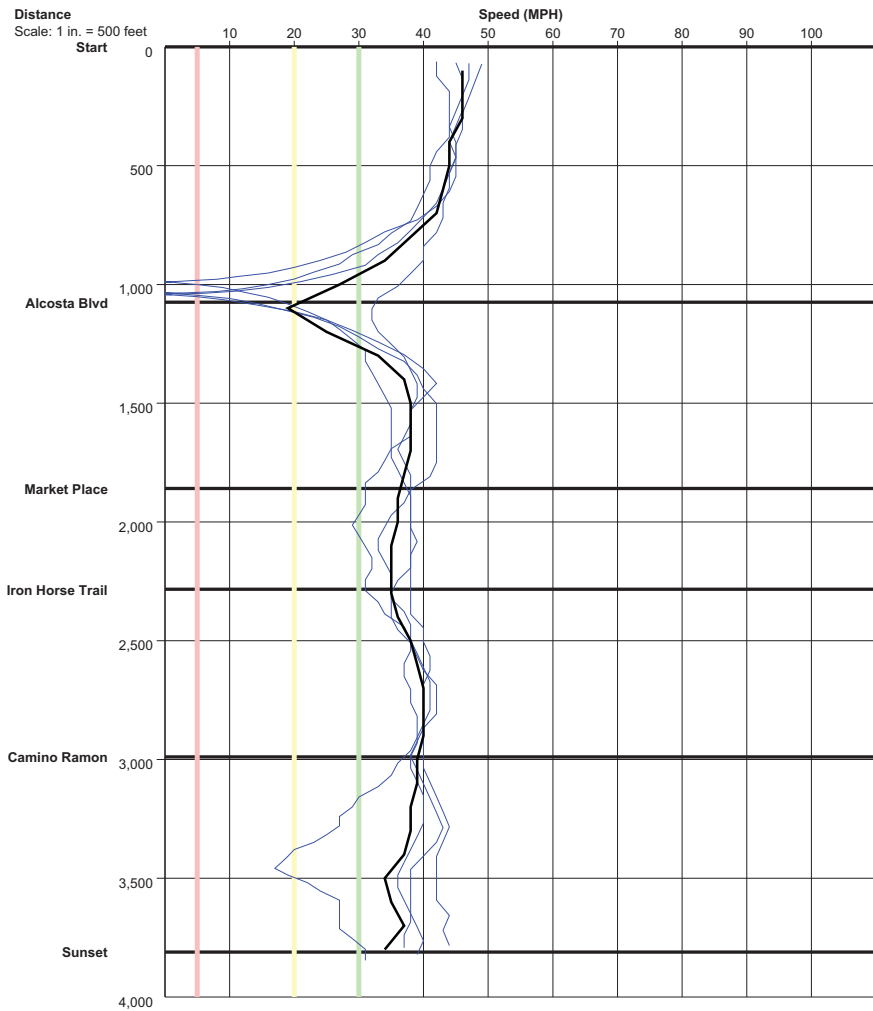


### Bollinger Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger - WB - AM D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

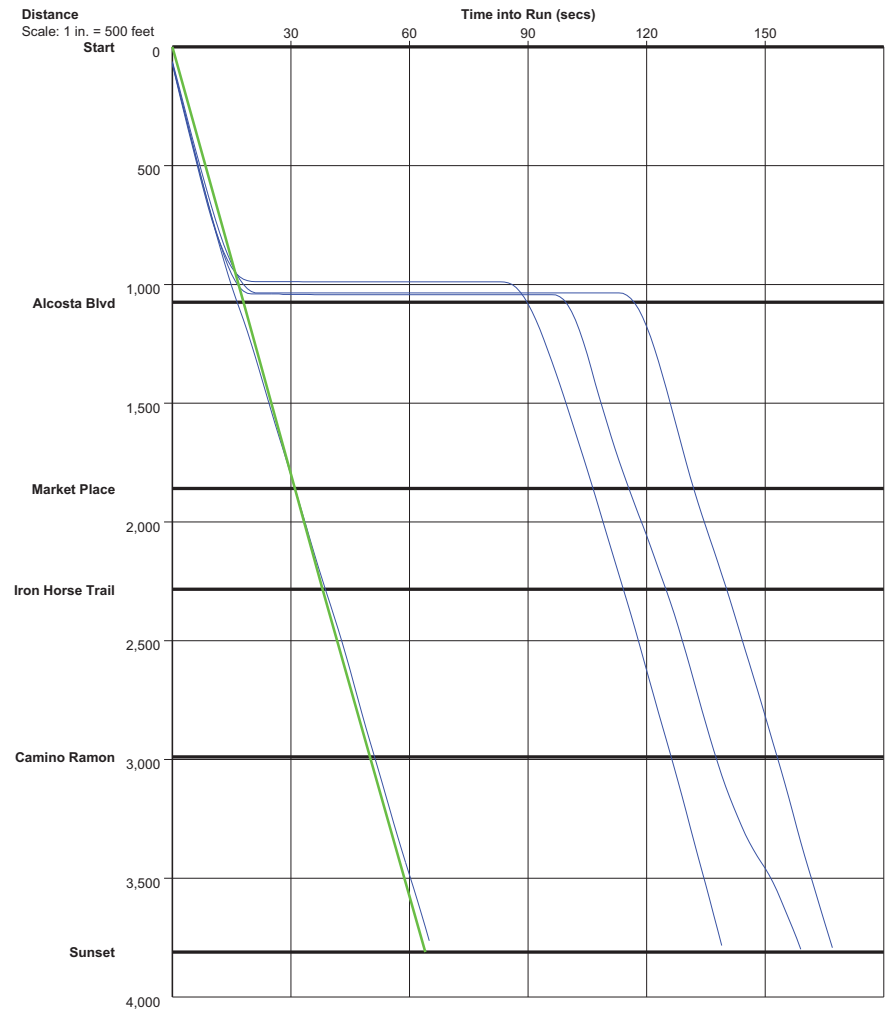


### Bollinger Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger - WB - AM D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

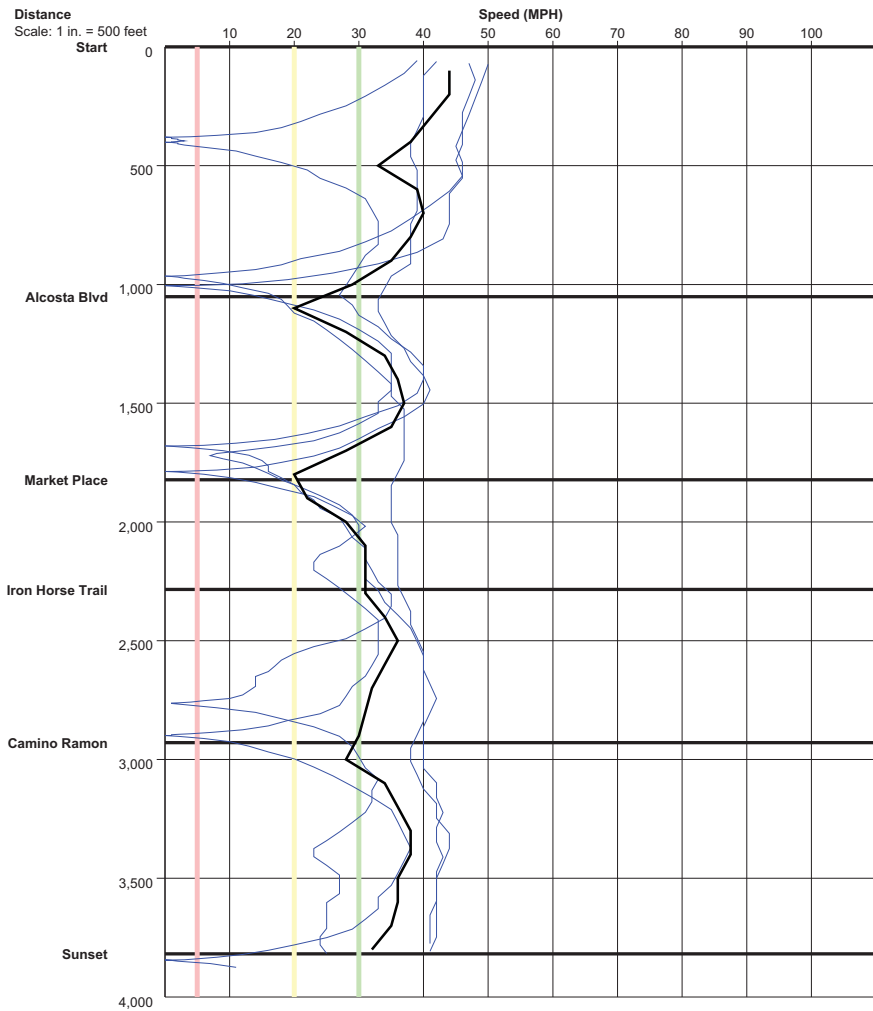


### Bollinger Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger - WB - AM D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

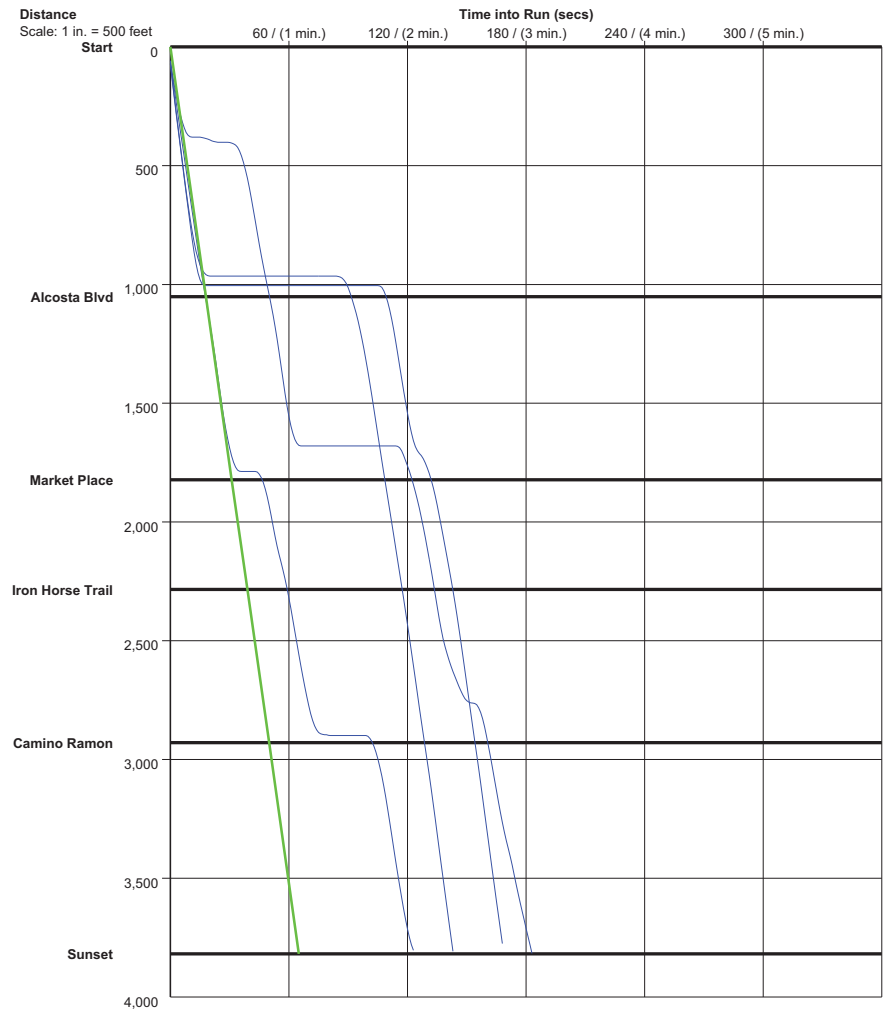


### Bollinger Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Bollinger - WB - AM D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



After Period  
Bollinger Canyon Road Westbound

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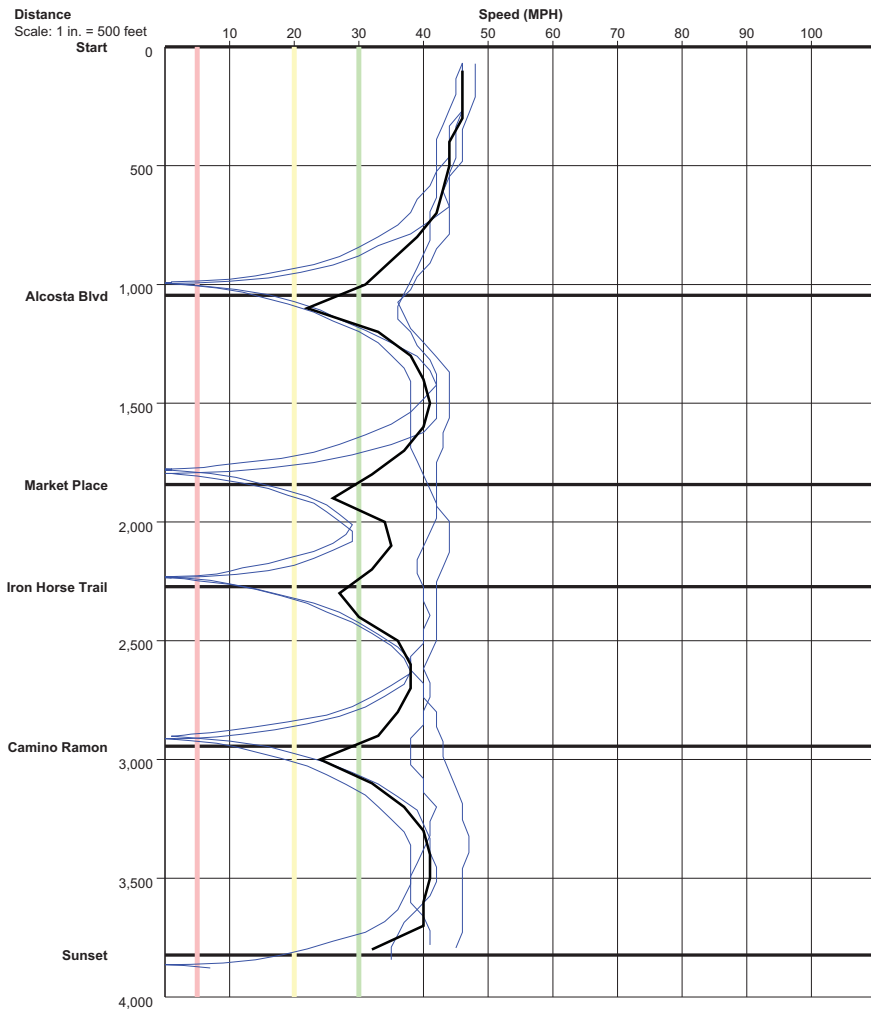
A.M. Off-Peak (9:00 to 11:00 AM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger - WB - AM OP D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

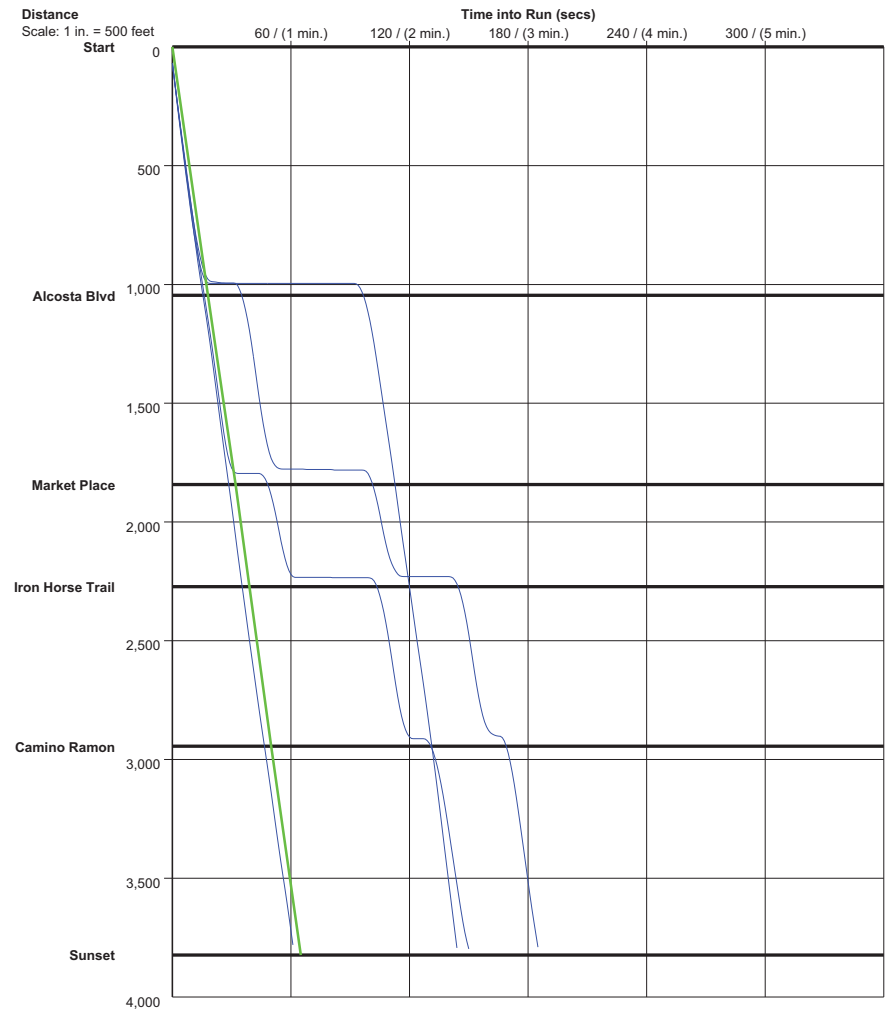


### Bollinger Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger - WB - AM OP D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

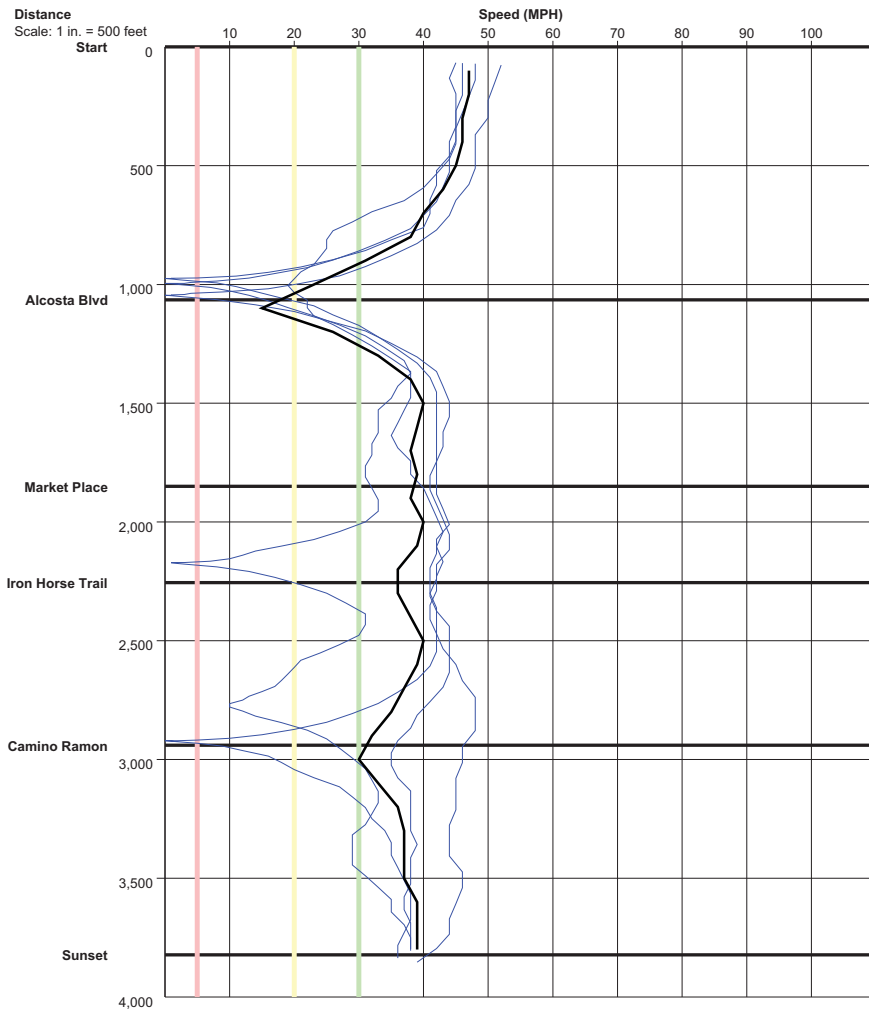


### Bollinger Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger - WB - AM OP D2**  
Study Date : 9/21/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

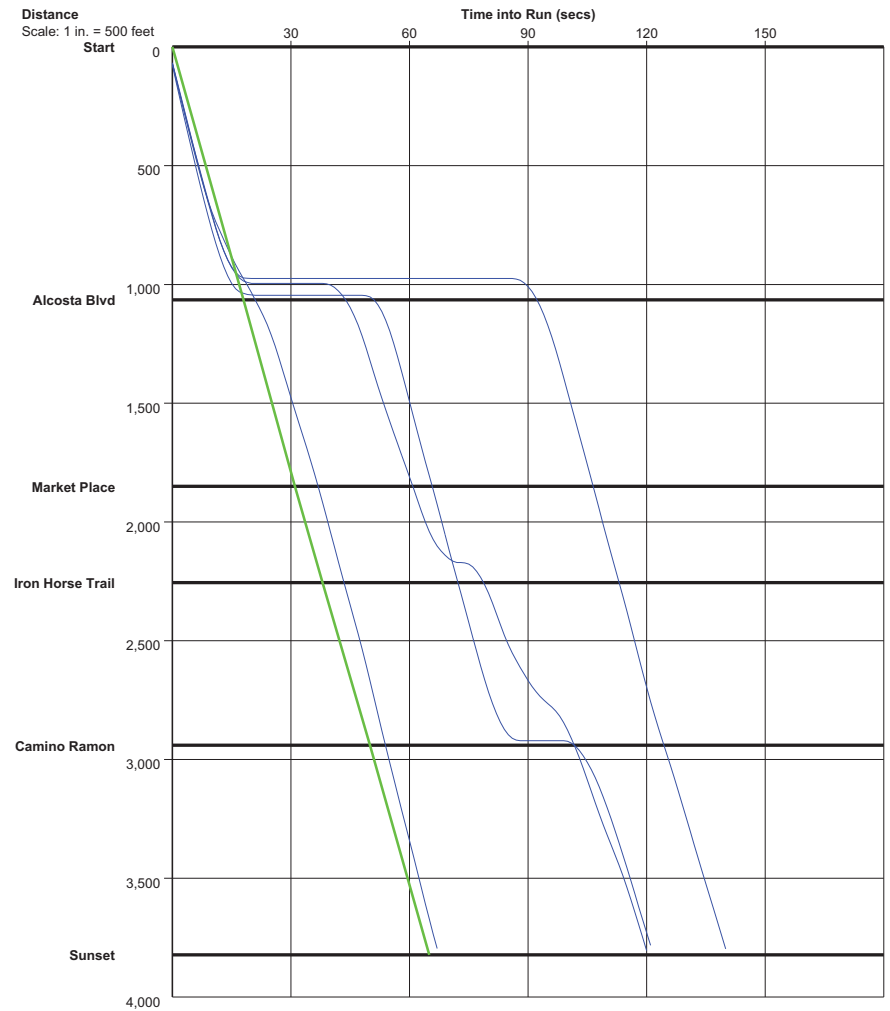


### Bollinger Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger - WB - AM OP D2**  
Study Date : 9/21/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

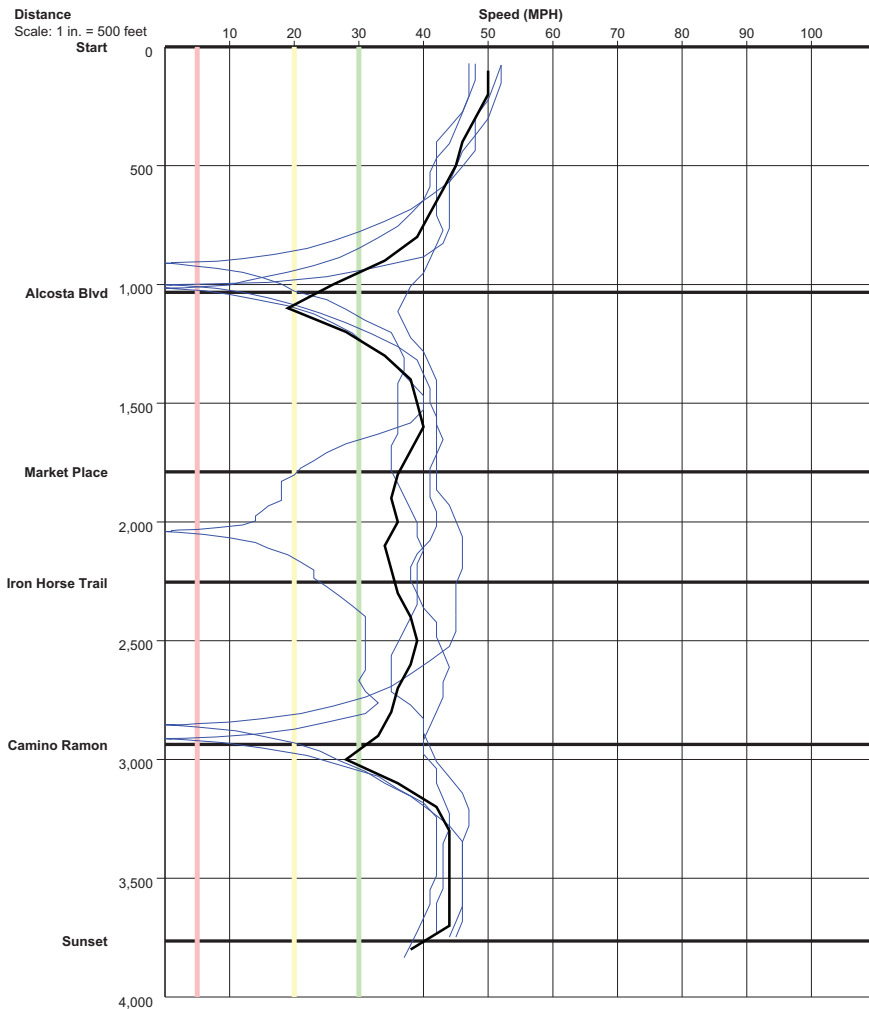


### Bollinger Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger - WB - AM OP D3**  
Study Date : 9/21/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

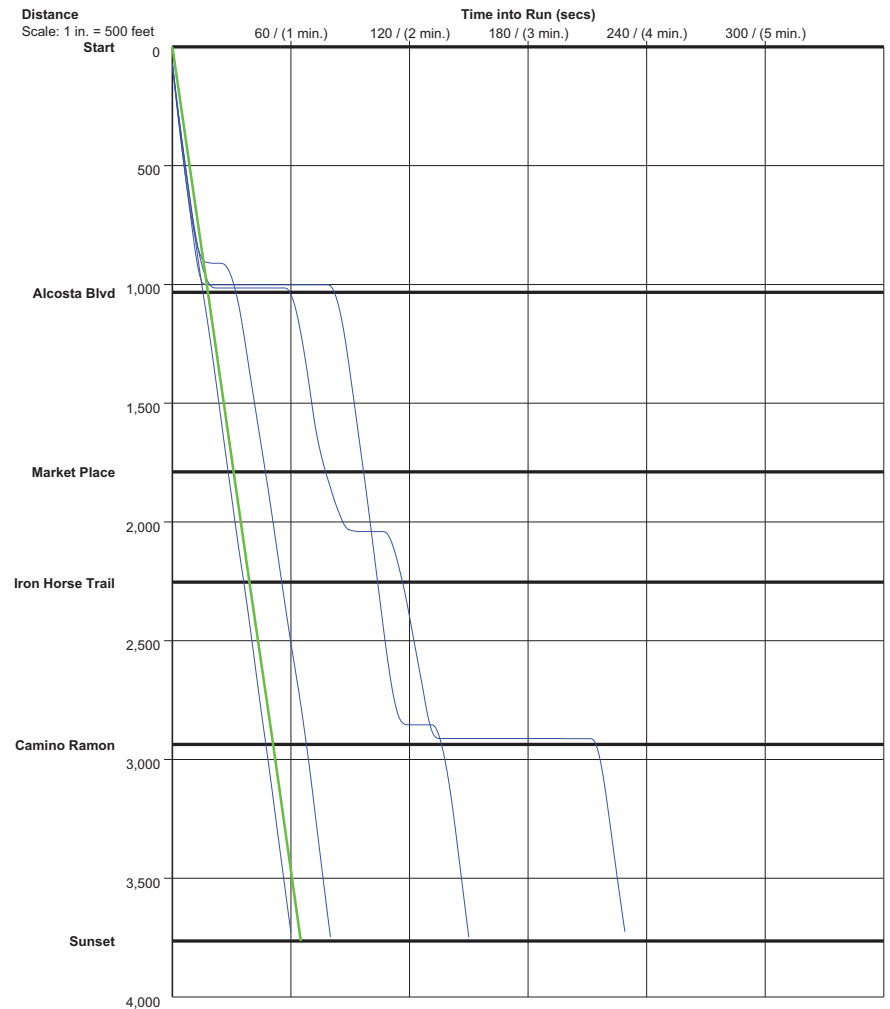


### Bollinger Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : **Bollinger - WB - AM OP D3**  
Study Date : 9/21/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



After Period  
Bollinger Canyon Road Westbound

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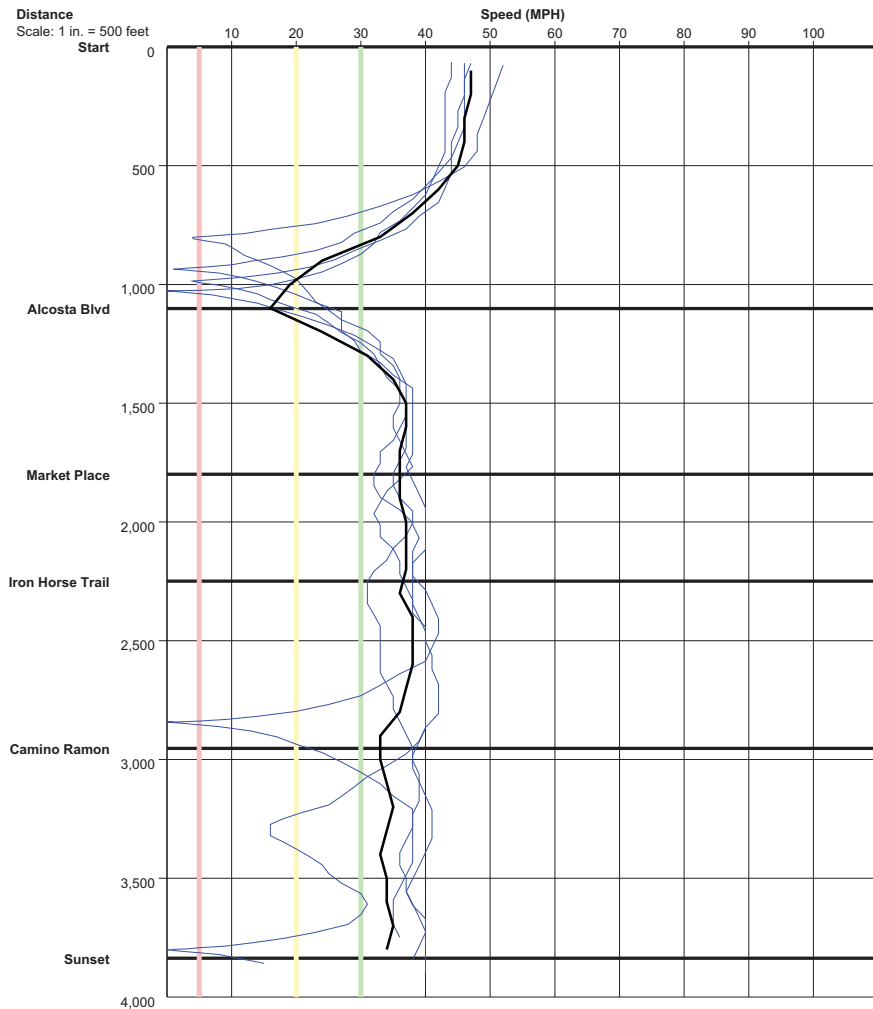
Midday Peak (11:30 AM to 1:30 PM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger - WB - MID D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

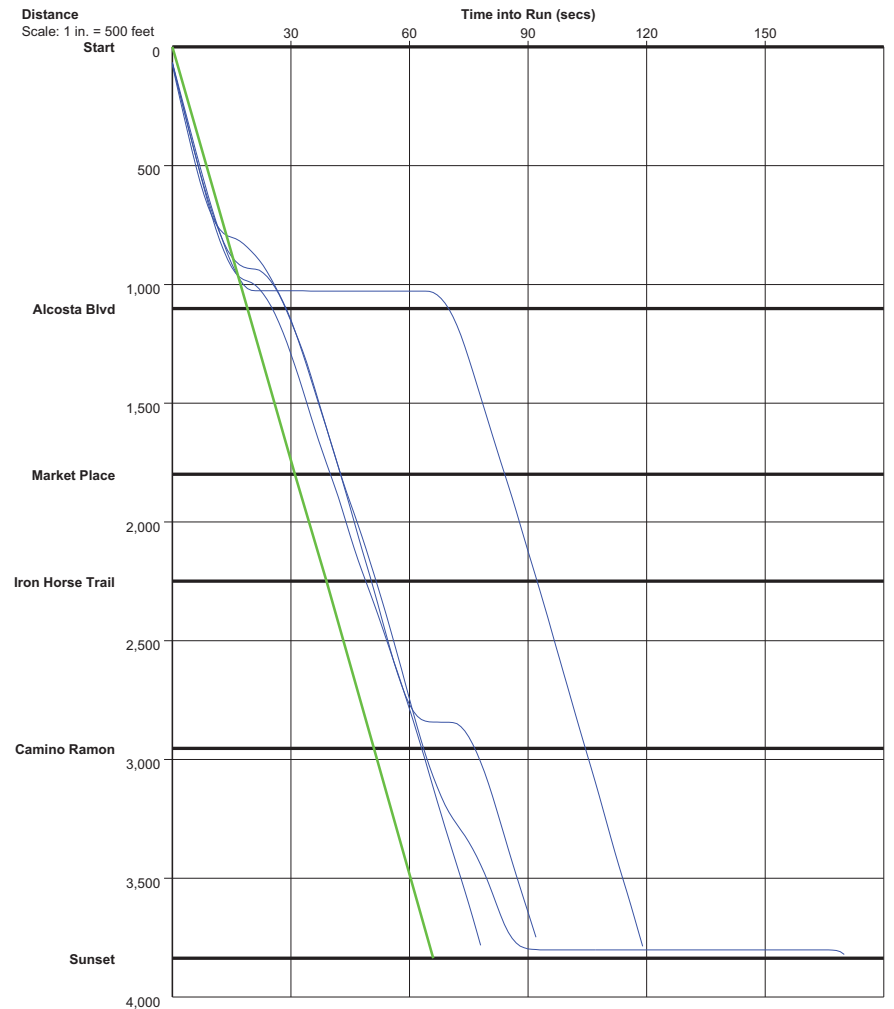


### Bollinger Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger - WB - MID D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

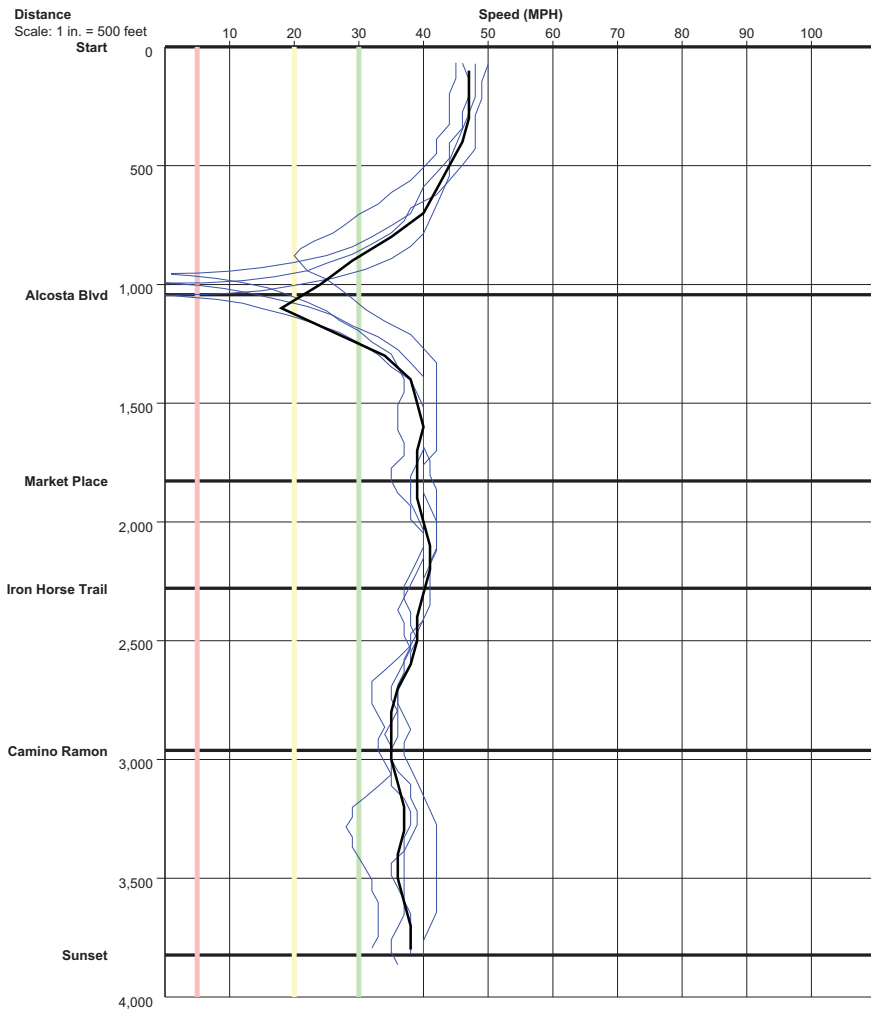


### Bollinger Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger - WB - MID D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

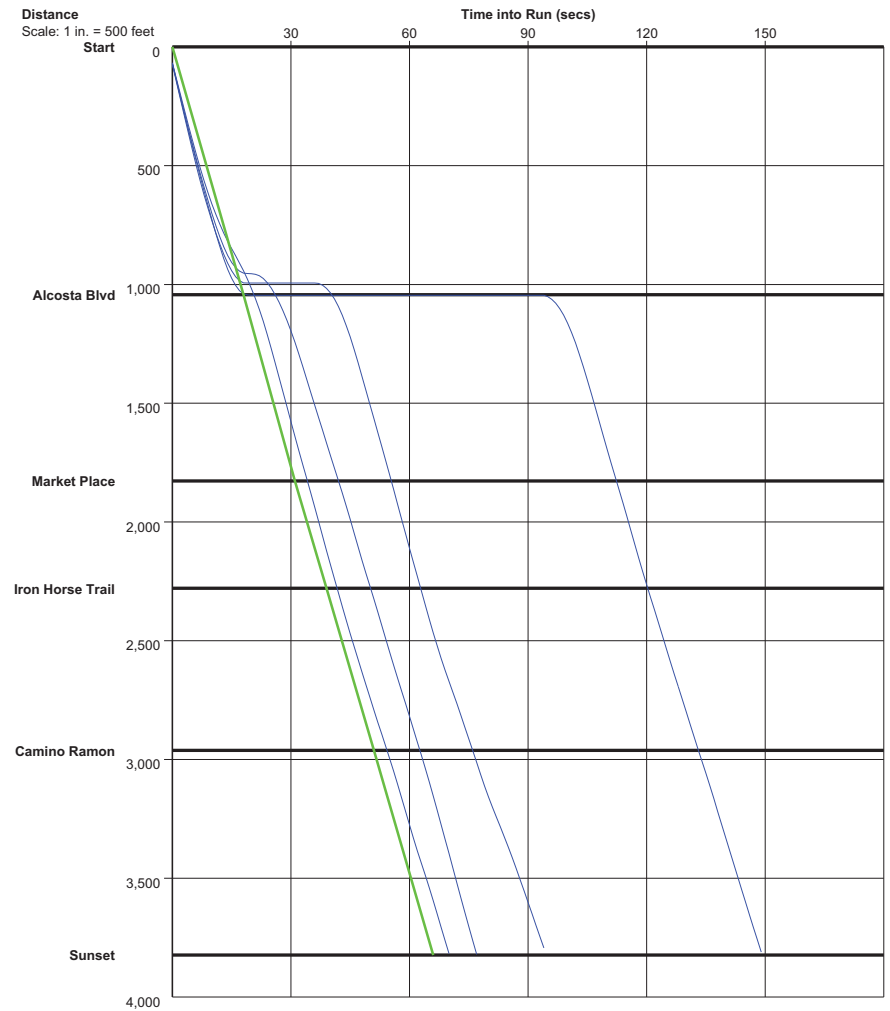


### Bollinger Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger - WB - MID D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

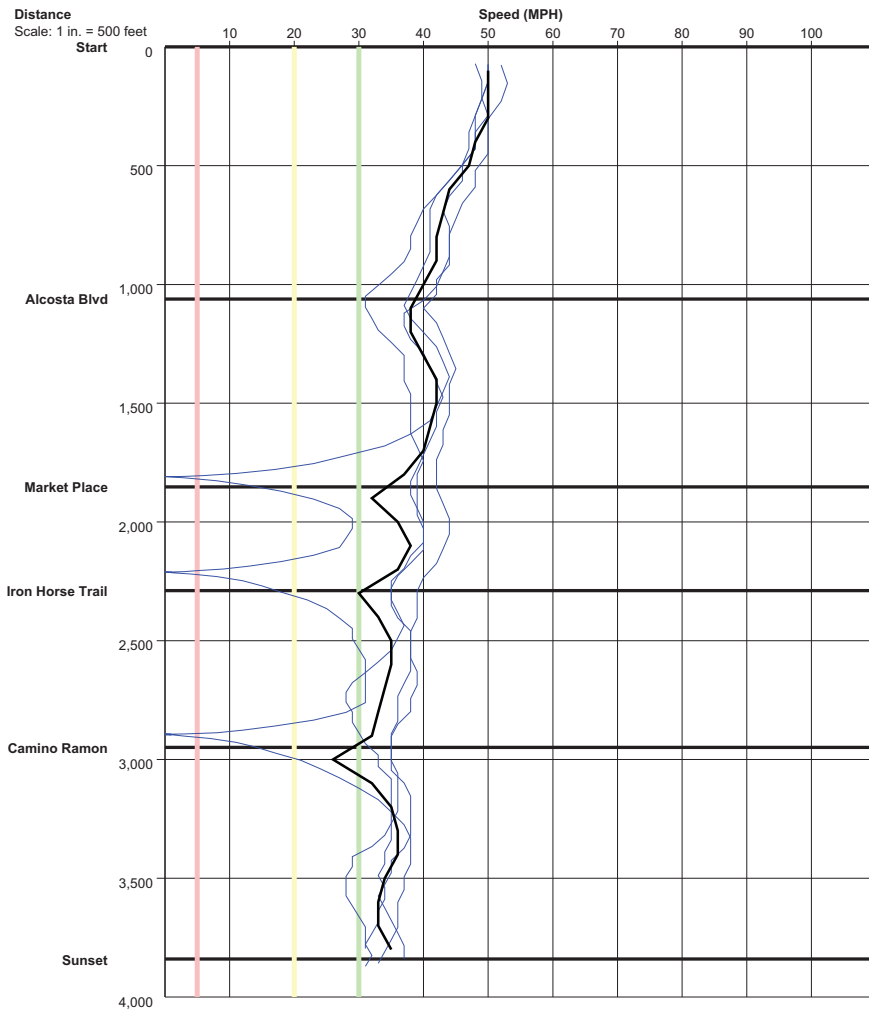


### Bollinger Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger - WB - MID D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

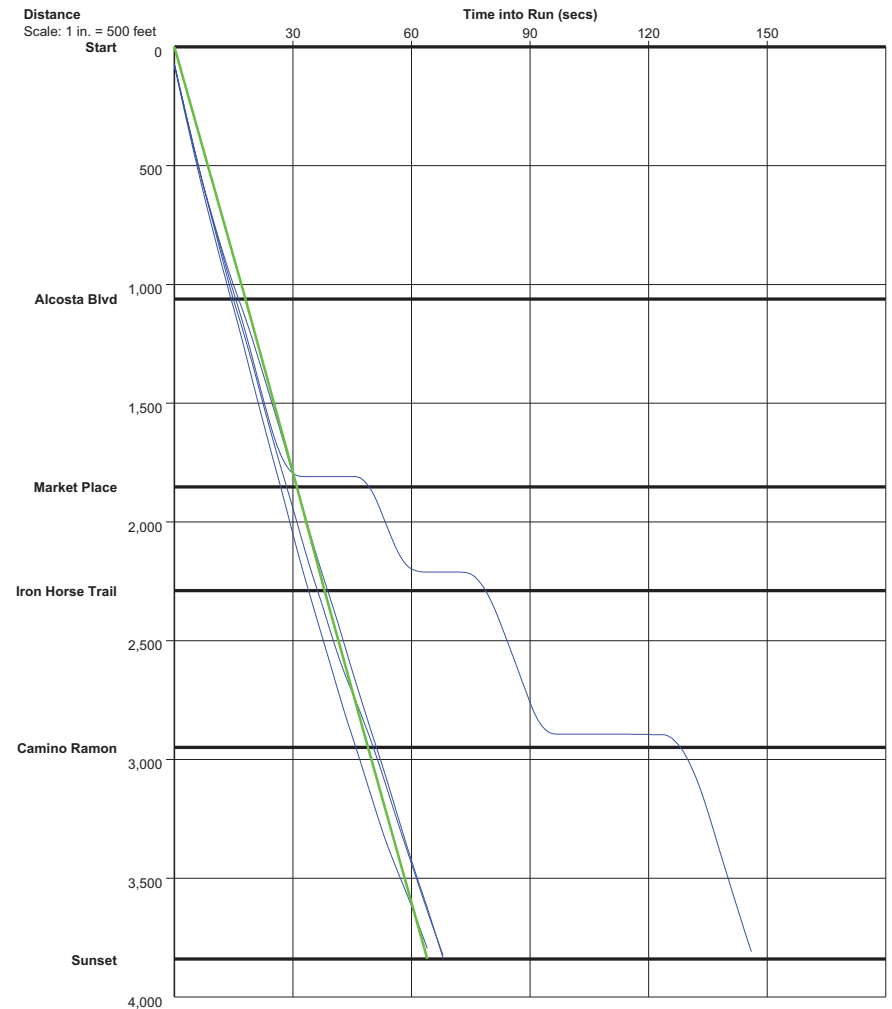


### Bollinger Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : **Bollinger - WB - MID D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



After Period  
Bollinger Canyon Road Westbound

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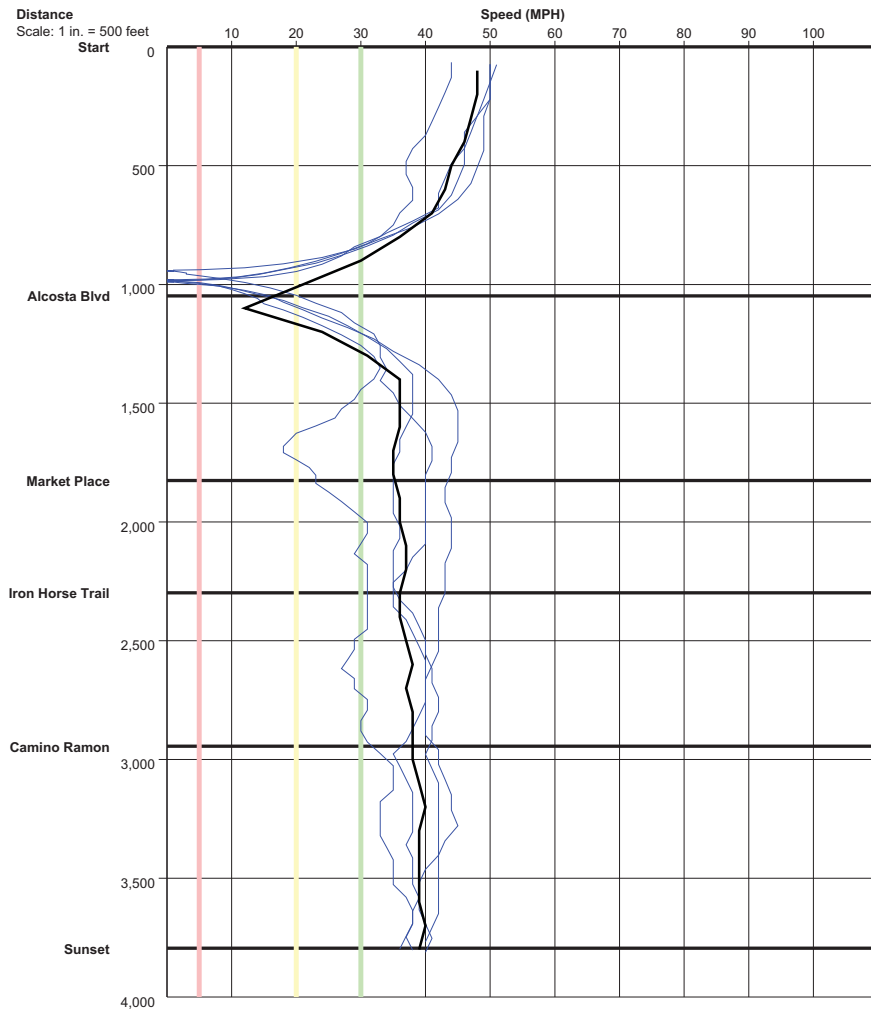
P.M. Peak (4:30 to 6:30 PM)

### Bollinger Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger - WB - PM D1**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

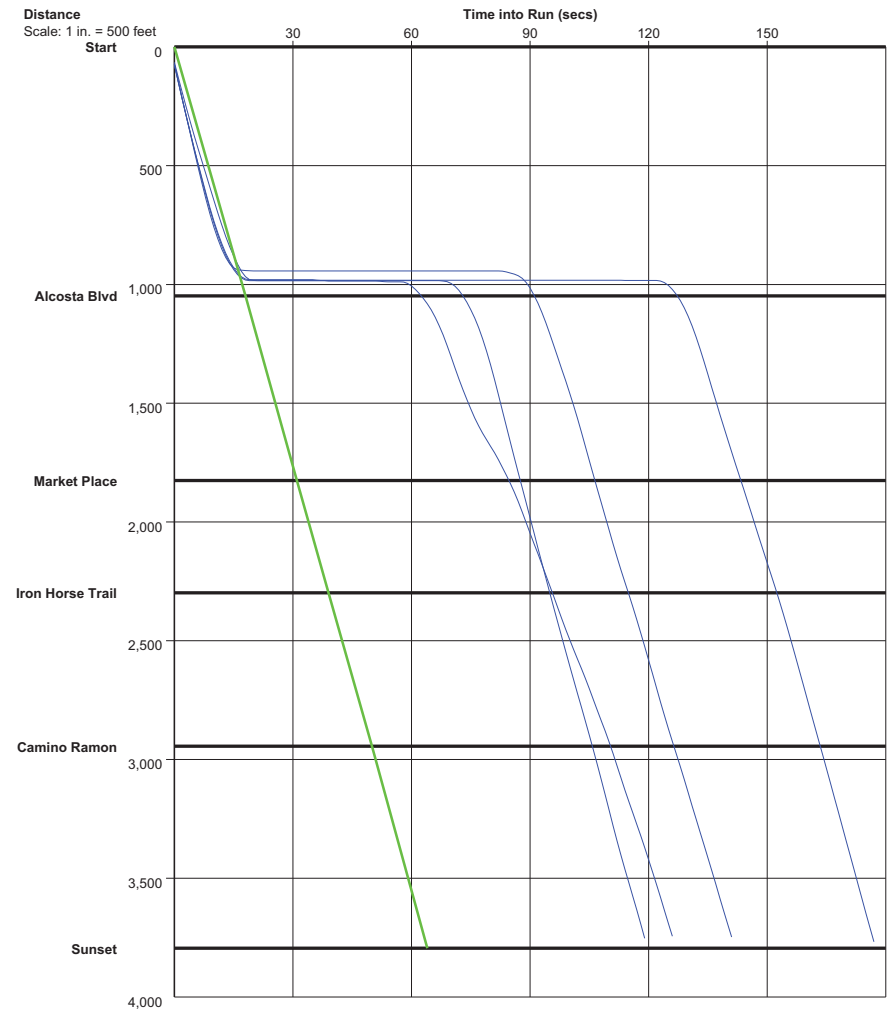


### Bollinger Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger - WB - PM D1**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

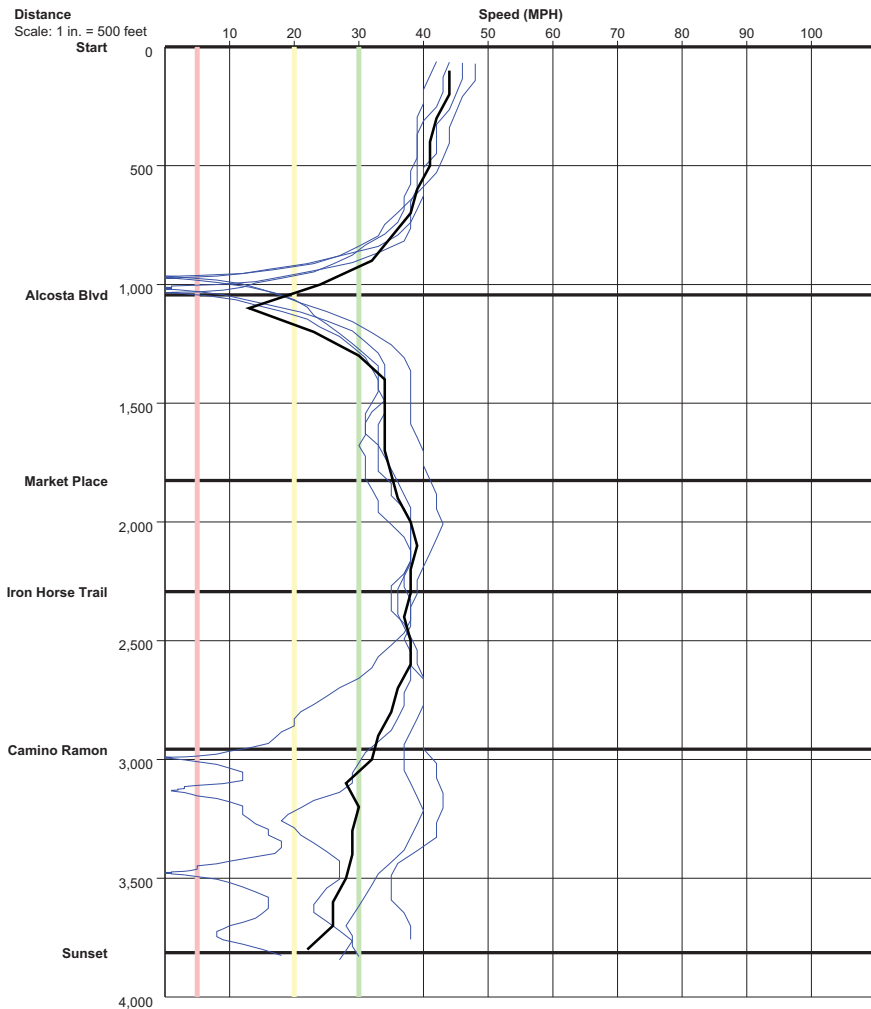


### Bollinger Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger - WB - PM D2**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

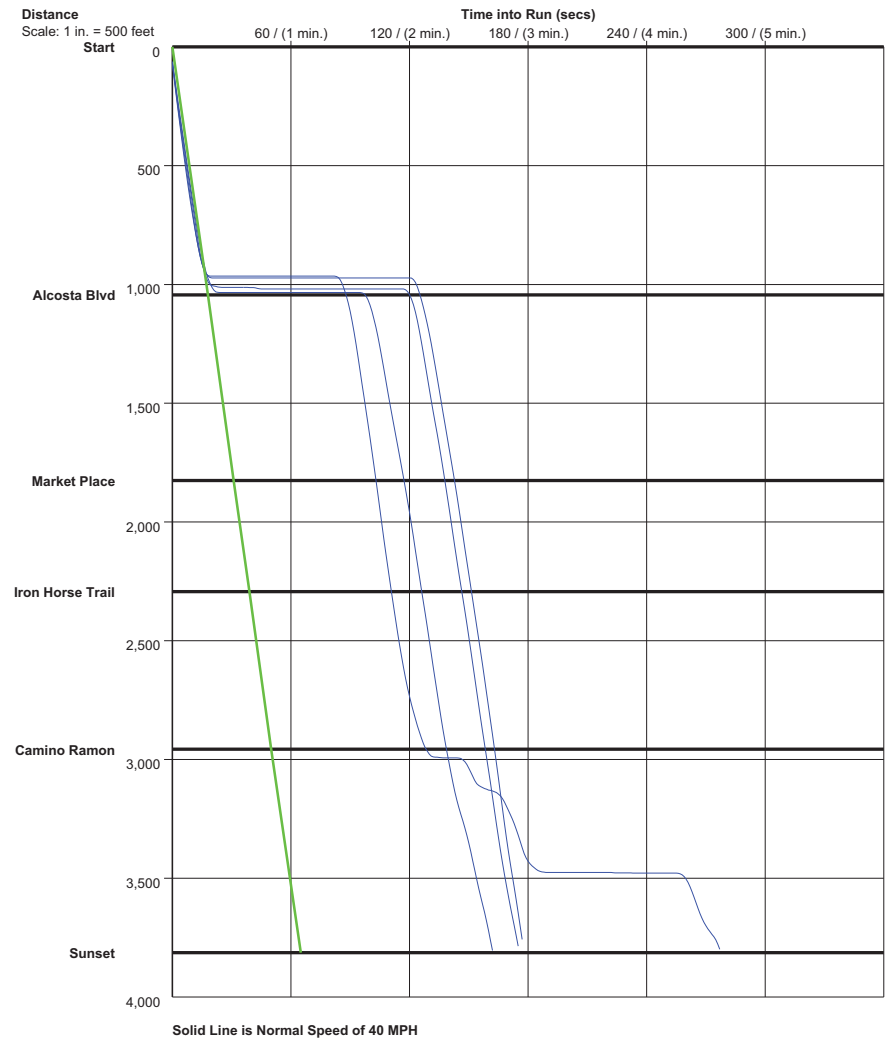


### Bollinger Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger - WB - PM D2**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

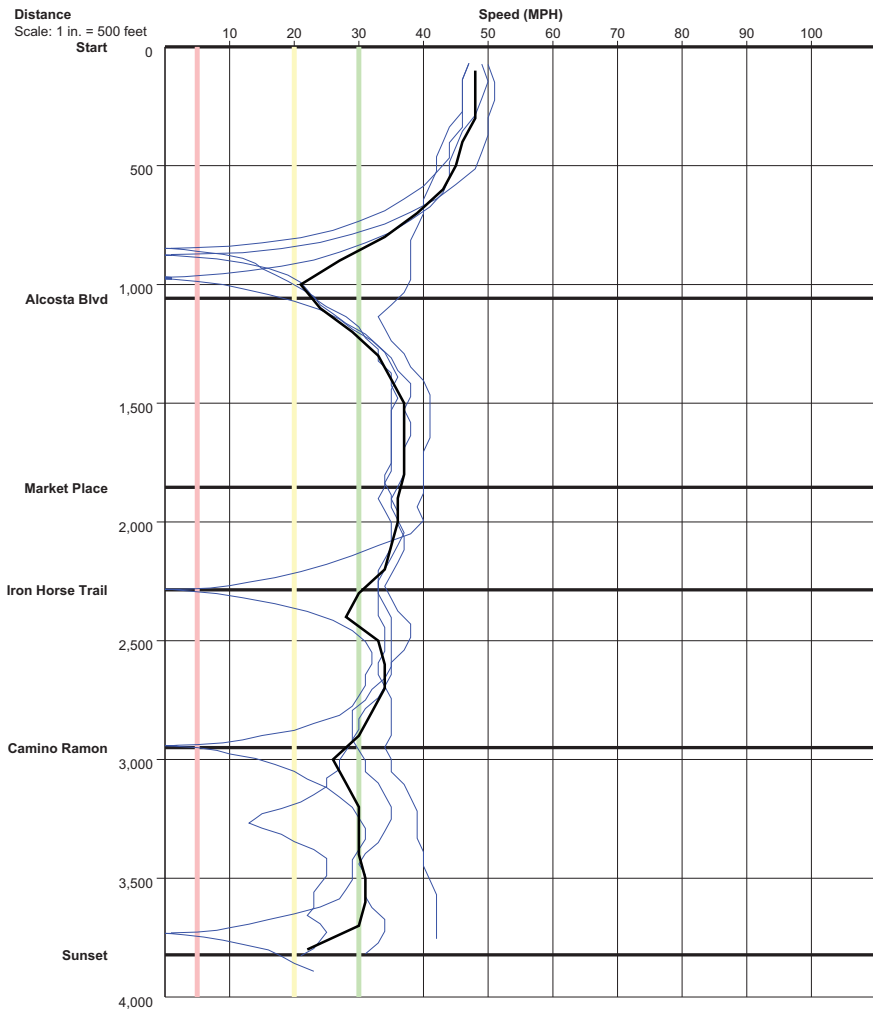


### Bollinger Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger - WB - PM D3**  
Study Date : **9/21/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

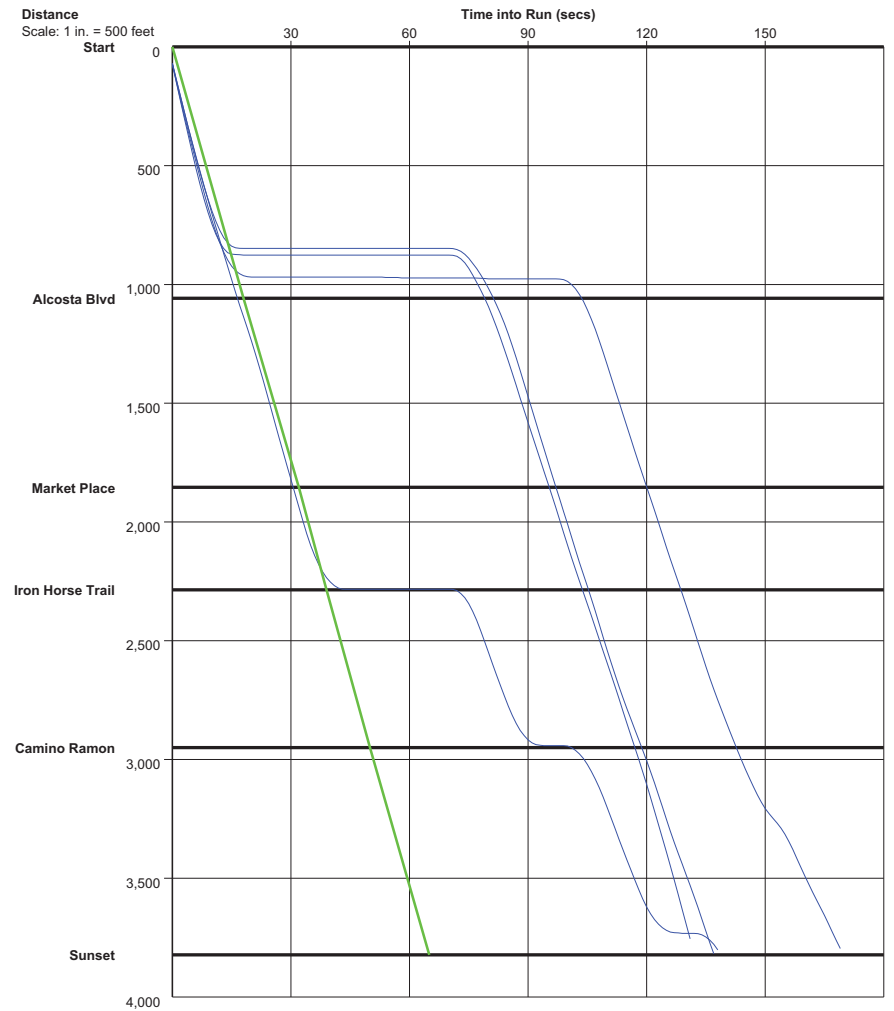


### Bollinger Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Bollinger - WB - PM D3**  
Study Date : **9/21/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



**Appendix A-7**  
After Period  
Crow Canyon Road Eastbound

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After Period  
Crow Canyon Road Eastbound

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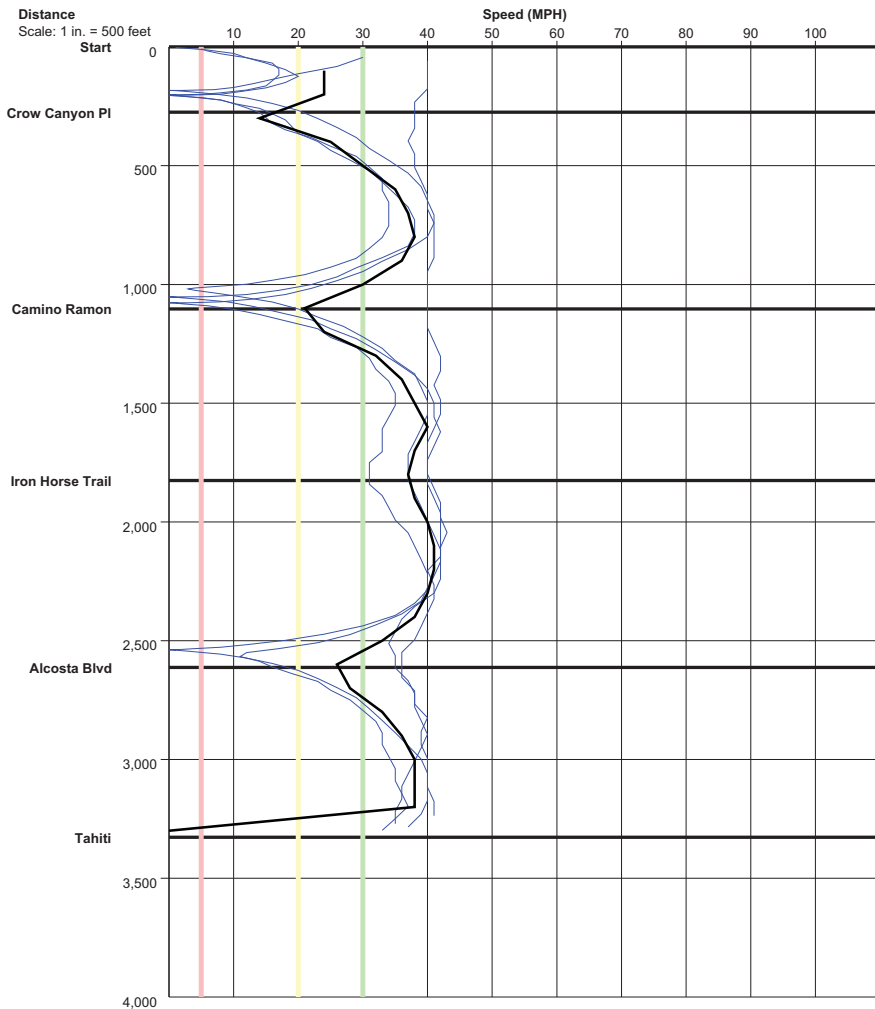
A.M. Peak (7:00 to 9:00 AM)

### Crow Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon - EB AM D1**  
Study Date : **9/22/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

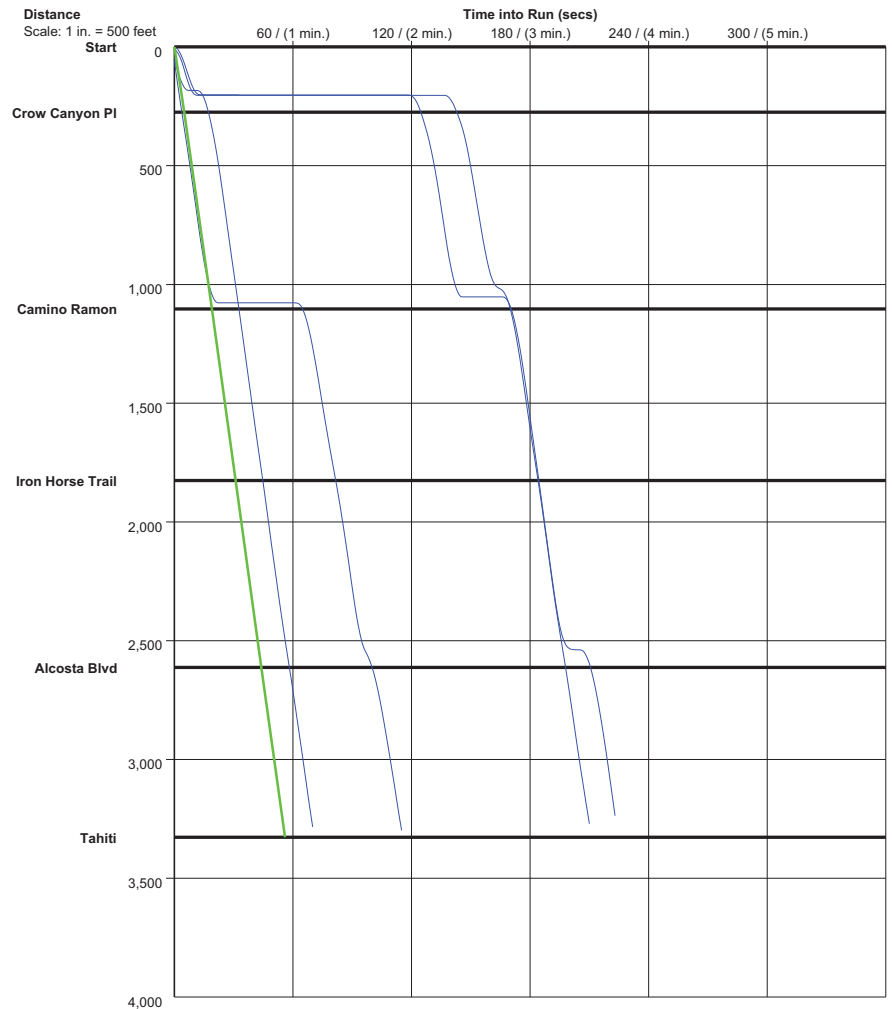


### Crow Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon - EB AM D1**  
Study Date : **9/22/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



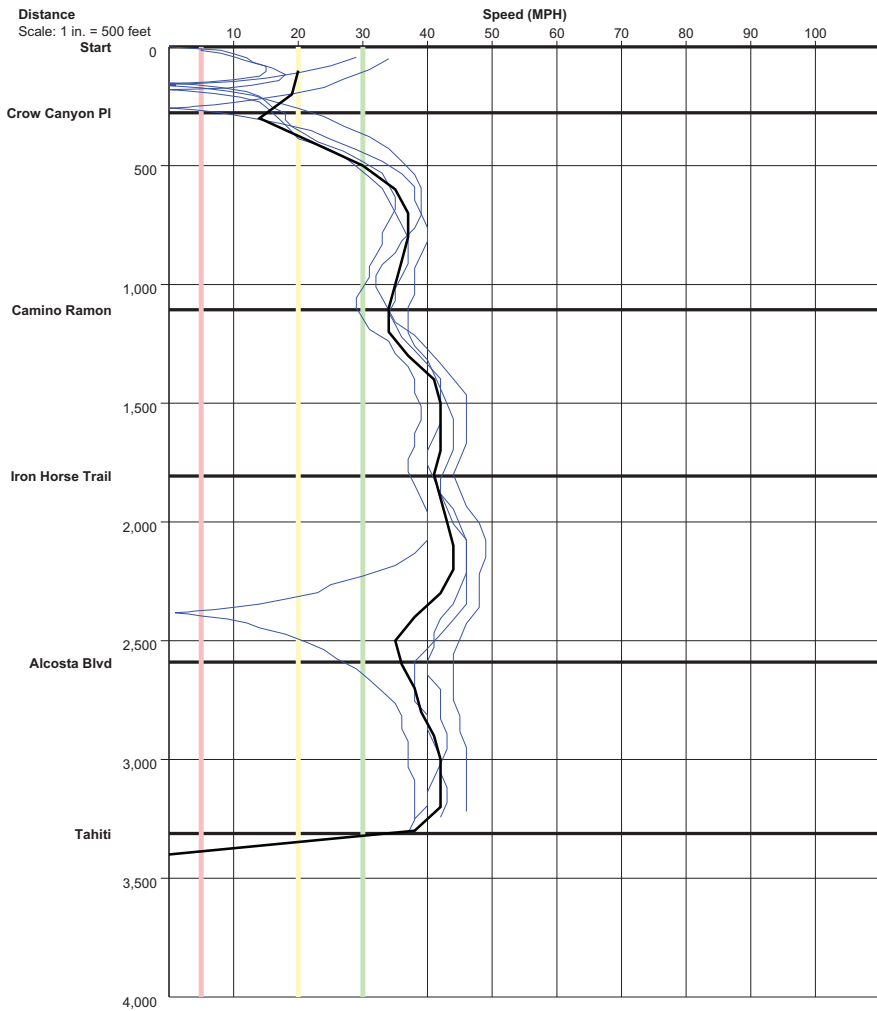
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon - EB AM D2**  
Study Date : **9/22/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

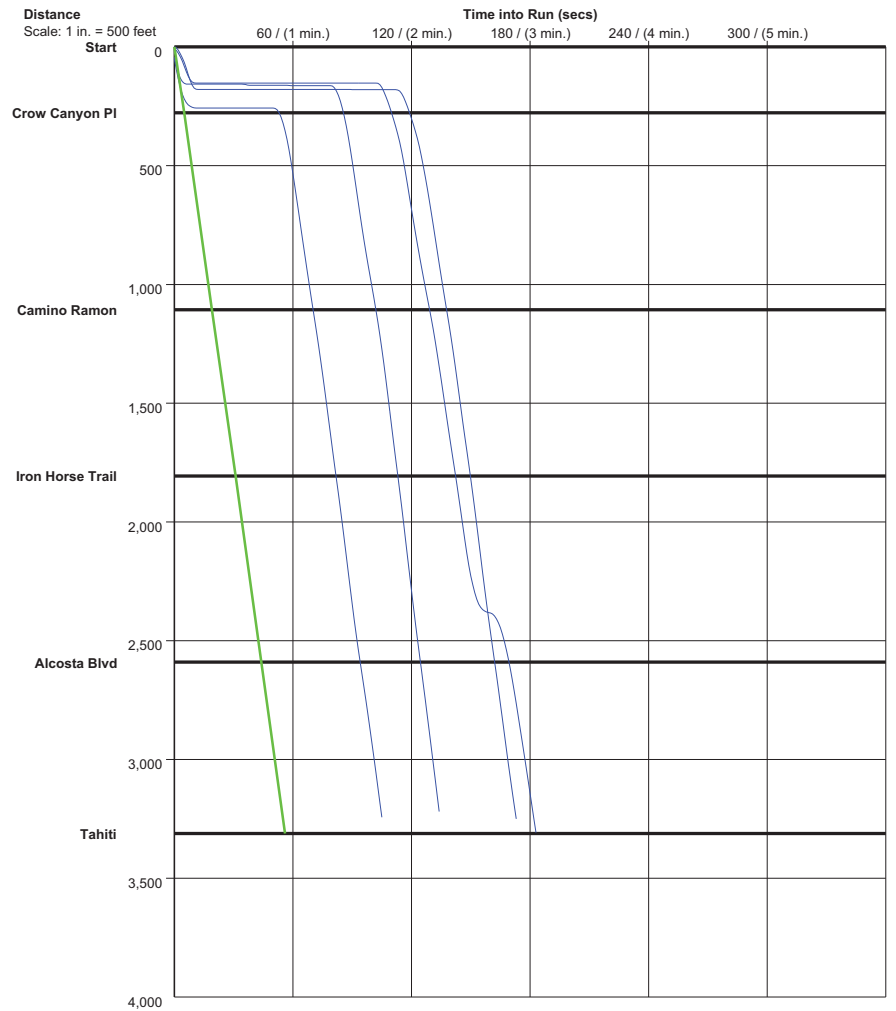


### Crow Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon - EB AM D2**  
Study Date : **9/22/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

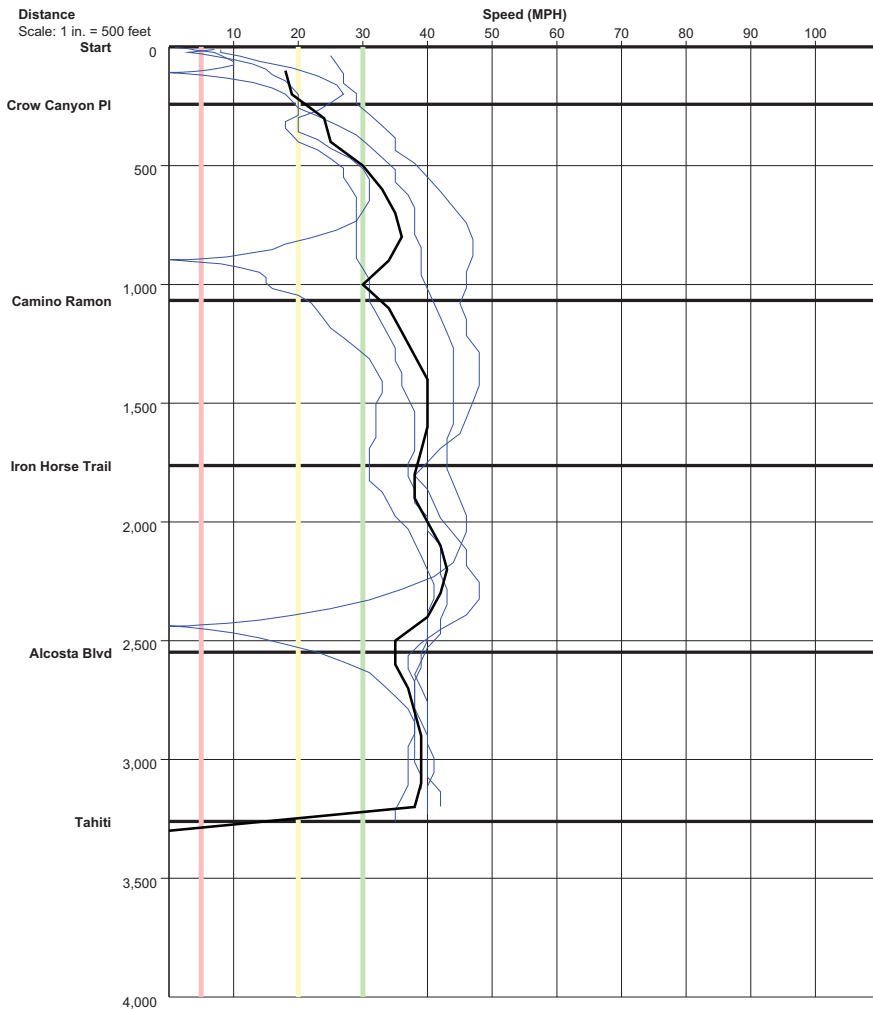


### Crow Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon - EB AM D3**  
Study Date : **9/22/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

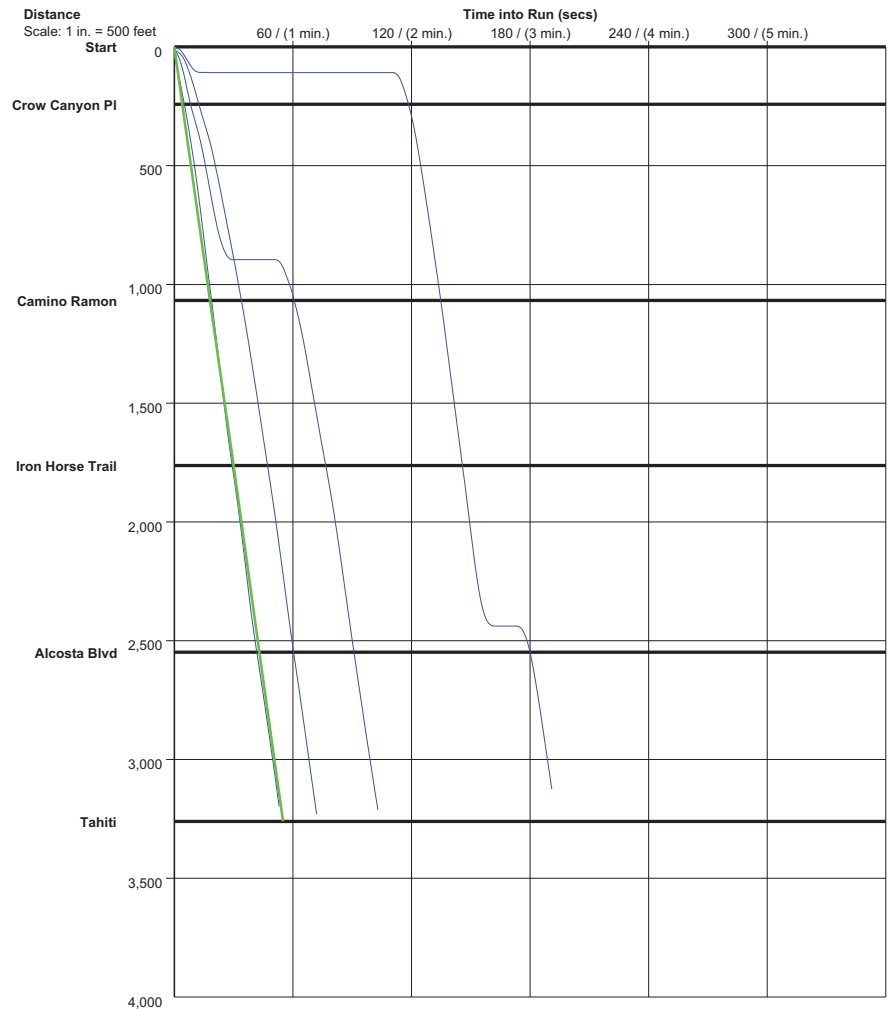


### Crow Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Eastbound

Study Name : **Crow Canyon - EB AM D3**  
Study Date : **9/22/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



Solid Line is Normal Speed of 40 MPH

After Period  
Crow Canyon Road Eastbound

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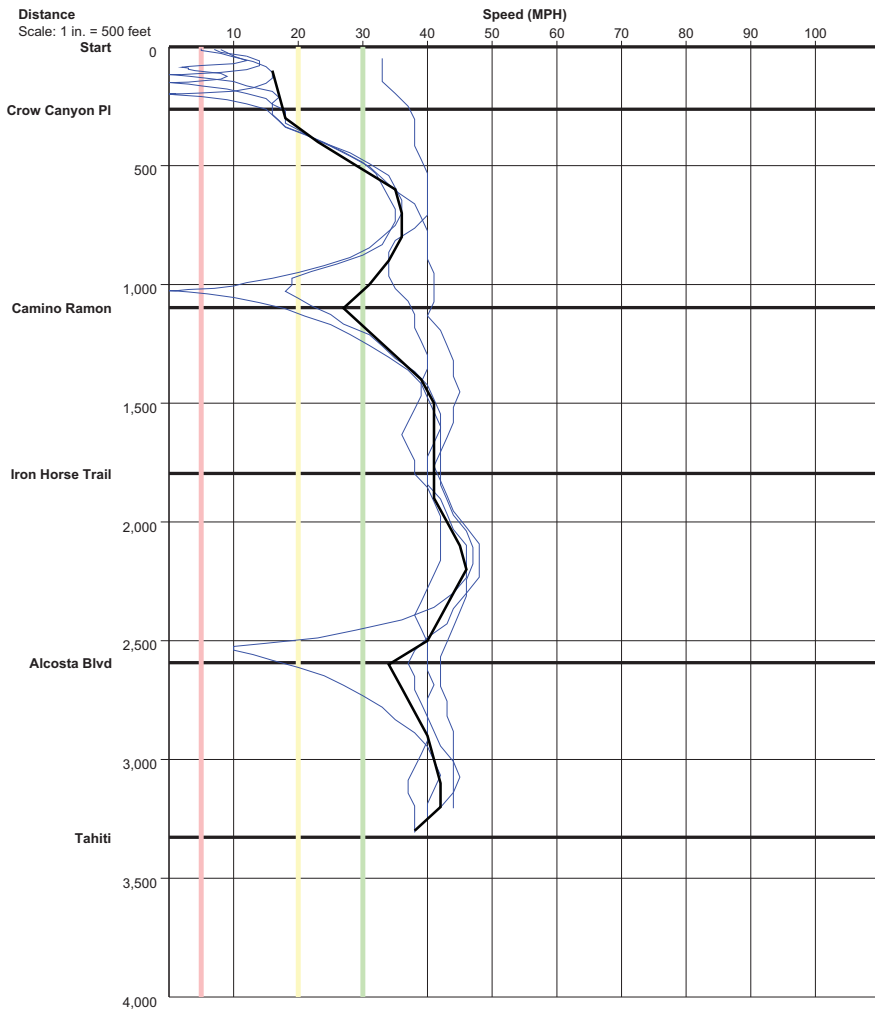
A.M. Off-Peak (9:00 to 11:00 AM)

### Crow Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : Crow Canyon - EB AM OP D1  
Study Date : 9/22/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

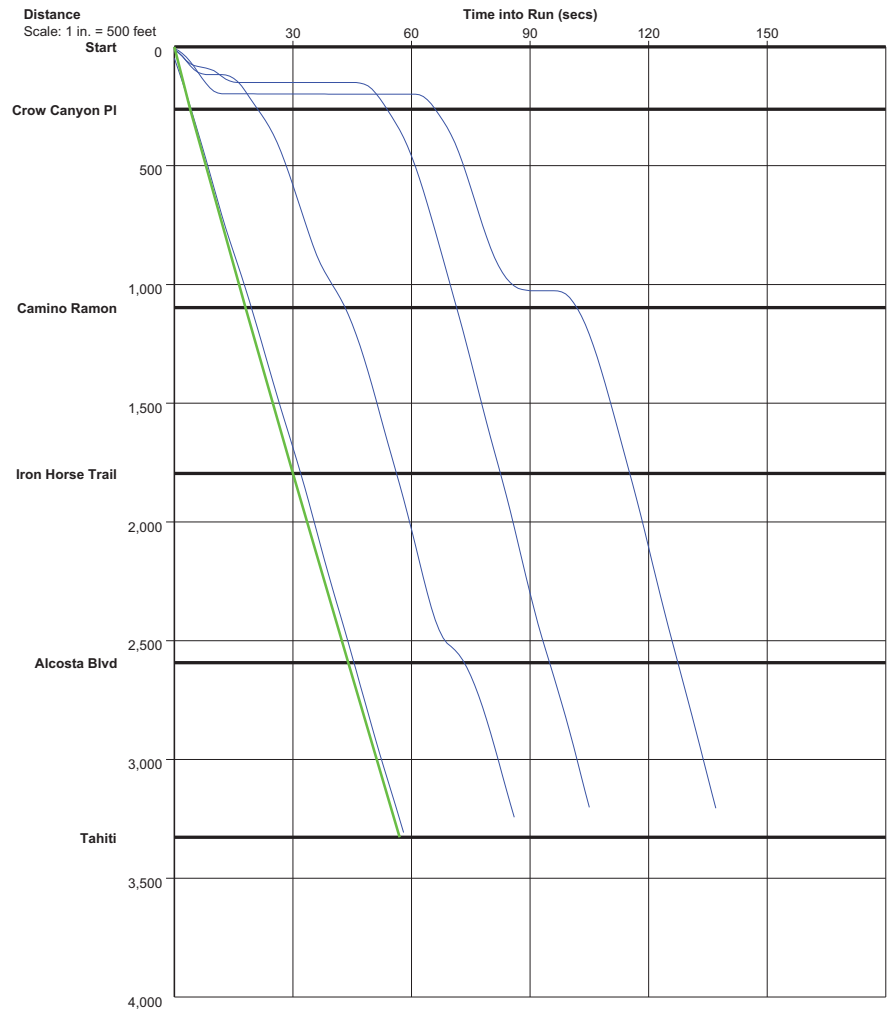


### Crow Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : Crow Canyon - EB AM OP D1  
Study Date : 9/22/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

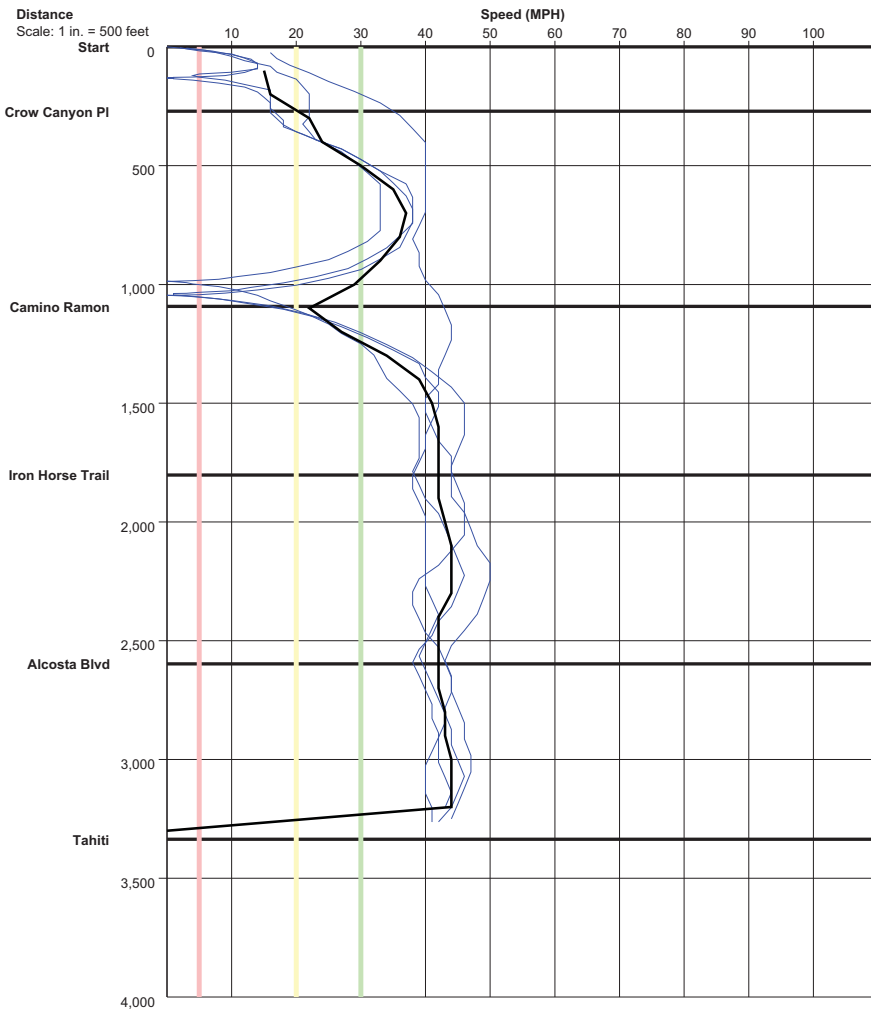


### Crow Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : Crow Canyon - EB AM OP D2  
Study Date : 9/22/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

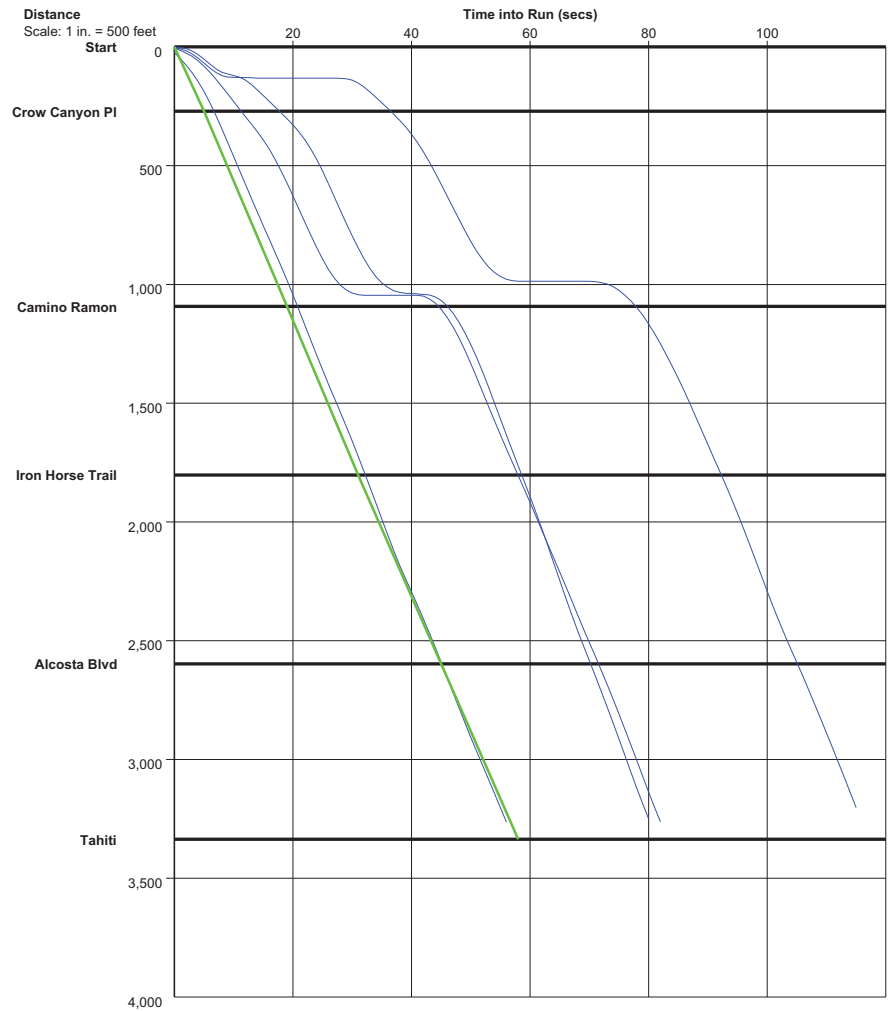


### Crow Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : Crow Canyon - EB AM OP D2  
Study Date : 9/22/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

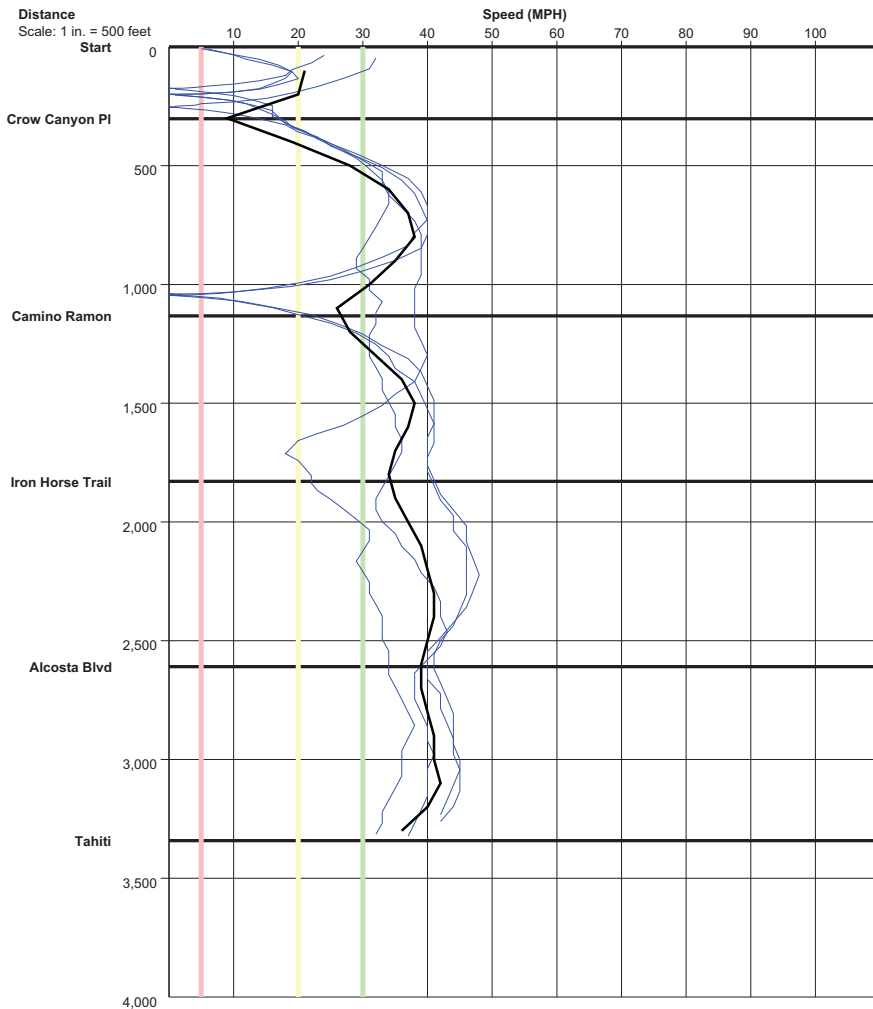


### Crow Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : Crow Canyon - EB AM OP D3  
Study Date : 9/22/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

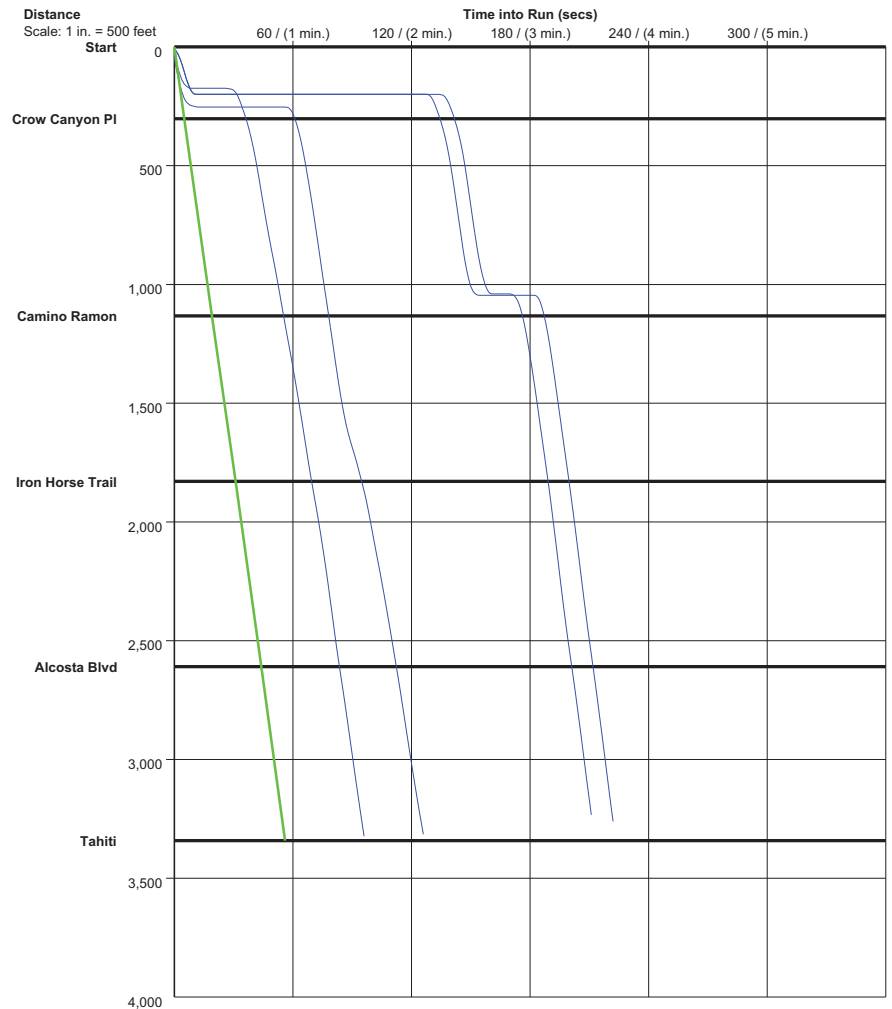


### Crow Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Eastbound

Study Name : Crow Canyon - EB AM OP D3  
Study Date : 9/22/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



After Period  
Crow Canyon Road Eastbound

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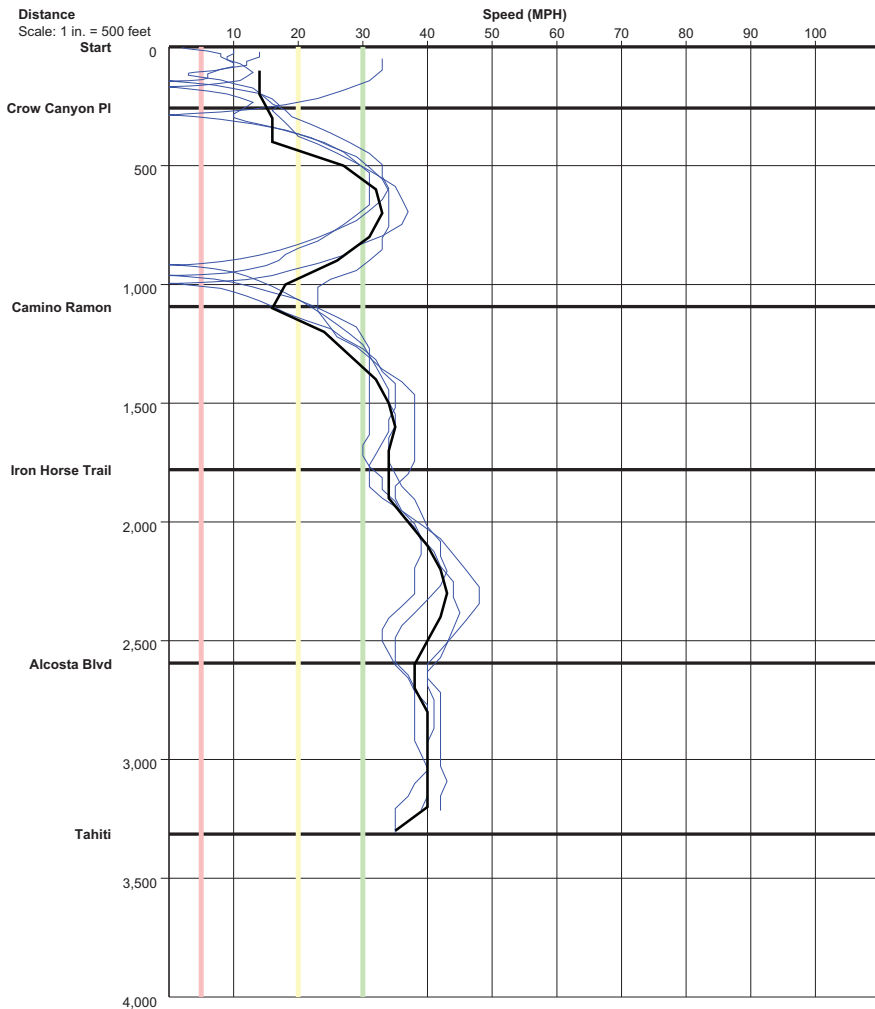
Midday Peak (11:30 AM to 1:30 PM)

### Crow Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon - EB MID D1  
Study Date : 9/22/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

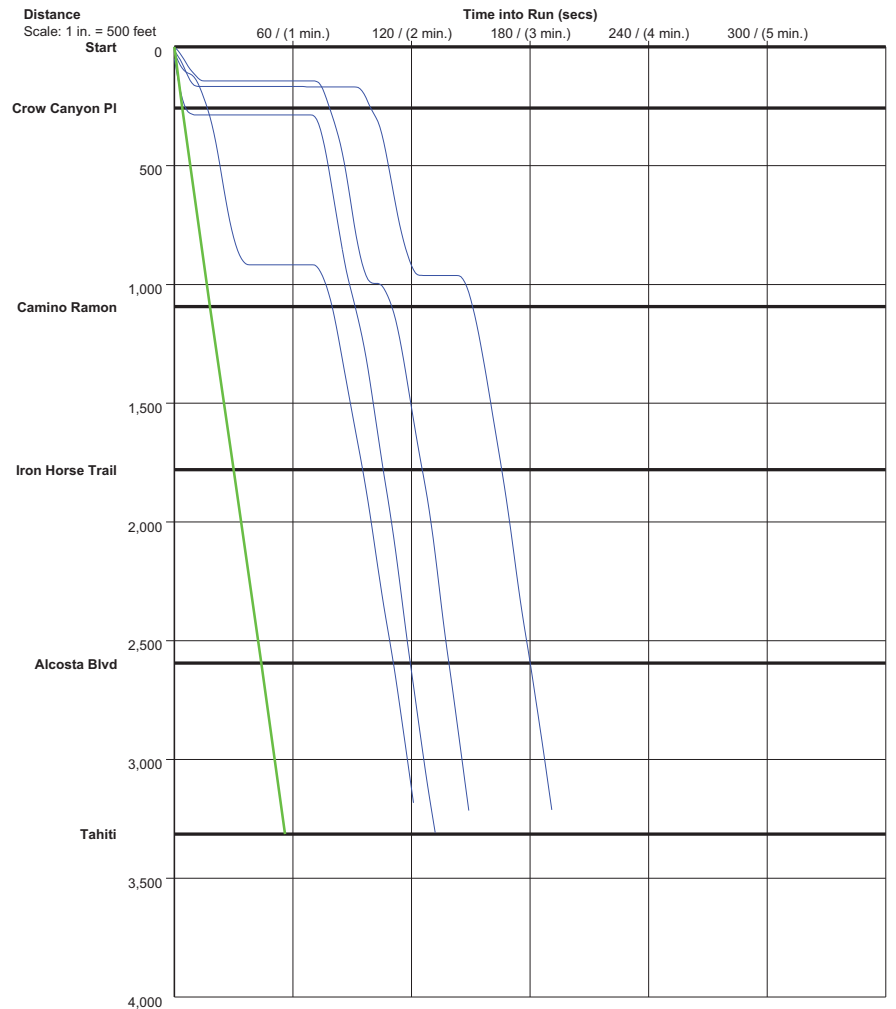


### Crow Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon - EB MID D1  
Study Date : 9/22/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



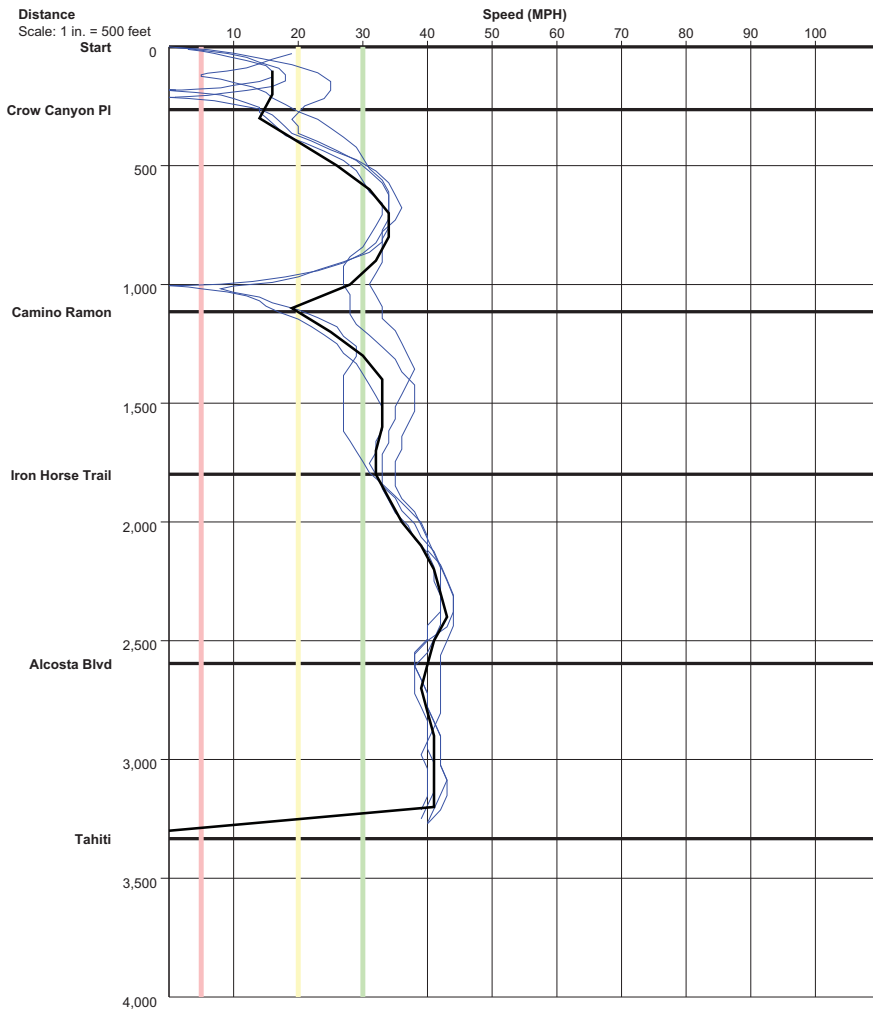
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon - EB MID D2  
Study Date : 9/22/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

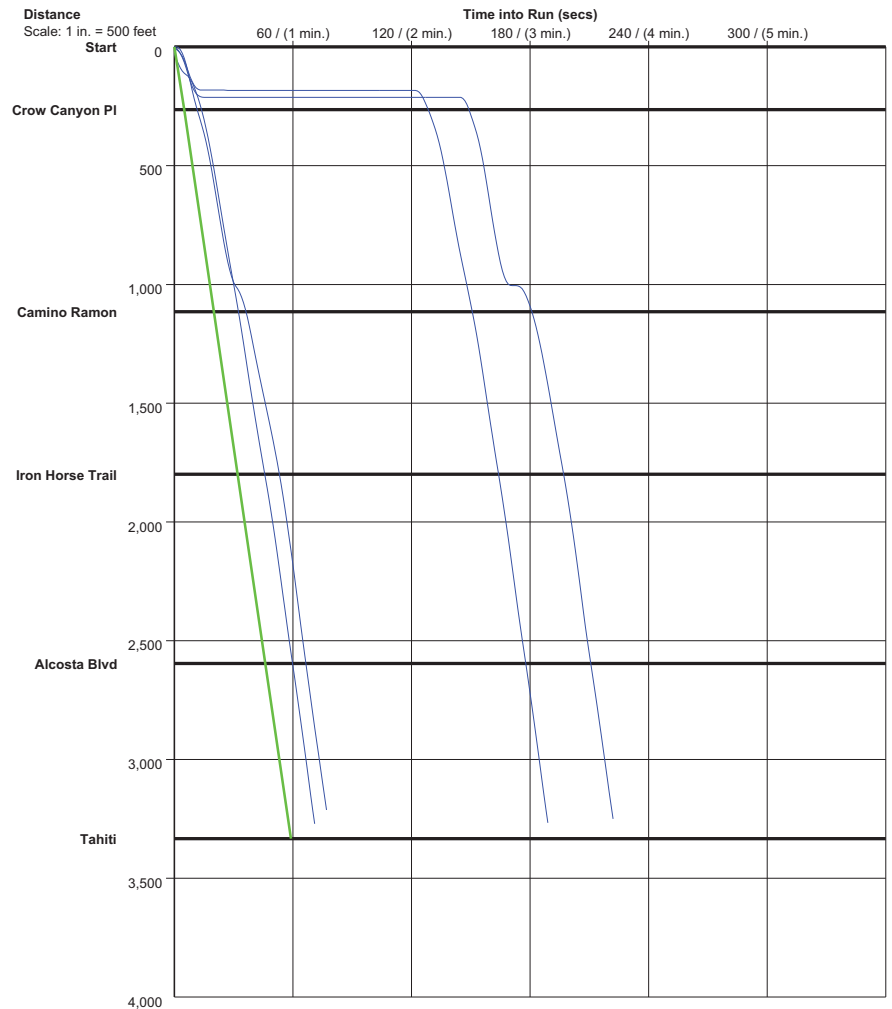


### Crow Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon - EB MID D2  
Study Date : 9/22/2010  
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#### Time/Space Trajectories of All Runs

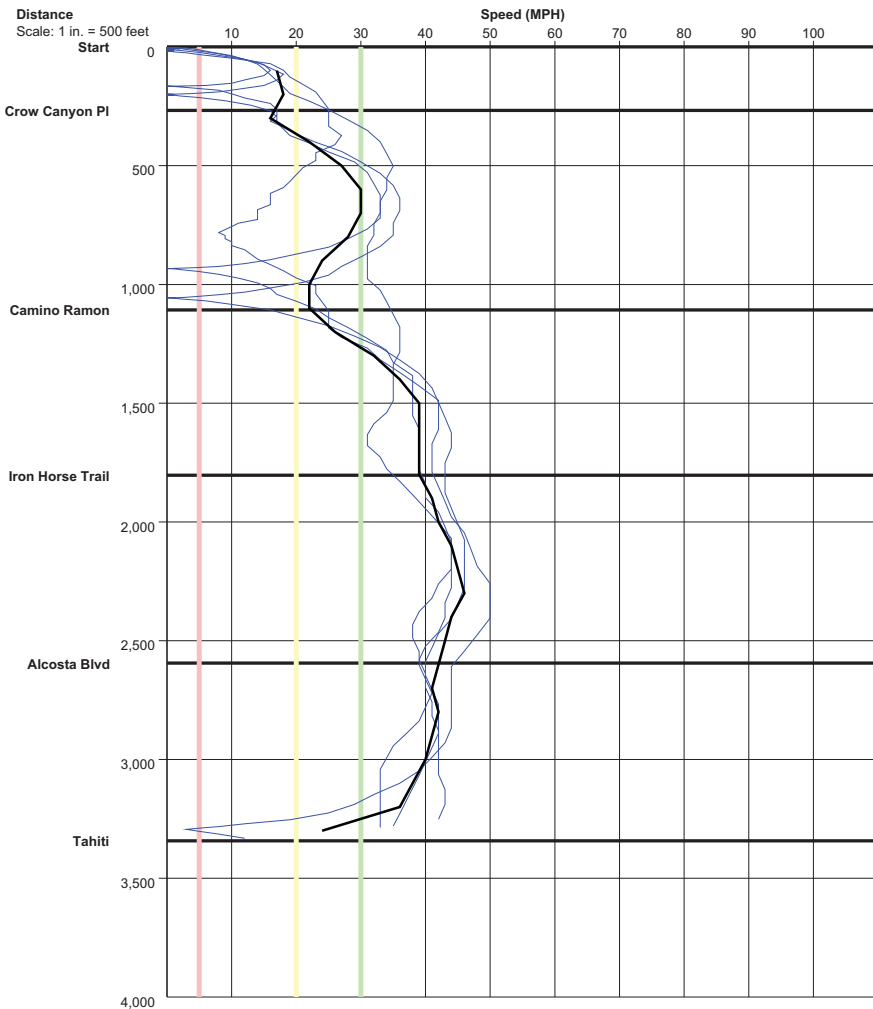


### Crow Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon - EB MID D3  
Study Date : 9/22/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

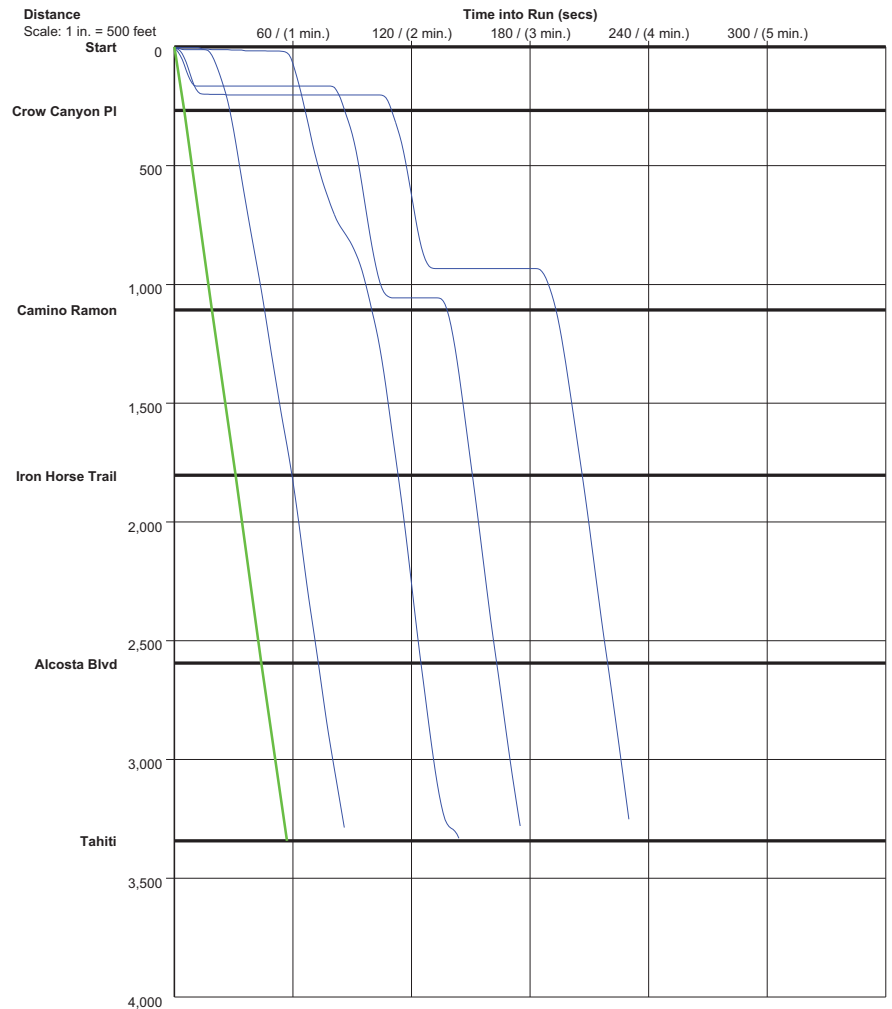


### Crow Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Eastbound

Study Name : Crow Canyon - EB MID D3  
Study Date : 9/22/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



After Period  
Crow Canyon Road Eastbound

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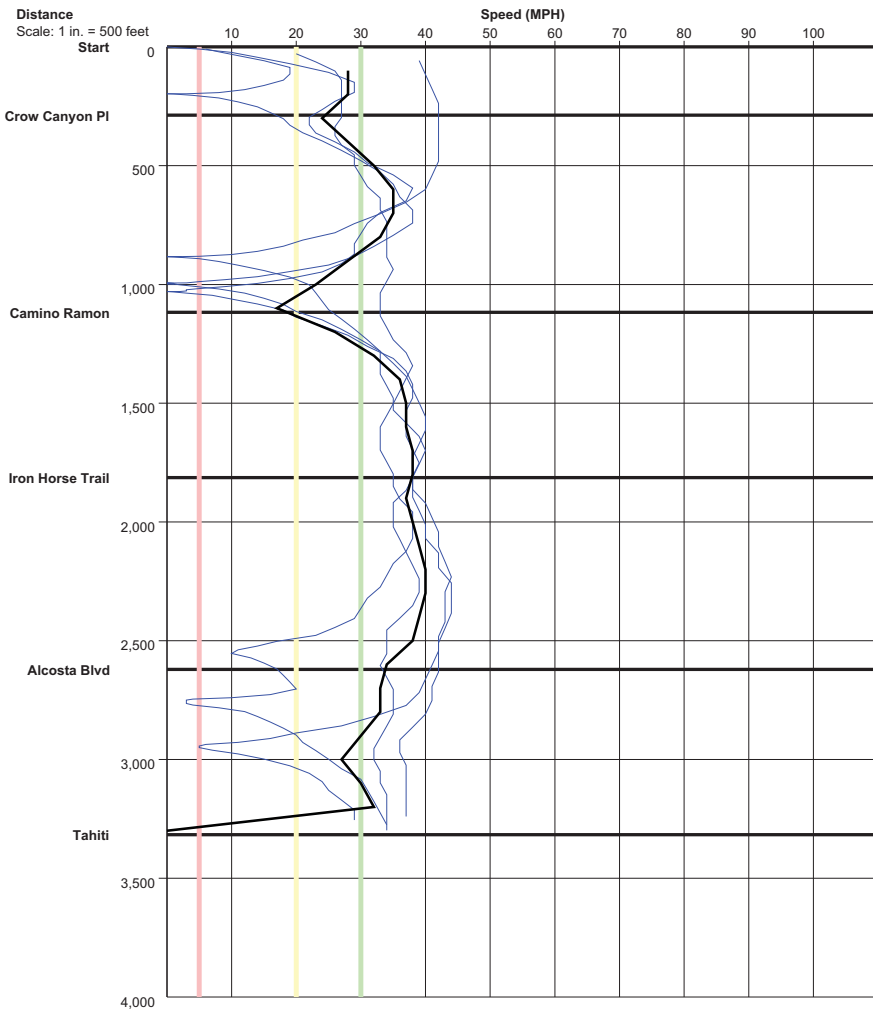
P.M. Peak (4:30 to 6:30 PM)

### Crow Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Crow Canyon - EB PM D1**  
Study Date : **9/22/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

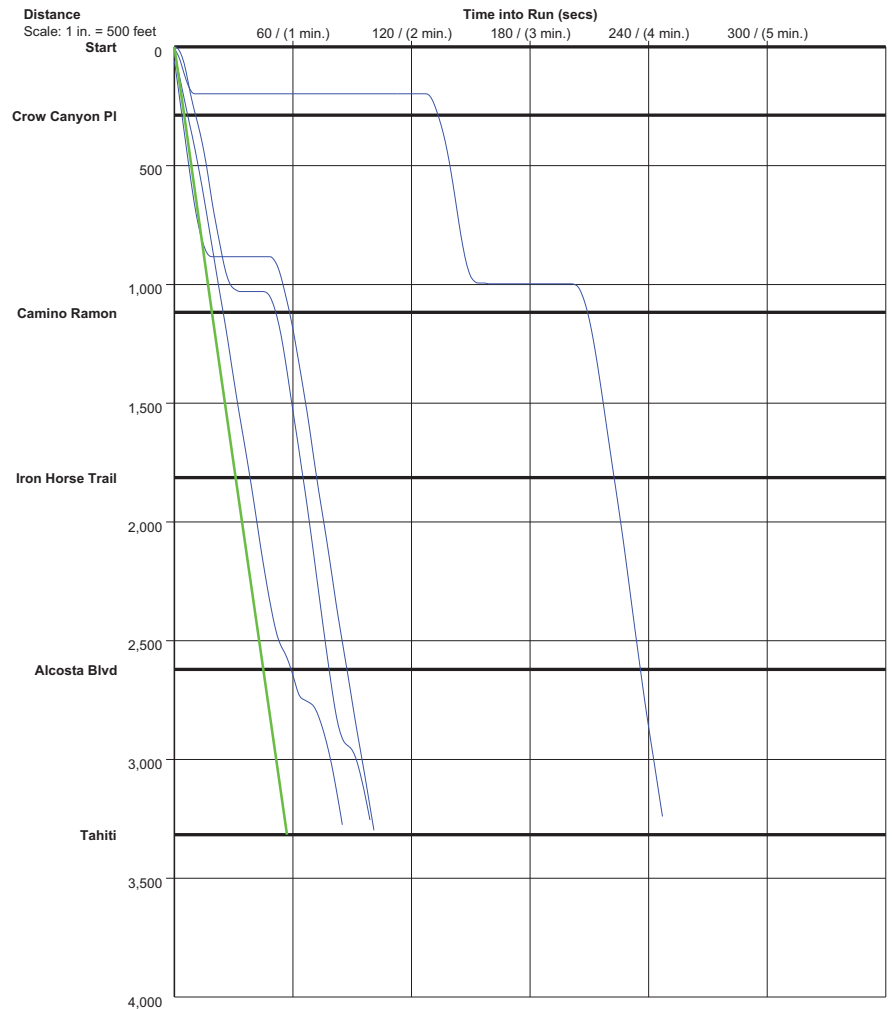


### Crow Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Crow Canyon - EB PM D1**  
Study Date : **9/22/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



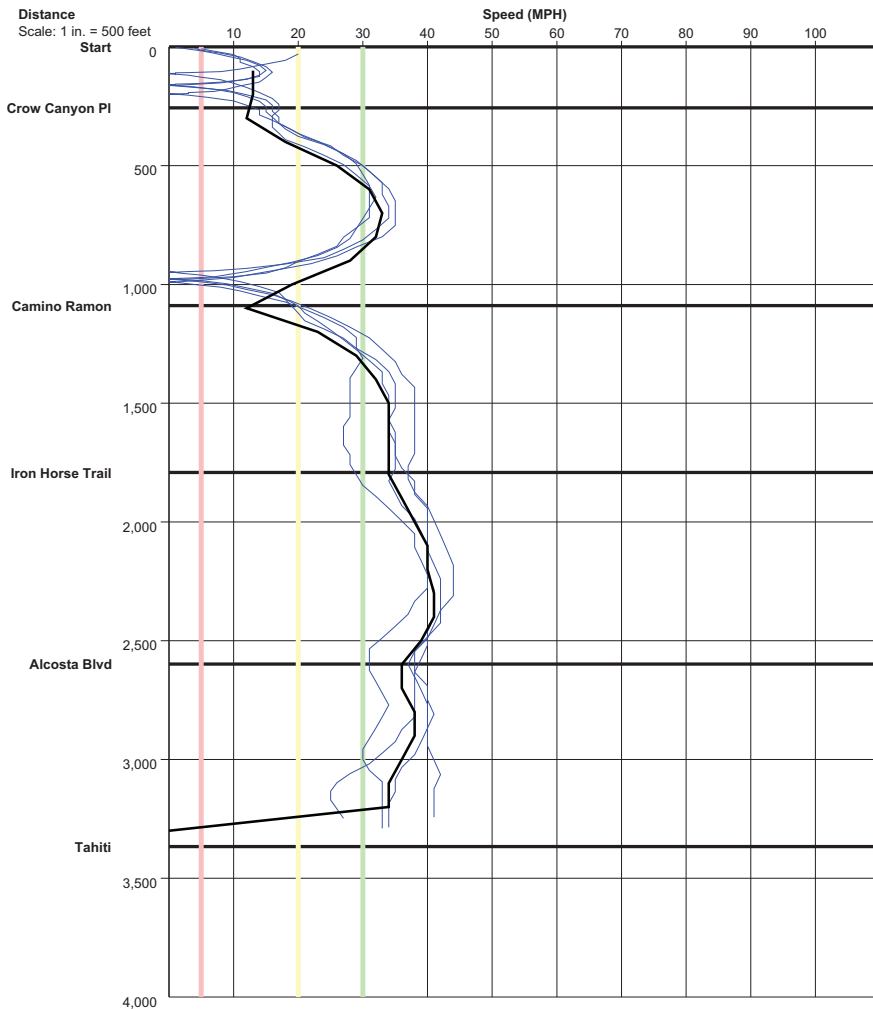
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Crow Canyon - EB PM D2**  
Study Date : **9/22/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

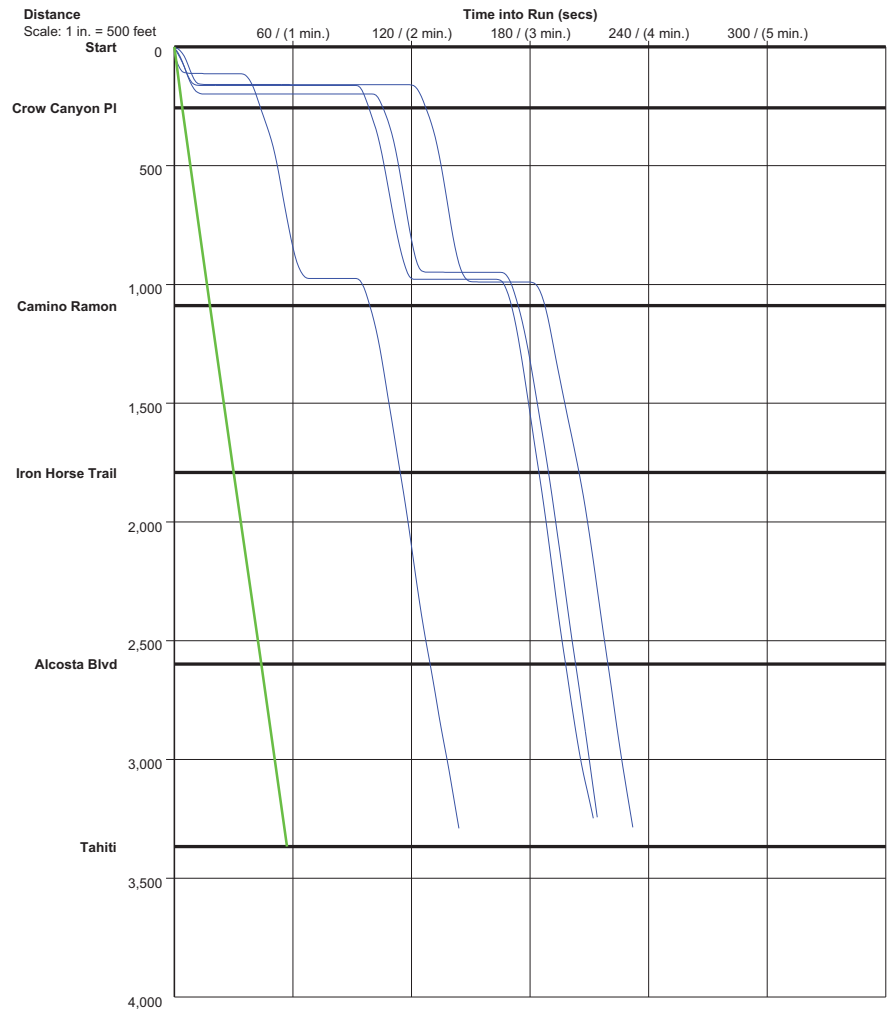


### Crow Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Crow Canyon - EB PM D2**  
Study Date : **9/22/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



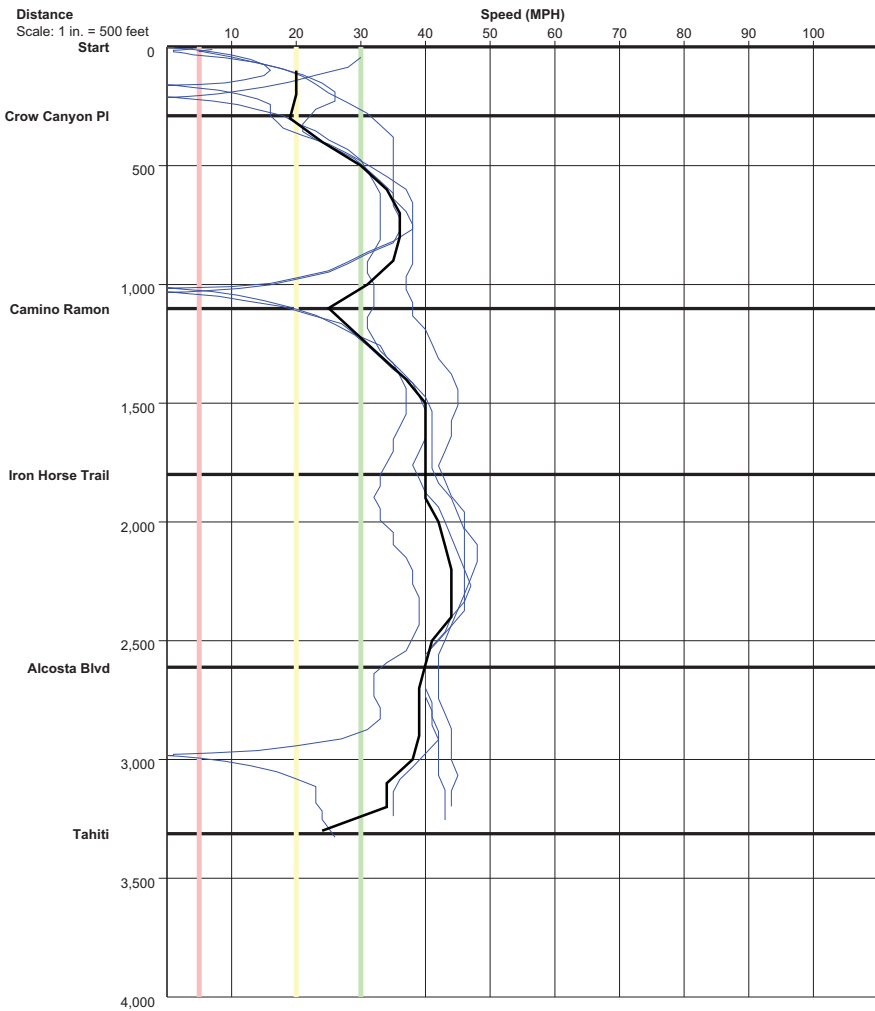
Solid Line is Normal Speed of 40 MPH

### Crow Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Crow Canyon - EB PM D3**  
Study Date : **9/22/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

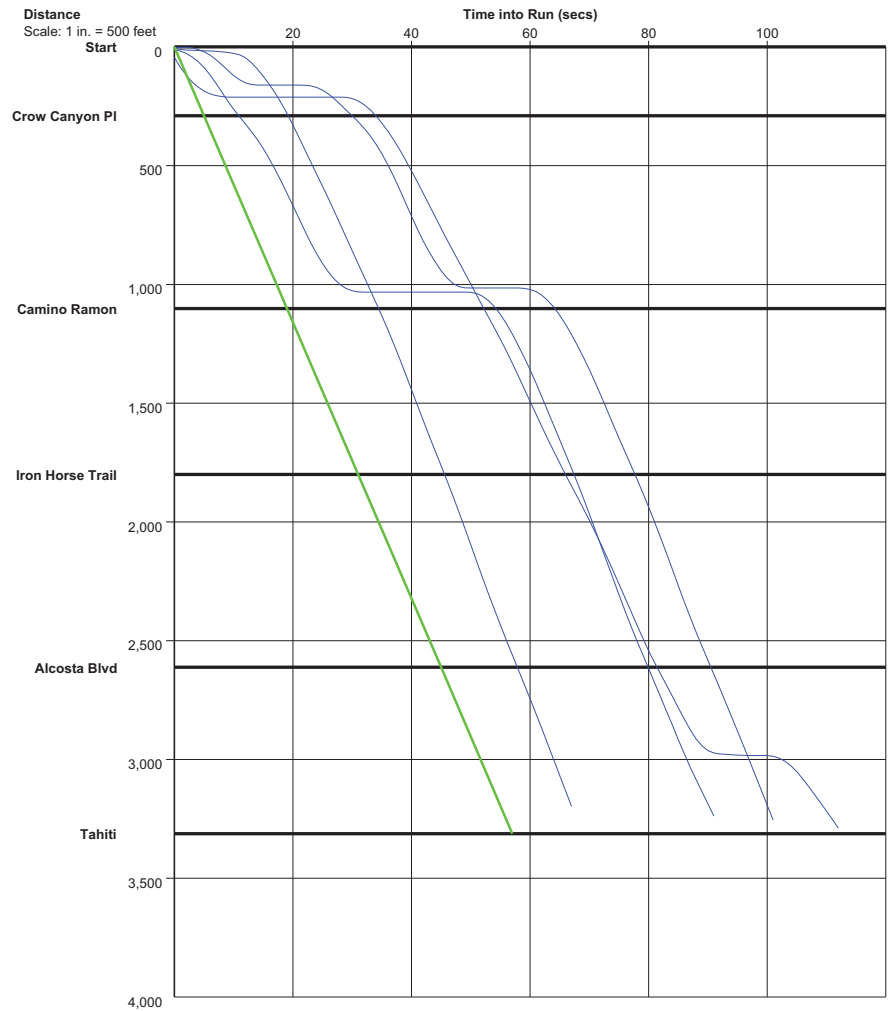


### Crow Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Eastbound

Study Name : **Crow Canyon - EB PM D3**  
Study Date : **9/22/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



**Appendix A-8**  
After Period  
Crow Canyon Road Westbound

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After Period  
Crow Canyon Road Westbound

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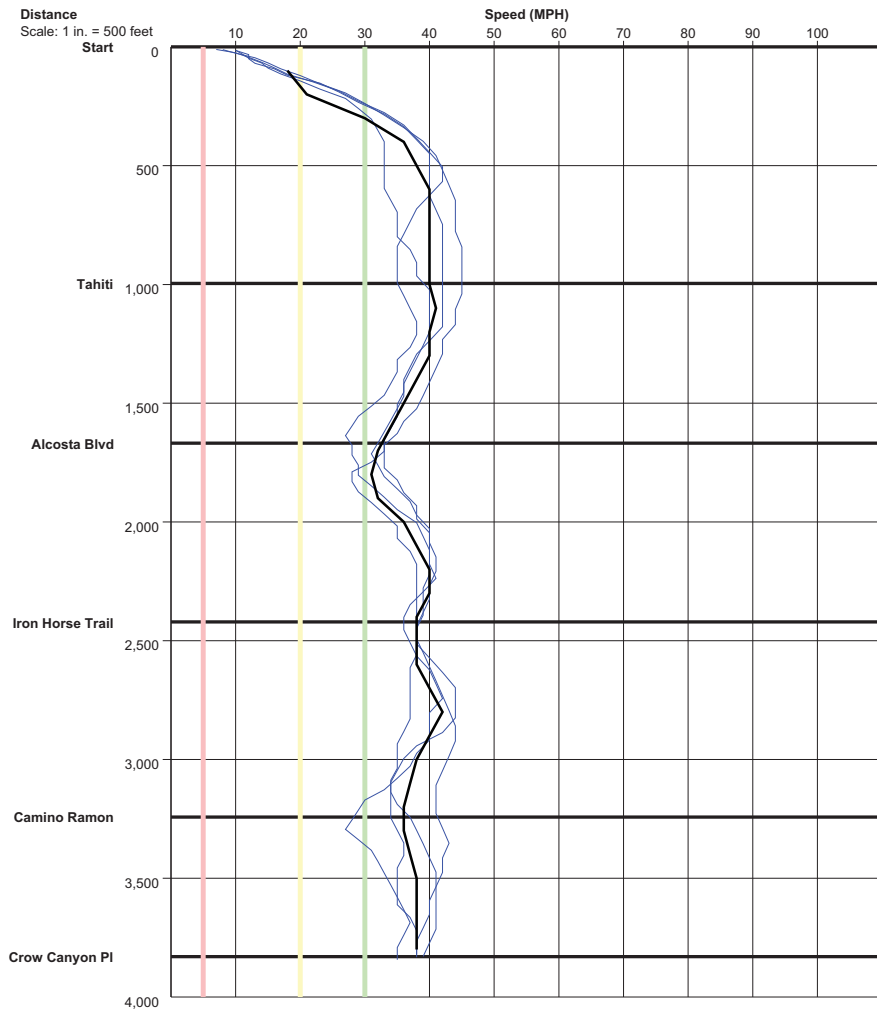
A.M. Peak (7:00 to 9:00 AM)

### Crow Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Crow Canyon - WB - AM D1**  
Study Date : **9/23/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

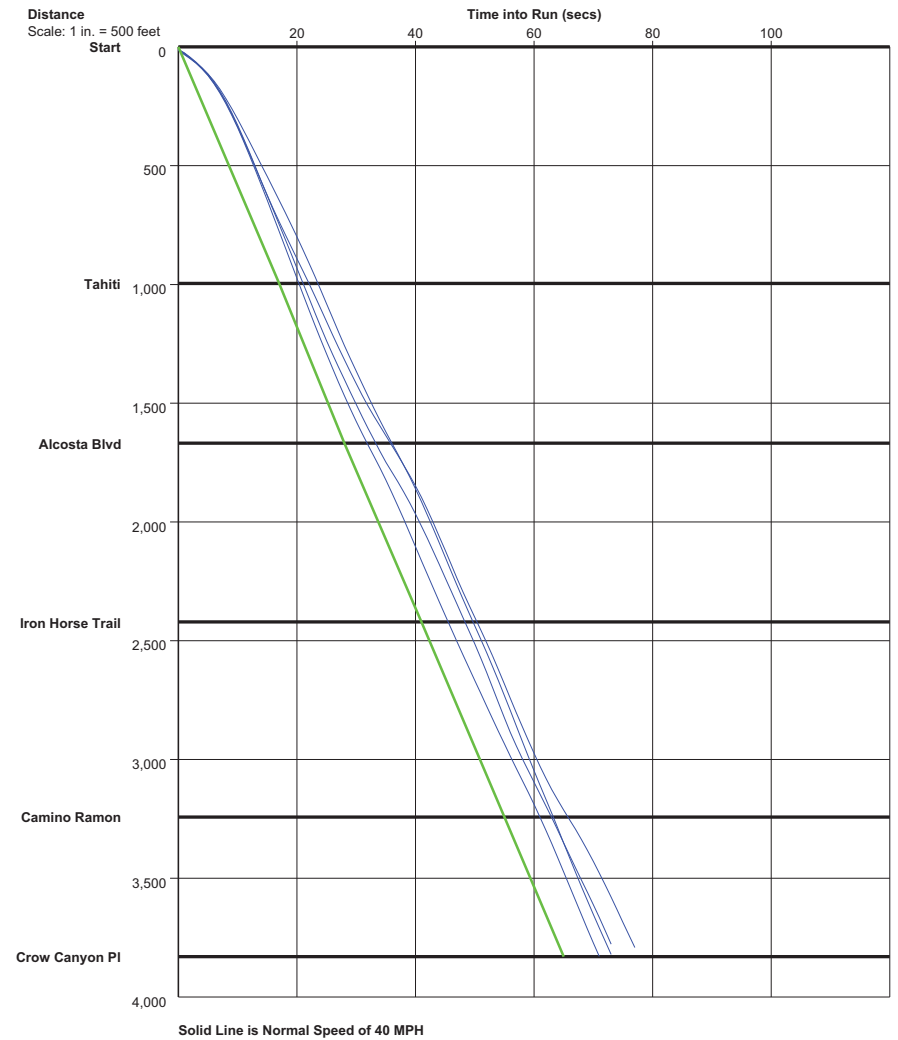


### Crow Canyon

Tuesday - September 14, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : **Crow Canyon - WB - AM D1**  
Study Date : **9/23/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

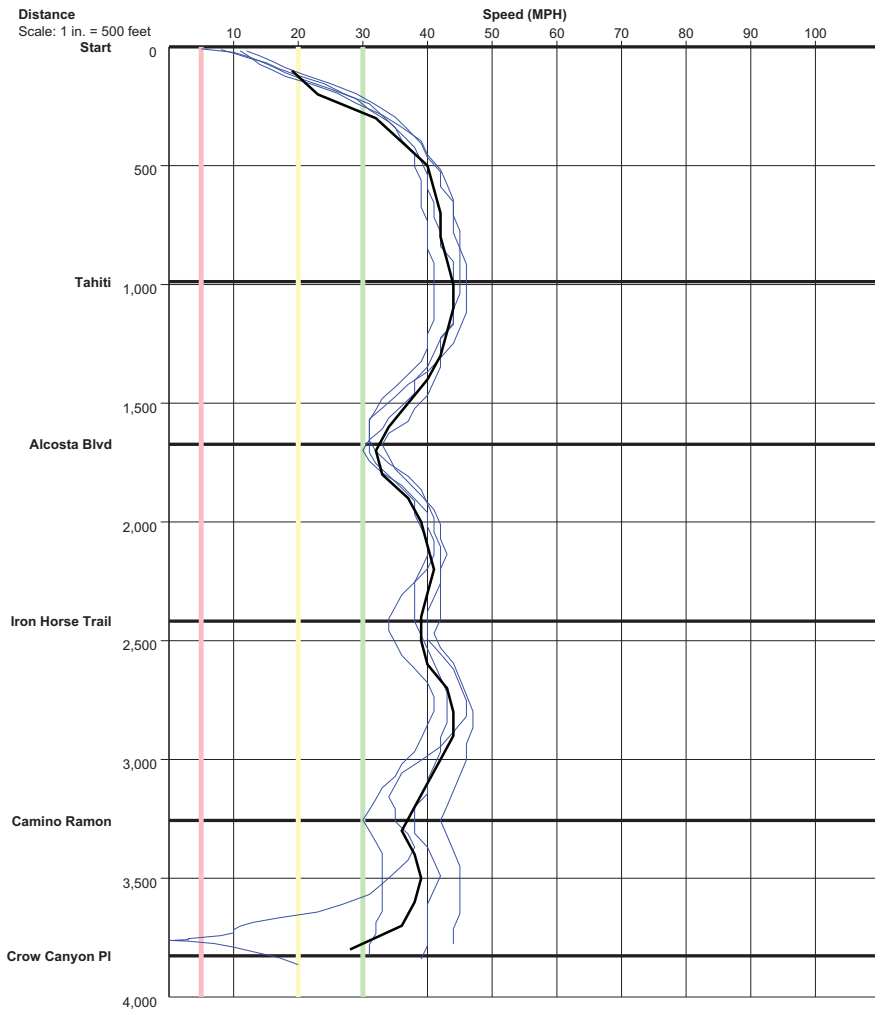


### Crow Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM D2  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

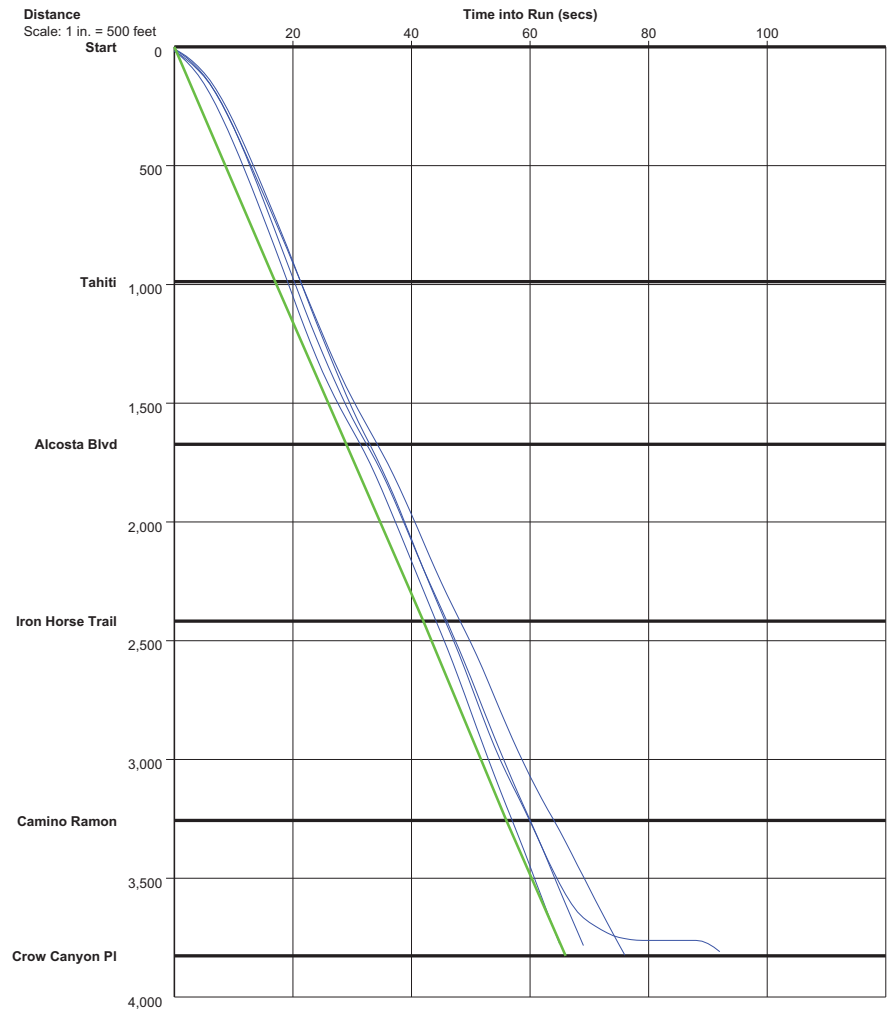


### Crow Canyon

Wednesday - September 15, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM D2  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

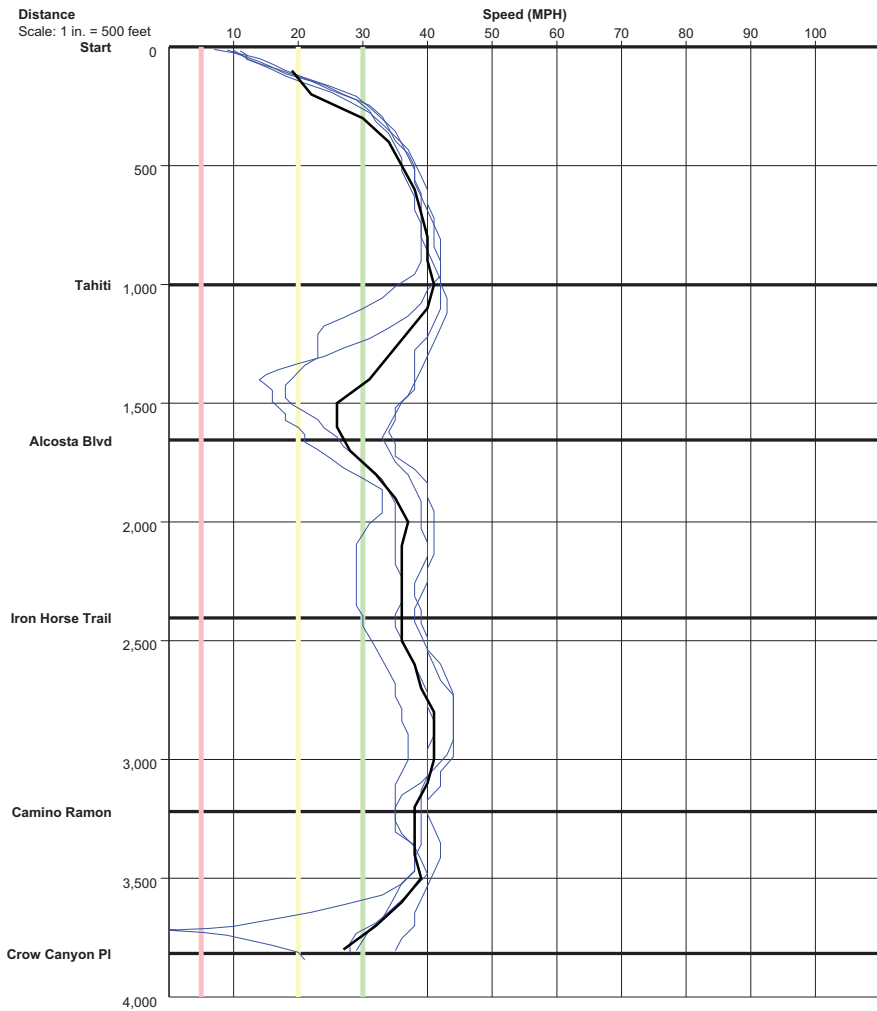


### Crow Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM D3  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

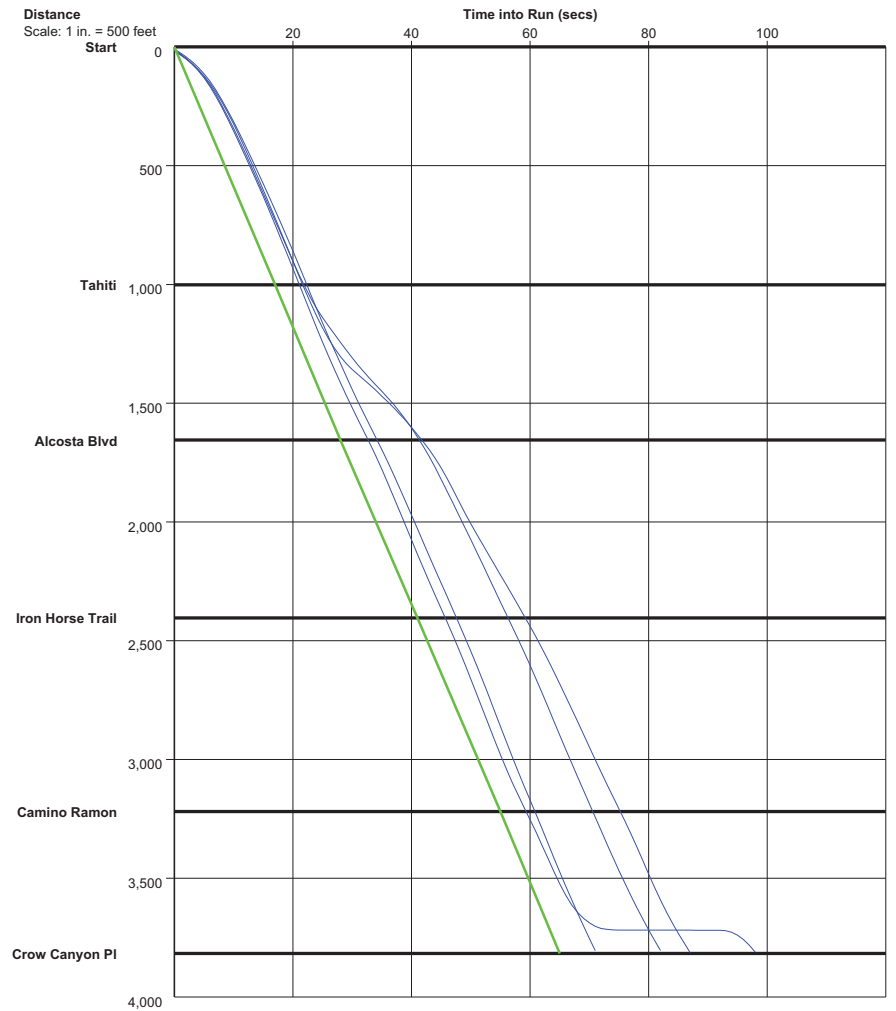


### Crow Canyon

Thursday - September 16, 2010 - 7:00 AM - 9:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM D3  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



After Period  
Crow Canyon Road Westbound

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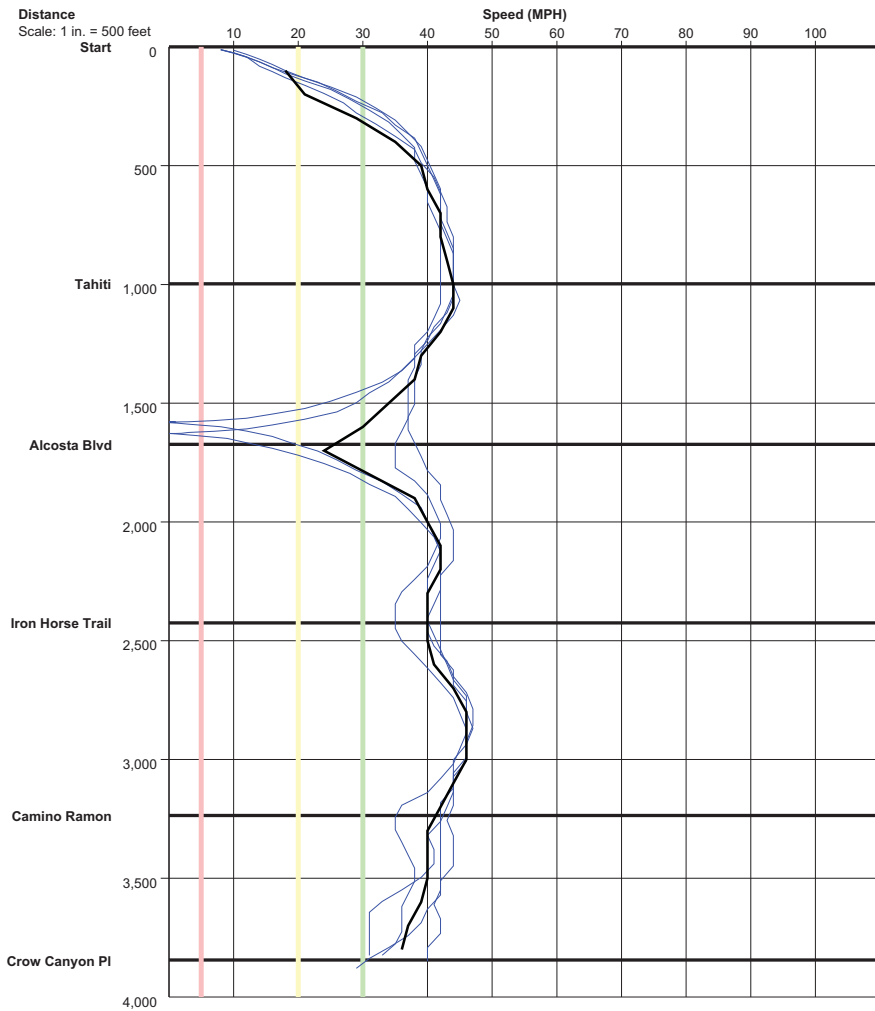
A.M. Off-Peak (9:00 to 11:00 AM)

### Crow Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM OP D1  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

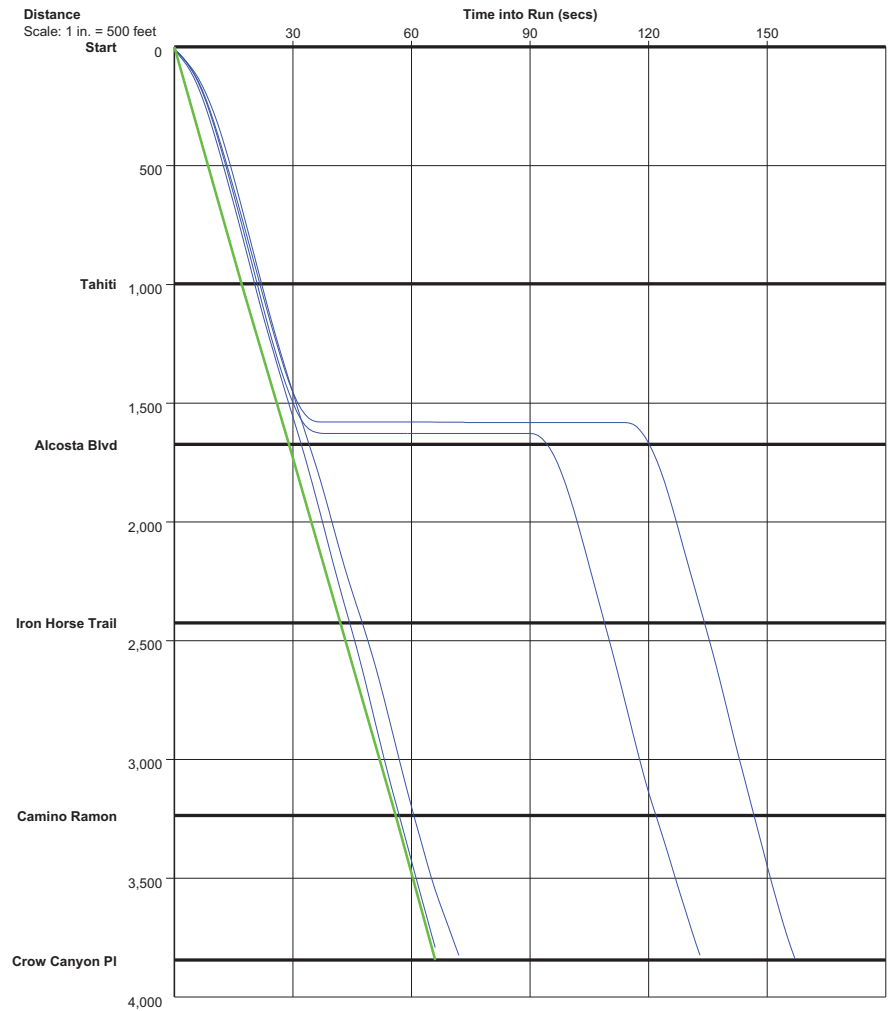


### Crow Canyon

Tuesday - September 14, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM OP D1  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

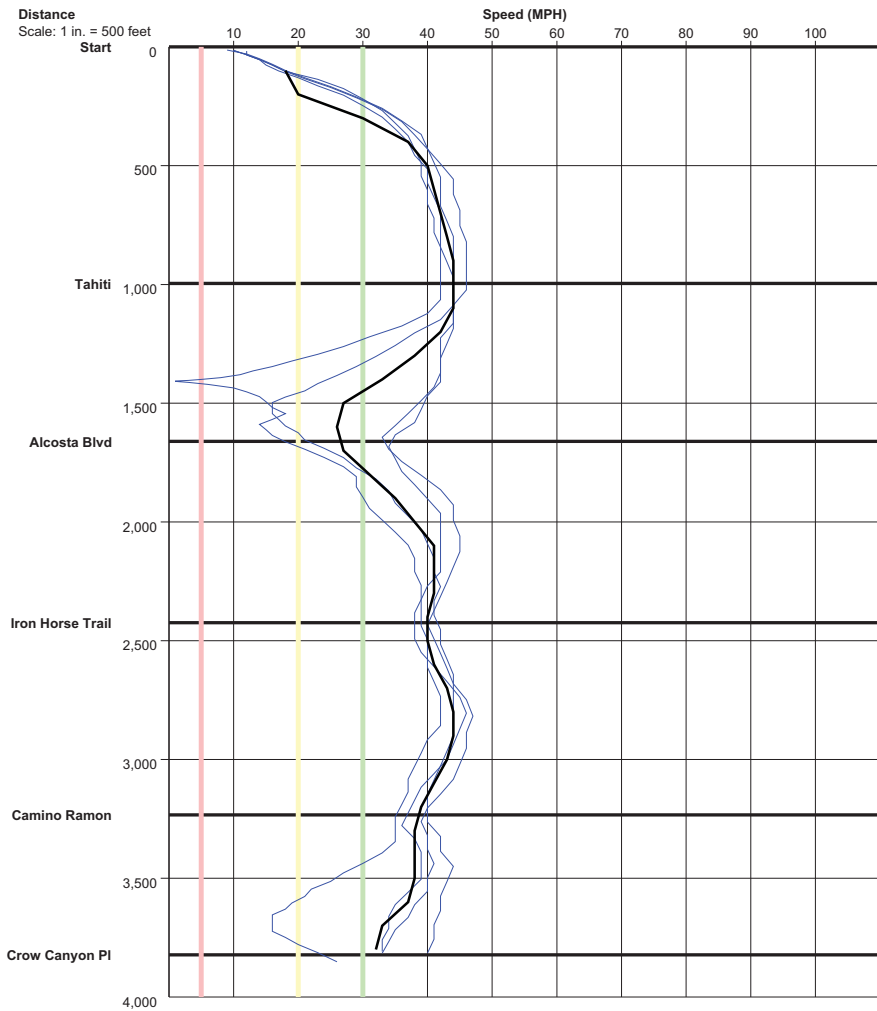


### Crow Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM OP D2  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

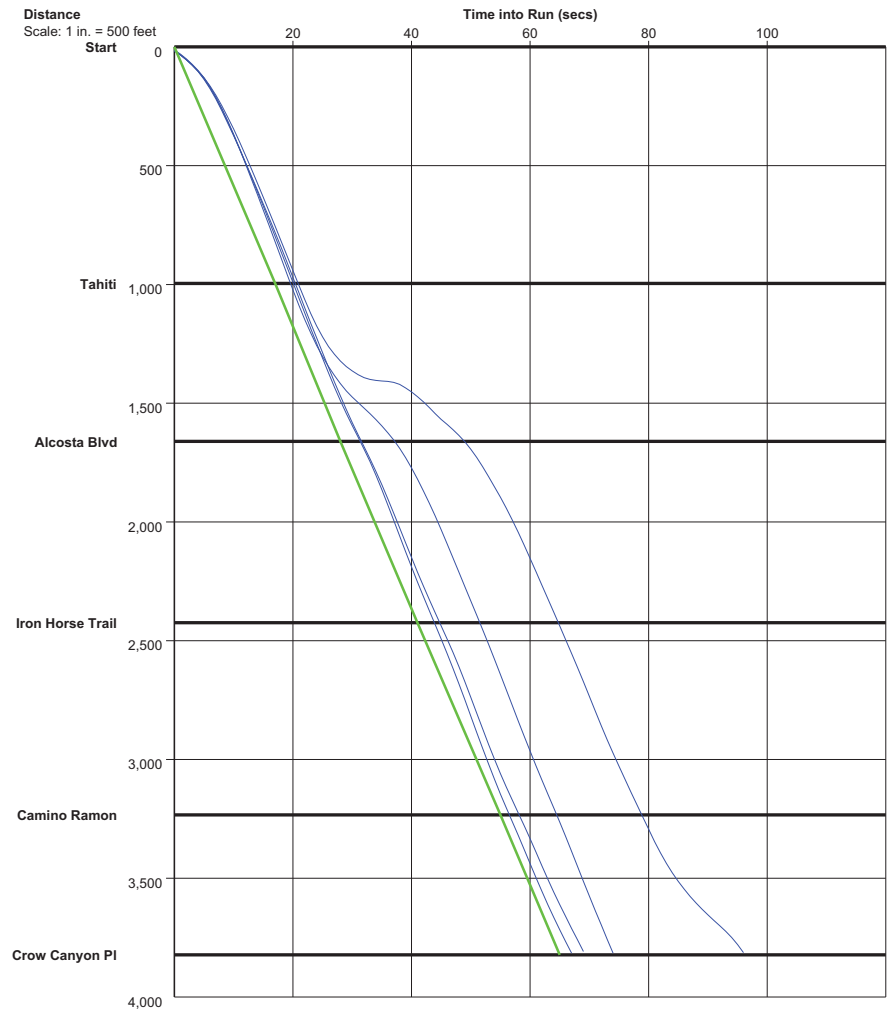


### Crow Canyon

Wednesday - September 15, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM OP D2  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

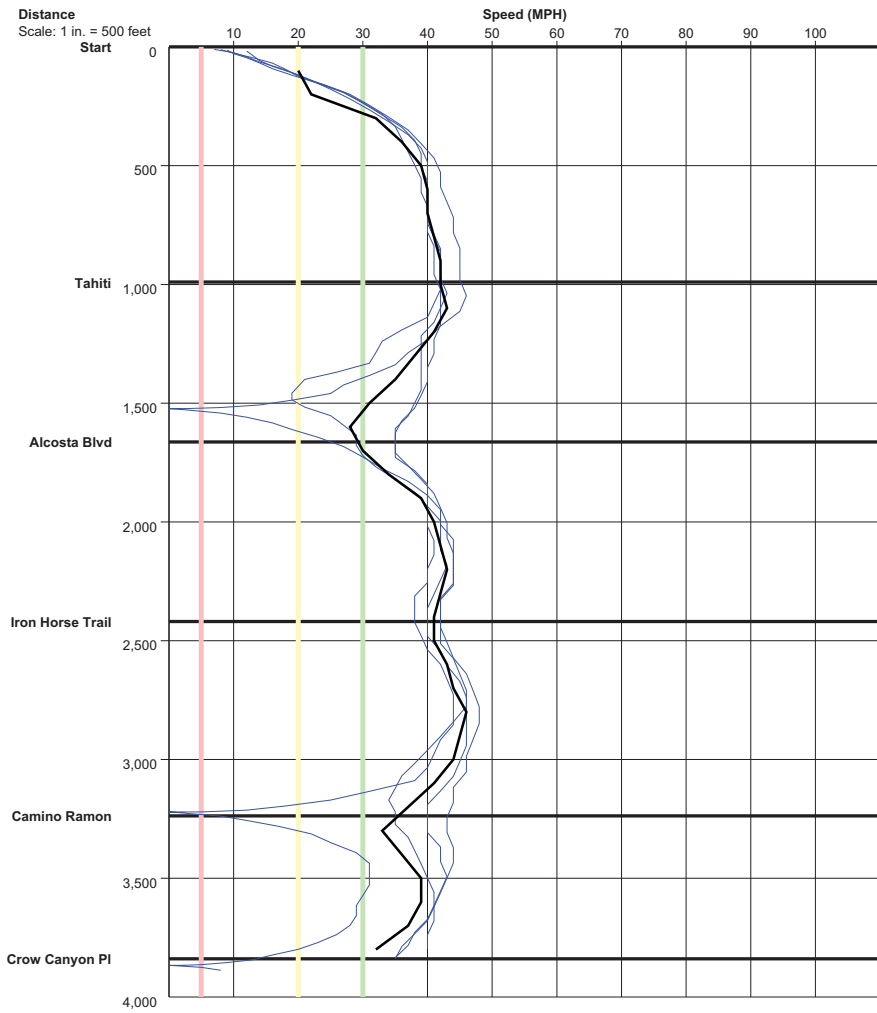


### Crow Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM OP D3  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

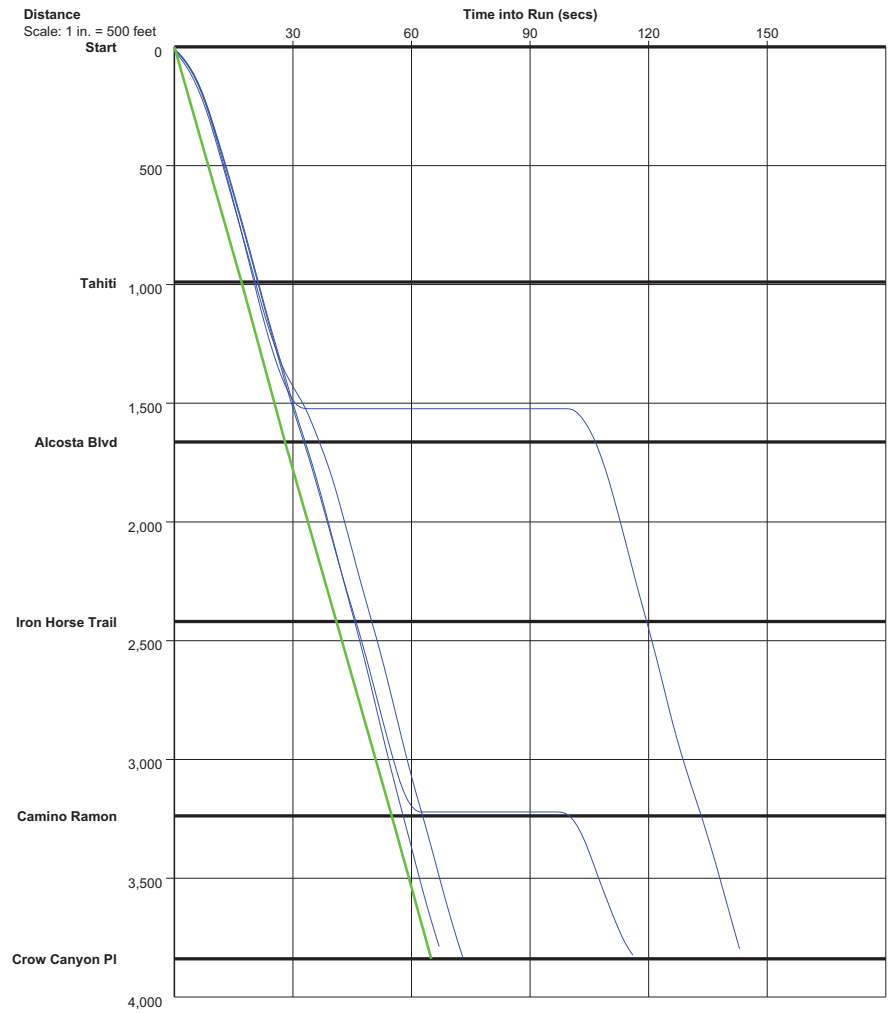


### Crow Canyon

Thursday - September 16, 2010 - 9:00 AM - 11:00 AM  
Westbound

Study Name : Crow Canyon - WB - AM OP D3  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



After Period  
Crow Canyon Road Westbound

---

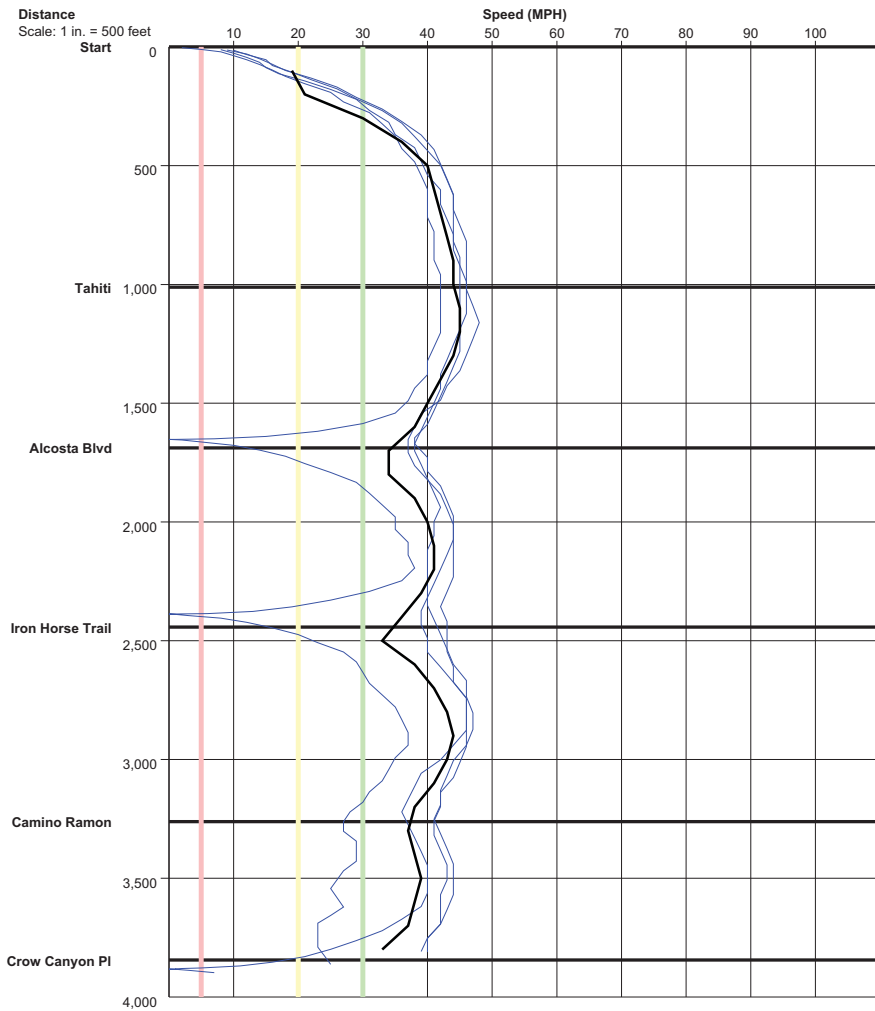
Midday Peak (11:30 AM to 1:30 PM)

### Crow Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : Crow Canyon - WB - MID D1  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

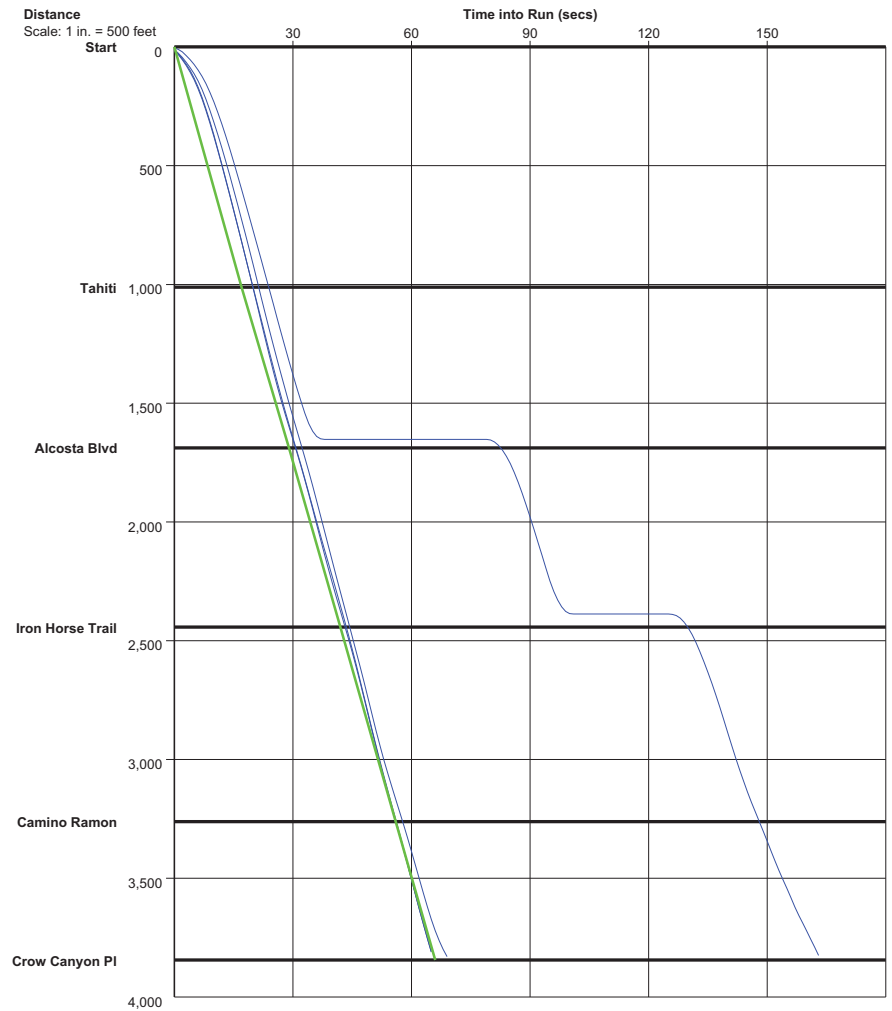


### Crow Canyon

Tuesday - September 14, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : Crow Canyon - WB - MID D1  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

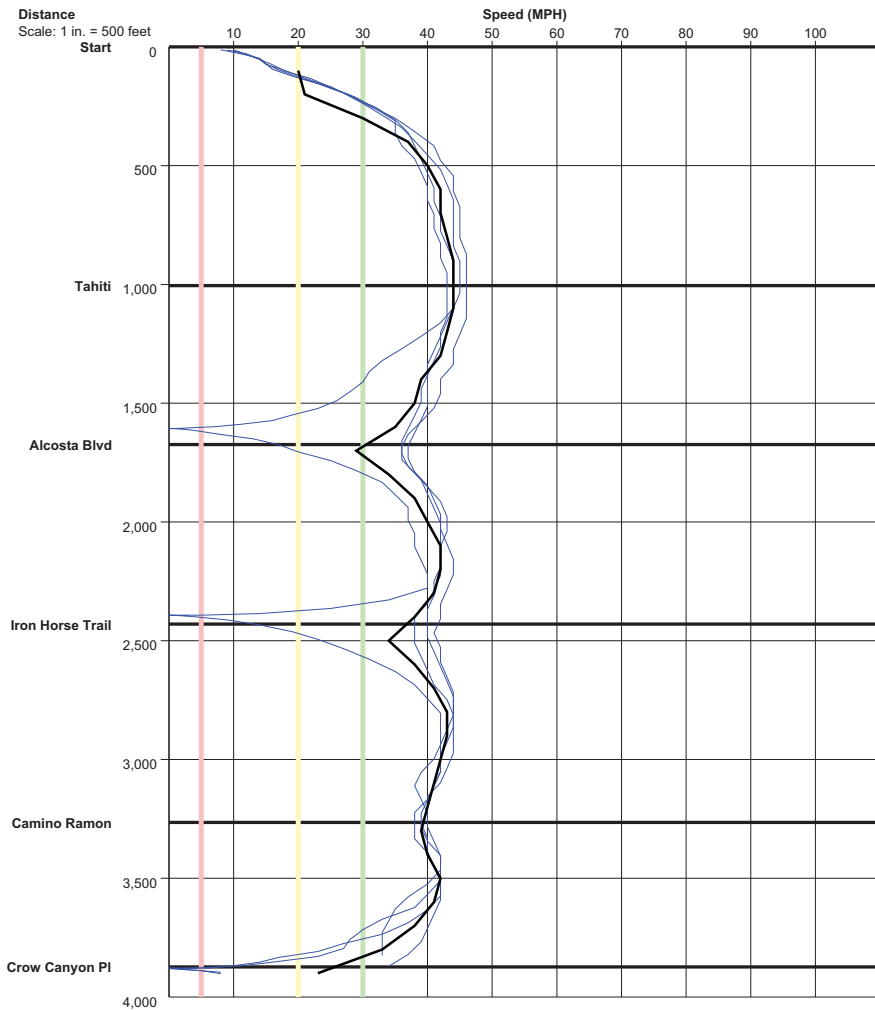


### Crow Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : Crow Canyon - WB - MID D2  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

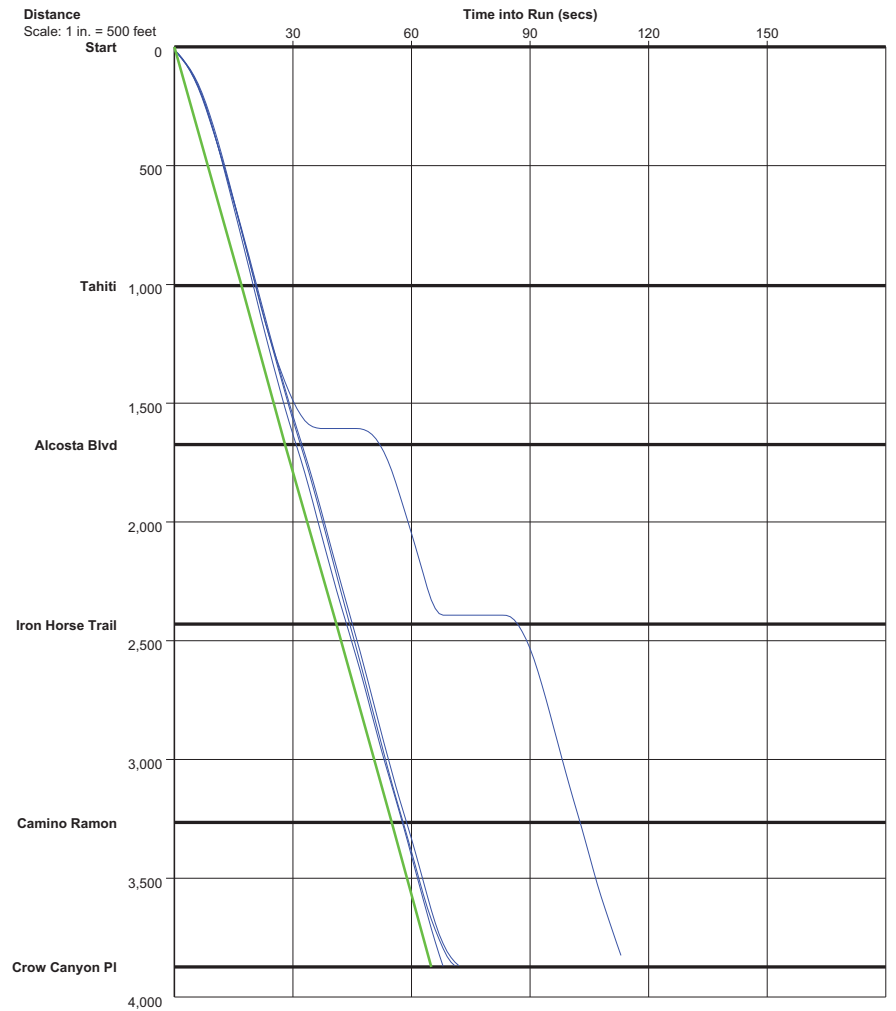


### Crow Canyon

Wednesday - September 15, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : Crow Canyon - WB - MID D2  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs

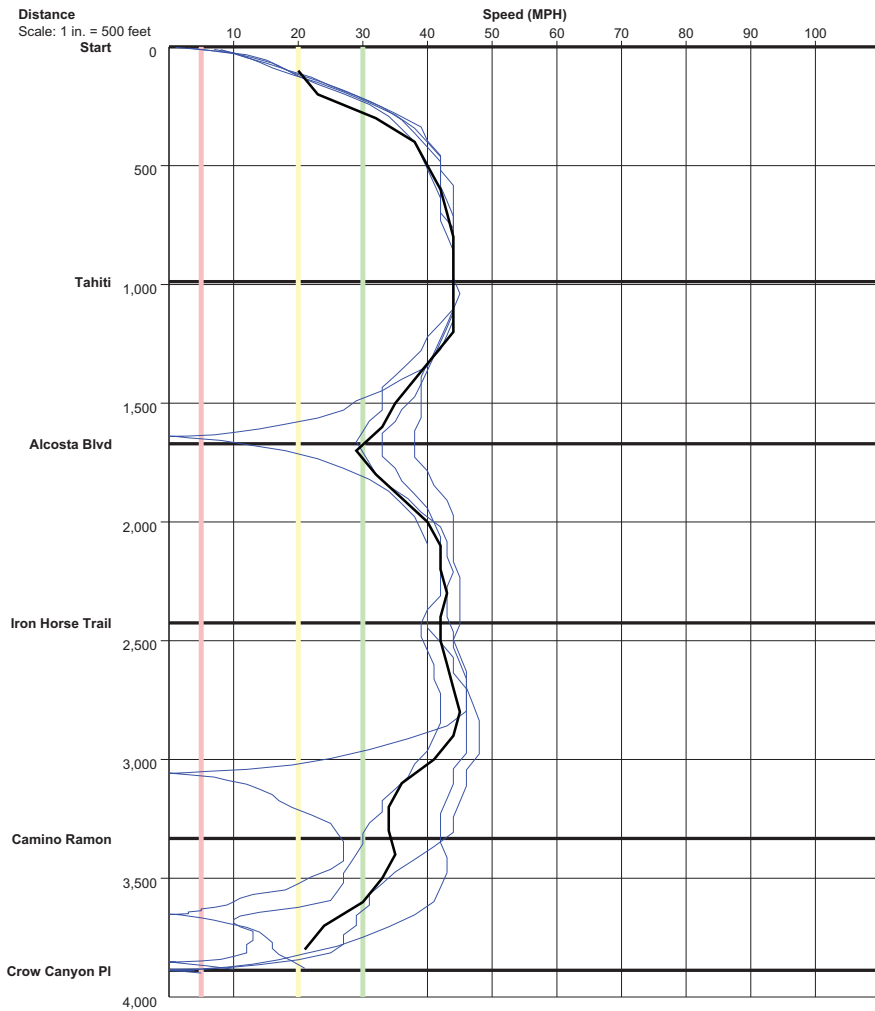


### Crow Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : Crow Canyon - WB - MID D3  
Study Date : 9/23/2010  
Page No. : 16

#### Speed/Distance Profiles of All Runs

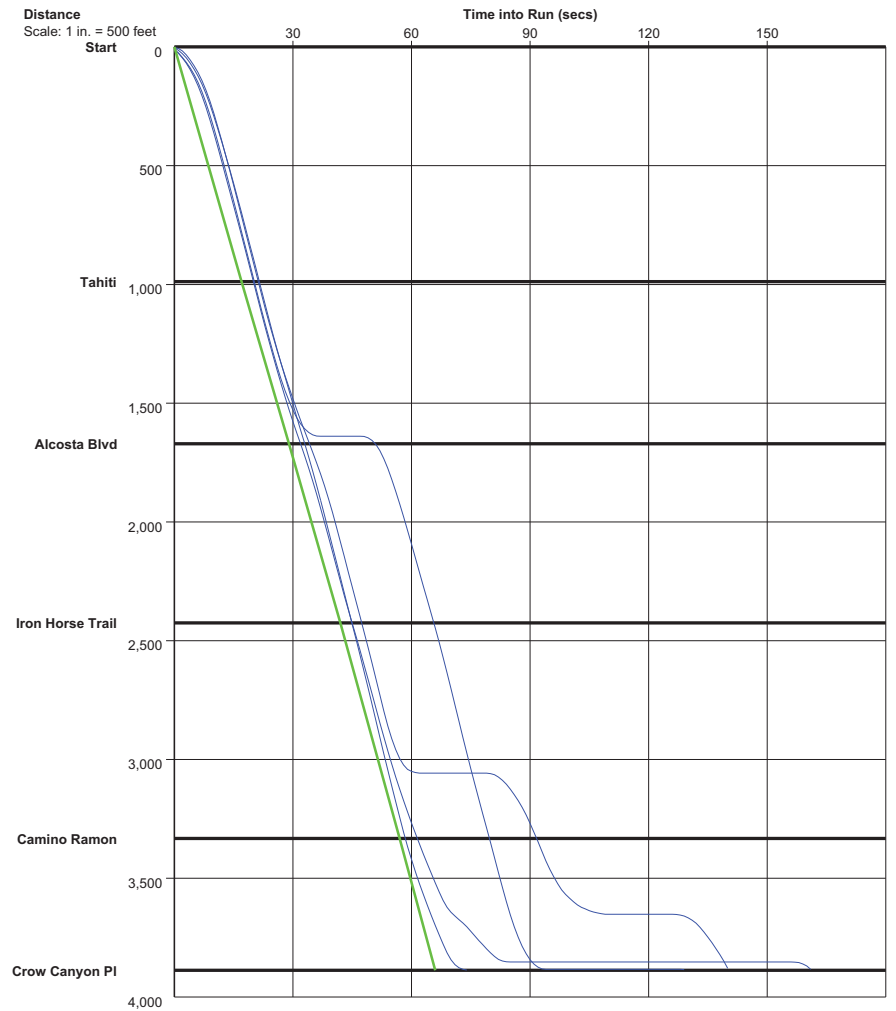


### Crow Canyon

Thursday - September 16, 2010 - 11:30 AM - 1:30 PM  
Westbound

Study Name : Crow Canyon - WB - MID D3  
Study Date : 9/23/2010  
Page No. : 17

#### Time/Space Trajectories of All Runs



After Period  
Crow Canyon Road Westbound

---

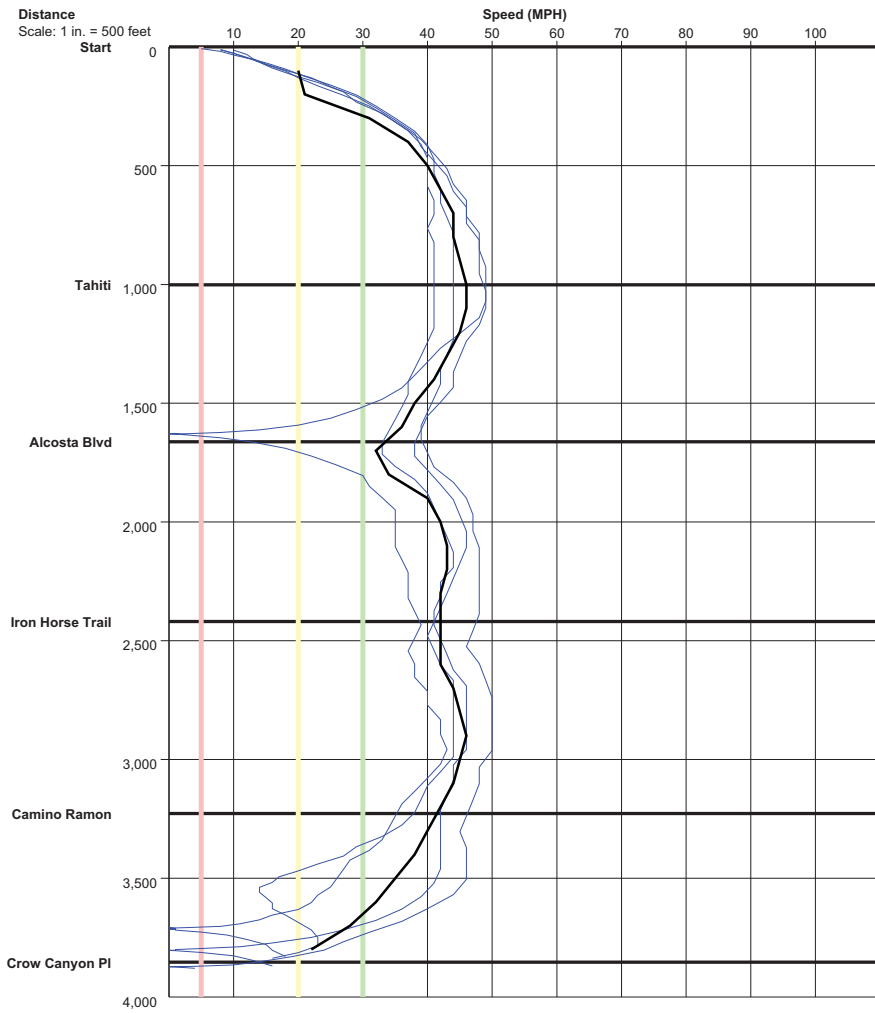
P.M. Peak (4:30 to 6:30 PM)

### Crow Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Crow Canyon - WB - PM D1**  
Study Date : **9/23/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

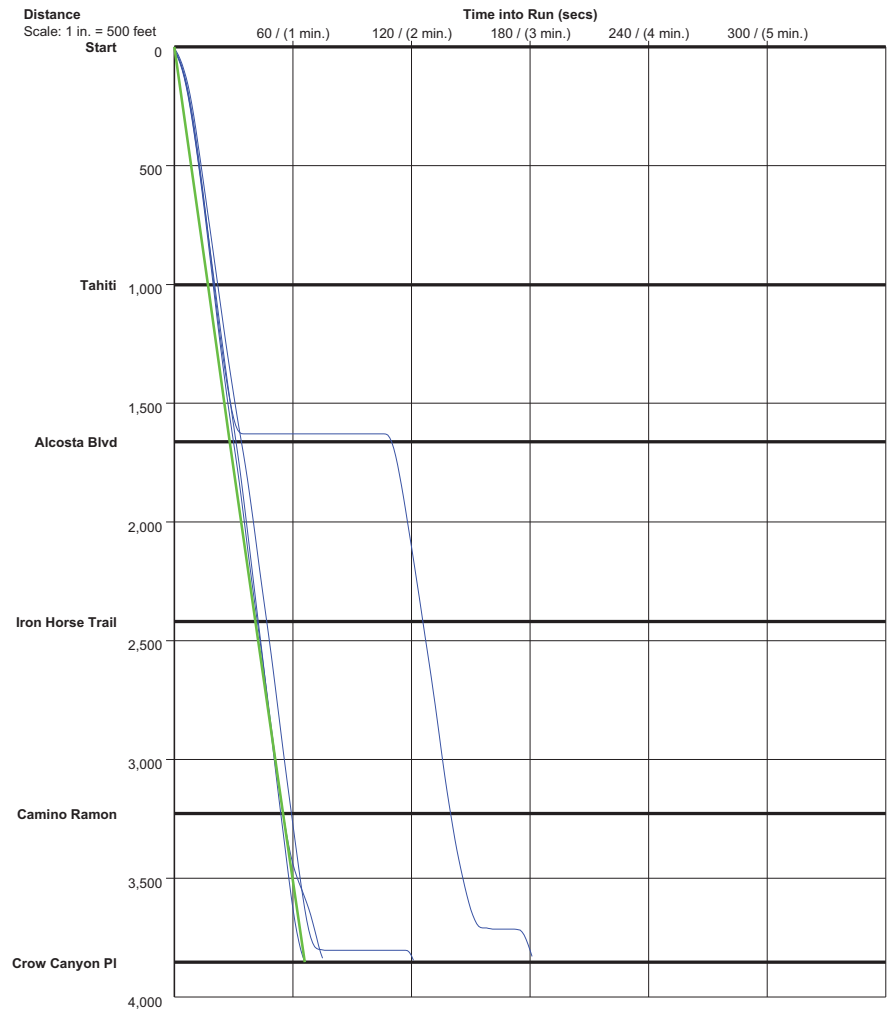


### Crow Canyon

Tuesday - September 14, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Crow Canyon - WB - PM D1**  
Study Date : **9/23/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

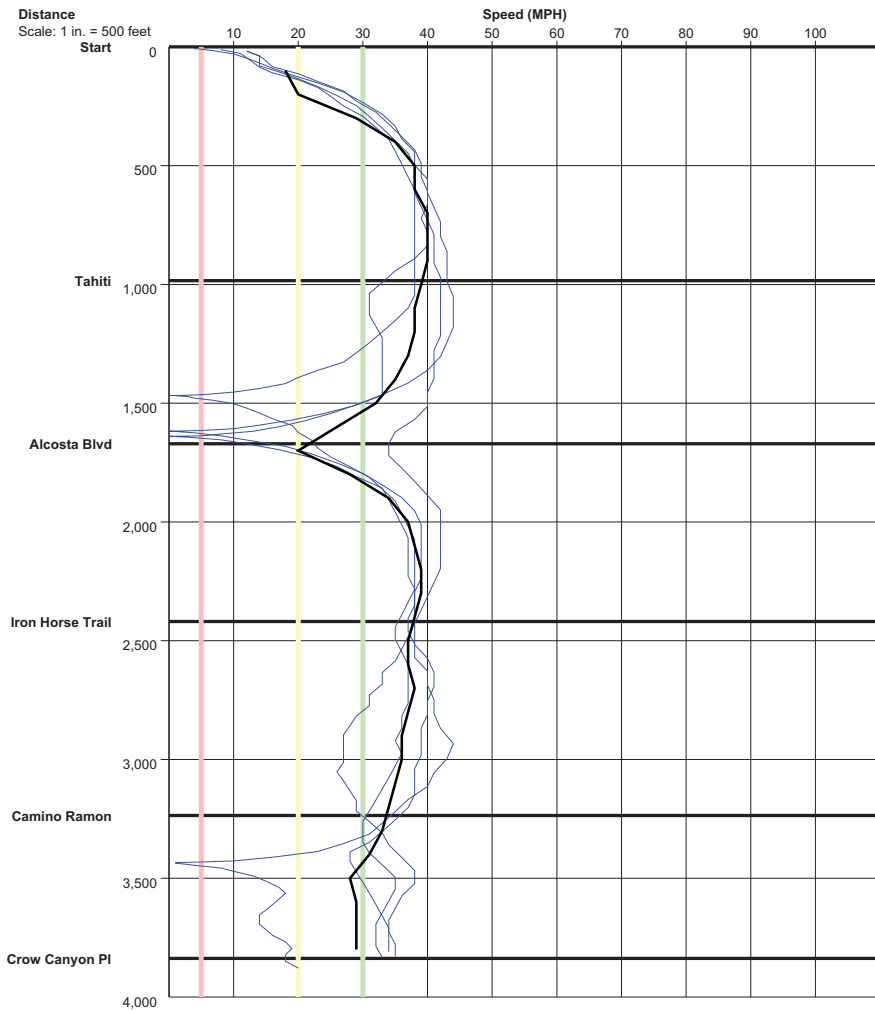


### Crow Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Crow Canyon - WB - PM D2**  
Study Date : **9/23/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

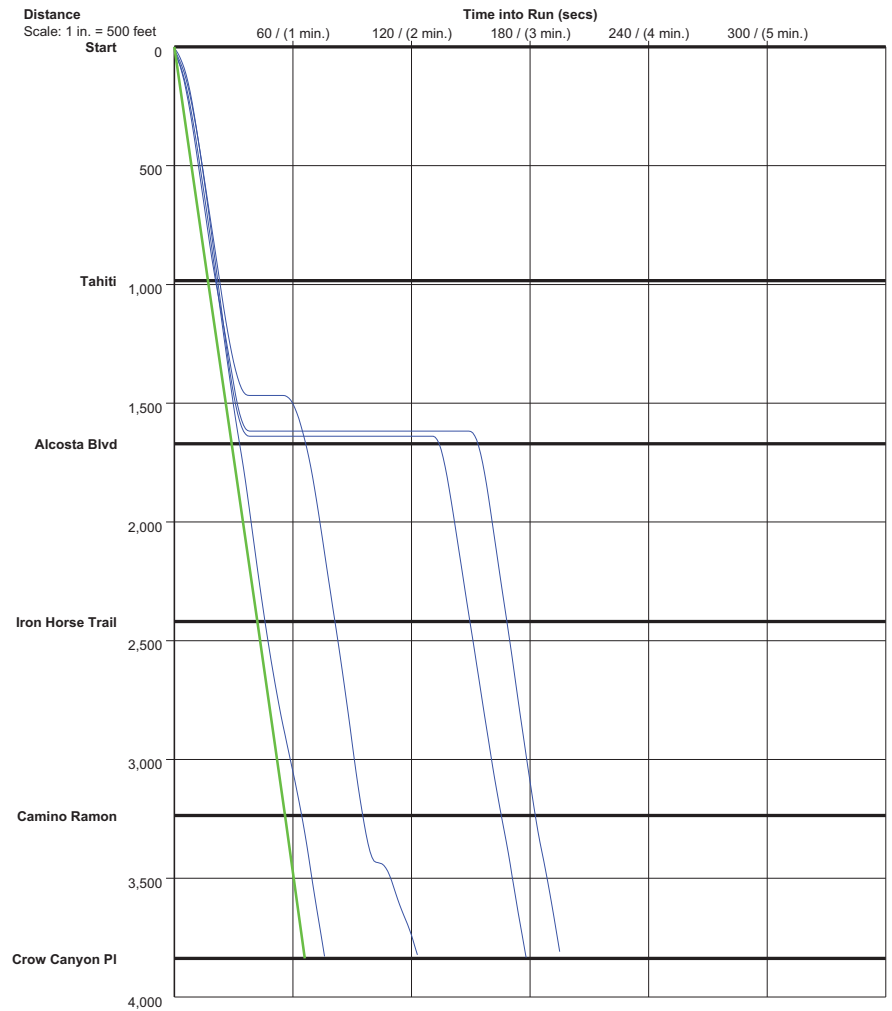


### Crow Canyon

Wednesday - September 15, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Crow Canyon - WB - PM D2**  
Study Date : **9/23/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs

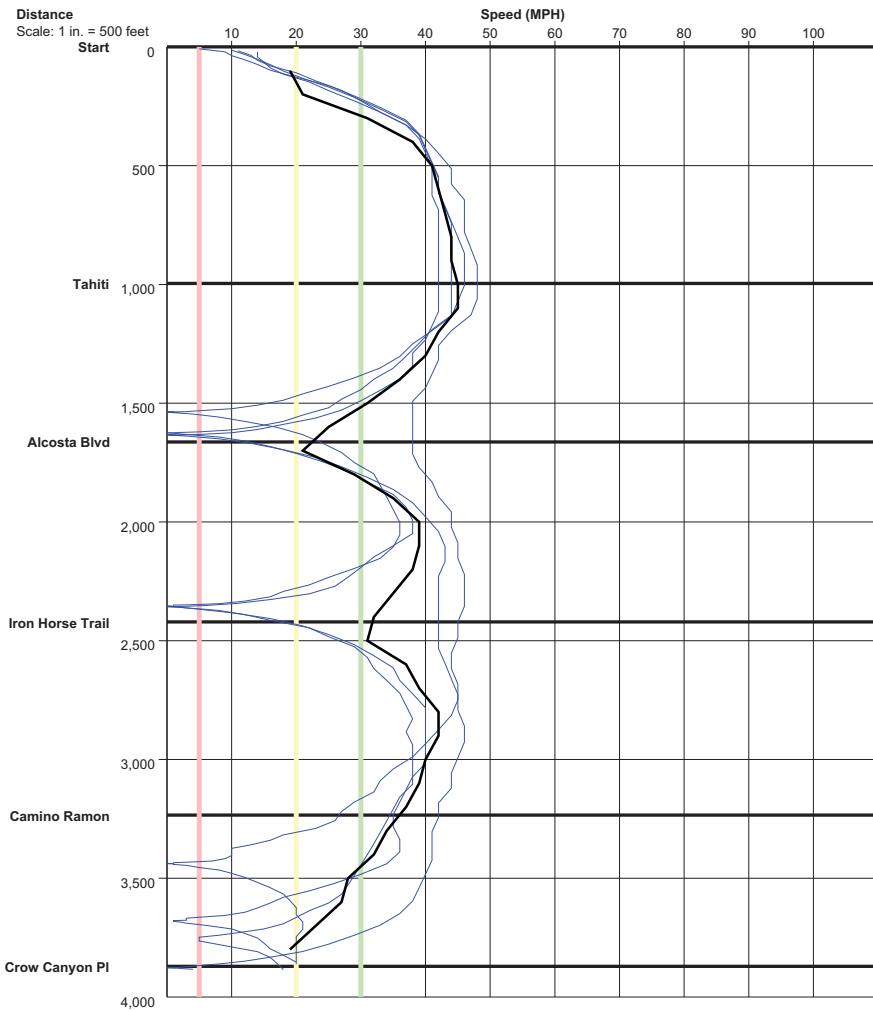


### Crow Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Crow Canyon - WB - PM D3**  
Study Date : **9/23/2010**  
Page No. : **16**

#### Speed/Distance Profiles of All Runs

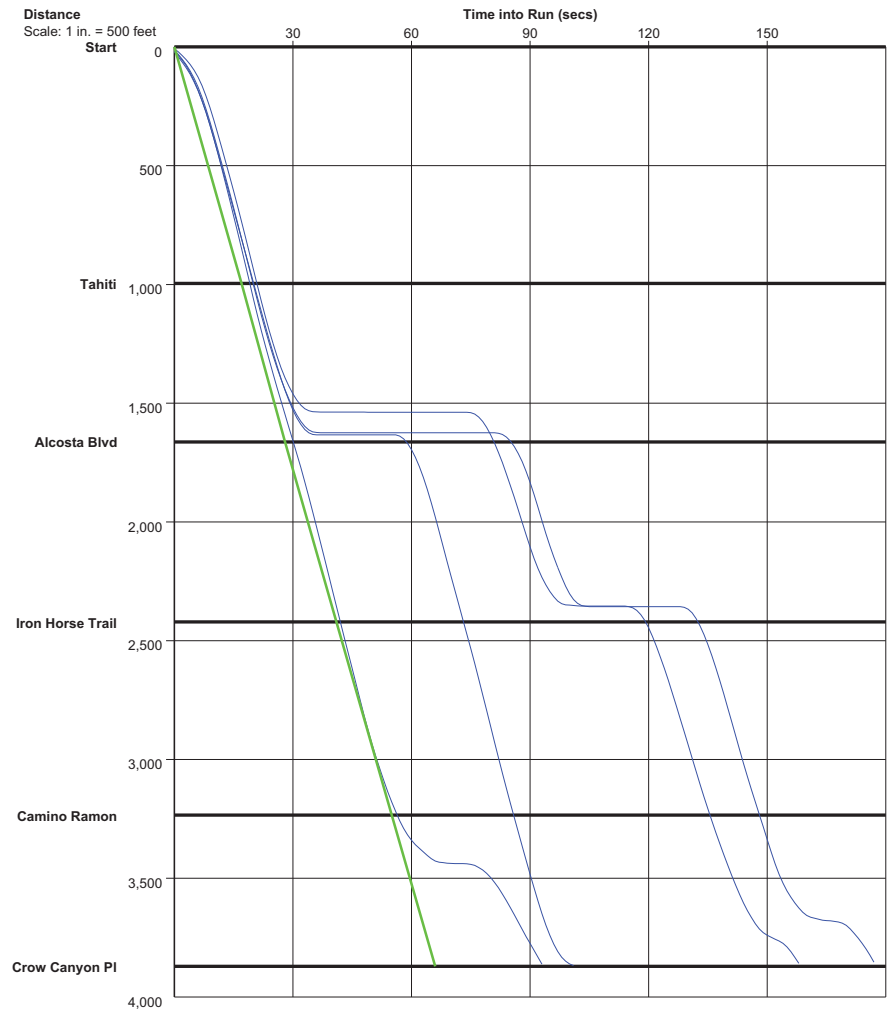


### Crow Canyon

Thursday - September 16, 2010 - 4:30 PM - 6:30 PM  
Westbound

Study Name : **Crow Canyon - WB - PM D3**  
Study Date : **9/23/2010**  
Page No. : **17**

#### Time/Space Trajectories of All Runs



**Appendix B-1**  
Before Period  
Traffic Volume Counts

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Before Period  
Crow Canyon Road  

---

East of Crow Canyon Place

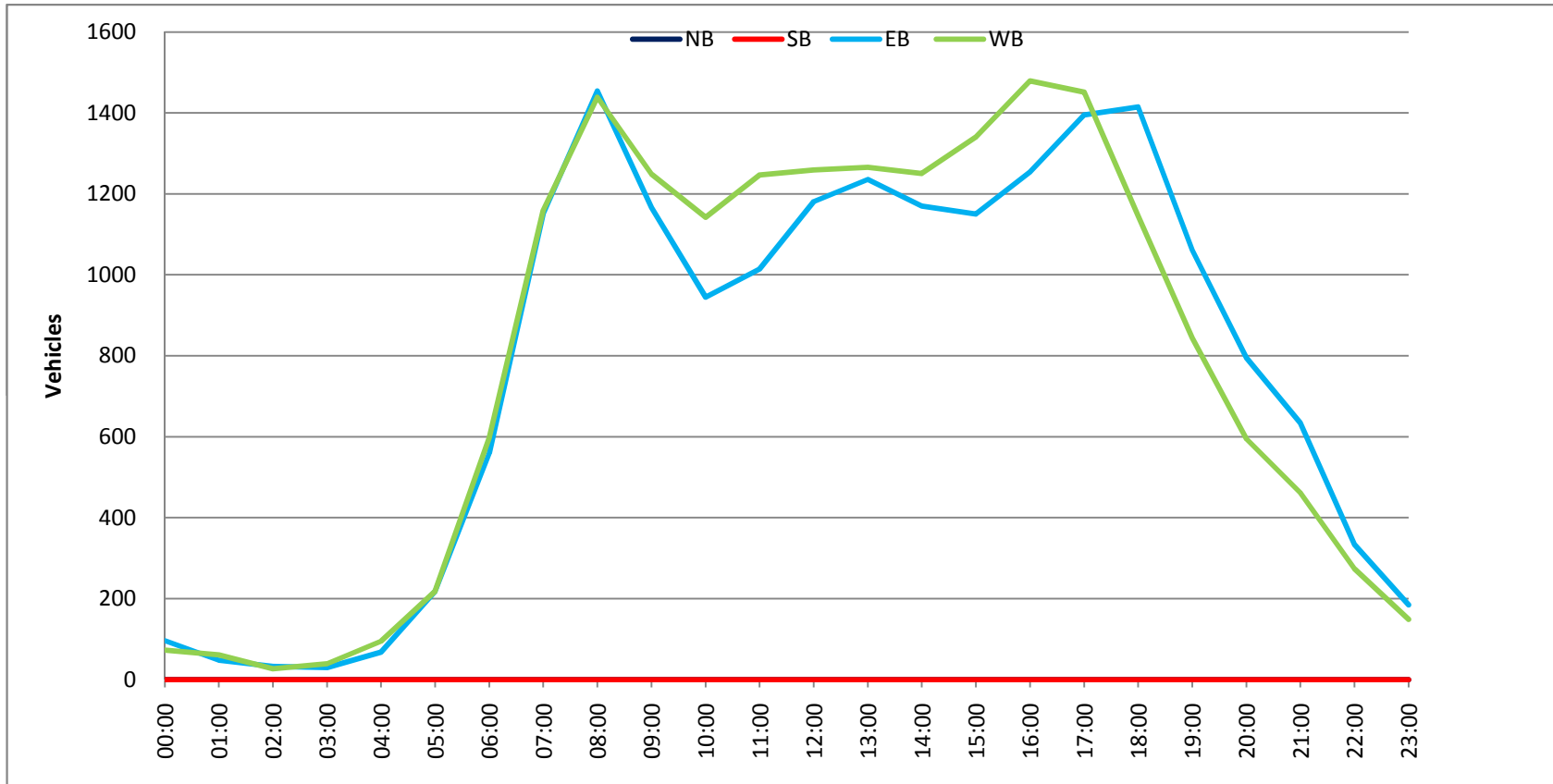
Prepared by NDS/ATD

Project #: 10-7268-001

City: San Ramon

Location: Crow Canyon Rd E/o Crow Canyon Pl

Date: Tuesday, July 13, 2010



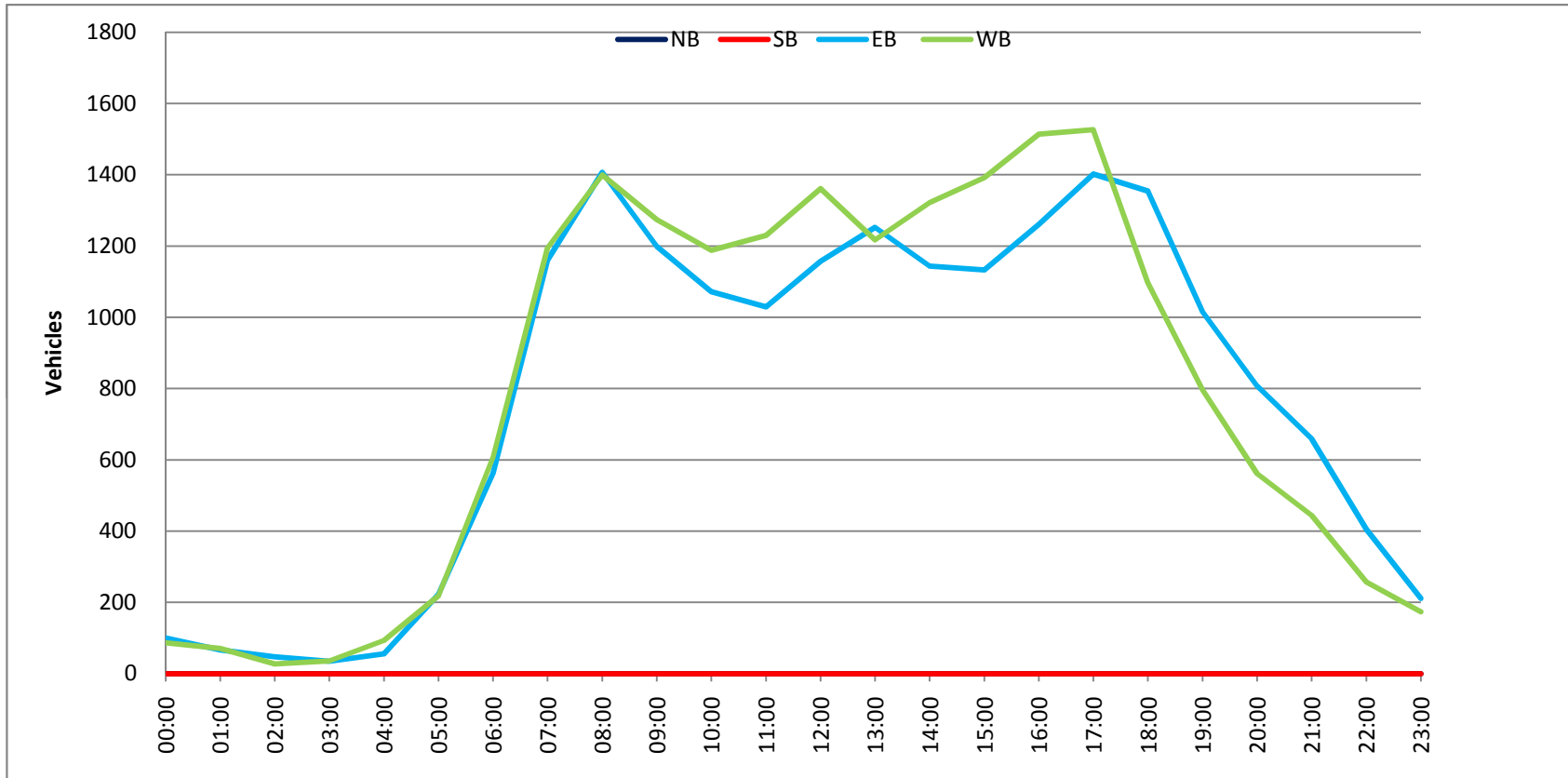
Prepared by NDS/ATD

Project #: 10-7268-001

City: San Ramon

Location: Crow Canyon Rd E/o Crow Canyon Pl

Date: Wednesday, July 14, 2010



Prepared by NDS/ATD

Project #: 10-7268-001

City: San Ramon

Location: Crow Canyon Rd E/o Crow Canyon Pl

Date: Thursday, July 15, 2010



Before Period  
Crow Canyon Road

---

Between Alcosta Boulevard and El Capitan Drive

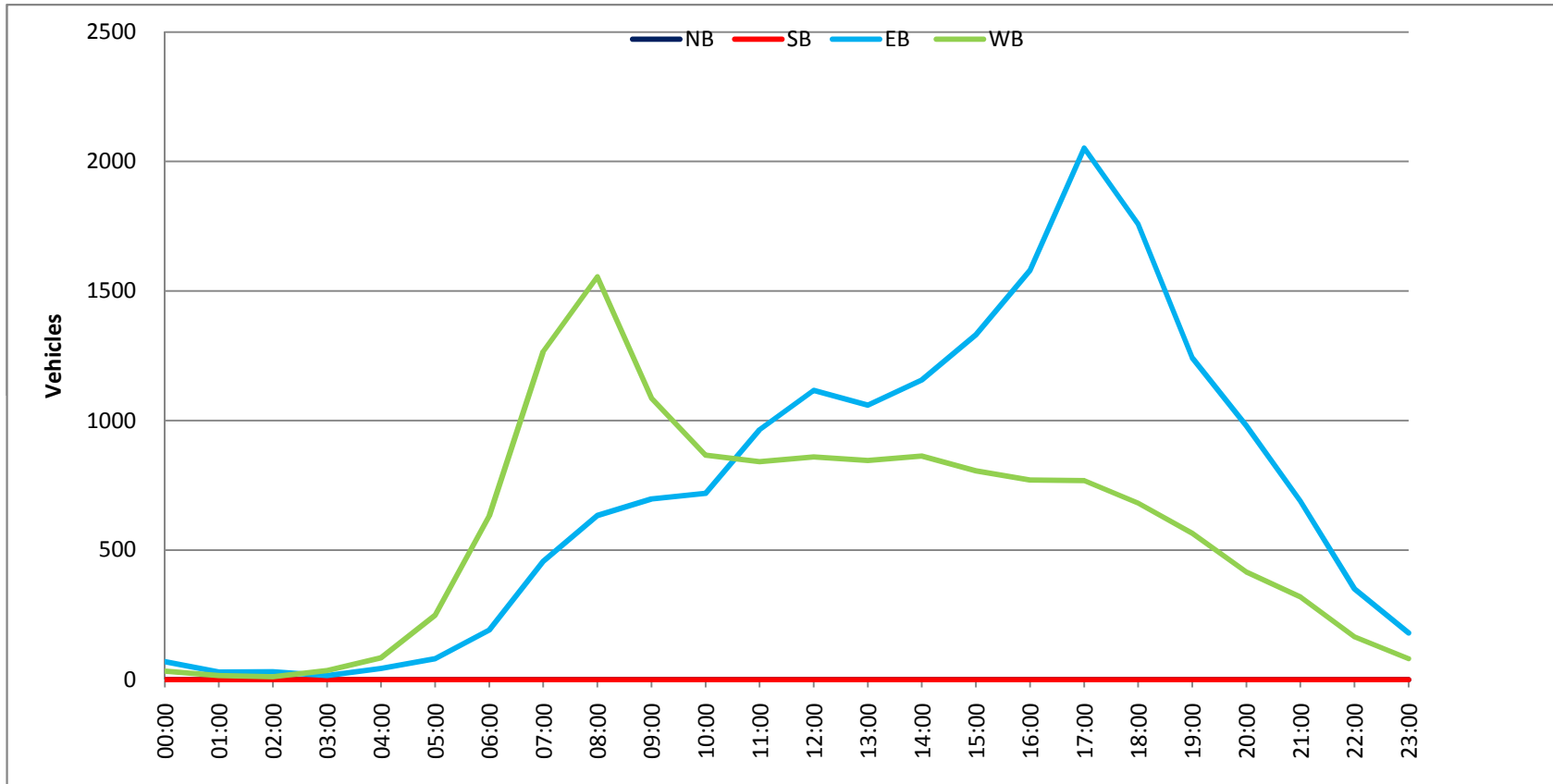
Prepared by NDS/ATD

Project #: 10-7268-002

City: San Ramon

Location: Crow Canyon Rd between Alcosta Blvd &  
El Capitan Dr

Date: Tuesday, July 13, 2010



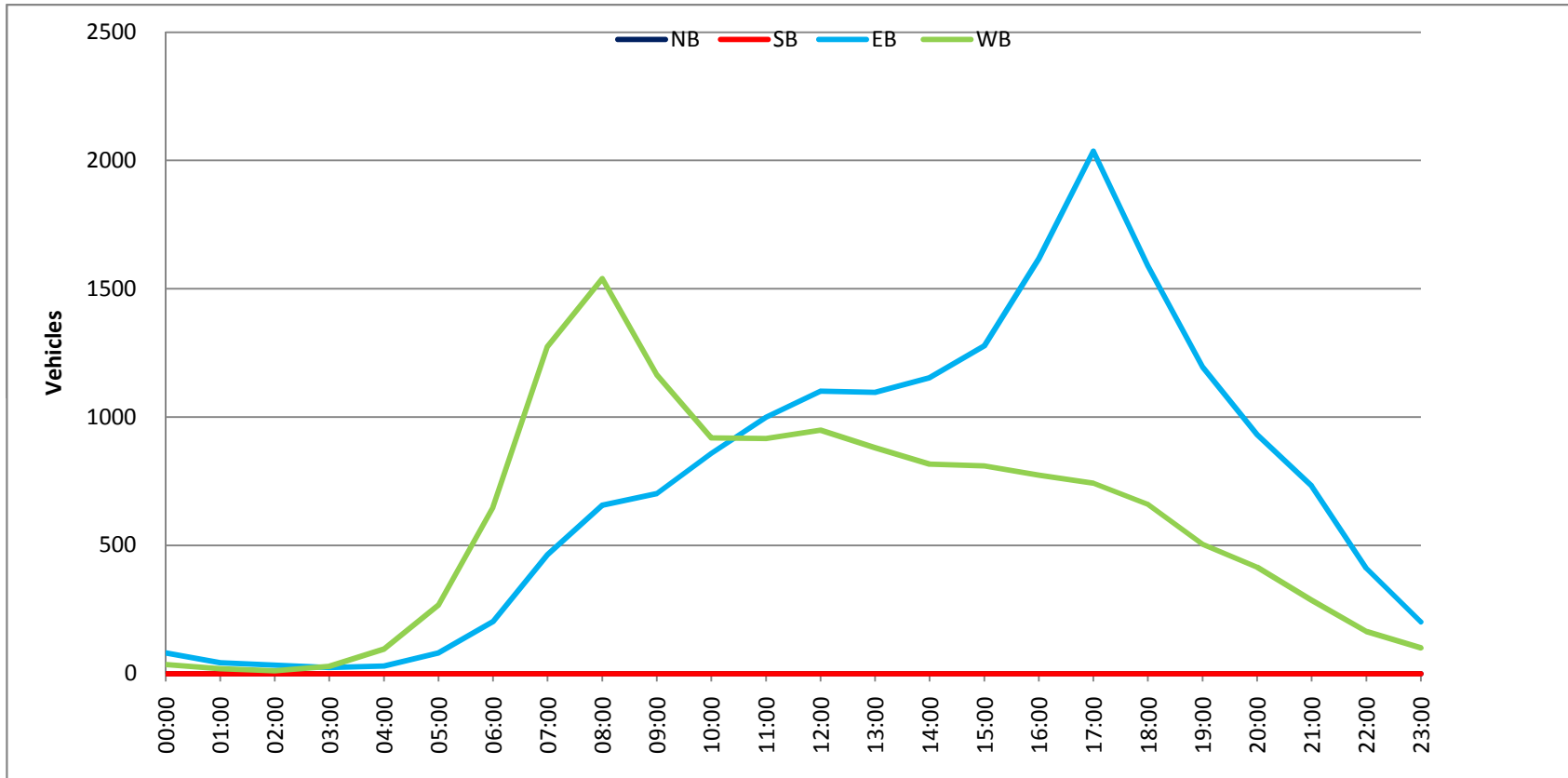
Prepared by NDS/ATD

Project #: 10-7268-002

City: San Ramon

Location: Crow Canyon Rd between Alcosta Blvd &  
El Capitan Dr

Date: Wednesday, July 14, 2010



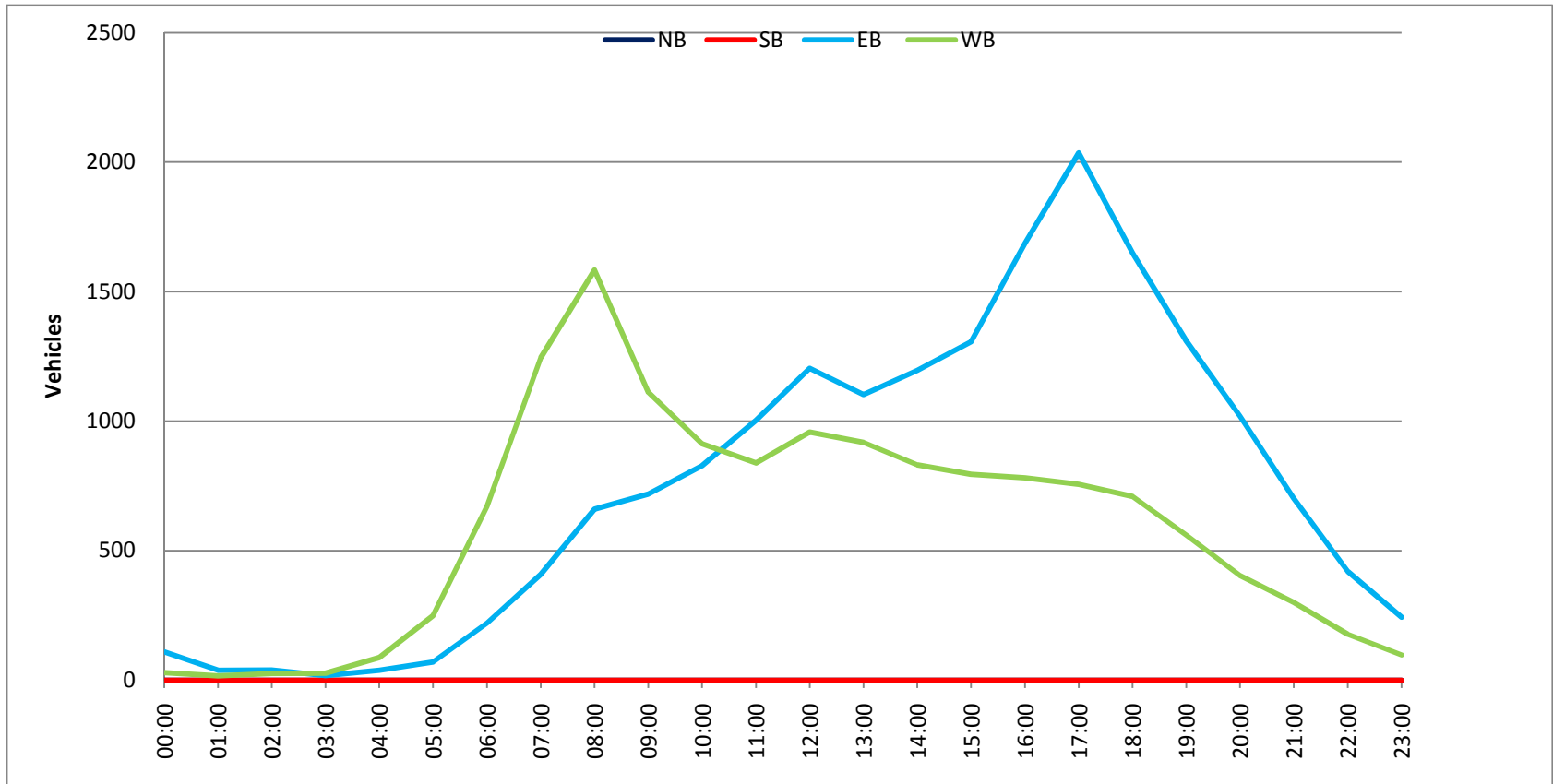
Prepared by NDS/ATD

Project #: 10-7268-002

City: San Ramon

Location: Crow Canyon Rd between Alcosta Blvd & El Capitan Dr

Date: Thursday, July 15, 2010



Before Period  
Bollinger Canyon Road

---

Between Sunset Drive and Camino Ramon

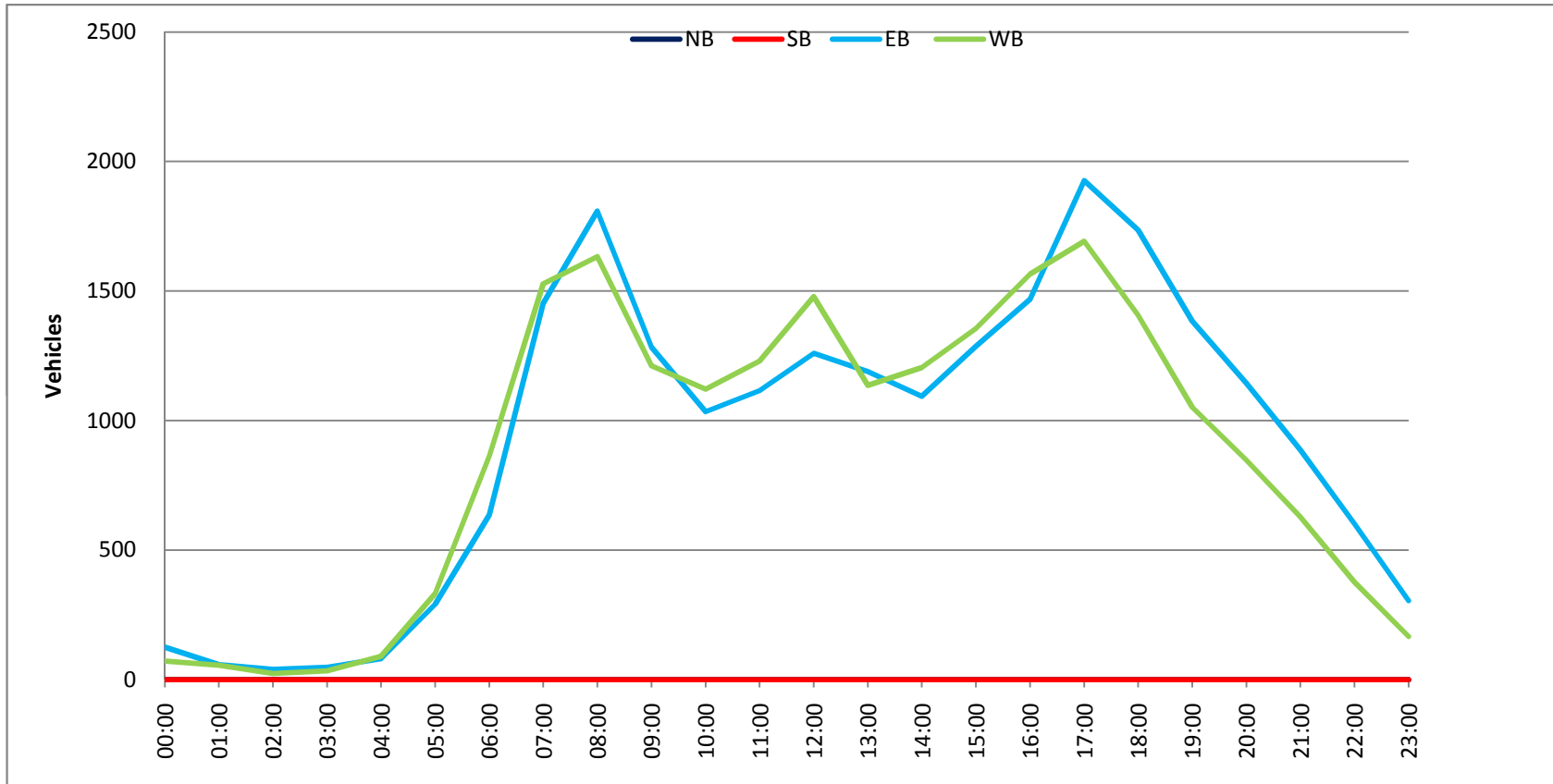
Prepared by NDS/ATD

Project #: 10-7268-003

City: San Ramon

Location: Bollinger Canyon Rd between Sunset Dr &  
Camino Ramon

Date: Tuesday, July 13, 2010



Prepared by NDS/ATD

Project #: 10-7268-003

City: San Ramon

Location: Bollinger Canyon Rd between Sunset Dr &

Camino Ramon

Date: Wednesday, July 14, 2010



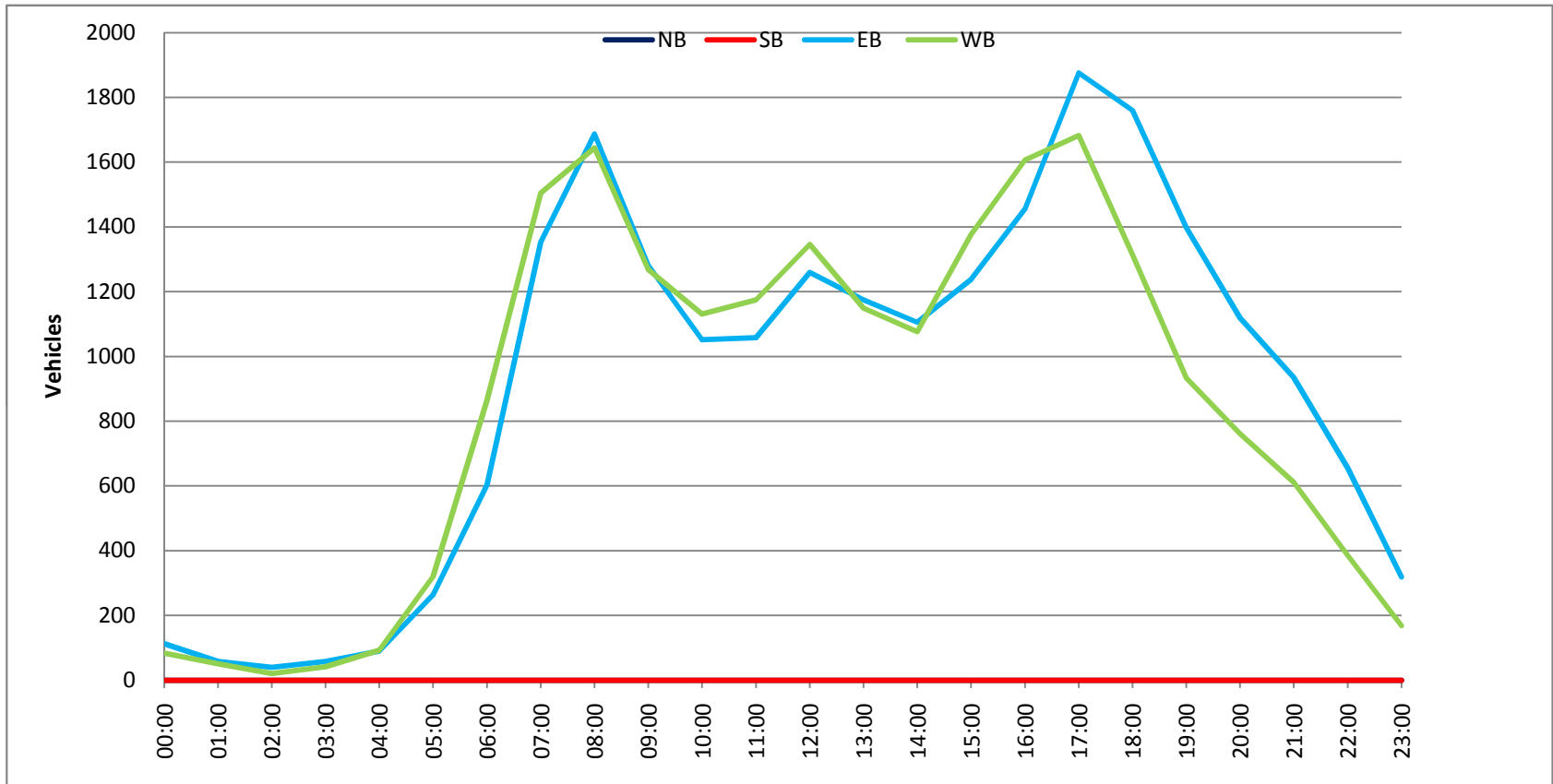
Prepared by NDS/ATD

Project #: 10-7268-003

City: San Ramon

Location: Bollinger Canyon Rd between Sunset Dr &  
Camino Ramon

Date: Thursday, July 15, 2010



Before Period  
Bollinger Canyon Road

---

Between Market Place and Alcosta Boulevard

Prepared by NDS/ATD

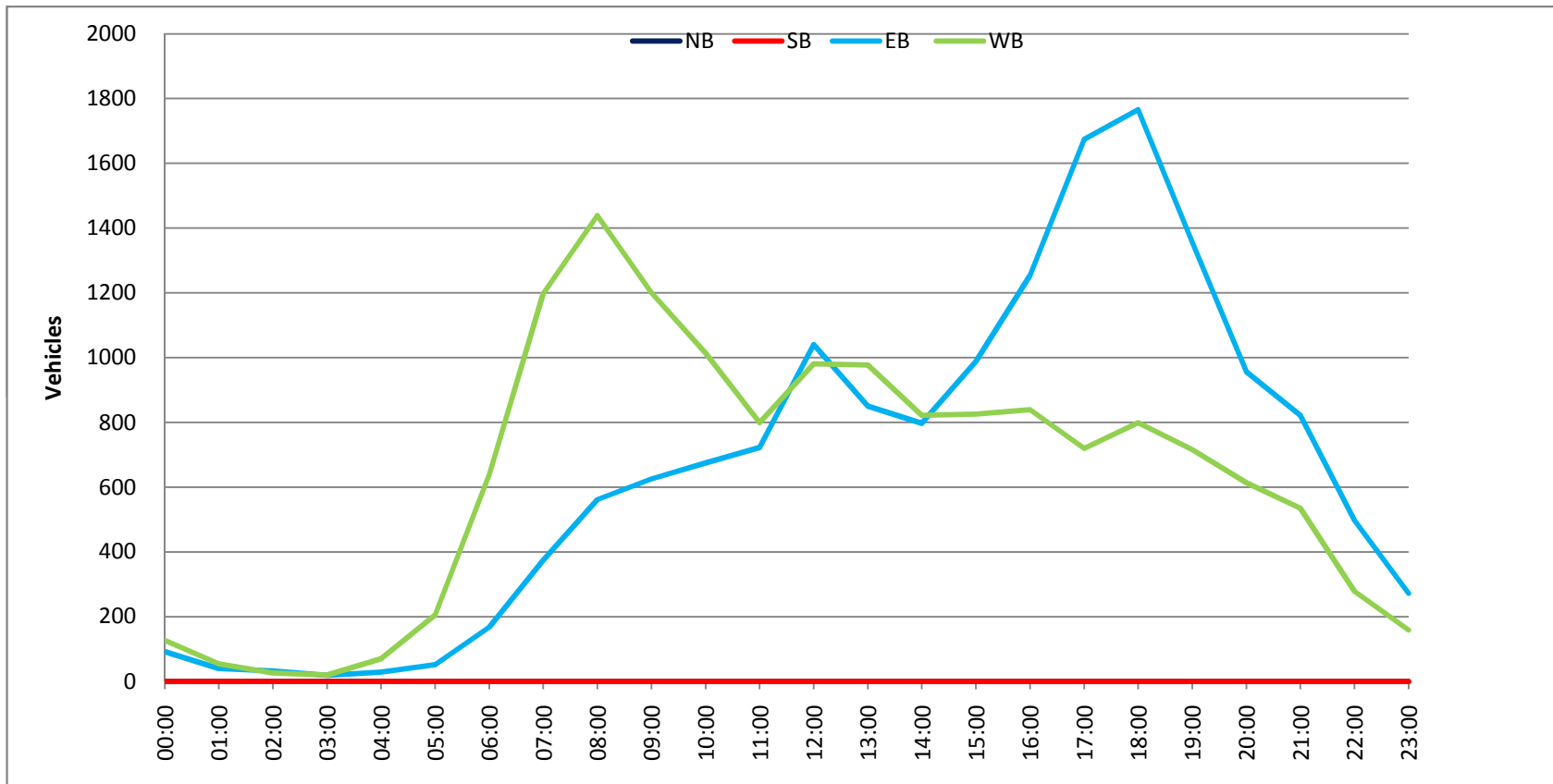
Project #: 10-7268-004

City: San Ramon

Location: Bollinger Canyon Rd between Market Pl &

Alcosta Blvd

Date: Tuesday, July 13, 2010



Prepared by NDS/ATD

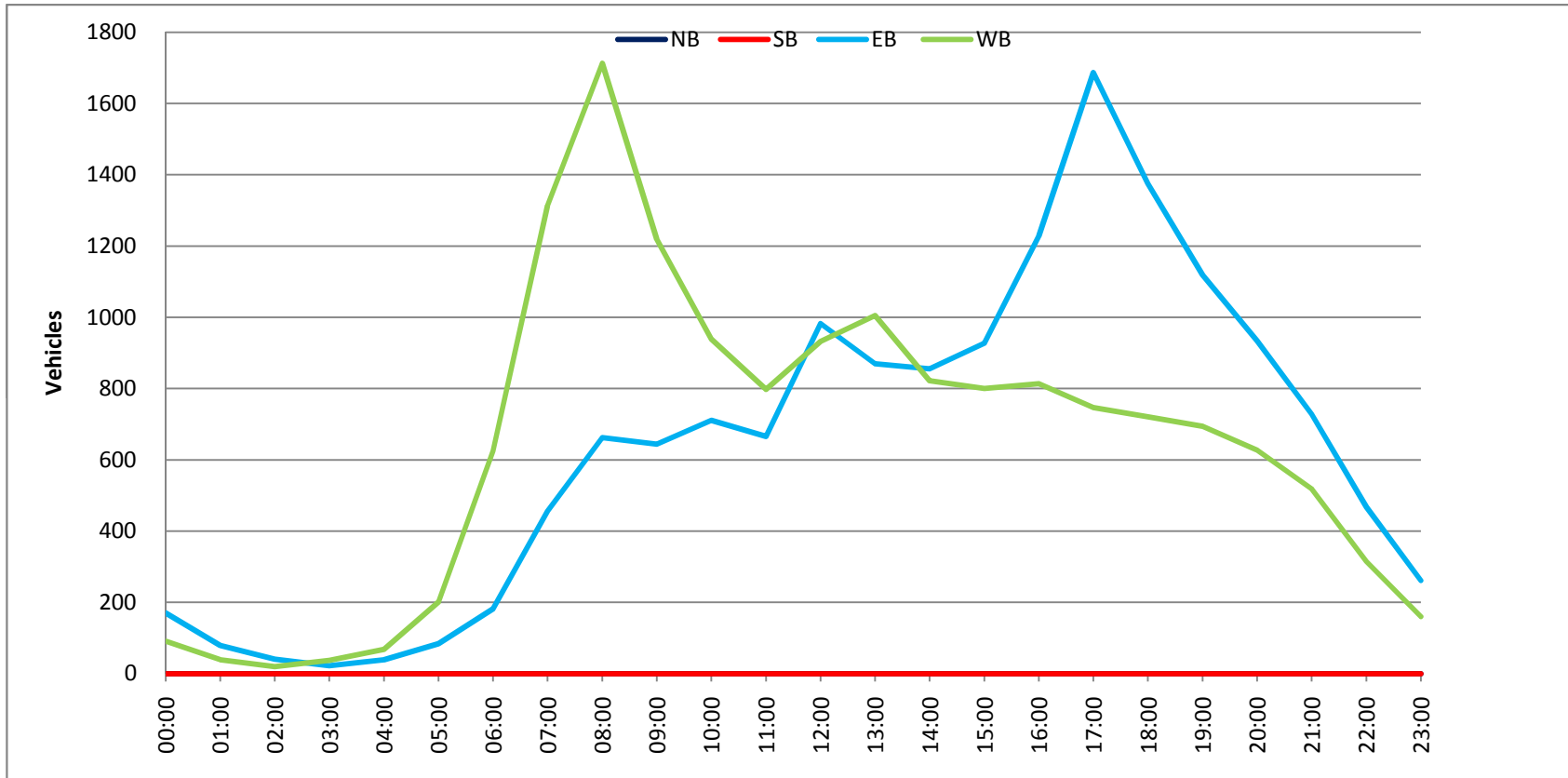
Project #: 10-7268-004

City: San Ramon

Location: Bollinger Canyon Rd between Market Pl &

Alcosta Blvd

Date: Wednesday, July 14, 2010



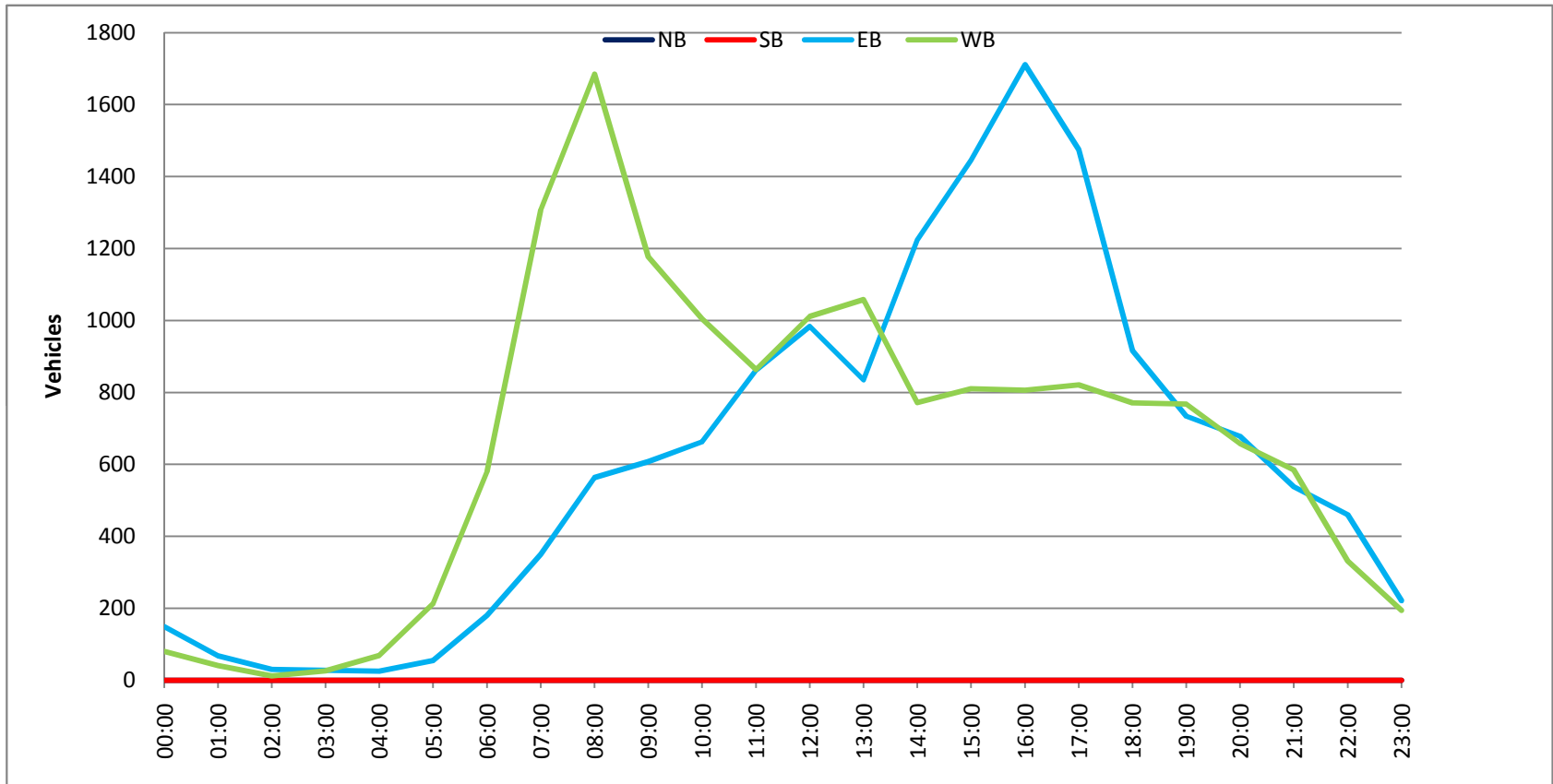
Prepared by NDS/ATD

Project #: 10-7268-004

City: San Ramon

Bollinger Canyon Rd between Market Pl &  
Location: Alcosta Blvd

Date: Thursday, July 15, 2010



**Appendix B-2**  
After Period  
Traffic Volume Counts

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After Period  
Crow Canyon Road  

---

East of Crow Canyon Place

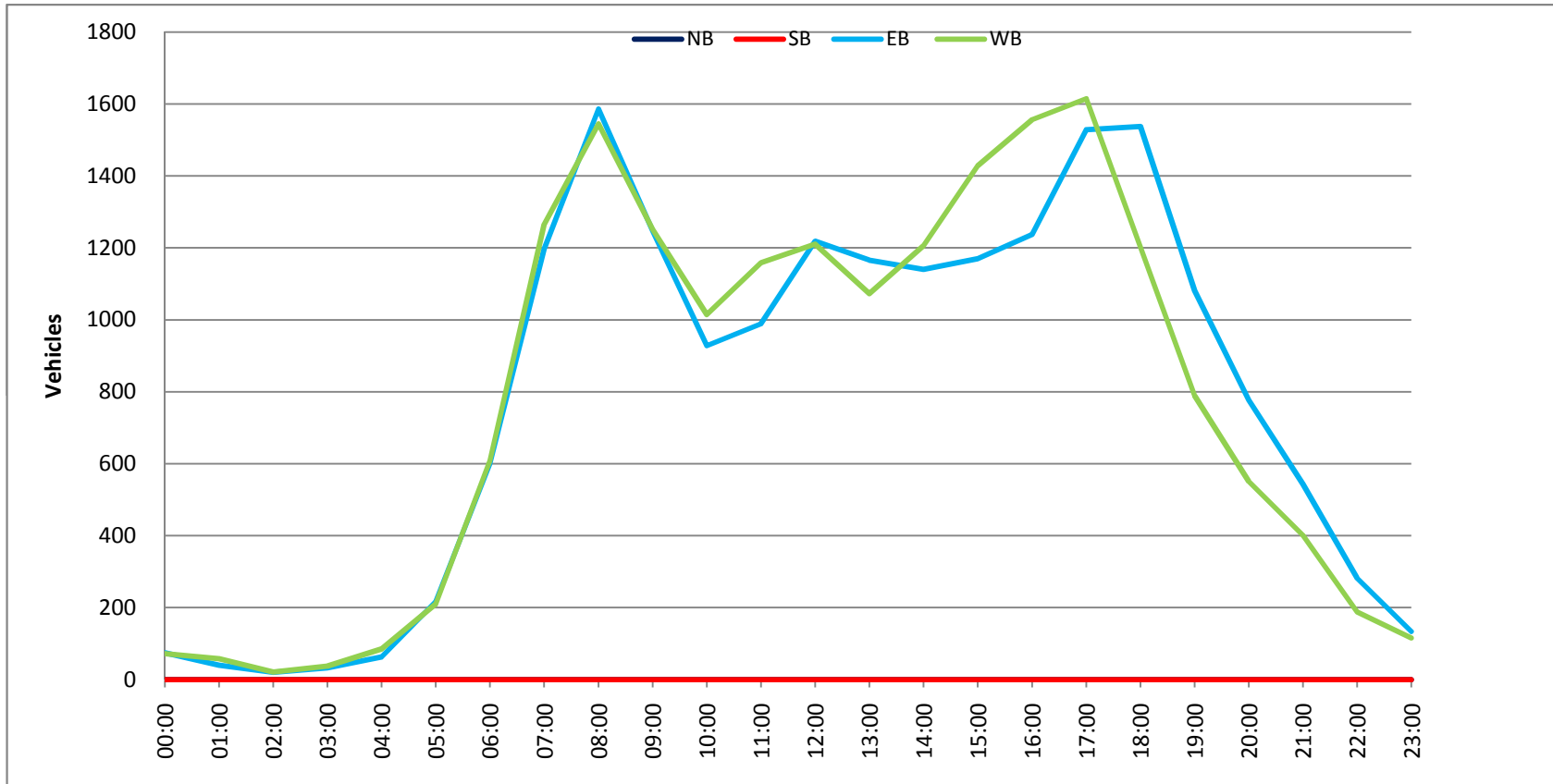
Prepared by NDS/ATD

Project #: 10-7317-001

City: San Ramon

Location: Crow Canyon Rd E/o Crow Canyon Pl

Date: Tuesday, September 14, 2010



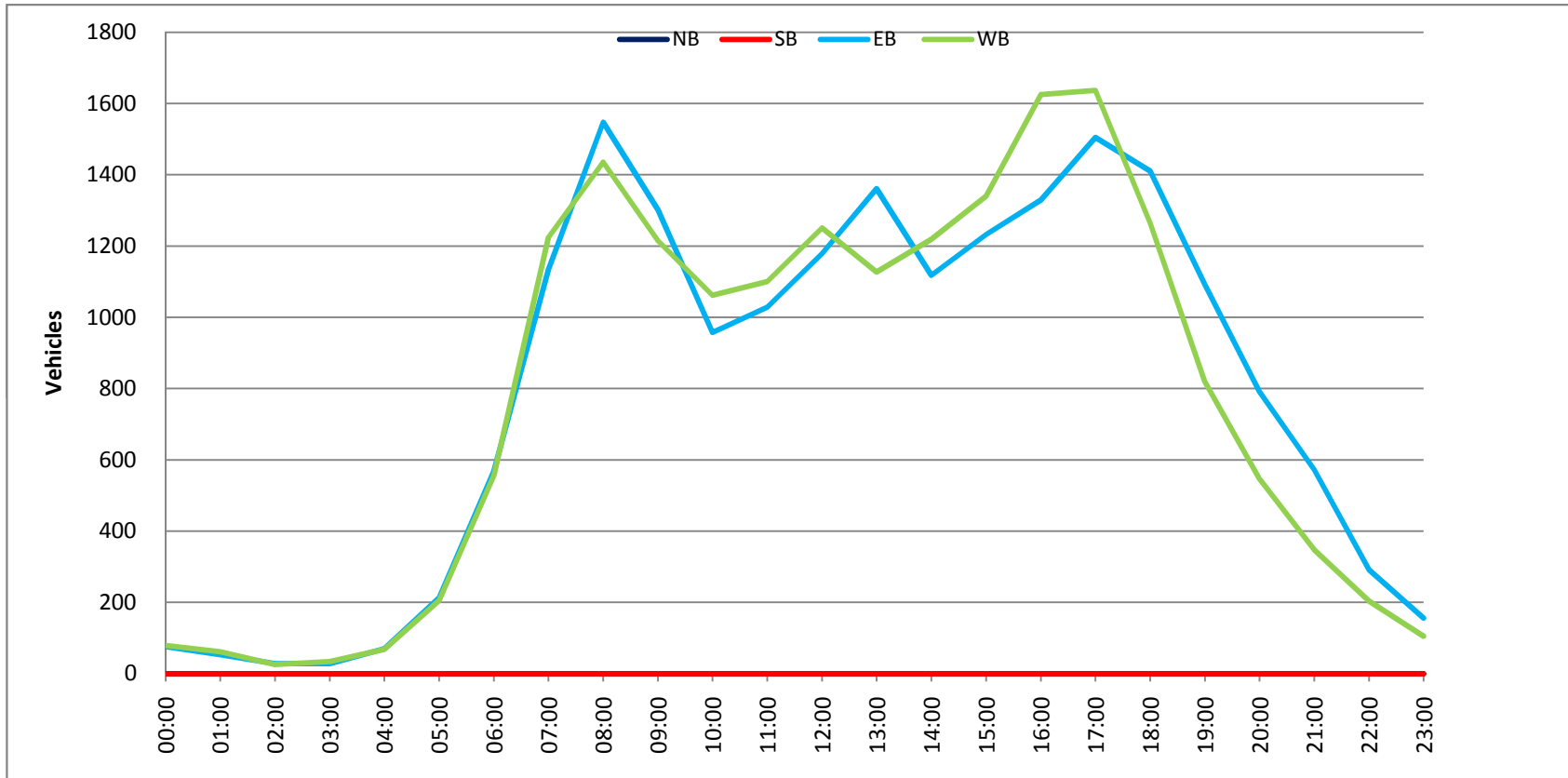
Prepared by NDS/ATD

Project #: 10-7317-001

City: San Ramon

Location: Crow Canyon Rd E/o Crow Canyon Pl

Date: Wednesday, September 15, 2010



Prepared by NDS/ATD

Project #: 10-7317-001

City: San Ramon

Location: Crow Canyon Rd E/o Crow Canyon Pl

Date: Thursday, September 16, 2010



After Period  
Crow Canyon Road

---

Between Alcosta Boulevard and El Capitan Drive

Prepared by NDS/ATD

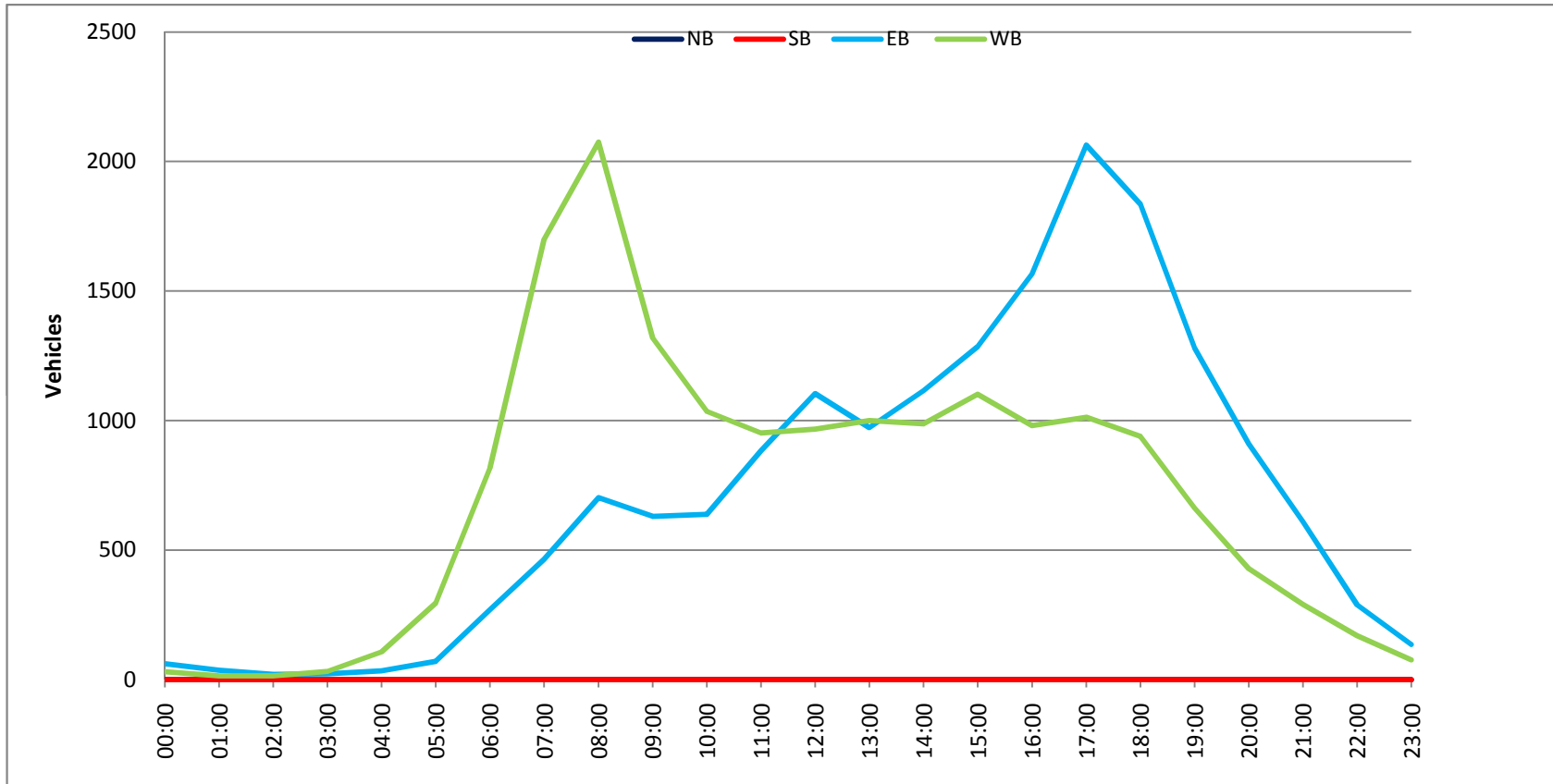
Project #: 10-7317-002

City: San Ramon

Location: Crow Canyon Rd between Alcosta Blvd &

El Capitan Dr

Date: Tuesday, September 14, 2010



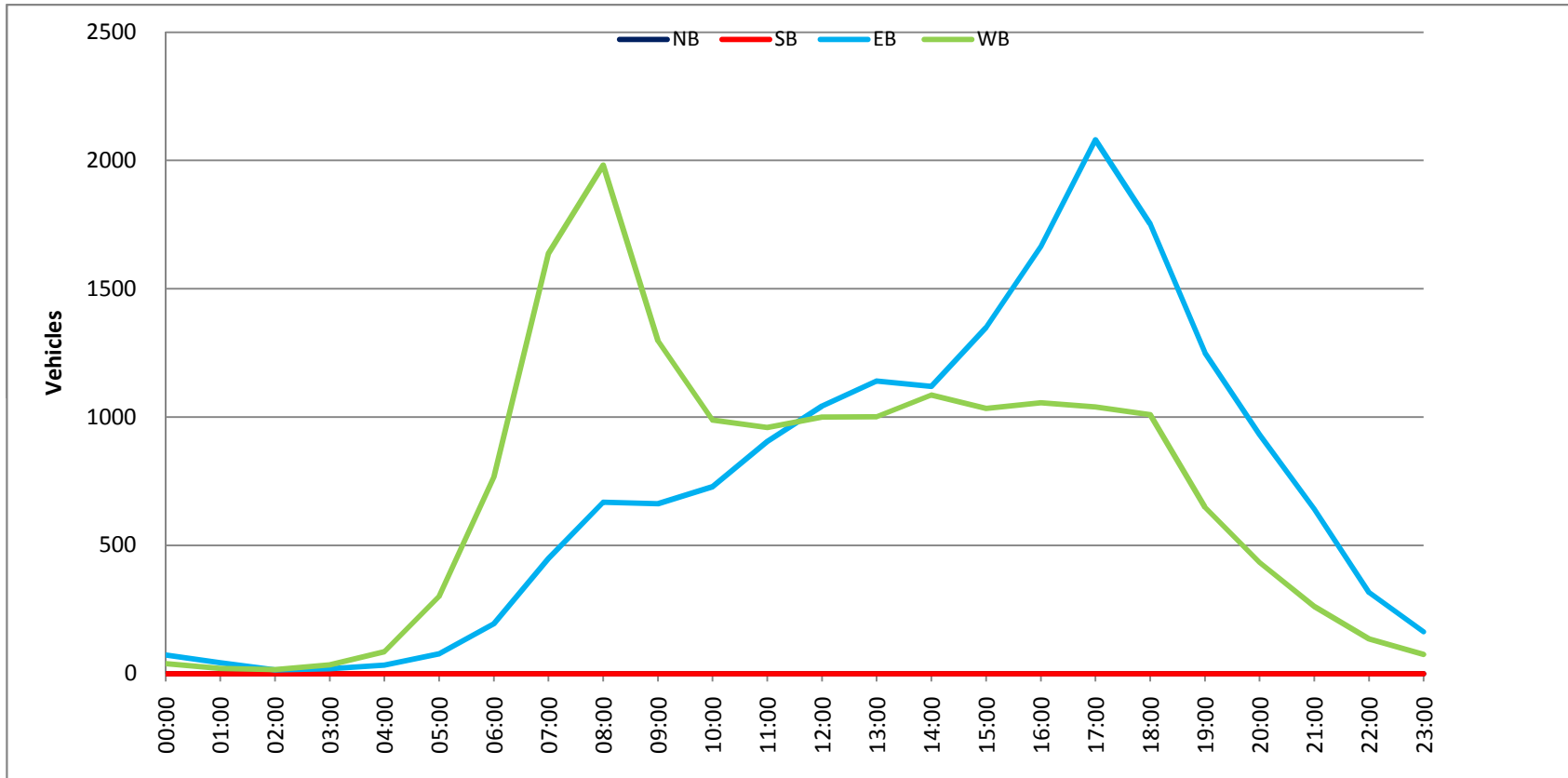
Prepared by NDS/ATD

Project #: 10-7317-002

City: San Ramon

Location: Crow Canyon Rd between Alcosta Blvd &  
El Capitan Dr

Date: Wednesday, September 15, 2010



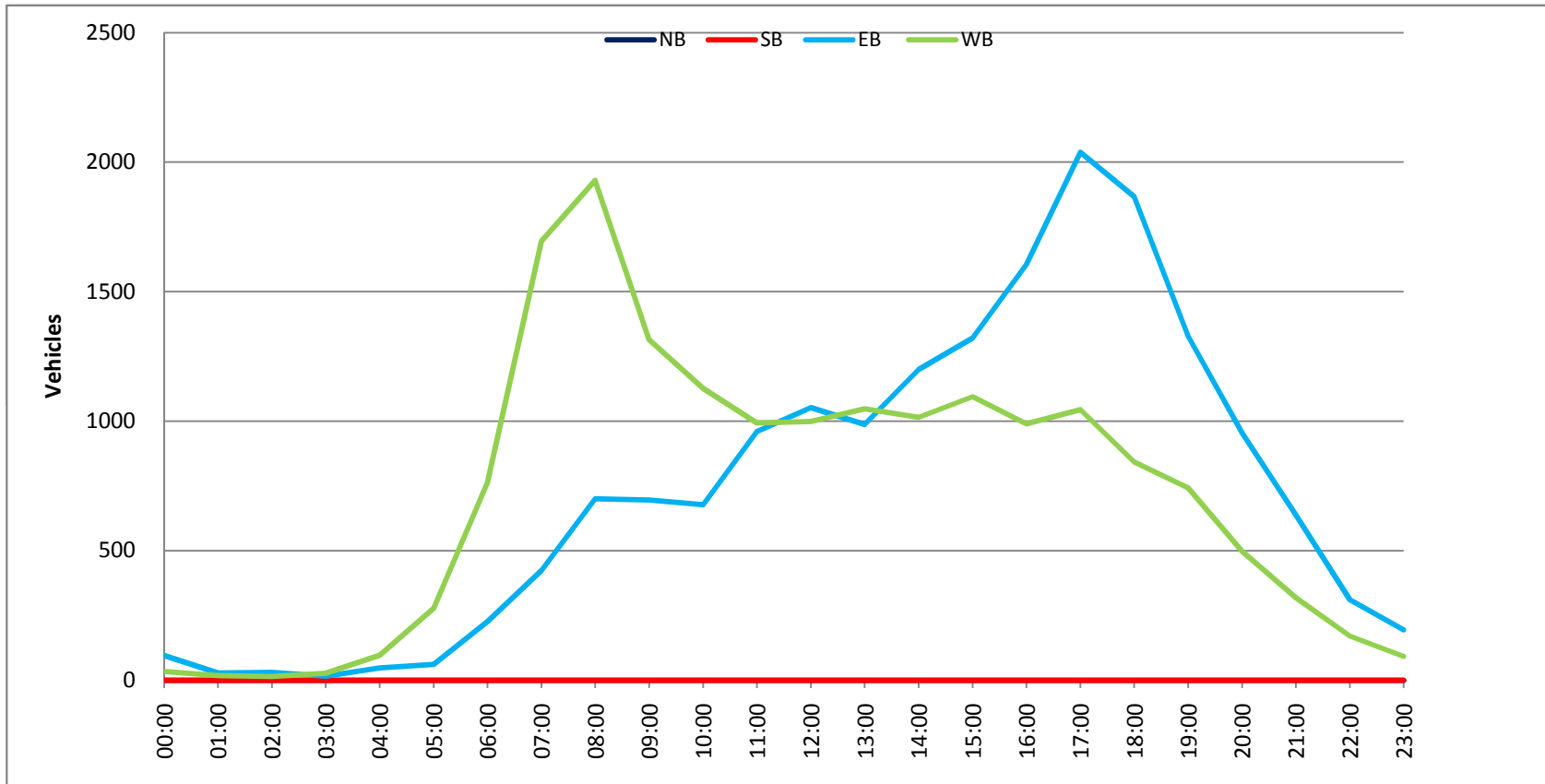
Prepared by NDS/ATD

Project #: 10-7317-002

City: San Ramon

Location: Crow Canyon Rd between Alcosta Blvd &  
El Capitan Dr

Date: Thursday, September 16, 2010



After Period  
Bollinger Canyon Road

---

Between Sunset Drive and Camino Ramon

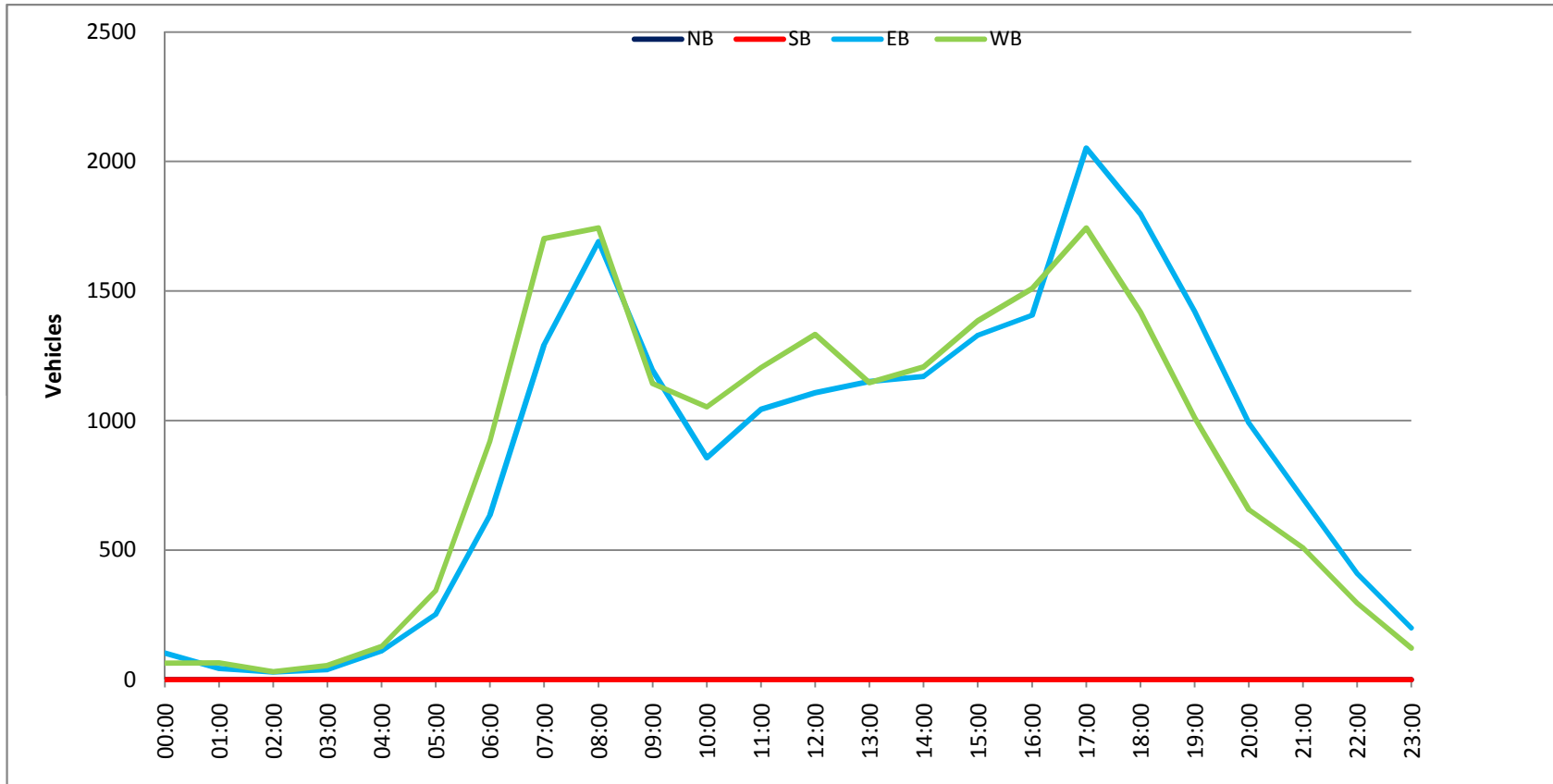
Prepared by NDS/ATD

Project #: 10-7317-003

City: San Ramon

Location: Bollinger Canyon Rd between Sunset Dr &  
Camino Ramon

Date: Tuesday, September 14, 2010



Prepared by NDS/ATD

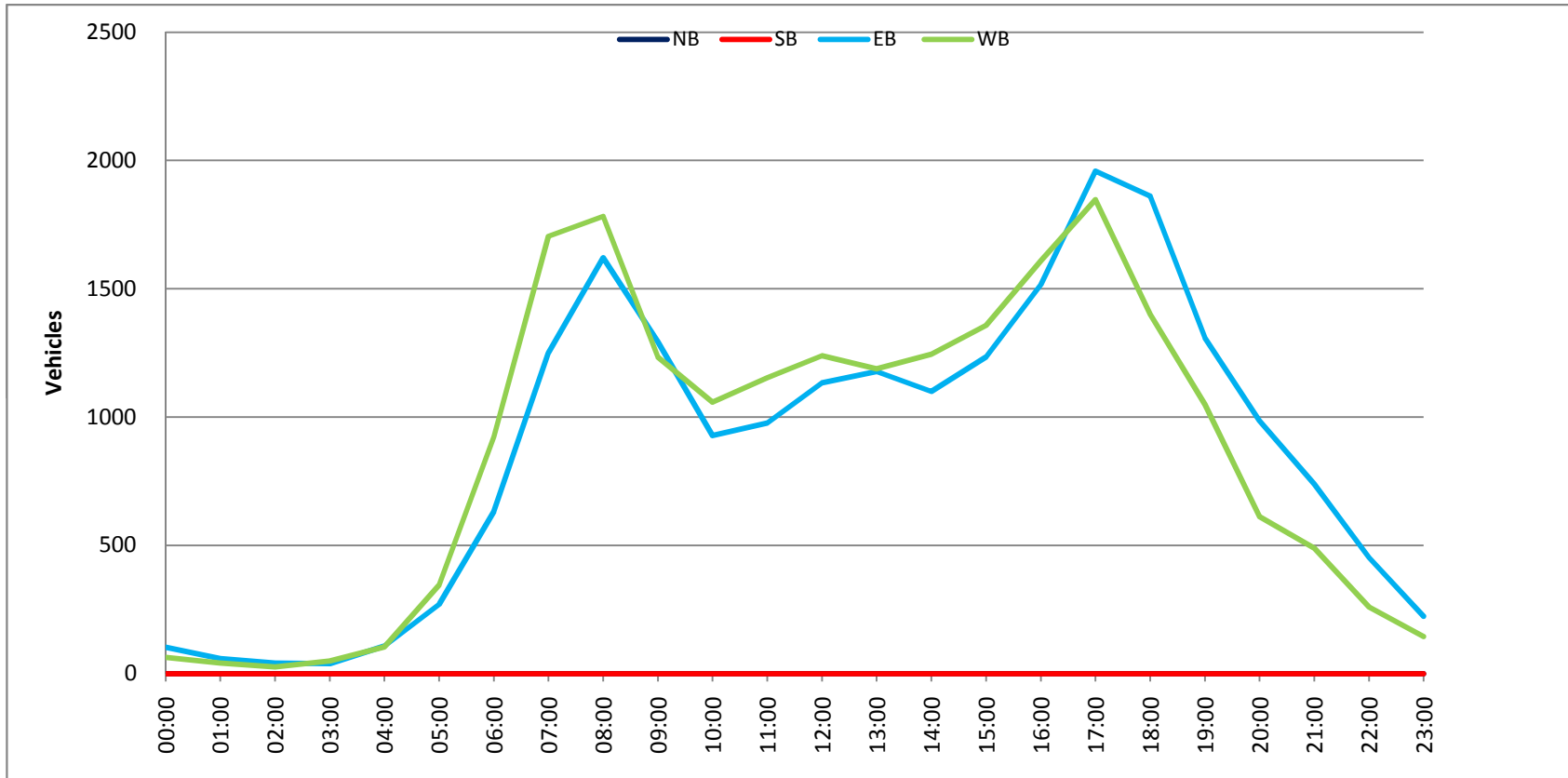
Project #: 10-7317-003

City: San Ramon

Location: Bollinger Canyon Rd between Sunset Dr &

Camino Ramon

Date: Wednesday, September 15, 2010



Prepared by NDS/ATD

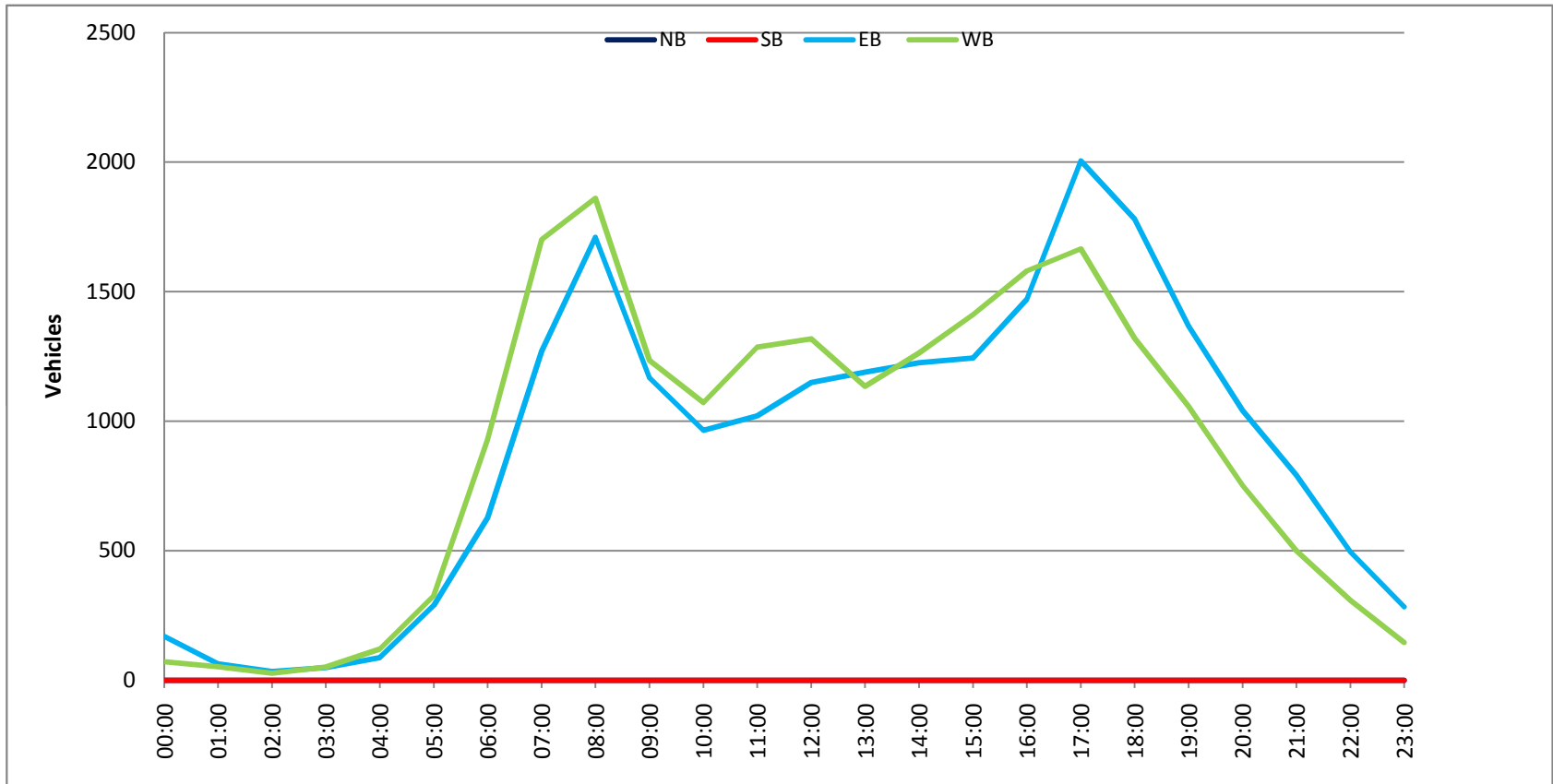
Project #: 10-7317-003

City: San Ramon

Location: Bollinger Canyon Rd between Sunset Dr &

Camino Ramon

Date: Thursday, September 16, 2010



After Period  
Bollinger Canyon Road

---

Between Market Place and Alcosta Boulevard

Prepared by NDS/ATD

Project #: 10-7317-004

City: San Ramon

Location: Bollinger Canyon Rd between Market Pl &

Alcosta Blvd

Date: Tuesday, September 14, 2010



Prepared by NDS/ATD

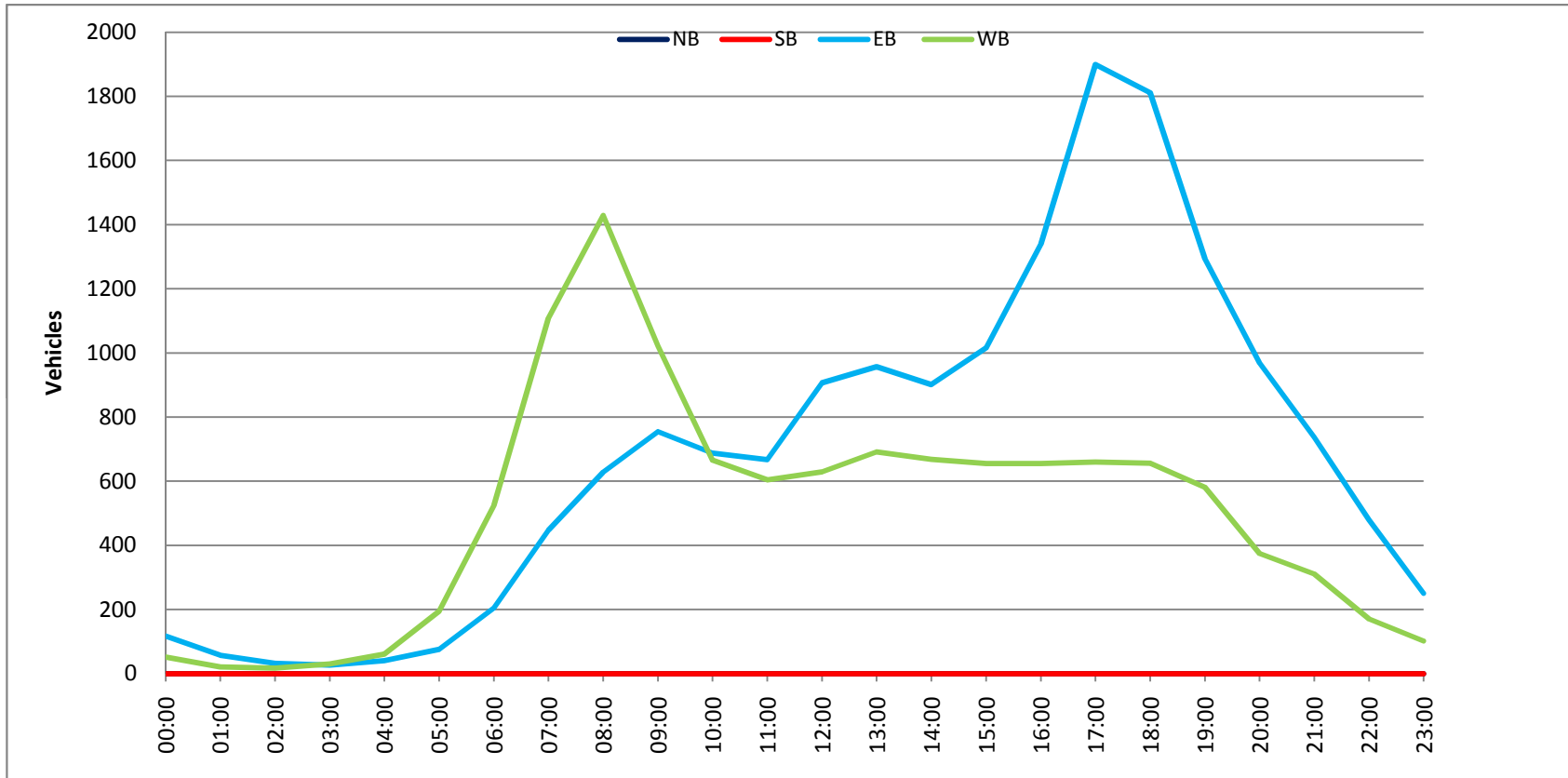
Project #: 10-7317-004

City: San Ramon

Location: Bollinger Canyon Rd between Market Pl &

Alcosta Blvd

Date: Wednesday, September 15, 2010



Prepared by NDS/ATD

Project #: 10-7317-004

City: San Ramon

Location: Bollinger Canyon Rd between Market Pl &

Alcosta Blvd

Date: Thursday, September 16, 2010

