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To: Park City Department of Transportation

From: Rob Sunderlage, PE

Date: June 20th, 2019 **Memorandum**

Subject: Traffic Impact Study: Hillside Ave and Highway 224

Introduction

The purpose of this memorandum is to present the findings of the Traffic Impact Study (TIS) regarding the redirection of traffic at the intersection of Hillside Ave and Highway 224 in Park City, UT. This study specifically discusses the study area, and the different scenarios conducted in the peak hours of the winter and summer time.

Study Area:

The study area includes the following intersections:

- Hillside Avenue and Highway 224
- Deer Valley Drive and Highway 224
- Heber Avenue and Highway 224

Analysis of Existing Conditions

Seasonal Growth

To imitate winter and summer conditions, Horrocks counted vehicles at the study intersections during the PM peak hours in May 2019 and used past data to find the seasonal growth in January (winter) and August (summer). Seasonal growth factors can be found on **Table 1.**

Table 1: Seasonal Growth

Time	Winter	Summer
Weekday	55%	29%
Weekend	56%	13%

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Level of Service

In order to quantify the winter and summer traffic conditions exhibited in the study area, the roadway geometries, traffic data, and signal timings were entered in the Synchro 10 software package. Using the 2010 Highway Capacity Manual (HCM) method of calculating intersection delay, a Level of Service (LOS) grade was assigned to the intersection for PM peak hours in the weekday and weekend.

Level of Service (LOS) is a term used by the HCM to describe the traffic operations of an intersection, based on congestion and delay. LOS ranges from A (almost no congestion or delay) to F (traffic demand exceeds capacity and intersection experiences long queues and delay). LOS E is the threshold when the intersection exceeds an acceptable standard and intersection improvements are required. The delay criteria used to assign a letter grade to an intersection for signalized and unsignalized intersections is shown below in **Table 2**.

Table 2: LOS Delay Criteria

Level of Service	Average Control Delay (sec/veh)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	> 10 - 20	> 10 - 15
C	> 20 - 35	> 15 - 25
D	> 35 - 55	> 25 - 35
E	> 55 - 80	> 35 - 50
F	> 80	> 50

Shuttle Schedule

Shuttle data was obtained from resorts surrounding the study area. Due to increased tourism in the winter and summer, more shuttles tend to drive through Park City to get to and from the airport and other hotels/resorts. Horrocks obtained Deer Valley shuttle schedule to imitate shuttle traffic during winter and summer. The data showed an increase of 57% over the existing shuttle schedule. This growth was implemented in all scenarios presented in this TIS.

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Scenario 1

This scenario was created by applying the corresponding seasonal growth factor to the counts obtained in May 2019. This was done to create the most accurate traffic conditions seen during the winter and summer. The following sections discuss the impact in travel time, LOS and queuing in all study intersections.

Level of Service and Delays

Table 3 shows the modeled winter existing conditions at the study intersections including their average control delay per vehicle and corresponding LOS. All intersections perform at acceptable LOS C or higher. No mitigations are recommended at this time.

Table 3: Winter Existing PM Peak Hour Intersection Operations

Intersection	Weekday		Weekend	
	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service
Existing Conditions (Winter)				
Hillside Ave & Hwy 224	9.2	A	6.8	A
Deer Valley Dr & Hwy 224	3.3	A	3.4	A
Heber Ave and Hwy 224	24.3	C	16.2	C

Table 4 shows the modeled summer existing conditions at the study intersections including their average control delay per vehicle and corresponding LOS. All intersections perform at acceptable LOS C or higher. No mitigations are recommended at this time.

Table 4: Summer Existing PM Peak Hour Intersection Operations

Intersection	Weekday		Weekend	
	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service
Existing Conditions (Summer)				
Hillside Ave & Hwy 224	7.1	A	6.2	A
Deer Valley Dr & Hwy 224	2.9	A	2.9	A
Heber Ave and Hwy 224	15.7	C	12.3	B

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Queuing

The queue length during PM peak hours in a weekday and weekend can be seen in **Tables 5-6** for winter conditions and **Tables 7-8** for summer.

During the winter, the highest queue length is seen in the northbound-left approach with 861 ft. and 211 ft. in a weekday and weekend, respectively, at Deer Valley Drive with Highway 224. Queue lengths can also be seen in **Figure 1.** If the queue length at Deer Valley Drive reaches 860 feet, a vehicle driving from Hillside Avenue to Heber Avenue would take approximately 4.81 minutes. However, at a queue length of 2,000 feet from Deer Valley Drive, a vehicle would take 8.87 minutes to reach Heber Avenue under the same circumstances.

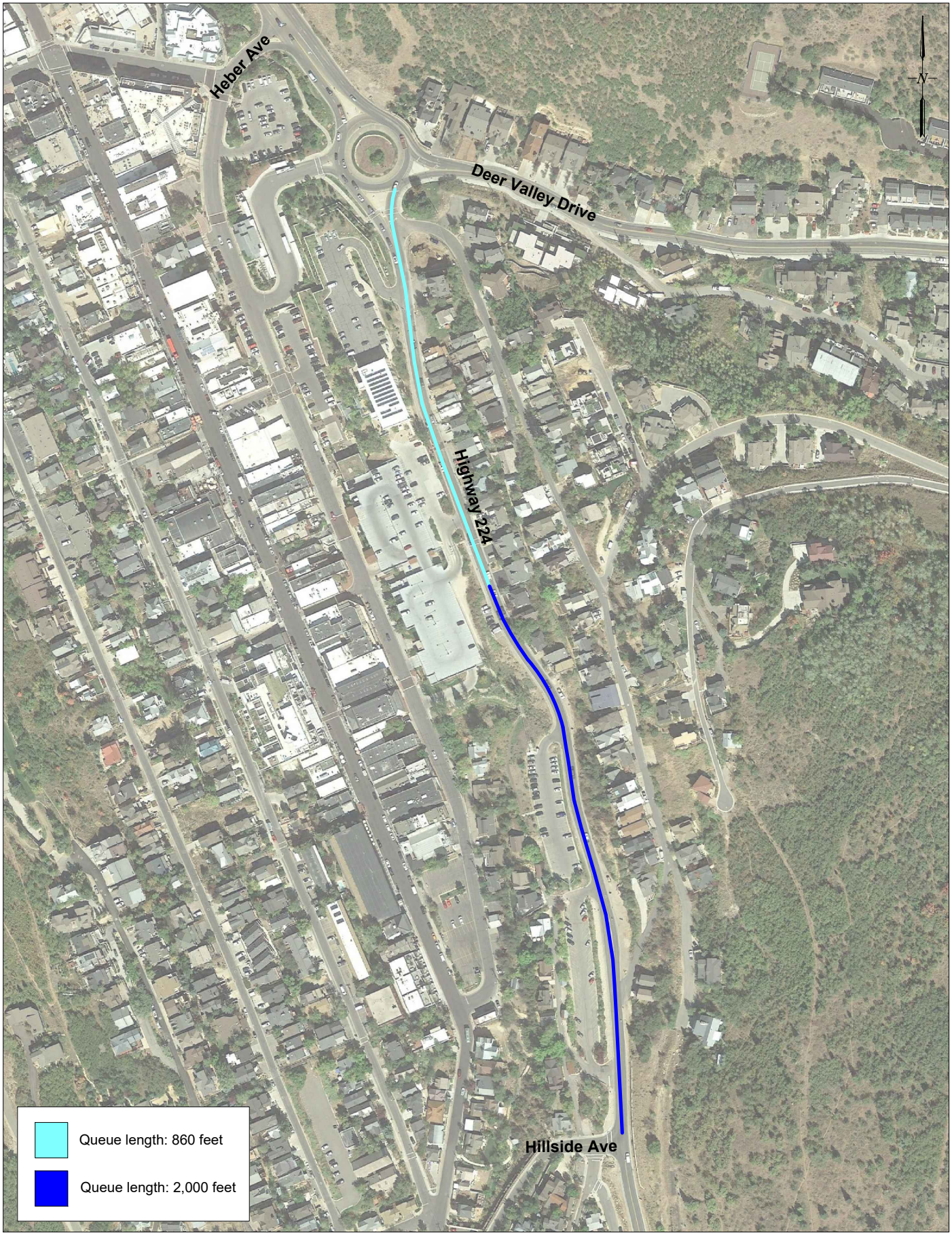
Table 5: Winter Weekday Existing Queue Length

Intersection	Max Queue (ft)	95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	805	861	NBLR
Heber Ave & Hwy 224	91	71	NBL
Hillside Ave & Hwy 224	155	150	NBLT

Table 6: Winter Weekend Existing Queue Length

Intersection	Max Queue (ft)	95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	243	211	NBLR
Heber Ave & Hwy 224	53	50	NBL
Hillside Ave & Hwy 224	112	105	NBLT

Exhibit C



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Queue Lengths
Winter Existing Scenario

FIGURE 1

SCALE: N/A

DATE: 06/2019

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During the summer, the highest queue length is in the northbound approach with 332 ft. and 93 ft. in a weekday and weekend, respectively, at Deer Valley Drive with Highway 224.

Table 7: Summer Weekday Existing Queue Length

Intersection	Max Queue (ft)	95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	368	332	NBLR
Heber Ave & Hwy 224	67	54	NBL
Hillside Ave & Hwy 224	141	120	NBLT

Table 8: Summer Weekend Existing Queue Length

Intersection	Max Queue (ft)	95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	117	93	NBLR
Heber Ave & Hwy 224	42	40	NBL
Hillside Ave & Hwy 224	95	83	NBLT

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Scenario 2

This scenario was created by using scenario 1 and moving all northbound left traffic turning onto Hillside Avenue with Highway 224 to Heber Avenue with Highway 224. The following sections discuss the impact in LOS and queuing in all study intersections.

Level of Service and Delays

Table 9 shows the modeled winter existing conditions at the study intersections including their average control delay per vehicle and corresponding LOS. All intersections perform at acceptable LOS C or higher. No mitigations are recommended at this time.

Table 9: Winter No Left PM Peak Hour Intersection Operations

Intersection	Weekday		Weekend	
	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service
No Lefts Conditions (Winter)				
Hillside Ave & Hwy 224	7.4	A	6.4	A
Deer Valley Dr & Hwy 224	3.3	A	3.4	A
Heber Ave and Hwy 224	24.3	C	16.2	C

Table 10 shows the modeled summer existing conditions at the study intersections including their average control delay per vehicle and corresponding LOS. All intersections perform at acceptable LOS C or higher. No mitigations are recommended at this time.

Table 10: Summer No Left PM Peak Hour Intersection Operations

Intersection	Weekday		Weekend	
	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service
No Left Conditions (Summer)				
Hillside Ave & Hwy 224	6.8	A	5.8	A
Deer Valley Dr & Hwy 224	2.9	A	2.9	A
Heber Ave and Hwy 224	15.7	C	12.3	B

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Queuing

The queue length during PM peak hours in a weekday and weekend for this scenario can be seen in **Tables 11-12** for winter conditions and **Tables 13-14** for summer.

During the winter the highest increase in queue length is 18 ft. in the northbound-left approach at the roundabout of Highway 224 and Deer Valley Drive. During the weekend, the highest increase in queue length is 73 ft. in the northbound-left approach also at Deer Valley with Highway 224.

Table 11: Winter Weekday Existing No Lefts Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	906	101	879	18	NBLR
Heber Ave & Hwy 224	107	16	92	21	NBL
Hillside Ave & Hwy 224	140	-15	122	-28	NBT

Table 12: Winter Weekend Existing No Lefts Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	334	91	284	73	NBLR
Heber Ave & Hwy 224	77	24	65	15	NBL
Hillside Ave & Hwy 224	132	20	96	-9	NBT

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During the summer the highest increase in queue length during the 95th queuing is 69 ft. in the northbound approach at the roundabout of Highway 224 and Deer Valley Drive. During the weekend, the highest increase in queue length is 13 ft. for both Highway 224 with Deer Valley Drive and Heber Avenue with Highway 224.

Table 13: Summer Weekday Existing No Lefts Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	471	103	401	69	NBLR
Heber Ave & Hwy 224	67	3	58	4	NBL
Hillside Ave & Hwy 224	135	-6	107	-13	NBT

Table 14: Summer Weekend Existing No Lefts Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	138	21	106	13	NBLR
Heber Ave & Hwy 224	62	20	53	13	NBL
Hillside Ave & Hwy 224	94	-1	78	-5	NBT

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Scenario 3

This scenario was created by using the same conditions of scenario 2 in addition of removing the northbound stop sign at Highway 224 with Hillside Ave. The following sections discuss the impact in LOS and queuing in all study intersections.

Level of Service and Delays

Table 15 shows the modeled winter existing conditions at the study intersections including their average control delay per vehicle and corresponding LOS. All intersections perform at acceptable LOS C or higher. No mitigations are recommended at this time.

Table 15: Winter No Left and No Stop PM Peak Hour Intersection Operations

Intersection	Weekday		Weekend	
	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service
No Left and No Stop Conditions (Winter)				
Hillside Ave & Hwy 224	10.1	B	9.1	A
Deer Valley Dr & Hwy 224	3.4	A	3.4	A
Heber Ave and Hwy 224	24.3	C	16.2	C

Table 16 shows the modeled winter existing conditions at the study intersections including their average control delay per vehicle and corresponding LOS. All intersections perform at acceptable LOS C or higher. No mitigations are recommended at this time.

Table 16: Summer No Left and No Stop PM Peak Hour Intersection Operations

Intersection	Weekday		Weekend	
	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service
No Left and No Stop Conditions (Summer)				
Hillside Ave & Hwy 224	9.3	A	7.6	A
Deer Valley Dr & Hwy 224	2.9	A	2.9	A
Heber Ave and Hwy 224	15.7	C	12.3	B

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Queueing

The queue length during PM peak hours in a weekday and weekend for this scenario can be seen in **Tables 17-18** for winter conditions and **Tables 19-20** for summer.

During the winter the highest increase in queue length is 50 ft. in the northbound-left approach at the roundabout of Highway 224 and Deer Valley Drive. During the weekend, the same intersection faces the highest increase in queue length of 42 ft.

Table 17: Winter Weekday Existing No Lefts & No Stop Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	943	138	911	50	NBLR
Heber Ave & Hwy 224	111	20	97	26	NBL
Hillside Ave & Hwy 224	79	NA	62	NA	EBL

Table 18: Winter Weekend Existing No Lefts & No Stop Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	302	59	253	42	NBLR
Heber Ave & Hwy 224	80	27	66	16	NBL
Hillside Ave & Hwy 224	74	NA	60	NA	EBL

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During the summer, the highest increase in queue length is 6 ft. in the northbound approach at the roundabout of Highway 224 and Deer Valley Drive. During the weekend, the highest increase in queue length is 21 ft. also occurring at the roundabout.

Table 19: Summer Weekday Existing No Lefts & No Stop Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	446	78	338	6	NBLR
Heber Ave & Hwy 224	73	6	61	7	NBL
Hillside Ave & Hwy 224	83	NA	62	NA	EBL

Table 20: Summer Weekend Existing No Lefts & No Stop Queue Length

Intersection	Max Queue (ft)	Increase Over Existing Max Queue (ft)	95th Queue (ft)	Increase Over Existing 95th Queue (ft)	Direction
Hwy 224 & Deer Valley Dr	150	33	114	21	NBLR
Heber Ave & Hwy 224	60	18	51	11	NBL
Hillside Ave & Hwy 224	62	NA	53	NA	EBL

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Summary

- **Scenario 1**
  - **Winter:** All study intersections perform at acceptable LOS C or higher. The highest queue length is in the northbound approach with 861 ft. and 211 ft. in a weekday and weekend, respectively, at Deer Valley Drive with Highway 224.
  - **Summer:** All study intersections perform at acceptable LOS C or higher. The highest queue length is in the northbound approach with 332 ft. and 93 ft. in a weekday and weekend, respectively, at Deer Valley Drive with Highway 224.
- **Scenario 2:**
  - **Winter**: All study intersections perform at acceptable LOS C or higher. Highest increase of queue length was 18 ft. in a weekday and 73 ft. in the weekend.
  - **Summer:** All study intersections perform at acceptable LOS C or higher. Highest increase in queue length was 16 ft. in a weekday and 13 ft. in the weekend.
- **Scenario 3:**
  - **Winter:** All study intersections perform at acceptable LOS C or higher. Highest increase of queue length was 50 ft. in a weekday and 42 ft. in the weekend.
  - **Summer:** All study intersections perform at acceptable LOS C or higher. Highest increase of queue length was 6 ft. in a weekday and 21 ft. in the weekend.

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Appendix

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Winter Scenarios

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Summer Scenarios