

TECHNICAL MEMORANDUM

Project: ISD High School #4 / Elementary School #17

Subject: Trip Generation and Distribution – Updated

Date: June 9, 2020

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1. Introduction

This memorandum presents updated trip generation and trip distribution for a new high school (High School #4) and new elementary school (Elementary School #17) proposed by the Issaquah School District (ISD). The site is located within Issaquah, but the proposed access intersection is within Sammamish. Because the site is located at the boundary between Issaquah and Sammamish, there is potential for transportation impacts in both cities. Therefore, the transportation study area encompasses portions of both cities, and all transportation analysis will be completed in accordance with each City's requirements. Please contact Jennifer Barnes at (206) 324-3623 with any questions regarding this memorandum.

The information presented in this memorandum supersedes the initial trip generation and distribution estimates reviewed by the Cities,¹ and reflects the following updates:

- The proposed enrollment capacity for the proposed High School #4 has been increased from 1,680 to 1,823 students.
- The anticipated attendance boundary for Elementary School #17 has been adjusted.
- A graphic has been added that shows the analysis intersections that have been confirmed with both the Cities of Sammamish and Issaquah, where detailed traffic operational analysis will be provided in the Transportation Technical Report prepared for the project.
- The commuter PM peak hour (defined as the peak hour for traffic on the adjacent streets) has been shifted by 15 minutes (from the hour beginning at 5:00 P.M. to the hour beginning at 4:45 P.M.) to align with the Sammamish Municipal Code (SMC) 14A.05.010 specified model PM peak hour. This had negligible effect on the high school trip generation rate, but resulted in a small increase in the elementary school trip rate. It is noted that the schools' combined AM peak hour is offset from the City-defined peak hour by 15 minutes (starting at 7:15 A.M. instead of 7:00 A.M.) but this results in a more conservatively high trip estimate so it was not adjusted.
- Minor adjustments have been made to the trip distribution assumptions, based upon feedback provided by the City of Sammamish. Specifically, adjustments have been made to reflect the presence of the Providence Point Community directly to the south of the site which is not expected to generate school trips, and assumptions about the portion of trips through the NE Inglewood Road / 228th

¹ Heffron Transportation, Inc., ISD High School #4 / Elementary School #17 – Trip Generation and Distribution, December 12, 2019.

Avenue NE intersection (located outside of both schools' anticipated enrollment boundaries, and primarily reflecting staff commute and family vehicle work-linked trips) has been reduced.

- Projected trip distribution at the proposed site access driveway has been presented in more detail.
- Information has been added about the schools that students within the anticipated enrollment boundaries would attend if the proposed school project is not constructed, as well as the peak hour trips that would be shifted away from the existing schools, as a result of the proposed new schools.

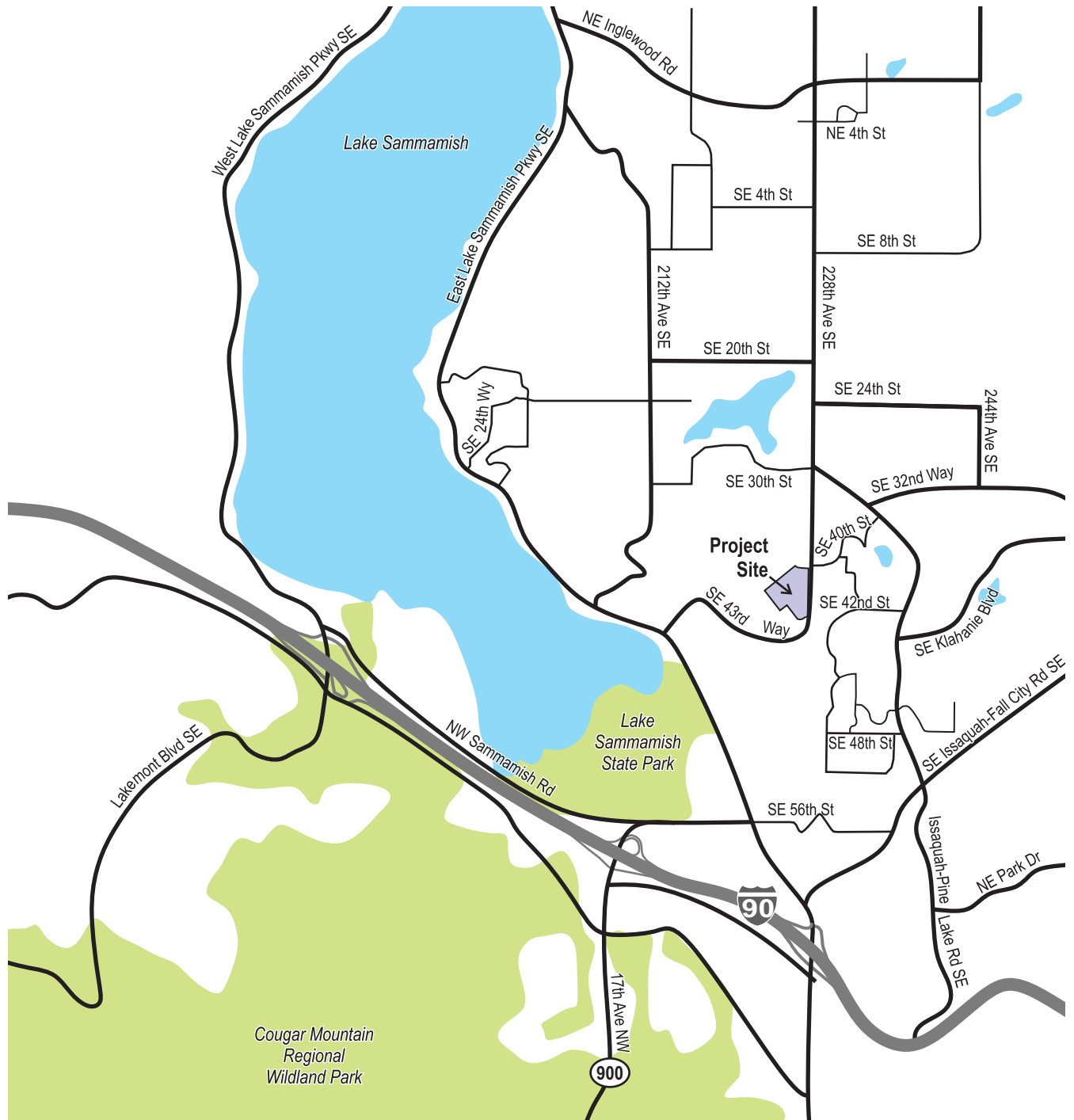
2. Project Description

ISD proposes to co-locate a new elementary school (serving grades pre-kindergarten through 5) and a new high school (serving grades 9 through 12) on a property located west of 228th Avenue SE and north of SE 43rd Way. The site location is shown on **Figure 1**.

The elementary school is planned for an enrollment capacity of 744 students (552 in permanent buildings plus potentially 192 in portable classrooms) with about 75 faculty and staff. The high school is planned for an enrollment capacity of 1,823 students (1,631 in permanent buildings plus potentially 192 in portable classrooms) with about 150 faculty and staff. About 668 vehicle parking spaces and 30 bus parking spaces are currently planned, although the parking supply could be adjusted as site design progresses. An additional 91 parking spaces could be provided in family vehicle and bus loading areas during off-peak periods, allowing up to 759 vehicles to be parked on site during special events.² The proposed school facilities include athletic fields, tennis courts, an auditorium, and a gymnasium. The preliminary site plan for the project is shown on **Figure 2**.

A signalized access driveway is planned on 228th Avenue SE. A separate emergency-access/service driveway connection to the fire lane east of the school building is also proposed on the south side of the site. Subsequent analysis will determine the lane geometry and signal operating parameters for the primary access intersection, and evaluate use of the secondary service driveway to determine if it should be restricted to emergency/service use only or if it should accommodate some regular school traffic.

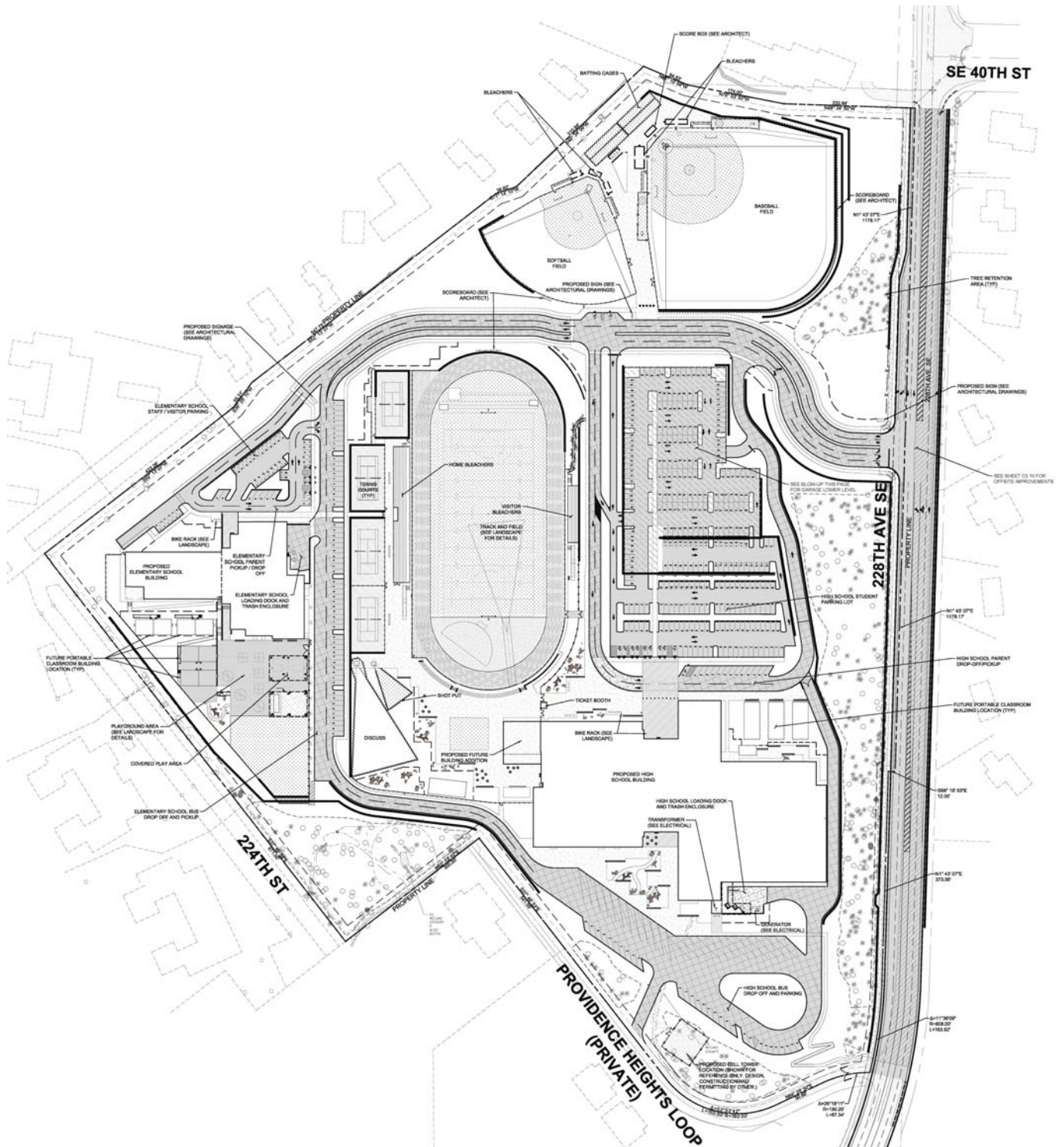
² Parking supply estimates provided by AHBL, March 26, 2020.



**High School #4
Elementary #17**

Figure 1
Site Location





Source: AHBL, June 9, 2020

**High School #4
Elementary #17**

Figure 2
Preliminary Site Plan



3. Trip Generation

3.1. Overview of Approach

Trip generation estimates for new school projects are typically developed using one of two methods. The most common method applies rates published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*,³ and is used when little may be known about expected operational characteristics. In some cases, however, it is appropriate to derive trip generation rates and travel characteristics based on observed conditions at an existing school with similar or representative characteristics. Since the published ITE rates are based on data collected from sites across the country, rates and travel patterns derived from local schools can offer representative travel characteristics for a particular school within the subject school district. The methodology applied herein combines these methods. Local trip generation data were obtained for four local schools in the Issaquah School District, which were compared to the ITE trip generation rates. The highest rates of those sets were then applied to reflect a conservative worst-case condition. Since the two schools sharing the site would have different bell schedules, the local data were also used to assess how the trips would overlap during the course of the day and to select the cumulative peak hour conditions used for the analysis.

After examining all elementary and high schools within the district, two elementary schools and two high schools were selected for data collection and observation. The representative schools were confirmed with City of Issaquah and City of Sammamish staff.⁴ Idax Data Solutions conducted three days of detailed traffic counts at each school on Tuesday, October 1, Wednesday, October 2, and Thursday, October 3, 2019. The morning counts were performed for a two-hour period in which morning arrivals predominantly occur, and afternoon counts were conducted for a six-hour period that included the afternoon dismissal period and the evening peak hour on the adjacent streets (commuter PM peak period). Counts were conducted at 15-minute intervals, and compiled to determine the trips generated by each school during the morning, afternoon and commuter PM peak hour, as well as the time that each peak hour occurred. The data collection efforts and results for these schools are described in Section 3.2.

Trip generation rates were then derived from the compiled count data based on each school's student enrollment at the time of the counts. The rates were compared to average ITE rates, and the higher rate (local or ITE) was then applied to each of the proposed new schools. Applying this approach, ITE rates were applied for the elementary school morning and afternoon peak hours, and local trip rates were applied for the high school for all peak hours, as well as the commuter PM peak hour for the elementary school. Since the peak arrival and departure times for each school would differ, the local count data were used to determine when the peak for each school would occur and to assess the cumulative trips for each 15-minute period. These were then used to select the peak analysis hours and derive peak-hour factors that will be applied in the traffic operations analysis. Trip generation for the proposed schools and site are described in Section 3.3.

3.2. School Trip Counts

Elementary Schools

Traffic counts were conducted at Discovery Elementary School, located at 2300-228th Avenue SE, and Sunny Hills Elementary School, located at 3200-Issaquah-Pine Lake Road SE, both in Sammamish. These schools were selected because they each have primary access on a major arterial street and the sites are configured such that their trips can be isolated from trips generated by other adjacent uses. Each

³ ITE, 10th Edition, 2017.

⁴ Confirmed at a meeting between ISD, City of Issaquah staff, and City of Sammamish staff, on September 26, 2019.

school has a single main driveway that provides access to its surface parking lot and family vehicle loading area, and a separate driveway that accesses its bus loading area. Counts were conducted at both driveways and reflect all trips generated by the schools during the analysis periods. With an enrollment of 666 students at the time of the counts, Discovery Elementary is smaller than the proposed Elementary #17. Sunny Hills Elementary is larger, with an enrollment of 795 students at the time of the counts.

Both schools have the typical bell schedule for ISD elementary schools. School starts at 9:15 A.M. every day; dismissal is at 3:40 P.M. every day except Wednesday, which has early dismissal at 1:30 P.M.

The observed peak hour trip generation, rates, and inbound/outbound distribution are summarized in **Table 1** for Discovery Elementary School and **Table 2** for Sunny Hills Elementary School. Appendix A includes the full counts by 15-minute period for each school. The ITE rates for Elementary School (ITE Land Use Code [LU] 520) are shown in each table for comparison. The tables show that the trip rates for the two elementary schools are very similar. While the observed rates are within the range of rates reflected in ITE's published data, the morning and afternoon peak hour rates are lower than ITE's average rates. The observed commuter PM peak hour rates are higher than ITE at Discovery and lower at Sunny Hills. Therefore, for analysis of Elementary School #17, ITE average rates were applied in the morning and afternoon analysis, and the derived rate from Discovery were applied in the commuter PM peak hour analysis, because each result in the more conservatively high trip estimate for the respective peak hours.

Table 1. Trip Generation Summary – Discovery Elementary School

Vehicle Trip Counts	Morning Peak Hour ¹			Afternoon Peak Hour ²			Commuter PM Peak Hour ³		
	In	Out	Total	In	Out	Total	In	Out	Total
Tuesday, October 1, 2019	144	138	282	77	108	185	56	82	138
Wednesday, October 2, 2019	140	108	248	76	116	192	---	---	---
Thursday, October 3, 2019	146	113	259	81	112	193	62	68	130
Average Day	145	126	271	79	110	189	59	75	110
Observed Trip Rates (vehicle trips per student) ⁴	% In	% Out	Rate	% In	% Out	Rate	% In	% Out	Rate
Average Rate	54%	46%	0.41	42%	58%	0.28	44%	56%	0.20
Peak Observed Rate	51%	49%	0.42	42%	58%	0.29	41%	59%	0.21
ITE Rates (vehicle trips per student) ⁵	% In	% Out	Rate ⁶	% In	% Out	Rate	% In	% Out	Rate
Elementary School (LU 520)	54%	46%	0.65	45%	55%	0.34	48%	52%	0.17

Source: Number of trips is based on turning movement counts performed at the school's driveways, October 1 through 3, 2019.

Average day values based upon Tuesday and Thursday data.

1. The school's morning peak hour began at 8:30 A.M. on Tuesday, and 8:15 A.M. on Wednesday and Thursday.
2. The school Afternoon peak hour began at 3:15 P.M. on Tuesday and Thursday, and 1:00 P.M. on Wednesday.
3. The Commute PM peak hour on the adjacent street is 4:45 to 5:45 P.M.; evening counts were not conducted on Wednesday due to early dismissal that is scheduled on that day.
4. Derived by dividing the observed trip counts by the total enrollment of 666 students.
5. ITE, Trip Generation Manual, 10th Edition, 2017.
6. Morning rate is for the peak hour of the generator.

Table 2. Trip Generation Summary – Sunny Hills Elementary School

Vehicle Trip Counts	Morning Peak Hour ¹			Afternoon Peak Hour ²			Commuter PM Peak Hour ³		
	In	Out	Total	In	Out	Total	In	Out	Total
Tuesday, October 1, 2019	158	142	300	107	111	218	51	78	129
Wednesday, October 2, 2019	123	121	244	95	114	209	---	---	---
Thursday, October 3, 2019	201	152	353	101	118	219	43	65	108
Average Day	180	147	327	104	115	219	47	72	119
Observed Trip Rates (vehicle trips per student) ⁴									
Average Rate	55%	45%	0.41	47%	53%	0.28	39%	61%	0.15
Peak Observed Rate	57%	43%	0.44	46%	54%	0.28	40%	60%	0.16
ITE Rates (vehicle trips per student) ⁵	% In	% Out	Rate ⁶	% In	% Out	Rate	% In	% Out	Rate
Elementary School (LU 520)	54%	46%	0.65	45%	55%	0.34	48%	52%	0.17

Source: Number of trips is based on turning movement counts performed at the school's driveways, October 1 through 3, 2019.

Average day values based upon Tuesday and Thursday data.

1. The school's morning peak hour began at 8:30 A.M. on Tuesday and Wednesday, and 8:15 A.M. on Thursday.
2. The school Afternoon peak hour began at 3:00 P.M. on Tuesday and Thursday, and 1:00 P.M. on Wednesday.
3. The Commute PM peak hour on the adjacent street is 4:45 to 5:45 P.M.; evening counts were not conducted on Wednesday due to early dismissal that is scheduled on that day.
4. Derived by dividing the observed trip counts by the total enrollment of 795 students.
5. ITE, Trip Generation Manual, 10th Edition, 2017.
6. Morning rate is for the peak hour of the generator.

High Schools

Traffic counts were conducted at Skyline High School, located at 1122-228th Avenue SE in Sammamish, and Liberty High School, located at 16656-SE 136th Street in Renton. These schools were selected because they have athletic facilities similar to those planned for High School #4, and the sites are configured such that their trips can be isolated from trips generated by other adjacent uses. With an enrollment of 2,003 students at the time of the counts, Skyline High School is larger than the proposed High School #4. Liberty High School is smaller, with an enrollment of 1,316 students at the time of the counts. Both schools have the typical bell schedule for ISD high schools. On every day except Wednesday, school starts at 8:00 A.M. with dismissal at 2:55 P.M.; Wednesdays have a later schedule, starting at 10:10 A.M. with dismissal at 3:45 P.M. It is noted that a high level of extra-curricular events was observed on Tuesday evening at Skyline High School.

Traffic counts were conducted at Skyline High School at its two driveways, one on 228th Avenue SE and one on SE 8th Street. Additionally, the school has leased parking at two nearby locations. At the Mary Queen of Hearts Church lot (located west of the school on 228th Avenue SE, with access directly across from the west school driveway) the school has leased 65 spaces. Parking in this lot is also generated by church activities, a preschool, and spaces are leased to the YMCA located directly to the north. School trips generated at this lot were estimated based upon driveway counts, review of the church and pre-school schedules, as well as counts of vehicles parked in the school's leased spaces. At the Sammamish Lutheran Church lot (located north of the school on SE 8th Street, with access to the west of the north school driveway) the school has leased 74 spaces. Parking in this lot is also generated by church activities, and a portion is used for transit Park and Ride. School-generated trips at this lot were estimated,

based upon an assumption that they would be similar in pattern to school trips at the Mary Queen of Peace lot, in proportion to the school-generated parked vehicles counted in the two lots.

Traffic counts were conducted at Liberty High School at its four driveways, and also along segments of 164th Avenue SE and 169th Avenue NE where school-generated vehicles were observed to park.

The observed peak hour trip generation, rates, and inbound/outbound distribution are summarized in **Table 3** for Skyline High School and **Table 4** for Liberty High School. Appendix A includes the full counts by 15-minute period for each school. The ITE rates for High School (LU 530) are shown in each table for comparison. The tables show that the trip rates for the two high schools are similar. While the observed rates are within the range of rates reflected in ITE's published data, they are higher than ITE's average rates. Therefore, for analysis of High School #4, derived average rates based upon observed data were applied because they reflect typical characteristics for ISD schools and result in more conservatively high trip estimates than applying ITE rates. For each peak hour, the higher derived rate observed between the two schools were applied.

Table 3. Trip Generation Summary – Skyline High School

Vehicle Trip Counts	Morning Peak Hour ¹			Afternoon Peak Hour ²			Commuter PM Peak Hour ³		
	In	Out	Total	In	Out	Total	In	Out	Total
Tuesday, October 1, 2019	805	356	1,161	198	563	761	157	158	315
Wednesday, October 2, 2019	743	419	1,162	185	593	778	144	166	310
Thursday, October 3, 2019	877	370	1,247	161	566	727	165	229	394
Average Day	841	363	1,204	180	565	744	161	194	355
Observed Trip Rates (vehicle trips per student) ⁴	% In	% Out	Rate	% In	% Out	Rate	% In	% Out	Rate
Average Rate	70%	30%	0.60	24%	76%	0.37	45%	55%	0.18
Peak Observed Rate	70%	30%	0.62	24%	76%	0.39	42%	58%	0.20
ITE Rates (vehicle trips per student) ⁵	% In	% Out	Rate ⁶	% In	% Out	Rate	% In	% Out	Rate
High School (LU 530)	68%	32%	0.55	32%	68%	0.33	48%	52%	0.14

Source: Number of trips is based on turning movement counts performed at the school's driveways, October 1 through 3, 2019.

Average day values based upon Tuesday and Thursday data.

1. The school's morning peak hour began at 7:15 A.M. on Tuesday and Thursday, and at 9:45 A.M. on Wednesday.
2. The school Afternoon peak hour began at 2:30 P.M. on Tuesday, 3:30 P.M. on Wednesday, and 2:45 P.M. on Thursday.
3. The Commuter PM peak hour on the adjacent street is 4:45 to 5:45 P.M.
4. Derived by dividing the observed trip counts by the total enrollment of 2,003 students.
5. ITE, Trip Generation Manual, 10th Edition, 2017.
6. Morning rate is for the peak hour of the generator.

Table 4. Trip Generation Summary – Liberty High School

Vehicle Trip Counts	Morning Peak Hour ¹			Afternoon Peak Hour ²			Commuter PM Peak Hour ³		
	In	Out	Total	In	Out	Total	In	Out	Total
Tuesday, October 1, 2019	536	248	784	142	330	472	81	92	173
Wednesday, October 2, 2019	422	267	689	139	372	511	52	94	146
Thursday, October 3, 2019	557	253	810	129	319	448	114	164	278
Average Day	547	251	798	136	325	461	98	128	226
Observed Trip Rates (vehicle trips per student) ⁴	% In	% Out	Rate	% In	% Out	Rate	% In	% Out	Rate
Average Rate	69%	31%	0.61	30%	70%	0.35	43%	57%	0.17
Peak Observed Rate	69%	31%	0.62	27%	73%	0.39	41%	59%	0.21
ITE Rates (vehicle trips per student) ⁵	% In	% Out	Rate ⁶	% In	% Out	Rate	% In	% Out	Rate
High School (LU 530)	68%	32%	0.55	32%	68%	0.33	48%	52%	0.14

Source: Number of trips is based on turning movement counts performed at the school's driveways and frontages, October 1 through 3, 2019. Average day values based upon Tuesday and Thursday data.

1. The school's morning peak hour began at 7:15 A.M. on Tuesday and Thursday, and 9:15 A.M. on Wednesday.
2. The school Afternoon peak hour began at 2:45 P.M. on Tuesday and Thursday, and 3:30 P.M. on Wednesday.
3. The Commute PM peak hour on the adjacent street is 4:45 to 5:45 P.M.
4. Derived by dividing the observed trip counts by the total enrollment of 1,316 students.
5. ITE, Trip Generation Manual, 10th Edition, 2017.
6. Morning rate is for the peak hour of the generator.

3.3. Project Trip Generation

Peak hour trip generation estimates were developed first for each school as if it were located on an individual site. The estimates assume that the bell schedule for the elementary school and high school would be the typical schedule for ISD schools of each respective type (described previously in *Section 3.2*). Then the overlap between trips generated by each school was determined to develop cumulative trip estimates for the combined schools, for the morning, afternoon, and commuter PM peak hours.

The trip generation estimates are based on data collected on Tuesday and Thursday. The data indicated that school-generated traffic on Wednesdays would be less intense than traffic on the other days. This is because with the later high school start time, the morning peak hour would occur after the commuter AM peak, instead of coinciding with it. Additionally, the early dismissal of the elementary school combined with the later dismissal of the high school would result in less overlap between their afternoon peak hours.

The trip generation estimation approach and results are described in the following sections.

Trips Generated by Individual Schools

As discussed previously, trip estimates for the proposed schools are based upon the higher rates between those published by ITE, and those derived from counts conducted at comparable ISD schools. For the elementary school, trip estimates are based upon ITE average rates, and for the high school, they are based upon average rates derived from counts conducted at Skyline and Liberty High Schools.

Table 5 summarizes the forecast peak hour trip generation for the proposed Elementary #17, based on the rates described above and the assumed enrollment of 744 students.

Table 5. Elementary #17 – Peak Hour Trip Generation

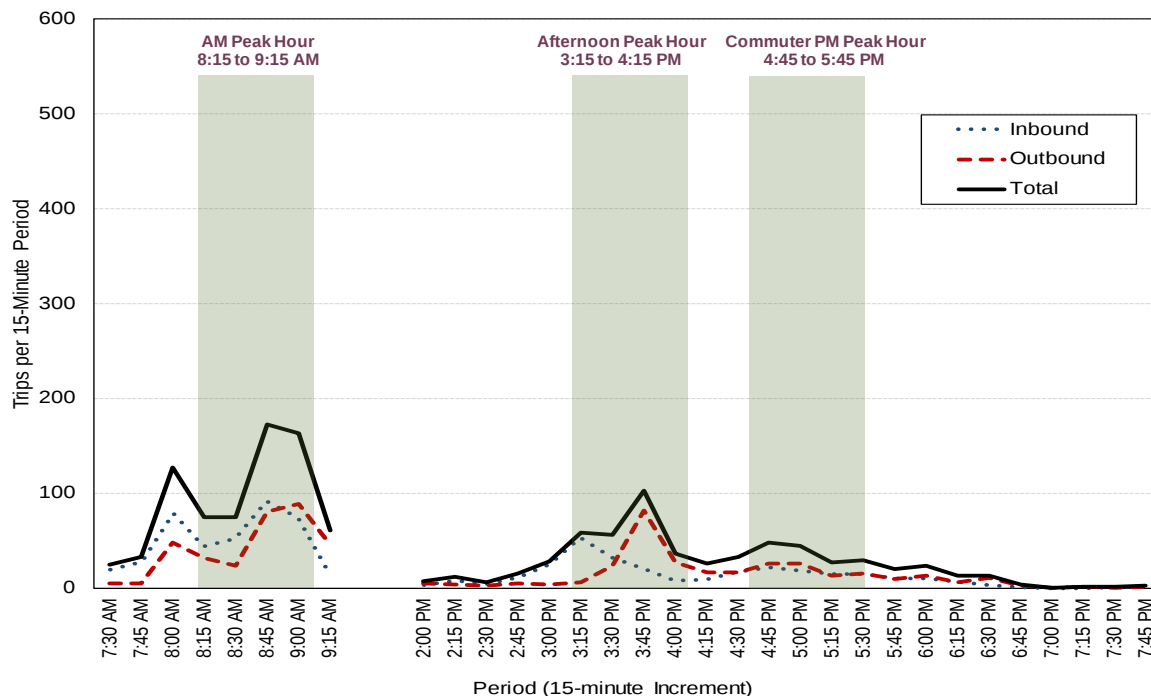
	Students	Daily Trips	Morning ¹ (8:15 – 9:15 A.M.)			Afternoon ¹ (3:15 – 4:15 P.M.)			Commuter PM ² (4:45 – 5:45 P.M.)		
			In	Out	Total	In	Out	Total	In	Out	Total
Vehicle Trips	744	1,410	261	223	484	114	139	253	69	80	149
ITE Trip Rates – Trips per student (% in, % out) ²	---	1.89	0.65 (54% in, 46% out)			0.34 (45% in, 55% out)			0.20 (46% in, 54% out)		

Source: Heffron Transportation, Inc., April 2020. Based upon rates published in ITE's Trip Generation Manual (10th edition, September 2017) and derived from traffic counts conducted at Discovery Elementary School, October 1 through 3, 2019.

1. Morning and afternoon peak hours reflect the hours in which the peak numbers of trips are generated by the school.
2. Commuter PM peak hour reflects the hour in which traffic volumes on the adjacent streets are highest.

A combination of the ITE and local data were used to determine the elementary school trips for each 15-minute period. These are shown on **Figure 3**.

Figure 3. Elementary #17 – Trips by 15-minute Period



Source: Heffron Transportation, Inc., April 2020. Derived using a combination of ITE rates for Elementary Schools and local data. Adjusted to reflect the expected student population at Elementary #17.

Table 6 summarizes the forecast peak hour trip generation for the proposed High School #4, based on the rates described above and the assumed enrollment of 1,823 students.

Table 6. High School #4 – Peak Trip Generation

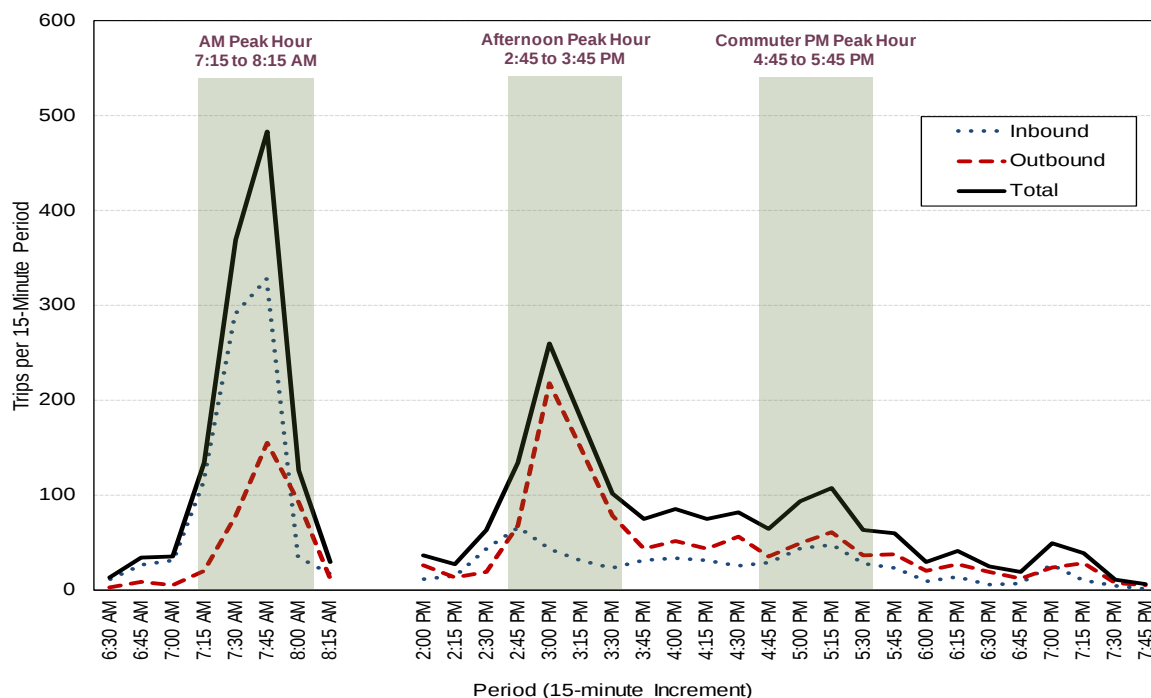
	Students	Daily Trips ¹	Morning ² (7:15 – 8:15 A.M.)			Afternoon ² (2:45 – 3:45 P.M.)			Commuter PM ³ (4:45 – 5:45 P.M.)		
			In	Out	Total	In	Out	Total	In	Out	Total
Vehicle Trips	1,823	4,140	767	345	1,112	162	513	675	148	180	328
Locally Derived Trip Rates – Trips per student (% in, % out) ²	---	2.27	0.61 (69% in, 31% out)			0.37 (24% in, 76% out)			0.18 (45% in, 55% out)		

Source: Heffron Transportation, Inc., April 2020. Rates derived from traffic counts conducted at Skyline High School and Liberty High School, October 1 through 3, 2019.

1. The daily trip rate was estimated by increasing the ITE daily average rate by 12%, based upon the proportion of observed morning and afternoon peak hour rates to the ITE rates for the same periods.
2. Derived from trip counts performed at Skyline and Liberty High Schools, October 2019. Morning and afternoon peak hours reflect the hours in which the peak numbers of trips are generated by the school. The morning peak hour for the high school coincides with the peak hour of the adjacent street.
3. Commuter PM peak hour reflects the hour in which traffic volumes on the adjacent streets are highest.

Local data were used to determine the high school trips for each 15-minute period. These are shown on **Figure 4**.

Figure 4. High School #4 – Trips by 15-minute Period

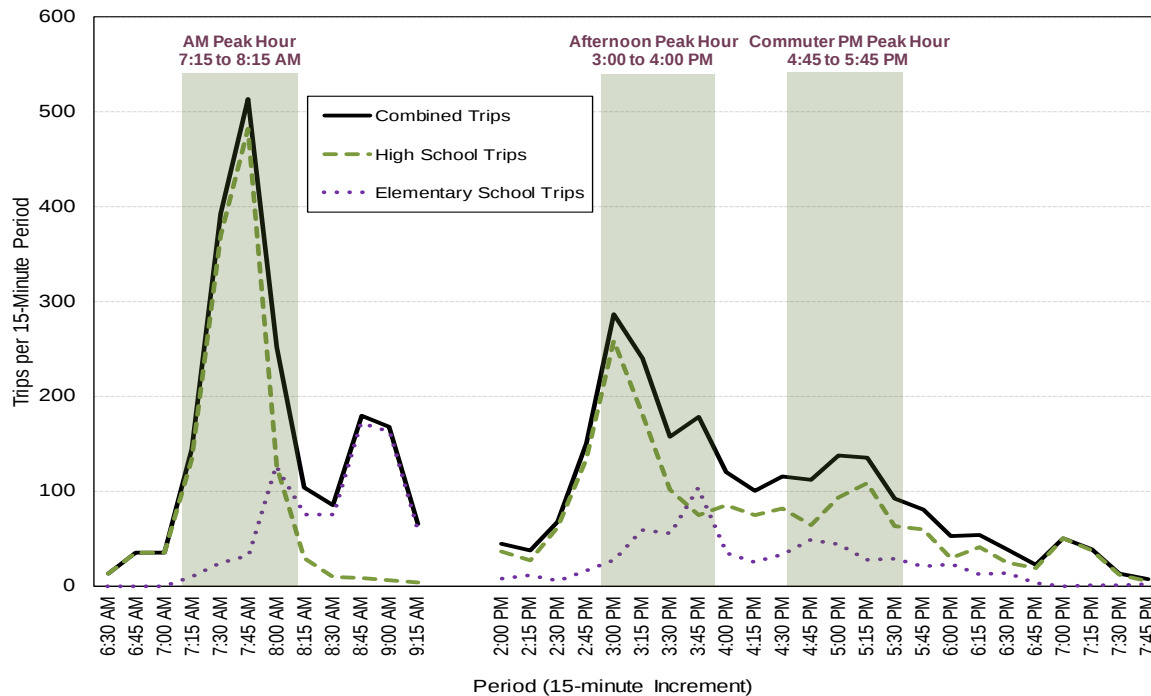


Source: Heffron Transportation, Inc.; April 2020. Derived using local trip generation data from Skyline and Liberty High Schools. Adjusted to reflect the expected student population at High School #4.

Cumulative School Trips

As noted above, the high school and the elementary school have different peak hours due to offset bell schedules. **Figure 5** shows the cumulative trips with these schools combined on one site. Because the high school would have a much larger student population than the elementary school, the peak hours for the cumulative trips are primarily influenced by the high school. However, some elementary trips would also occur during those peak hours. **Table 7** summarizes the cumulative trips for each 15-minute period.

Figure 5. Cumulative Trips for High School and Elementary School



Source: Heffron Transportation, Inc., April 2020.

Table 7. Cumulative Trips by 15-minute Period

Time	High School #4 Trip Generation			Elementary #17 Trip Generation			Total for Both Schools		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
6:30 AM	11	2	13	0	0	0	11	2	13
6:45 AM	27	8	35	0	0	0	27	8	35
7:00 AM	31	4	35	0	0	0	31	4	35
7:15 AM	114	20	134	8	2	10	122	22	144
7:30 AM	291	78	369	19	5	24	310	83	393
7:45 AM	328	154	482	27	5	32	355	159	514
8:00 AM	34	92	126	79	47	126	113	139	252
8:15 AM	17	12	29	44	31	75	61	43	104
8:30 AM	6	4	10	52	23	75	58	27	85
8:45 AM	5	3	8	92	80	172	97	83	180
9:00 AM	4	2	6	74	88	162	78	90	168
9:15 AM	2	2	4	15	46	61	17	48	65
2:00 PM	11	25	36	3	5	8	14	30	44
2:15 PM	14	13	27	8	3	11	22	16	38
2:30 PM	44	18	62	4	2	6	48	20	68
2:45 PM	66	68	134	11	5	16	77	73	150
3:00 PM	42	217	259	25	3	28	67	220	287
3:15 PM	31	150	181	53	6	59	84	156	240
3:30 PM	23	78	101	32	24	56	55	102	157
3:45 PM	31	44	75	21	82	103	52	126	178
4:00 PM	33	52	85	8	27	35	41	79	120
4:15 PM	31	44	75	9	16	25	40	60	100
4:30 PM	26	56	82	17	16	33	43	72	115
4:45 PM	29	35	64	22	26	48	51	61	112
5:00 PM	44	49	93	18	26	44	62	75	137
5:15 PM	47	61	108	14	13	27	61	74	135
5:30 PM	27	36	63	14	15	29	41	51	92
5:45 PM	23	37	60	10	10	20	33	47	80
6:00 PM	9	20	29	10	13	23	19	33	52
6:15 PM	14	27	41	6	7	13	20	34	54
6:30 PM	6	19	25	3	11	14	9	30	39
6:45 PM	7	12	19	1	2	3	8	14	22
7:00 PM	26	24	50	0	0	0	26	24	50
7:15 PM	10	28	38	0	1	1	10	29	39
7:30 PM	5	7	12	1	0	1	6	7	13
7:45 PM	1	4	5	1	1	2	2	5	7

Source: Heffron Transportation, April 2020. Elementary school trips derived using ITE rates and local trip generation data from Discovery and Sunny Hills Elementary Schools, adjusted to reflect the expected student population of Elementary School #17. High school trips derived using local trip generation data from Skyline and Liberty High Schools, adjusted to reflect the expected student population of High School #4.

■ = Analysis peak hours

XX = Estimated.

3.4. Traffic Peaking Characteristics

Standard practice and methodologies for traffic operations analyses are established in the *Highway Capacity Manual (HCM)*⁵ and are conducted using hourly traffic flow rates. However, the methodology recognizes that traffic volumes may vary within the analysis peak hour. To account for variable flow rates within the hour, a peak hour factor (PHF) is applied to the hourly flow rates. This factor adjusts the total hourly flow rate to reflect the rate of the highest 15-minute period across the hour. The peak hour factor (PHF) is calculated as follows:

$$PHF = (total\ hourly\ volume) / [(peak\ 15-minute\ volume\ within\ the\ hour \times 4)]$$

A PHF close to 1.0 indicates that traffic volumes are steady over the course of the hour and flows during each 15-minute period are about the same. A lower PHF indicates that volumes during one or two 15-minute periods are higher than those during the remaining 15-minute periods. For operational analyses, the hourly traffic volumes are divided by the PHF before levels of service are calculated. This results in an analysis that conservatively assumes the highest 15-minute vehicle flow rate occurs over the entire peak hour.

Traffic generation at schools tends to be more compressed within the peak hours than background traffic on surrounding roadways. This occurs because trips to and from the school occur relatively close to the school start and dismissal times as family drivers tend to arrive during the 20 to 30 minutes before each. Some school-generated trips, such as those by employees and/or visitors, also occur within the peak hour, but not within the highest 15-minute periods. For example, some staff may arrive about 45-minutes before school starts or may leave 45 minutes after dismissal. While they would be part of the overall peak hour traffic, they would not be part of the flows during the highest 15 to 30 minutes. Additionally, after the peak trips associated with school dismissal have subsided, later afternoon and evening trips may be more spread out, as after school activities begin and end at varying times.

Calculated PHFs for the combined school traffic are summarized in the following section. The cumulative PHF will be used for site access and off-site intersection analysis. However, the individual school peak hours will be used to evaluate queuing in each school's drop-off/pick-up area.

⁵ Transportation Research Board (TRB), Highway Capacity Manual, 6th Edition, 2016.

3.5. Summary of Trip Generation Estimates for Combined Schools

Table 8 summarizes the vehicle trip estimates for the morning, afternoon, and commuter PM peak hours, as well as the peak-hour factors described in the previous section.

Table 8. Cumulative Trips Generation for Analysis Peak Hours

Analysis Period	High School #4 Trip Generation			Elementary #17 Trip Generation			Total Trip Generation for Both Schools		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
AM Peak Hour (7:15 to 8:15 AM)									
Trips	767	344	1,111	133	59	192	900	403	1,303
Peak Hour Factor ^a	0.58	0.56	0.58	0.42	0.31	0.38	0.63	0.63	0.63
Afternoon Peak Hour (3:00 to 4:00 PM)									
Trips	127	489	616	131	115	246	258	604	862
Peak Hour Factor	0.76	0.56	0.59	0.62	0.35	0.60	0.77	0.69	0.75
Commuter PM Peak Hour (4:45 to 5:45 PM)									
Trips	147	181	328	68	80	148	215	261	476
Peak Hour Factor	0.78	0.74	0.76	0.77	0.77	0.77	0.87	0.87	0.87

Source: Heffron Transportation, April 2020. Elementary school trips derived using ITE rates and local trip generation data from Discovery and Sunny Hills Elementary Schools, adjusted to reflect the expected student population of Elementary School #17. High school trips derived using local trip generation data from Skyline and Liberty High Schools, adjusted to reflect the expected student population of High School #4.

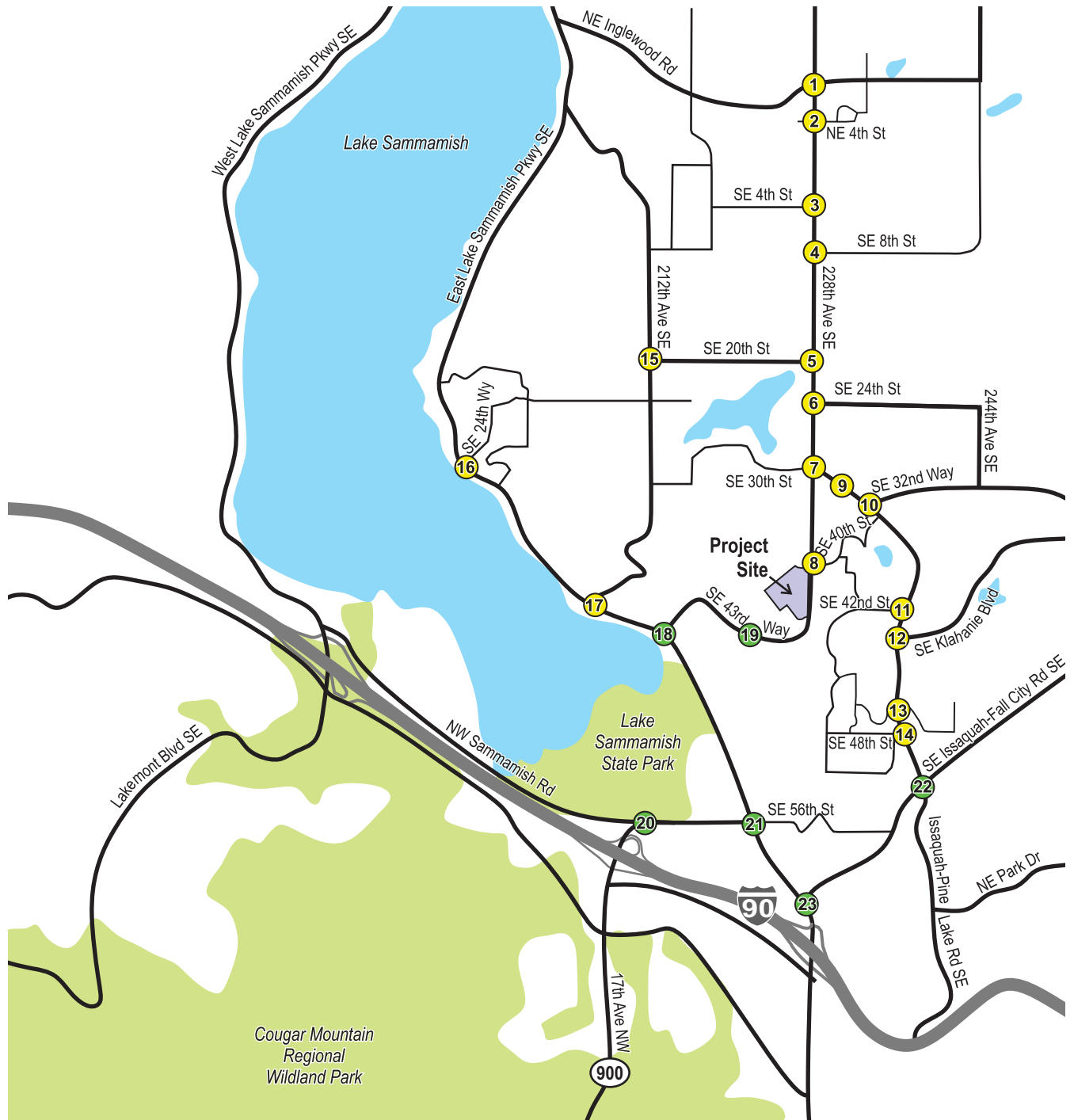
a. $PHF = \text{Peak Hour Factor} = \text{Peak Hour Volume} / (4 \times \text{Peak 15-minute Volume})$

4. Transportation Study Area

Figure 6 shows the transportation study area that has been defined for the project, based upon City review of the initial trip generation and distribution that was developed,⁶ as well as the anticipated enrollment areas for the two schools shown on **Figure 7**.⁷ The transportation technical report will include analysis of the project's traffic operational impacts at these 23 intersections (17 located in Sammamish and 6 located in Issaquah), in addition to the site access driveway, for each of the morning, afternoon, and commuter PM peak hours.

⁶ Heffron Transportation, December 12, 2019.

⁷ The Issaquah School District provided an estimated enrollment area for Elementary School #17 and High School #4; the actual enrollment service area is subject to review and final approval by the School Board.

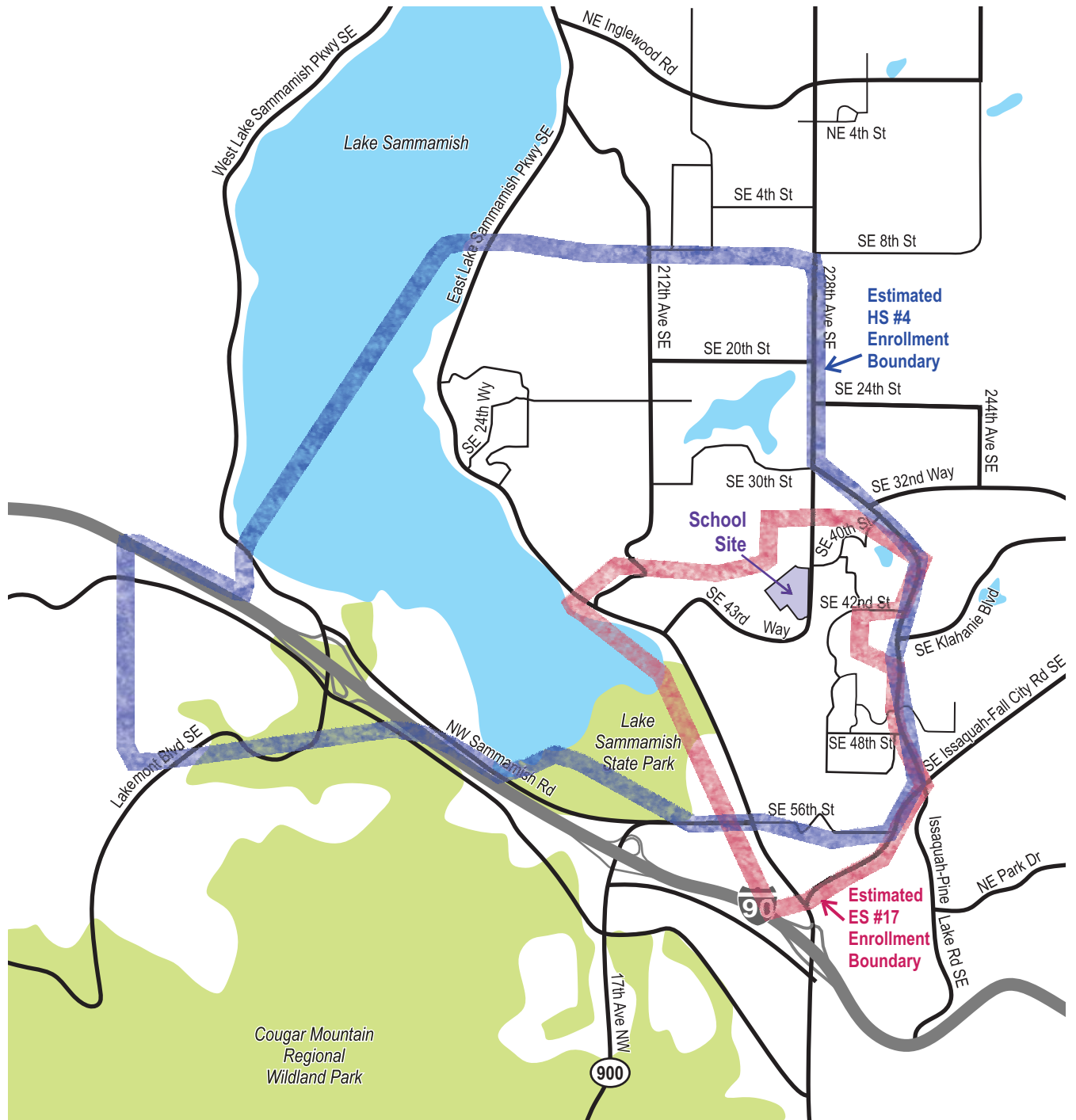


- Sammamish Analysis Intersection
- Issaquah Analysis Intersection

High School #4
Elementary #17

Figure 6
Transportation Study Area





Source: Issaquah School District, January 2020

**High School #4
Elementary #17**

Figure 7
Estimated Enrollment Areas



5. Trip Distribution and Assignment

The trip distribution patterns of school-generated trips were developed based on a combination of the overall residential density within ISD's estimated enrollment areas, and traffic patterns observed within the study area.⁸ Geographic Information System (GIS) data were used to determine the proportion of residences within neighborhoods in the respective school enrollment boundaries; Google Maps predictive travel times⁹ were utilized to estimate routes to and from the site based on the respective travel times. Separate project trip distribution patterns and assignments were developed for each analysis hour and also account for typical patterns of some family drivers linking school drop-off and pick-up trips with work trips.¹⁰

During the combined morning peak hour, which would begin more than an hour ahead of the elementary school start time, the data indicate that about half of the inbound elementary school trips would be arriving staff, and half would be early student drop-offs. Therefore, the distribution of elementary school trips assumes about 40% of inbound trips would originate from outside the enrollment area. The high school would have a larger enrollment area, and inbound trips would be generated predominantly by students being dropped off or driving and parking; 10% of inbound trips generated by the high school during the combined morning peak hour were assumed to be generated by staff from outside the enrollment area.

For the combined afternoon peak hour, which would begin about 40 minutes before the elementary school dismissal, it is expected that all elementary school trips would be generated by student pick-up activity. The high school generated trips are expected to be generally similar to the morning pattern but in reverse direction—with about 10% of outbound trips assumed to be staff departures to destinations outside the enrollment area.

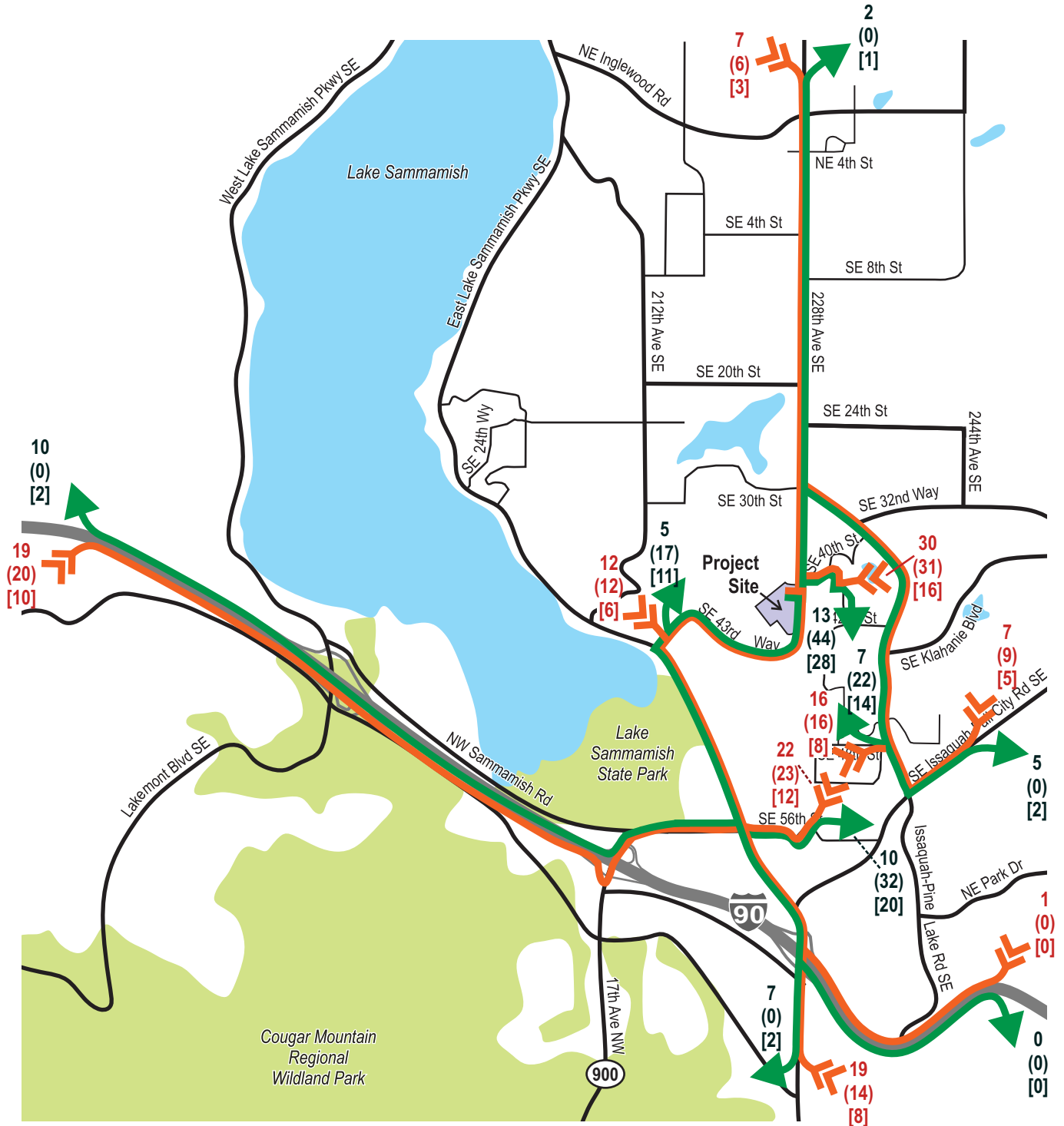
For the commuter PM peak hour, most trips generated by both schools are expected to be generated by student pick-up activity. A small number of trips departing the parking lots for each school are assumed to be staff departures to destinations outside the respective enrollment areas. For the elementary school, this was assumed to be all trips not associated with student pick-up (estimated to be 5). For the high school, this was estimated to be about 25% of trips not associated with student pick-up (estimated to be 7).

The project trip distribution patterns during for the elementary school are shown on **Figure 8**, and the corresponding trip assignments to the street network are shown on **Figure 9**. The project trip distribution patterns for the high school are shown on **Figure 10**, and the corresponding trip assignments to the street network are shown on **Figure 11**. The figures show the trip distribution and assignments for each school during the combined morning peak hour, combined afternoon peak hour, and commuter PM peak hour, as previously described. **Figure 12** shows the total trip assignments for the combined schools for each peak hour and **Figure 13** shows the total peak hour trips projected at the site access..

⁸ Peak hour traffic counts on 228th Avenue SE were conducted by Idax Data Solutions on Tuesday, October 1, through Thursday October 3, 2019.

⁹ Google Maps, <https://www.google.com/maps>, Accessed November 2019.

¹⁰ The estimated portion of total trips expected to be new trips, and not trips linked to existing trips on the street system, was based upon a pass-by trip study conducted for the Northshore School District (Gibson Traffic Consultants, *ITE School Pass-By Report*, January 2012). The study was based upon surveys conducted of parents at four Northshore elementary and middle schools. It found that in the morning, an average of 58% of trips generated at the school were primary (new) trips, and 42% were linked to existing trips that would occur with or without the school activity. In the afternoon, an average of 62% of trips generated at the school were primary (new) trips, and 38% were linked to existing trips that would occur with or without the school activity.



LEGEND

Combined Morning Peak Hour
Combined Afternoon Peak Hour
Commuter PM Peak Hour

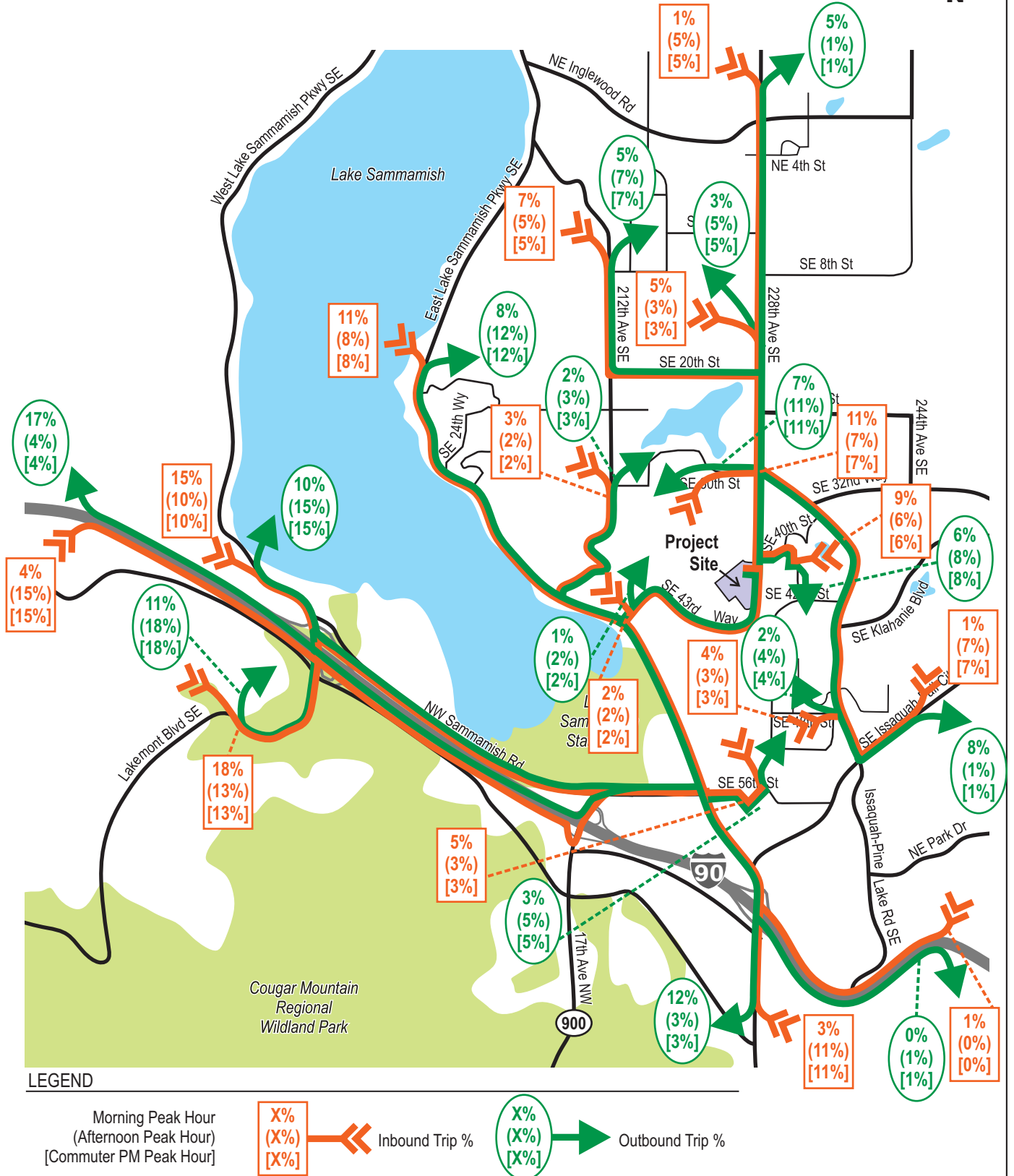
XX
(XX)
[XX]
Inbound Volume

XX
(XX)
[XX]
Outbound Volume

High School #4
Elementary #17

Figure 9
Trip Assignments for Elementary School
Combined AM, Afternoon, & PM Peak Hours

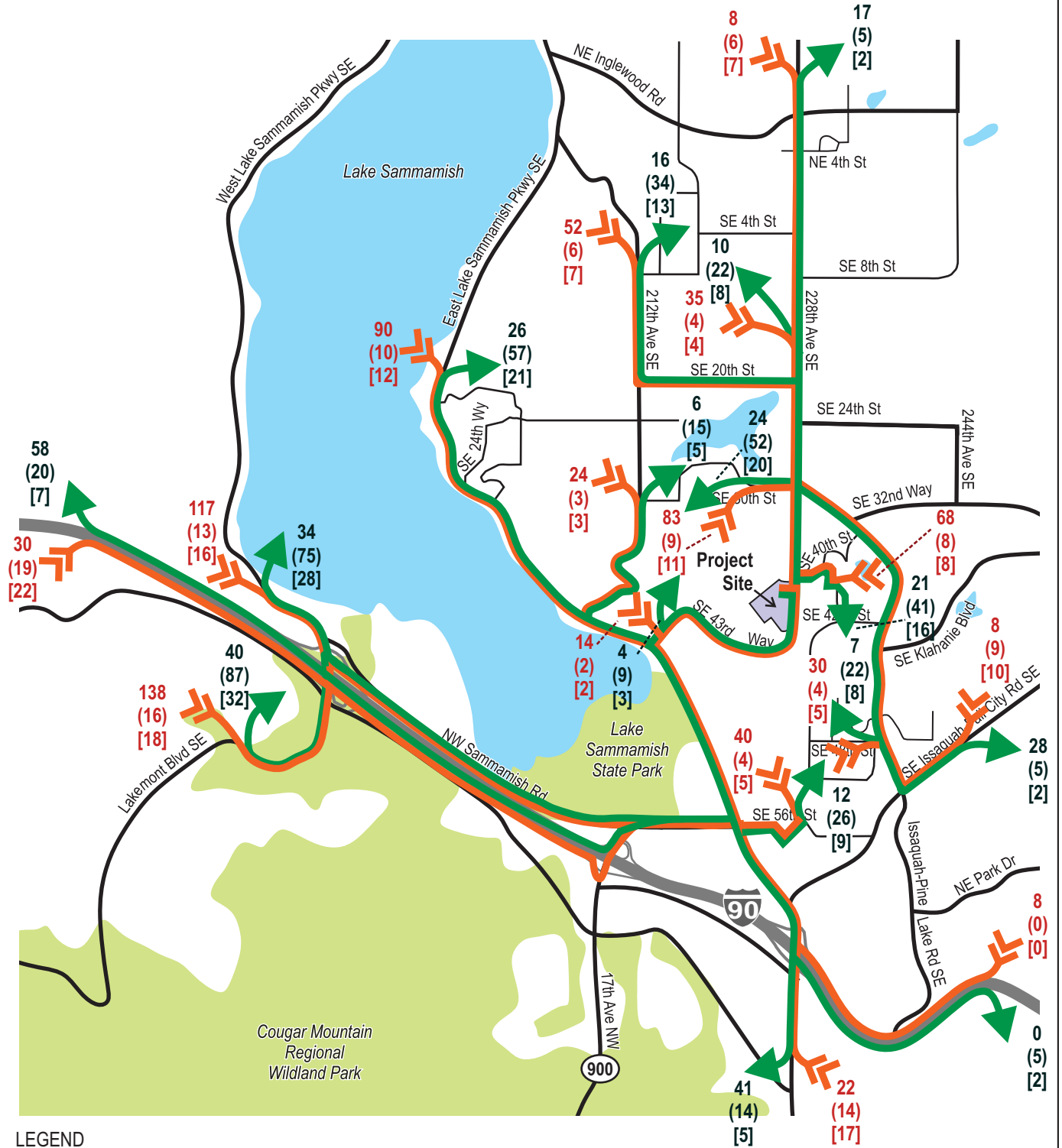




High School #4
Elementary #17

Figure 10
Trip Distribution for High School
Morning, Afternoon, & PM Peak Hours

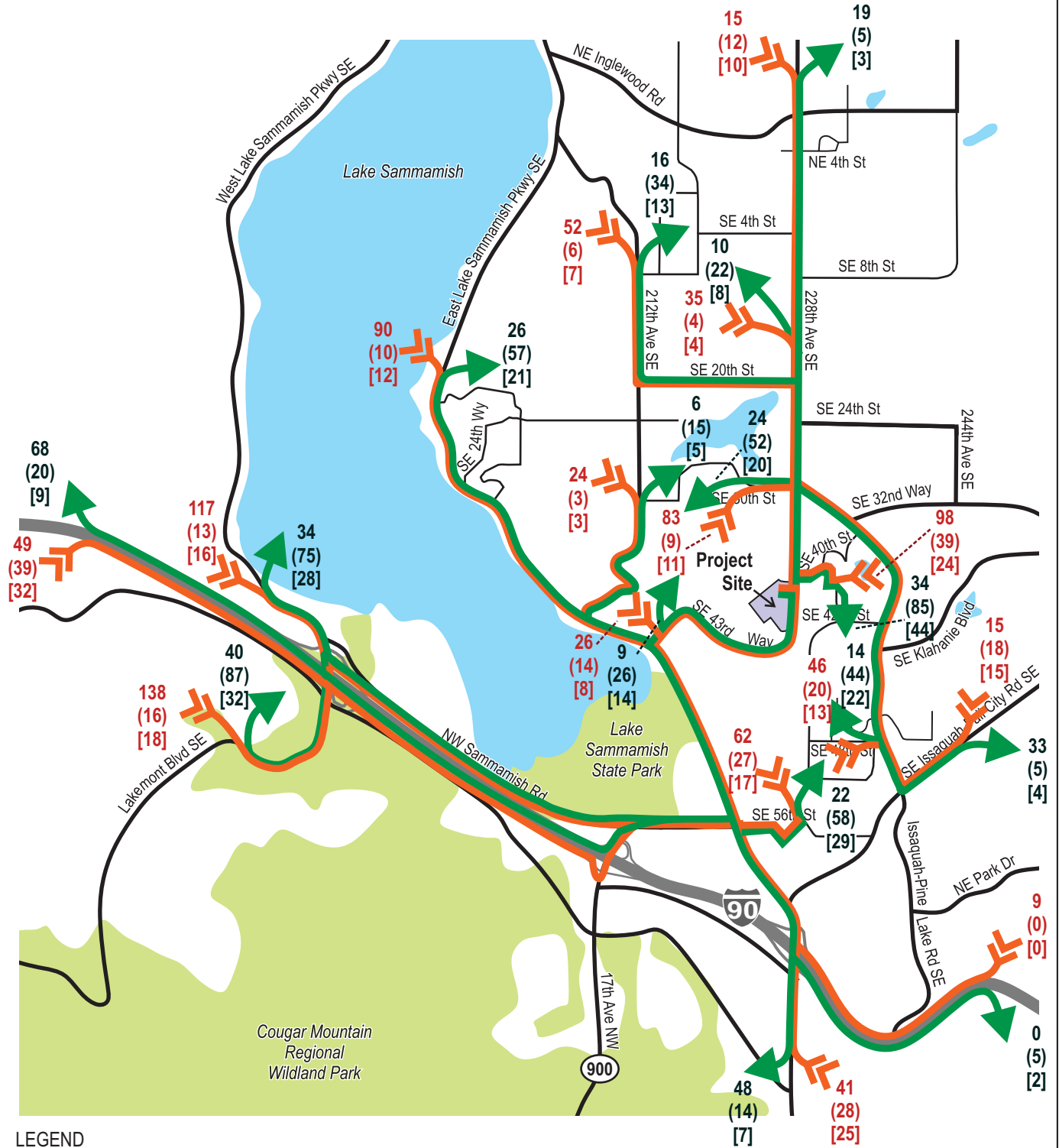




High School #4 Elementary #17

Figure 11
Trip Assignments for High School
Combined AM, Afternoon, & PM Peak Hours





**High School #4
Elementary #17**

Figure 12
Trip Assignments for Combined Schools
Combined AM, Afternoon, & PM Peak Hours

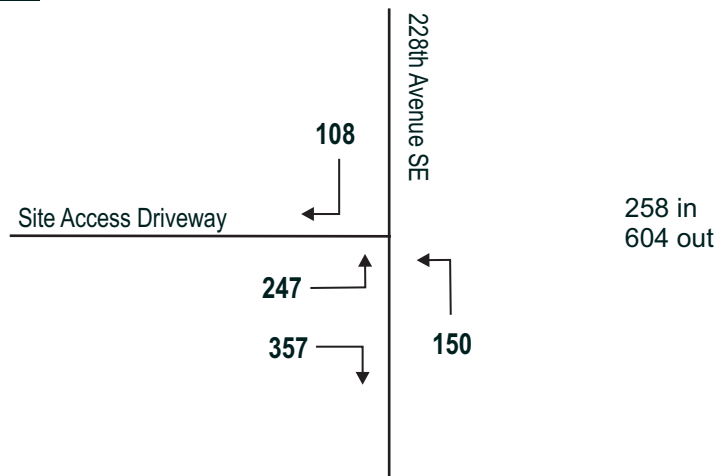




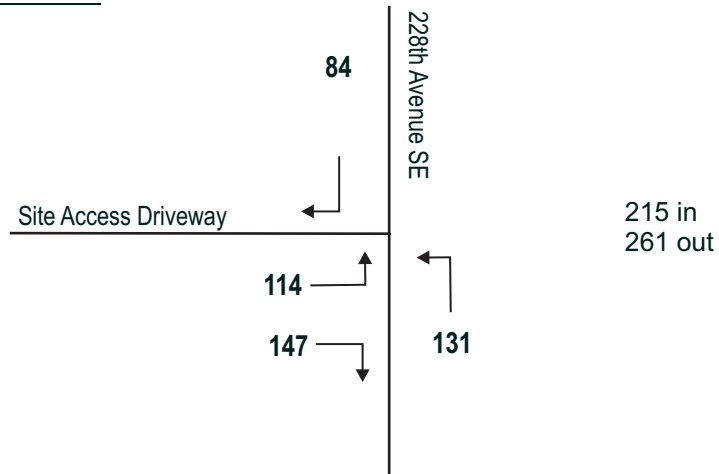
Morning Peak Hour



Afternoon Peak Hour



Commuter PM Peak Hour



**High School #4
Elementary #17**

Figure 13
School Trips at Site Access Driveway
Combined AM, Afternoon, & PM Peak Hours



6. Shifted School-Generated Trips

It is important to note that if the proposed schools are not constructed, the students living in the enrollment areas would still need to attend a different school, and therefore, would still generate trips to and from the schools they would otherwise attend. Additionally, morning drop-off trips and afternoon pick-up trips linked to work trips would also still occur. Therefore, while the school-generated trips shown on the figures would be new trips at and near the site access location, and would affect traffic volumes in the vicinity of the site, farther away from the site most would not be new trips on the street system.

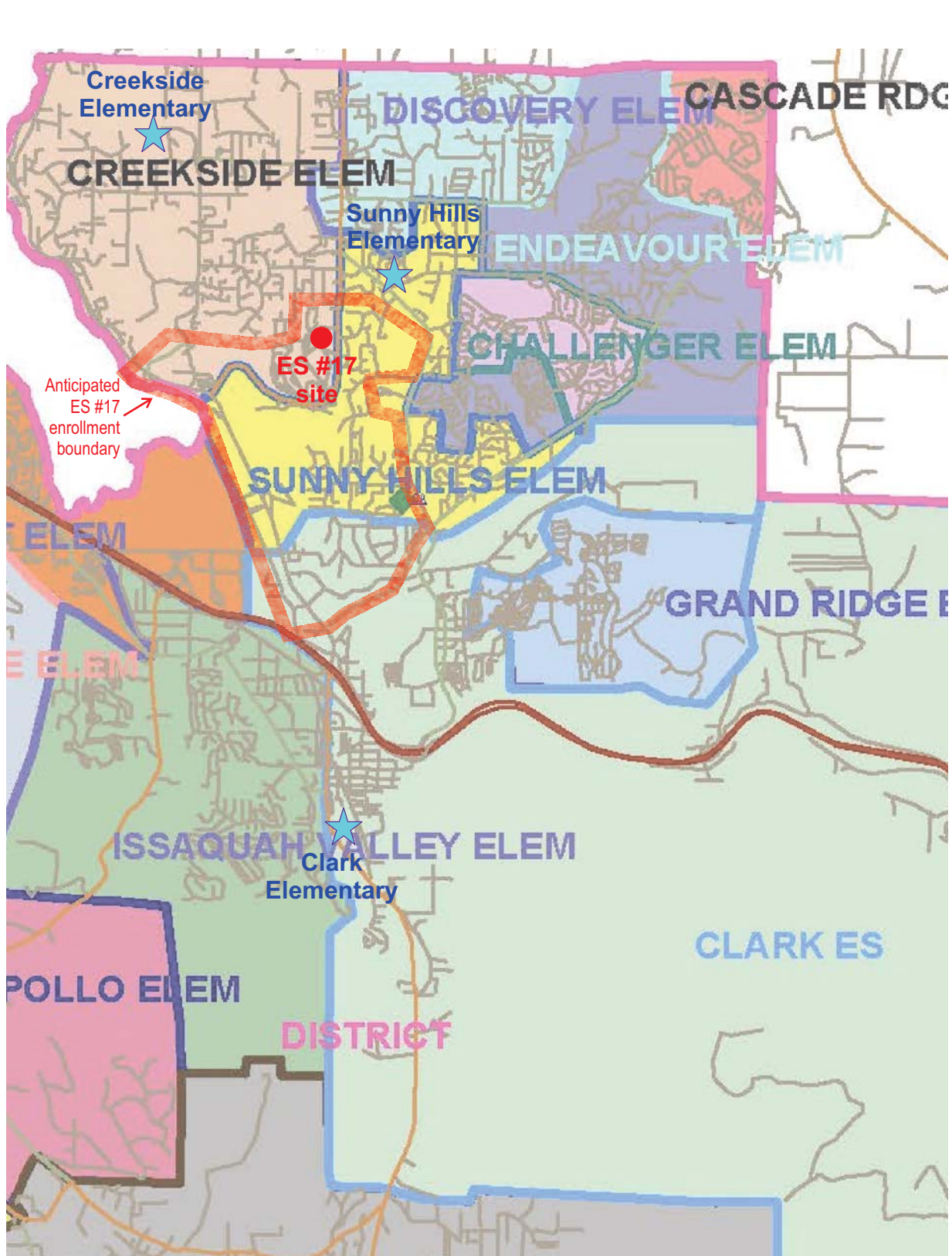
The overlap between the anticipated boundary for the proposed new schools and existing school boundaries are shown on **Figure 14** for the elementary school and **Figure 15** for the high school. Based upon the relative residential densities in the overlap areas, it is expected that the enrollment for Elementary School #17 would be comprised of about 57% from Sunny Hills Elementary, 28% from Clark Elementary, and 15% from Creekside Elementary. The trips that would be generated by the additional students at these schools if the proposed project is not constructed are shown on **Figure 16**, **Figure 17**, and **Figure 18**, respectively.

The enrollment for High School #4 would be comprised of about 50% from Skyline and 50% from Issaquah. The trips that would be generated by the additional students at these schools if the proposed project is not constructed are shown on **Figure 19** and **Figure 20**, respectively.

With the new schools in place, the trips generated by these students would be shifted from these existing schools that they would otherwise attend. Future traffic forecasts and operational analysis completed for the project will reflect the shifts that would occur with and without the project.

JAB/mch

Issaquah HS4-ES17_Trip Generation-Distribution-FINAL_06-09-20



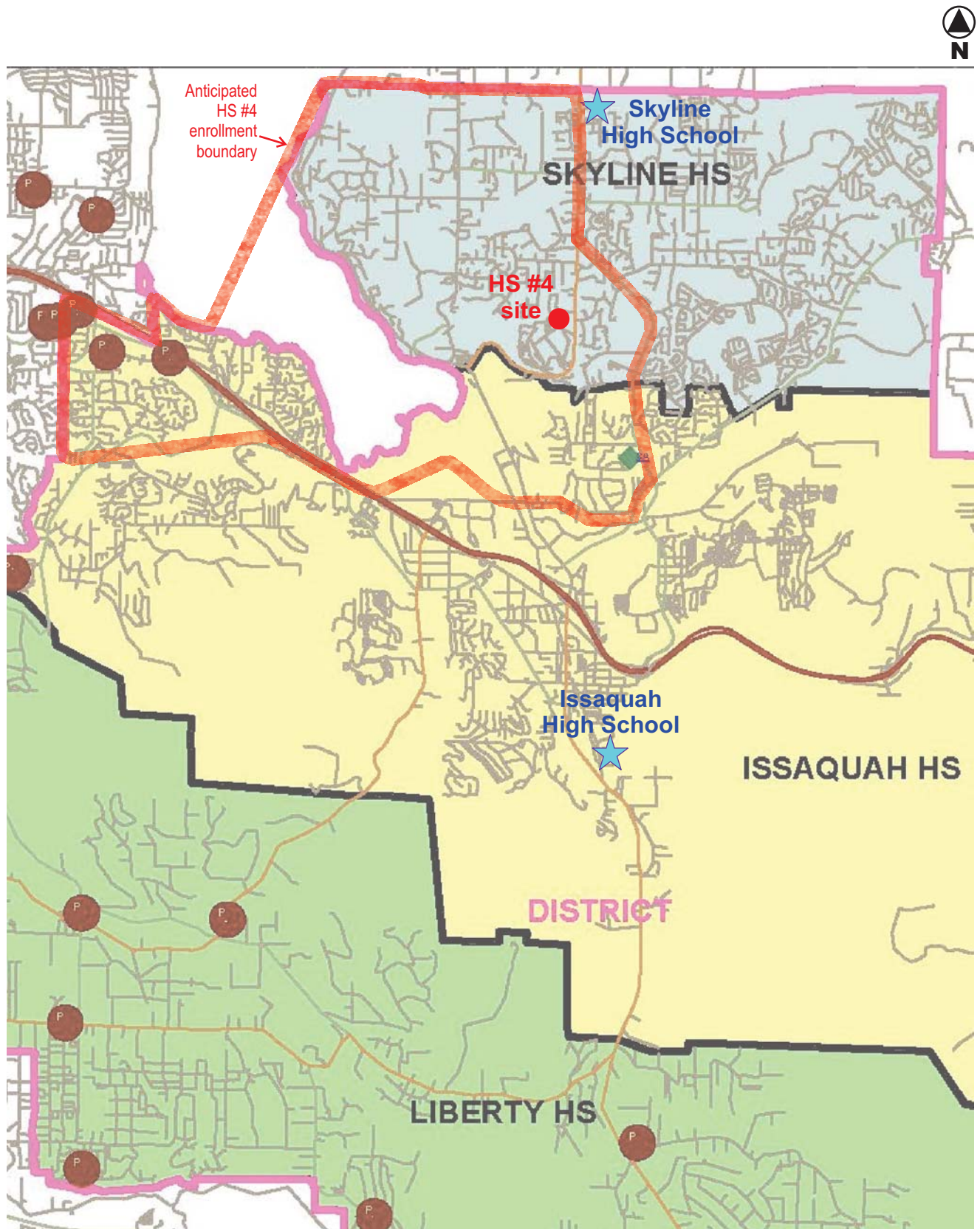
Source: Issaquah School District, April 2020

**High School #4
Elementary #17**

Figure14

Elementary School Boundary Overlap

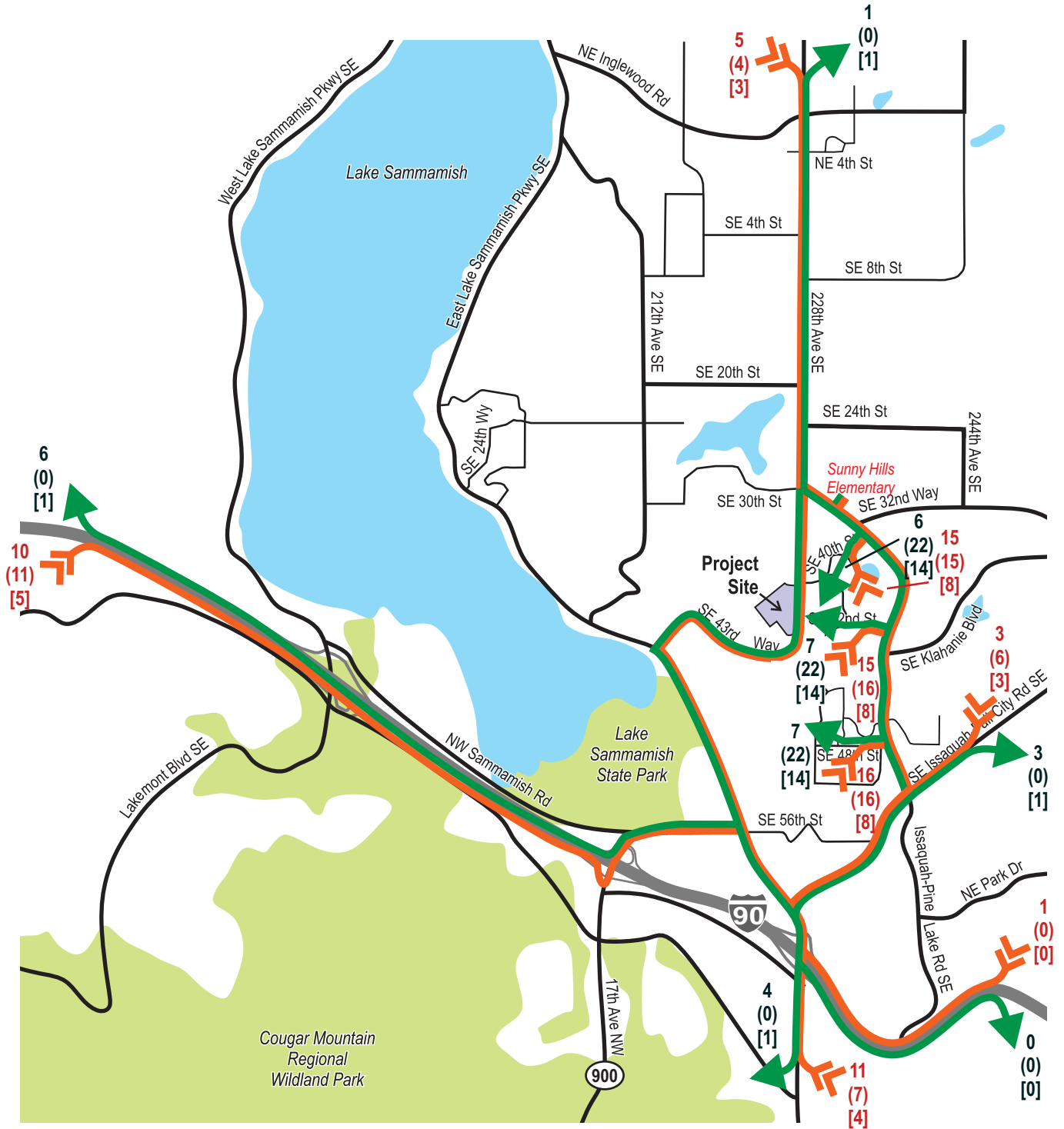




Source: Issaquah School District, April 2020

**High School #4
Elementary #17**

Figure 15
High School Boundary Overlap



LEGEND

Combined Morning Peak Hour
Combined Afternoon Peak Hour
Commuter PM Peak Hour

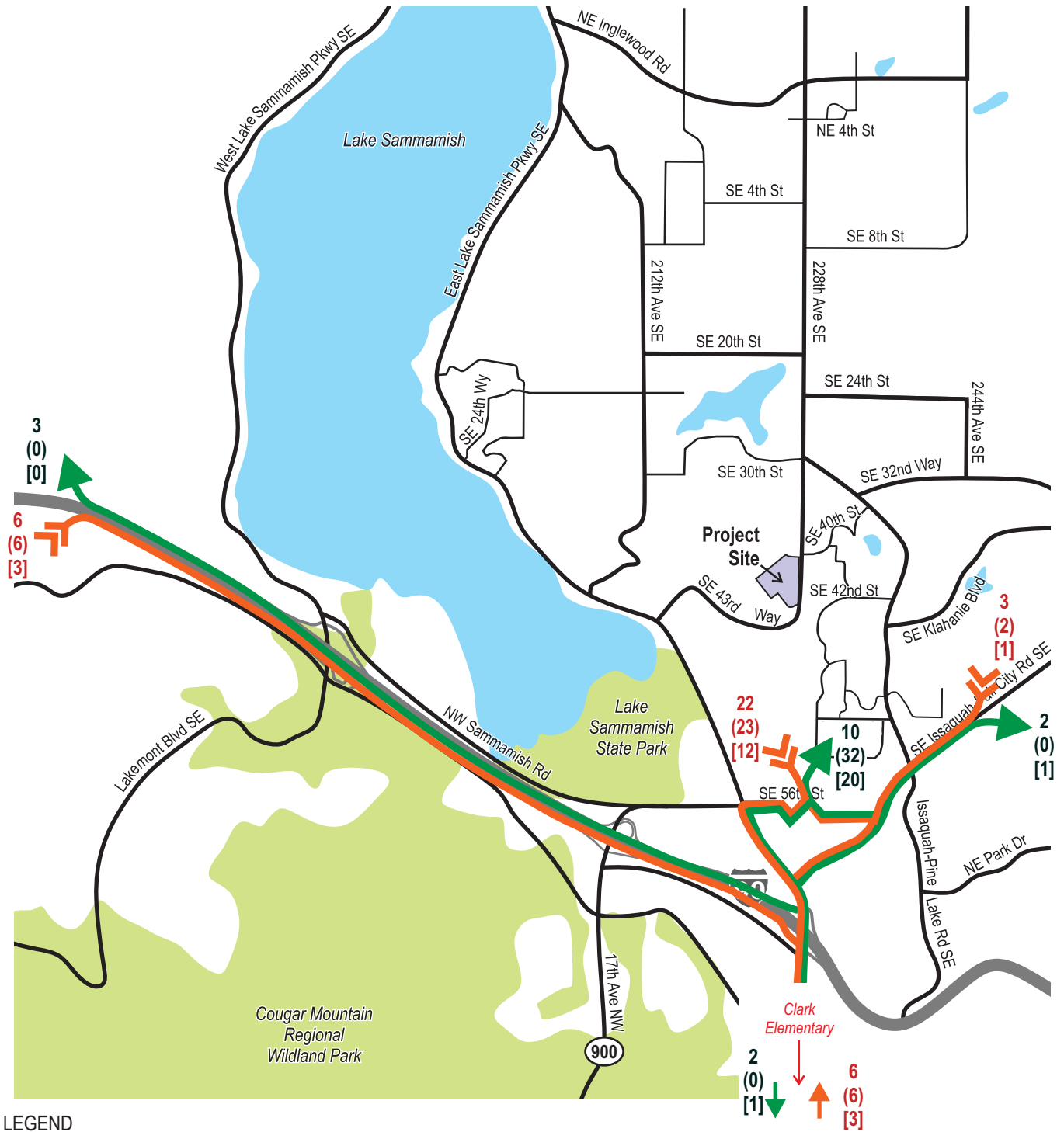
XX
(XX)
[XX]
Inbound Volume

XX
(XX)
[XX]
Outbound Volume

**High School #4
Elementary #17**

Figure 16
Trips Removed from Sunny Hills Elementary
Combined AM, Afternoon, & PM Peak Hours

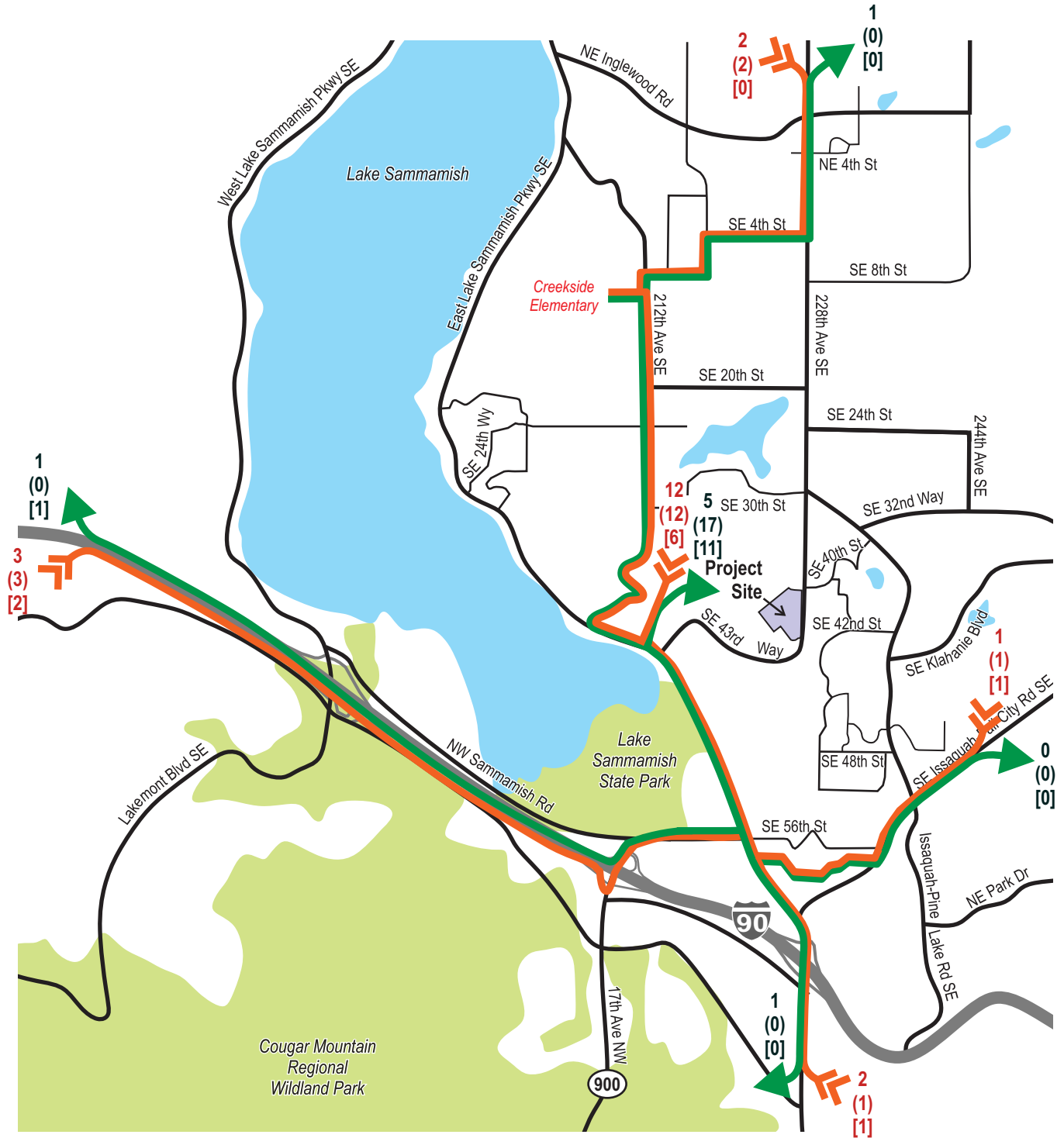




High School #4
Elementary #17

Figure 17
Trips Removed from Clark Elementary
Combined AM, Afternoon, & PM Peak Hours





LEGEND

Combined Morning Peak Hour
Combined Afternoon Peak Hour
Commuter PM Peak Hour

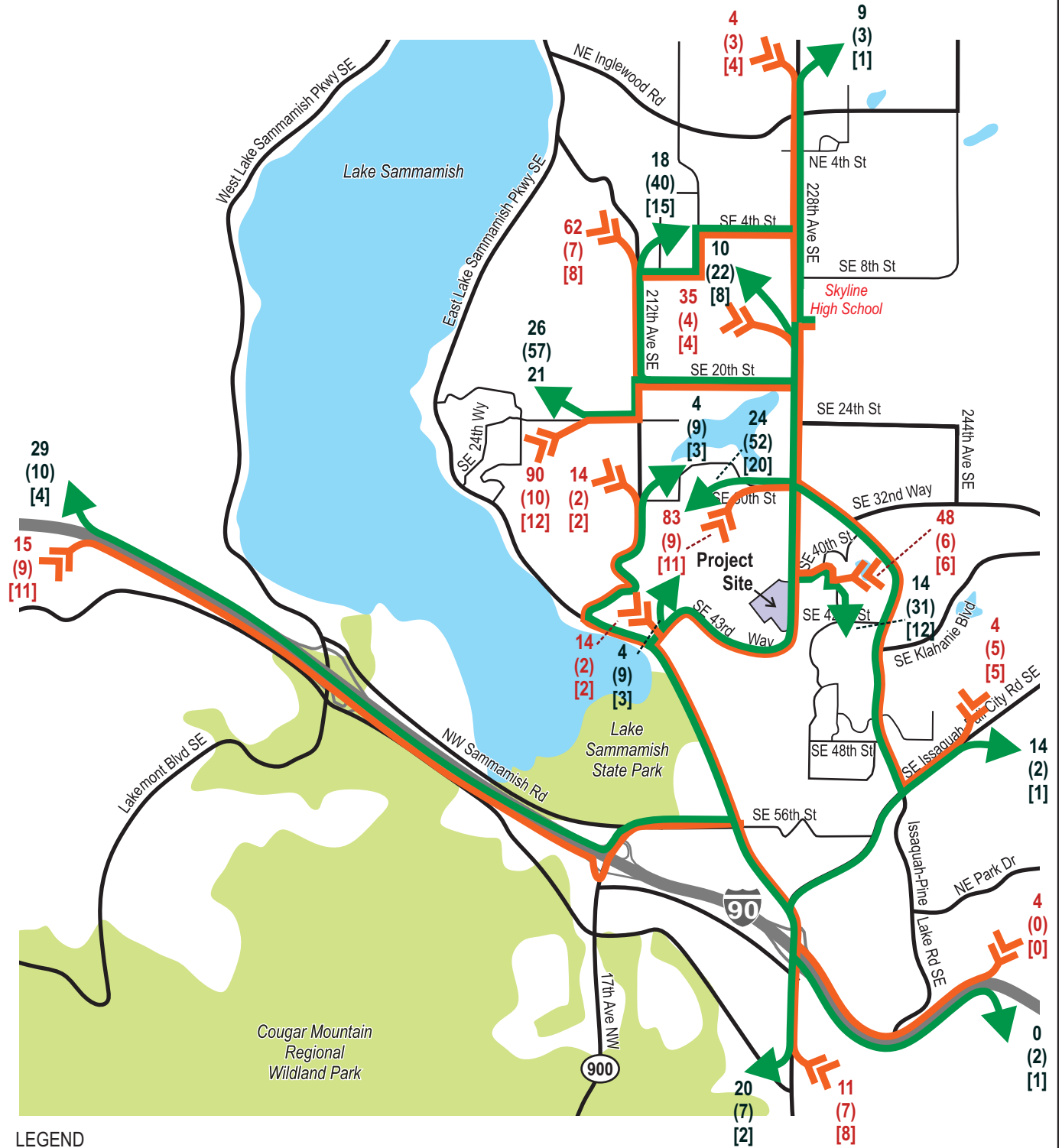
XX
(XX)
[XX]
Inbound Volume

XX
(XX)
[XX]
Outbound Volume

High School #4
Elementary #17

Figure 18
Trips Removed from Creekside Elementary
Combined AM, Afternoon, & PM Peak Hours





LEGEND

Combined Morning Peak Hour
Combined Afternoon Peak Hour
Commuter PM Peak Hour

XX
(XX)
[XX]
Inbound Volume

XX
(XX)
[XX]
Outbound Volume

High School #4
Elementary #17

Figure 19
Trips Removed from Skyline High School
Combined AM, Afternoon, & PM Peak Hours



APPENDIX
SCHOOL TRIP GENERATION
COUNT DATA

Summary of Driveway Trips
Discovery Elementary School

Time	Tuesday, October 1, 2019			Thursday, October 3, 2019			Average of Tues & Thurs		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
7:30 AM	13	2	15	13	6	19	13	4	17
7:45 AM	22	2	24	24	6	30	23	4	27
8:00 AM	23	12	35	63	47	110	43	30	73
8:15 AM	24	8	32	25	25	50	17	17	33
8:30 AM	8	8	16	17	6	23	36	14	50
8:45 AM	55	21	76	35	12	47	56	45	100
9:00 AM	76	77	153	69	70	139	37	51	88
9:15 AM	5	32	37	5	24	29	5	28	33
2:00 PM	4	6	10	2	6	8	3	6	9
2:15 PM	5	3	8	4	4	8	5	4	8
2:30 PM	6	4	10	2	1	3	4	3	7
2:45 PM	6	2	8	11	5	16	9	4	12
3:00 PM	7	2	9	13	2	15	10	2	12
3:15 PM	36	3	39	31	5	36	34	4	38
3:30 PM	23	21	44	25	21	46	24	21	45
3:45 PM	14	58	72	16	64	80	15	61	76
4:00 PM	4	26	30	9	22	31	7	24	31
4:15 PM	5	10	15	4	16	20	5	13	18
4:30 PM	14	14	28	13	15	28	14	15	28
4:45 PM	16	30	46	22	15	37	19	23	42
5:00 PM	16	20	36	12	31	43	14	26	40
5:15 PM	11	13	24	12	13	25	12	13	25
5:30 PM	13	19	32	16	9	25	15	14	29
5:45 PM	9	13	22	6	6	12	8	10	17
6:00 PM	9	11	20	6	12	18	8	12	19
6:15 PM	5	8	13	4	7	11	5	8	12
6:30 PM	3	13	16	2	6	8	3	10	12
6:45 PM	1	4	5	1	4	5	1	4	5
7:00 PM	0	0	0	1	1	2	1	1	1
7:15 PM	1	1	2	0	1	1	1	1	2
7:30 PM	2	0	2	0	0	0	1	0	1
7:45 PM	0	0	0	2	2	4	1	1	2

Peak Hour Conditions

Summary of Driveway Trips
Sunny Hills Elementary

Time	Tuesday, October 1, 2019			Thursday, October 3, 2019			Average of Tues & Thurs		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
7:30 AM	7	0	7	15	5	20	11	3	14
7:45 AM	11	5	16	11	4	15	11	5	16
8:00 AM	24	4	28	47	19	66	36	12	47
8:15 AM	25	10	35	55	40	95	38	22	59
8:30 AM	20	3	23	22	12	34	29	15	44
8:45 AM	35	18	53	26	13	39	59	54	112
9:00 AM	91	94	185	98	87	185	55	57	112
9:15 AM	12	27	39	12	29	41	12	28	40
2:00 PM	2	1	3	1	4	5	2	3	4
2:15 PM	4	4	8	9	1	10	7	3	9
2:30 PM	5	5	10	4	2	6	5	4	8
2:45 PM	7	5	12	6	5	11	7	5	12
3:00 PM	25	4	29	26	3	29	26	4	29
3:15 PM	42	7	49	41	6	47	42	7	48
3:30 PM	27	23	50	17	20	37	22	22	44
3:45 PM	13	77	90	17	89	106	15	83	98
4:00 PM	3	26	29	6	23	29	5	25	29
4:15 PM	8	15	23	12	17	29	10	16	26
4:30 PM	11	16	27	14	13	27	13	15	27
4:45 PM	18	20	38	13	29	42	16	25	40
5:00 PM	18	32	50	9	13	22	14	23	36
5:15 PM	5	10	15	16	11	27	11	11	21
5:30 PM	10	16	26	5	12	17	8	14	22
5:45 PM	10	10	20	8	8	16	9	9	18
6:00 PM	11	15	26	7	9	16	9	12	21
6:15 PM	5	3	8	4	6	10	5	5	9
6:30 PM	3	12	15	0	10	10	2	11	13
6:45 PM	0	1	1	0	0	0	0	1	1
7:00 PM	0	0	0	0	0	0	0	0	0
7:15 PM	0	0	0	0	0	0	0	0	0
7:30 PM	0	0	0	0	0	0	0	0	0
7:45 PM	0	0	0	1	0	1	1	0	1

Peak Hour Conditions

Summary of School Trips (Includes Driveways plus Trips to Off-Site Lots)
Skyline High School

Time	Tuesday, October 1, 2019			Thursday, October 3, 2019			Average of Tues & Thurs		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
6:30 AM	10	2	12	12	4	16	11	3	14
6:45 AM	27	6	33	34	7	41	31	7	38
7:00 AM	36	4	40	44	5	49	40	5	45
7:15 AM	114	11	125	130	21	151	121	16	137
7:30 AM	346	93	439	334	75	409	340	84	424
7:45 AM	321	147	468	368	132	500	345	140	485
8:00 AM	24	105	129	45	142	187	35	123	158
8:15 AM	14	3	17	29	20	49	22	12	34
2:00 PM	11	28	39	17	43	60	14	36	50
2:15 PM	21	18	39	16	10	26	19	14	33
2:30 PM	57	21	78	54	19	73	56	20	76
2:45 PM	66	85	151	68	94	162	63	58	120
3:00 PM	46	308	354	40	297	337	53	191	244
3:15 PM	29	149	178	23	108	131	35	208	243
3:30 PM	21	40	61	30	67	97	30	108	138
3:45 PM	37	46	83	49	56	105	43	51	94
4:00 PM	31	53	84	51	81	132	41	67	108
4:15 PM	23	39	62	26	40	66	25	40	65
4:30 PM	12	16	28	25	59	84	19	38	57
4:45 PM	12	19	31	44	49	93	28	34	62
5:00 PM	40	30	70	37	66	103	39	48	87
5:15 PM	64	63	127	59	74	133	62	69	131
5:30 PM	41	44	85	25	37	62	33	41	74
5:45 PM	35	33	68	14	44	58	24	38	62
6:00 PM	57	44	101	37	16	53	47	30	77
6:15 PM	51	69	120	55	28	83	53	49	102
6:30 PM	38	49	87	40	17	57	39	33	72
6:45 PM	71	19	90	28	46	74	50	33	83
7:00 PM	181	52	233	38	38	76	110	45	155
7:15 PM	76	69	145	17	25	42	47	47	94
7:30 PM	53	53	106	9	9	18	31	31	62
7:45 PM	24	34	58	8	15	23	16	25	41

Peak Hour Conditions

Afterschool and Evening Events

Summary of School Trips (Includes Driveways plus Trips to On-Street Parking)
Liberty High School

Time	Tuesday, October 1, 2019			Thursday, October 3, 2019			Average of Tues & Thurs		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
6:30 AM	6	0	6	11	1	12	9	1	10
6:45 AM	14	5	19	17	6	23	16	6	22
7:00 AM	14	2	16	16	2	18	15	2	17
7:15 AM	72	16	88	98	21	119	85	19	104
7:30 AM	188	53	241	184	57	241	186	55	241
7:45 AM	250	134	384	247	137	384	249	136	385
8:00 AM	26	45	71	28	38	66	27	41	68
8:15 AM	7	10	17	8	7	15	8	9	17
2:00 PM	10	8	18	3	7	10	7	8	15
2:15 PM	9	13	22	9	3	12	9	8	17
2:30 PM	30	14	44	27	9	36	29	12	41
2:45 PM	69	64	133	63	57	120	66	60	126
3:00 PM	28	184	212	30	187	217	29	186	215
3:15 PM	28	52	80	23	52	75	26	52	78
3:30 PM	17	30	47	13	23	36	15	27	42
3:45 PM	13	19	32	18	31	49	16	25	41
4:00 PM	22	20	42	22	24	46	22	22	44
4:15 PM	38	29	67	32	43	75	35	36	71
4:30 PM	30	49	79	30	71	101	30	60	90
4:45 PM	21	27	48	26	28	54	24	28	52
5:00 PM	34	25	59	42	55	97	38	40	78
5:15 PM	10	17	27	33	58	91	22	38	60
5:30 PM	15	23	38	13	23	36	14	23	37
5:45 PM	11	33	44	19	23	42	15	28	43
6:00 PM	12	24	36	3	12	15	8	18	26
6:15 PM	15	46	61	8	2	10	12	24	36
6:30 PM	4	22	26	5	11	16	5	17	22
6:45 PM	3	3	6	9	18	27	6	11	17
7:00 PM	17	17	34	29	24	53	23	21	44
7:15 PM	10	27	37	7	22	29	9	25	34
7:30 PM	7	10	17	0	1	1	4	6	10
7:45 PM	1	2	3	1	5	6	1	4	5

Peak Hour Conditions