

Annual Emissions Report - 2024

Environmental Sustainability Committee Revision 0 June 17, 2024

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1 EXECUTIVE SUMMARY

Emissions from 2023-24 fiscal year operations were 166.1 metric tonnes of CO2e, down 15% from the previous season. The reduction arises predominantly from a 16% drop in diesel consumption arising from a warmer ski season and less early season grooming due to low snow falls.

The vastly different weather conditions in November and December of 2023 (cold and snowy) versus 2024 (warm and less snow than average) showed drops in diesel (grooming) and electricity (heating) consumption of 33% and 15%, respectively, over this period, and a drop of 18.3 metric tonnes of CO2e.

Visitors continue to move towards using battery electric, plug-in hybrid, and hybrid vehicles over gasoline cars (13% in 2024 survey vs 9% in 2023 survey). A more detailed assessment of vehicle (and flight) emissions based on visitor home towns showed that visitor emissions represent about seven times more emissions than from annual operations.

2 INTRODUCTION

This report provides an update to the initial emissions benchmark report produced in 2022-23 by the Sovereign Lake Nordic Club (SLNC) Environmental Sustainability Committee ("Committee") [1], and provides our best estimates for emissions for the latest (2023 June to 2024 May) fiscal year. As it is a second year of reporting, analysis of changes in SLNC emission levels show changes arising from (a) impact of weather differences between operating periods, (b) overall improvements in societal consumption factors (i.e., greater prevalence of hybrid/electric car use), (c) more detailed analysis that refines assumptions, and (d) efficiency improvements from changes in operations. An assessment of these factors is included in this document.

3 OPERATIONAL OVERVIEW

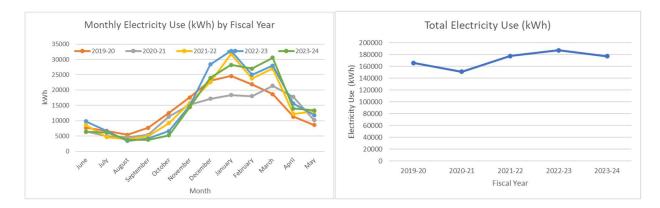
As documented in the initial benchmark report [1], Sovereign Lake Nordic Club (SLNC) emissions arise from (1) diesel consumption in grooming, (2) burning of wood for heat, (3) car emissions from staff and supplier commuting, (4) gasoline consumption to operate snowmobile, quad, fleet vehicles, and work-related vehicle trips, brush saws, and generators, (5) production of garbage from operations and visitors, and (6) electricity consumption. Our analysis also separately reports on estimated emissions from visitors.

Measures of consumption are regularly quantified for diesel and electricity, however gasoline consumption is not recorded on a Litre basis, and water use, firewood use, garbage and recycling volumes are not regularly recorded.

4 ANNUAL CONSUMPTION DATA AND ANALYSIS

4.1 Electricity

Consumption of electricity is invoiced on a monthly basis and this creates a clear record of use. The Figures below illustrate monthly and annual electricity use in kWh for fiscal years 2019-20 to 2023-2024. Note that 2020-21 consumption was impacted by COVID-related shutdowns, and shows materially lower electricity consumption.



For fiscal 2023-24, average monthly use was 14,750 kWh which was 5% lower than 15,583 kWh per month in fiscal 2022-23, but about the same as the 14,800 kWh used per month in 2021-22.

Although in 2023-24 several incandescent bulbs were replaced with LED bulbs, and the outdoor sodium bulb lighting system was split from one into three circuits to allow targeted (and less) use, the resulting reductions in electricity use are believed to be overshadowed by impact of warmer weather driving less need for electric heating. Nevertheless, these changes represent the first step in reducing site-wide electricity demand.

Note that in Reference [1], electricity reporting and calculations were done on a calendar basis. For this document, the analysis has been modified to report electricity consumption on a fiscal year basis, as this matches the analysis approach used for all other resource and emission types.

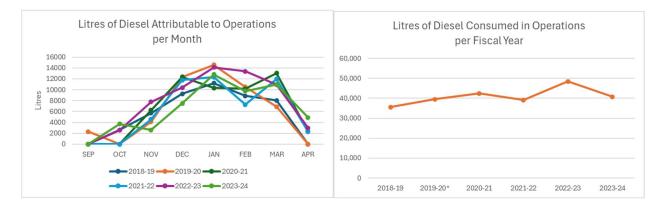
4.1.1 Energy Usage Intensity

Reference [2] recommends reporting energy use per square foot of space, referred to as Energy Usage Intensity (EUI), to allow comparison against industry benchmarks. From Reference [2], we can calculate that the applicable square footage is 11,609 square feet (sf). For 2023-24, 177,000 kWh of electricity use therefore converts into 15.25 kWh/sf. This value is higher than the 12 kWh/sf observed at typical ski clubs in Ontario (which have similar climates) [2], suggesting continued significant opportunity for energy efficiency improvement.

4.2 Diesel

SLNC receives regular deliveries of diesel between October and April, and sells about 26% of this diesel to a local supplier that provides snow clearing services using diesel-fueled equipment. Diesel fuel is used by the PistenBully snowcats as part of daily grooming operations. It is estimated that 15% of the diesel sold to the local supplier is used to clear SLNC parking lots and is attributable to SLNC operations.

With clear records of diesel volume purchases available, the volumes of diesel used to support operations can be closely calculated. The Figures below show the net consumption of diesel attributable to SLNC operations for the past six seasons on a monthly and annual basis. Diesel usage has remained relatively steady at around 40,000 L per season in recent years, with the exception of the very snowy 2022-23 season where diesel consumption was about 20% higher (at 48,416L).



4.3 Gasoline Used in Direct Operations

Gasoline purchase volumes are not tracked at SLNC, although the invoices for gasoline are categorized separately. Gasoline purchases between June 2023 and May 2024 totaled \$5,192 for use in fleet cars (including team van used to carpool athletes to race venues), a snow machine, a quad bike, and handheld equipment (e.g., brushsaws). Assuming an average purchase price of \$1.65/L, gasoline volume consumed throughout the fiscal year is 3,147L. Gasoline consumption is about half of the previous season. This is a result of reducing unnecessary trips but also modifications in tracking compared to estimations made previously. Further data is required to confirm annual gasoline consumption trends.

Although gasoline chainsaws were replaced with battery-electric chainsaws for the current fiscal year, the decline in total use (especially when compared to vehicle use) is expected to be very small. Nevertheless, their replacement represents the first step in eliminating gasoline use for all site-based equipment.

The committee has recommended updating the expense claim process to capture more detailed information on gasoline consumption (i.e., volume in L, use by vehicles versus equipment, etc).

4.4 Water

Water is drawn from a well and consumed in the day lodge, tech building, and shop. Unfortunately, there is no meter to measure site water consumption. While the true volume of water consumption on site cannot be quantified, the committee has recommended that a water meter be installed as part of the lodge renewal project to provide benchmark data for future use.

4.5 Firewood

No updates were made in the last year regarding the use of firewood. Consequently, the site is still estimated to still burn between 11 to 14 metric tons of firewood per year¹ as described in Reference [1].

¹ 10 cords*430kg/m3*3.625 m3/cord*0.72wood/cord = 11,223 kg, 12 cords*430 kg/m3*3.625 m3/cord*0.72 wood/cord = 13,467.6 kg. [3,4]

4.6 Waste

No updates were made in the last year regarding waste and recycling. Consequently, the total estimated garbage produced (using data from the 2021 study [2]) over a 150-day operating season is about 865 kg of garbage and 165 kg of recycling per season as described in Reference [1].

5 ESTIMATED EMISSIONS FROM TRAVELLING TO SLNC

SLNC is in a remote location, and commuting is required to reach the destination. Most visitors and staff members drive by gasoline-fueled personal vehicle (although some field trips are by school bus), while some members commute using electric vehicles. In addition, some visitors fly to Kelowna and commute from there to Silver Star accommodations.

In Reference [1] emissions from visitors were estimated at 897 metric tonnes of CO2-equivalent (CO2e) per season (based on simple assumptions of an average trip distance of 140 km per visit and the average fuel consumption per vehicle of 10.18 L per 100km²). In 2024, a more detailed analysis was performed using visitor home towns and pass type (e.g., day pass, 4+ pass, 8+ pass, season's pass). This assessment also included estimated emissions arising from visitors that fly to visit SLNC. The updated assessment provides a more detailed understanding of commuting and related emissions.

A survey on carpooling was launched in spring 2024, however with only 37 responses (compared with about 3000 members), the results were deemed as inconclusive and have not been reflected in any analysis.

5.1 Travel Distances, Modes, and Emissions

Emissions from visitor travel can be more precisely evaluated by using home location and pass type. For example, visitors with a local address can be assumed to drive, whereas those with home addresses in Ontario can be assumed to fly to Kelowna. Similarly, day pass purchases represent only one round trip of emissions, whereas 8+ passes can represent about 10 round trips.

An anonymous list of visitor home address and pass purchase data was developed from SLNC's sales system, and categorized by location and pass type to calculate emissions (all assumptions are provided in Appendix A). To help inform assumptions from faraway visitors, conversations were held with a few coaches from visiting team to understand their modes of travel (generally speaking, racers travel in team vans from home (or from other race sites), although some teams flew to Kelowna and rented a van). The total emissions from visitors using this more detailed analysis are summarized in the table below (with a more detailed breakdown provided in Appendix B).

Tonnes CO ₂ e Emissions Attributable to Visitor Travel				
Local driving 379.9				
Non-local driving	108.3			
Non-local flying 618.6				
Total 1,106.8				

² Emissions rates based on vehicle population type (i.e., ratio of EVs to gasoline vehicles in parking lot (as calculated in [1] using federally-reported emission rates for gasoline vehicles [5]).

5.2 Driving Emissions from Staff

No updates were made in the last year regarding calculation of staff driving and related emissions. In calculating the emissions attributable to SLNC operations we have approximated the emissions from staff commuting to site as well as from deliveries and service vehicle trips.

6 2023-24 ESTIMATED EMISSIONS FROM OPERATIONS

Based on the analysis above, emissions attributable to direct operations at SLNC are summarized below (in order of decreasing contributions).

Category	Annual Consumption	Conversion Factor to CO ₂ e	Metric Tons CO ₂ e emitted per year	% of Total Operations Emissions
Diesel	40,719 L	2.7 kg CO ₂ e/L [6]	109.94	66
Firewood ³	13,500 kg	1.8 kg CO ₂ /kg [7]	24.30	15
Staff & Suppliers	8,620 L	2.3 kg CO₂e/L [6]	19.83	12
Gasoline	3,147 L	2.3 kg CO ₂ e/L [6]	7.24	4
Waste ⁴	865 kg	2.89 tonnes CO ₂ /ton garbage [8]	2.76	2
Electricity	177,000 kWh	11.42 tonnes CO₂e/GWh [9]⁵	2.02	1
Total	-	-	166.1	100.0

Estimated emissions from visitors are summarized below, and account for nearly seven times the emissions from operations.

	Metric Tonnes	% of Total
Category	CO ₂ e emitted per	Operations
	year	Emissions
Visitors	1,106.8	666%

7 WEATHER IMPACTS ON RESOURCE USE AND SLNC EMISSIONS

The weather (temperature and snow fall) was markedly different between November and December of 2022 versus 2023. Early season in 2022 was marked by an abundance of snow and cold temperatures (which produced a multi-day full shutdown before Christmas), and a November 5th opening, whereas the same period in 2023 saw warm temperatures about half of average snowfall and an opening date of

³ No new data available, so assumed the same as in previous year.

⁴ No new data available, so assumed the same as in previous year. Calculations adjust for (a) converting conversion factor from "per ton" to "per 1000 kg", and (b) kgs recycling that was actually garbage and kgs garbage that was actually recyclable.

⁵ Latest available emission factor was 2023. Conversion factor used is based on weighted average over SLNC fiscal year based on calendar year emission factors reported by BC Hydro.

November 15th. Comparing consumption data between these two periods provides a sense of upper and lower consumption levels as they pertain to emissions from heating and grooming.

Electricity use from cold, snowy Nov 11 2022 to Jan 11 2023 was 61,200 kWh. Electricity use from warm and low snow Nov 9 2023 to Jan 10 2024 was 52,200 kWh. Thus, the later open and warmer conditions reduced electricity use by 14.7%. Due to the clean electricity supply, this represents a reduction of only 0.3 metric tons CO2e.

Total diesel litres attributable to operations from October through December 2022 totalled 16,069 L. Total diesel litres attributable to operations from October through December 2023 totalled 10,721 L. Thus, the later open and having fewer trails with enough snow to groom reduced diesel consumption by 33.3%. This represents a 14.4 metric ton reduction in emissions over this three-month period.

In Reference [1] it was deduced that heating is the primary source of electricity use (via baseboards heating). As heating of some buildings is also provided using firewood, a reduction of 14.7% in electricity use (i.e., lower heating requirements due to warmer temperatures) can be translated into an equivalent 14.7% drop in firewood use, resulting in a reduction of 3.6 metric tons CO2e emissions.

Category	Reduction between early season 2022 and 2023	Corresponding drop in emissions (metric tons CO2e)
Diesel	-33.3%	14.4
Firewood	-14.7%	3.6
Electricity	-14.7%	0.3
Total	-	18.3

From these calculations, we see that weather alone can account for a swing of 18.3 metric tons of CO2e, or 11% of operating emissions.

8 PUBLIC IMPACTS ON SLNC EMISSIONS

8.1 Impact of BC Hydro Grid Electricity Greenhouse Gas Emission Intensity Factors

SLNC draws all its power from the BC Hydro grid. BC Hydro reports its grid emission factors on an annual basis. In 2019, BC Hydro reported it emitted 7.5 tonnes CO2e/GWh across the entire grid. This grew to 11.5 tonnes CO2e/GWh in 2022 and dropped slightly to 11.3 tonnes CO2e/GWh in 2023. While this number is remarkably small (after all SLNC's emissions from a full year of electricity use equate to driving a car about 9,000 km), changes in these grid factors can cause changes in emissions levels for the same level of electricity use. From 2019 to 2023, emissions would have increased by 51% for the same electricity consumption, albeit only producing about 0.5 metric tons of CO2e more in emissions for SLNC operations.

8.2 Visitor Car Choices

With our emissions reporting in its second year, we are now afforded an opportunity to assess the change in car choices of visitors, and the related changes in average emission profiles. An inventory of

vehicle types in the two SLNC parking lots was described in Reference [1], and a new inventory taken on Saturday 17th February 2024. The data are summarized in the table below.

	2022-23		2022-23 2023-24			4
Vehicle	Count	Percent	Average Gasoline	Count	Percent	Average
Category	(Sat 18	of	Consumption	(Sat 17	of	Gasoline
	Feb	vehicles	(L/100km) [4]	Feb	vehicles	Consumption
	2023)	(%)		2024)	(%)	(L/100km)
	[snowy]			[sunny]		[4]
Regular car,	151	91	10.86	207	87	10.86
SUV, or						
Truck ⁶						
Hybrid	7	4	6.62	13	5.5	6.62
Plug-in	1	1	4.79	4	2	4.79
Hybrid						
Battery	7	4	0	13	5.5	0
electric						
Total	166	100	10.18 ⁷	237	100	9.93

The data show that 13% of visitors had cars that were hybrid, plug-in hybrid or battery electric, an increase from 9% of vehicles in 2023. Using the same fuel efficiency values per vehicle type as shown in Reference [5], the slight decrease in the prevalence of gasoline-only cars lowered average visitor fuel consumption per 100 km driven from 10.18 to 9.93 (or 2.5%). When this reduction is applied to car commuters, this change in visitor car fleet make-up represents a decrease of about 12.2 metric tons of CO2e⁸.

9 2023-24 IMPROVEMENTS AIMED AT REDUCING EMISSIONS

In the fall of 2023, SLNC completed two projects to reduce consumption and emissions (replacement of gasoline with battery electric chainsaws, and splitting the electrical circuit used to light up the parking lot, night ski loop, and biathlon range into three separate circuits). Based on the present analysis, these modifications have made immaterial changes to consumption and emissions to date (electricity use reductions are believed to be overshadowed by warmer weather effects). Nevertheless, continued further capital improvements are planned to reduce consumption and emissions.

10 ANNUAL CHANGES IN SLNC EMISSIONS

Estimated emissions for the past two fiscal years are summarized by resource category below. Emissions are estimated to have dropped by 15%. This is primarily attributable to experience a much warmer and less snowy ski season in 2023-24 than the previous year, resulting in less grooming (and diesel consumption). In addition, emissions from gasoline have dropped significantly through a reduction in unnecessary trips and improved tracking of total consumption for the latest season.

⁶ All pickup trucks were categorized as gasoline for ease of calculation.

⁷ Weighted average gasoline fuel consumption based on counts of vehicle types in parking lot.

⁸ 2.5% of emissions from table earlier in report showing driver emissions (excluding flyers) of 379.9 plus 108.3.

	2022-23 Metric	2023-24 Metric	
Category	Tonnes CO₂e	Tonnes CO ₂ e	
	emitted per year	emitted per year	
Diesel	130.72 ⁹	109.94	
Firewood*	24.30	24.30	
Staff &	10.92	10.92	
Suppliers*	19.83	19.83	
Gasoline	14.95	7.24	
Waste*	2.76	2.76	
Electricity	2.09	2.02	
Total	194.7	166.1	

^{*} Not re-assessed in 2023-24

Estimated emissions from visitors are summarized below, with 2023-24 estimates now reflecting emissions from air travel, and represent nearly seven times the emissions from operations.

Category	2022-23 Metric Tonnes CO2e emitted per year	2023-24 Metric Tonnes CO2e emitted per year
Visitors	896.7	1106.8

11 SUMMARY

This report compiles consumption data from SLNC operations for the past fiscal year, and compares this to past years. The following key observations have been made:

- Analysis shows that the milder start to the ski season in 2023-24 as compared to 2022-23 resulted in 33.3% less diesel use and 14.7% less electricity use.
- Emissions from operations are 166.1 metric tonnes of CO2e, and are down by 15% compared to 2022-23. This reduction is predominantly due to weather effects as described above.
- Gasoline consumption (and emissions) is roughly half of that estimated previously. This is a result of reducing unnecessary trips but also modifications in tracking compared to estimations made previously. Further data is required to confirm annual gasoline consumption trends.
- More detailed analysis of passholder address data (and the inclusion of emissions from flying) produced an estimate of 1106.8 metric tonnes of CO2e emissions from visitors, representing about seven times operational emissions.
- The percentage of visitor vehicles that were battery electric, plug-in hybrid, and hybrid increased from 9% to 13% over the last year. This produces 2.5% fewer emissions by (non-flying) visitors producing a 12.2 metric ton decrease in CO2e emissions.
- SLNC continues to work on establishing funding and implementing projects aimed at reducing consumption and emissions.

⁹ Reference [1] reported 105.06, but this was based on the latest available diesel purchases that extended only into 2022. This updated figure reflects collection of more detailed and recent diesel purchase data.

12 REFERENCES

- [1] Sovereign Lake Nordic Centre, "Initial Benchmark Report 2023", April 20 2023, Revision 0.
- [2] "Sovereign Lake Nordic Club Eco Efficiency Report", GreenStep Solutions Inc., January 26, 2021.
- [3] https://woodlot.novascotia.ca/book /export/html
- [4] https://forestandwildlifeecology.wisc.edu/sites/111/2017/07/44.pdf
- [5] Figure 3 from <u>https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-</u> <u>snapshots/2021/market-snapshot-plug-in-hybrid-vehicles-are-far-more-fuel-efficient-over-</u> <u>short-trips-than-long-trips.html</u> (using 50km distance driven)
- [6] www.nrcan.gc.ca/.../autosmart_factsheet_9.pdf mission Factors Used in Reporting BC Governments GHG Emissions
- [7] https://www.kaltimber.com/blog/2017/6/19/how-much-co2-is-stored-in-1-kg-ofwood#:~:text=It%20is%20reported%20that%201,to%201.80%20Kg%20of%20CO2.
- [8] <u>https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references</u>
- [9] Electricity Emission Intensity Factors for grid-connected entities, Province of British Columbia, Grid Factors for Integrated grid. <u>https://www2.gov.bc.ca/gov/content/environment/climatechange/industry/reporting/quantify/electricity</u>

APPENDIX A – TRAVEL DISTANCE, MODE, AND EMISSIONS ASSUMPTIONS

Assumptions

The assumptions used to make the calculations are as follows:

Transportation mode

- Racers drive in large vans whether from BC, Alberta and Washington or further away.¹⁰
- Non-racers from outside mainland BC, Alberta, Washington and Oregon drive.
- Non-racers from Vancouver Island or Gulf Islands fly to Kelowna and drive to SLNC from there.¹¹
- Local visitors, which includes everything between Kamloops to the north, West Kelowna to the south and Lumby to the east drive.
- A visitor's place of departure was the city/town given when their passes were purchased. When no address was given it was assumed to be a local user.

Emissions associated with flying

- An online calculator was used to calculate the CO₂e of a round-trip flight.¹²
- The international airport nearest the city/town associated with the pass was used as the departure airport and Kelowna airport was the destination airport.
- Emissions for driving from Kelowna airport to SLNC were calculated and added to the emissions associated with flying.
- While emissions associated with flying were attributed to one pass, it was assumed that two people were sharing the emissions associated with the drive from Kelowna airport to SLNC.

Emissions associated with driving

- The figure of 10.86 L/100km was used as the fuel efficiency of the large vans used by racing teams and the number of passengers/van was 8.
- The kg of CO₂e/L gas burned was 2.3.
- Emissions were calculated for a round trip between departure city/town and SLNC.
- For non-racers it was assumed there were 2 passengers/vehicle.
- For non-racers the fuel efficiency was assumed to be 10.18L/100km.
- Google Maps was used to calculated distances from a person's city/town to SLNC. Where more than one route was given the route with the shortest distance was used.

Pass types

- For all pass types where no address was given, it was assumed the purchaser was local.
- 4+ and 8+ passes:
 - For visitors considered to be local (likely to make the trip to SLNC and back in one day) it was assumed that a 4+ pass was used 5 times and accounted for that many round trips. Similarly, an 8+ pass was used 10 times and involved 10 round trips. Two passengers/vehicle was assumed.
 - For visitors from further away who had flown from their city/town it was assumed they stayed at Silver Star and did not drive back and forth between there and SLNC.
 - For other non-local visitors who had driven from their city/town it was assumed they also stayed at Silver Star and did not drive back and forth between there and SLNC.

¹⁰ This is based on a conversation with one coach who said their team travels from one race to another by van. In another reported conversation with a coach from Quebec that team flew to Kelowna and rented a large van for the Western Canada Cup race in Dec. 2023.

¹¹ This assumption may be inaccurate. There may be some visitors who will take ferries and drive from the lower mainland.

¹² https://co2.myclimate.org/en/flight_calculators/new

- Season passes:
 - These passes were sorted into 4 categories:
 - Non-racers flying
 - Non-locals driving
 - Local seniors
 - Local non-seniors
 - Non-racers flying were assumed to be staying at Silver Star and not driving back and forth between there and SLNC. Therefore their emissions were those associated with a round trip between their city/town to Kelowna and the emissions from a round trip driving between Kelowna airport and SLNC with 2 passengers/vehicle.
 - Non-locals driving were assumed to be staying at Silver Star and not driving back and forth between there and SLNC so their emissions were from the round trip driving between their city/town and SLNC.
 - Local senior season pass holders were assumed to make 2 round trips/week from December through mid March, a total of 14.5 weeks. Passengers/vehicle was assumed to be 2.
 - Other local pass holders (adult, family, student, youth) were assumed to make 1 trip/week over 14.5 weeks. Passengers/vehicle was assumed to be 2.
- Single day passes:
 - These passes were sorted into visitors who flew and visitors who drove. Where no address was given it was assumed the purchaser was local.

Calculations of CO ₂ e Emissions Attributable to Visitor Travel				
Type of pass	Location and mode of transportation	Tonnes CO2e		
4+	non-racers - flying	93.8		
	racers - driving	20.0		
	BC+AB non-racers - driving	8.5		
	local area - driving	10.7		
	no address	3.9		
	Total	136.9		
8+	non-racers - flying	12.2		
	racers - driving	2.8		
	BC+AB non-racers - driving	1.7		
	local area - driving	3.3		
	no address	1.9		
	Total	21.9		
Season's Pass	non-racers - flying	117.6		
	non-local - driving	17.8		
	local - senior	160.7		
	local - non-senior	142.0		
	Total	438.1		
Single day	flying	395.2		
<i></i>	driving	114.7		
	Total	509.9		
All pass types	Total	1,106.8		

APPENDIX B – EMISSION CALCULATIONS BY PASS TYPE AND VISITOR TYPE