Initial Benchmark Report - 2023

Environmental Sustainability Committee
Revision 0
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Contents

1 INTRODUCTION

As outlined in the Environmental Sustainability Committee strategy, the primary focus for 2022-23 is to develop benchmark data relating to environmental factors (i.e., consumed resources and environmental emissions). This report compiles relevant background operational information from an interview with the general manager, as well as consumption data obtained from past financial records. Where possible, estimates of environmental emissions have been calculated using public methodologies. The document summarizes benchmarks for monitoring and measuring improvements in environmental sustainability going forward. Detailed recommendations for improvement projects will follow in a separate report.

2 OPERATIONAL OVERVIEW

An overview of operations was obtained by interviewing the general manager using the questionnaire developed earlier this year. The completed questionnaire is provided in the Appendices to this report, while a summary of operations is provided below.

There are 10 buildings on site, with most receiving electricity but only three having running water. As there is no natural gas or propane on site, any building heating is provided by either burning wood or using electric heating, or both. Garbage cans are available in most building, with some also having recycling bins. A composting program was attempted three years ago, but the supplier cancelled service due to poor conditions on Sovereign Lake Road and low volume of compost.

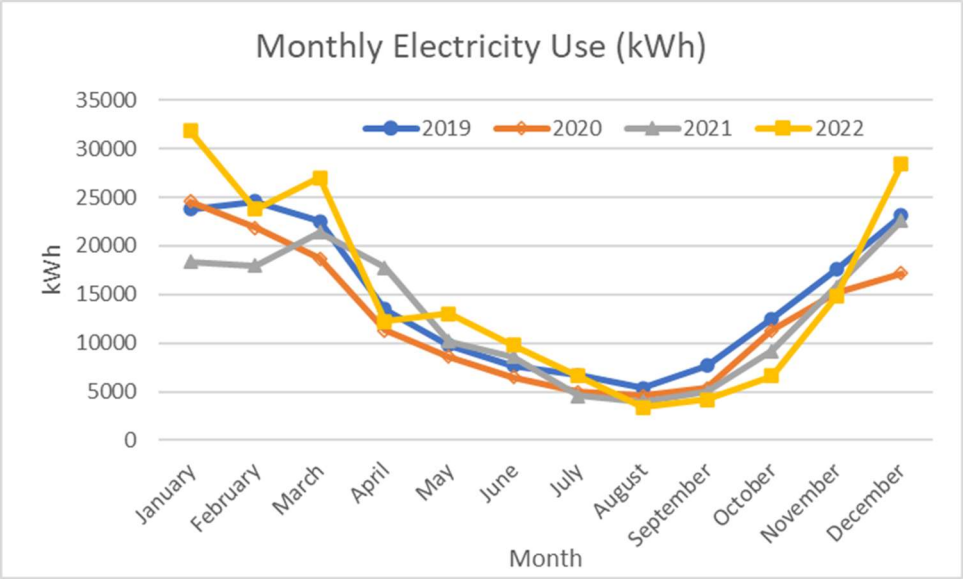
On-site equipment features two PistenBullys running on diesel, and one snowmobile, two quad bikes, three fleet vehicles and ~10 pieces of equipment (e.g., chainsaws, brush saws, generators) that all operate using gasoline.

Measures of consumption are regularly quantified for diesel and electricity, however gasoline consumption is not recorded, and nor are water use, firewood use, nor garbage and recycling volumes. In 2021, GreenStep Solutions Inc. released an Eco Efficiency report following an assessment of Sovereign Lake [1]. The assessment looked at the areas of energy, water and waste, and provided recommendations in each area. Their findings are discussed in the section below.

3 CONSUMPTION DATA AND OBSERVATIONS

3.1 Electricity

Consumption of electricity is invoiced on a monthly basis and this creates a clear record of use. The Figure below illustrates electricity use in kWh for calendar years 2019-2022. Four years of data were reviewed as consumption data was skewed in 2020 and 2021 due to COVID-related restrictions on operations (for example, electricity use dropped 14% in 2020). For 2022, average monthly use was 15,133 kWh which was 3.8% higher than the 14,575 kWh used per month in 2019. Total 2022 electricity use was 181,600 kWh.



Reference [1] recommended replacing existing lighting with LED lights throughout the Tech building, main lodge, shop, parking lot, and ski trails. This was estimated to reduce energy consumption by 3,160 kWh over a year. It is worth noting that these savings, while reducing lighting energy use by over 30% represent only 1.7% of 2022 total use, suggesting that heating is the primary consumer of site electricity. Reference [1] provided other considerations to reduce energy use (e.g., consideration of heat pumps, programming thermostats, and use of curtains and draft proofing to reduce heat loss).

As shown in the Figure, summer operations require the least electricity use, as would be expected as less heating and lighting is required. August consumption averaged 4,350 kWh over the past four years. Cool summer nights at altitude may warrant heating of key areas (i.e., where there is plumbing, or equipment that must stay warm) throughout the summer, but it is suggested that further assessment be undertaken to develop opportunities to further reduce summer consumption, and monthly consumption in general.

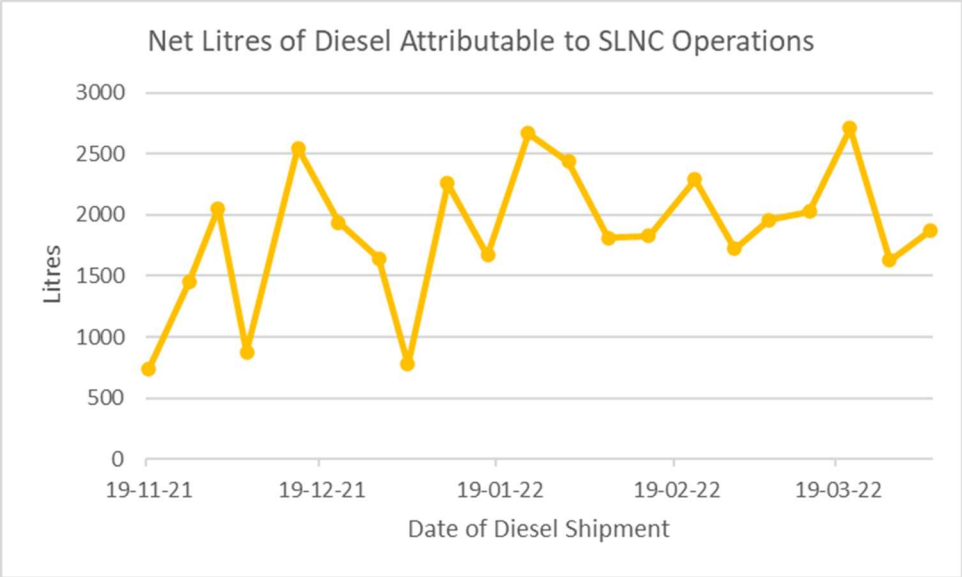
3.1.1 Energy Usage Intensity

Reference [1] recommends reporting energy use per square foot of space, referred to as Energy Usage Intensity (EUI), to allow comparison against industry benchmarks. From Reference [1], we can calculate that the applicable square footage is 11,609 square feet (sf). For 2022, 181,600 kWh of electricity use therefore converts into 15.6 kWh/sf (or 0.056 GJ/sf). This value is higher than the 12 kWh/sf observed at typical ski clubs in Ontario (which have similar climates) [1], suggesting significant opportunity for energy efficiency improvement.

3.2 Diesel

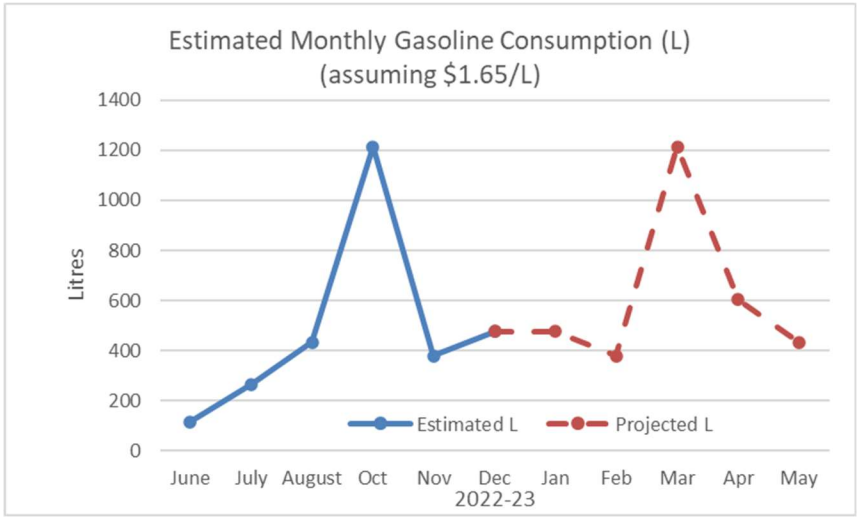
SLNC receives regular deliveries of diesel between November and April, and sells about 26% of the diesel to a local supplier that provides snow clearing services using diesel-fueled equipment. Diesel fuel is used by the PistenBully snowcats as part of daily grooming operations. It is estimated that 15%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

operations can be closely calculated. The Figure below shows the net consumption of diesel attributable to SLNC operations for the 2021-22 season. The total net annual consumption of diesel in the 2021-22 season was 38,912 L.



3.3 Gasoline Used in Direct Operations

Gasoline purchase volumes are not tracked at SLNC, although the invoices for gasoline are categorized separately. Assuming a price of $1.65/L we have conservatively estimated the volume of gasoline consumed based on available invoices spanning June 2022 to December 2022. The values were mirrored to provide projected consumption from January to May 2023, as shown in the Figure below. Total annual gasoline consumption is estimated to be about 6,500 L. This fuel was used by fleet cars, a snow machine, quad bikes, and various pieces of handheld equipment (e.g., chainsaws).



3.4 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. Nevertheless, projects were undertaken in the last two years to replace regular faucets with motion sensor timed flow faucets, and to replace all toilets with low-flush toilets. Faucets are estimated to save 30-70% of water consumption, and the toilets reduced water consumption per flush by over 30%. While the true volume of water consumption on site cannot be quantified, installing a meter on the well supply would allow quantification of these savings as well as provide benchmark data for future use.

3.5 Firewood

Firewood is used to heat the central areas of the main lodge as well as heat the old lodge, wax hut, biathlon hut, and Black Prince cabin. Firewood is sourced as dead wood from the park and is typically Balsam Fir and dried for 2 years before use. About 10-12 cords of wood are estimated to be burned per year. Air-dried (12% moisture content) Balsam Fir has a density of 430 kg/m^3 [2]. As a cord contains 3.625 m^3, but about 28% of stacked wood is air [3], the site is estimated to burn between 11 to 14 metric tons of firewood per year[1].

3.6 Waste

Waste and recycling are picked up on a bi-weekly basis at a fixed cost rate. Consequently, measurements are not made of volume (or weight) of waste streams. An assessment of the garbage and recycling was performed in January 2021 [1] and the results are summarized below. Although volumes were lower than normal (as indoor seating areas were closed due to Covid-19 protocols), 12.6 kg of garbage and 1.2 kg of recycling were inspected over a 2-day period[2]. The assessment showed the following major findings:

- 9.6% of garbage was recyclable.
- 12.8% of recyclables were actually not recyclable.
- 38.8% of garbage and 1.8% of recycling was compostable.

The study recommended better signage and labelling to improve waste stream separation by members.

As there are no measures of waste for site, the total estimated garbage produced (using data from the study and after correcting for recycling errors noted above) over a 150-day operating season is about 865 kg of garbage and 165 kg of recycling per season.

4 ESTIMATED EMISSIONS FROM DRIVING 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.

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[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.

[2] Refundable cans and bottles were collected separately and not included in the assessment.

SLNC operations have little influence over the choice of vehicle used by visitors (arguably the vehicle that is used is influenced by economics, national policy, and the end desire to eliminate sales of gasoline-fueled vehicles by 2035). For informational purposes, we have estimated the emissions from driving to SLNC and also approximated (a) the reduction in emissions from replacing 10 car trips with one shuttle bus, and (b) the reduction in emissions from eliminating 1 round trip (i.e., via carpooling). Note that the values provided here rough approximations and are used for informational and benchmarking purposes.

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.

4.1 Estimated Traffic Volumes

Prorating 2022-23 ticket scan data available to date, SLNC can expect to see an estimated 42,000 users per ski season. Assuming that 35% of visitors arrive alone in a car, represents 14,700 vehicles. Assuming that the remaining 65% of visitors arrive as two people in one car represents 13,650 vehicles. Combined, this represents 28,350 car round trips per winter season.

4.2 Vehicle Type

For informational purposes, an inventory of vehicle types in the two parking lots beside the main lodge was taken was taken at 10:30 Saturday 18 February 2023, as summarized below.

Vehicle Category	Count	Percent of vehicles (%)	Average Gasoline Consumption (L/100km) [4]
Regular car, SUV, or Truck[3]	151	91	10.86
Hybrid	7	4	6.62
Plug-in Hybrid	1	1	4.79
Battery electric	7	4	0
Total	166	100	10.18[4]

Based on this survey, the weighted average gasoline fuel consumption for visitors to SLNC is 10.18 L/100km.

4.3 Travel Distances

The Table below shows the breakdown of ticket sales as shown in the 2022 SLNC Strategic Plan [5]. As expected, the vast majority of sales are to resident of BC, and these are largely in the Okanagan valley. Sales for distant regions are typically to visitors that are staying long enough to benefit from the price of a season pass.

[3] All pickup trucks were categorized as gasoline for ease of calculation.
[4] Weighted average gasoline fuel consumption based on counts of vehicle types in parking lot.

2020-21 Geographical Ticket Sales		
Residence of Passholder	Count	% of Sales
BC	10886	85.7%
Alberta	764	6.0%
Ontario	353	2.8%
USA	348	2.7%
Quebec	187	1.5%
Saskatchewan	59	0.5%
Manitoba	52	0.4%
Yukon	29	0.2%
Newfoundland	8	0.1%
NWT	8	0.1%
International	7	0.1%
Nova Scotia	4	0.0%

The following assumptions have been made to simplify estimated driving distances of visitors:

- All residents of BC drive to SLNC. The assumed breakdown is:
    - 75% make round trips per visit (conservatively assuming average of 150 km daily round trip to cover Kelowna) and
    - 25% visit from Vancouver area for a 1 week stay at Silver Star Mountain Resort which results in 142 km/visit[5].
- All residents of Alberta drive for 1-week stay, and reside at Silver Star Mountain Resort, resulting in 172 km/visit[6].
- All other passholders fly to Kelowna and rent a car and stay at residences at Silver Star Mountain Resort for 1 week resulting in 27km/visit[7].
- Distance travelled by plane is excluded.

Using these assumptions, the average daily trip consists of ~140 km per visit.

4.4 Estimated Emissions

Based on an average trip distance of 140 km per visit and the average fuel consumption per vehicle of 10.18 L per 100km, then each visit consumes 13.75 L of gasoline. On average, 2.3 $kgCO_2e$ is emitted per litre of gasoline [6]. Thus, each trip emits 31.63 kg CO_2e. As there are an estimated 28,350 trips to SLNC per season, then 896,730 $kgCO_2e$, or 897 metric tonnes, of CO_2e are emitted per season. Over a 150-day season, this represents daily emissions of 5,978 $kgCO_2e$.

Daily trips attributable to staff and supplier commutes to SLNC are estimated at 13 visits per day. It is assumed that staff and suppliers all live in Vernon, and they drive 45 km round trip per visit. With the

[5] (2*464km+7*2*4.6km)/7 days = 142 km/day
[6] (2*570km+7*2*4.6km)/7 days = 172 km/day
[7] (2*61km+7*2*4.6km)/7 days = 27km/day

same emission levels, each trip consumes 4.42 L of gasoline and produces 10.17 kgCO_2e per round trip. Based on 150 day season, 13 staff and supplier trips per day each producing 10.17 kgCO_2e each, then 19,826 kg CO_2e, or 19.8 metric tonnes of CO_2e per winter season. This represents a further 2.2% of emissions compared to visitor trips estimated from ski pass scans.

Using the calculations above, one round trip from Vernon to SLNC emits 31.63 kgCO_2e. If a shuttle bus from Vernon had ten passengers, then it would save 9 round trips, or 284.67 kgCO_2e (or 4.8% of daily emissions per shuttle bus round trip).

5 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_2e	Metric Tons CO_2e emitted per year	% of Total Operations Emissions
Diesel	38,912 L	2.7 kg CO_2e/L [6]	105.06	62.2
Firewood	13,500 kg	1.8 kg CO_2/kg [7]	24.30	14.4
Staff & Suppliers	8,620 L	2.3 kg CO_2e/L [6]	19.83	11.7
Gasoline	6,500 L	2.3 kg CO_2e/L [6]	14.95	8.8
Waste	865 kg	2.89 tonnes CO_2/ton garbage [8]	2.76	1.6
Electricity	181,600 kWh	11.5 tonnes CO_2e/GWh [9]	2.09	1.2
Total	-	-	168.99	100.0

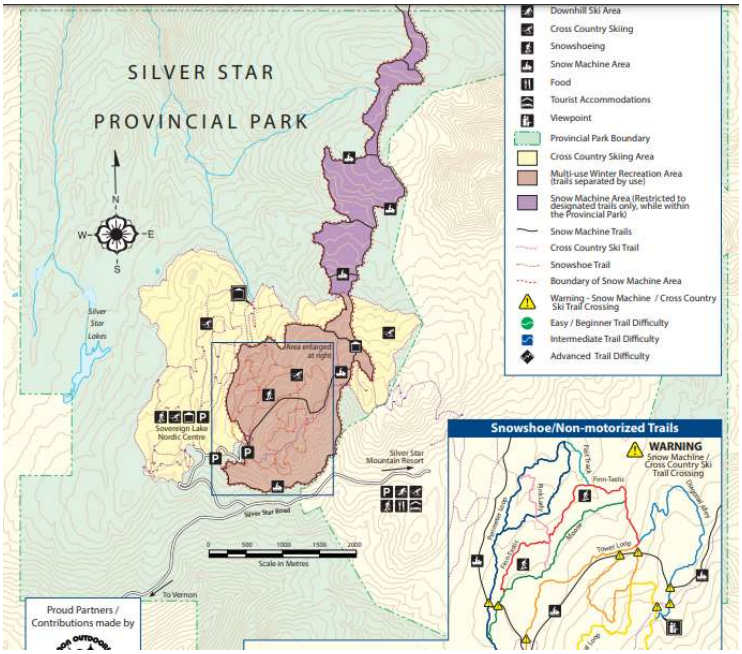
Estimated emissions from visitors are summarized below, and account for about five times the emissions from operations.

Category	Annual Consumption	Conversion Factor to CO_2e	Metric Tons CO_2e emitted per year	% of Total Operations Emissions
Visitors	389,882 L	2.3 kg CO_2e/L [6]	896.73	499.1

6 ESTIMATED CO_2 ABSORPTION BY PARK FOREST

Silver Star Provincial Park (SSPP) spans 5,573 hectares [10], while Silver Star Mountain Resort spans 1,328 hectares. It is unknown how many hectares are within the cross country skiing sub-area of SSPP. In researching how much a CO_2 a healthy forest can absorb, values varied widely depending on the source, tree species, and degree of clear cutting, amongst other factors. Absorption rates varies from 2 to 40 metric tons of CO_2 absorption per hectare of forest per year. Using this range of factors, the entirety of SSPP would absorb between 111 and 2,229 metric tons of CO_2 per year.

The wide range in data indicates that more analysis is required to determine whether the forest that encompasses the SLNC ski trails can absorb all annual emissions.



7 SUMMARY AND NEXT STEPS

This report compiles consumption data from SLNC operations for the first time, and in turn provides an estimate of annual operation CO_2e emissions totaling 169 tonnes of CO_2e per year. The report also provides an estimate of annual emissions from visitors of 897 metric tonnes of CO_2e per year. Unfortunately, there is insufficient data available to determine whether these emissions could be offset through absorption of CO_2 by the forest within SLNC.

These benchmarks will serve as guidance for future improvements. Such improvements will likely include improving measures (i.e., install water meter, firewood consumption, gasoline consumption), changes to equipment such as battery powered tools and snowmobiles, more efficient use of electric and wood heating, and improved ride sharing options and encouragement of use of electric vehicles in lieu of gasoline-fueled vehicles. A listing of recommended projects will be provided in a separate report.

8 REFERENCES

[1] "Sovereign Lake Nordic Club Eco Efficiency Report", GreenStep Solutions Inc., January 26, 2021.

[2] https://woodlot.novascotia.ca/book /export/html

[3] https://forestandwildlifeecology.wisc.edu/sites/111/2017/07/44.pdf

[4] Figure 3 from https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2021/market-snapshot-plug-in-hybrid-vehicles-are-far-more-fuel-efficient-over-short-trips-than-long-trips.html (using 50km distance driven)

[5] Sovereign Lake Nordic Club Strategic Plan 2022-26, December 13 2022.

[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-of-wood#:~:text=It%20is%20reported%20that%201,to%201.80%20Kg%20of%20CO2.

[8] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

[9] Electricity Emission Intensity Factors for grid-connected entities, Province of British Columbia, Grid Factors for 2022 Integrated grid. https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/reporting/quantify/electricity

[10] https://bcparks.ca/silver-star-park/

APPENDIX A - FACILITIES OVERVIEW

Building	Heat Source(s)			Water/Sewer supply		Electricity Supply		Waste Management		
	Wood	Electricity	Other	Supplied?	Used by	Supplied?	Used by	Garbage	Recycling	Compost
Main Lodge	Y (common areas wood only)	Baseboard in small areas (bathrooms, rental area, booths, etc)	None	Y (well-sourced)	Washrooms, kitchenette, maint. area	Y	Lights, IT, irons, heat, dehumidifier, fridge, dishwasher	Y	Y	N - Tried 3 years ago. Insufficient volume
Old Lodge	Y	N	N	N	-	Y	lights	Y	Y	N
Team Room	N	Baseboard	N	N	-	Y	Lights, heat	Y	N	N
Tech Building	N	Baseboard	N	Y	Washroom, kitchenette	Y	Lights, kitchenette, baseboard	Y	Y	N
Wax Hut	Y	1st aid area has baseboard	N	N	-	Y	Lights, plugs for wax irons (1st aid heat)	Y	N	N
Biathlon Hut	Y	Baseboard	N	N	-	Y	Lights, space heater in gun locker	Y	N	N
Black Prince Cabin	Y	N	N	N	-	N	-			
Shop	N	Electric furnace forced air	N	N	-	Y	Lights, tools, furnace	Y	Y	(Fluid separator, waste oils)
Old Race Office	N	Baseboard	N	N	-	Y	Lights, baseboards			
Other: Powerhouse	N	Y	N	N	-	Y	Cell system, Site power.	N	N	N

APPENDIX B – EQUIPMENT OVERVIEW

Equipment Type	Description	Quantity	Activity Overview	Fuel Type	Other chemicals used
Groomers	PistenBully 400	2	Winter use only – grooming, trail maintenance, occasional parking lot clearing	Diesel	Hydraulic fluid, oil, etc
Snowmobiles	~2014 Skandic 1000 snowmachine	1	Primarily on standby by for First aid support. Occasional use for trail maintenance and events.	Gasoline (4-stroek engine)	
Quad Bikes	2018 Polaris 1100 Skidoo 1100	2	Everyday use (Grooming, general support, competitions, hauling, etc)	Gasoline	
Fleet vehicles	2013 Ford F150 2017 Ford Transit 2022 F150 (sponsor vehicle)	3	General use. Team van for attending competitions, etc.	Gasoline	
General equipment	Chainsaws, Brush saws, Generator	6 3 1	General needs. (Generator is new – used for emergency back up, some events, replaced 2 old generators).	Gasoline	
Other:	Various cordless tools in Shop	6	Drills, grinders, etc.	Electric	

APPENDIX C – CONSUMABLES / RESOURCES

Resource	Is Consumption Measured/Reported?	Rough guess of volume	How can consumption be regularly reported?
Electricity	Y	Available on invoice	Regularly available
Water	N	Unknown	Could install meter on well line. Max flow rate measured when well commissioned.
Sewer	N	Unknown	Could look at invoices. [Past 2 years would have pumped by id-Jan but not so far in 2022-23 despite holding 2 events]
Firewood	N	10-12 cords per season	[primarily balsam fir from site – usually deadwood and/or dried for 2 years].
Diesel	Y	Available on invoice	Regularly available
Gasoline	N	Unknown	Volume can be estimated from invoices paid for gasoline.
Hydraulic Fluid	-		
Garbage	N	Unknown	Monthly pick up rate (not based on volume or weight)
Recycling	N	Unknown	Monthly pick up rate (not based on volume or weight)
Composting	N	Unknown	
Hazardous Materials: • Lead (range) • Oils	N	Unknown	[Biathlon upgrade project included design features to capture lead].
Other: Wax			[No longer sell flouro waxes].

APPENDIX D – OTHER TOPICS

Topic	Notes (related to description and related consumables)
Night Loop (Lighting)	Parking lot and night loop lights connected on one circuit. Still 600 m of poles that need lights installed ~170 sodium lights and 10 LED lights on night loop.
Communication practices on Improvements (regular/accessible/procedure)	Nothing regular or accessible online. Usually by emails to members. Reported also to BC Parks and Biosphere Sustainable Thompson Okanagan.
Supply chain policy for considering environmental sustainability before making purchase?	Need to ask Finance committee.
Practicality of installing EV chargers	Included in Lodge planning. Very doable now. Optimal site would be near ticket windows of main lodge in main parking lot.
Any other environmental assessment/reports/data available?	None
Other operational considerations: • Races • Lodge Renewal Project • Solar array • Shuttles • Information signs to educate on watershed	• Compostable cups and utensils used at all races. Should have composting bin at races. Use portable toilets which reduces water and septic use. • All environmental sustainability committee information shared with lodge committee. • Solar could work in winter (with right maintenance). Some sites successful on solar and batteries. • Lots of demand for electric shuttle from Vernon mall. • Improve awareness of water sources for region arising from ski area.

APPENDIX E - ACTIONS TAKEN BASED ON 2021 STUDY

Recommendation	Related resource	Describe Action Taken (or why not)
Replace main building track lighting with LED	Electricity consumption	Done in summer 2022.
Replace baseboard heaters with heat pump system	Electricity consumption	Not really practical.
Thermostat Programming	Electricity consumption	Looking at budgeting to install site wide.
Replace Toilets	Water/Sewer	Done everywhere. Taps also now motion sensored and timed.
Improve signage and labelling of Garbage and Recycling	Waste management	No. Building closed due to Covid. Lack of space to address properly.
Any other actions taken?		Lights replaced with LED in shop. Water heater replaced in shop with new model. Presently no lights on motion sensor. Tech building fluorescent lights to be replaced with LEDs.