South Anderson

All-Season Resort

Civil Engineering Feasibility Study

Draft Copy

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Attention: Pete Tatham

Reference: Civil Engineering Feasibility Study DRAFT – South Anderson All-Season Resort Project

This report was prepared to provide a feasibility level assessment of the civil infrastructure requirements anticipated as part of the South Anderson All-Season Resort.

We trust this document meets your expectations. If there are questions or concerns with information presented in the document, please contact the undersigned at your convenience.

Yours truly,

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Table of Contents

LIST OF TABLES

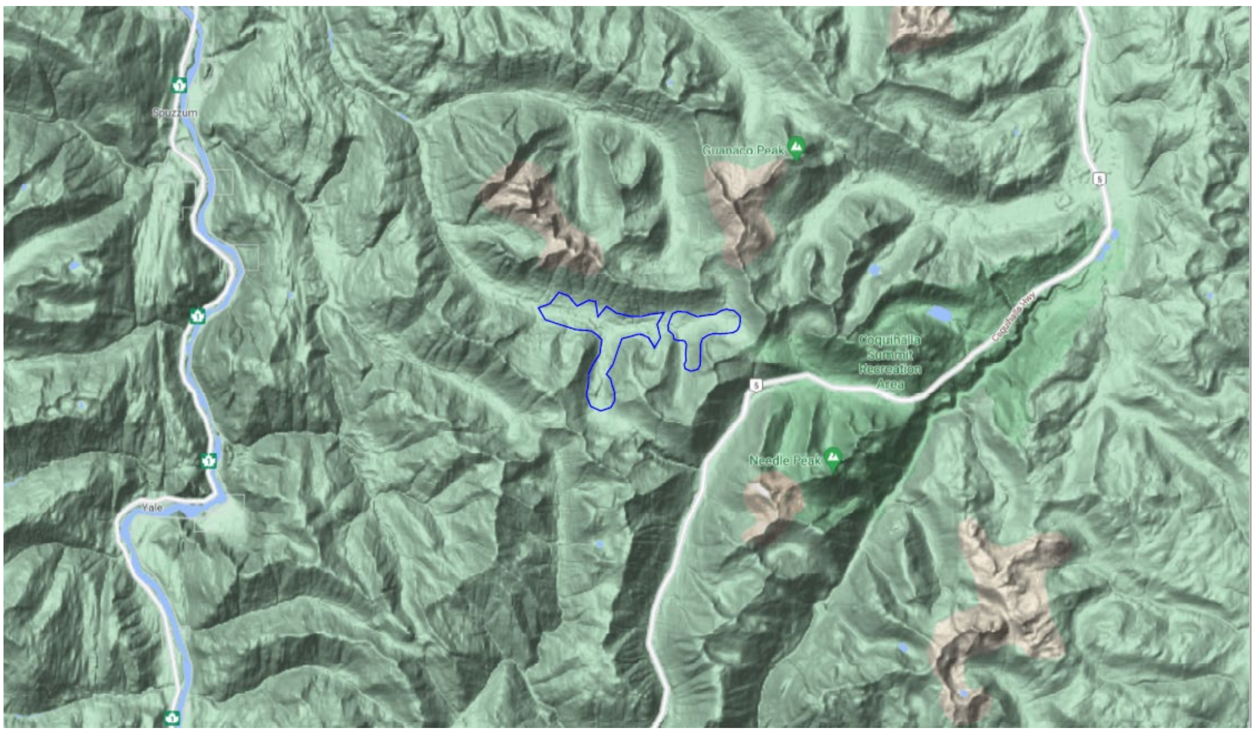
LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

Land Strategies Ltd. (LSL) intends to explore the feasibility of developing an all-season luxury resort nestled within the North Cascade mountains. The proposed site is positioned between the Gamuza and North Siwash mountain peaks, east of the Village of Spuzzum and west of the Coquihalla Highway (See Figures 1.1 and 1.2 below for reference). LSL has partnered with the Spuzzum First Nations Band, who offer their full support and have joined the project's group of stakeholders.

The project will strongly support the future regional growth strategy of the area. LSL will continue their public outreach and consultation efforts with First Nations Bands, the BC Mountain Resorts Branch and regional and community recreation associations. Regional context for the proposed project area can be found in ***Figure 1*** below.



1.1 Project Overview

The proposed South Anderson All-Season Resort (SAAR) intends to introduce a new experience using the surrounding landscape and mountain side for the recreation and enjoyment of multi-generational guests, disabled guests and others looking for a nature-based experience within the lower mainland and interior of BC. The project involves two (2) development sections, the Upper and Lower Anderson Areas, and is expected to include 3000 mixed use accommodation/housing units, alpine and cross-country skiing facilities (winter), golfing, downhill mountain biking and multi-use trails (summer).

Minimizing the proposed resort's impact on the environment been made paramount. LSL is committed to developing the resort in the most environmentally sustainable manner possible. All utilities, including water, sewer, drainage, roads, power, and communications, will be completed in environmentally conscious ways, ensuring demands and discharges are in accordance with all relevant standards and specifications in the area. LSL is working with environmentalists and geotechnical engineers to minimize the overall impact within the area and to provide a safe development location for both the environment and public.

The following report is a feasibility level assessment of the civil infrastructure demand requirements and facility location. It also discusses several water demand management strategies designed to reduce overall drinking water usage.

An aerial view of the proposed development area can be viewed in ***Figure 2*** below.

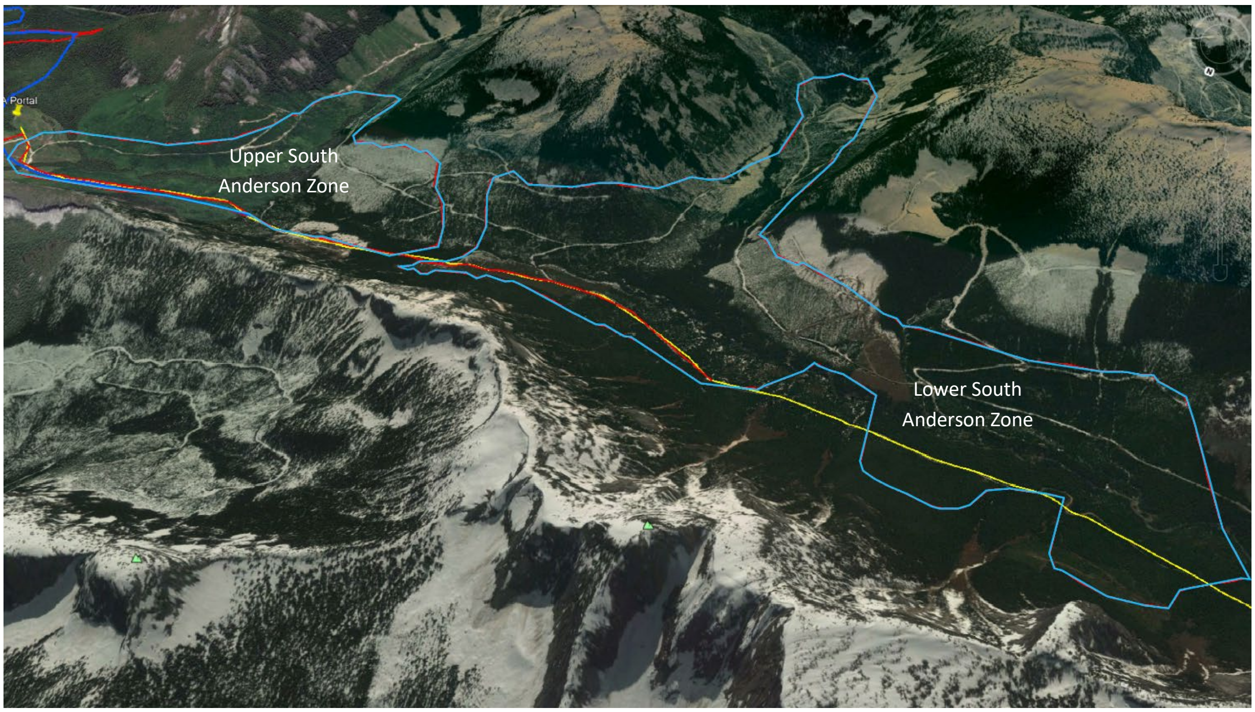


Figure 2 – Proposed Development Area

Access to the site is anticipated via an existing resource access road from the Anderson River FSR and Ottomite Mountain Road, accessible off Hwy 1 and travelling approximately 26 km east to the South Anderson area. The road is currently a 3-season, forest service road, only accessible by four-wheel drive or ATV. An alternative accessway is also under consideration, which stems off the Coquihalla Highway (Hwy 5), and travels west from the Zopkios truck stop to the SAAR area. Either option will require development of a two-lane, paved, Ministry of Transportation and Infrastructure (MoTI) approved roadway. Details for the route analysis can be found in Wedler's "South Anderson Route Analysis" report, dated December 15, 2021.

1.2 Executive Summary

The development of the SAAR will include all amenities associated with a resort setting. The village will host businesses such as restaurants, public washrooms, rental shops, shopping, staff buildings, golf courses, and much more. The outer areas of the village will become residential development with various forms of accommodation, such as apartment buildings, hotels, townhouses, multi-family, and single-family homes. It is estimated that over 3200 dwellings will be available within the SAAR area.

Environmental and archeological constraints and potential findings have been considered within the development of the conceptual layout. Further investigation of the site will be coordinated, as required, as design of the SAAR area progresses.

As such, utilities such as potable water, fire protection, sanitary sewers, stormwater collection, drainage, electrical and communications will be necessary for the SAAR development zones, along with adequate treatment and detention facilities. Providing utilities in this area will require special consideration. Areas of steeper slopes and higher elevations pose a unique and challenging environment, with significant engineering constraints and concerns.

Initial desktop reviews estimate that acceptable groundwater sources are available in the region based on the surrounding basin area and observed South Anderson River flows. A groundwater investigation will be conducted in the following phases of the project by Active Earth. Once a groundwater source and well locations are confirmed, a potable water network including water mains, booster pump stations, reservoirs, and treatment facilities will be designed, capable of accommodating all residential and commercial needs. Water quality shall be in accordance with all Municipal and Provincial regulations and standards.

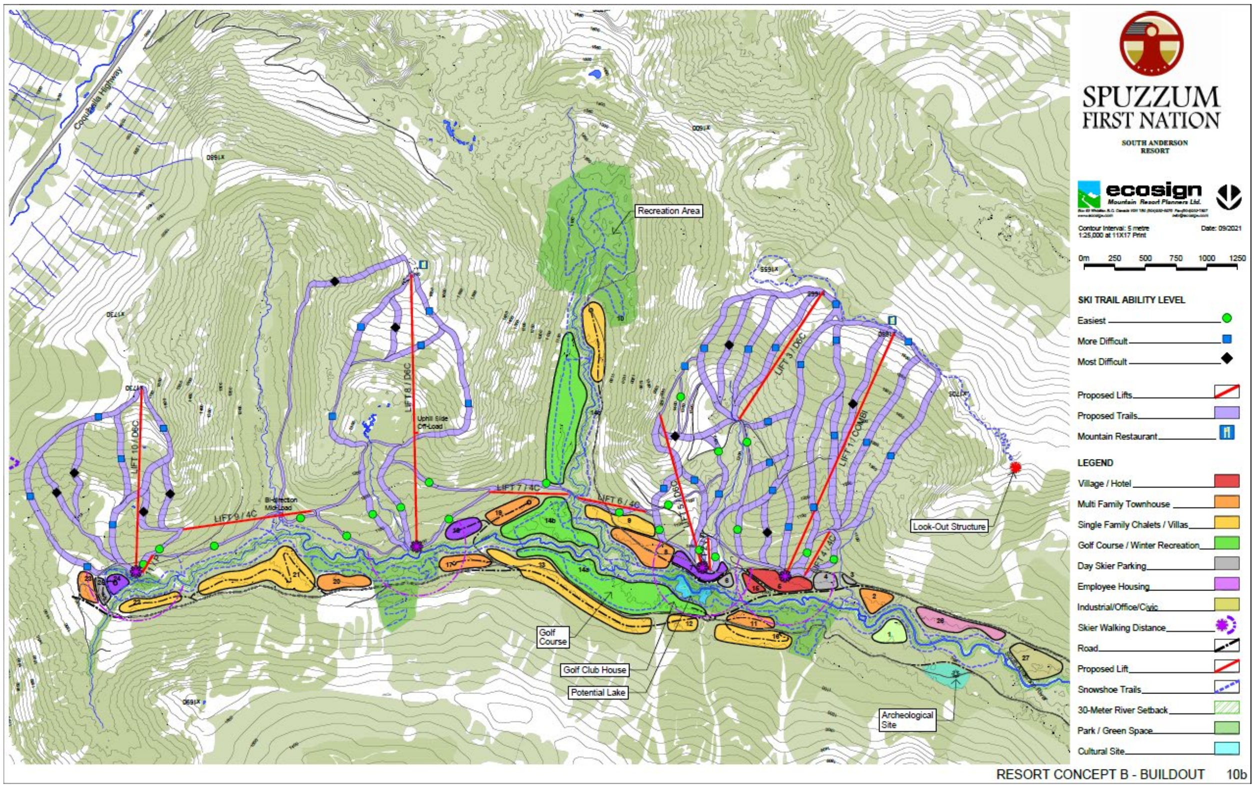
Preliminary sanitary considerations estimated that an on-site Wastewater Treatment Plant (WWTP) will require a *Municipal Wastewater Regulation*, issued by the Ministry of Environment (MOE). Arden Consulting Engineers Ltd. (ACE) has been contracted to investigate the SAAR area for feasible drainage and WWTP recommendations. Any WWTP shall be built to MOE standards and satisfy all relevant specifications. Based on the site's observed soil conditions, the area is expected to be suitable for groundwater disposal. Further site investigation, soil analysis and infiltration testing will be completed in subsequent phases of the project, prior to detailed design.

Rainwater collection/detention requirements for the SAAR will follow the development of a Stormwater Management Plan (SWMP). Upon finalization of the SAAR layout, a SWMP will be created to assess the hydrological effects of the proposed development on the surrounding area. Both Upper and Lower Areas are expected to manage their stormwater flows with methods individually suited to their layout and topography.

Hydro feed to the area has been investigated by Primary Engineering and summarized in their report, "South Anderson Electrical Servicing Analysis", dated November 1, 2021. The report provided three options which take advantage of local transmission lines to satisfy the electrical requirements of the SAAR. Further details on the electrical supply options are further discussed later in this report.

Communication providers will need to be approached for the SAAR. Satellite or wired services are potentially viable via electrical transmission line to the resort site. Mobile phone access is currently unclear.

Figure 3 displays the conceptual SAAR Layout, as provided by Ecosign Mountain Resort Planners (Ecosign). A copy of the Ecosign layout and report can be found within Appendix 1 of this document.



2.0 WATER SYSTEM

2.1 Water Demands and Reservoir Sizing

The following preliminary demand requirements have been calculated based on Ecosign's Concept B Buildout. The land use allocation specifies accommodation building use, allowing bed unit counts to be estimated.

Design requirements, including acceptable accommodation needs, are determined by incorporating the BC Government's Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Tourism and Resort Operations "All Season Resort Guidelines".

2.1.1 Water Demand Assessment

Indoor water demand rates for recreational resorts are evaluated based on the calculated number of bed units (BU) in accordance with the development's accommodation needs. Based on the "Design Guidelines for Rural Residential Community Water Systems" document, prepared by the Government of British Columbia, the "Maximum Daily Demand (MDD) criterion for indoor usage is 250 L/BU/day".

Based on preliminary forecasting, the following **Table 1** summarizes the evaluation of total number of BU and water consumption demands anticipated for the SAAR development:

Table 1 – South Anderson Land Use Plan - BU Counts

Unit Type	BU/ha	BU/Unit Type	Total Units	BU Count	Ha
Hotel/Village Condotel	400	2.0	1,155	2,310	5.8
Condo	300	3.0	700	2,101	7.0
Townhouses	100	4.0	701	2,805	28.1
Single-Family Units	80	6.0	605	3,630	45.4
Campground	100	3.0	50	149	3.0
Subtotal Accommodation			**3,211**	**11,000**	**89.2**
*Accommodation (80% Capacity)**			*2,569*	*8,800*	*89.2*
Employee Housing	300	3.0	***367***	***1,100***	
–Day-Use Skiers (50% Capacity)*		N/A	*2,400*		
18-Hole Golf Course / Winter Recreation					65.0
Day Use Parking**					5.0
TOTAL			**2,936**	**12,300**	**163.2**

*As estimated by EcoSign within their October 7, 2021, email correspondence

Maximum daily demands have been calculated in accordance with the assumptions made in EcoSign's October 7, 2021, email correspondence. Bed units for 80% of accommodation and 100% of Employee housing have been used for estimating flows, along with 50% of day-use skier capacity. Average resort occupancy was based on an average 400,000 skier visits over a 120-day season with a peak winter day of just under 4,800 day-skiers, with 50% of these skiers making use of SAAR accommodation. Peak hour demand has been estimated as 2.4 times the MDD.

Summer occupancy and water demands will be lower than overall winter demands, so winter peak day demands plus snow making has been used for design.

Water demands found in **Table 2** was summarized by applying the water usage rates to the estimated BU counts described in the previous table. A fully detailed water demand calculation breakdown has been included in Appendix 2 for further review.

Table 2 – South Anderson Water Demands

	Unit	Peak Daily Demand	TOTAL (L/s)
Max Design Accommodation Demands	9,900 BU*	250 L/BU/day	2,475 m^3/day (28.6 L/s)
Day-Use Skiers	2,400 ppl	60 L/ppl/day	144 m^3/day (1.7 L/s)
Snow Machine Demand	5 Units	18 m^3/hr x 6 hours/day	540 m^3/day

Average Daily Demands (ADD)	3,159 m^3/day (37 L/s)
Max Daily Demands (MDD) – 2.4 x BU**	6,624 m^3/day (77 L/s)

*80% of Resort Capacity plus 100% of empoyee housing
**MDD can be modified to 70 L/s with snow making activities monitored at Peak Day Demand timeframes

2.1.2 Water Pressure Requirements

The designed SAAR distribution network shall maintain system pressure requirements of 830 kPa (120 psi), with a maintained minimum of 300 kPa (43.5 psi), as per local design standards. Two booster pumps are anticipated to service the SAAR area. An estimated five Pressure Reducing Valve (PRV) stations will be required throughout the SAAR zones, reducing pressure in topographical areas. Distribution lines are estimated to follow roadway alignments to service all SAAR accommodation and infrastructure needs. A conceptual water system layout created by Wedler has been included in Appendix 3 of this document.

2.1.3 Reservoir Sizing

Reservoir sizing was completed in compliance with MMCD Design Guidelines and the FUS 2009 guide. The following formula represents the total required storage volume:

Total Storage Volume = A + B + C

Where: A = Fire Storage (from Fire Underwriters Survey guide)

B = Equalization Storage (25% of Maximum Day Demand)

C = Emergency Storage (25% of A + B)

Three separate reservoirs will be designed to service different areas of the SAAR development. Reservoir construction will align with phased construction, servicing the needs of each zone. A breakdown of reservoir sizing, phase and zone is as follows:

A = 500,000 Gal. (2,273 m^3) - Ph. 1 – Zones 1/2

B = 450,000 Gal. (2,045 m^3) – Ph. 1 – Zones 3/4

C = 300,000 Gal. (1,364 m^3) – Ph. 2

2.1.4 Fire Flow Requirements

A fire flow requirement of 150 l/s has been set in accordance with Section 2.5 of the 2014 Master Municipal Construction Document (MMCD) Design Guidelines. The Fire Underwriters Survey (FUS) guide could not be used for fire flow calculations at this time due to the infrastructure layout and sizing being unfinalized. All future resort buildings should be designed within the set fire flow availability.

Overall fire flow storage requirements may be reduced if reservoir systems can be used in tandem for fire flow supply. Reservoir A can be reduced in size if reservoir B can aid in fire flow supply. Additionally, reservoir B can be reduced if reservoir C can supply partial fire flows.

2.2 Water Treatment

2.2.1 Current Drinking Water Regulations

All potable water supplied to the SAAR development will meet the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) and operate in accordance with the BC Government Local Health Authority's "*Drinking Water Protection Act"* and the "*Drinking Water Protection Regulation"*. All testing, monitoring and infrastructure will follow the approved operating permits, Health Authority Drinking Water Office, and Public Health Engineers.

New potable water systems must undergo approval by Interior Health. Interior Health enforces a drinking water quality guideline known as "4-3-2-1-0 Dual Treatment Guidelines". The guideline objectives breakdown as follows:

- 4-log (99.99%) inactivation for enteric viruses;
- 3-log (99.9%) inactivation or removal for *Giardia*;
- 3-log (99.9%) inactivation or removal for *Cryptosporidium*;
- Dual stage treatment;
- Less than 1.0 NTU turbidity in the treated water at all times; and
- Zero total and fecal coliforms.

To ensure compliance with both the current and foreseeable future water quality regulations, the following additional water quality standards are recommended to be maintained:

- Less than 0.3 NTU turbidity for 95% of the time;
- Trihalomethanes (THM's), less than 80 ug/L, as measured on a locational running annual average. Running average THM concentration will never exceed 80 ug/L at any single sampling point in the distribution system; and
- Haloacetic acids (HAA's), less than 60 ug/L, as measured on a locational running annual average. Running average HAA concentration will never exceed 60 ug/L at any single sampling point in the distribution system.

2.2.2 SAAR Potable Water Supply

An estimated seven new wells are anticipated to service the SAAR area. A detailed assessment of the surrounding aquifers will need to be investigated upon detailed design. A high-quality groundwater supply well will include:

- Deep wells constructed in accordance with provincial guidelines;
- Well pump, riser pipe and pitless well unit;
- Treatment and Disinfection system;

- Electrical and mechanical control building.

The conceptual potable treatment and disinfection system for the SAAR is as follows:

- Groundwater intake system via a well, designed in accordance with provincial guidelines,
- Raw water transmission main,
- Microfiltration,
- Chlorine disinfection via injection,
- Secondary UV Lamp disinfection.

This conceptual treatment design is subject to change dependent on the actual raw water quality within the SAAR watershed. Potable water contaminants such as turbidity, Giardia and Cryptosporidium are not commonly experienced in groundwater systems, therefore have not been included in treatment options at this time. If future testing identifies these items to be of concern, then additional treatment measures will be included. Microfiltration has been included as a conceptual treatment, however, could be removed if water quality is found to be acceptable. Wedler has assumed treatment requirements based on potential pathogens commonly experienced in groundwater supply systems.

2.3 Water System Costs

A detailed breakdown of the estimated water system costs can be found within Appendix 4 of this document.

3.0 SANITARY SEWER

3.1 Peak Wastewater Demands

The SAAR development area will include a full collection network with service connections to all dwelling units. Gravity fed sanitary lines will be incorporated as much as possible, with lift stations and forcemains kept to a minimum. Sanitary collection lines are estimated to follow roadway alignments, with further details found in Section 6.0 of this document.

The following data was calculated under the assumption that the SAAR development will maintain the same average bed units as the above-mentioned water systems. Sanitary flows are summarized as described in Table 5 below:

Table 3 - Estimated Maximum Daily Sewage Flow

Unit Type	Total Units	BU Count	Design Flows	Total Flows
Max Design Accommodation Demands*	2,936	9,900	230 L/BU/day	2,277 m^3/day (26.4 L/s)
Day-Use Skiers	2,400	N/A	50 L/unit/day	120 m^3/day (1.4 L/s)
Infiltration Allowance	66.9 ha**		7500l/ha/day	502 m^3/day (5.8 L/s)
TOTAL Peak Wet Weather Flow				**2,899** m^3/day (33.6L/s)

*80% of Resort Capacity plus 100% of empoyee housing

Using 75% of the devleopment boudnary being fully used

With an estimated wastewater flow of 2,899,000 L/day, the SAAR development exceeds the *Sewerage System Regulation* (SSR) limit of 22,700 L/day, triggering the need for a *Municipal Wastewater Regulation* (MWR) administered by the Ministry of Environment.

3.2 Sanitary Sewage Treatment

3.2.1 Current Sanitary Effluent Regulations

Target effluent criteria is anticipated to be governed by the BC MWR, which provides treatment quality guidelines dependent on the Municipal Effluent Class. The post treatment effluent must satisfy the quality parameters laid out in **Table 6**, as per the Province of British Columbia's MWR regulation, Part 5, Section 75.

Table 4 – BC MWR Municipal Effluent Quality Requirements

Requirements	Class A[4]	Class B[4]	Class C
BOD_5 (mg/L)	10	10	45
TSS (mg/L)	10	10	45
Fecal Coliform (MPN/100 mL)	Median: 2.2 Any Sample: 14	400, if maximum daily flow is $\geq 37m^3/d$	N/A
Turbidity (NTU)	Average: 2 Any Sample: 5	N/A	N/A
Nitrogen (mg/L)	Nitrate-N: 10 Total N: 20	N/A	N/A

(4) In respect of class A and B municipal effluent that is discharged to a drainfield,

(a) filtration is required to prevent solids carrying over into the disposal field, and

(b) monitoring controls must be maintained to signal an alarm when filtration begins to malfunction.

Discharge from the SAAR is anticipated to be Class A Municipal Effluent with treatment facilities discharging to an on-site disposal area.

3.2.2 Disposal Area

An adequate location for a WWTP drain field within the SAAR area will determine the type of WWTP facility appropriate for servicing the region. EcoFluid Systems will provide a concept WWTP design based on the desktop and site reviews completed to date. Further site soil investigation and permeability testing will be completed by Arden Consulting Engineers in the next phases of the project to confirm the final WWTP design, location and ground disposal area.

An adequate drainage field must include a well draining soil structure capable of accommodating the calculated WWTP flow rates. Ideally, the drainage field will be in an area topographically lower than the SAAR collection network, as to accommodate gravity lines as much as possible.

3.2.3 Wastewater Treatment

We anticipate piping the SAAR Development Zone wastewater to a common WWTP for processing and safe disposal.

The proposed WWTP model is conceptually based on the existing Sun Peaks Resort WWTP system. We understand Sun Peaks Resort, with the aid of EcoFluid, have incorporated a multi-phased WWTP design with each phase capable of accommodating approximately 500 m^3/day of sanitary flows. Their overall system can treat up to 1500 m^3 max daily flow, accommodating Sun Peak's average 400,000 skier visits per year and few hundred permanent residents. Predictions for SAAR are estimated at 400,000 skier visits after 10 years of operation.

As the SAAR development will include a multi-phased construction schedule, the EcoFluid WWTP is anticipated to meet the ongoing growth of each phase. Sun Peak's facility has been upgraded 3-4 times throughout it's current lifecycle. As skier visits increase and additional accommodation is developed, the WWTP can grow to meet the continuing needs of the SAAR skiers and permanent residents.

The EcoFluid WWTP effluent is treated to secondary treatment standards with infiltration fields used for final polishing. As discussed, the facilities will require a MWR administered by the Ministry of Environment and will be designed in compliance to FVRD standards and bylaws.

If treated effluent is considered for use within the golf course irrigation system, then wastewater will need to be treated to tertiary standards. As the EcoFluid WWTP is modular, it is possible to upgrade only one or two modules to tertiary treatment requirements, capable of accommodating the future golf course irrigation demands. Tertiary treatment capability is estimated to add an additional $500k to the module cost, therefore the capability of upgrading individual modules will result in a more economic solution.

3.3 Sanitary System Cost Analysis

A detailed breakdown of the estimated sanitary system costs can be found within Appendix 4 of this document.

4.0 WATER AND SEWER DEMAND MANAGEMENT

4.1 Water Management

The vision of the South Anderson Resort is to provide a unique all-season community for residents and visitors, with safe and easy access to enjoy the surrounding environment and amenities. It is SAAR's intent to make the public more aware of their environment, incorporating input from local First Nations, the consultant team, and the Province of British Columbia. As part of SAAR's commitment, it is paramount that local resources be preserved, including minimizing the development's draw on local water sources as much as possible.

Reduction of the SAAR water demand will aid in the draw rates required from groundwater sources and reduce the size of site reservoirs. Additionally, reducing water demands will reduce the overall sanitary flows collected for treatment.

The following are some low-flow, ultra-low flow (ULF) and water-efficient appliances and fixtures, and practices which are proposed for the SAAR development:

- ULF and Dual Flush Toilets
- Faucet Aerators
- Water-efficient restaurant appliances – dishwasher, refrigerator, etc.
- Leakage Control/Detection (Best Practice)
- Grey Water Irrigation – In combination with proposed irrigation reservoir (if required)
- Water metering

Water management options will be further explored as more details become available for the development. A detailed plan/design for reducing overall water demand will be implemented during the detail design phase of the project.

4.1.1 ULF and Dual Flush Toilets

It is accepted that approximately 26% of indoor water use in typical Canadian residences is from toilet flushing. Thirteen litre per flush toilets are permitted in most parts of Canada and are the predominant technology. However, many other countries, including the United States, have 6 litre per flush "Ultra Low Flow" (ULF) toilets as a standard. Countries like Australia and Singapore require dual flush toilet technology which provides an even higher level of water conservation than ULF toilets. Dual Flush toilets utilize a lower volume flush to dispose of liquid waste and a higher volume flush for solid waste.

Attached in **Appendix 5** is a copy of a CMHC paper published in 2002 that compares dual flush toilets to the Canadian norm. This paper reports that flush volumes in single family homes were reduced by 68% and flush volumes in restaurants were reduced by 52%. The paper also notes that dual flush toilets were found to save 26% more water than ULF toilets when used to replace non-efficient toilets.

Based on their ability to reliably reduce demand on both the water supply resources and the sanitary sewer system and to promote the SAAR's "green" objectives, we recommend that Dual Flush toilets be mandated in residential developments and commercial washroom applications.

4.1.2 Faucet Aerators

Faucets account for approximately 16% of typical indoor residential water use. Faucet aerators are commonly used to reduce the flow of water from household taps while maintaining the "feel" of a higher water flow.

We recommend that faucet aerators be adopted as the standard for the SAAR, as they will reduce water and sewer demands and reduce energy consumption, in line with SAAR's "green" objectives.

4.1.3 Water-Efficient Restaurant Appliances

Industrial use appliances typically found in commercial settings such as restaurants are responsible for large water demands and higher electrical draws. By incorporating water efficient appliances, hot water use is reduced, demands are lower, and overall energy requirements are minimized. Some examples of water-efficient appliance upgrades are as follows:

- Commercial Ice Makers – Incorporate ice makers equipped with closed loop coolant systems in lieu of single-pass coolants. Water is recirculated instead of discharged.
- Dishwashers – Incorporate rack sensors to only allow water flow when dishes present. Ensure equipment is Energy Star rated. Review volume requirements and size dishwasher accordingly.
- Refrigerators – Energy Star Rated. Closed loop coolant system.

We recommend that restaurants be mandated to use water-efficient appliances, wherever possible, as they will reduce overall water and sewer demands and energy consumption, in line with SAAR's "green" objectives.

4.1.4 Leakage Control/Detection

Controlling water leakage is clearly an important part of water conservation and is best practice for a green facility such as SAAR. Water leaks can develop in all parts of the water system, from source to tap, and it will be important to put Best Practice procedures in place that require rigorous attention to identifying and fixing leaks. At the development stage, the water distribution and plumbing systems should be constructed to a high standard that will minimize future water leakage.

4.2 Grey Water Conservation

In efforts to further reduce the overall water demands on overall water and sanitary infrastructure, various grey water recycling systems are proposed throughout the SAAR Development Zones. Grey water is classified by the BC Ministry of Health as "used household water sourced from baths, showers, bathroom basins and laundries, but doesn't include toilet, kitchen sink, or dishwasher waste". Following BC MOE classifications, faucet basins could be used, potentially in combination with a rainwater collection system, to fill onsite irrigation reservoirs (potential for reducing golf course irrigation demands).

A full assessment of the available grey water volumes would be required to determine its feasibility however, a grey water system has the potential to reduce overall water and sanitary system demands. The implementation of an on-site grey water system aligns with SAAR's overall "green" objectives for a reduced environmental footprint.

4.3 Sanitary Sewer Management

By implementing water reducing fixtures, appliances and practices, overall sanitary sewer flows will resultingly be reduced as well. This will be largely important for reducing overall WWTP sizing.

5.0 STORMWATER DRAINAGE

5.1 Impact of Development

The Department of Fisheries and Oceans guidelines state that post development stormwater flows for a 6-month, 2 year and 5-year recurring storm intensity should be maintained at pre-development levels.

With the SAAR development consisting of alpine areas at high elevation changes, stormwater management will require careful designing to prevent site erosion and maintaining/enhancing natural site drainage and hydrology.

5.2 Stormwater Management Plan

A detailed stormwater management plan will be paramount in the overall design, construction, and operations of the SAAR development. An integrated stormwater management plan will allow the Village operators to manage an array of rainwater conditions, providing planned procedures for mitigating high rainfall events.

General objectives for a stormwater management plan include:

- Drainage Objectives - reduce potential drainage, erosion, and flooding concerns.
- Stream Protection Objectives - Protect stream health, including riparian and aquatic habitat.
- Water Quality Objectives – Identify, remediate, and reduce potential water quality problems.

General stormwater management principals will be identified throughout the resort as they relate to construction and operational activities.

General principals upon which a site-specific stormwater management plan will be developed include:

- Minimizing disturbance of natural areas where possible, especially riparian vegetation.
- Minimizing the creation of impervious or less pervious areas and surfaces (development of structures, concrete surfaces, and/or compacted gravel surfaces)
- Maximizing revegetation of disturbed areas,
- Directing stormwater into natural infiltration areas (landscaped areas), and/or run excess water through bio-filtration swales prior to discharging into natural drainages.

In conjunction with the stormwater management plan, a snow removal plan for minimizing snow clearing environmental impacts should be considered. Recognizing overall impacts from snow clearing activities, such as the increased snow load on surrounding vegetation, and snow melt creating concentrated sediment deposits resulting in riparian and aquatic habitat damage. General principles that should apply to snow management plans include:

- Snow must not be dumped into watercourses or wetlands
- Snow storage areas should not drain directly into aquatic habitat or watercourses
- Snow should not be piled on vegetation or in riparian buffer areas.

- Proper cleared snow storage areas should be identified, where sediment can be contained, and removed after snowmelt has occurred

5.3 Stormwater Design

Where possible, engineered materials and natural designs intended for reducing stormwater flows will be incorporated. Items such as permeable road surfaces, rain gardens and detention/infiltration features will be integrated wherever feasible.

Further details on the stormwater design will not be available until the layout of the Upper and Lower Development Zones have been finalized and all site investigations have been completed. Each area of the SAAR development is expected to manage its stormwater flows separately. Design methods appropriate for the SAAR area will be dependent on available space, environmental impact, site geology, and calculated stormwater volumes and velocities. Natural design resources, such as rain gardens and engineered structures (bio-swales, infiltration basins and/or detention ponds) will be incorporated as permissible. Stormwater piping, at this time, is estimated to follow roadway alignments. Further assessment and layout of the stormwater collection network will be completed upon final resort layout. All materials, designs and construction shall be compliant with MMCD, MOTI and FLNRORD standards and regulations.

5.4 Stormwater Cost Analysis

As the extent of stormwater collection and detention needs cannot be calculated at the time of this report, an associated cost analysis cannot be completed. Stormwater management measures can vary drastically, therefore a cost breakdown will not be provided at this time, prior to the completion of a SWMP.

6.0 ROADWAYS

Access to the site will require extensive roadwork development. Assessment of the SAAR accessway has been reviewed in detail by Wedler Engineering and summarized in a separate report. Please see “20211209 – C21-5817A - South Anderson Accessway and Georisk Assessment” for a detailed review of the required roadway upgrades.

Resort roadways will be designed based on standard highway design principles and subdivision roads, as per the latest edition of the British Columbia MoTI “Standard Specifications of Highway Construction”.

A main arterial road connects the highway accessway to the resort area. Once at the resort boundary, local roads are anticipated for access to housing, amenities, chairlifts, etc.

6.1 Cross-Sections

An allocated roadway cross-section of 13.5 m has been selected for the main village roadway. Each road section would typically consist of two, 3.5 m wide asphalt lanes, including 1.0 m shoulders, 2.5 m open cut ditch, and 2.0 m walkway. Some areas may require dedicated curb side gutters, catch basins and storm sewers in areas more densely developed. Specific walkways will be incorporated into the site plan and along the proposed roads. The resorts roadways will include full services and utilities.

Wedler has prepared a preliminary roadway layout and a typical preliminary cross-section detail for the resort area. A copy of these sketches can be found in Appendix 6 of this document.

6.2 Utilities Alignment

It is expected that all civil works, including water, sanitary and stormwater collection/distribution lines, will follow the overall roadway alignment. All services will be incorporated into roadway design, allowing trenching activities to be completed in conjunction with subgrade compaction activities. A conservative unit pricing to account for all civil utility works has been included in roadway cost pricing.

6.3 Roadway Costs

A detailed breakdown of the estimated roadway system costs can be found within Appendix 4 of this document.

7.0 SITE POWER

Primary Engineering was contracted to assess electrical servicing options within the SAAR area. The findings of their assessment have been summarized in their November 1, 2021; report titled "South Anderson – Electrical Servicing Analysis". The following sections will summarize their findings and recommended power supply options. A copy of their report has been included in Appendix 7 of this report for further information on the associated sections.

7.1 Load Calculation

Load calculations assume that not all utilities and loads are in service at one time. A diversity factor is commonly chosen to account for load variance to achieve a "forecast peak demand". Diversity factors vary depending on load profiles and time of day. Load variances are typically characterized as residential, commercial, and industrial profiles.

Calculated forecasted peak demands have been summarized by Primary Engineering a presented in their report. The following Table is a copy of the Sum of Code Peak Demand table of that report:

Table 5 - Sum of Code Peak Demands

Sum of Code Peak Demand kVA			
Load Type	Phase 1	Phase 2	Grand Total
Commercial	7804	3339	11143
Industrial	3209	2708	5917
Residential	32472	34575	67047
Grand Total	43486	40622	84108

7.2 Power Supply Options

SAAR power supply is dependent on the surrounding BC Hydro infrastructure in the region. Due to the remote nature of the area, power supply options are limited and expected to require extensive infrastructure.

An existing 69 kV transmission line, owned by BC Hydro and running from Hope to Boston Bar was identified along Highway 1. This transmission line is located roughly 14 km from the proposed SAAR area and is expected to have sufficient capacity to accommodate the load calculations. The capacity will need to be confirmed with BC Hydro prior to detailed design.

Two 25 kV distribution lines were also identified, running from the BC Hydro Meritt substation and the BC Hydro Hope substation and past the proposed Hwy 5 interchange. Capacity in these lines is typically 13 MVA, which, based on the load calculations, would not be sufficient for servicing the complete SAAR area. A possible option exists in servicing the initial phase of this system; however, the focus will be to utilize the existing Hwy 1, 69 kV transmission line.

7.3 Options Analysis

Three separate options for power supply were identified from Primary's report and will be briefly discussed in the following sections. Full details on each option can be found in Primary's report.

7.3.1 Option 1 – *BC Hydro Owned Transmission, Substation, and Distribution*

A BC Hydro owned transmission line would run from the existing 69 kV transmission line at Spuzzum, BC to a new substation and distribution network. All infrastructure would be owned and operated by BC Hydro.

No maintenance would be required, however would have higher installation costs and minimal control of schedule.

7.3.2 Option 2 – Privately Owned Transmission, Substation, and Distribution

Same as Option 1, however all infrastructure would be privately owned and operated by SAAR.

This would require ongoing maintenance of the system, however, would result in lower installation costs and greater control of schedule. Additionally, surplus power could be sold back to BC Hydro.

7.3.3 Option 3 – BC Hydro Owned Transmission, Privately Owned Substation and Distribution

A new BC Hydro owned transmission line would run off the existing 69 kV transmission line at Spuzzum, BC. The transmission line would run to a privately owned substation and distribution network.

This option will result in lowered maintenance requirements and lower installation costs. SAAR will have better control of the overall schedule than Option 1 with potential of additional revenue from power sell back.

7.4 Estimated Power Supply Costs

A detailed breakdown of the estimated power system costs, provided by Primary, can be found within Appendix 7 of this document.

APPENDIX 1 - ECOSIGN CONCEPTUAL LAYOUT

APPENDIX 2 - WATER DESIGN CALCULATIONS

APPENDIX 3 - CONCEPTUAL WATER SYSTEM LAYOUT

APPENDIX 4 - CIVIL COST ESTIMATES

APPENDIX 5 - CMHC STUDY

APPENDIX 6 - WEDLER PRELIMINARY ROADWAY DESIGNS

APPENDIX 7 - PRIMARY ENGINEERING – SOUTH ANDERSON ELECTRICAL SERVICING ANALYSIS