Quebec Lodge Project

"Recommendations for a Sustainable Future"

Report from *ESG 354: Environmental Impact Assessment* class

Environmental Studies and Geography,

Bishop's University

April 3, 2013

Forward:

Like Bishop's University, Quebec Lodge has a long history in the Eastern Townships of Quebec, and though it had previously appeared to be coming to an end, in-fact a new chapter is about to be written. When offered the opportunity to contribute to this, as a class, it was a clear choice to make.

As students of Environmental Studies and Geography it can sometimes be difficult to find avenues through which to apply our learning outside of the classroom. However, this project provided us the opportunity to bridge the gap between the classroom and the real world; all the while being able to maintain our upmost commitment to the environment and creatively apply what we have learned throughout our time here at Bishop's.

When approached by Dr. Bardati with the option of being able to assist in both the creation of the new Quebec Lodge, and a partnership between two great institutions of the Estrie it was a very exciting prospect. We have approached this project enthusiastically seeking to provide the best knowledge and insights we can. While we are not technical experts or professionals of any kind we believe that our collective passion for sustainability coupled with our ongoing education has lent itself to some useful and implementable ideas on how Quebec Lodge can best move forward.

We decided that it would be best to confront this challenge by dividing it up into three sections:

Determining the environmental impact of the buildings that are to be erected on the property.

The best location and practices for the construction of paths and boardwalks

Suggestions and opportunities through which the camp can attain greater overall sustainability and increase its environmental focus.

In each section you will find various ideas and descriptions of best practices which can be implemented either at the beginning, or in Quebec Lodge's future in order to improve its sustainability. Though this is by no means exhaustive we believe it will provide meaningful assistance to Quebec Lodge and help establish a partnership between Bishop's University and Quebec Lodge, which we all look forward to seeing flourish in the future.

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Chapter 1:

Part 1: Baseline and Environmental Assessment

Prior to any construction it will be important that a proper environmental site assessment has been accomplish to ensure the least amount of pollution and disturbance to the environment.

Phase 1: This primary phase usually includes a site history and review of records to ascertain previous ownership and land use. Provincial environmental officials are contacted to confirm whether or not there have ever been remediation orders on the land. On occasions previous land owners might be contacted in order to verify the past activities on the property. This allows for the new owner and construction team, that the land will be environmentally safe and also provide good working conditions for the employees.

Phase 2: indicates the possibility of soil or underground water contamination, phase 2 is done through testing which involves sample testing; generally this sample testing is two-fold.

1. To ascertain whether the potential contaminants indicated from a Phase 1 ESA are present on the site.
2. To identify, characterize and assess the concentrations and limits of any contaminants.

Phase 3: This phase involves the possible remediation, if phase 2 has identified possible contaminants.

1.1 Identifying and protecting local Valued Ecosystems Components

Quebec Lodge's hopes to minimize the changes and damages that will be done to this environment, of course ecosystems and biodiversity's will be affected, but in the grand scheme of things, these changes should be minimal. The construction of the road, soccer field and main lodge will represent the largest stressors to the environment. It is important the environmentally friendly ways and techniques must be used to avoid too much impact on the ecosystems, because this area is home to many species of animals, fishes, plants and many more. It is important that a proper analysis is done prior to the construction in order to properly respect the possible endangered species that may be affected by the change in their environment. Once the

construction has begun it will also be important to install environmentally friendly practices to mitigate the negative impact on the ecosystems.

Part 2: Environmentally friendly construction

2.1 How Can Building/Housing Construction Affect the Environment?

Wastes associated with building/housing construction include unused and excess material generated during site excavation, site clearance, construction, and renovation activities. These wastes may be rubble (concrete, bricks, and asphalt), wood and wood products, plaster, metals, plastics, and insulation. These materials comprise approximately 15 to 30 percent of all waste disposed of in landfills. Further, some of these waste products may contain toxic constituents that pose a risk to human health and the environment.

The least amount of debris should be left behind during the construction of the main building, and stored in a safe location, which would not allow for waste to seep into the ground in case of precipitation. Especially when the inclination of the hillside is fairly steep and that a small creek leading to the Lake Massawippi can be found at the bottom of this hill, it is very important that waste flows into this creek and possibly affect the biodiversity. For this reason, it is very important that the construction planner look into a safe and environmentally way to disregard the waste, and to attempt to use environmentally friendly ways and products.

What Questions Should Be Asked To Ensure That These Effects Are Minimized or Eliminated?

Ecosystem Concerns: The clearing of lands for construction can lead to the loss of wildlife habitats, erosion and sedimentation associated with the use of heavy machinery, loss of native plant life, and contamination of soils and surface and groundwater. However, proper design and planning can help reduce these impacts

Here are some of the questions that should when erecting a building.

- Is the construction project necessary? Is the project over-designed? In some cases, the construction of additional structures is not needed and minor alterations to existing facilities may be sufficient.
- Have attempts been made to avoid construction in environmentally sensitive areas (such as wetlands and threatened or endangered species habitats)?
- Are specifications for construction practices designed to control and exclude pest entry in contained habitats?
- Does the construction contract specify that contractors should cause the least possible disturbance to the site's vegetation? For example, under certain circumstances, it may be

possible to preserve individual trees or stands of old growth that would otherwise be destroyed.

- Does the construction plan provide for erosion and sediment control during construction as well as after? Uncontrolled soil erosion can have adverse effects on local water bodies and aquatic life. A Rain garden would be a great possible ways to ensure that pollutants do not reach the stream at the bottom of the hill, local plants species should be used in this rain garden.
- Will soil excavated from the construction site be reused? Topsoil can be re-spread in areas to be landscaped to enhance plant health. This would be a great idea to use this soil for the soccer field.
- Does the plan include the re-vegetation of areas disturbed by construction?
- Is there a plan to reduce the use of materials containing constituents that can negatively affect the environment?
- Is there a spill control and countermeasure plan to properly address spills of hazardous construction materials?
- Will hazardous materials be stored properly at the construction site? Hazardous materials should be kept in storage buildings (with secondary containment and hard stands) located away from the active construction zone. Examples of hazardous materials typically found at construction sites are petroleum products (lubricating oils and greases), fuels (gasoline, kerosene), solvents, paints, batteries, and miscellaneous equipment maintenance supplies.

2.2 Procurement Concerns:

Environmentally sound purchasing decisions are an important element of pollution prevention, helping reduce the amount of waste generated by a building/housing construction project. In addition, the purchasing of recycled-content material helps support markets for materials collected for recycling; the most efficient environmental practice is to keep the waste material for future project.

- Will the project include the use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time?
- Are there provisions for the proper storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements?
- Will perishable construction materials (such as paints) be purchased incrementally to ensure reduced spoilage of unused materials?
- Will the project use building materials that have minimal packaging to avoid the generation of excessive packaging waste?

- Will the project use building materials that are produced locally to avoid energy use and pollution generated from transportation? This would be easily achievable in the context of a straw-bale construction.
- Will the project use construction materials containing recycled content when possible and in accordance with accepted standards? Examples of recycled-content materials include concrete containing fly ash and thermal insulation containing cellulose (i.e., recovered newspaper with fire retardant).
- Does the construction plan include the use of alternative, environmentally preferable construction materials? Alternative construction materials include lumber products containing recycled plastic and/or wood, lead-free and low-VOC paints and coatings, and recycled steel for use in building frame applications.

2.3 Reuse and Recycling

Many of the waste materials generated as a result of building/housing construction can be reused, refurbished, or recycled into usable products. The benefit of these practices is that materials that would otherwise be disposed of from the waste stream are diverted for productive uses.

- Will the construction contract specify that construction materials left over at the end of the project be reused in other projects rather than be disposed of?
- Is there a plan to use or sell trees cut down during construction activities as lumber or compost? This could be used for wood chips, which can be used during the construction of the paths.
- Will any metal, wood, or packaging wastes generated as a result of construction activities be collected for reuse or recycling into other usable products? Commonly recycled construction materials include concrete, asphalt roofing material, metals, and structural wood.

Energy Efficiency: Employing energy efficient technologies and practices can have a significant positive effect on the environment. There are a number of opportunities to include energy efficiency in building/housing construction projects.

- Does the construction plan specify the use of "low-embodied energy" construction products whenever possible? The energy required to make a product should be considered in making purchasing decisions.
- Does the construction plan specify the use of energy efficient lighting systems?
- Will preference be given to purchasing energy-efficient electric products and equipment (such as appliances and heating and cooling systems)?

- Does the construction plan call for sufficient insulation to reduce heat loss and conserve energy?
- Will the proposed facility participate in the EPA Energy Star Buildings program?

Part 3: Predicting Environmental Impacts of the Quebec Lodge

3.1 Lessons from established eco-villages

From comparing and analyzing other eco-friendly, sustainable, low-impact, low energy villages, conclusions can be drawn for optimal guidelines, principles and goals. Clearwater Commons in Washington, USA and OUR Ecovillage in British Colombia, Canada, presented substantial information about their eco-villages that are relatable to the Quebec Lodge.

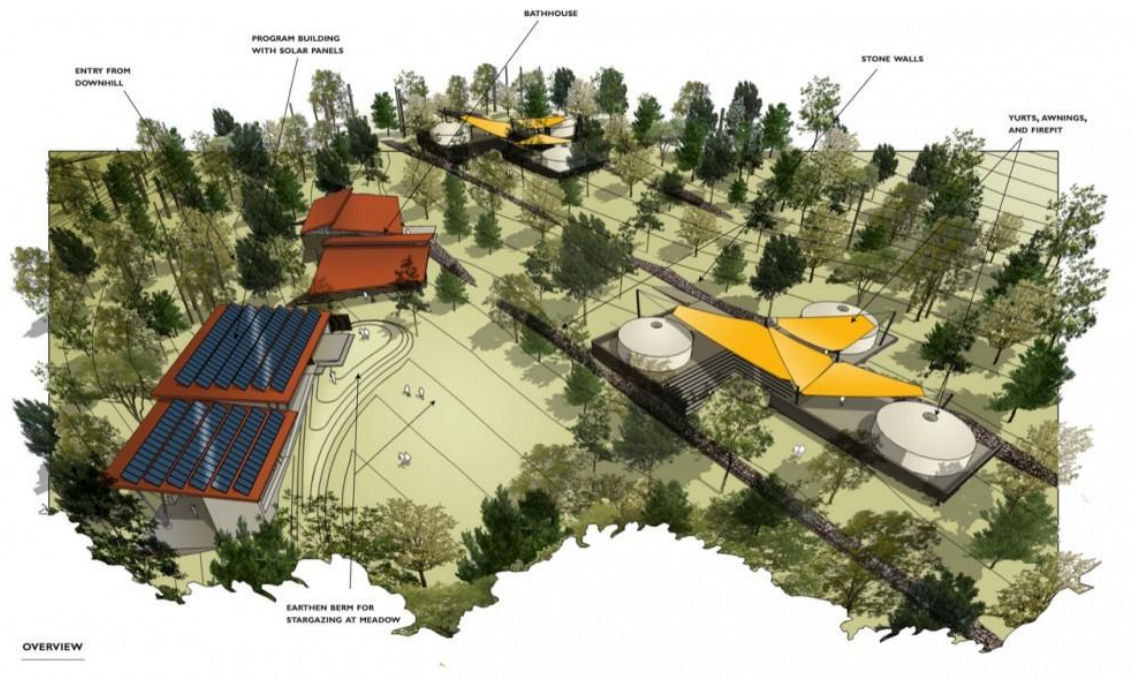
"The term eco-village refers to a full featured settlement in which human activities are harmlessly integrated into the natural world in a way that is supportive of healthy human development and can be successfully continued into the indefinite future" (Ecovillages and Sustainable Communities, Robert Gilman, 1991). The guiding values and principles of both Clearwater Commons and OUR Ecovillage, ensure that the present and future state of the environment will be minimally effected by human impact. By taking into account the topography, land ownership, soils, services, historic land use and environmental features of the property, impacts and mitigation practices can be determined that will protect and preserve the ecosystem.

- Develop the community according to low impact development processes
- Restore the stream and the wetlands – and support the natural habitat
- Use green building practices that conserve energy; minimize the embodied cost of materials and substances, and avoid depleting resources
- Influence greater community by providing public access to our development and community processes and practices
- Wisely recycle wastes and manage waste usage

The eco-villages are committed to low-impact, sustainable practices that balance community needs and the environment by "acting as stewards of the land- restoring and enhancing the natural environment including streams, wetlands, habitat and wildlife" (Clearwater Commons). By implementing low impact development methods and community goals, the health of the ecosystem can be ensured for future generations while also setting precedents in the push towards low-impact, sustainable design.

- Restoration of creek and wetlands

- Pedestrian friendly layout
- Centralized parking area
- Energy conservation and green energy (solar)
- Storm water management
- Rain gardens
- Minimal site disturbance
- Green roofs
- Rainwater harvesting
- Re-planting of native species



3.2Grassroots organization suggestions

To ensure that the health of the watershed and surrounding area continues and improves, it will be important to cross-reference the Massawippi and Memphremagog protection and conservation committees as to continue to protect the watershed. The Association for the Protection of Lake Massawippi, for example, can provide expertise, analysis, and hiring experts to help improve the Lake's health, publishing articles and documents and as well as performing fieldwork at Lake Massawippi. MRC Memphremagog provides suggested practices for maintaining the natural environment. Some suggestions include building specs for the preferred location of the main building for Quebec Lodge:

- Minimum of 10m from the shore
- When the hill slope is less than 30 percent
- Or when the slope is more than 30 percent but the elevation is lesser than 5m

- Minimum of 15 m from the shore
- When the slope is continuous and more than 30 percent
- When the hill slope is more than 30 percent and the elevation is more than 5m

As well as providing building specs, the MRC Memphremagog proposes five basic concepts for protection and preservation practices for the watershed that can be reiterated throughout any development project on the shores of the Massawippi.

- To ensure the sustainability of the water resources, and the water flow, maintaining and improve their qualities and to provide minimal protection to the shoreline, and swamps.
- To prevent the degradation and erosion of the shoreline, and the swamps by favoring their natural course
- Ensure the protection, the quality and biodiversity of the field of interest by controlling the interventions that can promote accessibility and the showcasing the natural beauty of the shoreline and swamps
- Protect fauna and flora and the uniqueness of swamp environment, by keeping in mind the biological aspect of these environments, and by also allowing the natural flow of the waterways.
- To promote the restoration of the effected shoreline, by attempting to focus on natural ways of fixing this problem.

Figure 2 Lake Massawippi

Figure 3 Massawippi Watershed

Part 4: Predicting environmental impacts criteria

The chart and following summary is a tool builders and affiliates of the project can use to showcase where the general impacts will occur in the camp, and to what extent they are significant or if they are of no real consequence. The criterion is based on research from other eco-villages, as well as priori Canadian environmental assessments of development along watersheds. The basic criteria allows for easily understandable explanations of the impacts the project will have in the ecosystem, economy and the community to the general public and as stepping stone to further assessment if required.

- **Permanent Environmental Criteria:**

- **Heritage:** there will be very minimal change in the "heritage" or the layout of the land as the objective is to have the least amount of impact on the land, exemplifying a balanced human-nature environment mitigating adverse environmental effects.
- **Risk of Watershed Contamination:** very low risk of contamination of the watershed by the camp due to the eco-friendly design and environmental additives to mitigate for any contamination.
- **Inconvenience caused by the presence of a construction site**: work is done on site, including storage and work requires more then a year to complete, hoping to be entirely finished by 2017.

- **Inconveniences caused by trucking**: minimal inconveniences due to location of camp.

- **Impact of work on flora and fauna:** Impact will be temporary, and further restored during and after construction.

- **Infrastructure related work:** the infrastructures erected will have minimal impact on the natural site, but the topography will have minor altercations to allow for the structure to be built.

- **Technical feasibility**: there is commercially proven and tested technology allowing for an eco-camp to be constructed in an environmentally, sustainable way. [Natural building]

- **Follow-up measures and associated costs:** monitoring and follow –up will be easy and fairly inexpensive due to the significant reduction in energy costs. Implementing

educational programs, and having clear and objective guidelines and principles will easily keep the maintenance of the eco-friendly design and mitigation measures employed.

- **Community Impact:** constructing an eco-friendly camp, utilizing local goods and services, could potentially increase local environmental awareness and public participation in their own local ecosystems and stimulate the local economy. As well, as potentially creating a precedent for further eco-friendly camp design in the future.

- **Temporal Scale:** the Quebec Lodge business plans stipulates a time scale beginning in 2013, having the camp fully, up and running as an overnight camp by 2017.

- **Total cost:** the total cost of the project is yet to be determined but it projected to be around 1.5 millions dollars. If local goods and services are employed the cost could potentially be reduced.
- **Local economy:** stimulated economy, again if local good and services are used. Also, by creating a camp, there is an opening up for employment opportunities, benefitting the both the youth and adults.

Part 5: Managing Project Impacts

The purpose of this project is to build a camp that is sustainable and as low impact as possible. This section is detected to designing management strategies to address the effects and impacts identified. In this section you will find recommendations to avoid, minimize or offset those impacts. Anticipating the effects and impacts prior to building can be seen as beneficial if and when uncertainties around the project arise. Thus, this management system is designed to be flexible enough to respond to unanticipated impacts as well as predicting the level and significance of these impacts.

5.1 Main Building\Boardwalk Construction - Potential impacts and management approaches:

During the course of the construction phase actions that will take place may have potential impacts. Highlighted below is a chart that easily depicts the component being dealt with, as well as, the impacts and management strategies that can be used to avoid, minimize or offset any effects.

When the construction takes place, wildlife habitat can be altered and destroyed. Soil derogation can cause unexpected erosion while vegetation and natural resources can be negatively affected.

These potential impacts can be avoided by re-routing the placement of the boardwalk and location of the main buildings to ensure minimal damage to the natural environment.
Soil erosion is an environmental impact that is crucial to consider when clearing and working with un-touched grounds. The soil is fresh and living therefore all precautions must be taken. Manufacturing a riparian zone can ensure environmental management and soil conservation is being accomplished. Riparian zones can be engineered for soil stabilization and restoration as they supply shelter from human intervention during erosion control.
The clearing of the land is a large process that has the potential for maximum negative impacts. During this process that takes place before the initial building can begin, worker safety, noise disruption and vegetation destruction are high risk factors. Worker safety, being the up most important, is crucial. Ensuring that certified and properly trained individuals are as individuals are assigned to this task can make the difference between failure and success. Erosion is a high risk factor as well, however, it can be managed by riparian zones.
Pollution at a construction site is often neglected as is noise disruption, unwanted debris and vehicle emissions. These three impacts can be avoided by regulating vehicle standards on the grounds when building is taking place, scheduling construction during appropriate work hours, and having designated garbage zones that are to be collected and cleared after every shift.
A great way to help the local economy is to offer employment opportunities locally. Hiring locally can cut down on the vehicles being on site as workers can commute to the work site by carpooling.

Component\Action	**Impact**	**Management**
Habitat\Wildlife	• Vegetation destruction • Soil derogation • Loss of habitat • Disturbance\disruption	• Avoid by re-routing • Restore or create elsewhere (a project for campers)
Clearing	• Worker safety • Vegetation destruction • Noise disruptions • Erosion	• Inspections and proper training • Restore or create elsewhere • Schedule construction during appropriate working hours • Riparian Zone
Pollution	• Emissions • Noise disruption • Garbage and unwanted debris	• Vehicle standards • Schedule construction during appropriate working hours • Designated garbage zones – to be collected after each shift

Economics	• Employment opportunities • Vehicle collisions\safety mechanisms	• Hire locally • Avoid by limiting the number of vehicles allowed on site during working hours

5.2 Mitigating Impacts:

For the Quebec Lodge Project impacts and effects will become more noticeable during the construction phase. In order to eliminate and minimize these effects standards must be made and reached by the management team and employees. The primary goal for this project is to create a sustainable camp with as little impact as possible. Impact mitigation is a term used in the environmental industry to describe projects with the intent to offset visible impacts and create a way around them. The term means to make less harsh, therefore when a project "debits" the environment and causes impacts the developers must "credit" back to the land.

- **Mitigating visual impacts**
- **Carpooling**
- **Camper programs to help restore habitat and wildlife destruction**

1. **Mitigating Visual Impacts:** by creating and building an eco-friendly camp one thing that must be considered is the appearance of the camp itself. Both the design and colour should blend into the surrounding landscape. This minimizes the visual impact and represents a harmonious relationship with the surrounding environment and especially wildlife. This tactic can be used on all buildings and structures.
2. **Carpooling:** During the construction phase, the high number of vehicles needed during the process could allow for potential accidents and pollution. To avoid this from occurring, hiring locally and carpooling can minimize potential accidents, harmful emissions, and pollution. This mitigation tactic does not prevent any impacts, however, it reduces the severity and chances of any impacts on the environment.
3. **Camper Programs:** During the construction phase soil, vegetation, wildlife habitat and the natural environment have the potential of being destroyed and disturbed. Although this can be minimized, the impacts and effects of the construction phase cannot be avoided. In order to help reconstruct the effected areas, camper programs can be established where they can build new habitats for wildlife, as well as, constructing an area where campers can garden and grow their own plants and vegetables. This will allow for an educational opportunity as well as offering campers a "hands on" experience as they watch their work in progress. Other ideas for camper and sustainability learning opportunities can be seen throughout the report.

Chapter 2:

This section of the report will focus on the construction of the trail and the boardwalk. Our areas of focus within this section are on the trail design and planning, trail materials, trail maintenance, trail creep, ways to control surface water, trail signs, and materials used to build the boardwalk. We also compared our findings for the boardwalk with a real life example of the Johnville Bog.

Part 1: Trail Design and Planning

Trail design should best utilize the surrounding landscape and terrain. It is also important to keep the integrity of the physical environment while designing a trail to meet the needs of intended users. In the case of trail design at Quebec Lodge, needs must be met for users between the ages of 6 to 15. There will be approximately 90 campers using the trail at any given time. The trail must accommodate ATV usage, with emphasis on creating a boardwalk over the swampy area meeting the needs of the aforementioned groups.
According to the International Mounting Bicycling Association Canada (IMBA), trails are best located on side slopes to avoid pooling of water and allow for adequate drainage preventing erosion. Referring to figure one, the rolling hills of Quebec Lodge's landscape are ideal in following IMBA's suggested practice.

Figure 4 Pre-existing trail along the rolling landscape of Quebec Lodge
SOURCE: Darren Bardati

1.1 Trail Maintenance

A solid, outsloped surface is the objective of trail maintenance. Remove and scatter berm material that collects at the outside edge of the trail. Reshape the tread and restore the outslope. Maintain the tread at the designed width. Remove all the debris that has fallen on the tread--the sticks and stones and candy wrappers. Maintenance includes removing obstacles such as protruding roots and rocks on easier trails. It also means repairing any sections that have been

damaged by landslides, uprooted trees, washouts, or boggy conditions. Compact all tread and sections of backslope that were reworked.

1.2 Trail Creep

In regards to figure 5, does your contour trail display:

Exposed bedrock or roots along the uphill side of the tread?

Tread alignment that climbs over every anchor point and drops before climbing to the next anchor point?

Pack bumpers?

All three are indications that the tread surface has been eroded and compacted by travel along the outside edge. Insidious tread creep is at work. Tread creep should be stopped or the trail will eventually become very difficult or dangerous to travel.

Figure 5 Slope along the pre-existing trail at Quebec Lodge

SOURCE: Darren Bardati

In order to keep users on the trail and water off the trail, the shape of the trail should follow the contours of existing hillsides and slopes. The IMBA claims sustainable trails should have a grade no more than 50% of the side slope grade. This is referred to as the “half rule”. The higher the trail grade the more challenging the trail is for users. With Quebec Lodge users in mind, the ideal trail grade should be 10% or less of the side slope grade. For example, if the side slope grade is 60%, the trail grade should be no steeper than 6%. Trail design for Quebec Lodge needs to provide a trail grade conducive to ATV access, therefore, a trail grade of 3% is ideal. Designing a sustainable trail grade will allow for proper drainage of water. Water should flow across the trail, rather than along the trail to avoid pooling of water and ruts. Having a trail grade will aid in directing water across the trail to avoid erosion.

Wheeled traffic and some hikers have a natural tendency to travel the outside edge of side hill trails which causes treed creep. Sloughing makes the edge of the trail the flattest place to walk. Back slopes that are too steep may slough material onto the tread, narrowing the trail. The trail becomes too narrow. The result is that traffic travels closer to the outside edge.

Figure 6: Causes of Trail Creep

SOURCE:http://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/07232806/toc.cfm

In reference to figure three, to fix tread creep, cut the back slope properly, remove slough, and re-establish the 5% out slope. Take advantage of large stationary objects to prevent the campers from walking along the edge. Trees, the ends of logs, rocks, and stumps that are left close to the downhill edge of the trail will keep the campers closer to the middle.

Where soil is in short supply, you may have to install a short retaining wall and haul in tread material. The tread should be benched back into the slope in the original alignment. Guide structures should be installed on the outside edge of the tread to keep traffic toward the centre.

1.3 Surface Water Control

Diverting surface water off the trail is going to be one of the top priorities to consider during construction of the trail. Water erosion is a trails worst enemy. A simple and affordable way to divert water off trails is to build grade dips. The general idea is to use a reversal in grade to force water off of the trail. Terrain dips take advantage of the natural dips in trail therefore no excess material is required. Grade dips entail very little to no maintenance and

are the least obtrusive drainage system if they are built with smooth grade transitions. The figure below demonstrates what a regular terrain dip looks like.

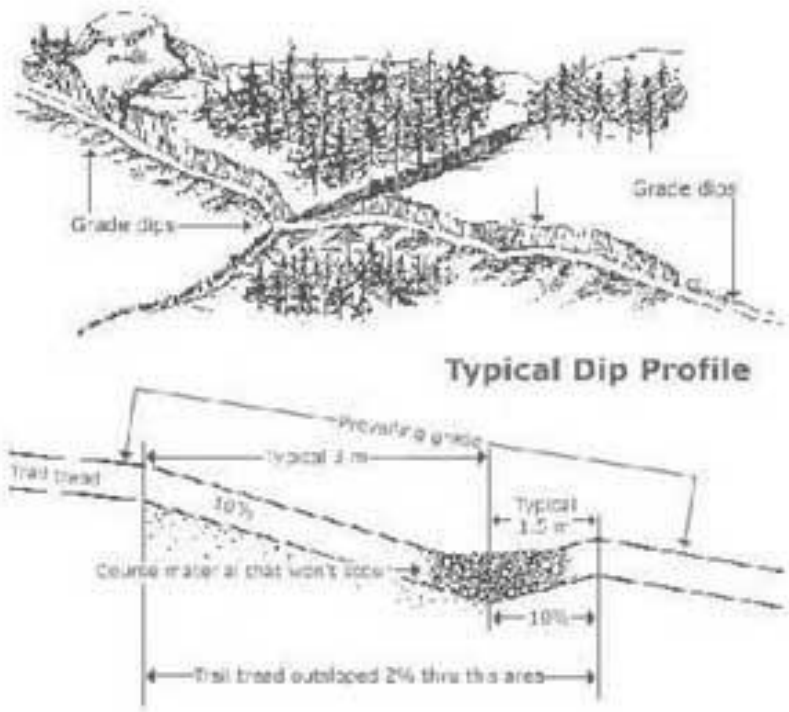


Figure 7: Typical Dip Profile

SOURCE:http://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/07232806/toc.cfm

For grade dips to be effective they should be placed rather frequently along the trail to keep water from increasing in volume and velocity to carry off the tread surface. Figure four is an example of what a typical dip should look like. The best location for terrain dips are usually around the mid-slope of the trail because they are ineffective at the top of grades. This method is affordable and safe for the campers. This method is meant to be built during the original construction of the trail. If the existing trail is going to be used for the new camp, waterbars may be more of an effective way to keep water off the trail.

Waterbars are another popular drainage structure used on trails where grade dips are not present. Waterbars are used to direct water off the trail at strategic locations and minimize some effects of erosion. Wood or rock waterbars are very useful for foot trails. Generally waterbars are natural looking and do not interfere with people walking on the path, so it won't get in the way of the campers. If the grade is less than 5%, waterbars are less likely to clog, but on steeper grades waterbars are more susceptible to clogging if the bar is at less than a 45° angle to the trail. If the grade is steeper than 20% the waterbar will most likely not be effective. Trails should not exceed 10% in grade or else water management becomes a big problem. Placement of the bar is crucial. Waterbars must be anchored 300 millimetres into the cutslope and extend into the fillslope. The longer the tread, the longer the bar must

be. If the bar is too short clogging will occur. The figure below displays the appropriate angle the waterbar should be placed in regards to the angle of the trail slope.

According to figure five, if the water bar is built correctly it should be effective for many years diverting water off the trail. The campers can walk right over it without even noticing it is there. Waterbars do not require too much maintenance. An annual cleaning is all that is necessary because of the build up of sediment and debris. The figure below demonstrates how a waterbar operates.

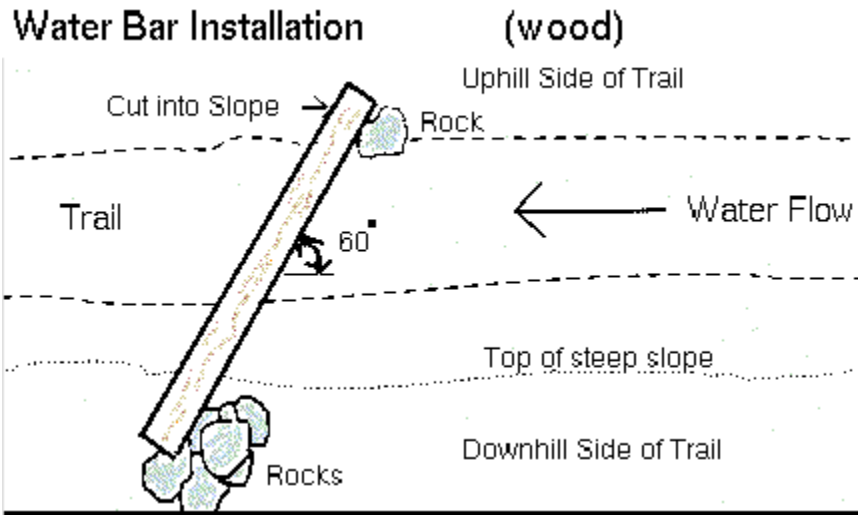


Figure 8: Water Bar Installation

SOURCE:http://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/07232806/toc.cfm

Puddles that formulate along the trail are another source of concern while building a trail. Puddles can produce many kinds of tread damage and can widen the tread. A bog can develop if certain kinds of soils are present which can lead to step-throughs and tread creep. To effectively prevent puddles from formulating a wide drain should be constructed. The drain must be deep enough to allow the water to escape the tread. A puddle drain of at least 600 millimetres wide should be cut across the entire width of the tread. The drain has to be deep enough to allow the water to escape the tread. Guide structures should be planted along the lower edge of the tread to keep campers in the centre of the trail away from the drains.

To accommodate two-way traffic of campers and ATV users, the trail should be between 8-12 feet wide. The trail should be located on the uphill side of large trees which will act as a natural bench. Doing this also prevents damage to roots which are located on the downhill side. Abrupt and tight turns in the trail can cause obstacles for ATV use. The Quebec Lodge trail should keep a low turning radius when the trail curves.

Previous scouting of the Quebec Lodge campsite reveals a pre-existing primitive trail leading to the waterfront from the area of the camp that will house the yurt village. Proposed trail design will use the existing trail as a guideline building the new trail. Building upon the pre-existing

trail will require less removal of trees and plants and less disturbance to the environment and wildlife habitat. Using the aforementioned trail design procedures, appropriate changes can be made to the trail.

1.4 Trail Materials

Choosing tread material for a trail depends on the trails purpose, landscape, and intended usage. As mentioned in the design and planning, the trail needs is intended for multiple users getting from camps main buildings/yurt villages to the beach. The landscape surrounding the trail is hilly with slopes and must be conducive to ATV usage.
According to Bartlow et al. (n.d.), mineral soil is the most sustainable and lowest maintenance for tread material. Mineral soil is made up of sand, silt, and clay. Previous scouting of Quebec Lodge was undertaken during the winter season so appropriate analysis of the camps soil type was not conducted. Upon spring and thawing of ground ice and snow, informed observations can be made.

Rocky materials including gravel and stones are best suited for the Quebec Lodge trail. These materials are ideal for trails with heavy usage. Rocks compact well under pressure and provide a relatively smooth surface when compacted by weight of campers and ATV's. Gravel and stones do not absorb water, but rather allow adequate drainage. Low trail grades will allow for gravel to stay on the trail with minimal displacement

No matter what material is decided upon, compaction and displacement play an important role. According to Bartlow et al. (n.d.), when tread is completely compacted, it maintains its shape and resists displacement and erosion. Too much compaction, however, can be detrimental and cause depressions disrupting the drainage and flow of water.

Tread material between guide structures might creep downhill, creating a situation where the trail climbs over every tread anchor and descends again. At the bottom of these dips, water and sediment collect. This is the weakest portion of the tread and the most prone to catastrophic failure. The tread can be so soft that pack stock may punch completely through the tread.

1.5 Signs

Signs along the trail provide users with information outlining rules, directions, and educational features. Keeping environmental integrity is an important aspect of Quebec Lodge. Frequent signage along the trail will enable campers to stay informed on the importance of staying on the trail and not damaging the environment.

The beginning of the trail should have a sign with a trail map and directional arrows. Trail maps can be placed all throughout the trail with "you are here" markers so campers know where they are at all times and how far they are from their destination.

Signs explaining the importance of following the trail and not venturing off into the forest should be placed along the trail where a change of direction or curve occurs. Campers will naturally have to slow down at these points along the trail, increasing the likelihood they will see the signs and read them. Signs should not be word heavy and include pictures to keep children from

overlooking the signs. Signs can include explaining consequences of going off the trail. This may give campers more of an incentive to stay on the trail if they know the potential consequences. An example of a sign that can be placed along the trail is shown below:

Figure 9 Example of an Informative Sign
SOURCE: http://suhsteyn.files.wordpress.com/2012/09/blog4.jpg

2.1 Johnville Bog

The Johnville Bog is located in Cookshire-Eaton, Quebec and is a park full of ponds and the peat bog. This ecosystem is very relatable to look at in terms of building a boardwalk over a swampy area because of the similar characteristics within both environments. The Johnville Bog has a boardwalk to cross over the wet land. This boardwalk is also ATV accessible, which is a requirement for the proposed boardwalk at the Quebec Lodge. Comparisons to the type of boardwalk they have constructed on their site will continuously be made through out this entire section on the boardwalk. Another key factor that is interesting to note for the actual construction of the Quebec Lodge boardwalk would be that construction should be done in the winter. The Johnville Bog built their boardwalk during the winter so there was less impact on the environment. This impact on the environment is also reduced in another way because the white cedar does not need to be stained. Staining would normally happen because of the damage done to the wood planks during wet seasons. However, white cedar planks do not need protectant against moisture because it is already a moisture resistant material. This is good because then the stain and protectant does not get washed into the soil and water.

Figure 10: Boardwalk at Johnville Bog
SOURCE: http://www.bonjourquebec.com/fr/images/municipal-and-regional-park-nature-interpretation-centre-johnville-bog-and-forest-park-238058947.jpg

2.2 Boardwalk Structure Suggestions

Within the boardwalk construction, to gain extra support and add an aesthetic view to the boardwalk, the addition of tree stumps underneath the boardwalk can be added. The Johnville Bog has implemented this technique into their boardwalk. They used white cedar tree stumps for their boardwalk. They purchased their white cedar in Quebec, therefore good for (local business) as well as the environment because this type of wood is resistant to moisture. This will be key for the swampy area where the boardwalk will be built as there will be a lot of water in the built environment. Boardwalks also allow trail users to cross over sensitive environments and keep the ecological factors protected and undisturbed.

According to Bartlow et al. (n.d.), alternatives for crossing over wet soil include the obvious boardwalk, as well as bridges, stepping stones and fords, and culverts. Bridges tend to be an expensive option as they take a lot of materials to build, as well as specialized expertise. Stepping stones are also another option for crossing over water, however because the water level rises depending on the season at the Quebec Lodge, this doesn't seem like the best option. Also, the Quebec Lodge is aimed for a kids ages (4-14)* so the stepping stones across the water would not provide the safest passage. Culverts are aimed more at moving small volumes of water underneath a trail through a pipe. This would only work if the trail around this area was made to be ATV accessible as well as identifying the surrounding areas ecological impacts. Boardwalks definitely look like the most stable and effective option.

2.3 Boardwalk Material Suggestions

When constructing the boardwalk, it is also important to take into consideration the types of materials used on the boardwalk and with the trail leading up to it. For the Quebec Lodge case, depending on what areas of the trail need to be accessible to ATV's, Bartlow et.al (n.d) suggest gravel is a good option for ATV's to travel over. At the very least, there should be ATV friendly material, like gravel, leading up to the boardwalk. Other areas of the trail may differ depending on what their main purpose is.

As for the materials for the construction of the boardwalk, we can learn a lot from the Johnville bog. The materials for the white cedar stumps have been previously discussed but as for the wood on the boardwalk and trail, they constructed theirs out of red cedar. The Johnville Bog purchased these materials from a company that recycled the phone posts from British Columbia. This company cut down phone poles and used them as recycled material to provide wood. This type of cedar is good because it resists humidity, and when analyzing figure eight, it is apparent that the boggy area of Quebec Lodge will receive much humidity.

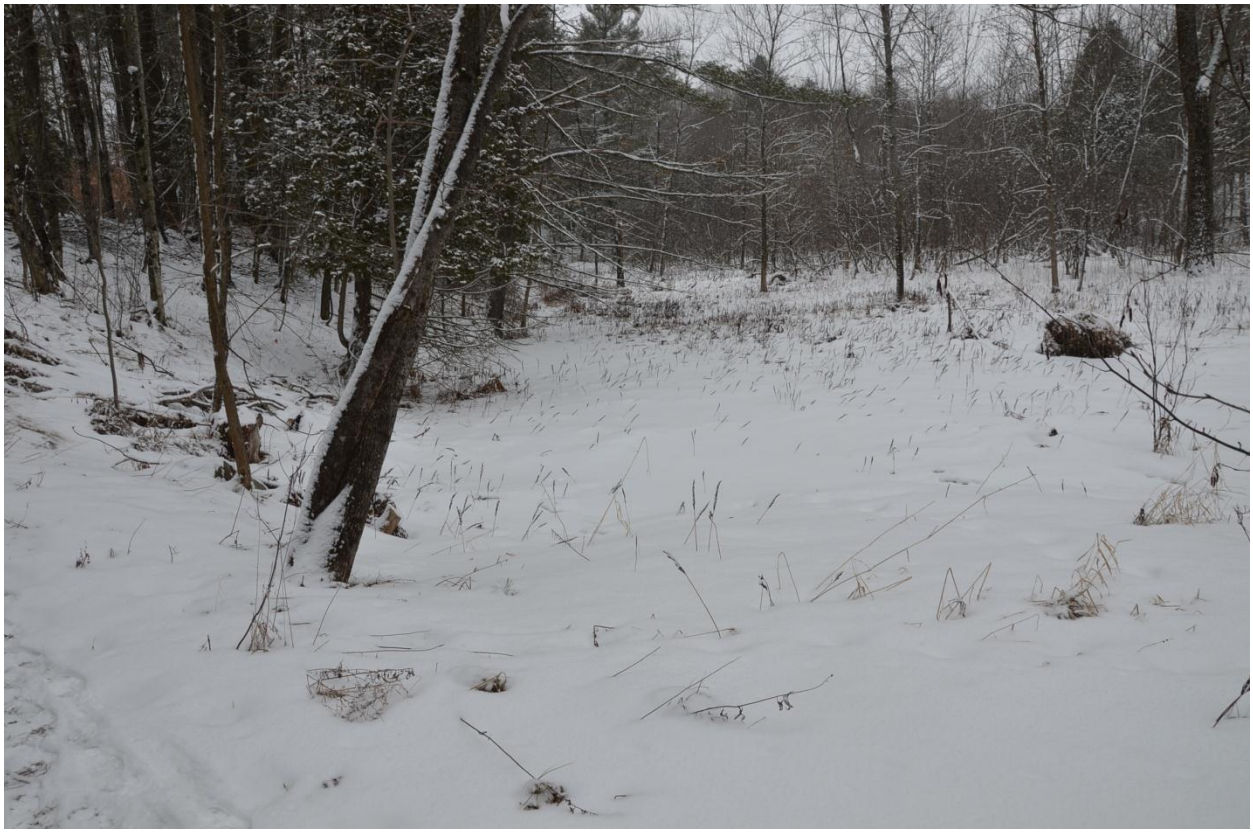


Figure 11: Boggy area of Quebec Lodge
SOURCE: Darren Bardati

Chapter 3:

Forward:

For the purposes of Quebec Lodge summer camp, our group decided to incorporate different ideas and suggestions on how to make the camp as sustainable and eco-friendly as possible. We did our best to cover advantages and disadvantages of these concepts as well as the suggestions on the actual implementation of these ideas in relation to the camp grounds and the environmental conditions of the area.

Part 1: Main Building Ideas

1.1 Straw Bale Construction

Plastered straw bale construction has proven itself over the past century to be durable, highly fire-resistant, non-toxic, and structurally superior to many other systems.

Advantages	Disadvantages
• Environmentally friendly: main materials are natural and biodegradable	• Moisture is the biggest concern, imperative that there is no cracks or damage that will allow water penetration
• Insulation is twice to three times that of traditional frame wall systems	• Not the most suitable for climates that are very wet and humid
• Can be purchased locally from farmers so the community benefits	• Local building codes may make it more difficult to get construction plans approved
• Low embodied energy: little energy is needed to manufacture the products. The only energy needed otherwise is for the bailing process and transportation.	• More of overall square footage of house is unusable because of wall thickness

• More flame retardant than conventional houses	• Shipping costs associated with transporting straw bales could potentially be expensive
• Little concern for rodents, insects etc.	• Snow drifts can be problematic
• Serious reductions in heating/ cooling costs	

Costs

The costs of constructing a straw bale building depend largely on the size and detail of the desired building. With the tremendous increase in materials costs today, the average home, with hired labour will likely fall closer to $200-250/sq. ft. Associated cost can be decreased by: minimizing the intensity of the design; asking for volunteers (because straw-bale construction can be done by anyone), and using donated material or materials from the land (like trees that will be removed).

Although the construction cost may not be much cheaper, the insulation of straw bale infrastructure is incredible and the long term decrease in heating and cooling costs are much lower than that of conventional buildings.

1.2 Sustainable forms of Insulation

List of Sustainable forms of Insulation

Recycled Denim

The insulation is made from old jeans that have been cleaned, stripped and then covered in boric acid (which is fire, insect and mold resistant).

Sheep Wool

Sheep wool has the amazing ability to form air pockets that trap air, which in turn keeps the sheep warm in the winter and cool in the summer.

Straw Bale

Straw bale insulation has been around for centuries. It consists of stacking bales of straw together that have been packed and tied together with bamboo or wood.(see previous section on straw bale construction)

Cellulose (Recycled Paper)

Cellulose insulation is primarily made from recycled newspaper that has been shredded and mixed with fire resistant Boric acid. It is blown and packed into your walls and ceilings and can be used to fill in the smallest of spaces.

\
Soy Spray Foam

The soy bean is everywhere, and apparently it's now being used as an eco-friendly foam insulation. Soy bean spray is perfect to use in tight spaces because it's expandable, chemical-free and creates a seal that reduces air infiltration.

Type of insulation	Advantages	Disadvantages
Denim	• 100% recyclable • Doesn't contain throat/skin irritants • Safe to touch • Easy to install • Creates good sound barrier • Available in most building stores	• Difficult to cut. • do not completely seal the cavity against air movement requires a vapor retarder or barrier • hard to dry if a leak allows excessive moisture into the insulated cavity
Sheep's wool	• All natural/renewable • Requires 15% less energy to produce than fiber glass insulation • Completely safe to touch and easy to install • Doesn't irritate your eyes, skin or lungs. • Will extinguish itself in the event of a fire	• Few producers • Maybe treated with pesticides, fungicides, and flame retardants • Poor ranching practices • Usually not locally produced
Straw bale	• Highly renewable • Grows quickly • Extremely energy efficient • More affordable than other forms	• Heavy, bulky to install • Wet conditions cause mold/decay • Requires regular maintenance (requires a layer of plaster to seal water) • Sensitive to structural movement

cellulose	• 100% recyclable • Uses 10x less energy to produce than fiberglass insulation • Non-corrosive to steel, copper and aluminum • Doesn’t support mold/fungus growth	• Doesn't seal bypasses very well • Weight may cause ceilings to sag if the material is very heavy. • inhibits convection more effectively • Will settle over time losing some of its effectiveness • May absorb moisture
Soy spray foam	• Contains all natural ingredients • Expands 100 times its size – fills small places • Lightweight and easy to control • Resistant to mold and mildew	• Must be installed by a professional • Hard to predict rate of expansion • expensive

1.3 Sustainable Kitchen practices

Sustainability In the Kitchen:
For the purpose of Quebec Lodge, we highly recommend procuring food as locally as possible. We also encourage cooking seasonally, using items that are locally in season. Below is a list of locations for the procurement of local food.

Location:

Marche Le Vegetarien
777, Rue King Est
Sherbrooke QC
819-821-2318

Beaulieu Farm Market
3750 Route 143 (intersection de la 147)
Waterville, QC
819-562-6477

Orchard La Pomalbonne
6291 Route Louis S. St-Laurent
Compton, QC
819-835-9159

L’Abri Vegetal
350 Chemin Drouin
Compton, QC
819-837-3081

La Station De Compton Fromagerie
440 Hatley Road (Route 208)
Compton, QC
www.fromagerielastation.com

Le Poulet du Pont Couvert
6150 Route 112
Ascot Corner, QC
819-563-1453

Crousset
190 Rue Centre
Magog, QC
819-868-0796

Bleutieres L'Or Bleu
3465 Route 143
Stanstead, QC
819-876-7568

Boeuf Biologique Blonde D'Aquitaine
450 Chemin Vallancourt
Compton, QC
819-849-3143

Mycoflor
7850 Chemin Stage
Stanstead, QC
819-876-5972

Marche de la gare Sherbrooke
720 Place de la Gare
Sherbrooke, QC
819-564-6232

Water Saving policies:

Furthermore, we strongly recommend not using trays as they are unnecessary and require extra water to clean, also people take more food than they actually need; it is better to have them take what they can carry and then come back if they are actually still hungry. This is especially pertinent and applicable to the younger campers.

1.4 Green Roofs

A green roof is the incorporation of a "contained" green space on top of a human infrastructure. Green roofs are easily adjustable to different climates and building structure needs making them a realistic and feasible option to integrate into new or existing buildings.

Green Roofing has been around for centuries although it has only recently started gaining momentum in North America. Germany has been providing financial support for green roof initiatives since 1986 and now has an estimated 25% of all roofs being vegetative.

With the design plans for the Quebec Lodge main office building still underway, the construction of a green roof is significantly more possible because financial burdens associated with restructuring old roofing can be avoided and the specific engineering requirements for green roofs can be implemented into the original construction of the building.

Green roofs can be divided into two broad categories: intensive and extensive.

Extensive	Intensive
• < 6 inches of growing medium	• > 6 inches of growing medium
• Lower weight	• Heavy weight load
• Limited diversity of vegetation	• High vegetative diversity (trees, plants, shrubs etc.)
• Low irrigation and maintenance requirements	• Often area for human activity of recreation.
• Usually inaccessible for human activity/ limited accessibility	• Usually requires some irrigation, fertilizations therefore require more maintenance
• Less expensive	• More diversity = more expenses

Green Roof Structure

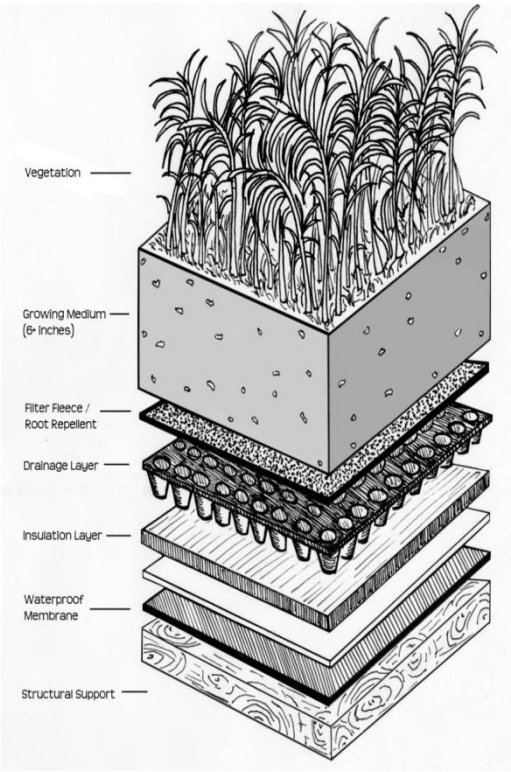


Figure 12: Green Roof Structure

Whether a green roof is intensive or extensive, the basic underlying design is relatively similar and consistent with green roof buildings everywhere (figure 12).

If the Quebec Lodge decides to proceed with green roof technology there are some important structural factors to consider beforehand:

1. **Slope:** the ideal slope for an extensive GR is around one inch per foot. The slope will affect the water drainage, in turn affecting the vegetation on the roof. Plants that enjoy more water would be better suited further down the slope, where as drought resistant plants need to be higher on the slope.
2. **Accessibility:** even for extensive GRs, some accessibility is important for basic maintenance, changes or repairs. Accessibility could be through a back stair case, an

internal door entrance or some other means, but definitely needs to be approached with the building design.

3. **Other roof top structures:** including cold/hot air vents, chimneys, sky-light windows, etc. These will potentially impact the GR and its vegetation or require additional designing.
4. **Paved areas:** if needed how they should be constructed
5. **Protection devices:** for potential slippage or falls

Green roofs are constructed using components that:

- have the strength to bear the added weight;
- seal the roof against penetration by water, water vapour, and roots;
- retain enough moisture for the plants to survive periods of low precipitation, yet are capable of draining excess moisture when required
- provide soil-like substrate material to support the plants;
- maintain a sustainable plant cover, appropriate for the climatic region;
- offer a number of hydrologic, atmospheric, thermal and social benefits for the building, people and the environment;
- protect the underlying components against ultraviolet and thermal degradation.

Benefits/Advantages

Green Roof technology has a number of benefits that can be advantageous for the building, the community and the environment:

- **Water storage:** GRs can significantly decrease the amount of run off, particularly storm water. This decreases the pressure on surrounding water channels which slows erosion processes. Improved water storage can also help protect structural components of the building including the foundation. The water storage also permits more water to be evaporated.
- **Filtration:** as water is absorbed into the soil membrane it is also filtered and cleaned of some particulates. GRs also capture atmospheric deposition and pollutants while filtering noxious gases. In urban areas and large cities this helps diminish dust distribution and dust.
- **Insulation:** GRs improve the insulation of a building. Roofs are usually where the most heat is lost during the winter, and also the hottest during the summer. The growing membrane acts as a buffer which will decrease the energy needed for heating and cooling.
- **Fire protection:** The risk of fueling fires is 15-20 times higher on bare roofs with fully adhered bituminous waterproofing membranes as on extensive green roofs.
- **Natural Reserves:** GRs can be a means of compensating for land lost during construction of the building. It can also be a means of preserving native species in the areas and can provide habitat for migrating birds, insects and other animals.

GR Technology Expenses

The costs associated with installing GR technologies vary largely depending on many things but mainly the intensity and design of the desired green roof; the more complicated and diverse the system becomes, the more expensive it will cost.

There are resources to help lower the financial burden associated with green technology practices available in Quebec. There is a direct incentive program, of $5 a square foot towards green roof installation, offered by The Quebec Energy Efficiency Fund. Gaz Métropolitan (the gas utility), provides the funding.
Natural Resources Canada also provides financial support for the improvement of commercial and institutional buildings in energy efficiency; green roofs have been eligible since 2004.

Other Recommendations
If the Quebec Lodge decides to proceed with GR technology they should consider the following:

- That native species should be prioritized for planting
- The microclimate of the area, including wind and sun exposure, shading and any other factors that could affect the success of the green roof habitat.

1.5 Sustainable forms of Heating

Heating Yurts:
The most common sources of heating are wood stove and propane. Wood heating can be done in a variety of ways such as from a large outdoor furnace which can heat multiple buildings to smaller interior wood or wood pellet stoves. The drawback of centralized outdoor furnaces is they expense of installing the piping from building to building. A traditional wood stove provides the ability to source fuel (firewood) on source which decreases transportation and production emissions. Whereas a wood pellet stove is very user-friendly, requires minimal work, and can add fuel to the fire as needed without the need of the user to do anything. Propane heating is very reliable, effective, cost efficient and if installed and operated properly very safe. However it is a much less sustainable source of heat.

Type of Heating	Advantages	Disadvantages
Propane	• User Friendly • Cost Effective • Efficient	• Not as Sustainable • requires professional installation
Traditional wood stove	• Very sustainable • Can be sourced on site • Very affordable	• Requires more physical labour then all other options

Pellet wood stove	• Very efficient • User friendly • Requires small amounts of labour	• Local sourcing can be difficult

1.6 Grey Water Systems

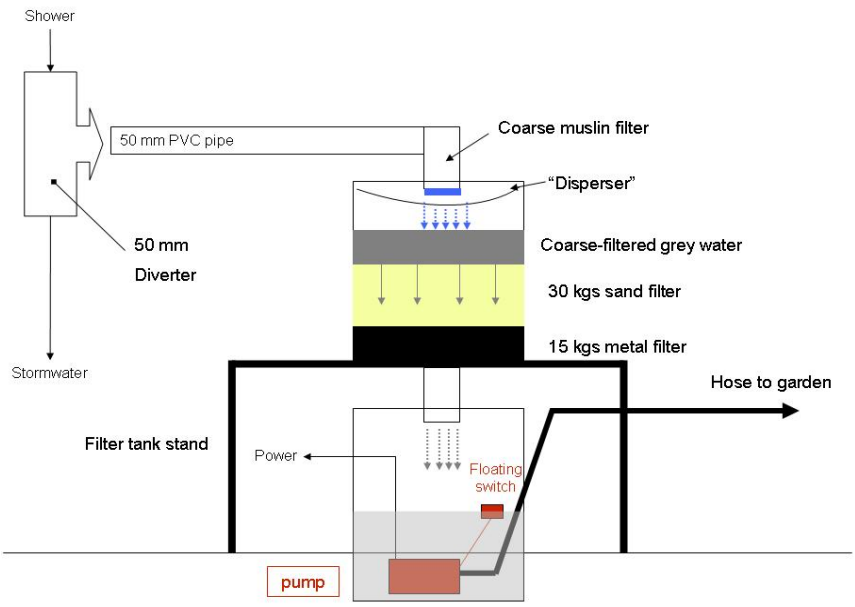
Grey water is water that has already been used through household appliances such as showers, baths, washing machines, dishwashers and most sinks.

Although grey water cannot be consumed, if treated correctly it can be recycled and used to water non-edible plants and grasses. Not only does its use on landscapes conserve treated tap

Advantages of Grey Water Systems	Reason
• **Reduces fresh water use**	The average household in North America is for outdoor use. Capturing the indoor grey water for use outdoors can cut water usage in half.
• **Reduces strain on septic system or treatment plan**	Grey water makes up the majority of the household wastewater stream, so diverting it from the septic system extends the life and capacity of the system.
• **Groundwater recharge**	Grey water recycling for irrigation replenishes groundwater, helping the natural hydrologic cycle to keep functioning.
• **Plant growth (non-edible)**	Grey water can support plant growth in areas that might otherwise not have enough water.
• **Maintain soil fertility**	The nutrients in the grey water are broken down by bacteria in the soil and made available to plants. This helps to maintain soil fertility.
• **Enhance water quality**	The quality of groundwater and surface waters are much better preserved by the natural purification processes the grey water undergoes in the top layers of the soil than by any engineered water treatment.
• **Develop property that in unsuitable for a septic tank**	A grey water recycling system, along with the use of composting toilets, can enable the development of property that is unsuitable for a septic system.

water, but grey water may also benefit plants because it often contains nutrients such as nitrogen or phosphorus. The use of grey

water systems at Quebec Lodge would contribute greatly to being the most sustainable camp possible.



Possible Contaminants Found in Grey Water:

Types of Grey Water Systems

Type A: Diversion System

Diversion systems are commonly used to divert

Contaminant	Reason
• **Automatic dishwasher**	Organic material and suspended solids, bacteria, increased salinity and pH, fat, oil and grease, detergent
• **Bathtub and shower**	Bacteria, hair, organic material and suspended solids, oil and grease, soap and detergent residue
• **Sinks, including kitchen**	Bacteria, organic matter and suspended solids, fat, oil and grease and detergent residue

grey water into toilet tanks for toilet flushing, systems that divert grey water to outdoor irrigation, and systems that divert grey water to treatment wetlands. These systems typically involve some filtration to capture lint, hair, fats, grease, etc. These systems may also involve disinfection (i.e through the use of chlorine tablets) there are a variety of commercially available systems that divert water from shower and sink drains into toilet water tanks. Systems that reuse sink water to fill toilet tanks can cost between $100 and $500. These basic diversion systems include two-way valves that can be set to an open or closed position. This system is affordable and could easily be installed in the bathrooms in the main building.

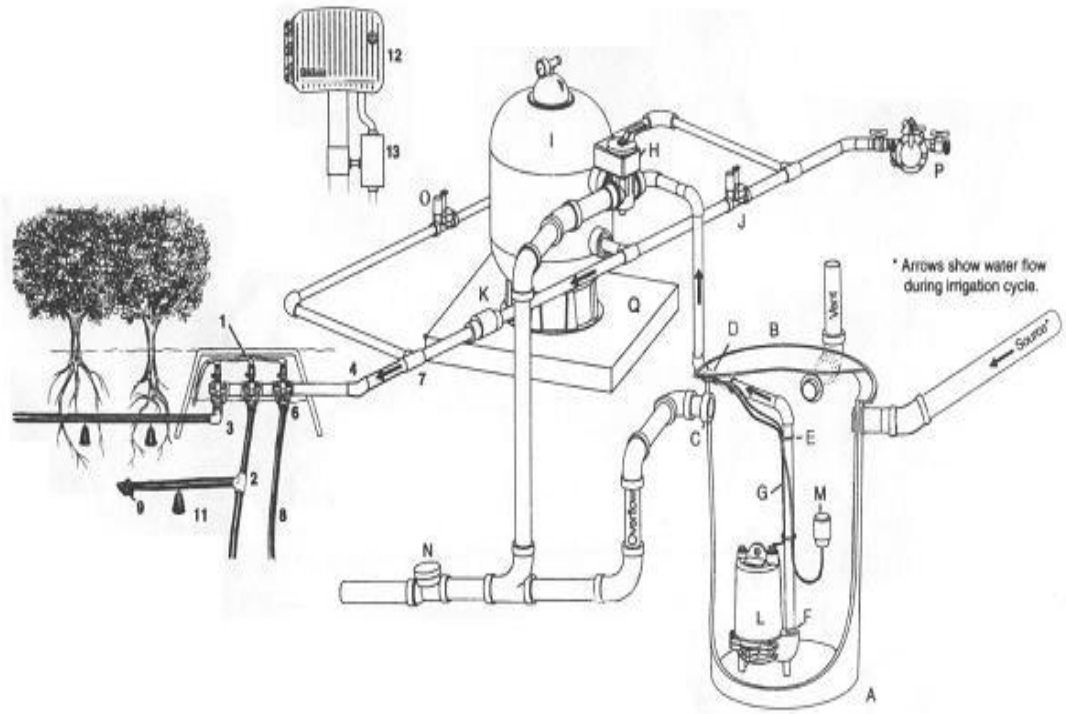


Figure 13

Type A diversion

<u>Type B: Physical/Chemical Grey Water System</u>

Grey water systems that involve storing grey water must treat the grey water to reduce the bacteria and other microorganisms that can multiply in stagnant water. Physical and chemical grey water treatment systems primarily utilize disinfection and filtration to remove contaminants. Physical and chemical treatment systems usually involve holding tanks, filters, and pumps. Many basic grey water treatment and storage systems also incorporate activated carbon and/or clay filters and disinfection (e.g., chlorination, purification with ultraviolet radiation). These systems can cost between $1,000 and $5,000 and can be fairly land-intensive, requiring space for holding tanks and filtration units. Below is an example of a chemical system:

Figure 14: Type B Diversion system

This type of filtration system could be beneficial because it is durable for any type of climate, although it has a high instalment cost; it's low maintenance and would be the best option due to the harsh winters Quebec can experience.

Grey Water Treatment Technologies:

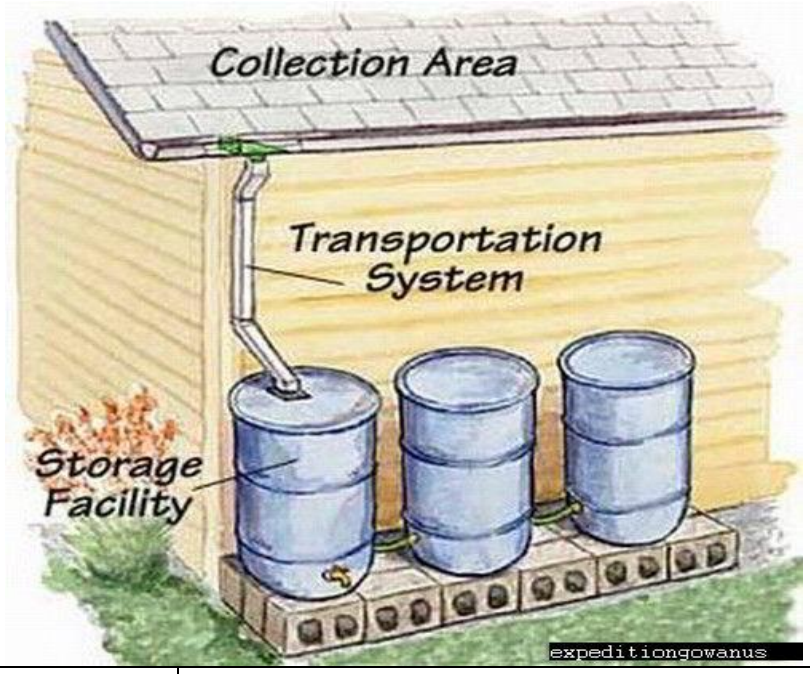
Treatment Technique	Description	Advantages	Disadvantages
Disinfection	Chlorine, ozone, or Ultra-violet light can all be used to disinfect grey water.	Highly effective in killing bacteria if properly designed and operated, low operator skill requirement.	Chlorine and ozone can create toxic byproducts, ozone and ultraviolet can be adversely affected by variations in organic content of grey water.
Sand Filter	Beds of sand or in some cases coarse bark or mulch which trap and adsorb contaminants as grey water flows through.	Simple operation, low maintenance, low operation costs.	High capital cost, reduces pathogens but does not eliminate them, subject to clogging and flooding if overloaded.

Home Made Systems:

- Do-it-yourself filtration systems can be used for to irrigate grass and non-edible plants.
- These systems can be easily made for low cost and minimal supplies
- This could be a potential activity for the Quebec Lodge campers, if this is the route decided to recycle water
- You can find a great DIY project, that offers simple step by step instruction at: http://ecoexist.net/archives/61

The report Overview of Grey Water Systems found at: http://www.pacinst.org/reports/greywater_overview/greywater_overview.pdf offers more information on grey water systems and also has case studies from around the world showcasing the benefits of grey water systems, such as saving on costs, and fresh water.

1.7 Rain Water Catchment Methods

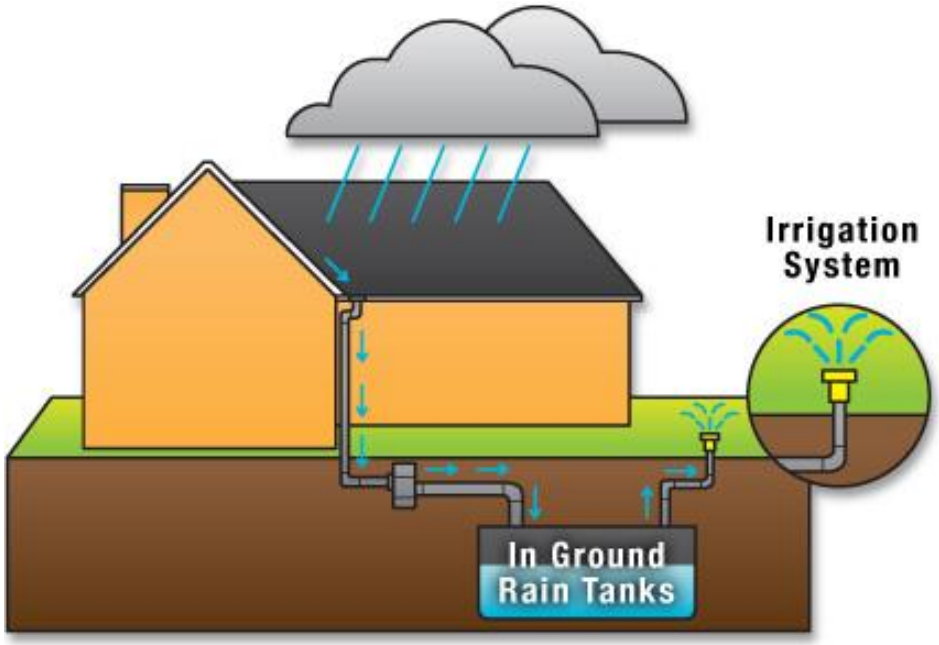


Rainwater Catchment	Advantages

	• Rainwater has no cost • Only cost is the materials used to collect the rainwater • Lessens demand on other water supplies • Can recharge groundwater • Great for irrigation of landscape plants and gardens • Uses simple technologies • Can be main source of water, or as a back up source • Excellent emergency water source, if storage unit is installed • Underground systems are another great way to maximize the benefits of rainwater, the main building at Quebec Lodge could easily incorporate a simple system (Fig 16) • This could be used to irrigate a garden, or for grass re-growth after the construction period

Figure 15: Rainwater catchment

Figure 16: Irrigation system method



1.8 Cold Storage Concepts

<u>Sustainable Storage: Basement/Underground root cellar</u>

For the purposes of your project we highly recommend incorporating an underground or basement root cellar to preserve produce and other foods for the camp. Root cellars offer low temperature and low humidity conditions that prevent foods from freezing in the winter and overheating in the summer. In the case of an underground cellar, the soil on top acts as the temperature control.

Advantages	Disadvantages
• completely sustainable, uses the earth's passive cooling geothermal system NO ADDED ENERGY NEEDED	• can be difficult to maintain optimal conditions

• versatile: can be incorporated in many areas (basement/ under a porch/ north facing slope)	• not all foods can be stored in this method
• ideal for saving/preserving seeds	• ethylene gas build up can quicken ripening process
• extends shelf-life of most fruits and vegetables	
• maintains nutritional content of food (avoids freezing and canning)	
• conserves energy: reduces trips to the store	

Key Factors:

1. **temperature**

- optimal temperature is 1-5 degrees Celcius
- should be built ideally below the frost line
- keep a thermometer in the cellar to track temperature changes

2. **humidity**

- ideal humidity level of 95%
- leaving the floor of cellar bare earth will greatly assist in humidity levels

3. **ventilation**

- proper air circulation is crucial to prevent mold growth/ remove ethylene gas
- vents should be rodent proof

Building a root cellar:

Building materials can include:

- native stone
- concrete cinder blocks
- earth-packed tires
- cedar logs

OR:

- use a fiberglass water tank (easy to modify and bury)
- bury a 50 gallon plastic drum in the ground

Building a Root Cellar: The Process

1. **Digging a hole**

Option 1: Build your root cellar into a hill.

- You don't have to find a door lying on the ground when it is under 3 feet of snow.
- There is less chance of flooding during very wet conditions
- Your cellar can be graded so any water that should run or seep in will run out the door.
- Can be much more difficult to excavate.

Option 2: Build your root cellar on flat ground.

- Availability: not everyone has a steep hill in their back yard
- Easier to excavate
- Easier and cheaper to build (you don't have to brace your cellar for all that extra weight from the hill). But that added dirt will keep your cellar cooler!
- You can build a vertical door around a staircase if you don't want to be shoveling snow to get at a horizontal door

Guidelines to keep in mind:

- Digging into a hillside will provide easier access to walk into
- Locate in an area that has good drainage away from it
- Size of hole will depend on how much is planned on being stored
- A 5 foot by 8 foot root cellar will store 30 bushels of produce.

- An 8 foot by 8 foot cellar should hold plenty for the average family.
- A 10 foot by 10 foot cellar should take care of everything you can produce.
- Regardless of size, dig hole several feet larger than intended size to allow room to manoeuvre

2. Create a structure to hold the soil

- Build a structure that will hold back the walls of the soil
- When the walls are buried, there should be at least 4 ft. of coverage
- Floor of cellar should be at least 7-8 ft. below the surface
- Line the floor with wire mesh is ideal

3. Ventilation

- One vent to allow warm air to leave near the ceiling
- One vent to allow fresh air in near the floor of cellar
- Vents must be screened to prevent pests
- PVC piping ideal and can easily be used recycled from other projects
- Alternatives include: ductile iron, vitrified clay, copper, aluminium, brass and ABS plastic

4. Entrance

- Keeps pests OUT and keeps cool air IN
- Most root cellars have 1 door at the surface and a second at the wall that opens to the root cellar (this method acts as extra insulation to keep cool air in)

5. Shelves

- Use rot resistant or pressure treated wood (eco-friendly options are available)

• Liberal use of shelves will enhance the storage capacity of your cellar considerably.

Vegetables and their optimum storage conditions

Cold and very moist (32-40 degrees F and 90-95 % humidity			
Carrots Beets Parsnips Rutabagas Turnips	Celery Chinese Cabbage Celeriac Salsify Scorazonera	Winter radishes Kohlrabi Leeks Collards Broccoli (short term)	Burssels Sprouts (short term) Horseradish Jerusalem artichokes Hamburg-rooted parsley
--	--	--	--
Cold and Moist 32-40 degrees F and 80-90% humidity	**40-50 degrees F and 85-90 % humidity**	**Cool and Dry 35-40 degrees F 60-70% humidity**	**Moderately Warm and Dry 50-60 degrees F and 60-70% relative humidity**
Potatoes Cabbage Cauliflower (short term) Apples Grapes (40 degrees F) Oranges Pears Quince Endive, escarole Grapefruit	Cucumbers Sweet peppers (45-55 degrees F) Cantaloupe Watermelon Eggplant (50-60 degrees F.) Ripe tomatoes	Garlic Onions soybeans in the pod (short term)	Dry hot peppers Pumpkins Winter squash Sweet potatoes Green tomatoes (up to 70 degrees F is OK)

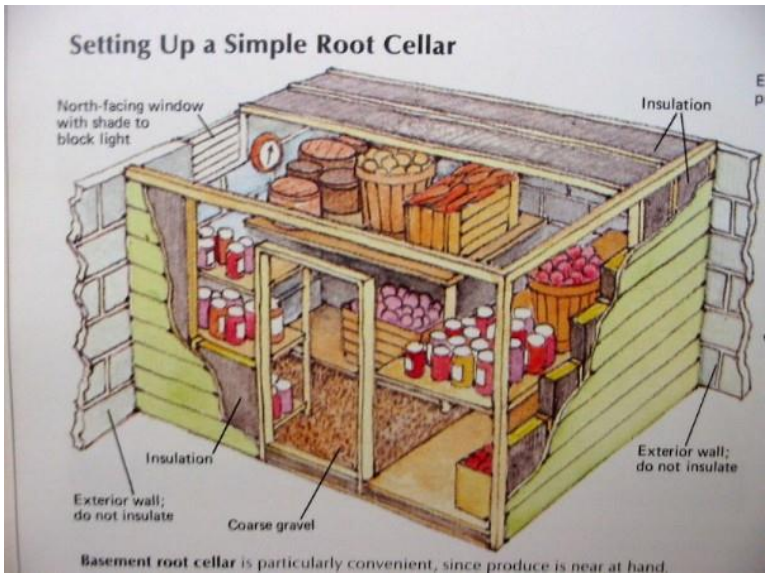


Figure 17: Root Cellar

Basement Root Cellar

You could also easily incorporate a root cellar into the construction of the main building if it is to include a basement. In modern homes and structures, basement temperatures are too high for a root cellar but this can be accommodated by walling off a portion of the basement and adding vents as seen in fig. 18. The two vents (#1 in the illustration) create a siphon effect that lets you regulate the flow of cold outside air into the insulated cellar room, allowing the temperature to remain near freezing through the winter months. As you custom-cut your wall studs to length, make them short enough to leave an eighth- to a quarter-inch gap between the top of the wall and the joists above when combined with the top and bottom plates (#2).

Figure 18: Basement Root Cellar

Guidelines to keep in mind:

- Choose a position for the cellar that includes access to a window for access to fresh air
- Choose a corner location that allows maximum masonry surface to create maximum cooling action
- If possible, choose a location that has the highest soil height outside
- If possible, choose a location with northern facing exposure
- Choose a composite deck material for the floor to accommodate for basement dampness tendencies
- Wood-plastic composites are available with all the desired features and made using recycled plastics and waste products of wood industries
- Composites are rot-proof and will not contribute to musty smells even if they get wet
- Consider the sustainable forms of insulation mentioned previously as traditional fiberglass batts have almost no ability to resist mold growth and are not as sustainable
- be sure to insulate the ceiling aswell

For more information you can refer to "The Complete Root Cellar Book: Building Plans, Uses and 100 Recipes" by Steve Maxwell and Jennifer MacKenzie. This book contains tons of construction tips and recipes for building and maintaining basement root cellars.

1.9 Yurts

Yurt Communities

If the Quebec Lodge intends on installing Yurt villages for the campers the very first decision needed is which type of structural pattern they would like to use. Yurt's can be made from many different materials so depending on which direction the QL would like to follow will determine many other factors.

Does the QL want fabric yurt's or hard wall yurts?
The underlining idea of both structures is relatively the same but there are important

differences between the two as well.

Similarities:

- Both are more efficient for heating and cooling than rectilinear buildings.
- relatively low impact and portable
- both can install windows and doors
- excellent use of space and openness

Differences:

Fabric	Hard-wood
• More efficient heating/ cooling than rectangular building structures	• better insulation than fabric yurts
• Fabric is vulnerable to damage by birds, squirrels, racoons, etc. also offer more opportunity for insect habitation	• less risk of rodents and have more protection from damage by animals
• only plastic windows can be installed which wear down faster and allow more energy loss	• Conventional glass windows and doors can be installed
• Much quicker to install (3o minutes to 3 hours) and much quicker to take down	• Installation time depends on the intensity of the structure
• Fabric coverings need to be washed every so often and replaced every 15-20 years	• Hard-word: can allow skylight windows, rain water catchment and solar panels
• Radiation will break down the outer materials faster	• More wind resistance and have a higher snow load
• More intimacy with nature	• Can have lofts or a second floor
•	• Can install running water, and electricity

Other Recommendations for Yurt Construction:

- check with local building codes: usually the biggest obstacle

The Basic Structure

The roof is an amazing architectural design providing a great strength and requiring no internal support system, thereby leaving the yurt open and spacious inside.

Purchasing Yurts

If Quebec Lodge choses to purchase Yurts there are two Quebec-based options. Grovy Yurts and Biome. Both of these companies provide a wide variety of Yurts and can build to order and handle the entire installation process if desired.

One notable difference between the two is Grovy Yurts have their products hand built in Mongolia. This supports native tradespeople in a developing nation and helps them earn their livelihood while maintaining their culture, although it also dramatically increases the environmental footprint of the yurt.

More information:
http://autonopedia.org/buildings-and-shelter/build-a-mongolian-yurt/

http://www.smilingwoodsyurts.com/gallery/yurt-exteriors/

http://www.spiritmountainyurts.com/questions.htm

http://www.groovyyurts.com/en/ (Yurt manufacturer)

http://www.yourte.ca/en_index.html (Yurt manufacturer)

Part 2: Camp Ground Ideas

1.1 Compostable Toilets

Composting Toilets for the Yurt Villages

There are two primary objectives that need to be met by a compost toilet:

1. To contain and immobilize, or destroy, pathogens that could potentially harm humans. This is to be accomplished in a manner that eliminates contamination of the environment and minimizes harm to its inhabitants.

2. To transform the nutrients in humanure into an inoffensive, and reasonably dry, end-product that can be handled with minimal risk. This end-product can then be used as a soil amendment for horticultural plants and trees

The goal is to create an environment in which beneficial microbes (i.e. bacteria and fungi) will proliferate. These microbes are the workforce behind the breakdown of your humanure. To create an ideal microbial environment in your toilet, you'll need moisture, oxygen, and heat.

Moisture - The moisture in a compost toilet comes from urine as well as the solid excrement. If not properly controlled, the moisture levels can get too high, resulting inanaerobic composting and an unpleasant odor - just like in your garden compost pile. Most manufactured composting toilets do a great job of regulating moisture levels using fans, evaporation chambers, and separation trays. The addition of bulking agents also help to control moisture levels. For the

purposes of your project, we would best recommend those in **bold** which could be found and easily collected in abundance on the property.

- sawdust
- **partially composted leaves (leaf mold)**
- shredded paper
- peat moss
- straw or hay
- **grass clippings**
- garden refuse
- **weeds**
- rice hulls

  TIP: Sprinkling any of the above materials after each use of the outhouse will also help with reducing unpleasant odors and speed up the decomposition process

Oxygen - The oxygen in a composting toilet system comes from several sources, including automatic mixers, pile-leveling devices, tumbling drums, and manual turning. Bulking agents also provide pore space for air to enter into the composting mix.

Heat - The heat in a composting toilet system can come from the pile itself (i.e. the heat generated by the microbial activity) as well as an electrical or solar heater. Solar composting toilets are a great way to take an already eco-friendly invention - the composting toilet - to the next level of environmental stewardship.

Types of Composting Toilets

Compost toilets can be divided based on several different criteria. However, we believe it's easiest to think of the different types of toilets by first looking at how they process the waste, and then considering how they are built.

All composting toilet systems use an **active** or a **passive** process to breakdown their contents. An active system can be compared to an outdoor, dynamic composting pile - these both produce heat. Active composting toilets rely on various features, such as fans and thermostat-controlled heaters, to provide aeration and heat to the composting waste. A passive system, on the other hand, can be compared to an outdoor, static composting pile - these decompose over a longer period of time in cooler environments.

For the purposes of your project, we reccommend a **continuous composting toilet design**. This means that the catchment receptacle is constantly receiving new waste materials, while at the same time producing finished product. A toilet using a continuous composting process usually requires only one catchment chamber. Proponents of continuous composting maintain that it is simple (takes place in one fixed reactor), allows urine to constantly moisten the process, and allows the center of the mass to heat up through uninterrupted microbial activity.

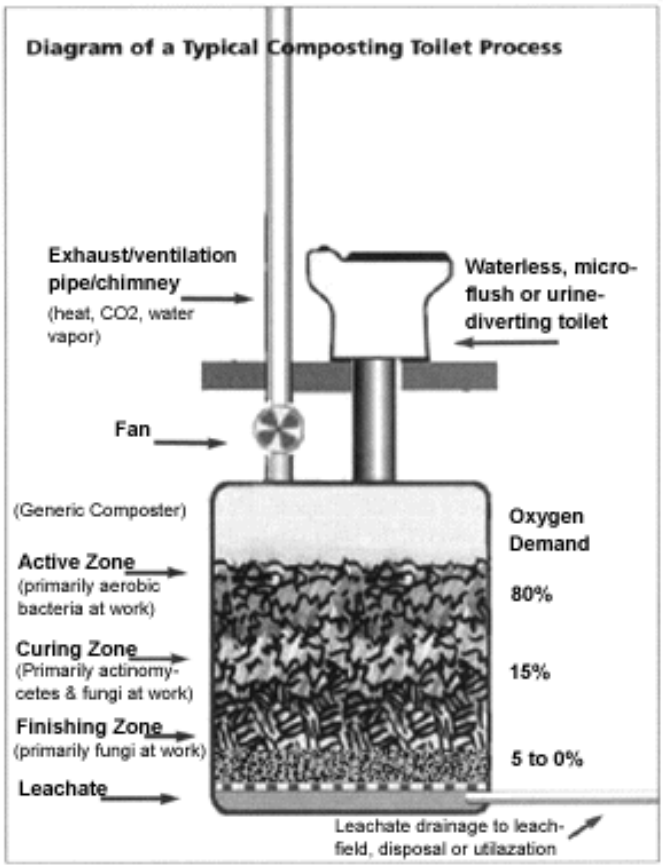


Figure 19 diagram of typical composting toilet

Solar Toilets

Another feasible option might to consider solar power. A solar evaporative toilet uses thermal solar energy to reduce excrement to a dehydrated solid and removes the released gases through a roof vent, all provided by solar thermal energy. Then the dry solid can be either hauled off by a septic truck to a waste-treatment plant or put in a composting facility with garden waste.

Another similar possibility is shown in the diagram below. Instead of using thermal solar energy to dehydrate the excrement, it uses solar electricity to run a fan to move the air to dehydrate.

When material falls into the bottom chamber it is ready to be put into a standard composting system for further composting with vegetative organic matter. Only a couple of solar panels would be needed for this operation. A 5 Watt solar panel will keep the fan running under most daylight conditions but will not keep it running at night. However, an 11 watt panel will keep a batter topped up so you can power the fan from a battery. This will keep the fan running during 5 straight days with no sunlight. We think that this option would be perfectly practicable for your camp and would certain increase the value of sustainability by using green energy.

It is important to note that compost from these types of composting toilets should **not** be used in edible gardens.

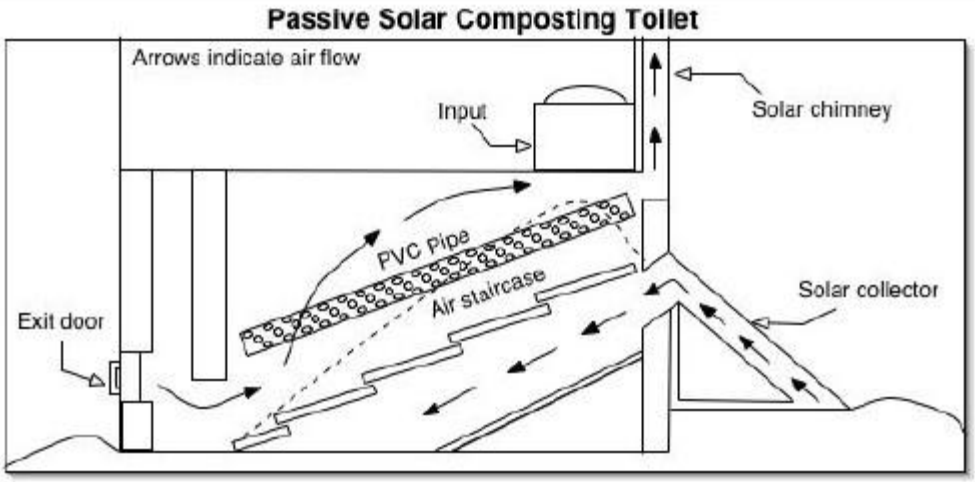


Figure 20: Passive Solar Toilet

Continuous Composting Toilets:

Advantages	Disadvantages
• container is permanently fitted under toilet seat, never has to be fully emptied	• may allow fresh material and pathogens to be deposited on top of pile (could contaminate successfully composed material)
• simple design that allows for easy access to composted material	• container can become too compacted and difficult to move
• decomposition occurs faster	• regular maintenance required
• simple to install	• un-compostable matter cannot be put in the toilet
• Reduces area occupied by the septic tank	•

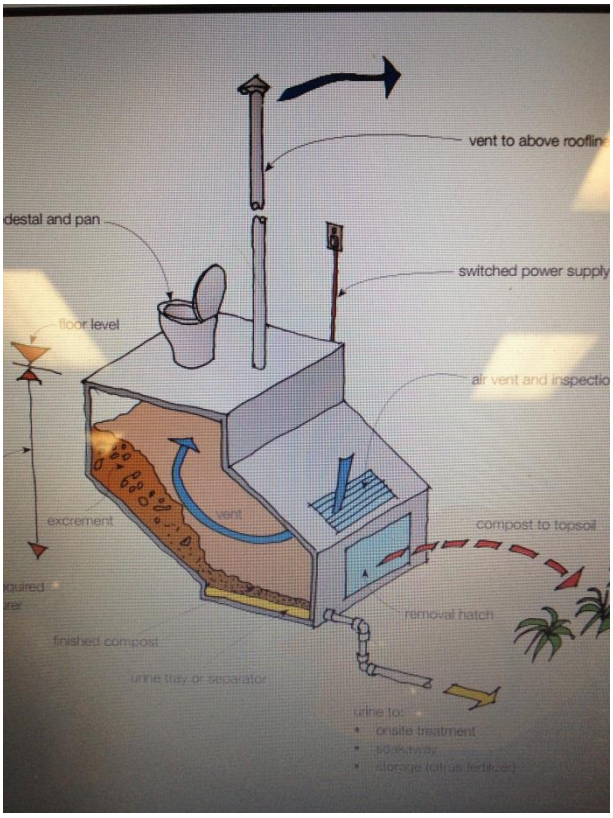


Figure 21: Continuous Composting Toilet

Building Tips:

- Pressure-treated or creosoted timbers are the best material for the base of the structure; untreated hemlock or tamarack (also known as eastern larch) are also good choices for their natural ability to resist decay.
- Use 6″ X 6″ timbers (minimum) to frame the hole. Half-lap corners are advisable.
- If you use pressure-treated wood, remember to treat all cut ends with an appropriate preservative.
- Avoid letting soil touch the floor frame.
- A good-sized hole for an outhouse is about 3'-5' deep and an average outhouse is about 4' x 4' around and 7' tall.
- The bench, or shelf, should be about 2' wide and 2' high, and of course, completely boxed in.
- The hole can be about 10"-12" in diameter.
- Dig the hole first.
- Outhouse should be located 50 to 150 feet from any well, water source or residence.
- Do not dig the pit in an area where water runoff is common, because groundwater should never enter the pit or drain from it.
- Build a shallow mound around your outhouse so that gases do not escape from beneath the floor.

Lighting in the Outhouse

1. Passive lighting

- Passive solar power is free and plentiful.
- "Passive" means simply letting sunlight into your outhouse, usually through a window
- Advanced methods will collect and even amplify sunlight as it enters the outhouse.
- Because you want privacy in an outhouse, windows should be made of distorted or frosted glass
- Certain roof structures, such as tubular skylights and roof monitors, can amplify light but cut down on the sun's heat, an important feature in an outhouse that will be more odorous as the temperature rises

2. Solar Panel

- A small solar panel, if it has clear access to sunlight, can easily provide enough energy to power one light bulb for an outhouse
- A 5-watt solar panel, for example, connected to a 12-volt battery can light a 5-watt fluorescent
- A 5-watt fluorescent bulb puts out as much light as a 25- to 30-watt incandescent bulb.
- Cost of a 5-watt solar panel begins around $25, and these systems can be added to any existing structure

3.Portable Solar Lantern

- Another option is a portable solar lantern, kept outside the door of the outhouse by day and brought inside only during use.
- can multitask, providing light during camping trips or nighttime hikes as well
- Some of them last longer than others, and they will function best if turned off when not in use.
- range in price from about $25 to $75. You also can get small garden solar lamps for lighting the way to the outhouse.

Figure 22 simple portable solar lantern

Maintaining the Outhouse

- keep all paper and feminine hygiene products from the hole (Solid paper products can interfere with the bacterial breakdown of other solids)
- Keep these paper products in a disposable container that can be either burned or properly disposed.
- Keep a broom handy inside the room
- Use biodegradable cleansers for maintaining the sanitary conditions of the seat and adjacent areas
- Controlling the vegetation growth around the building will go a long way in preventing unwanted visitors to the area.
- Keeping the roof free of debris and sealed against leaks during inclement weather not only adds to the comfort, but also aids in keeping the enclosed area sanitary
- Maintaining the walls in good repair will keep out the varmints and insects that could inhabit any building.

For more information refer to "The Humanure Handbook- Chapter 6: Composting Toilets and Systems" http://humanurehandbook.com/downloads/Chapter_6.pdf By Joseph Jenkins

1.2 Lighting the Yurts

Lighting Structure Suggestions:

1. **Sky lights:** skylights are a very effective and sustainable way of lighting a building during the day time, however they reduce the building's heat retention capabilities as well as must be cleared of snow in the winter time.

2. **Solar powered lights**: Can be relatively inexpensive and effective. Often the solar panel is attached directly above where the light will be inside the building and connected via a small wire through the roof. An example of such a light is the Sunforce solar hanging light (which can be purchased at a variety of retailers and on amazon.com), it is sold for around $50

dollars and comes with a remote control to operate it. There are many other companies which make similar products which can be found at locations such as Canadian Tire.

Figure 23 solar light

3. **Solar Tubes**: An effective way to capture natural light is the use of solar tubes. These are very cost-effective and efficient ways to take advantage of natural light throughout a building regardless of whether or not a specific room has roof access. As well they have significantly better heat retention and have proven very reliable.

Figure 24 Solar Tubes

1.3 Sustainable Programming/Activities

Sustainable Programing Sugesstions:

1. **Eco-Art**

Eco- Art can be a very entertaining and educational way for young people to realize just how many products we create end up being deemed waste and polluting our natural environment. Eco-art is the act of reusing almost any materials for arts and crafts. These materials would otherwise be deposited in a landfill, or may be things which are undesirable recycling. Common materials are:

- Old clothing
- Left over bits of fabric
- Bottle caps

Eco-Art may be combined with other activities as well, such as bird watching. Campers can be taught about the various birds of the area on nature walks and then create bird houses to take home with them out of recycled materials.

Eco-art on a larger scale perhaps as a group project among campers could be used to create larger pieces of art which can be displayed out doors or at the entrance of the main lodge this could serve as a showcase of the camp's mission to blend sustainability with youth development.

2. **Growing Structures:**

This activity would be a summer long activity which would likely have to involve multiple groups of campers. It involves the planting of climbing plants such as beans around a stick frame structures, as the plant grows it acts as the walls of the structure.

Figure 25: Growing Structure

3. **Calculating Need:**

Get the campers to brain storm all of their daily uses of faucet water and get them to determine if there are any ways they could eliminate faucet use and substitute rainwater instead!

4. **Rain Barrel Harvesting:**

- Barrels can be placed under downspouts where there are gutters on camp buildings
- Cost of making a rain barrel is estimated to be around $120 versus $266 of store bought barrels
- The camp could also use these barrels as a fundraising option by selling them to the community

Figure 26 Eco Art Examples

Environmental Impact Assessment ESG 354 class 2013

top from left: Paddy Enright, Brenna Croal, Emily McLellan, Jennifer Ward, Kristen Walker

bottom from left: Melanie Abbott, Kathleen Mulawka, Danielle Vallat

missing from photo: Valerie Jones, Charles Parent-Moreau